

# RADIO TEST REPORT

No. 1610688STO-002, Ed. 1

## RF Performance

### EQUIPMENT UNDER TEST

Equipment: Wireless dimmer with ZigBee  
Type/Model: ICTC-G-1  
Manufacturer: IKEA of Sweden AB  
Tested by request of: IKEA of Sweden 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 (2015): Subpart C: Intentional radiators. Section 15.247

47 CFR Part 15 (2015): Subpart B: Unintentional radiators

RSS-GEN Issue 4 (2014): General requirements of compliance of radio apparatus (2014)

RSS-247 Issue 1 (2015): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices

For details, see clause 2 – 4.

Date of issue: 2016-07-04

Tested by:

  
Robert Hietala

Approved by:

  
Matti Virkki

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## Revision History

| Edition | Date       | Description   | Changes |
|---------|------------|---------------|---------|
| 1       | 2016-07-04 | First release |         |
|         |            |               |         |

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## 1 CLIENT INFORMATION

The EUT has been tested by request of

Company IKEA of Sweden AB  
Box 702  
343 81 Älmhult  
Sweden

Name of contact Stefan Backlund  
Phone +46 476 81 000

## 2 EQUIPMENT UNDER TEST (EUT)

### 2.1 Identification of the EUT

Equipment: Wireless dimmer with ZigBee  
Type/Model: ICTC-G-1  
Brand name: IKEA  
Serial number: --  
Manufacturer: IKEA of Sweden

---

Transmitter frequency range: 2405 – 2480 MHz  
Receiver frequency range: 2405 – 2480 MHz  
Frequency agile or hopping: ☐ Yes ☒ No  
Antenna: ☒ Internal antenna ☐ External antenna  
Antenna connector: ☒ None, internal antenna ☐ Yes  
Antenna gain: -0.5 dBi  
Rating RF output power: 3.3 dBm (measured conducted)  
Type of modulation: OQPSK  
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 +45°C

Transmitter standby mode supported: ☒ Yes ☐ No

## 2.2 Additional information about the EUT

The EUT consists of the following units:

| Unit   | Type            | Serial number | Comment               |
|--------|-----------------|---------------|-----------------------|
| Unit 1 | Wireless Dimmer | --            | With internal antenna |
| Unit 2 | Wireless Dimmer | --            | With SMA-connector    |

During the tests the EUT supported following software:

| Software                | Version | Comment |
|-------------------------|---------|---------|
| Trådfri Wireless Dimmer | 1.0     |         |

## 2.3 Peripheral equipment

Peripheral equipment is equipment needed for correct operation of the EUT, but not included as part of the testing and evaluation of the EUT.

| Equipment       | Type / Model   | Manufacturer | Serial no. |
|-----------------|----------------|--------------|------------|
| Laptop computer | ThinkPad T440s | Lenovo       | --         |

## 2.4 Test signals and operation modes

Continuous signal with modulation and a duty cycle of 100 %.

### 3 TEST SPECIFICATIONS

#### 3.1 Standards

Requirements:

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

47 CFR Part 15 (2015): Subpart B: Unintentional radiators

RSS-GEN Issue 4 (2014): General requirements of compliance of radio apparatus (2014).

RSS-247 Issue 1 (2015): Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and License-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,  
P.O. 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

Measurement chambers

| Measurement Chamber | Type of chamber               | IC Site filing # |
|---------------------|-------------------------------|------------------|
| STORA HALLEN        | Semi-anechoic<br>10 m and 3 m | 2042G-2          |

#### 4 TEST SUMMARY

The results in this report apply only to sample tested:

| Requirement                                                 | Description                                                                                               | Result      |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------|
| FCC §15.203<br>RSS-GEN 8.3                                  | <b>Antenna requirement</b>                                                                                | <b>PASS</b> |
|                                                             | The EUT has integrated non detachable antenna which can't be remove without breaking the EUT.             |             |
| FCC §15.207,<br>15.107<br>RSS-GEN 8.8 table 3               | <b>Conducted continuous emission in the frequency range 150 kHz to 30 MHz, AC Power input port</b>        | <b>NA</b>   |
|                                                             | Battery powered.                                                                                          |             |
| FCC §15.247 (d),<br>15.209(a)<br>RSS-GEN 8.9<br>RSS-247 5.5 | <b>Radiated emission of electromagnetic fields in the frequency range 30 – 1000 MHz</b>                   | <b>PASS</b> |
|                                                             | The EUT complies with the limits.<br>The margin to the limit was at least 10 dB.<br>See clause 6.4 – 6.5. |             |
| FCC §15.247(d),<br>15.209(a)<br>RSS-GEN 8.9<br>RSS-247 5.5  | <b>Radiated emission of electromagnetic fields in the frequency range above 1 GHz</b>                     | <b>PASS</b> |
|                                                             | The EUT complies with the limits.<br>The margin to the limit was at least 10 dB.<br>See clause 6.6 – 6.7. |             |
| FCC §15.247(a)(2)<br>RSS-GEN 6.6<br>RSS-247 5.2(1)          | <b>Occupied bandwidth</b>                                                                                 | <b>PASS</b> |
|                                                             | The EUT complies with the limits.<br>See clause 8.4.                                                      |             |
| FCC §15.247(b)<br>RSS-247 5.4(4)                            | <b>Conducted output power</b>                                                                             | <b>PASS</b> |
|                                                             | The EUT complies with the limits.<br>See clause 7.4.                                                      |             |
| FCC §15.247(e)<br>RSS-247 5.2(2)                            | <b>Peak power spectral density</b>                                                                        | <b>PASS</b> |
|                                                             | The EUT complies with the limits.<br>See clause 10.4.                                                     |             |
| FCC §15.247(e)<br>RSS-247 5.5                               | <b>Band edge</b>                                                                                          | <b>PASS</b> |
|                                                             | The EUT complies with the limits.<br>See clause 5.4.                                                      |             |

## 5 BAND EDGE

|                      |                |                           |                 |
|----------------------|----------------|---------------------------|-----------------|
| <b>Date of test:</b> | 2016-06-30     | <b>Test location:</b>     | Wireless Center |
| <b>EUT Serial:</b>   | --             | <b>Ambient temp:</b>      | 22 °C           |
| <b>Tested by:</b>    | Robert Hietala | <b>Relative humidity:</b> | 39 %            |
| <b>Test result:</b>  | Pass           | <b>Margin:</b>            | > 10 dB         |

### 5.1 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.

### 5.2 Test conditions

Detector: Peak, max hold  
 RBW: 100 kHz  
 VBW: 3 x RBW  
 Span: 30 MHz

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

### 5.3 Requirement

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.

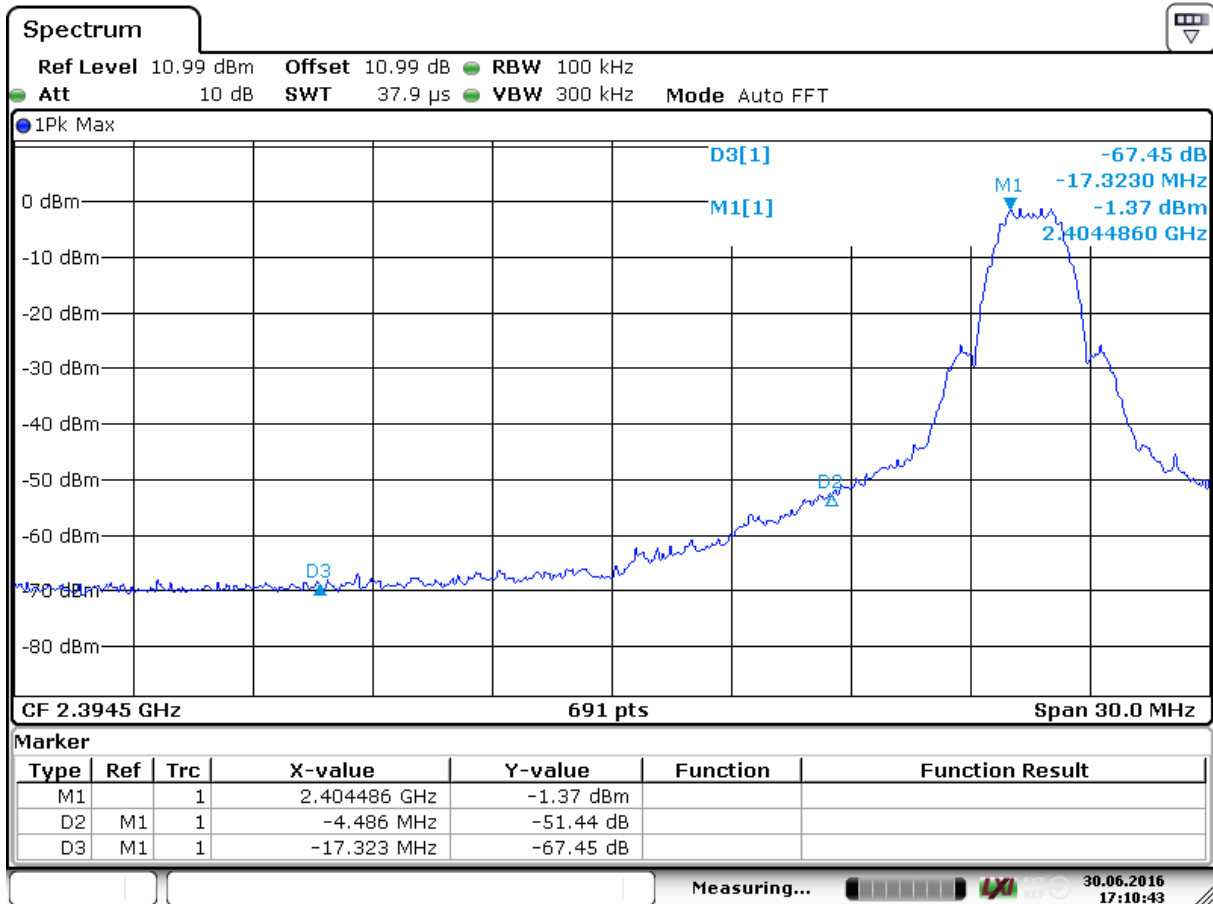
Within restricted bands:

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

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

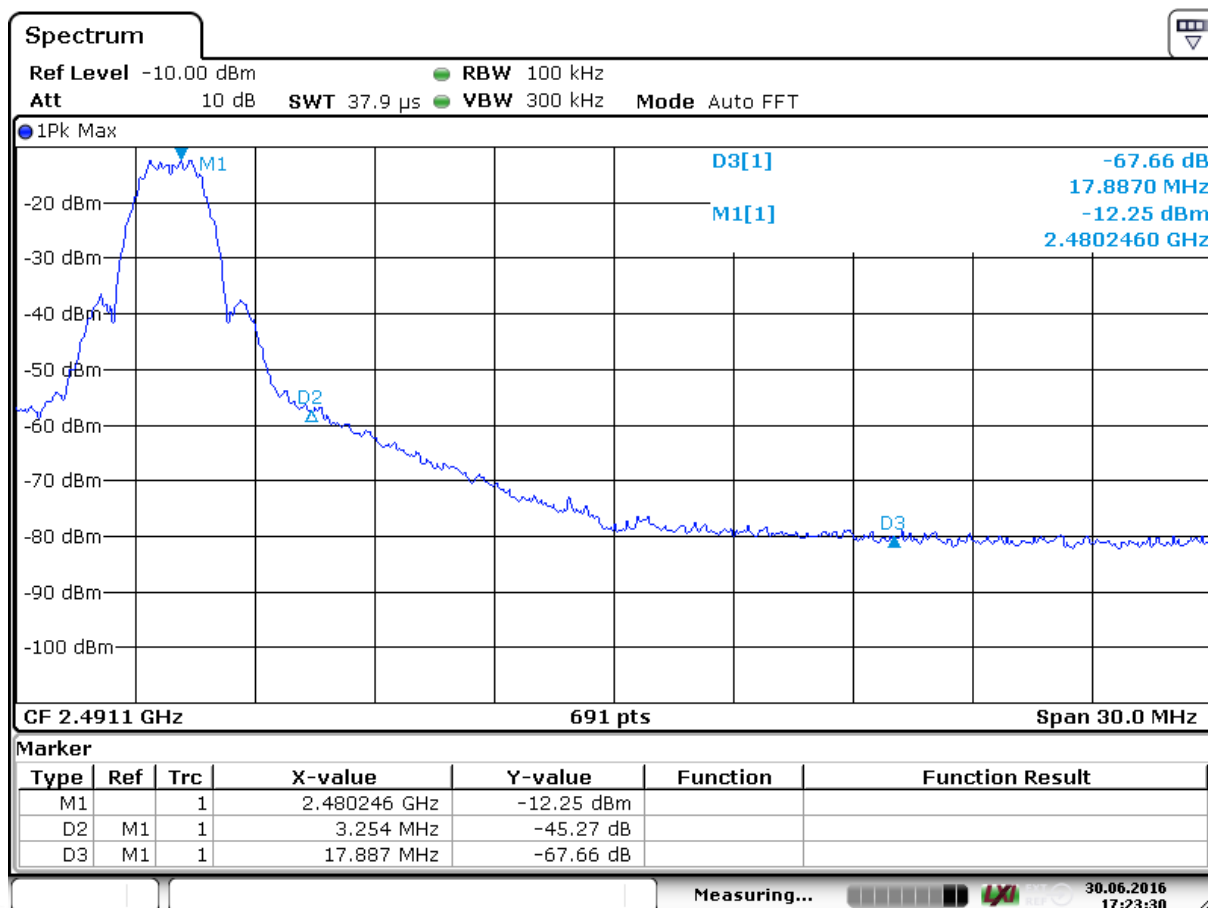
| Frequency range [MHz] | Field strength at 3 m (dB $\mu$ V/m) | Field strength at 10 m (dB $\mu$ V/m) | Detector (dB $\mu$ V/m) |
|-----------------------|--------------------------------------|---------------------------------------|-------------------------|
| 30 – 88               | 40.0                                 | 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          |

## 5.4 Test results



Date: 30 JUN 2016 17:10:43

## Lower band edge



Date: 30 JUN 2016 17:23:30

**Upper band edge****Test results**

| Band edge | Delta [dBc] | Limit [dBc] | Margin [dB] |
|-----------|-------------|-------------|-------------|
| Lower     | 51.4        | 20.0        | 31.4        |
| Upper     | 45.3        | 20.0        | 25.3        |

**6 RADIATED RF EMISSION IN THE FREQUENCY-RANGE 30 MHZ TO 26.5 GHZ**

|                      |                |                           |                                   |
|----------------------|----------------|---------------------------|-----------------------------------|
| <b>Date of test:</b> | 2016-05-20     | <b>Test location:</b>     | Stora Hallen /<br>Wireless Center |
| <b>EUT Serial:</b>   | --             | <b>Ambient temp:</b>      | 22 °C                             |
| <b>Tested by:</b>    | Robert Hietala | <b>Relative humidity:</b> | 39 %                              |
| <b>Test result:</b>  | Pass           | <b>Margin:</b>            | > 10 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.

Portable device, pre scan was made in two orthogonal EUT orientations.

