# Test report for

# 47 CFR Part 15 Subpart C

# RSS-247, RSS-Gen



The RvA is signatory to ILAC - MRA


| | |
|---|---|
| Product name | : BM-IA007-1 |
| Applicant | : Velux America Inc. |
| FCC ID | : XSG866062 |
| IC | : 8642B-866062 |

Test report No. : P000327337 001 Ver 2.0

# Laboratory information

## Accreditation

Kiwa Nederland B.V. complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2017. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L248 and is granted by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

Kiwa Nederland B.V. is designated by the FCC as an Accredited Test Firm for compliance testing of equipment subject to Certification under Parts 15 & 18. The Designation number is: NL0001.

Kiwa Nederland B.V. is a Wireless Device Testing laboratory recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.
The Industry Canada company number for Kiwa Nederland B.V. is: 4173A. The CABID is NL0001.

Kiwa Nederland B.V. is a registered Conformity Assessment body (CAB) under the Japan-EC MRA (Agreement on Mutual Recognition between Japan and the European Community). The registration number is: 201.

## Documentation

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at Kiwa Nederland B.V.

## Testing Location

| | |
|---|---|
| **Test Site** | Kiwa Nederland B.V. |
| **Test Site location** | Wilmersdorf 50<br>7327 AC Apeldoorn<br>The Netherlands<br>Tel. +31 88998 3393 |
| **Test Site FCC** | NL0001 |
| **CABID** | NL0001 |

## Revision History

| Version | Date | Remarks | By |
|---|---|---|---|
| v0.50 | 31-10-2023 | First draft | RvB |
| v1.00 | 24-01-2024 | Initial release | RvB |
| V2.00 | 04-06-2024 | Change FCC and IC id + added E.I.R.P values in chapter 3.4 | RvB |
| | | | |

# Table of Contents

## Summary of Test results

| FCC | ISED | Description | Section in report | Verdict |
|---|---|---|---|---|
| 15.247(d)<br>15.209 (a) | RSS-Gen 8.9 | Radiated spurious emissions | 3.1 | Pass |
| 15.205 (a) | RSS Gen 8.10 | Spurious emissions in the restricted bands | 3.1 | Pass |
| 15.247 (a) | RSS-247 5.2(a) | 6 dB bandwidth | 3.2 | Pass |
| -- | RSS-Gen 6.7 | 99% bandwidth | 3.3 | Pass |
| 15.247 (b) | RSS-247 5.4 (d) | RF output power | 3.4 | Pass |
| 15.247 (e) | RSS-247 5.2 (b) | Power spectral density | 3.5 | Pass |
| 15.247 (d) | RSS-247 5.5 | Band edge | 3.6 | Pass |

Decision rule: Pass/Fail decisions are based on measurement results without taking into account measurement uncertainty.

# 1 General Description

## 1.1 Applicant

| | |
|---|---|
| **Client name:** | Velux America Inc. |
| **Address:** | Greenwood, South Carolina, United States of America |
| **Zip code:** | 29648 |
| **Telephone:** | +45 30581588 |
| **E-mail:** | j.a.m.thomsen@velux.com |
| **Contact name:** | Mr. J.A Thomsen |

## 1.2 Manufacturer

| | |
|---|---|
| **Manufacturer name:** | Velux America Inc. |
| **Address:** | Greenwood, South Carolina, United States of America |
| **Zip code:** | 29648 |
| **Telephone:** | +45 30581588 |
| **E-mail:** | j.a.m.thomsen@velux.com |
| **Contact name:** | Mr. J.A Thomsen |

## 1.3 Tested Equipment Under Test (EUT)

| | |
|---|---|
| **Product name:** | BM-IA007-1 |
| **Brand name:** | Velux |
| **FCC ID:** | XSG866062 |
| **IC:** | 8642B-866062 |
| **Product description:** | Blind |
| **Variant model(s):** | -- |
| **Batch and/or serial No.** | -- |
| **Software version:** | -- |
| **Hardware version:** | -- |
| **Date of receipt:** | 21-09-2023 |
| **Tests started:** | 26-09-2023 |
| **Testing ended:** | 25-10-2023 |

## 1.4 Product specifications of Equipment under test

| | |
|---|---|
| **Tx Frequency:** | 2425 – 2475 MHz |
| **Rx frequency:** | 2425 – 2475 MHz |
| **Occupied channel width:** | 2 MHz |
| **Antenna type:** | PCB antenna |
| **Antenna gain:** | 0.89 dBi |
| **Type of modulation:** | DSSS, According to 802.15.4 |
| **Emission designator** | 2M05MID |

Disclaimer: The operating frequency bands are declared by the applicant

## 1.5 Environmental conditions

Normal test conditions:

Temperature (*) : +15°C to +35°C
Relative humidity(*) : 20 % to 75 %

## 1.6 Measurement standards

- ANSI C63.10:2013
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02

## 1.7 Applicable standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.209
- FCC Part 15 Subpart C §15.247
- RSS-Gen Issue 5
- RSS-247 Issue 3

## 1.8 Observation and remarks

The EUT is powered by a 4.8V battery.

## 1.9 Modifications to the EUT (Equipment Under Test)

None.

## 1.10 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specifications stated in paragraph 1.7 of this report.

The results of the test as stated in this report, are exclusively applicable to the product items as identified in this report. Kiwa Nederland B.V. accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.7 *"Applicable standards".*

All tests are performed by:

Name : ing. R. van Barneveld

Review of test methods and report by:

Name : P. van Wanrooij, BASc

The above conclusions have been verified by the following signatory:

Date : 05-06-2024

Name : P. van Wanrooij

Function : Test Engineer

Signature :

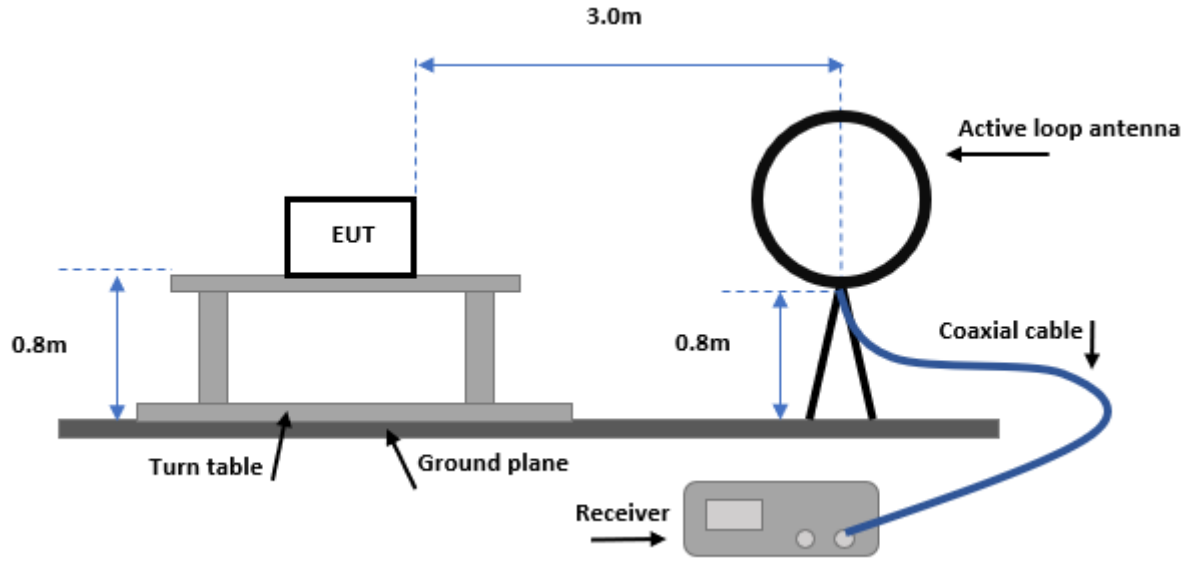
# 2 Test configuration of the Equipment Under Test

## 2.1 Test mode

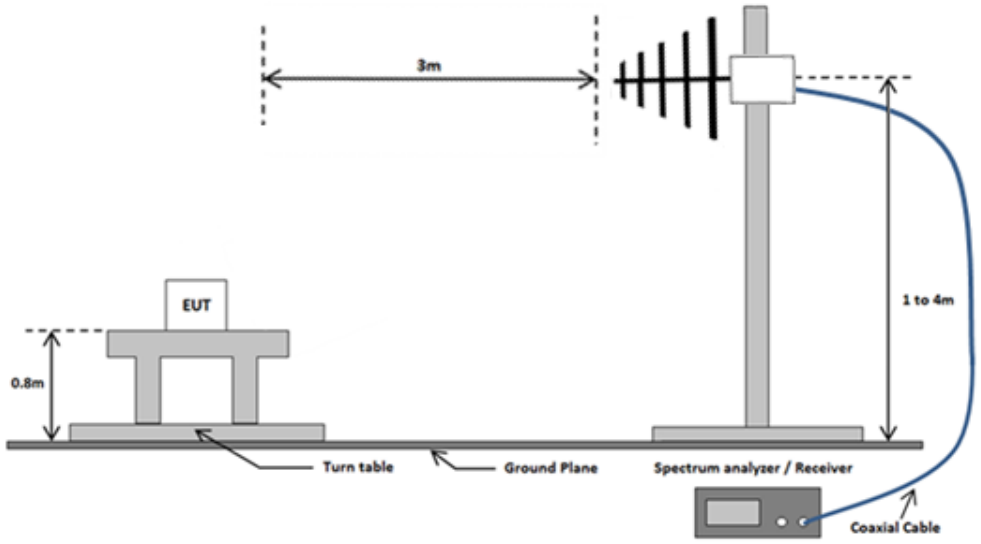
The client provided test mode samples, with which it was possible to configure the EUT in the correct test mode.

## 2.2 Test setups

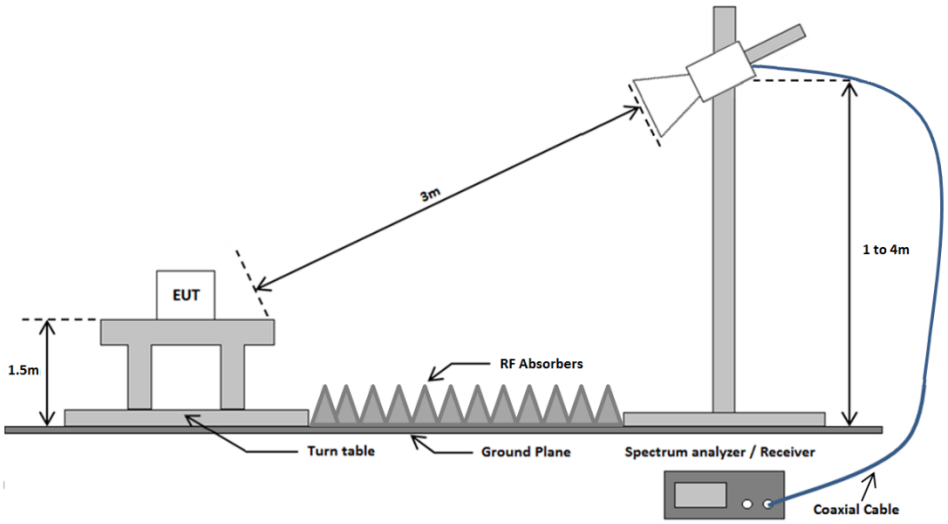
**Radiated emissions test setup 9 kHz – 30 MHz**



**Radiated emissions test setup 30 MHz - 1 GHz**

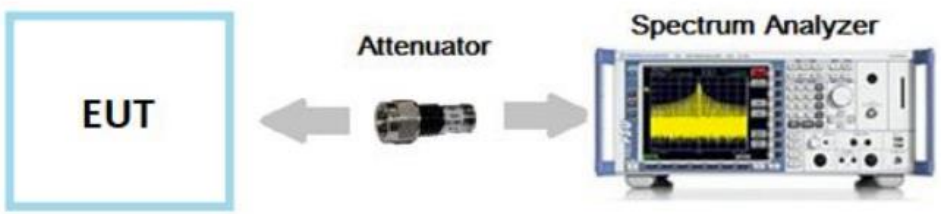



**Radiated emissions test setup above 1 GHz**




Antenna port conducted tests

**Conducted test setup**



## 2.3 Equipment used in the test configuration

| Description | Manufacturer | Model | ID | Cal. Done date | Cal. due date | Used at Par. |
|---|---|---|---|---|---|---|
| EMI Receiver | Rohde & Schwarz | ESR7 | 114534 | 04-2023 | 04-2024 | 3.1 |
| Spectrum Analyzer | Rohde & Schwarz | FSV40 | 114527 | 11-2023 | 11-2024 | 3.1 |
| 3.0 GHz HPF | Wainwright | WHK3.0/18G-10EF | 114682 | 07-2021 | 07-2024 | 3.1 |
| Active loop antenna | EMCO | 6502 | 114515 | 01-2022 | 01-2024 | 3.1 |
| Biconical antenna + 6dB attenuator | Schwarzbeck + HP | VHA9103 + 8491A | 114436 + 114254 | 03-2021 | 03-2024 | 3.1 |
| Log periodic antenna | EMCO | 3147 | 114385 | 03-2021 | 03-2024 | 3.1 |
| Horn antenna | EMCO | 3115 | 114607 | 01-2021 | 01-2024 | 3.1 |
| Horn antenna | FLANN-MICROWAVE | 20240-25 | 114518 | NA* | NA* | 3.1 |
| Preamplifier 1-18 GHz | Schwarzbeck | BBV 9718D | 114874 | 01-2023 | 01-2024 | 3.1 |
| Preamplifier 18-40 GHz | Miteq | JS4-18004000-33-8P | 114693 | 01-2023 | 01-2024 | 3.1 |
| Spectrum Analyzer | Rohde & Schwarz | FSV3044 | 115043 | 09-2023 | 09-2024 | 3.2-3.6 |
| Test Software | Rohde & Schwarz | WMS32 | -- | -- | -- | 3.2-3.6 |
| Test Software | Raditeq | 2023 | -- | -- | -- | 3.1 |
| OSP150 | Rohde & Schwarz | OSP150 | 115041 | 11-2022 | 11-2024 | 3.2-3.6 |
| OSP220 | Rohde & Schwarz | OSP220 | 115042 | 01-2022 | 01-2024 | 3.2-3.6 |

*Note: Standard gain horn antennas do not need calibration
NA= Not Applicable

## 2.4 Sample calculations

All formulas for data conversions and conversion factors are reported in chapter 4 of this test report.