**6.2 Test conditions****Test set-up:****30 MHz to 1000 MHz**

Test receiver set-up:

Preview test: Peak, RBW 120 kHz VBW 1 MHz

Final test: Quasi-Peak, RBW 120 kHz VBW 1 MHz

EUT height above ground plane: 0.8 m

Measuring distance: 3 m

Measuring angle: 0 – 359°

Antenna

Height above ground plane: 1 – 4 m

Polarisation: Vertical and Horizontal

Type: Bilog

**Test set-up:****1 GHz – 26.5 GHz**

Test receiver set-up:

Preview test: Peak, RBW 1 MHz VBW 3 MHz

Average, RBW 1 MHz VBW 3 MHz

Final test: Peak, RBW 1 MHz VBW 3 MHz

Average

EUT height above ground plane: 1.5 m

Measuring distance: 3 m

Measuring angle: 0 – 359°

Antenna

Height above ground plane: 1 – 4 m

Polarisation: Vertical and Horizontal

Type: Horn

Antenna tilt: Activated

### 6.3 Requirements

Within restricted bands and receive mode:

Reference: CFR 47 §15.209, §15.109, 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 $\mu$ V/m) | Field strength at 10 m (dB $\mu$ V/m) | Detector (dB $\mu$ 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))

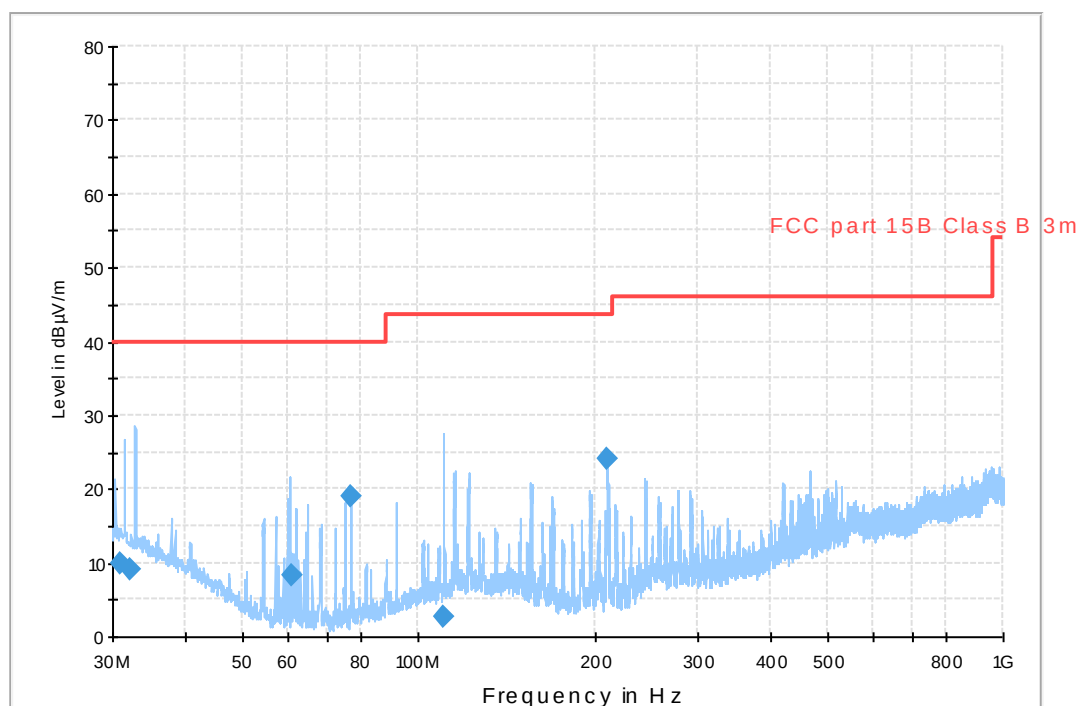
Outside the restricted bands:

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.

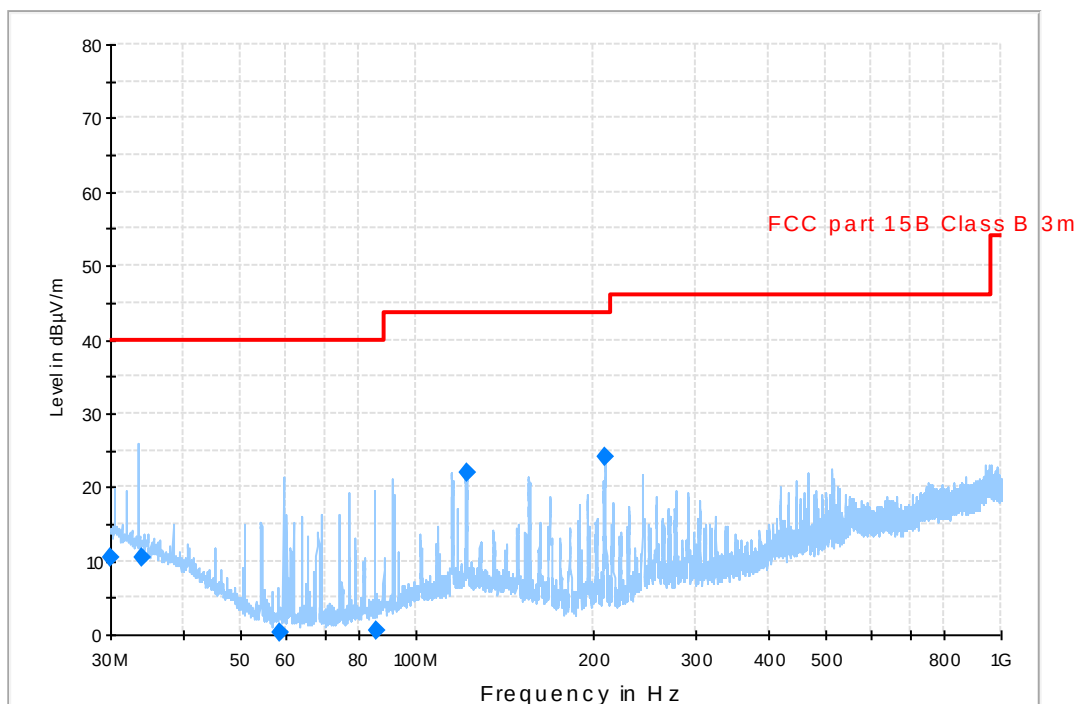
### 6.4 Test results 30 MHz – 1000 MHz, TX

Radio FCC 30 - 1000 MHz FCC class B 10m continuous TT rotation



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

## Radio FCC 30 - 1000 MHz FCC class B 10m continuous TT rotation



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

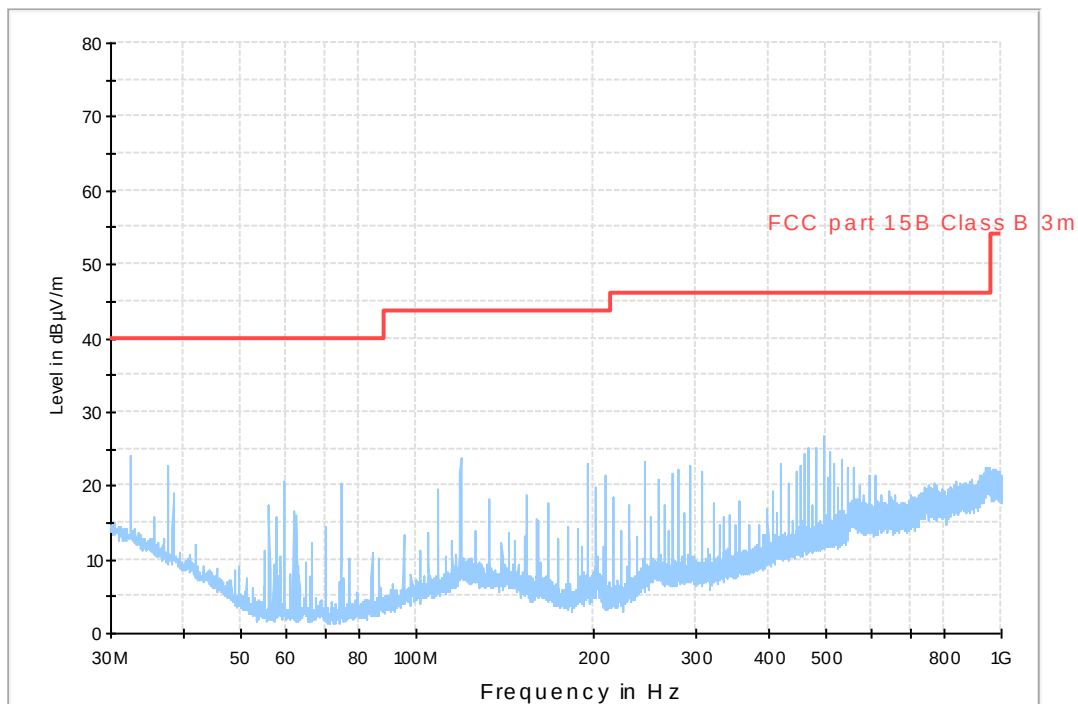
## Measurement results, Quasi Peak

| Frequency [MHz] | Level [dBμV/m] | Limit [dBμV/m] | Polarization H/V | Position | Margin [dB] |
|-----------------|----------------|----------------|------------------|----------|-------------|
| 30.080          | 10.0           | 29.5           | V                | Y        | 19.5        |
| 30.887          | 9.9            | 29.5           | V                | X        | 19.6        |
| 32.205          | 9.0            | 29.5           | V                | X        | 20.5        |
| 33.875          | 10.0           | 29.5           | V                | Y        | 19.5        |
| 58.589          | -0.2           | 29.5           | V                | Y        | 29.7        |
| 61.001          | 8.3            | 29.5           | V                | X        | 21.2        |
| 76.794          | 18.9           | 29.5           | V                | X        | 10.6        |
| 85.376          | -0.1           | 29.5           | V                | Y        | 29.6        |
| 110.682         | 2.5            | 33.0           | V                | X        | 30.5        |
| 122.045         | 21.0           | 33.0           | H                | Y        | 12.0        |
| 210.121         | 22.9           | 33.0           | H                | Y        | 10.1        |
| 210.523         | 24.0           | 33.0           | H                | X        | 9.0         |

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

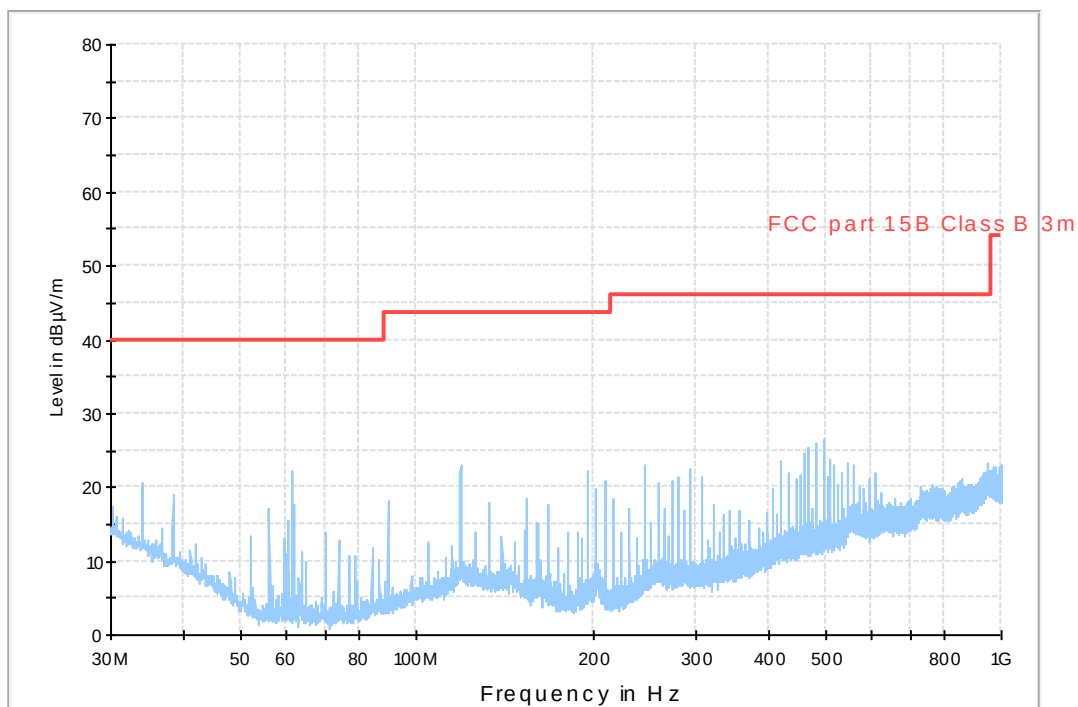
## 6.5 Test results 30 MHz – 1000 MHz, RX

Radio FCC 30 - 1000 MHz FCC class B 10m continuous TT rotation



Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. RX low channel, EUT orientation X.

Radio FCC 30 - 1000 MHz FCC class B 10m continuous TT rotation



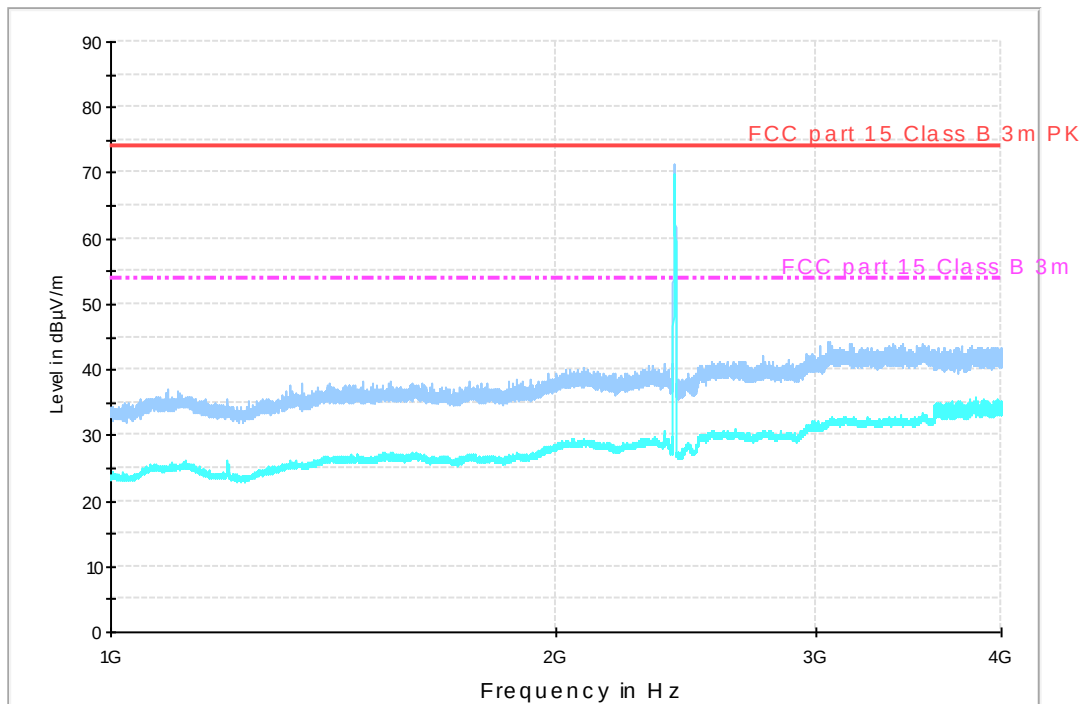
Diagram, Peak overview sweep, 30 – 1000 MHz at 3 m distance. RX low channel, EUT orientation Y.

## Measurement results, Quasi Peak

No emissions are found above noise floor or closer than 20 dB from limit.

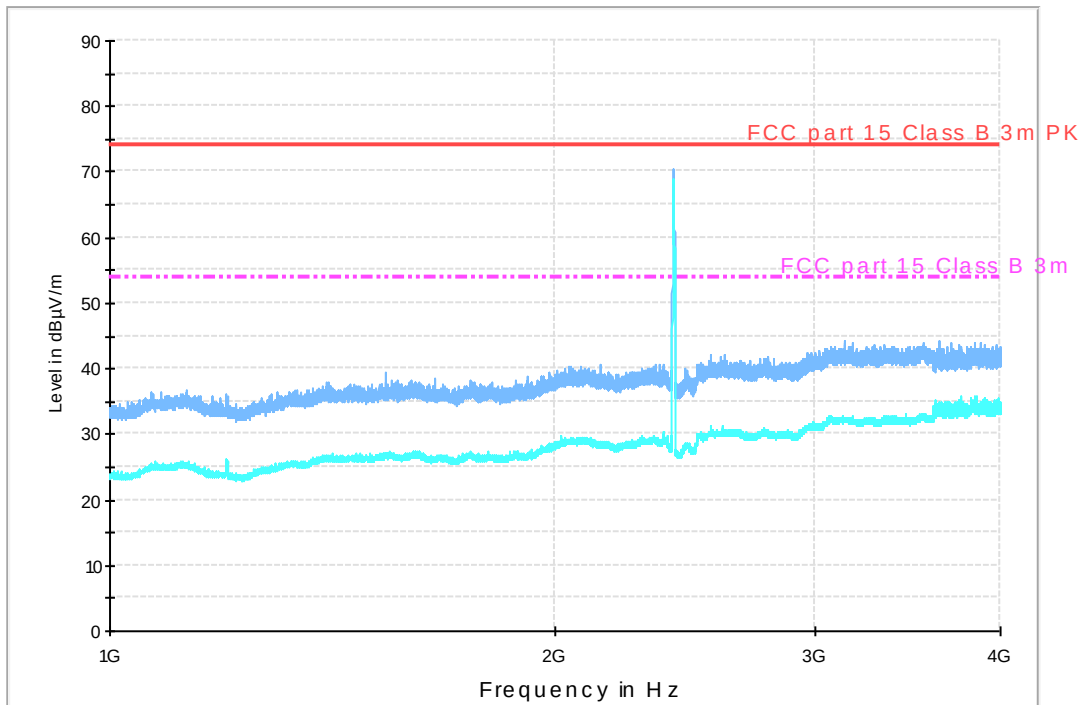
### 6.6 Test results 1 GHz –26.5 GHz, TX