# 3 Test results

## 3.1 Radiated spurious emissions

### 3.1.1 Limit

15.209(a)
The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field strength (µV/m) | Field strength (dBµV/m) | Measurement distance(m) |
|---|---|---|---|
| 0.009 – 0.490 | 2400/F(kHz) | 20*{log[2400]-log[F(kHz)]} | 300* |
| 0.490 – 1.705 | 24000/F(kHz) | 20*{log[24000]-log[F(kHz)]} | 30* |
| 1.705 – 13.11<br>14.01 – 30.0 | 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 |

*Note: Measured values in the plots 9 kHz to 30 MHz corrected to 30m or 300m limit distance according to the method described in ANSI C63.10-2013, clause 6.4

### 3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

### 3.1.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

### 3.1.4 Test procedure

9 kHz – 30 MHz: According to ANSI C63.10-2013, section 6.4
30 MHz to 26.5 GHz: According to ANSI C63.10-2013, section 6.5 and 6.6

9 kHz to 30 MHz: IRN 441 – Method 10
30 MHz to 1 GHz: IRN 441 – Method 1
1 GHz to 18 GHz: IRN 441– Method 2
18 to 26 GHz: IRN 441– Method 3

In case of handheld and/or body-worn equipment, the EUT's orientation (X, Y, Z) was varied in order to ensure that maximum emission amplitudes were attained. In all other cases the associated cabling and the EUT orientation was varied for maximum emissions.

The spectrum was examined from 0.009 MHz to 10 times X GHz, not more than the 10th harmonic of the highest intentional generated frequency (X GHz). Final radiated emission measurements were made at 3m distance.

The 6 highest emission amplitudes relative to the appropriate limit were recorded in this report. Field strength values of radiated emissions at frequencies not listed in the tables are more than 20 dB below the applicable limit.

### 3.1.5 Measurement Uncertainty

| Frequency range | Polarization | Uncertainty |
|---|---|---|
| 9 kHz – 30 MHz | -- | ±1.6 dB |
| 30 – 200 MHz | Horizontal | ±4.5 dB |
| | Vertical | ±5.4 dB |
| 200 -1000 MHz | Horizontal | ±3.6 dB |
| | Vertical | ±4.6 dB |
| 1 – 18 GHz | Horizontal | ±5.7 dB |
| | Vertical | ±5.7 dB |
| 18 – 26.5 GHz | Horizontal | ±4.9 dB |
| | Vertical | ±4.9 dB |

### 3.1.6 Test results

**Low channel**

| Frequency | Peak | Peak Limit | Average | Average Limit | Status | Angle | Height | Polarization |
|---|---|---|---|---|---|---|---|---|
| 7,273 GHz | 51,9 dBµV/m | 74 dBµV/m | 47,4 dBµV/m | 54 dBµV/m | Pass | 176 degrees | 2 m | Vertical |

**Mid channel**

| Frequency | Peak | Peak Limit | Average | Average Limit | Status | Angle | Height | Polarization |
|---|---|---|---|---|---|---|---|---|
| 7,352 GHz | 51,8 dBµV/m | 74 dBµV/m | 44,6 dBµV/m | 54 dBµV/m | Pass | 144 degrees | 1,5 m | Vertical |
| 7,349 GHz | 49,4 dBµV/m | 74 dBµV/m | 45,8 dBµV/m | 54 dBµV/m | Pass | 170 degrees | 1,5 m | Horizontal |

**High channel**

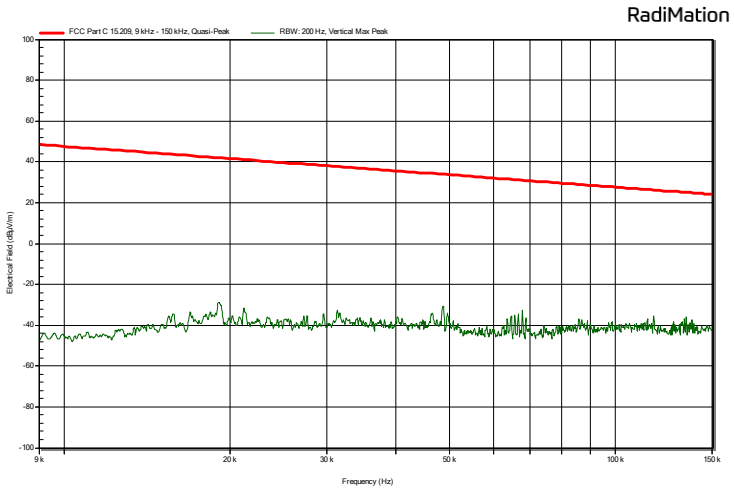
| Frequency | Peak | Peak Limit | Average | Average Limit | Status | Angle | Height | Polarization |
|---|---|---|---|---|---|---|---|---|
| 7,426 GHz | 52,7 dBµV/m | 74 dBµV/m | 47,2 dBµV/m | 54 dBµV/m | Pass | 196 degrees | 2 m | Vertical |

The results of the radiated emission tests are depicted in the table above. A selection of plots is provided on the next pages

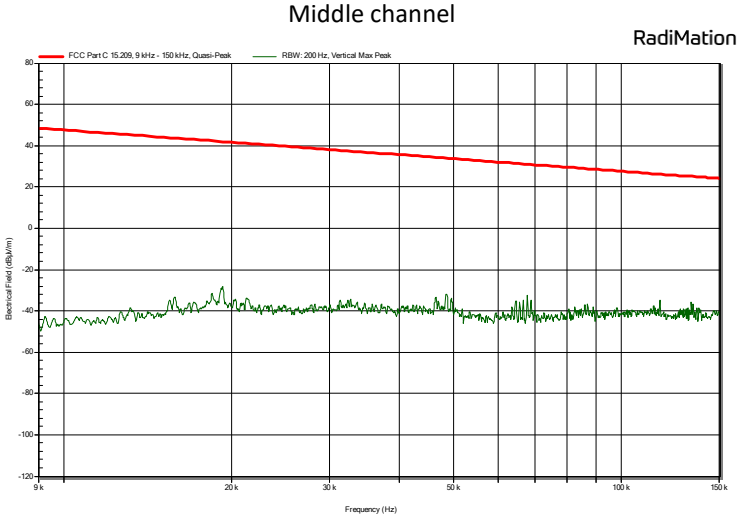
### 3.1.7 Plots of the Radiated Spurious Emissions Measurement

9 kHz – 150 kHz

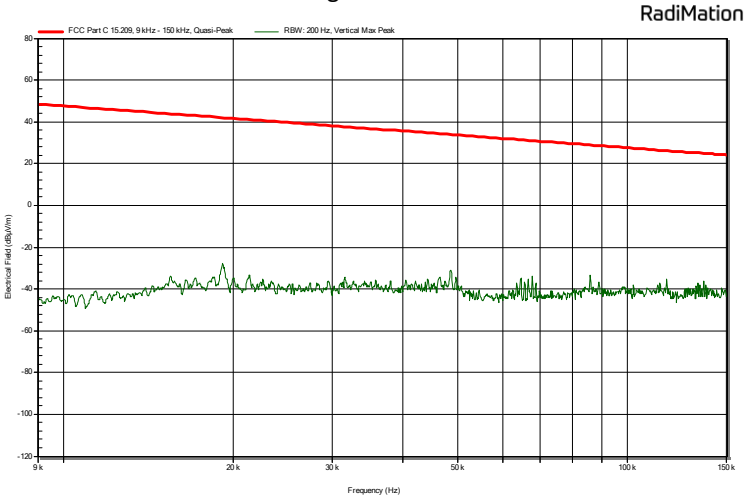
Low channel




Middle channel



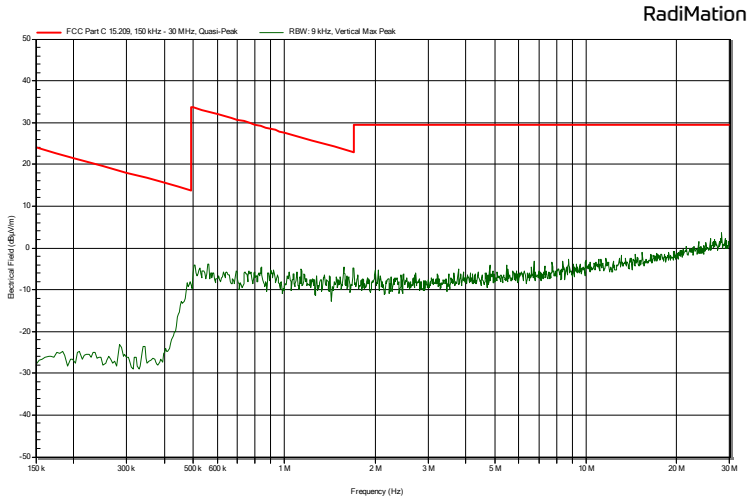

High channel



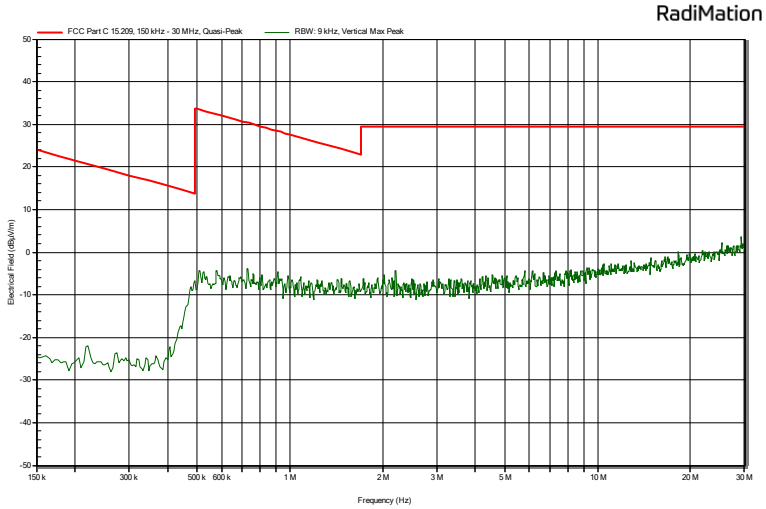

(pre-scan peak values shown)

150 kHz – 30 MHz

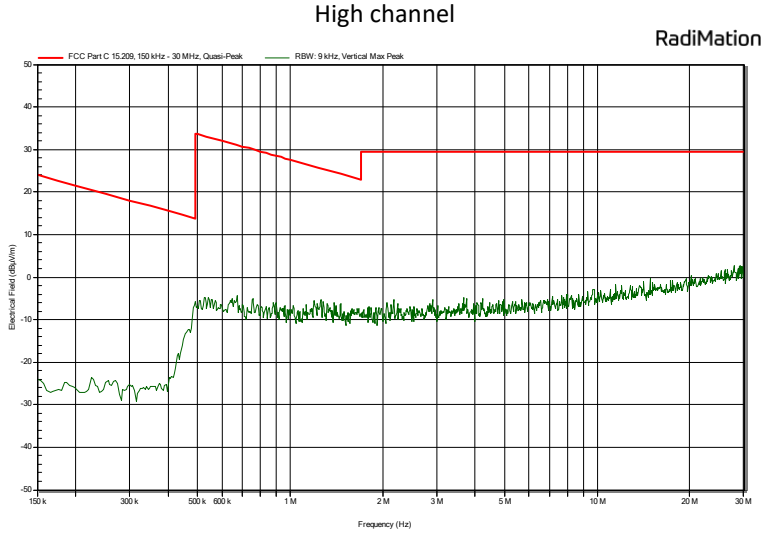
Low channel




Middle channel

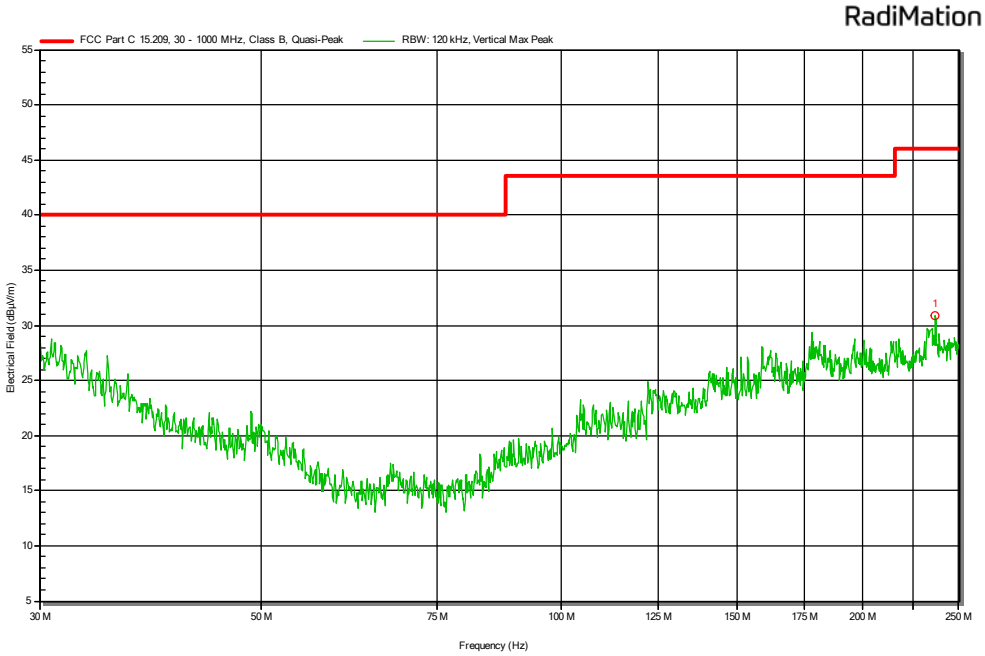



High channel

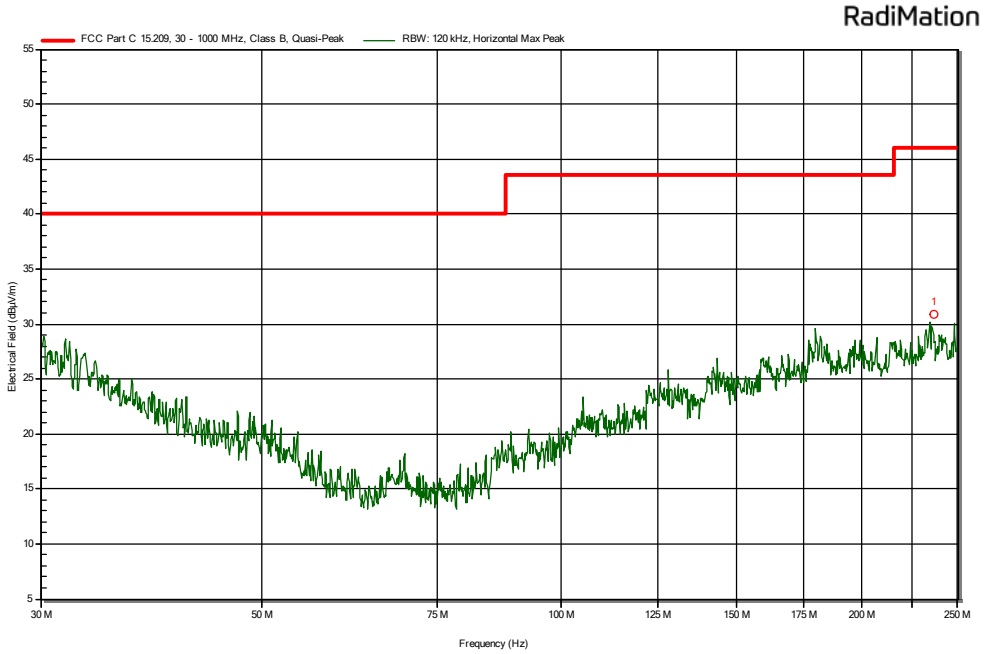



(pre-scan peak values shown)

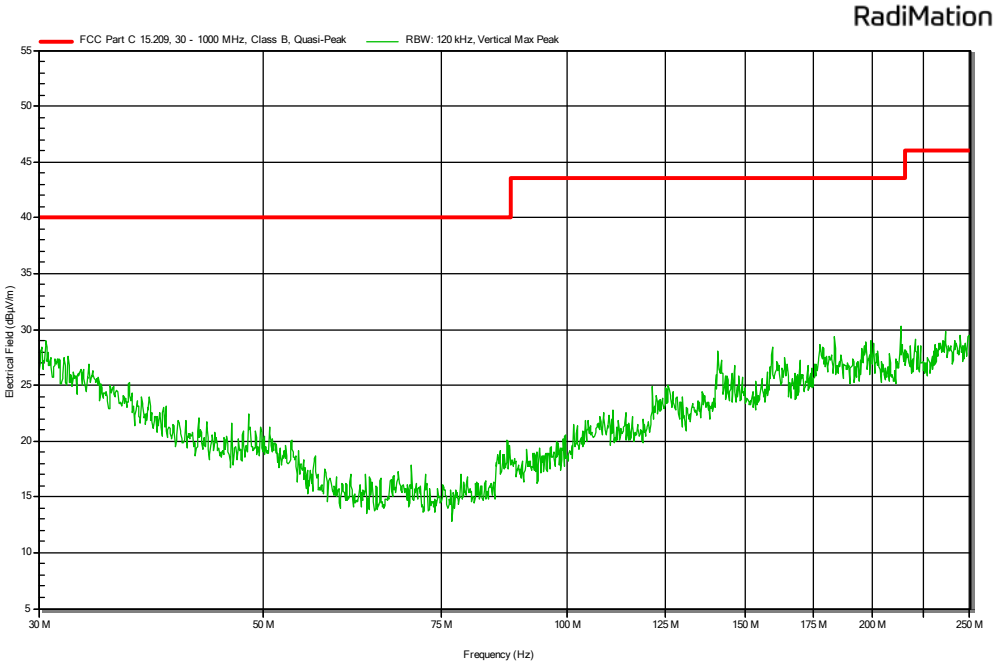
Plot 1: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz
(pre-scan peak values shown)
Low channel



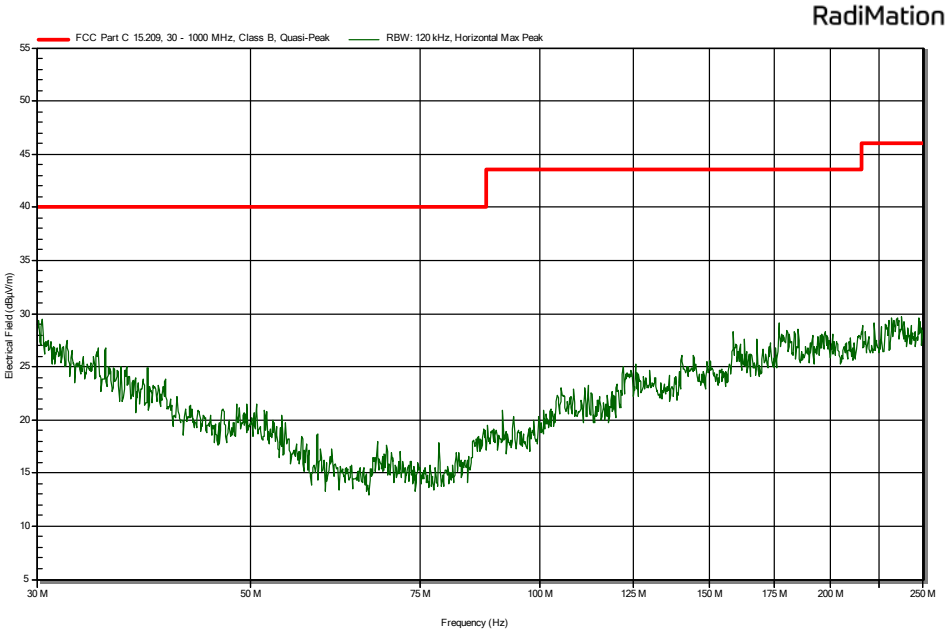

Plot 2: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz
(pre-scan peak values shown)
Low channel



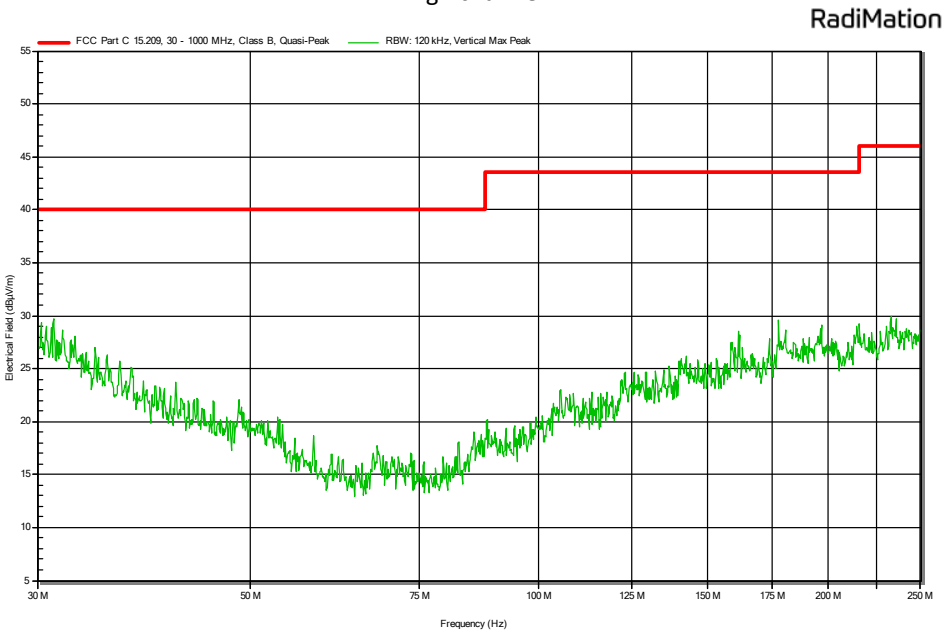
Plot 3: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz
(pre-scan peak values shown)
Middle channel



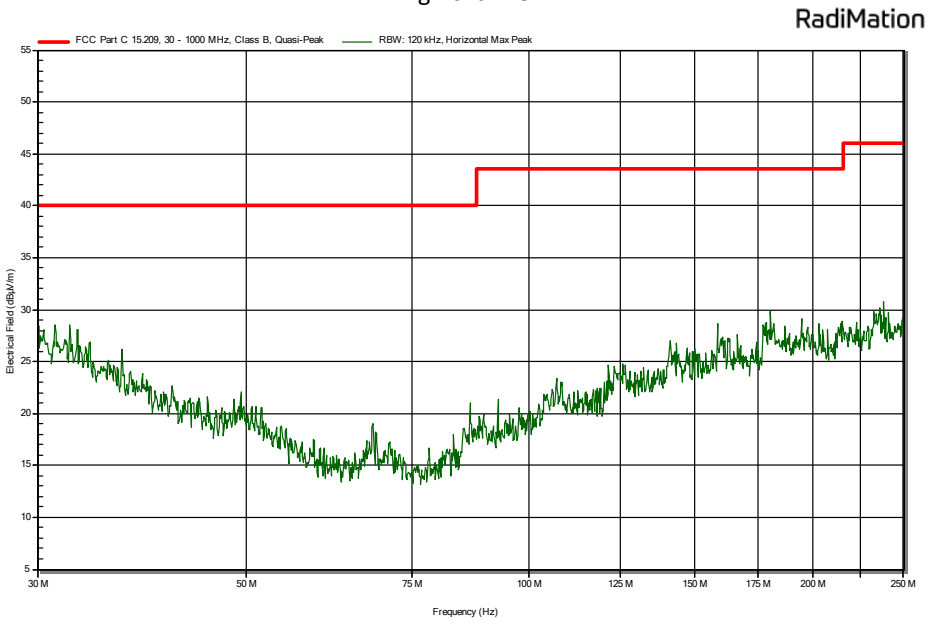

Plot 4: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz
(pre-scan peak values shown)
Middle channel



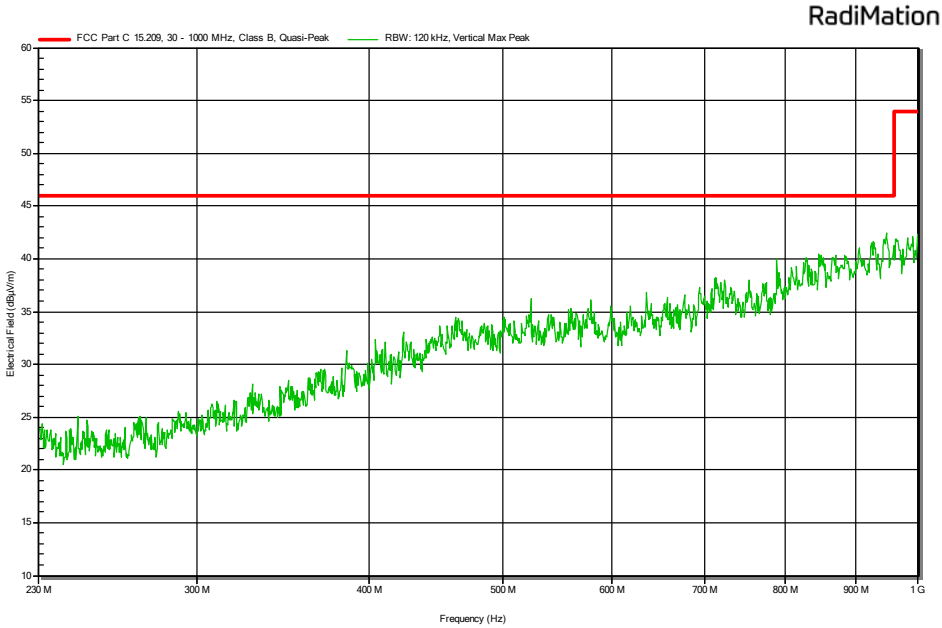
Plot 5: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz
(pre-scan peak values shown)
High channel



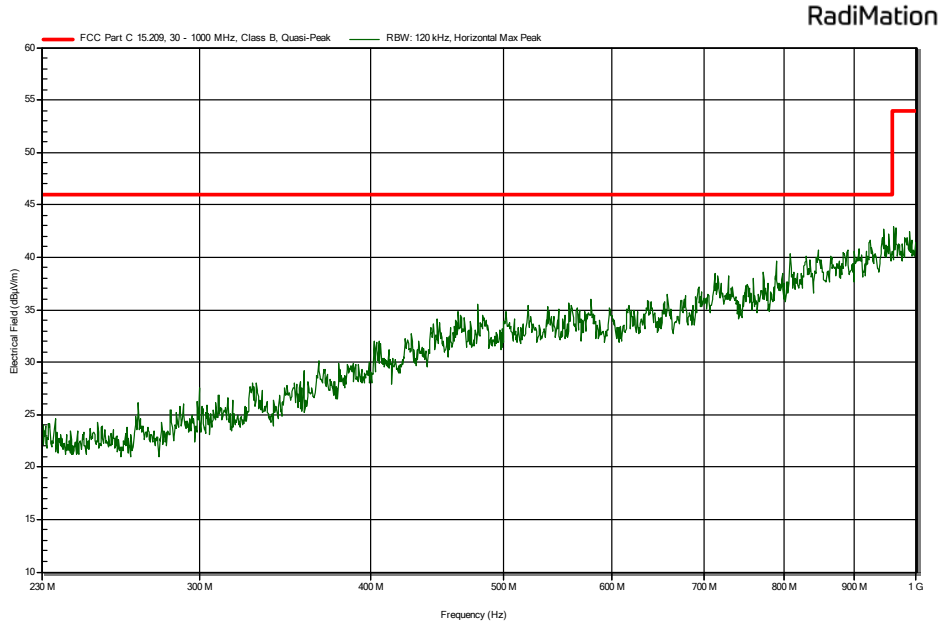

Plot 6: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz
(pre-scan peak values shown)
High channel