FCC 1 G - 4 G class B 3m ESU40 Continuous TT rotation



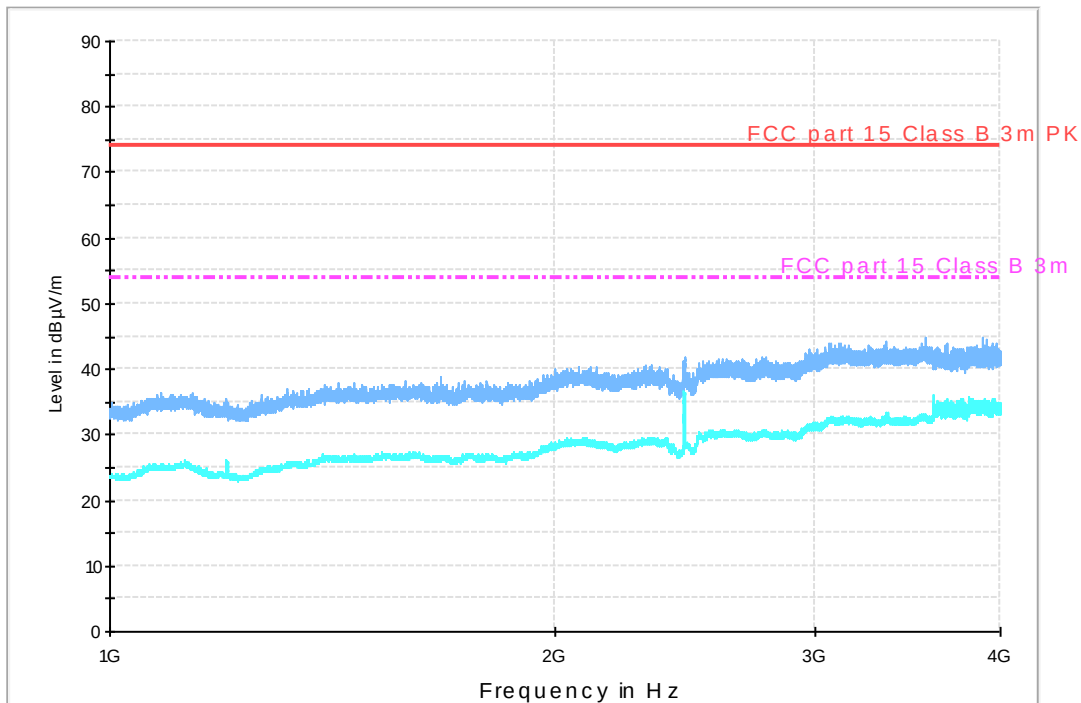
**Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX low channel, EUT orientation X. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.**

FCC 1 G - 4 G class B 3m ESU40 Continuous TT rotation



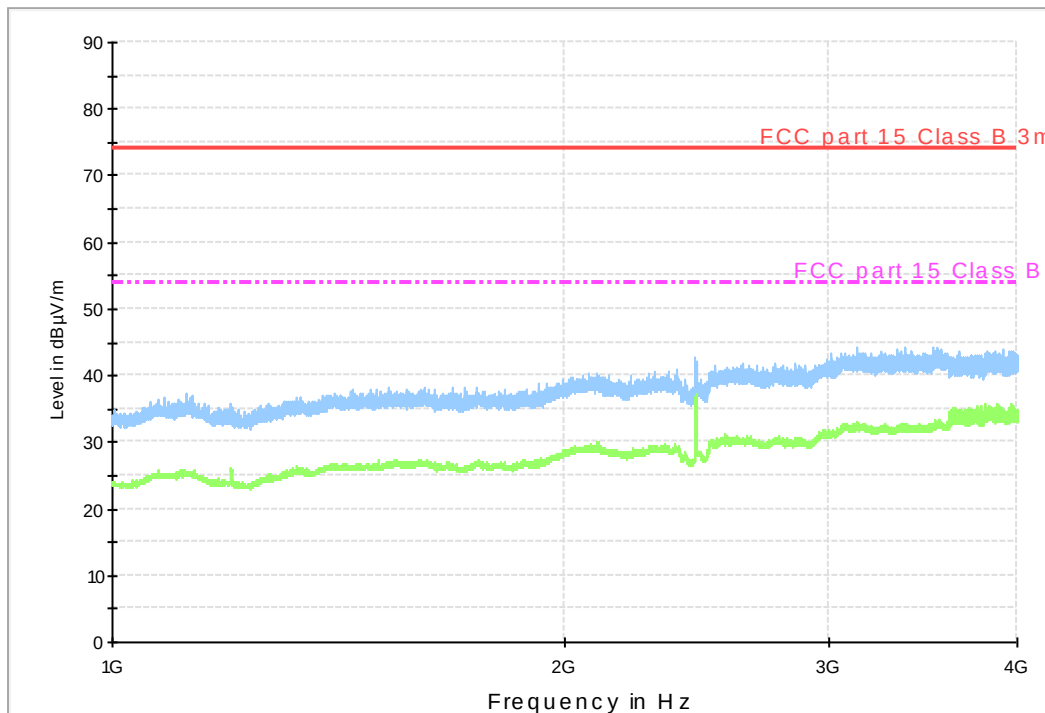
**Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX low channel, EUT orientation Y. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.**

FCC 1 G - 4 G class B 3m ESU40 Continuous TT rotation



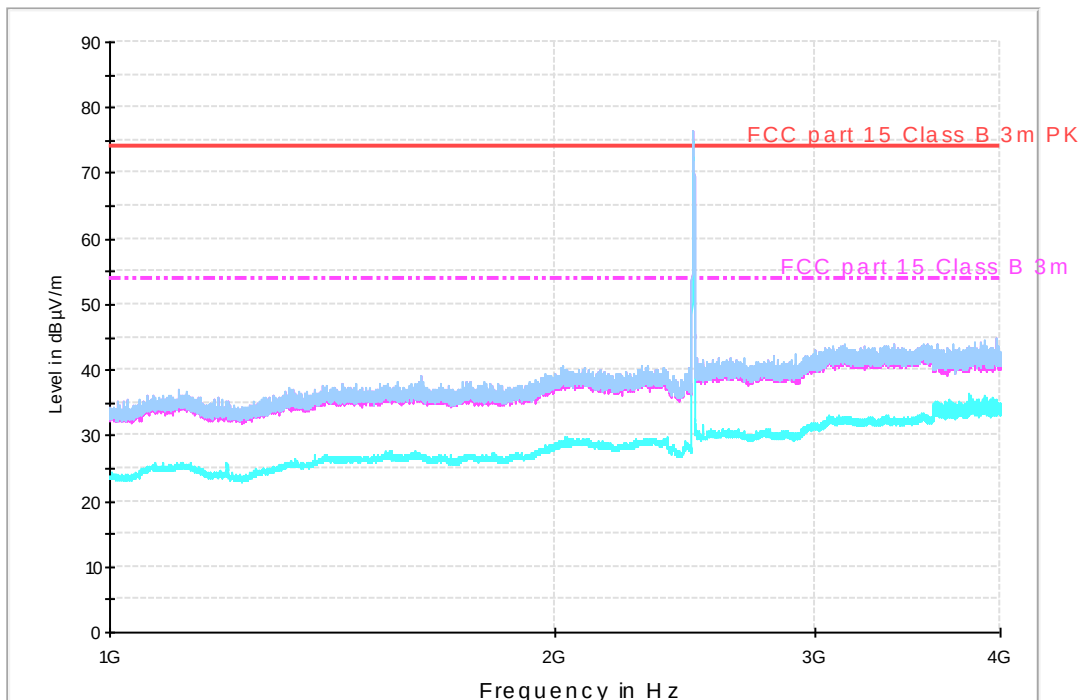
**Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX mid channel, EUT orientation X. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.**

FCC 1 G - 4 G class B 3m ESU40 Continuous TT rotation



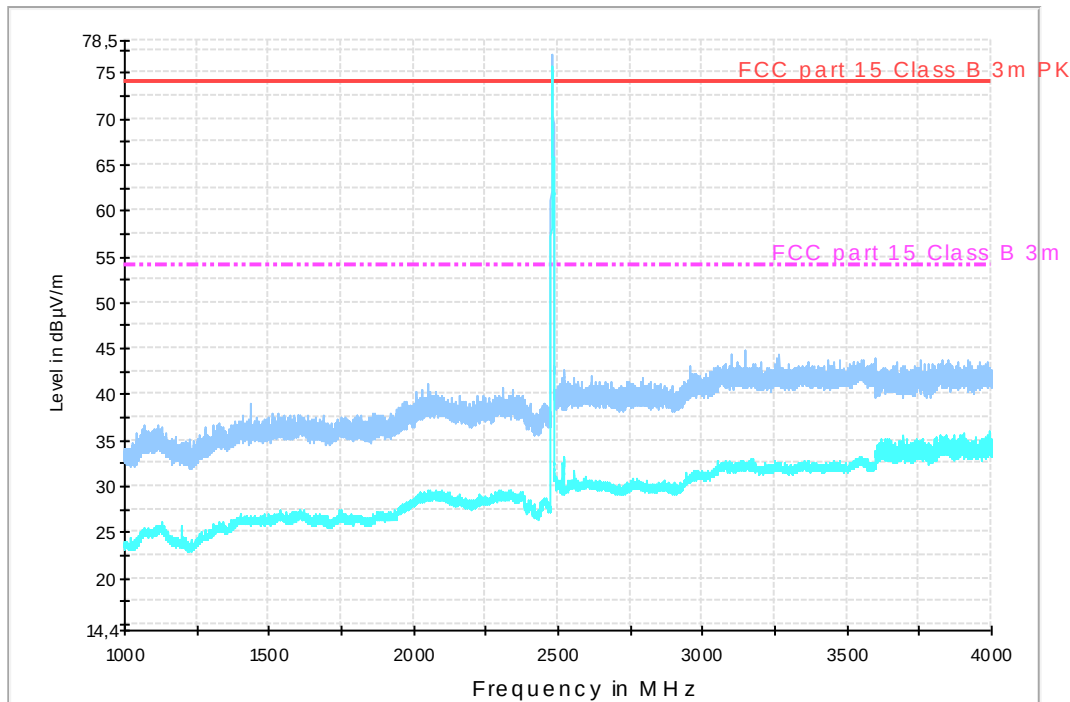
**Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX mid channel, EUT orientation Y. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.**

FCC 1 G - 4 G class B 3m ESU40 Continuous TT rotation



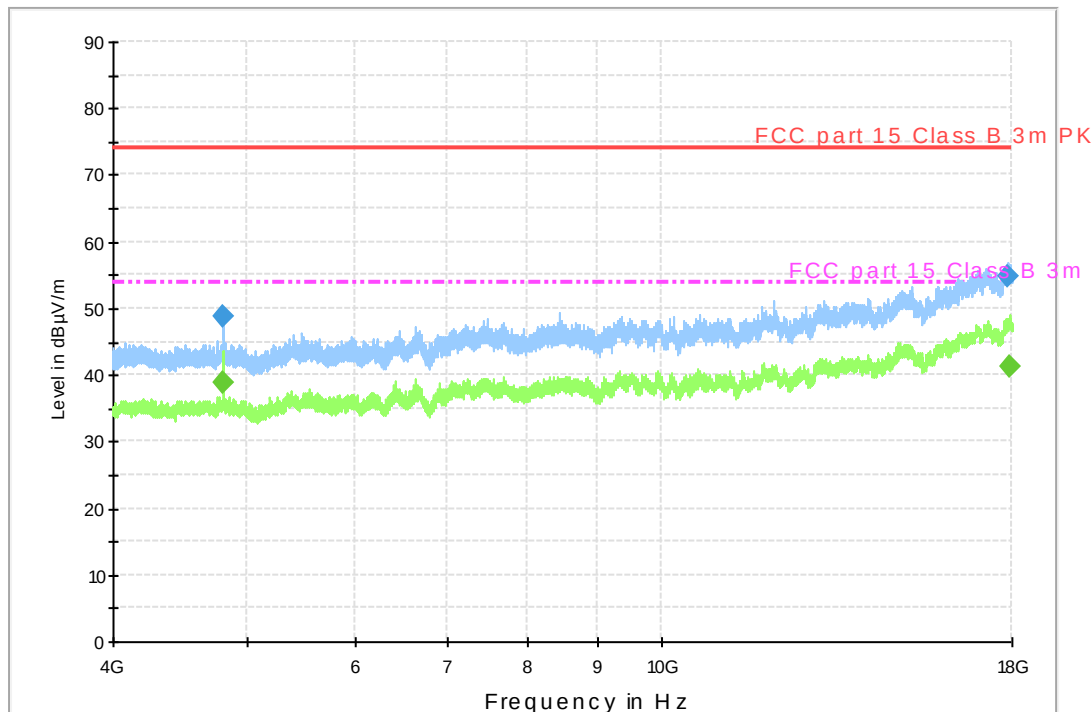
**Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX highd channel, EUT orientation X. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.**

FCC 1 G - 4 G class B 3m ESU40 Continuous TT rotation



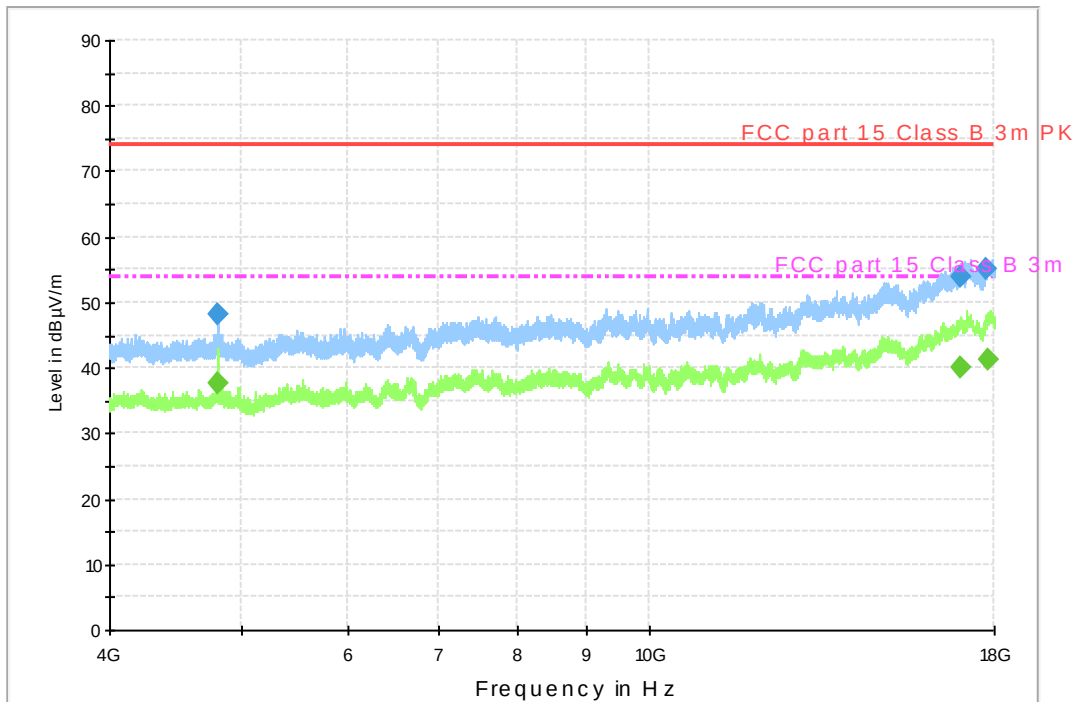
**Diagram, Peak overview sweep, 1– 4 GHz at 3 m distance. TX highd channel, EUT orientation Y. Carrier is attenuated by band rejection filter K&L 6N45-2450/T 100-0/0.**

FCC 4 G - 18 G class B 3m ESU40 Continuous TT rotation



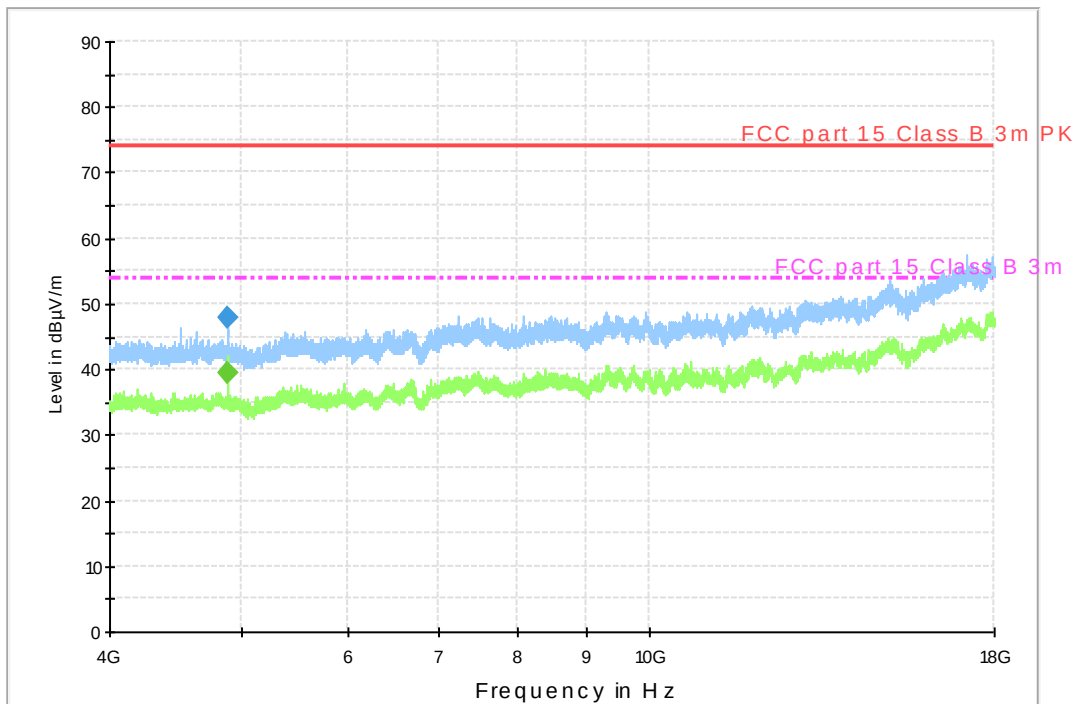
**Diagram, Peak overview sweep, 4 – 18 GHz at 3 m distance. TX low channel, EUT orientation X.**