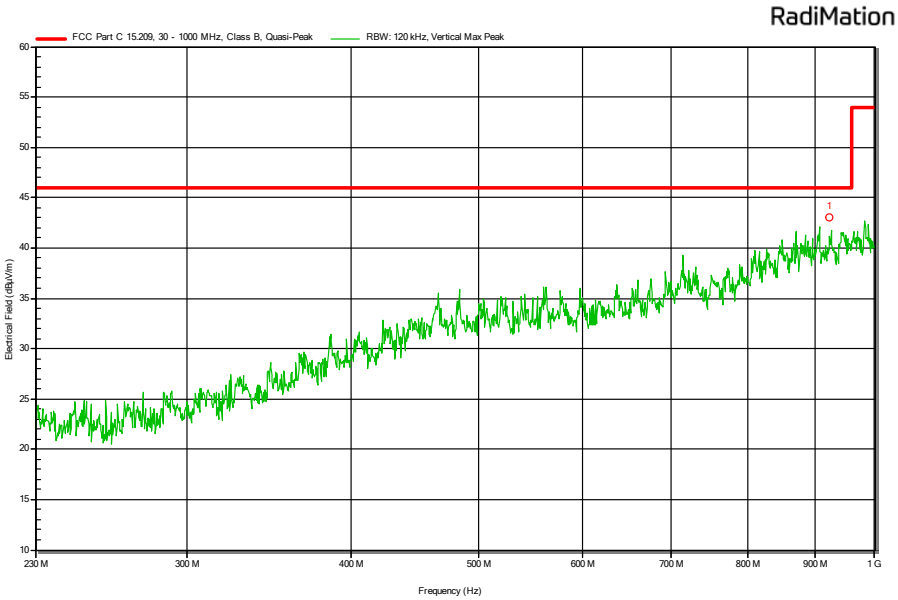
Plot 7: radiated emissions of the EUT, Antenna vertical, in the range 250-1000 MHz
(pre-scan peak values shown)
Low channel



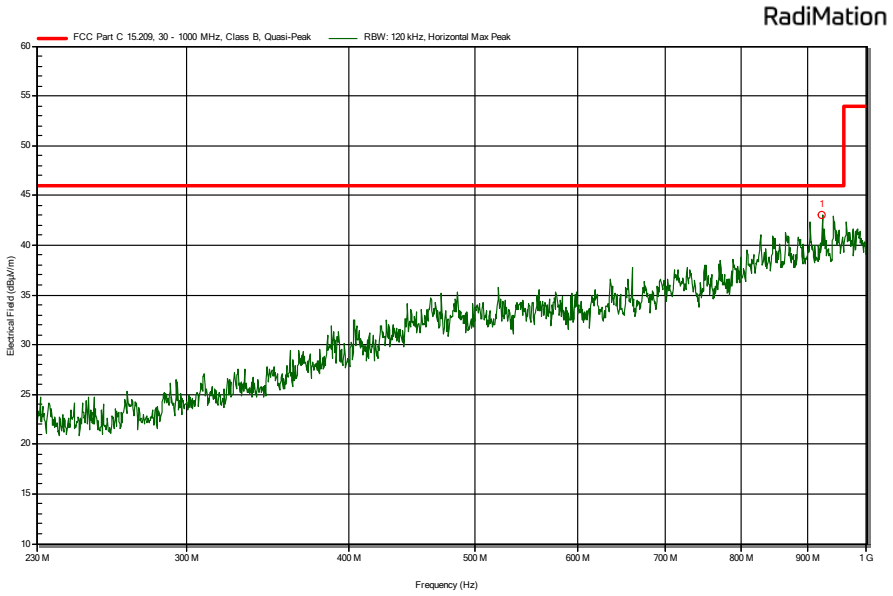

Plot 8: radiated emissions of the EUT, Antenna horizontal, in the range 250-1000 MHz
(pre-scan peak values shown)
Low channel



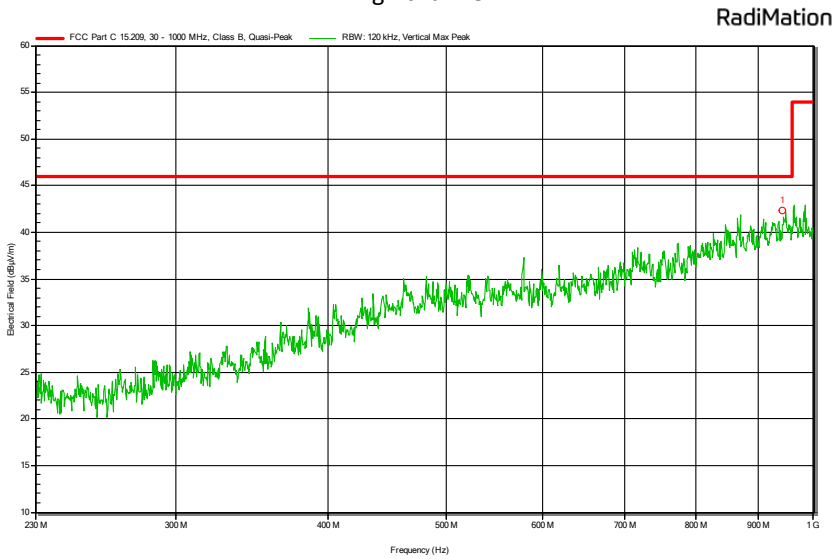
Plot 9: radiated emissions of the EUT, Antenna vertical, in the range 250-1000 MHz
(pre-scan peak values shown)
Middle channel



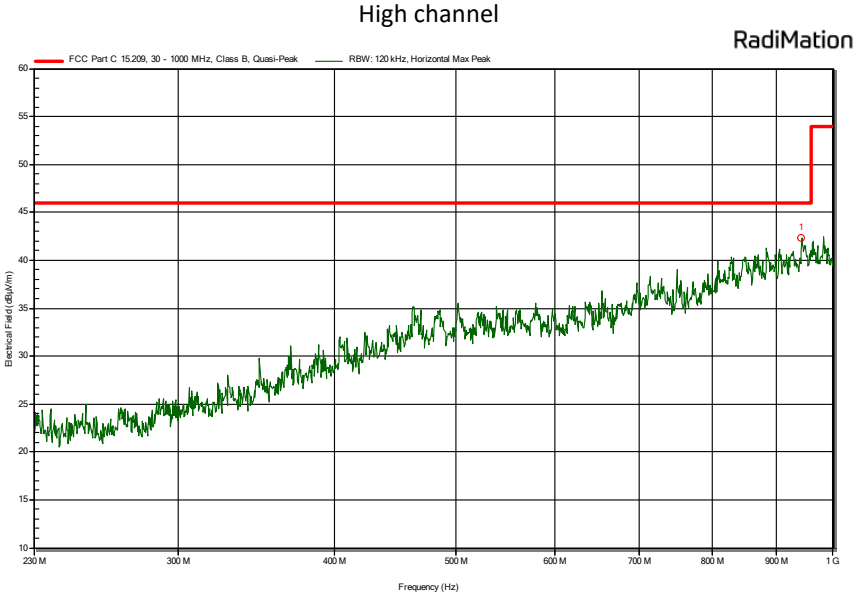

Plot 10: radiated emissions of the EUT, Antenna horizontal, in the range 250-1000 MHz
(pre-scan peak values shown)
Middle channel



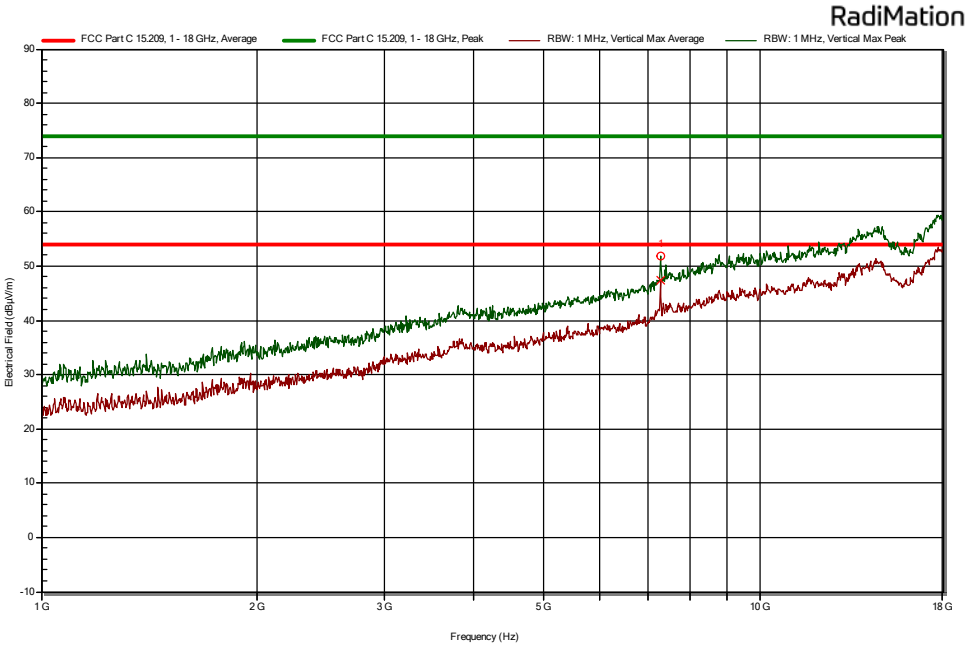
Plot 11: radiated emissions of the EUT, Antenna vertical, in the range 250-1000 MHz
(pre-scan peak values shown)
High channel



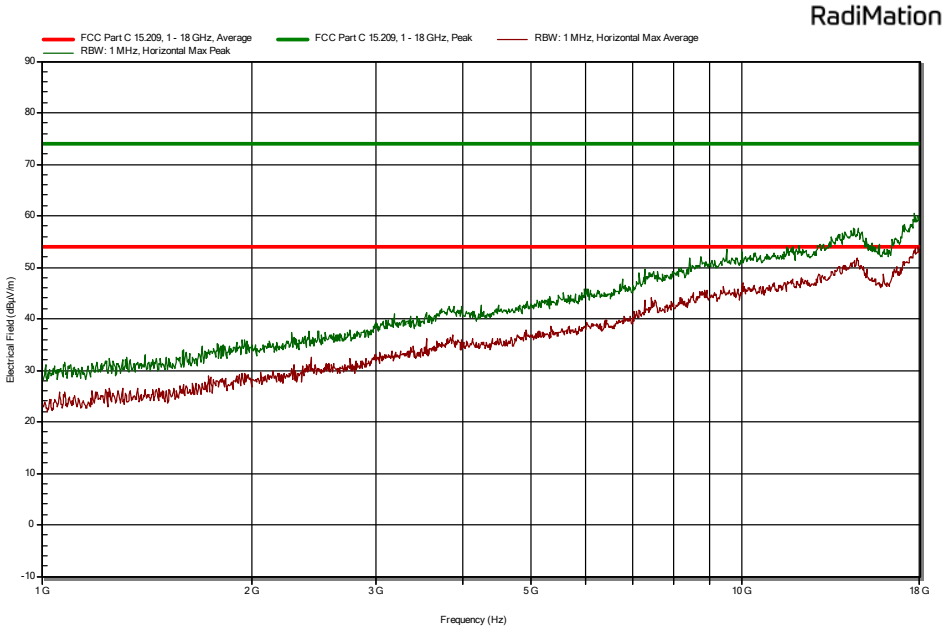

Plot 12: radiated emissions of the EUT, Antenna horizontal, in the range 250-1000 MHz
(pre-scan peak values shown)
High channel



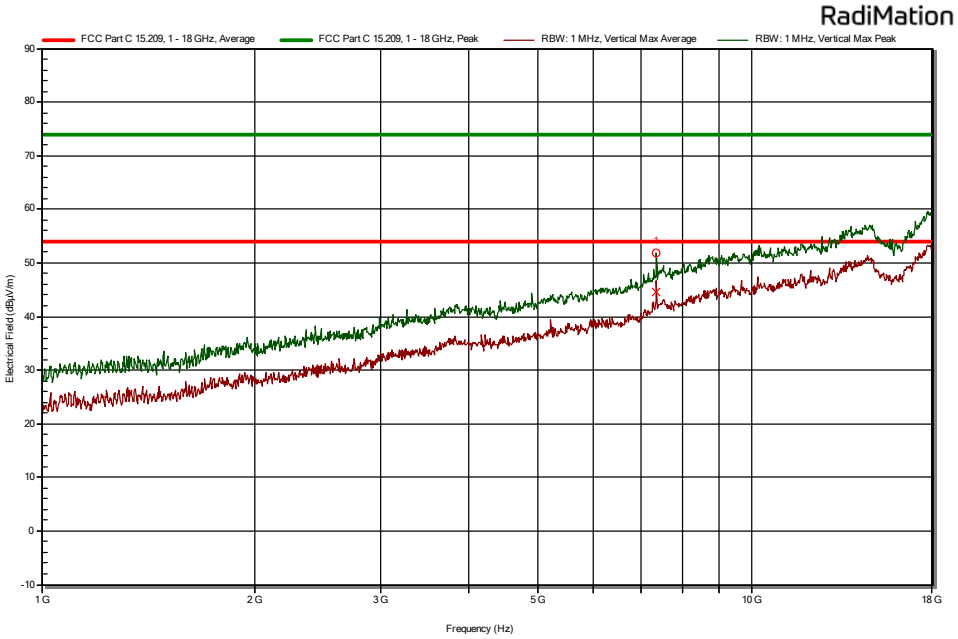
Plot 13: radiated emissions of the EUT, Antenna vertical, in the range 1 – 18 GHz
(peak and average values shown)
Low channel



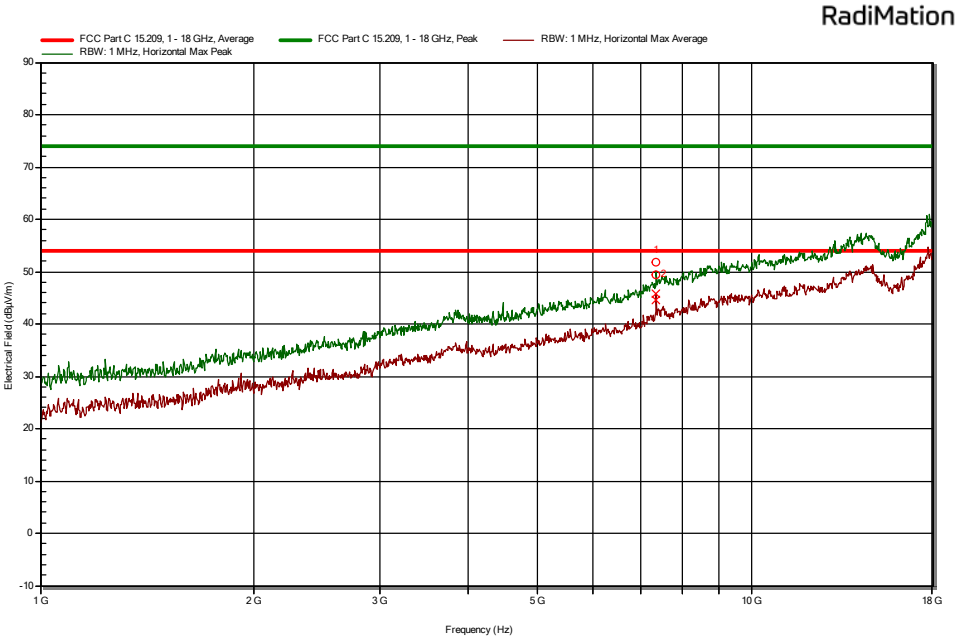

Plot 14: radiated emissions of the EUT, Antenna horizontal, in the range 1 – 18 GHz
(peak and average values shown)
Low channel



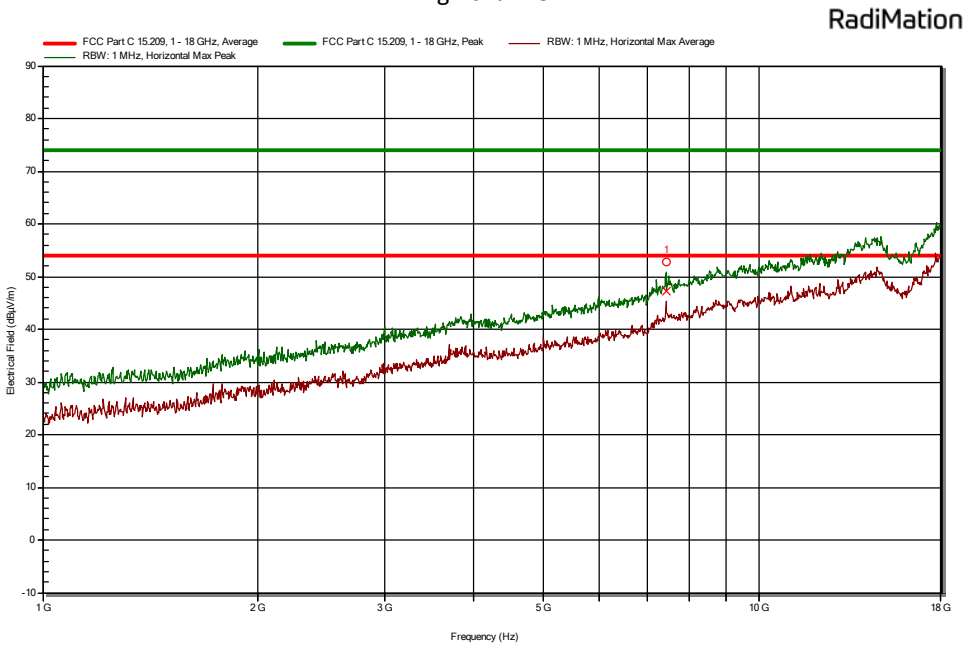
Plot 15: radiated emissions of the EUT, Antenna vertical, in the range 1 – 18 GHz
(peak and average values shown)
Middle channel



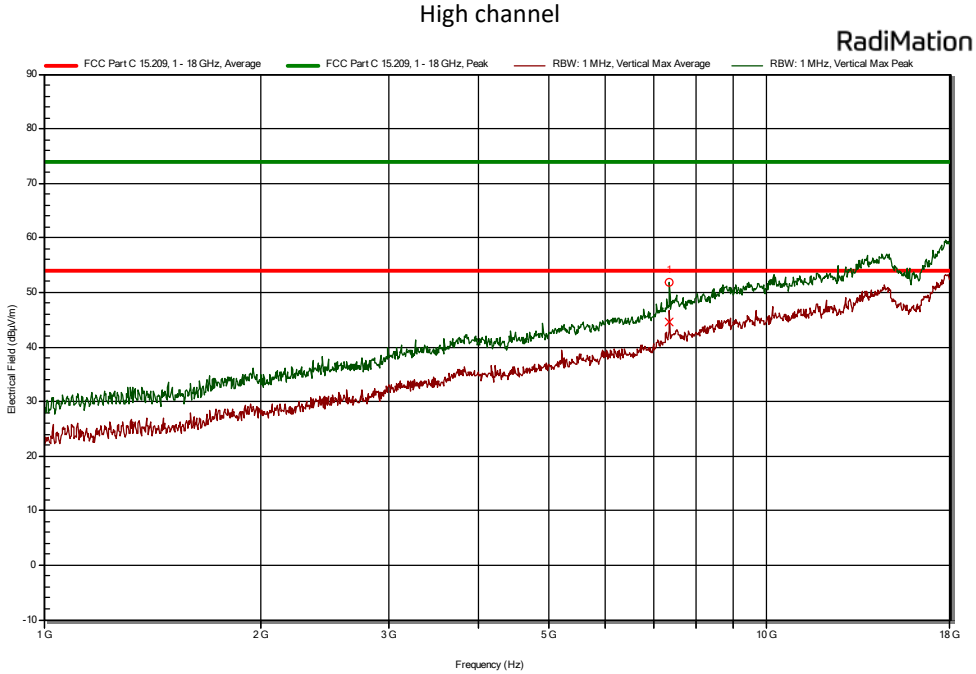

Plot 16: radiated emissions of the EUT, Antenna horizontal, in the range 1 – 18 GHz
(peak and average values shown)
Middle channel



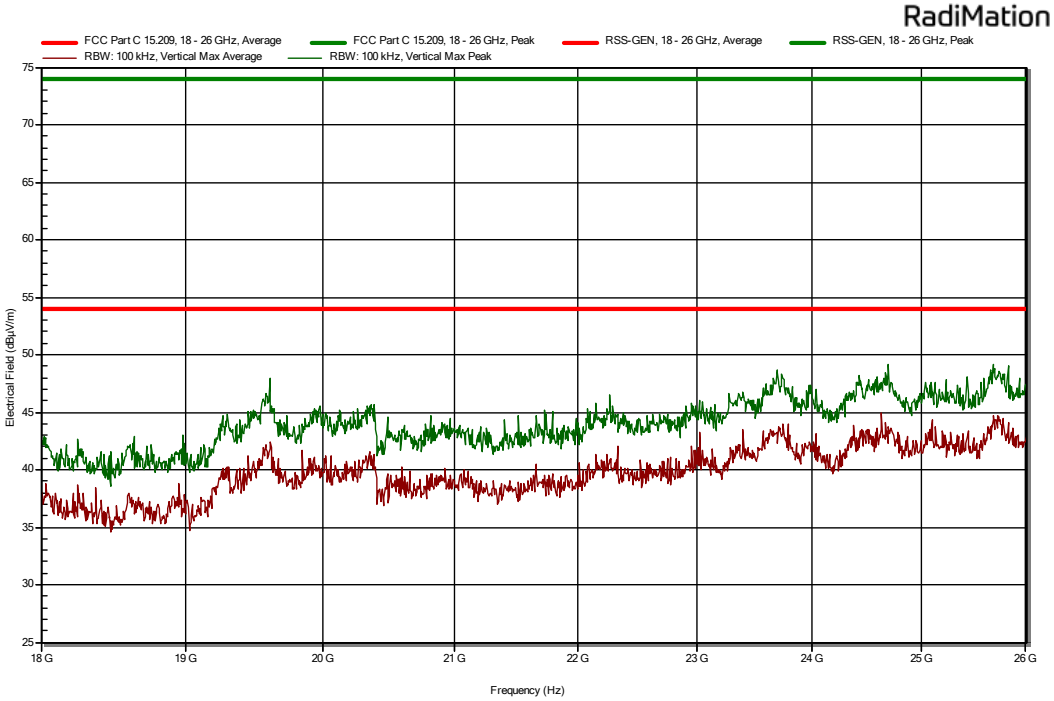
Plot 17: radiated emissions of the EUT, Antenna vertical, in the range 1 – 18 GHz
(peak and average values shown)
High channel



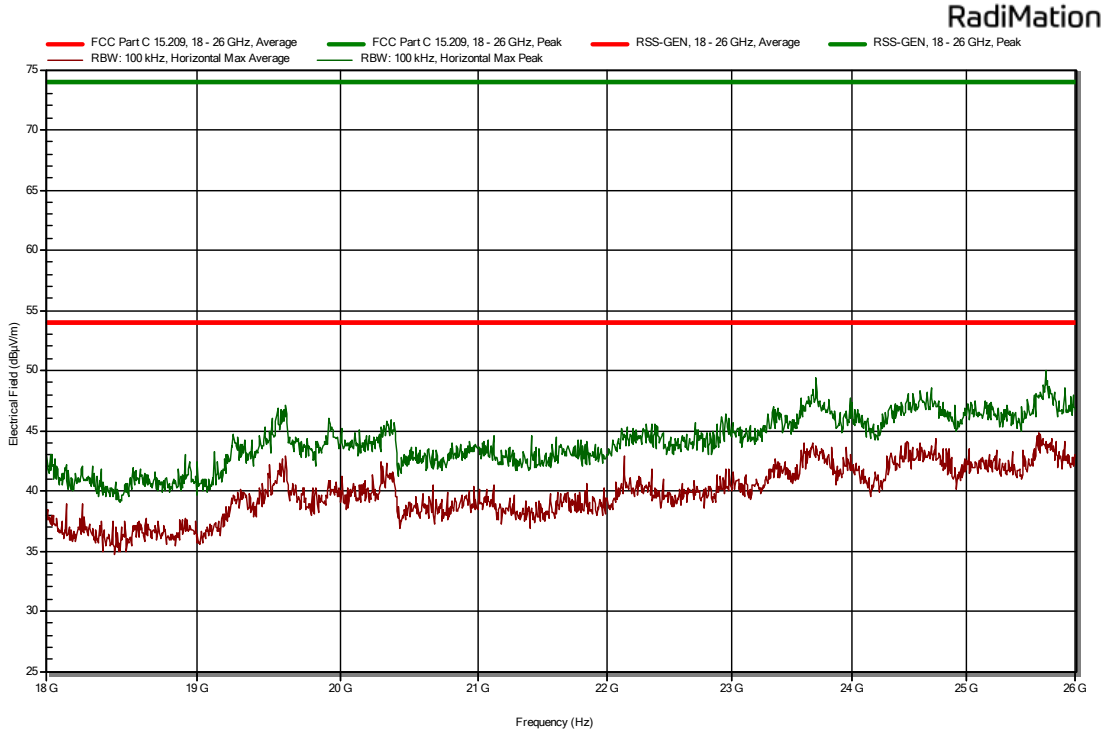

Plot 18: radiated emissions of the EUT, Antenna horizontal, in the range 1 – 18 GHz
(peak and average values shown)
High channel



Plot 19: radiated emissions of the EUT, Antenna vertical, in the range 18 – 26 GHz
(peak and average values shown)
Low channel

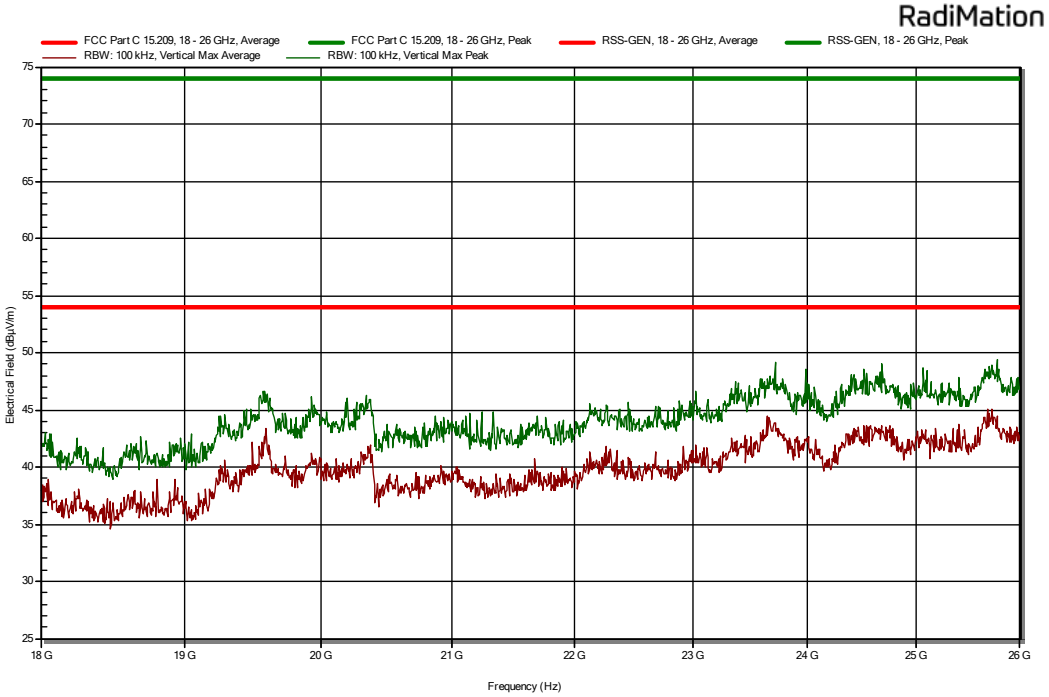



Plot 20: radiated emissions of the EUT, Antenna horizontal, in the range 18 – 26GHz
(peak and average values shown)
Low channel

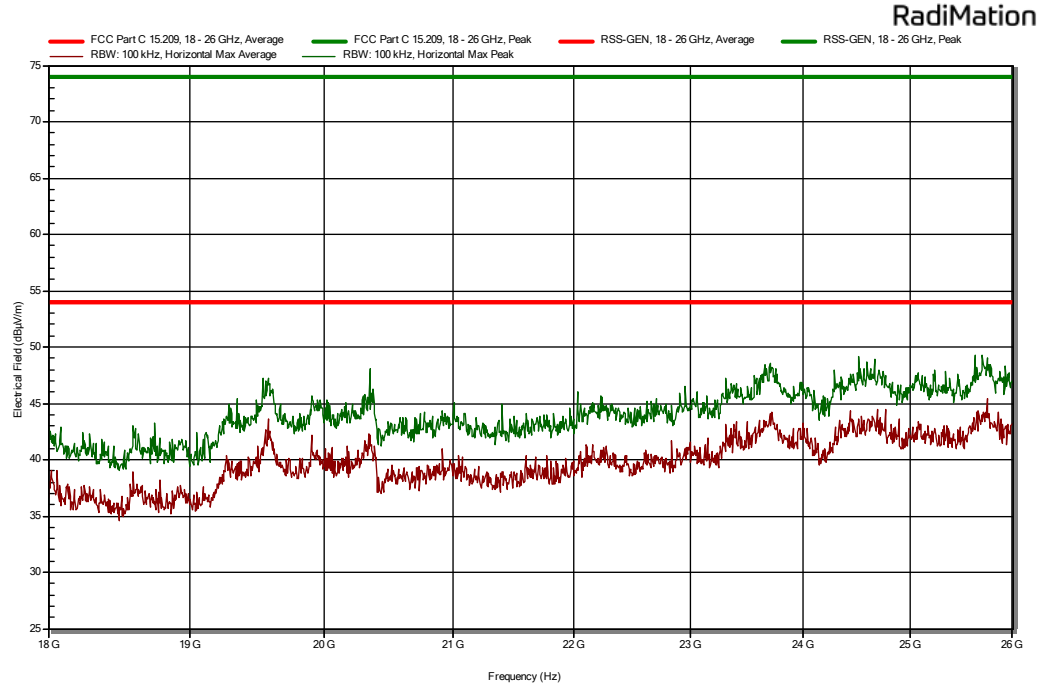



Note: Pre-scan performed with RBW 100 kHz, any peaks found are final measurement are performed with RBW 1MHz.