FCC 4 G - 18 G class B 3m ESU40 Continuous TT rotation



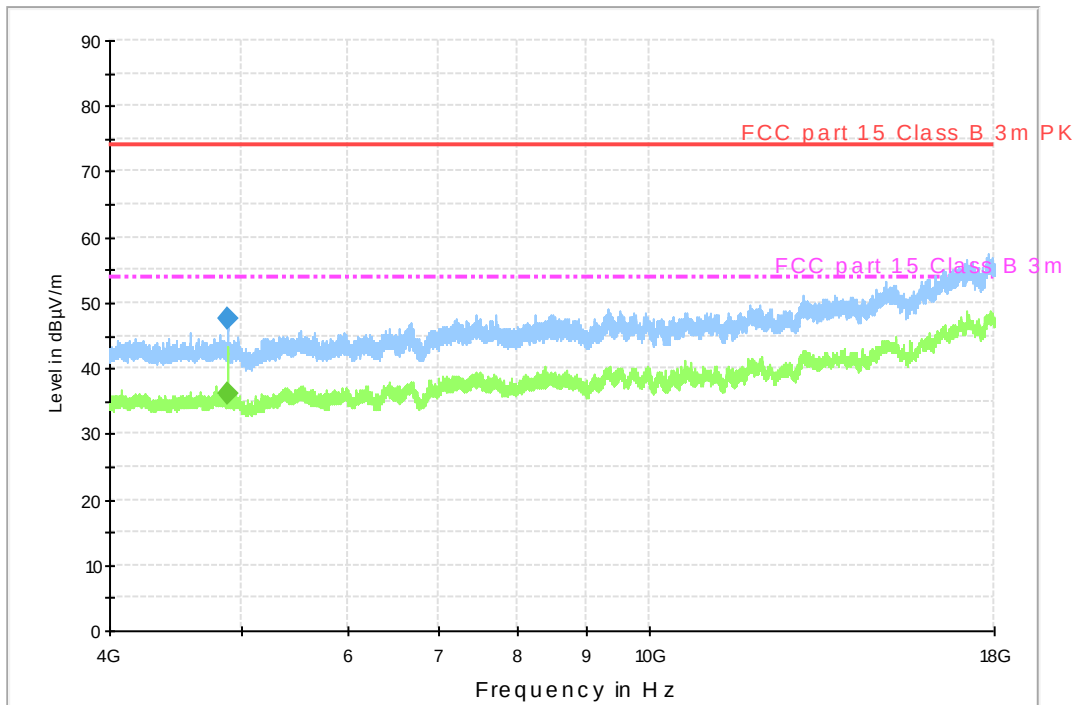
Diagram, Peak overview sweep, 4 – 18 GHz at 3 m distance. TX low channel, EUT orientation Y.

FCC 4 G - 18 G class B 3m ESU40 Continuous TT rotation



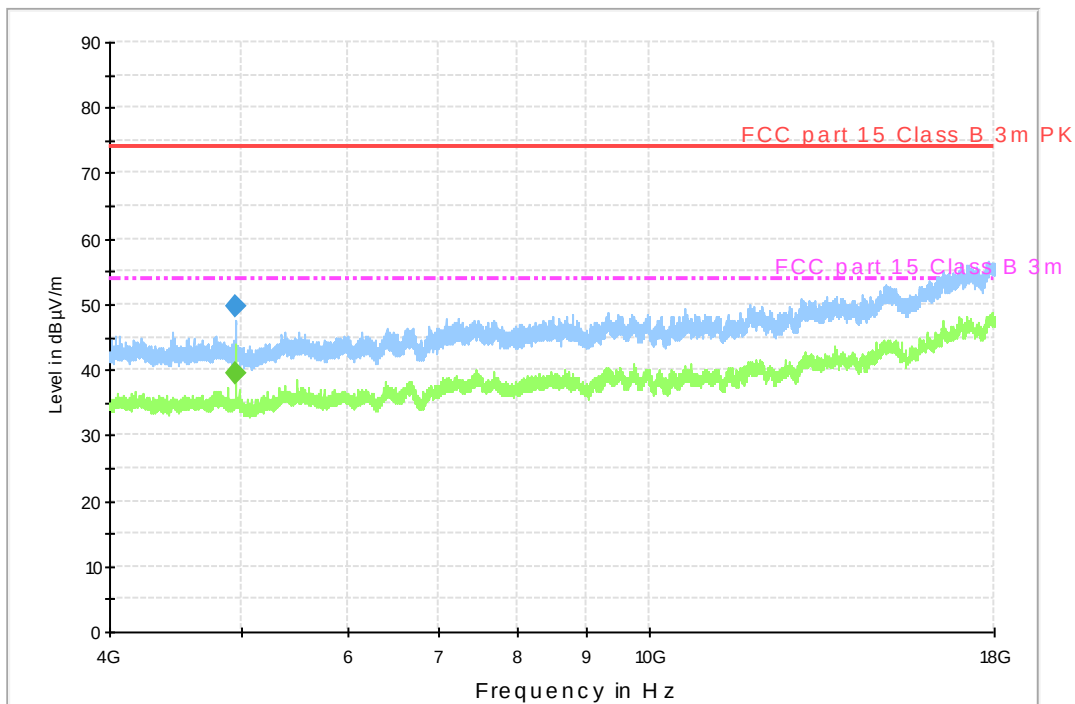
Diagram, Peak overview sweep, 4 – 18 GHz at 3 m distance. TX mid channel, EUT orientation X.

FCC 4 G - 18 G class B 3m ESU40 Continuous T T rotation



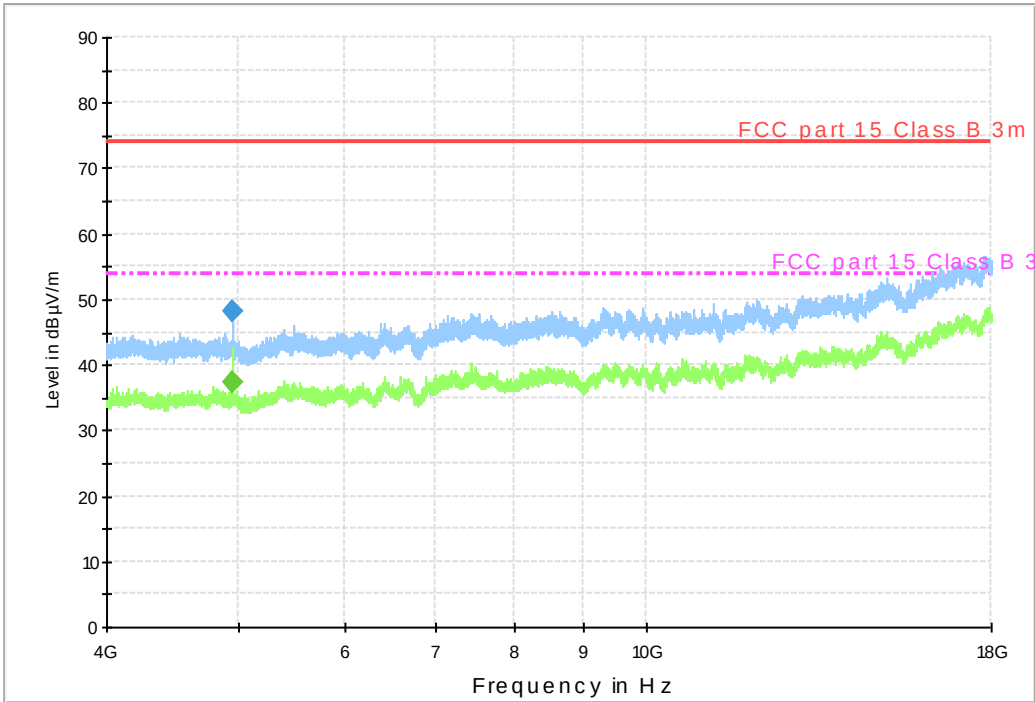
Diagram, Peak overview sweep, 4 – 18 GHz at 3 m distance. TX mid channel, EUT orientation Y.

FCC 4 G - 18 G class B 3m ESU40 Continuous T T rotation



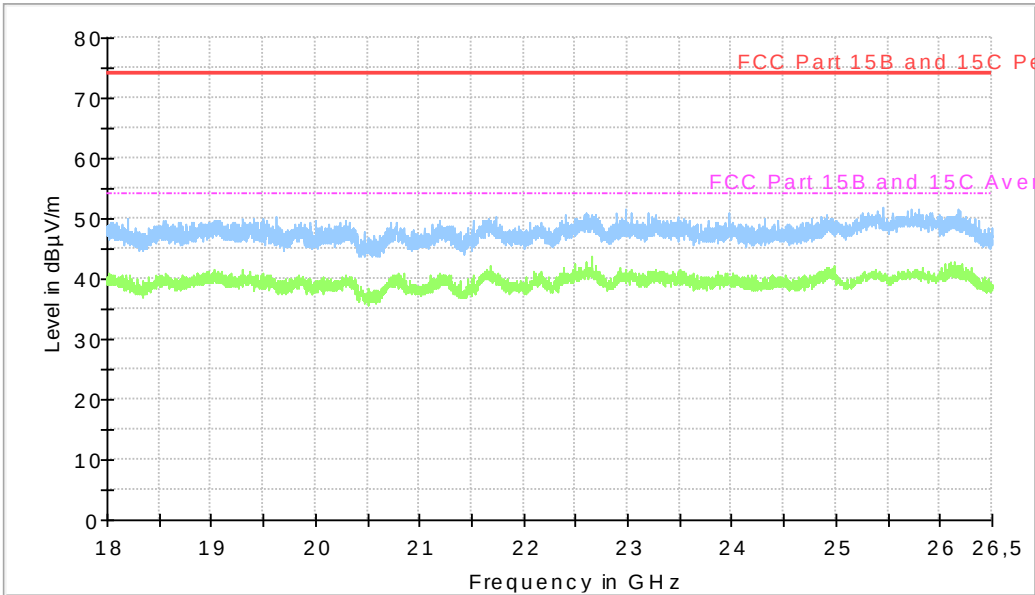
Diagram, Peak overview sweep, 4 – 18 GHz at 3 m distance. TX high channel, EUT orientation X.

FCC 4 G - 18 G class B 3m ESU40 Continuous TT rotation



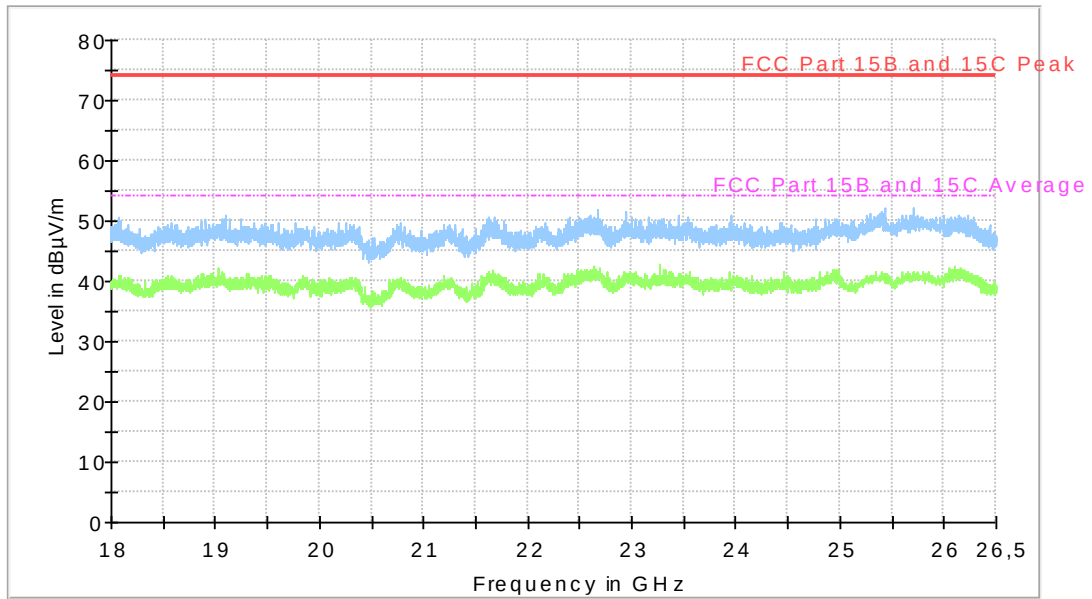
Diagram, Peak overview sweep, 4 – 18 GHz at 3 m distance. TX high channel, EUT orientation Y.

Full Spectrum



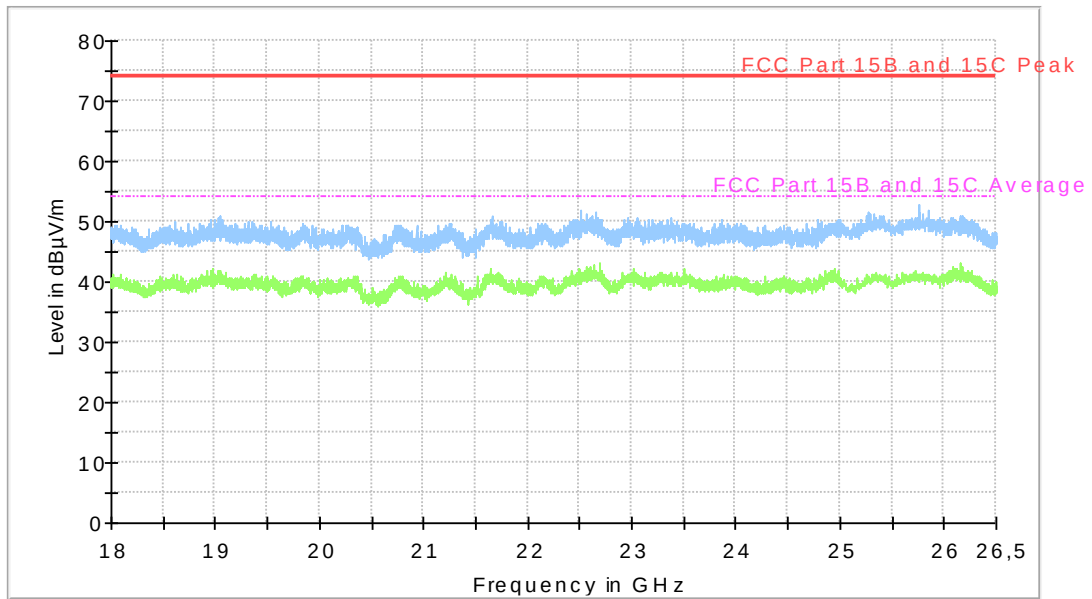
Diagram, Peak overview sweep, 18 – 26.5 GHz at 3 m distance. TX low channel, EUT orientation X.

Full Spectrum



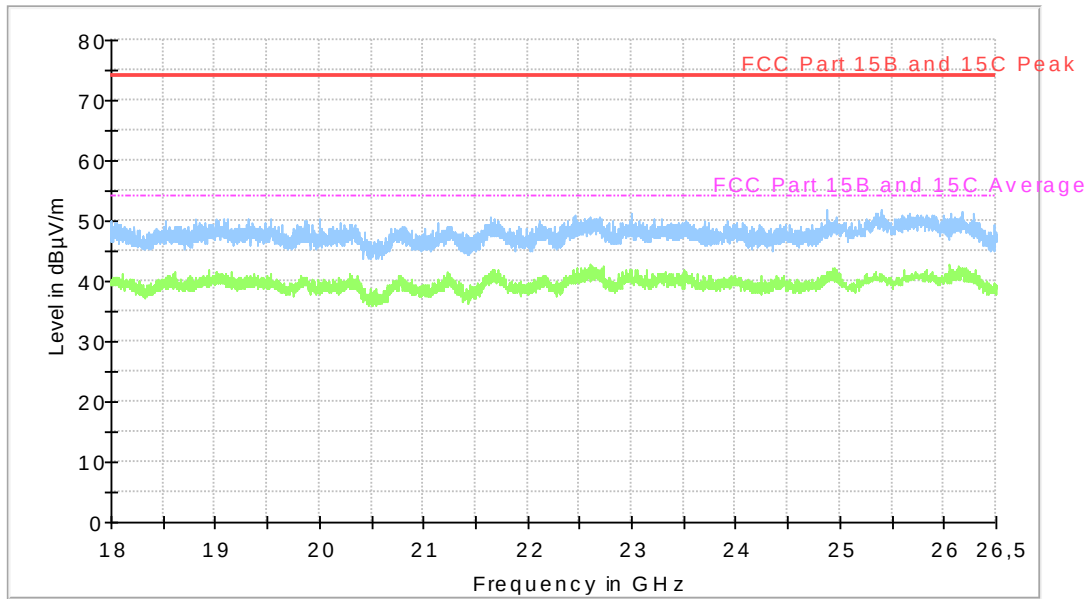
Diagram, Peak overview sweep, 18 – 26.5 GHz at 3 m distance. TX low channel, EUT orientation Y.