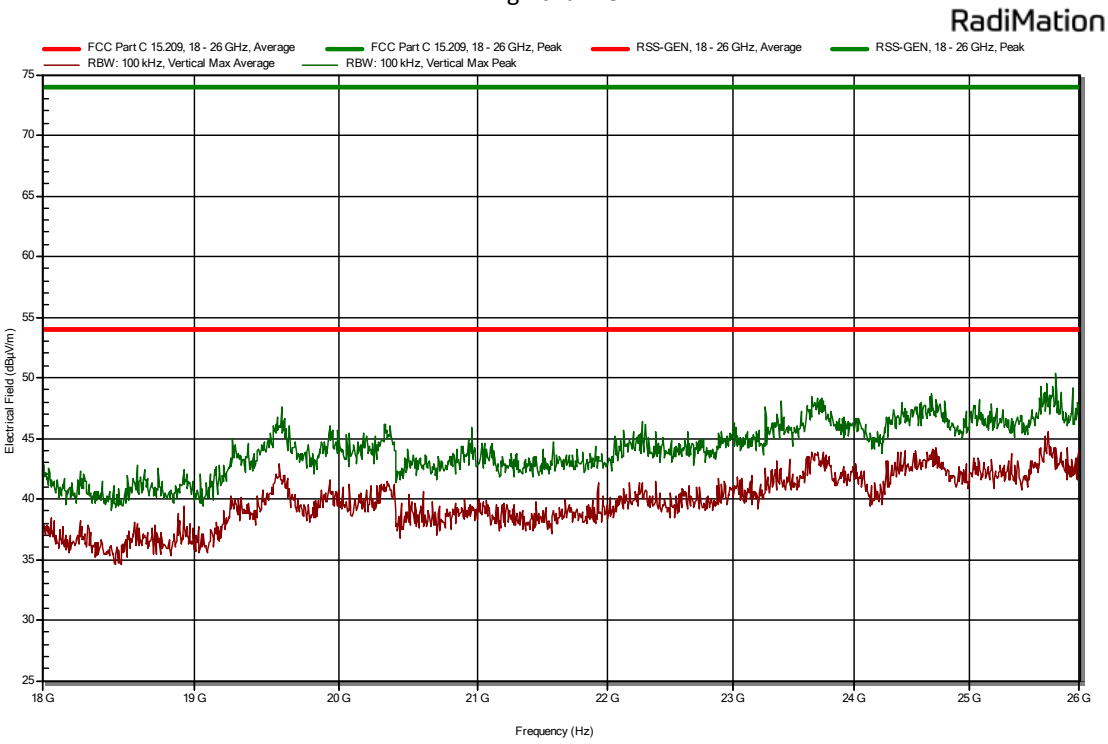
Plot 21: radiated emissions of the EUT, Antenna vertical, in the range 18 – 26GHz
(peak and average values shown)
Middle channel



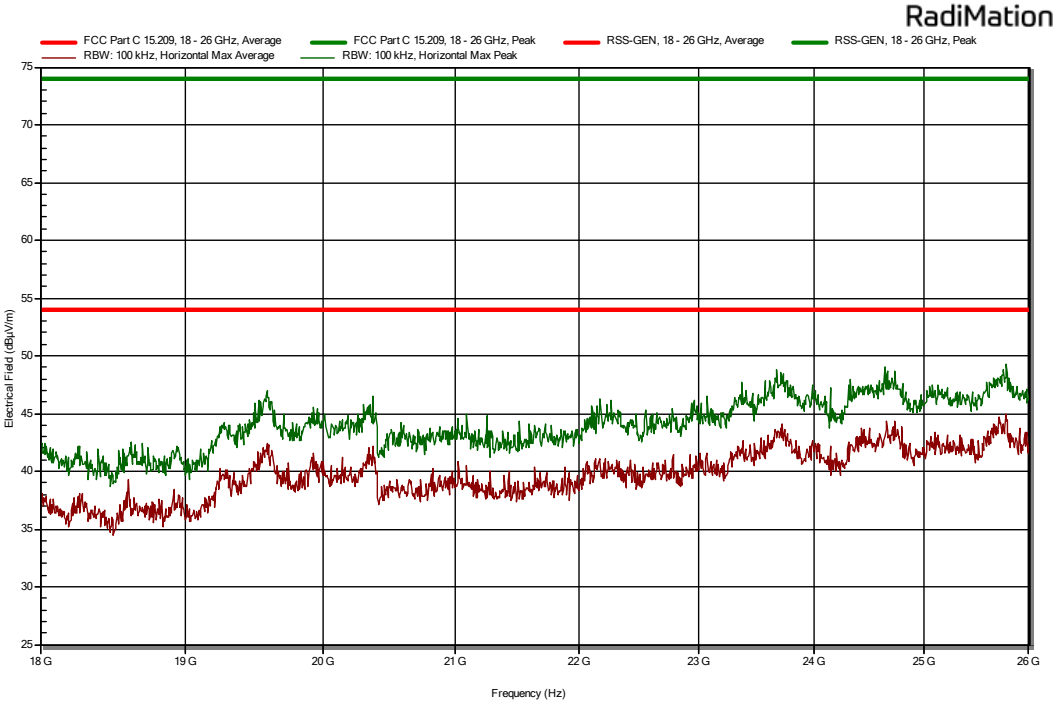

Plot 22: radiated emissions of the EUT, Antenna horizontal, in the range 18 – 26GHz
(peak and average values shown)
Middle channel



Plot 23: radiated emissions of the EUT, Antenna vertical, in the range 18 – 26GHz
(peak and average values shown)
High channel




Plot 24: radiated emissions of the EUT, Antenna horizontal, in the range 18 – 26 GHz
(peak and average values shown)
High channel



## 3.2 6dB bandwidth Measurement

### 3.2.1 Limit

The minimum 6 dB Bandwidth shall be at least 500 kHz.

### 3.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

### 3.2.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

### 3.2.4 Test procedure

According to ANSI C63.10, section 6.9
IRN 404 - Occupied bandwidth (Hz)  Method 4 – DTS Bandwidth.

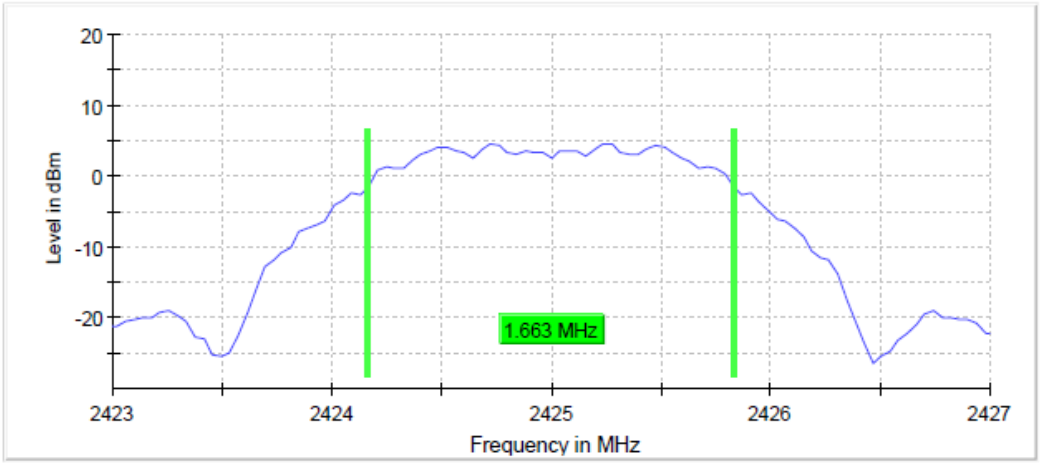
### 3.2.5 Test Results of the 6 dB bandwidth Measurement

| Technology Std. | Channel | Frequency (MHz) | Data rate | 6dB bandwidth (MHz) |
|---|---|---|---|---|
| Zigbee | 1 | 2425 | 250 KB/s | 1.663 |
| | 2 | 2440 | 250 KB/s | 1.663 |
| | 3 | 2475 | 250 KB/s | 1.663 |
| Uncertainty | ± 36.2 kHz | | | |

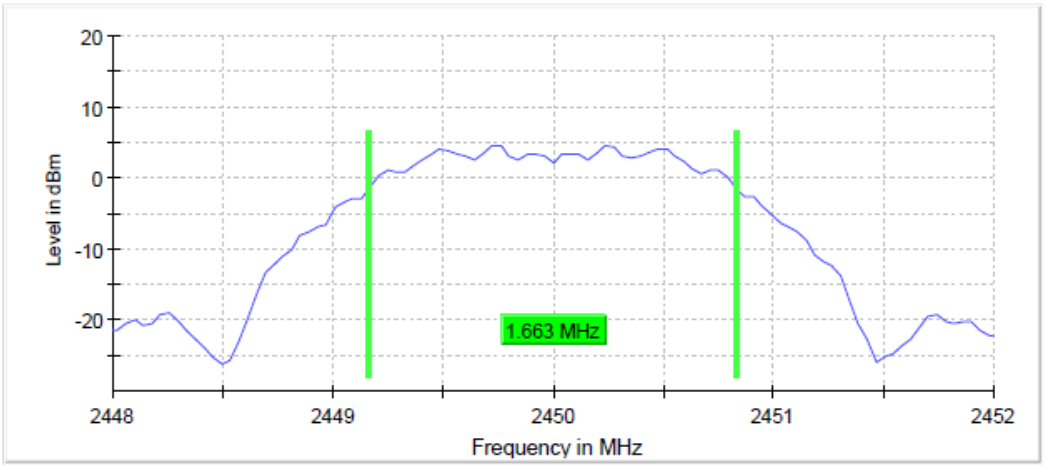
Note: plots are provided on the next page.

### 3.2.6 Plots of the 6 dB bandwidth

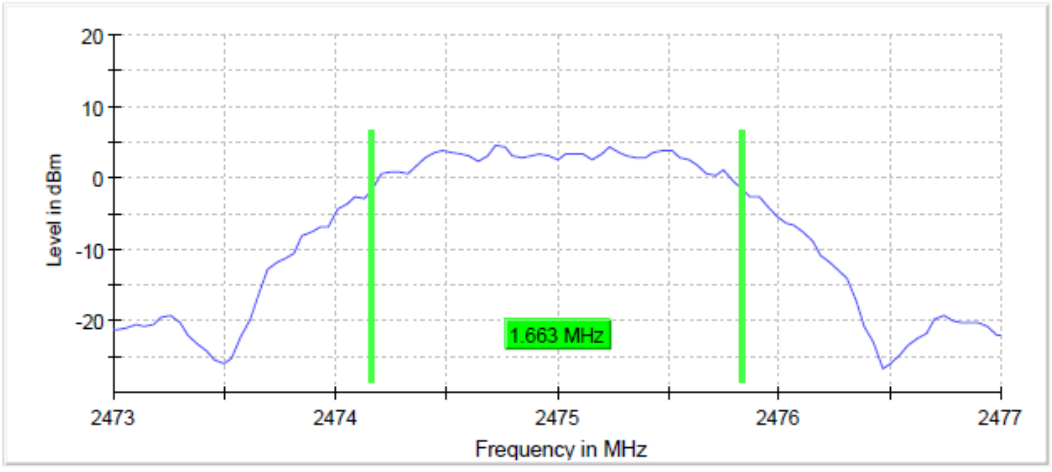
Low channel




Middle channel




High channel



## 3.3 99% Occupied Bandwidth

### 3.3.1 Limit

According to RSS-Gen 6.7

### 3.3.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

### 3.3.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

### 3.3.4 Test procedure

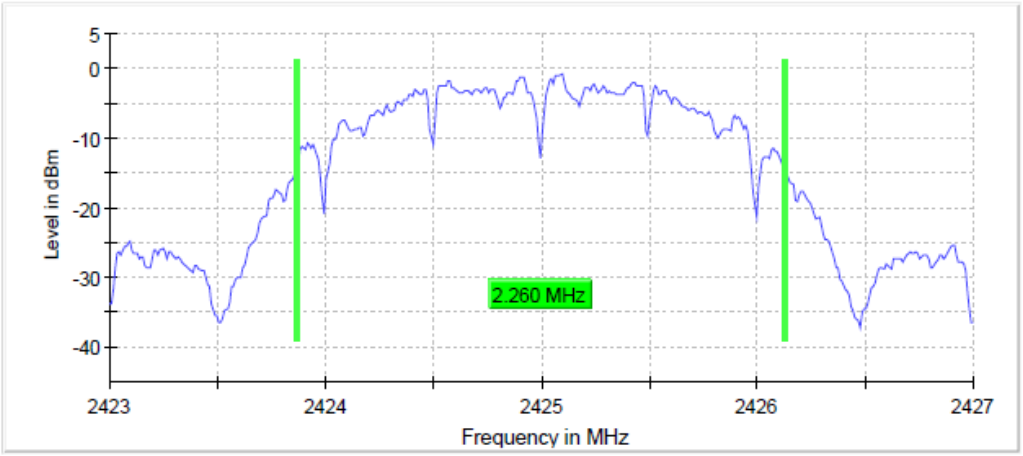
According to ANSI C63.10, section 6.9
IRN 404 - Occupied bandwidth (Hz)  Method 1 – XX % power bandwidth.

### 3.3.5 Test results of the 99% occupied bandwidth measurement

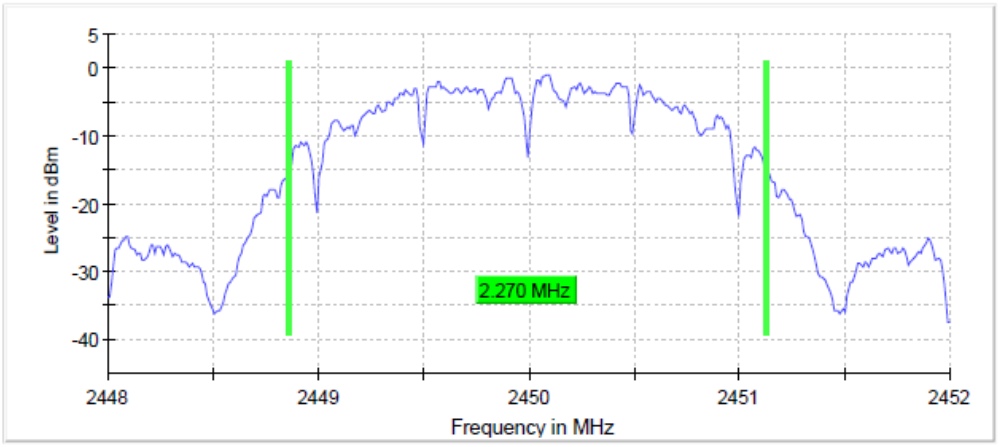
| Technology Std. | Channel | Frequency (MHz) | Data rate | 99% bandwidth (MHz) |
|---|---|---|---|---|
| Zigbee | 1 | 2425 | 250 KB/s | 2.26 |
| | 2 | 2440 | 250 KB/s | 2.27 |
| | 3 | 2475 | 250 KB/s | 2.26 |
| Uncertainty | ± 12 kHz | | | |

### 3.3.6 Plots of the 99% occupied bandwidth measurement

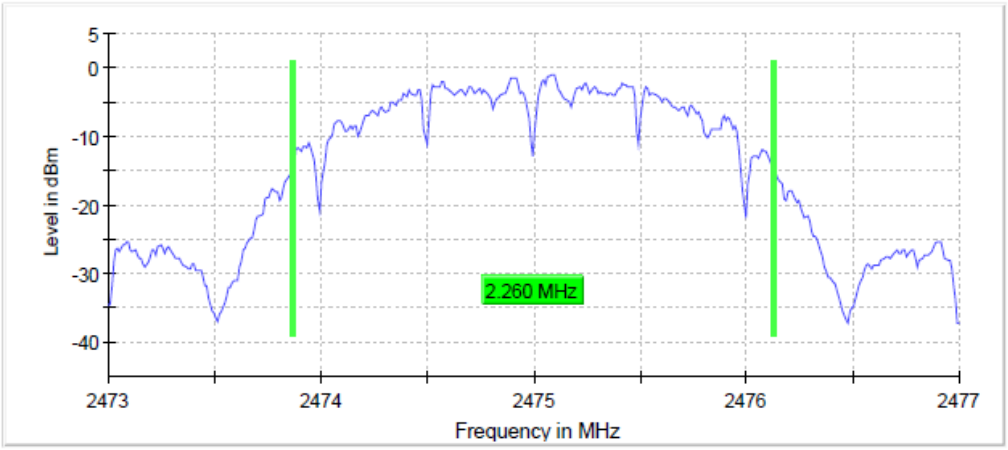
**Channel 1**




**Channel 2**




**Channel 3**



## 3.4 Output Power Measurement

### 3.4.1 Limit

FCC: For systems using digital modulation in the 2400-2483.5 MHz, the limit for the peak output power is 1W (30 dBm). If transmitting antenna of directional gain greater than 6 dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point to point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

RSS: For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4W

### 3.4.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

### 3.4.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

### 3.4.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02.
IRN 402 - RF power (W) - Method 12 – Peak method according to ANSI C63.10.

### 3.4.5 Test results of Output Power Measurement

**Peak method**

| Technology Std. | Channel | Frequency (MHz) | Data rate | Peak output power conducted (dBm) | Peak output power conducted (mW) |
|---|---|---|---|---|---|
| Zigbee | 1 | 2425 | 250 KB/s | 8.1 | 6.45 |
| | 2 | 2450 | 250 KB/s | 7.9 | 6.16 |
| | 3 | 2475 | 250 KB/s | 7.8 | 6.02 |
| Uncertainty | ±0.71 dB | | | | |

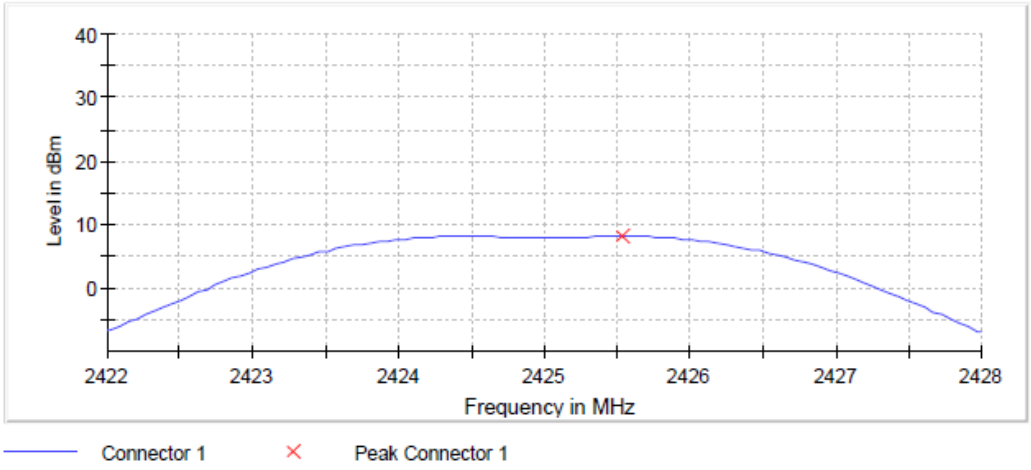
Note: plots are provided on the next page

| Technology Std. | Channel | Frequency (MHz) | Data rate | E.I.R.P (dBm) |
|---|---|---|---|---|
| Zigbee | 1 | 2425 | 250 KB/s | 8.99 |
| | 2 | 2450 | 250 KB/s | 8.79 |
| | 3 | 2475 | 250 KB/s | 8.69 |

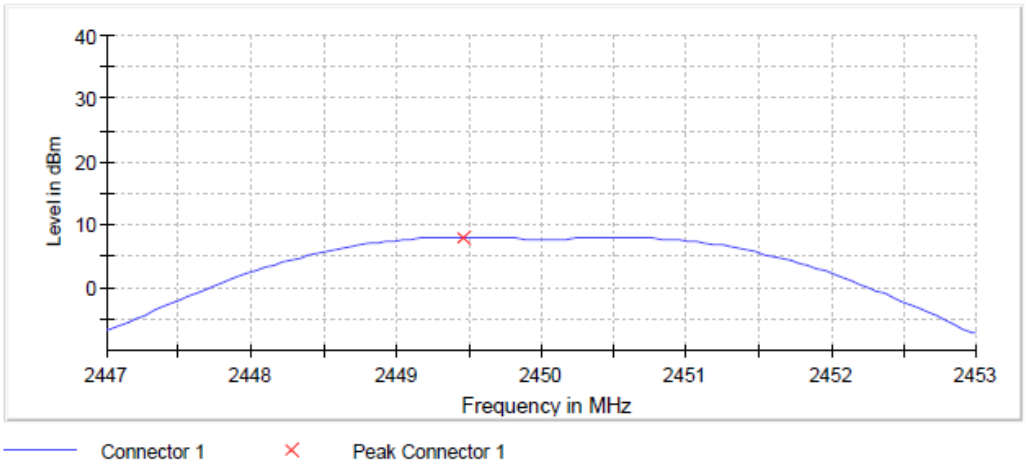
Note: E.I.R.P(dBm) = Peak output power conducted (dBm) + antenna gain

### 3.4.6 Plots of the Output power

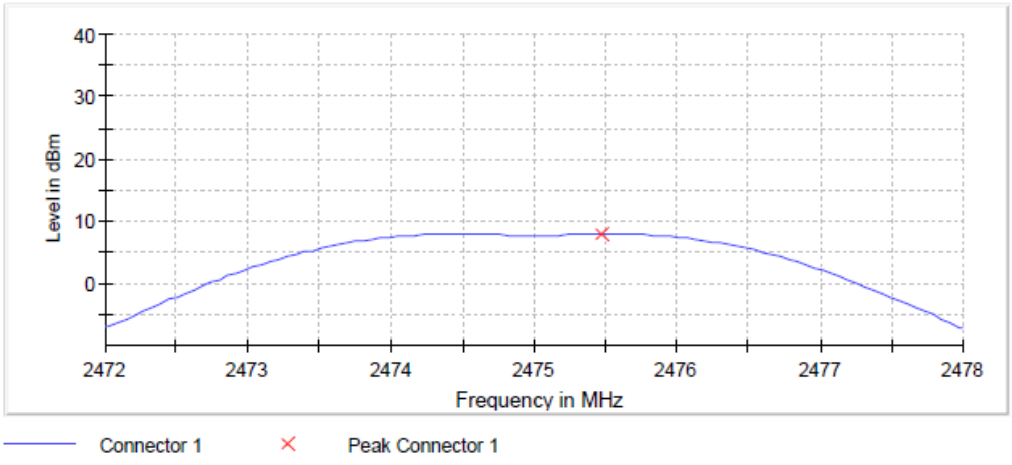
Low channel




Middle channel




High channel



## 3.5 Power Spectral Density

### 3.5.1 Limit

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band at any time interval of continuous transmission.

### 3.5.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

### 3.5.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

### 3.5.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02.
IRN 412 - Spectral power density (W per n.Hz) - Method 5 – Peak method PKPSD (PSD in 3 kHz band)

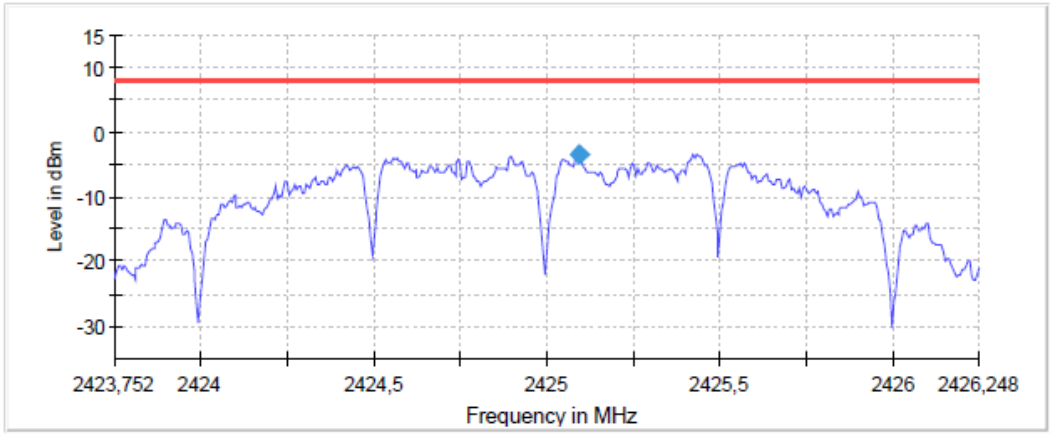
### 3.5.5 Test results of Power Spectral Density Measurement

| Technology Std. | Channel | Frequency (MHz) | Data rate | PSD Conducted (dBm/3 kHz) | Limit (conducted) (dBm/3kHz) |
|---|---|---|---|---|---|
| Zigbee | 1 | 2425 | 250 KB/s | -3.287 | 8 |
| | 2 | 2450 | 250 KB/s | -3.482 | 8 |
| | 3 | 2475 | 250 KB/s | -3.464 | 8 |
| Uncertainty | ±2 dB | | | | |

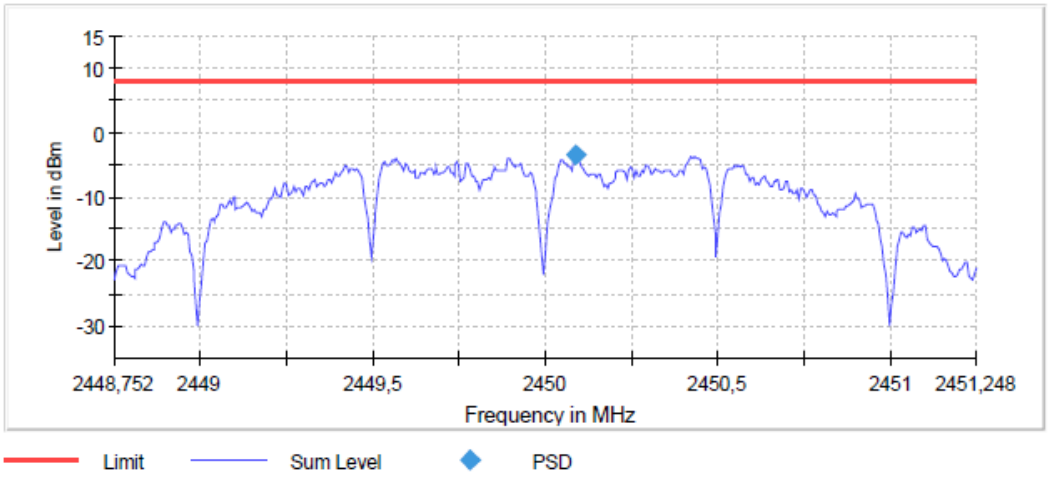
Note: plots are provided on the next page