Full Spectrum



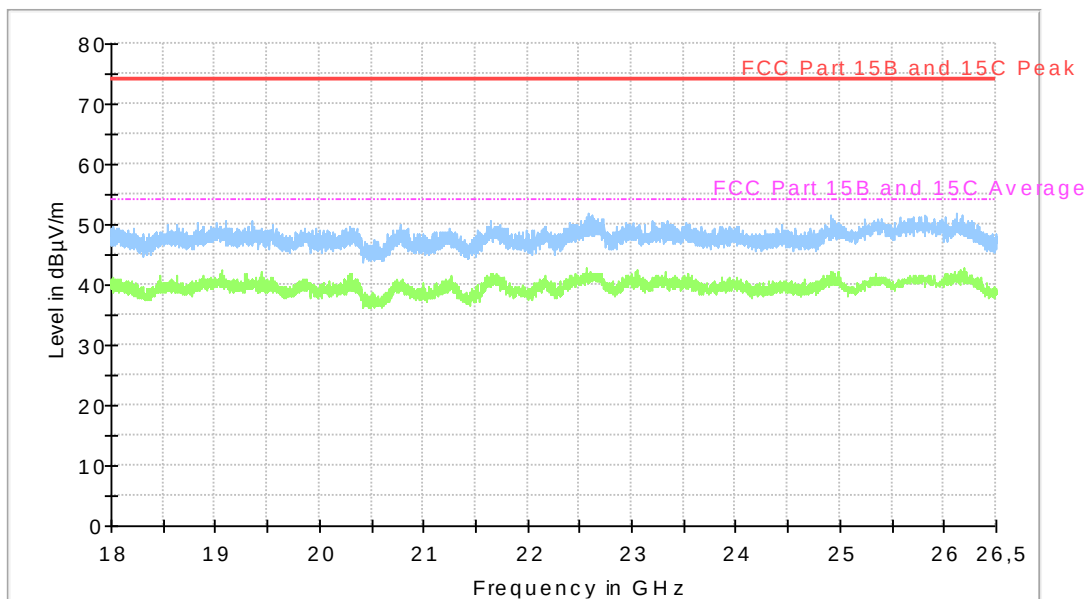
Diagram, Peak overview sweep, 18 – 26.5 GHz at 3 m distance. TX mid channel, EUT orientation X.

Full Spectrum



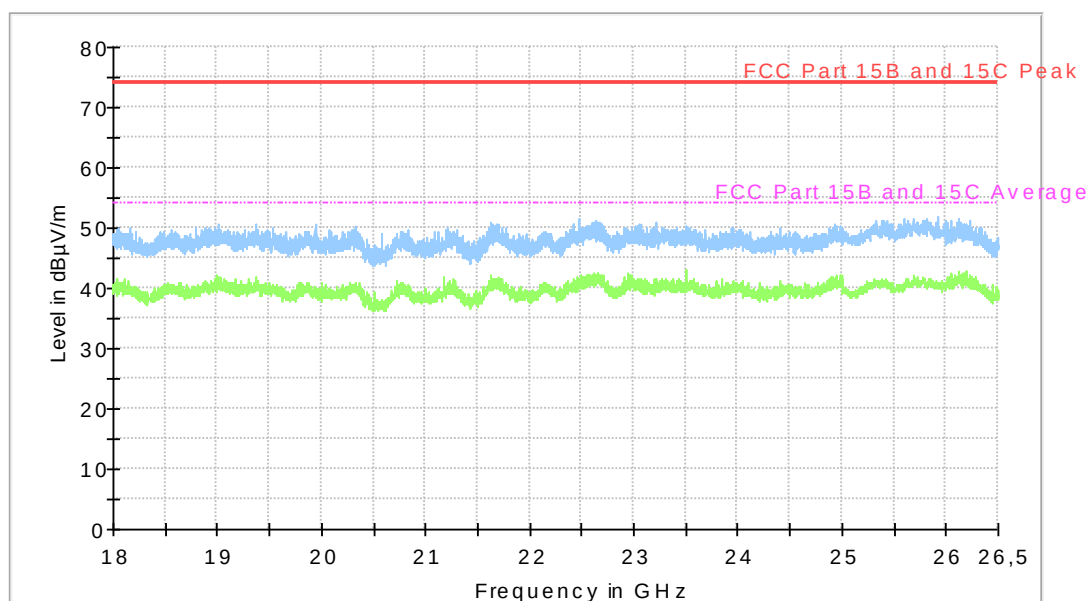
Diagram, Peak overview sweep, 18 – 26.5 GHz at 3 m distance. TX mid channel, EUT orientation Y.

Full Spectrum



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

Full Spectrum



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

Measurement results, Peak, TX low channel

| Frequency [MHz] | Level [dBµV/m] | Limit [dBµV/m] | EUT orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 4811.1          | 48.7           | 74.0           | X               | H                | 25.3        |
| 4811.1          | 48.2           | 74.0           | Y               | V                | 25.8        |
| 17006.9         | 54.0           | 74.0           | Y               | H                | 20.0        |
| 17784.9         | 55.0           | 74.0           | Y               | H                | 19.0        |
| 17906.2         | 54.7           | 74.0           | X               | H                | 19.3        |

Measurement results, Average, TX low channel

| Frequency [MHz] | Level [dBµV/m] | Limit [dBµV/m] | EUT orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 4810.6          | 38.9           | 54.0           | X               | H                | 15.1        |
| 4810.6          | 37.5           | 54.0           | Y               | V                | 16.5        |
| 16999.9         | 39.9           | 54.0           | Y               | V                | 14.1        |
| 17827.3         | 41.1           | 54.0           | Y               | V                | 12.9        |
| 17951.5         | 41.2           | 54.0           | X               | H                | 12.8        |

Measurement results, Peak, TX middle channel

| Frequency [MHz] | Level [dBµV/m] | Limit [dBµV/m] | EUT orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------|----------------|-----------------|------------------|-------------|
| 4889.9          | 47.7           | 74.0           | X               | H                | 26.3        |
| 4891.3          | 47.5           | 74.0           | Y               | V                | 26.5        |

## Measurement results, Average, TX middle channel

| Frequency [MHz] | Level [dB $\mu$ V/m] | Limit [dB $\mu$ V/m] | EUT orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------------|----------------------|-----------------|------------------|-------------|
| 4890.4          | 36.2                 | 54.0                 | Y               | V                | 17.8        |
| 4890.9          | 39.6                 | 54.0                 | X               | H                | 14.4        |

## Measurement results, Peak, TX high channel

| Frequency [MHz] | Level [dB $\mu$ V/m] | Limit [dB $\mu$ V/m] | EUT orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------------|----------------------|-----------------|------------------|-------------|
| 2483.5          | 43.4                 | 74.0                 | X               | H                | 30.6        |
| 2483.5          | 45.2                 | 74.0                 | Y               | V                | 28.8        |
| 4960.9          | 48.0                 | 74.0                 | Y               | H                | 26.0        |
| 4961.3          | 49.7                 | 74.0                 | X               | H                | 24.3        |

## Measurement results, Average, TX high channel

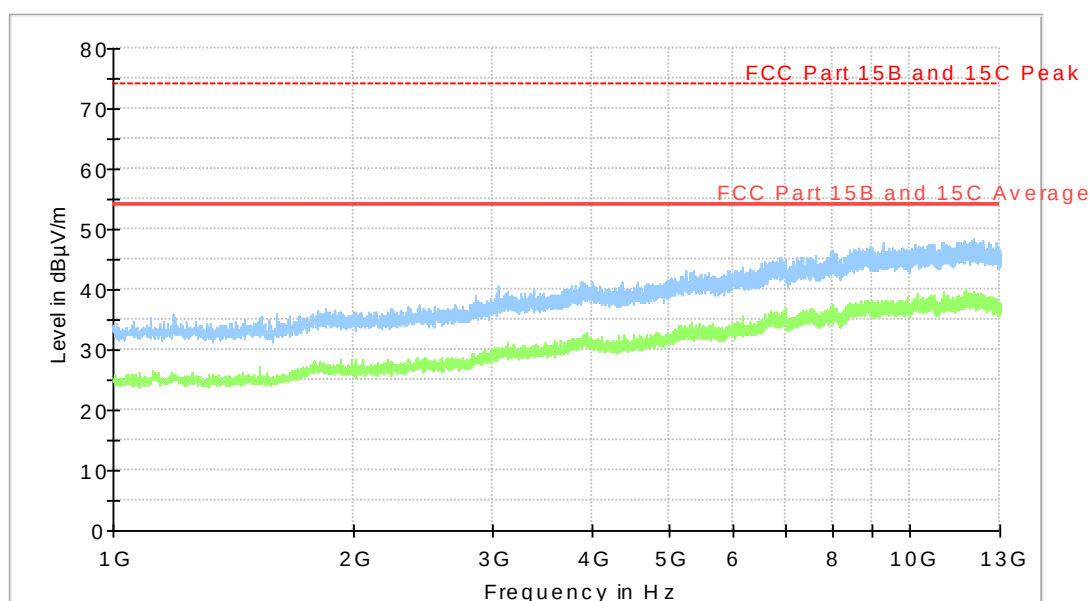
| Frequency [MHz] | Level [dB $\mu$ V/m] | Limit [dB $\mu$ V/m] | EUT orientation | Polarization H/V | Margin [dB] |
|-----------------|----------------------|----------------------|-----------------|------------------|-------------|
| 2483.5          | 31.8                 | 54.0                 | X               | H                | 22.2        |
| 2483.5          | 33.1                 | 54.0                 | Y               | V                | 20.9        |
| 4930.4          | 39.6                 | 54.0                 | X               | H                | 14.1        |
| 4960.9          | 37.5                 | 54.0                 | Y               | V                | 16.5        |

All other measured disturbances have a margin of more than 20 dB to the limits.

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

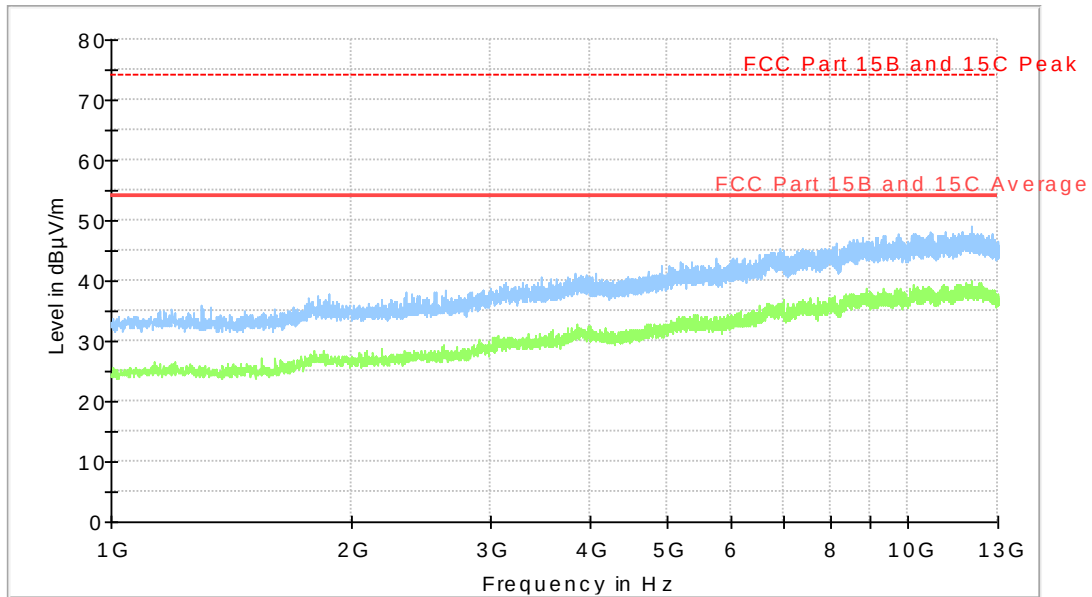
## 6.7 Test results 1 GHz – 13 GHz, RX

Full Spectrum



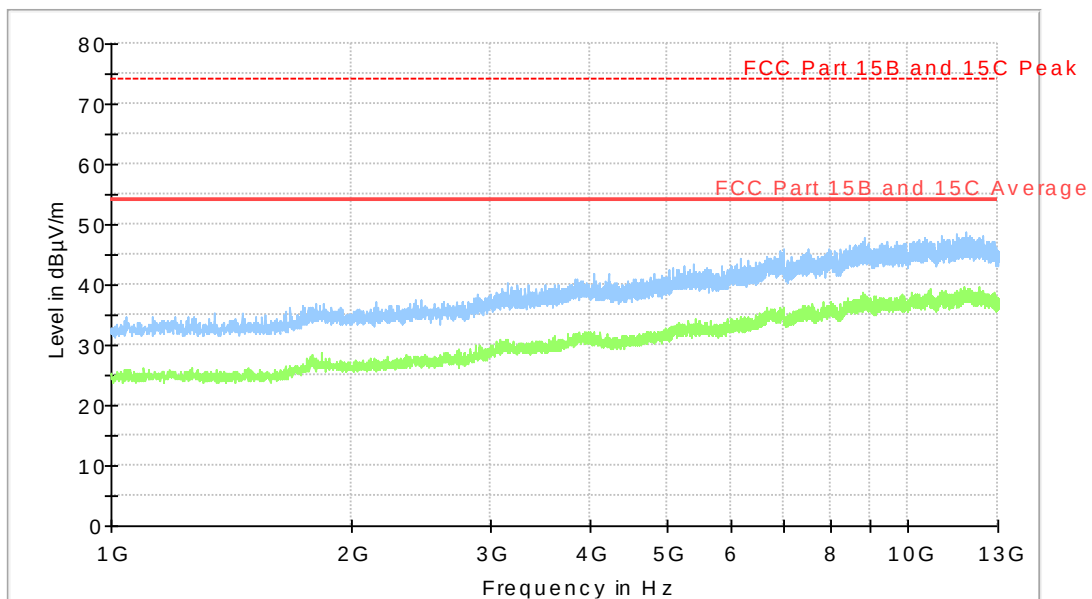
Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. RX low channel, EUT orientation X.

Full Spectrum



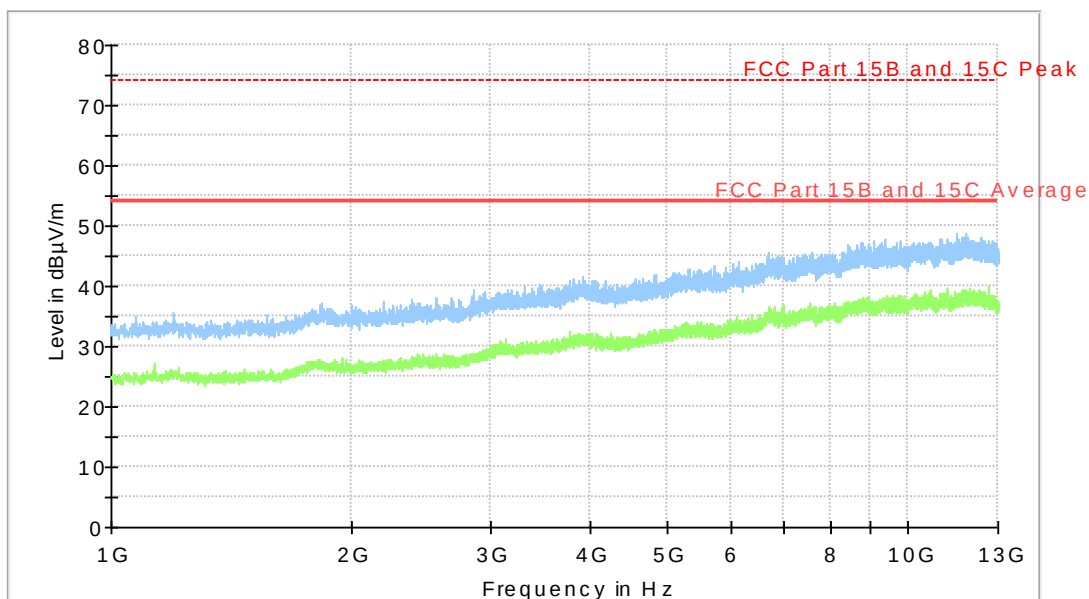
Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. RX low channel, EUT orientation Y.

Full Spectrum



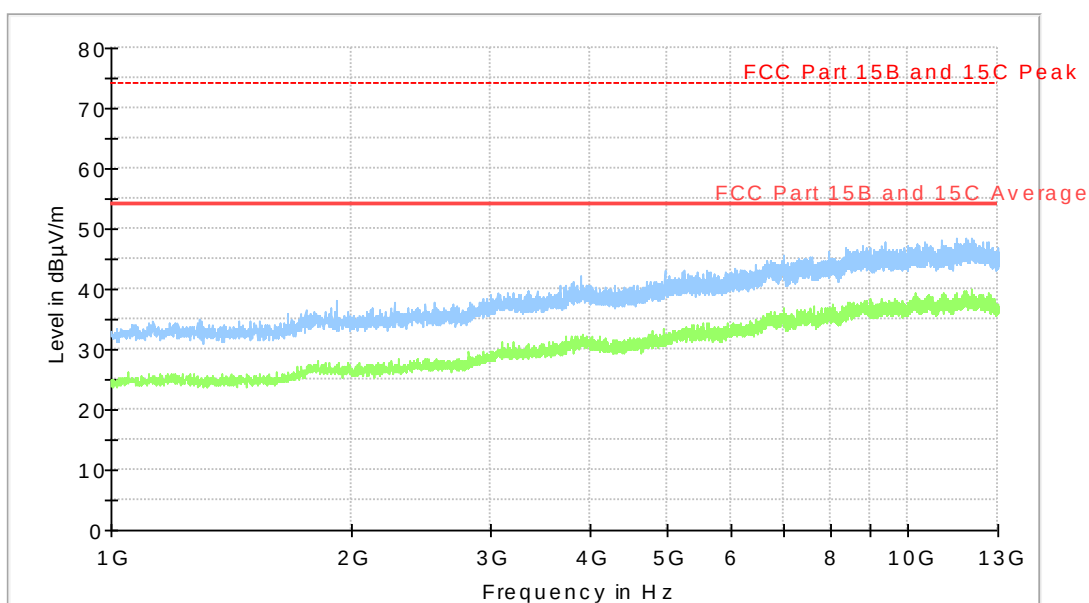
Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. RX mid channel, EUT orientation X.

Full Spectrum



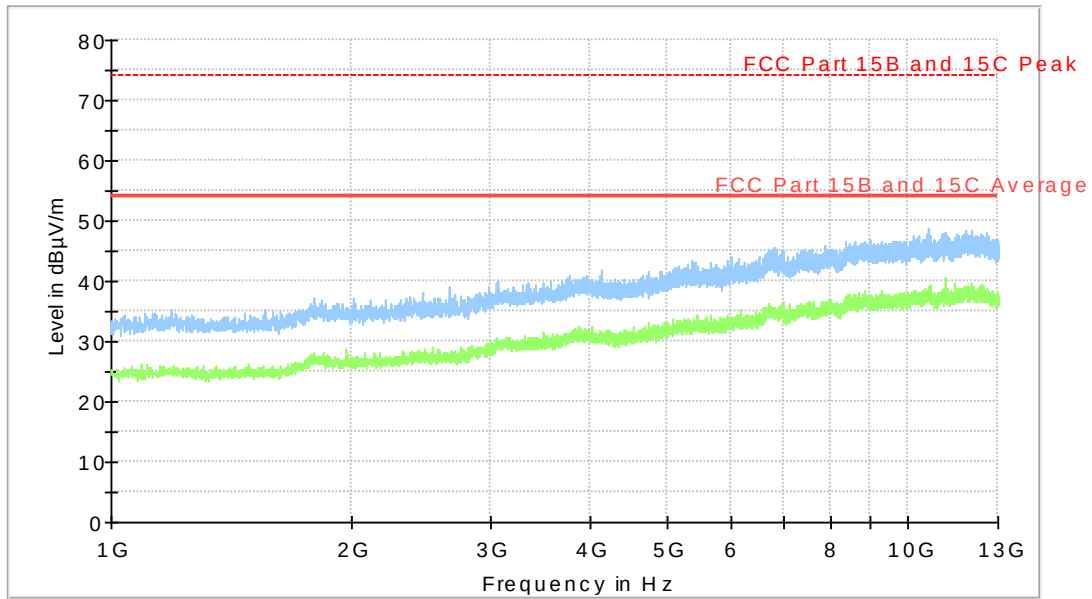
Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. RX mid channel, EUT orientation Y.

Full Spectrum



Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. RX high channel, EUT orientation X.

Full Spectrum



**Diagram, Peak overview sweep, 1– 13 GHz at 3 m distance. RX high channel, EUT orientation Y.**

#### Measurement results

No emissions are found above noise floor or closer than 20 dB from limit

## 7 PEAK CONDUCTED OUTPUT POWER

|                      |                |                           |                 |
|----------------------|----------------|---------------------------|-----------------|
| <b>Date of test:</b> | 2016-05-16     | <b>Test location:</b>     | Wireless Center |
| <b>EUT Serial:</b>   | --             | <b>Ambient temp:</b>      | 20 °C           |
| <b>Tested by:</b>    | Robert Hietala | <b>Relative humidity:</b> | 36 %            |
| <b>Test result:</b>  | Pass           | <b>Margin:</b>            | > 10 dB         |

### 7.1 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.

### 7.2 Test conditions

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

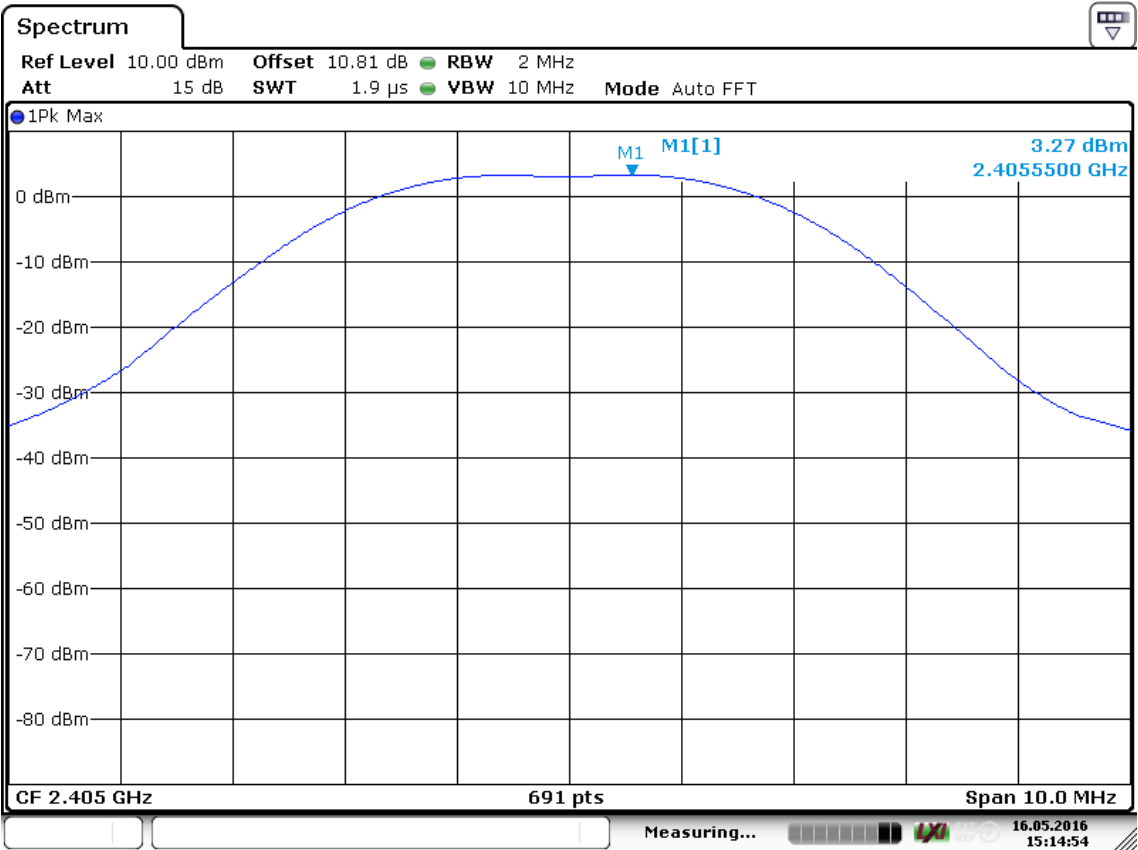
The EUT was set up in order to emit maximum disturbances.

### 7.3 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.

7.4 Test results



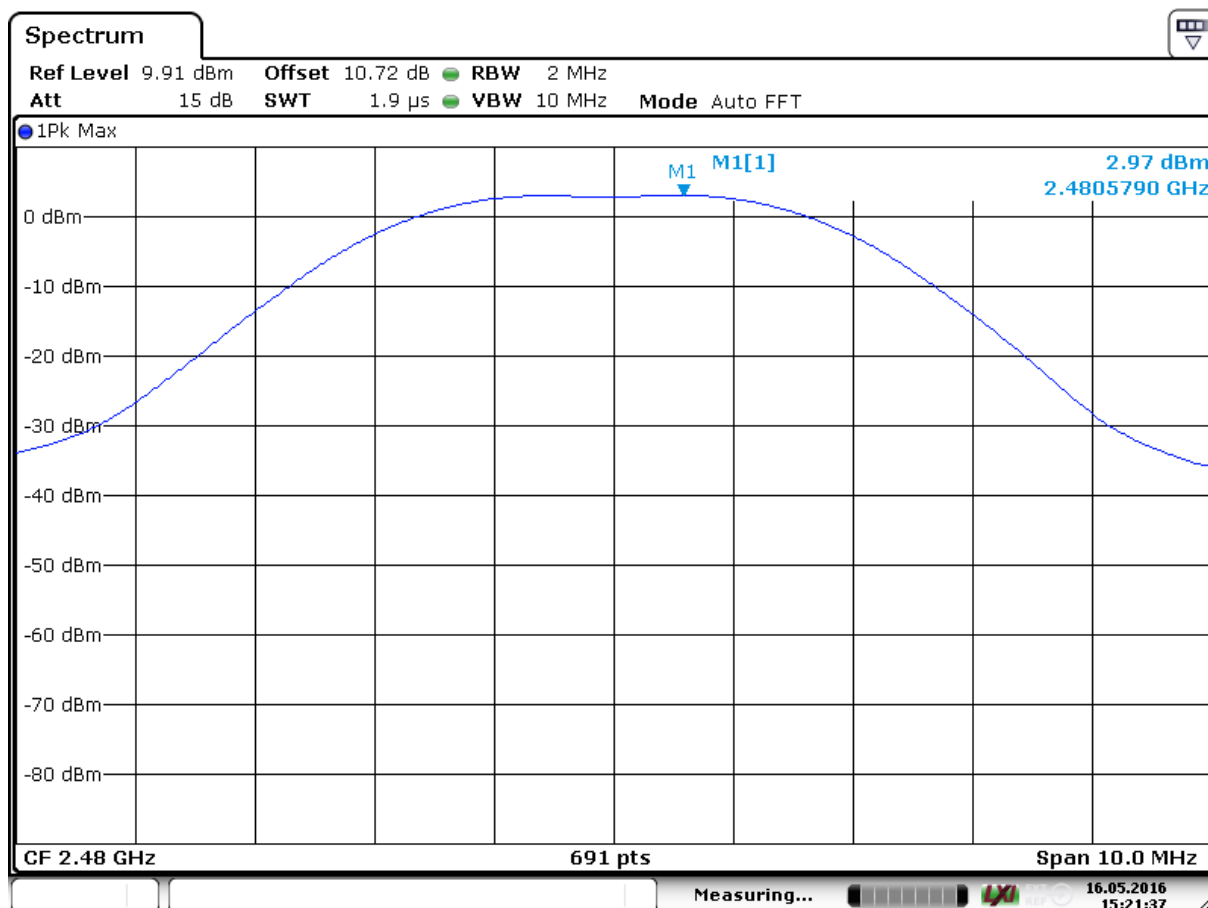
Date: 16 MAY 2016 15:14:54

Screenshot: Output power, low channel



Date: 16 MAY 2016 15:17:58

**Screenshot: Output power, middle channel**



Date: 16 MAY 2016 15:21:38

### Screenshot: Output power, high channel

#### Test result

| Channel [MHz] | Output power [dBm] | Limit [dBm] | Margin [dB] |
|---------------|--------------------|-------------|-------------|
| 2405          | 3.3                | 30.0        | 26.7        |
| 2445          | 2.9                | 30.0        | 27.1        |
| 2480          | 3.0                | 30.0        | 27.0        |

## 8 OCCUPIED 6 DB BANDWIDTH

|                      |                |                           |                 |
|----------------------|----------------|---------------------------|-----------------|
| <b>Date of test:</b> | 2016-05-16     | <b>Test location:</b>     | Wireless Center |
| <b>EUT Serial:</b>   | --             | <b>Ambient temp:</b>      | 20 °C           |
| <b>Tested by:</b>    | Robert Hietala | <b>Relative humidity:</b> | 36 %            |
| <b>Test result:</b>  | Pass           | <b>Margin:</b>            | 1.1 MHz         |

### 8.1 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.

### 8.2 Test conditions

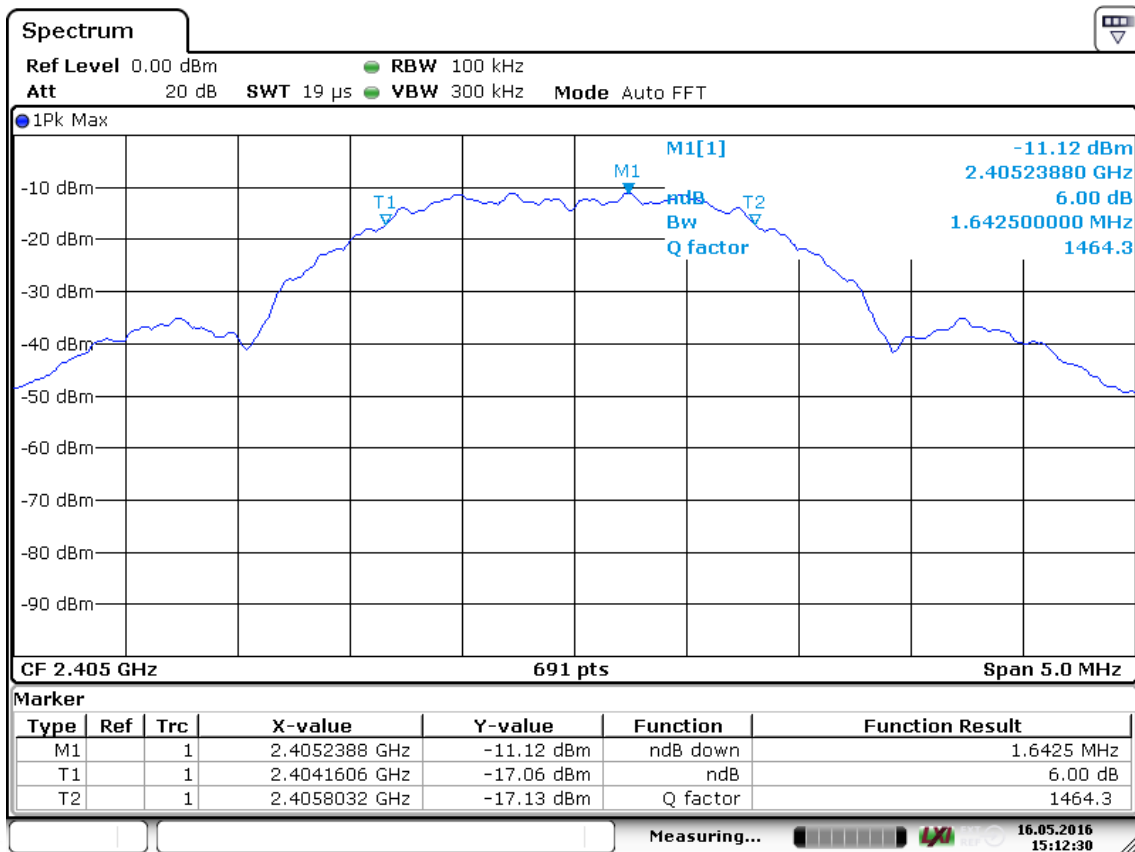
Detector: Peak,  
RBW: 100 kHz  
VBW: 3 x RBW  
Span: >1.5 x OBW