### 3.5.6 Plots of the Power Spectral Density

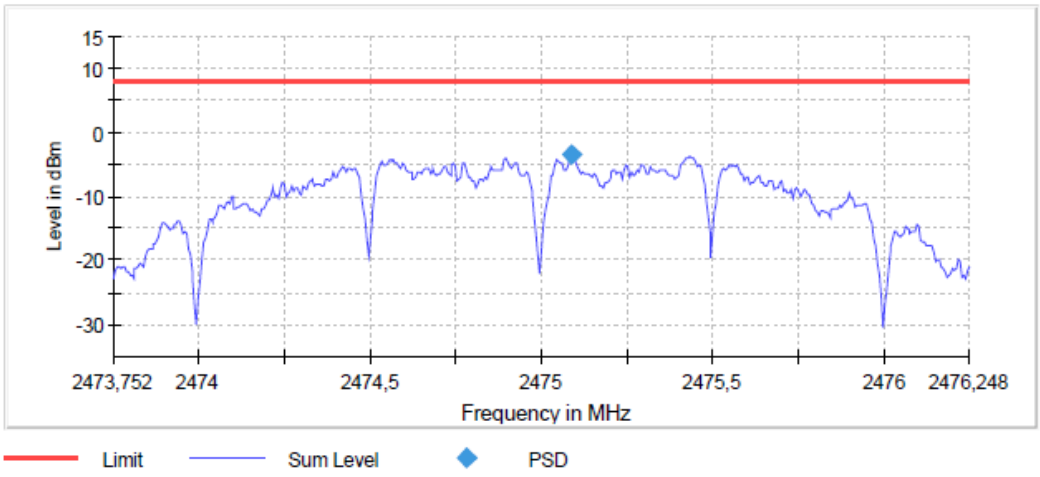
Low channel




Middle channel




High channel



## 3.6 Band edge Measurement

### 3.6.1 Limit

**Band edge:**
At the edge of the authorized band the RF power shall be at least 20 dB down.

### 3.6.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

### 3.6.3 Test setup

The test setup is as shown in chapter 2.2 of this report. Antenna port conducted

### 3.6.4 Test procedure

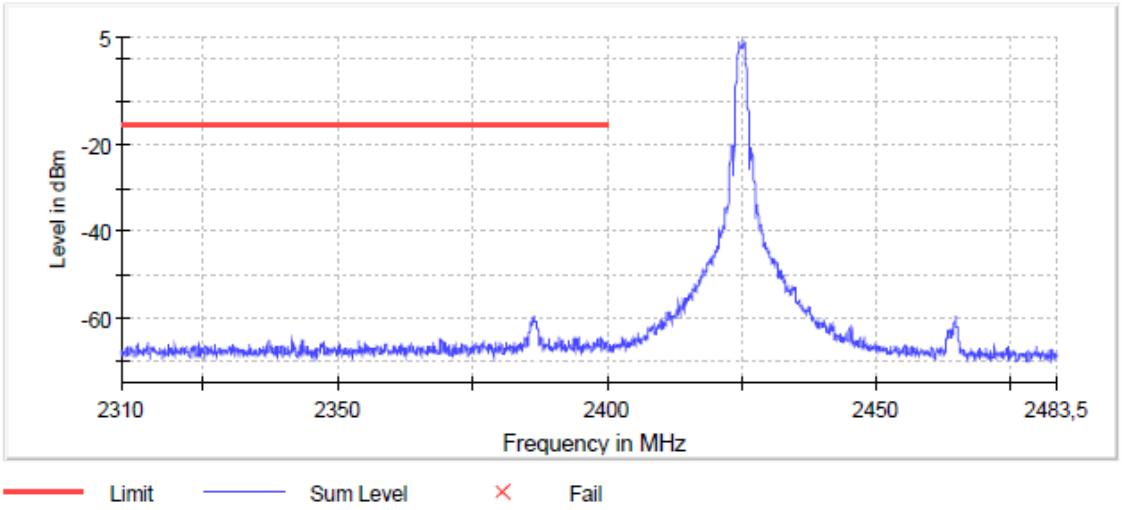
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02, section 8.7.
IRN 441 - Radiated electrical disturbance (V per m)  Method 6 – Radiated electrical disturbance at the Authorized band edge.

### 3.6.5 Measurement Uncertainty

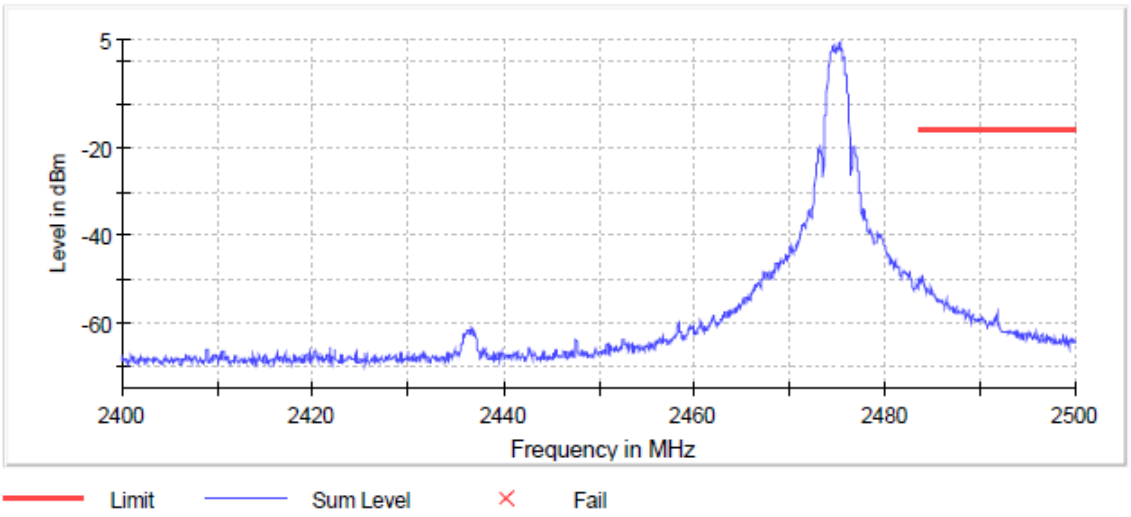
± 0.8 dB

### 3.6.6 Plots of the Band edge Measurements

**Zigbee Lower band edge**




**Zigbee Upper band edge**



## Sample calculations

All formulas for data conversions and conversion factors are reported in this chapter.

Magnetic field strength measurement:

$$H\left[dB\left(\mu\frac{A}{m}\right)\right] = V[dB(\mu V)] + L_c[dB] + AF^H[\frac{dB}{\Omega m}]$$

Where:
H is the magnetic field strength (to be compared to the limit)
V is the voltage level measured by the receiver or spectrum analyzer
$L_C$ is the cable loss
$AF^H$ is the magnetic antenna factor

| Frequency (MHz) | AF (dB/Ωm)<br>114515<br>EMCO 6505<br>S/N:9112-2710 | CL (dB)<br>SAR cable | Corr. (dB) |
|---|---|---|---|
| 0,009 | -32,35 | 0,7 | -31,65 |
| 0,01 | -33,16 | 0,05 | -33,11 |
| 0,02 | -37,56 | 0,07 | -37,49 |
| 0,03 | -39,29 | 0,1 | -39,19 |
| 0,04 | -40,11 | 0,1 | -40,01 |
| 0,1 | -41,27 | 0,1 | -41,17 |
| 0,2 | -41,48 | 0,1 | -41,38 |
| 0,5 | -41,58 | 0,1 | -41,48 |
| 1 | -41,62 | 0,2 | -41,42 |
| 3 | -41,6 | 0,2 | -41,4 |
| 5 | -41,65 | 0,3 | -41,35 |
| 10 | -42,11 | 0,6 | -41,51 |
| 15 | -42,88 | 0,9 | -41,98 |
| 20 | -43,78 | 1 | -42,78 |
| 25 | -44,85 | 0,7 | -44,15 |
| 27 | -45,36 | 1,2 | -44,16 |
| 30 | -46,25 | 1 | -45,25 |

Field Strength Measurement:

E (dBµV/m) = U(dBµV) + AF (dB/m) + Corr. (dB)

Where:
E = Electric field strength
U = Measuring receiver voltage
AF = Antenna factor
CL = Cable loss

Corr. = sum of single correction factors of used cable and amplifier (if applicable).
Linear interpolation will be used for frequencies in between the values in the table.
Tables shows an extract of the values.

| **Frequency (MHz)** | **AF (dB/m)**<br>**ID: 114436**<br>**VHA 9103 + BBA 9106**<br>**SN: 9856** | **Cable loss (dB)**<br>**Id: SAR cable** | **Corr. (dB)** |
|---|---|---|---|
| 30 | 18.6 | 0.68 | 19.28 |
| 100 | 10.4 | 1.15 | 11.55 |
| 150 | 14.8 | 1.41 | 16.21 |
| 200 | 16.0 | 1.63 | 17.63 |
| 250 | 16.9 | 1.93 | 18.83 |

| **Frequency (MHz)** | **Gain (dBi)**<br>**ID: 114385**<br>**EMCO LPDA**<br>**SN: 9856** | **Cable loss (dB)**<br>**Id: SAR cable** | **Corr. (dB)** |
|---|---|---|---|
| 250 | 11.8 | 1.93 | 13.73 |
| 300 | 13 | 2.12 | 15.12 |
| 350 | 15.6 | 2.2 | 17.8 |
| 400 | 17.1 | 2.29 | 19.39 |
| 450 | 17.3 | 2.53 | 19.83 |
| 500 | 17.7 | 2.67 | 20.37 |
| 550 | 18.4 | 2.9 | 21.3 |
| 600 | 19.2 | 3.02 | 22.22 |
| 650 | 19.7 | 3.09 | 22.79 |
| 700 | 20.3 | 3.22 | 23.52 |
| 750 | 21.4 | 3.56 | 24.96 |
| 800 | 22 | 3.69 | 25.69 |
| 900 | 22.1 | 3.81 | 25.91 |
| 950 | 22.6 | 3.91 | 26.51 |
| 1000 | 22.5 | 4.3 | 26.8 |

| Frequency (MHz) | AF (dB/m)<br>Kiwa ID: 114607<br>Emco 3115<br>SN: 9412-4377 | Gain (dB)<br>Kiwa ID: 114693<br>Miteq<br>JS4-18004000-30-8P-A1 | Cable loss (dB)<br>TE 01315 | Corr. (dB) |
|---|---|---|---|---|
| 1000 | 23,6 | 40,4 | 2,0 | 66 |
| 1500 | 25,1 | 40,5 | 2,4 | 68 |
| 2000 | 27,1 | 40,5 | 2,7 | 70,3 |
| 2500 | 28,6 | 40,7 | 3,2 | 72,5 |
| 3000 | 30,5 | 40,7 | 3,2 | 74,4 |
| 3500 | 31,2 | 40,7 | 3,4 | 75,3 |
| 4000 | 32,7 | 40,9 | 4,9 | 78,5 |
| 4500 | 32,4 | 40,9 | 4,4 | 77,7 |
| 5000 | 33,2 | 40,7 | 4,6 | 78,5 |
| 5500 | 34,0 | 40,5 | 4,5 | 79 |
| 6000 | 34,6 | 40,0 | 5,2 | 79,8 |
| 6500 | 34,3 | 39,4 | 5,9 | 79,6 |
| 7000 | 35,2 | 38,6 | 5,7 | 79,5 |
| 7500 | 36,4 | 39,2 | 5,9 | 81,5 |
| 8000 | 37,0 | 38,9 | 6,3 | 82,2 |
| 8500 | 37,5 | 38,4 | 6,4 | 82,3 |
| 9000 | 38,1 | 37,4 | 6,5 | 82 |
| 9500 | 37,8 | 37,0 | 7,1 | 81,9 |
| 10000 | 38,2 | 36,5 | 7,3 | 82 |
| 10500 | 38,1 | 36,7 | 7,6 | 82,4 |
| 11000 | 38,3 | 36,9 | 8,3 | 83,5 |
| 11500 | 38,5 | 37,6 | 8,1 | 84,2 |
| 12000 | 39,1 | 38,3 | 8,4 | 85,8 |
| 12500 | 38,7 | 38,5 | 8,3 | 85,5 |
| 13000 | 39,2 | 38,9 | 9,2 | 87,3 |
| 13500 | 40,5 | 40,2 | 8,3 | 89 |
| 14000 | 41,1 | 40,0 | 8,2 | 89,3 |
| 14500 | 41,4 | 40,1 | 8,2 | 89,7 |
| 15000 | 40,2 | 41,4 | 8,3 | 89,9 |
| 15500 | 37,9 | 41,4 | 8,6 | 87,9 |
| 16000 | 37,5 | 42,8 | 9,2 | 89,5 |
| 16500 | 38,6 | 42,3 | 8,8 | 89,7 |
| 17000 | 41,1 | 43,1 | 9,4 | 93,6 |
| 17500 | 42,7 | 43,2 | 9,4 | 95,3 |
| 18000 | 44,0 | 44,2 | 9,8 | 98 |

| Frequency (MHz) | AF (dB/m)<br>Kiwa ID: 114518<br>Flann 20240-25<br>SN: 163703 | Gain (dB)<br>Kiwa ID:114693<br>Miteq<br>JS4-18004000-30-8P-A1 | Cable loss (dB)<br>TE 01315 | Corr. (dB) |
|---|---|---|---|---|
| 18000 | 31,3 | 26,2 | 9,8 | 67,3 |
| 19000 | 31,5 | 26,1 | 9,6 | 67,2 |
| 20000 | 31,7 | 25,9 | 11 | 68,6 |
| 21000 | 31,9 | 24,3 | 10,7 | 66,9 |
| 22000 | 32,1 | 18,3 | 10,5 | 60,9 |
| 23000 | 32,2 | 18,9 | 10,8 | 61,9 |
| 24000 | 32,3 | 23,6 | 11,4 | 67,3 |
| 25000 | 32,4 | 24,5 | 11,6 | 68,5 |
| 26000 | 32,5 | 25,3 | 11,7 | 69,5 |

<< END OF REPORT>>