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

### 8.3 Requirements

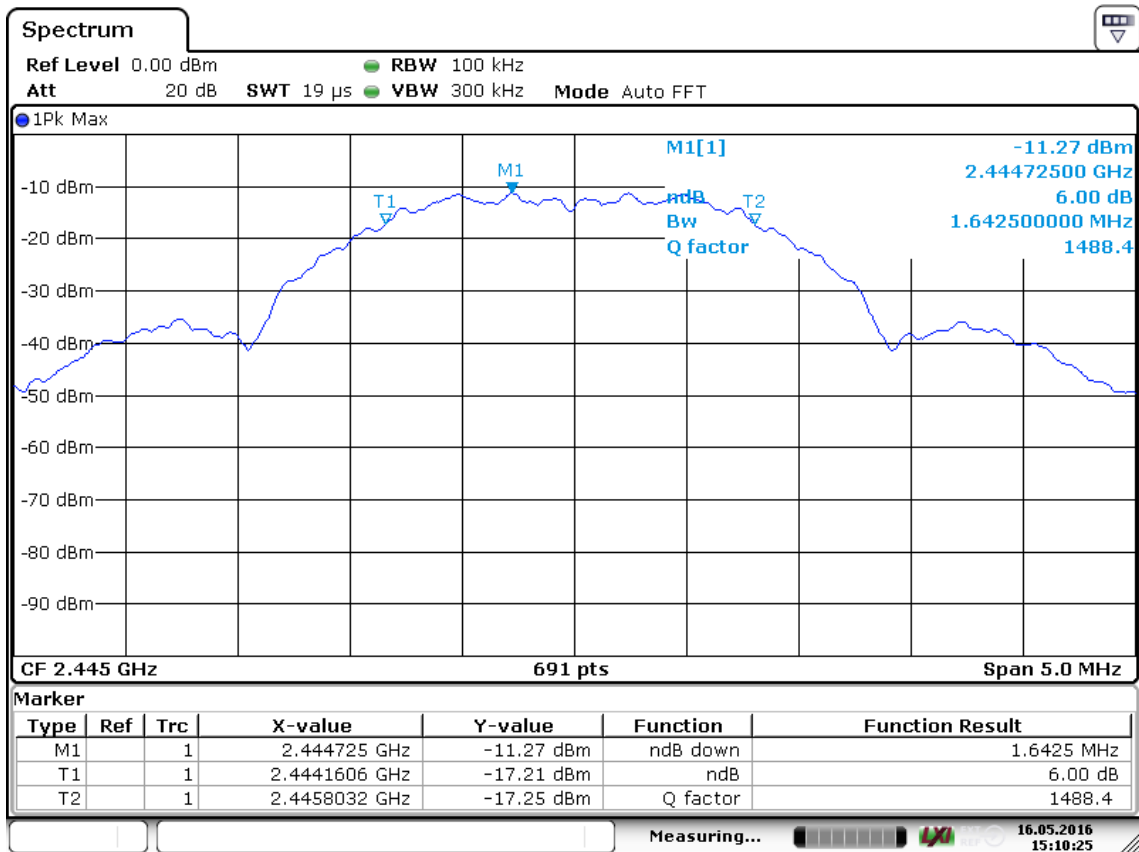
Reference: CFR 47§15.247(a)(2), RSS-247 5.2(1)  
The minimum 6 dB bandwidth shall be 500 kHz.

## 8.4 Test results



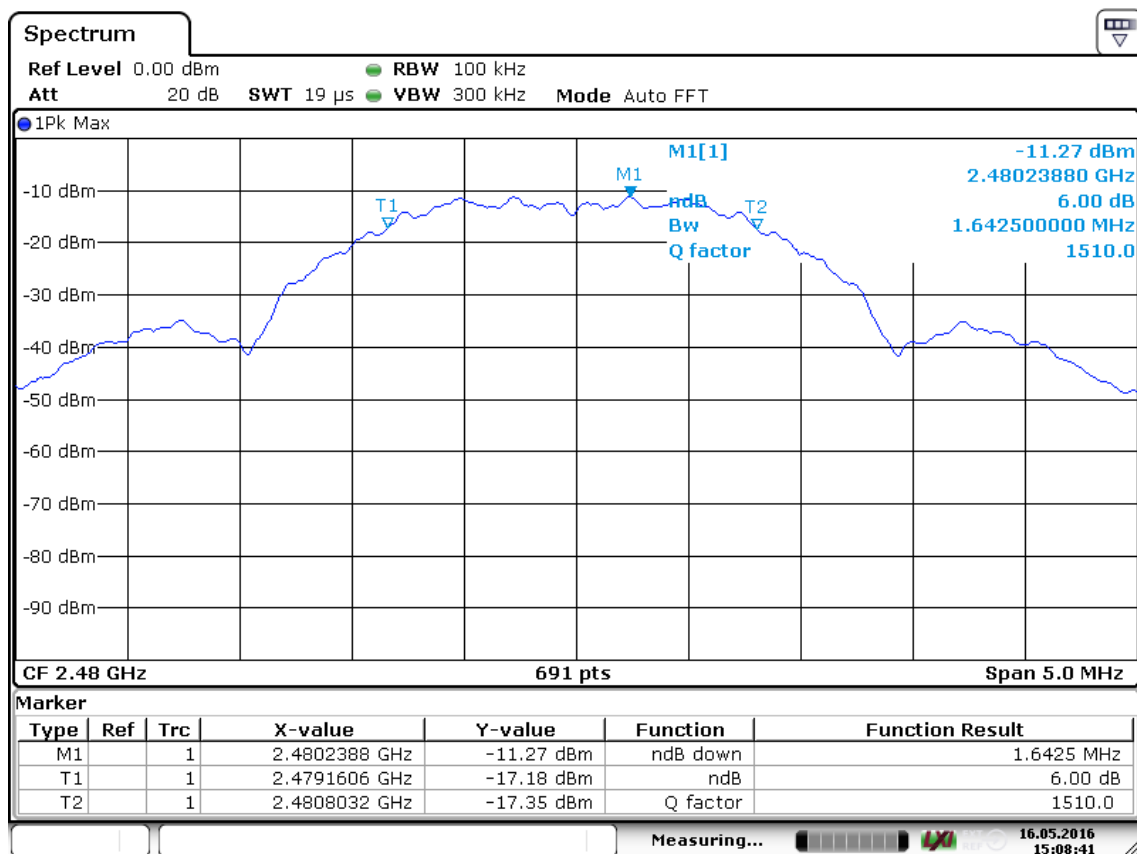
Date: 16 MAY 2016 15:12:29

Screenshot: Occupied 6 dB bandwidth Measurement, low channel



Date: 16 MAY 2016 15:10:25

Screenshot: Occupied 6 dB bandwidth Measurement, middle channel



Date: 16 MAY 2016 15:08:42

### Screenshot: Occupied 6 dB bandwidth Measurement, high channel

#### Test result

| Channel [MHz] | 6 dB BW [MHz] | Limit [MHz] | Margin [MHz] |
|---------------|---------------|-------------|--------------|
| 2405          | 1.6           | 0.5         | 1.1          |
| 2445          | 1.6           | 0.5         | 1.1          |
| 2480          | 1.6           | 0.5         | 1.1          |

## 9 99 % BANDWIDTH

|                      |                |                           |                 |
|----------------------|----------------|---------------------------|-----------------|
| <b>Date of test:</b> | 2016-05-30     | <b>Test location:</b>     | Wireless Center |
| <b>EUT Serial:</b>   | --             | <b>Ambient temp:</b>      | 22 °C           |
| <b>Tested by:</b>    | Robert Hietala | <b>Relative humidity:</b> | 38 %            |
| <b>Test result:</b>  | Pass           | <b>Margin:</b>            | --              |

### 9.1 Test set-up and test procedure.

The test method is in accordance with RSS-GEN section 6.6.

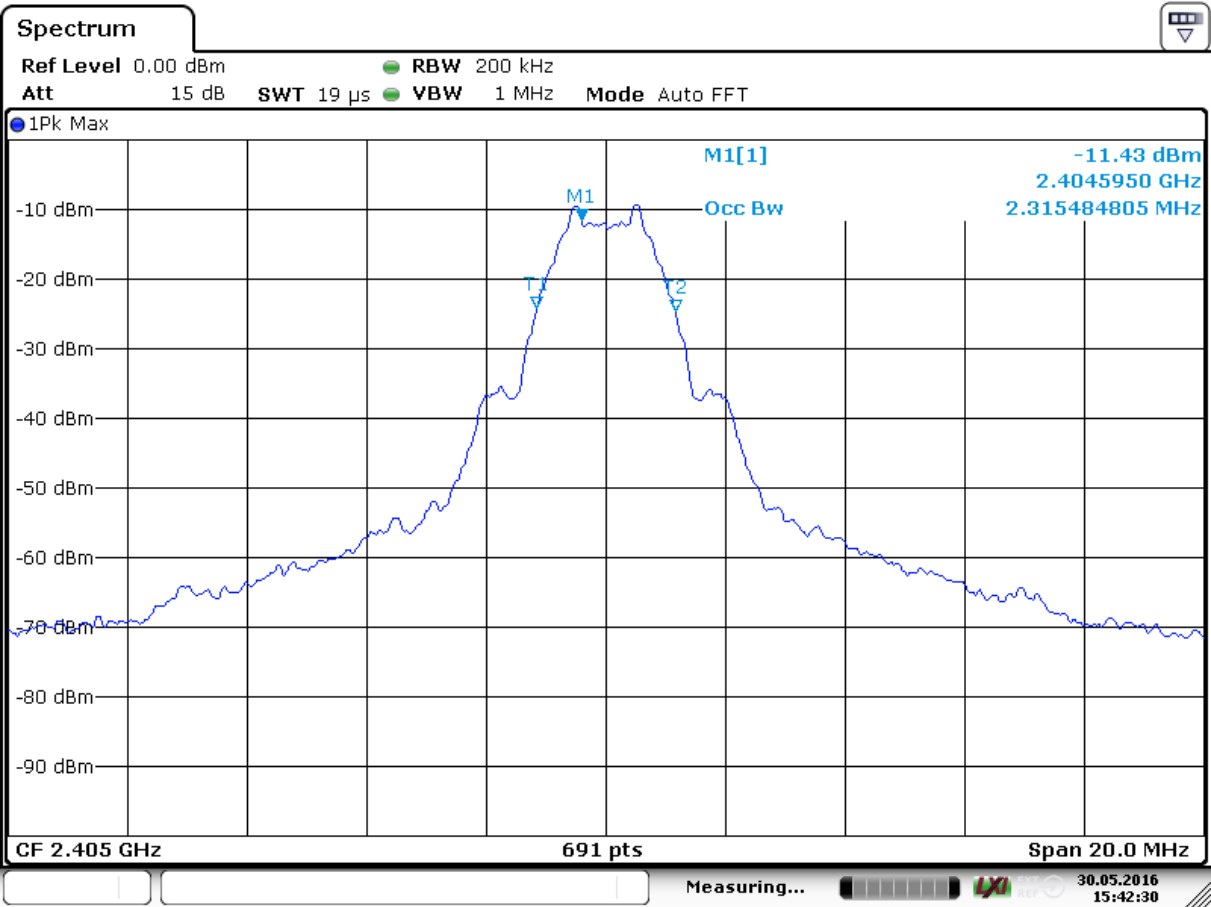
The EUT was connected to spectrum analyser via rf-cable and attenuator. Spectrum analyser with occupied bandwidth measurement function is used to determine the occupied bandwidth.

### 9.2 Test conditions

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

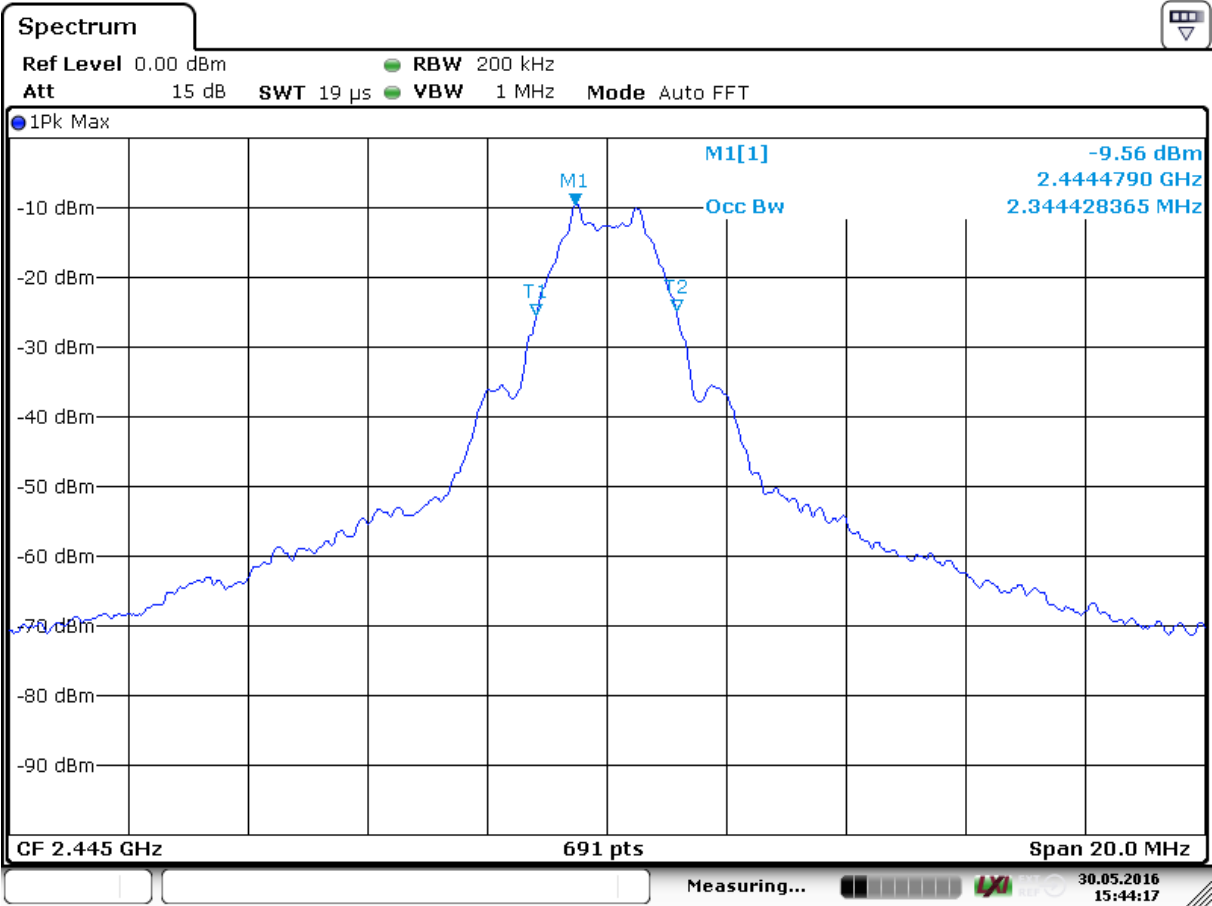
The EUT was set up in order to emit maximum disturbances.

9.3 Test results



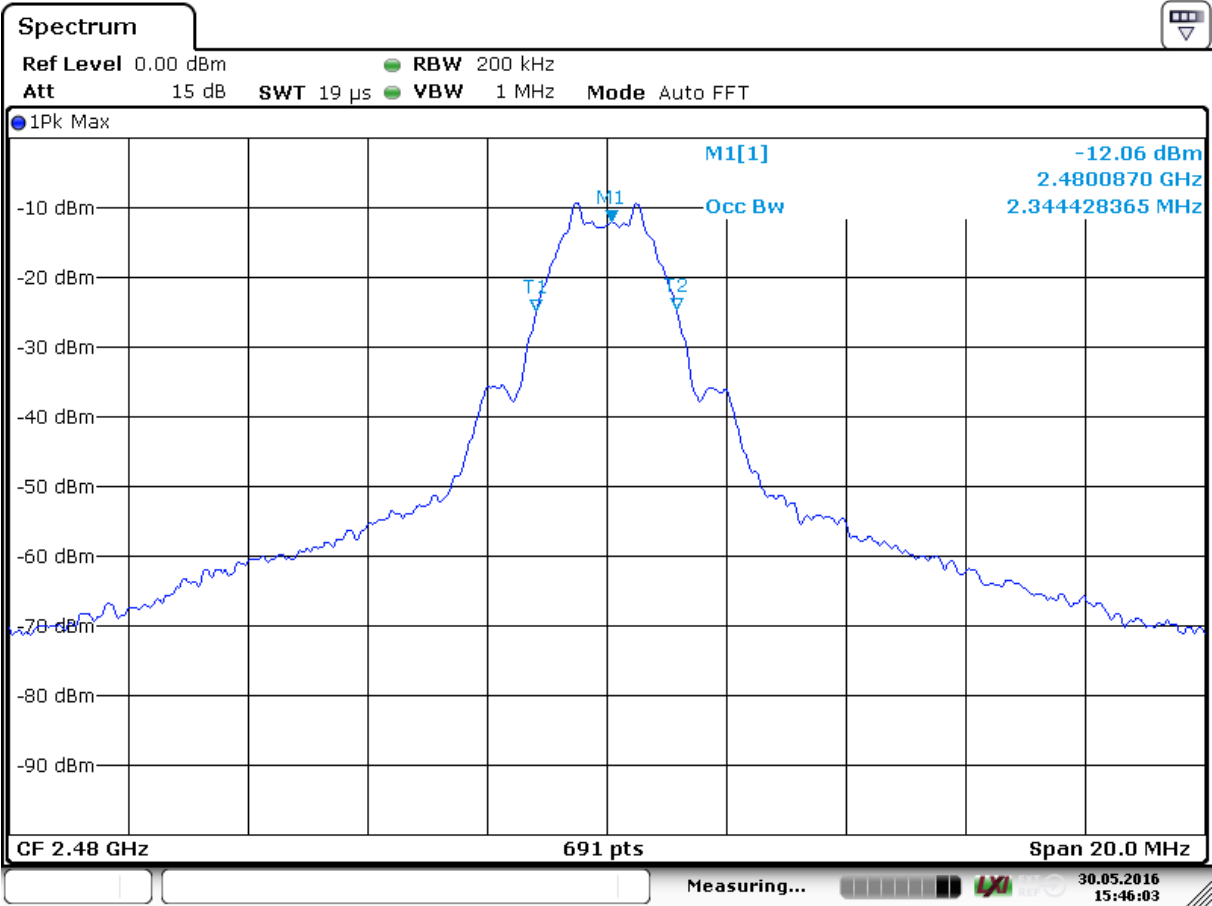
Date: 30 MAY 2016 15:42:30

Screenshot: 99 % bandwidth Measurement, low channel



Date: 30 MAY 2016 15:44:16

Screenshot: 99 % bandwidth Measurement, middle channel



Date: 30 MAY 2016 15:46:03

Screenshot: 99 % bandwidth Measurement, high channel

Test result

| Channel [MHz] | 99 % BW [MHz] | Limit [MHz] | Margin [MHz] |
|---------------|---------------|-------------|--------------|
| 2405          | 2.3           | --          | --           |
| 2445          | 2.3           | --          | --           |
| 2480          | 2.3           | --          | --           |

## 10 PEAK POWER SPECTRAL DENSITY

|                      |                |                           |                 |
|----------------------|----------------|---------------------------|-----------------|
| <b>Date of test:</b> | 2016-05-16     | <b>Test location:</b>     | Wireless Center |
| <b>EUT number:</b>   | --             | <b>Ambient temp:</b>      | 21 °C           |
| <b>Tested by:</b>    | Robert Hietala | <b>Relative humidity:</b> | 36 %            |
| <b>Test result:</b>  | Pass           | <b>Margin:</b>            | > 10 dB         |

### 10.1 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.

### 10.2 Test conditions

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

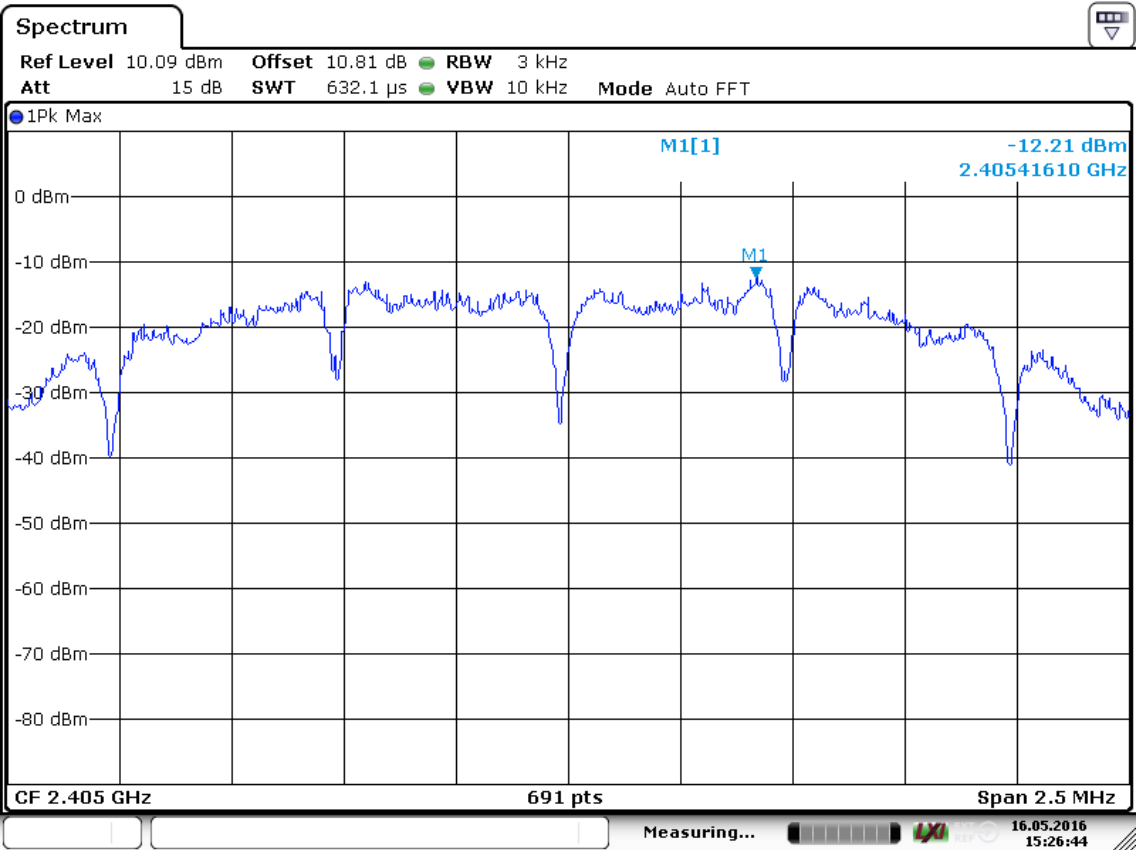
The EUT was set up in order to emit maximum disturbances.

### 10.3 Requirements

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

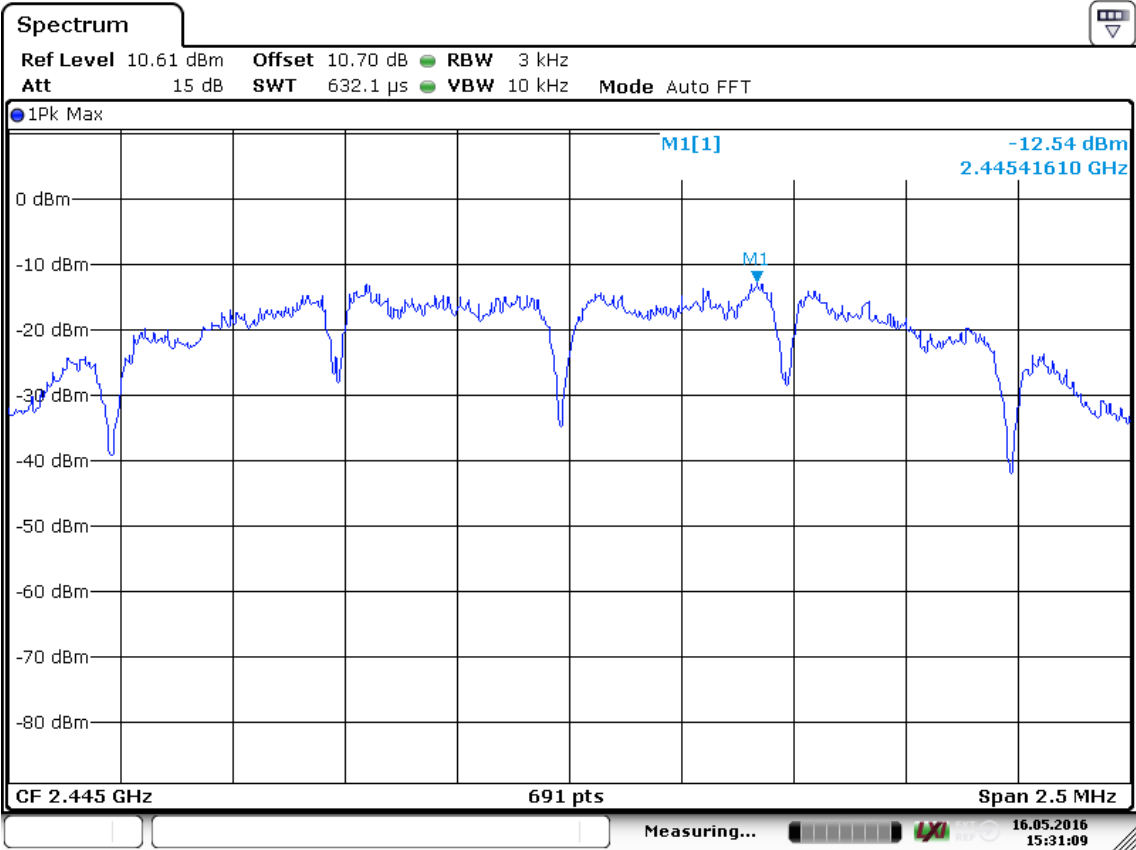
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

10.4 Test results



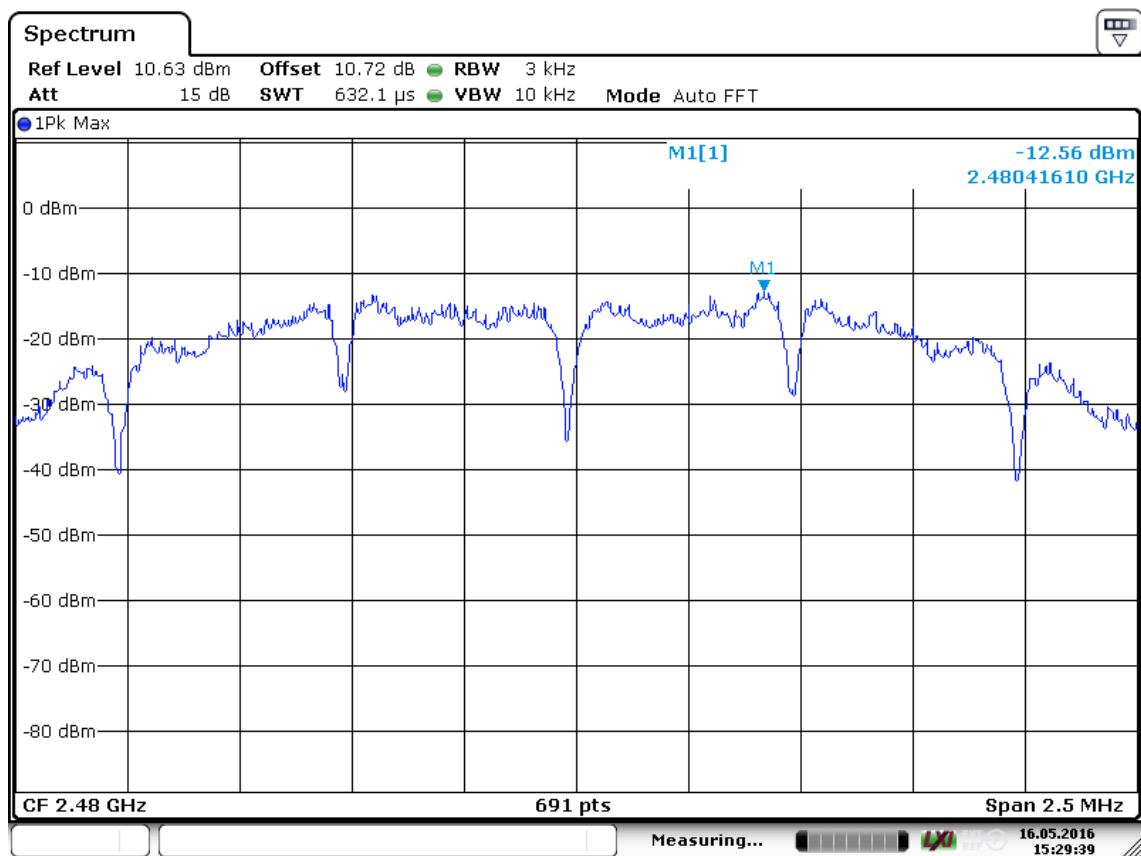
Date: 16 MAY 2016 15:26:45

Screenshot: Peak power spectral density, low channel



Date: 16 MAY 2016 15:31:09

**Screenshot: Peak power spectral density, middle channel**



Date: 16 MAY 2016 15:29:38

### Screenshot: Peak power spectral density, high channel

#### Test result

| Channel [MHz] | PSD [dBm/3kHz] | Limit [dBm] | Margin [dB] |
|---------------|----------------|-------------|-------------|
| 2405          | -12.2          | 8.0         | 20.2        |
| 2445          | -12.5          | 8.0         | 20.5        |
| 2480          | -12.6          | 8.0         | 20.6        |

## 11 TEST EQUIPMENT

## Stora Hallen

| Equipment type              | Manufacturer      | Model                | Inv. No.    | Last Cal. date | Cal. interval |
|-----------------------------|-------------------|----------------------|-------------|----------------|---------------|
| Measurement software        | Rohde & Schwarz   | EMC32 – 8.51.0       | --          | --             | --            |
| Receiver                    | Rohde & Schwarz   | ESU 8                | 12866       | 07-2015        | 1 year        |
| Receiver                    | Rohde & Schwarz   | ESU 40               | 13178       | 07-2015        | 1 year        |
| BiLog antenna               | Chase             | CBL6110A             | 971         | 07-2015        | 3 years       |
| Preamplifier                | HP                | --                   | 7992 / 7993 | 06-2015        | 1 year        |
| Horn antenna                | Rohde & Schwarz   | HF907                | 31246       | 06-2015        | 1 year        |
| 2,4 GHz band reject filter: | K&L MICROWAVE INC | 6N45-2450/T100-0/0   | 12389       | 03-2016        | 1 year        |
| 4 GHz high pass filter      | K&L MICROWAVE INC | 4410-X4500/18000-0/0 | 5133        | 07-2015        | 1 year        |

## Wireless Center and 3m FAC

| Equipment type              | Manufacturer      | Model                                            | Inv. No. | Last Cal. date | Cal. interval |
|-----------------------------|-------------------|--------------------------------------------------|----------|----------------|---------------|
| Measurement software        | Rohde & Schwarz   | EMC32 – 9.21.0                                   | --       | --             | --            |
| Signal analyzer             | Rohde & Schwarz   | FSIQ 40                                          | 12793    | 07-2015        | 1 year        |
| Measurement cable           | Huber + Suhner    | Sucoflex 104 PE                                  | 39070    | 07-2015        | 1 year        |
| Measurement cable           | Huber + Suhner    | Sucoflex 104 PE                                  | 39079    | 07-2015        | 1 year        |
| Measurement cable           | Huber + Suhner    | Sucoflex 104                                     | 5191     | 07-2015        | 1 year        |
| Horn antenna                | EMCO              | 3115                                             | 4936     | 04-2014        | 3 years       |
| Pre amplifier               | Sangus            | 00101400-23-10P -6-S ; AFS44-12002400-32-10P -44 | 12335    | 07-2015        | 1 year        |
| Horn antenna                | EMCO              | 3160-08                                          | 30099    | 10-2013        | 3 years       |
| Horn antenna                | EMCO              | 3160-09                                          | 30101    | 10-2013        | 3 years       |
| Signal analyzer:            | Rohde & Schwarz   | FSV 30                                           | 32594    | 07-2015        | 1 year        |
| Signal generator:           | Rohde & Schwarz   | SMB100A                                          | 32592    | 07-2015        | 1 year        |
| Signal analyzer             | Rohde & Schwarz   | FSIQ 40                                          | 12793    | 07-2015        | 1 year        |
| 2,4 GHz band reject filter: | K&L MICROWAVE INC | 6N45-2450/T100-0/0                               | 12389    | 03-2016        | 1 year        |
| 4 GHz high pass filter      | K&L MICROWAVE INC | 4410-X4500/18000-0/0                             | 5133     | 07-2015        | 1 year        |
| Multimeter                  | Fluke             | 179                                              | 33105    | 10-2015        | 1 year        |

## 12 MEASUREMENT UNCERTAINTY

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

Measurement uncertainty for radiated disturbance

|                                                            |              |
|------------------------------------------------------------|--------------|
| Uncertainty for the frequency range 30 to 1000 MHz at 3 m  | $\pm 5.1$ dB |
| Uncertainty for the frequency range 30 to 1000 MHz at 10 m | $\pm 5.0$ dB |
| Uncertainty for the frequency range 1.0 to 18 GHz at 3 m   | $\pm 4.7$ dB |
| Uncertainty for the frequency range 18 to 26 GHz at 3 m    | $\pm 4.8$ dB |
| Uncertainty for the frequency range 26 to 40 GHz at 3 m    | $\pm 5.7$ dB |

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

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

## 13 TEST SET UP AND EUT PHOTOS

EUT photos are in separate document 1610688STO-001 Annex 1.

Test set up photos are in separate document 1610688STO-001 Annex 2.