

# EMI – TEST REPORT

- FCC Part 15.247, RSS210 -

**Test Report No. :** T38545-00-02TK

20. January 2015

Date of issue

**Type / Model Name** : Fidbox V6

**Product Description** : Bluetooth module, low energy 4.0

**Applicant** : fp floor protector GmbH

**Address** : Außermanzing 28

3033 ALTLENGBACH, AUSTRIA

**Manufacturer** : fp floor protector GmbH

**Address** : Außermanzing 28

3033 ALTLENGBACH, AUSTRIA

**Licence holder** : fp floor protector GmbH

**Address** : Außermanzing 28

3033 ALTLENGBACH, AUSTRIA

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

**POSITIVE**



The test report merely corresponds to the test sample.  
It is not permitted to copy extracts of these test results  
without the written permission of the test laboratory.

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Attachment A as separate supplement

## 1 TEST STANDARDS

The tests were performed according to following standards:

### **FCC Rules and Regulations Part 15, Subpart A - General (September, 2014)**

|                                   |   |
|-----------------------------------|---|
| Part 15, Subpart A, Section 15.31 | Measurement standards                         |
| Part 15, Subpart A, Section 15.33 | Frequency range of radiated measurements      |
| Part 15, Subpart A, Section 15.35 | Measurement detector functions and bandwidths |

### **FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September, 2014)**

|                                    |   |
|------------------------------------|---|
| Part 15, Subpart C, Section 15.203 | Antenna requirement   |
| Part 15, Subpart C, Section 15.204 | External radio frequency power amplifiers and antenna modifications             |
| Part 15, Subpart C, Section 15.205 | Restricted bands of operation   |
| Part 15, Subpart C, Section 15.207 | Conducted limits  |
| Part 15, Subpart C, Section 15.209 | Radiated emission limits, general requirements                                  |
| Part 15, Subpart C, Section 15.247 | Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz |

### **FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969**

|                                   |   |
|-----------------------------------|---|
| Part 1, Subpart I, Section 1.1310 | Radiofrequency radiation exposure limits                      |
| Part 1, Subpart 2, Section 2.1093 | Radiofrequency radiation exposure evaluation: portable device |

### **OET Bulletin 65, 65A, 65B Edition 97-01, August 1997 – Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.**

|                       |   |
|-----------------------|---|
| KDB 447498 D01 v05r02 | Mobile and portable devices RF Exposure procedures and equipment authorisation policies, February 7, 2014.                            |
| ANSI C63.4: 2014      | Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. |
| ANSI C63.10: 2013     | Testing Unlicensed Wireless Devices   |
| ANSI C95.1: 2005      | IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz            |
| CISPR 16-4-2: 2013    | Uncertainty in EMC measurement  |
| KDB 558074 D01 v03r02 | Guidance for performing compliance measurements on DTS operating under §15.247, June 5, 2014.   |

## **2 EQUIPMENT UNDER TEST**

### **2.1 Photo documentation of the EUT – Detailed photos see Attachment A**

### **2.2 Equipment type**

Bluetooth Low Energy device for stationary use

### **2.3 Short description of the equipment under test (EUT)**

The EUT is a Bluetooth 4.0 Low Energy system. The EUT is compatible with the standard 802.15.1. It supports the 2.4 GHz frequency band. A single PCB antenna is used within the system. The modulation used by the EUT is GFSK with a data rate of 1000 kbits which means worst case for testing. The EUT has a special firmware that allows enabling a permanent advertising mode with three advertising channels. The output power is set to -23 dBm by firmware and cannot be changed during tests. The EUT has only one integrated antenna, no temporary connector and no external antenna can be connected. The EUT is run with a 3.0V Lithium cell battery. There are no external connectors.

Number of tested samples: 1  
 MAC address: 20:CD:39:AE:7C:10  
 Serial number: N/A  
 Firmware version: Test Firmware

#### **EUT configuration:**

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

### **2.4 Variants of the EUT**

none

### **2.5 Operation frequency and channel plan**

The operating frequency is 2400 MHz to 2483.5 MHz.

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 37      | 2402      | 18      | 2442      |
| 0       | 2404      | 19      | 2444      |
| 1       | 2406      | 20      | 2446      |
| 2       | 2408      | 21      | 2448      |
| 3       | 2410      | 22      | 2450      |
| 4       | 2412      | 23      | 2452      |
| 5       | 2414      | 24      | 2454      |
| 6       | 2416      | 25      | 2456      |
| 7       | 2418      | 26      | 2458      |
| 8       | 2420      | 27      | 2460      |
| 9       | 2422      | 28      | 2462      |
| 10      | 2424      | 29      | 2464      |
| 38      | 2426      | 30      | 2466      |
| 11      | 2428      | 31      | 2468      |
| 12      | 2430      | 32      | 2470      |
| 13      | 2432      | 33      | 2472      |
| 14      | 2434      | 34      | 2474      |
| 15      | 2436      | 35      | 2476      |
| 16      | 2438      | 36      | 2478      |
| 17      | 2440      | 39      | 2480      |

Note: the marked frequencies are determined for final testing.

## 2.6 Transmit operating modes

The EUT uses GFSK modulation and may provide following data rates:

- 1000 kbps

(kbps = *kilobits per second*)

## 2.7 Antennas

The following antennas shall be used with the EUT:

The EUT has only an integrated PCB antenna, no temporary connector and no external antenna to be connected.

## 2.8 Power supply system utilised

Power supply voltage,  $V_{nom}$  : 3.0 V DC (Battery powered)

Power supply voltage (alternative) : None

## 2.9 Peripheral devices and interface cables

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

- \_\_\_\_\_ Model : \_\_\_\_\_
- \_\_\_\_\_ Model : \_\_\_\_\_
- \_\_\_\_\_ Model : \_\_\_\_\_

## 2.10 Determination of worst case conditions for final measurement

Measurements are made in all three orthogonal axes and the settings of the EUT are changed to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X position.

The tests are carried out in the following frequency band:

**2400 MHz – 2483.5 MHz**

The output power cannot be set by application and is fixed to - 23 dBm.

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

| Wireless system | Available channel | Tested channels | Power setting | Modulation | Modulation type | Data rate |
|-----------------|-------------------|-----------------|---------------|------------|-----------------|-----------|
| 802.15.1        | 00 to 39          | 37, 38, 39      | -23 dBm       | DSSS       | GFSK            | 1000 kbps |

- TX continuous mode, 802.15.1

**2.10.1 Test jig**

No special test jig was used for testing.

**2.10.2 Test software**

The test firmware provides to perform measurements in EUT's advertising mode. Therefore the advertising mode was set to continuous active. RX mode is not supported by test firmware.

### **3 TEST RESULT SUMMARY**

BLE device using digital modulation:

Operating in the 2400 MHz – 2483.5 MHz:

| FCC Rule Part   | RSS Rule Part    | Description                       | Result         |
|-----------------|------------------|-----------------------------------|----------------|
| 15.207(a)       | RSS Gen, 8.8     | AC power line conducted emissions | not applicable |
| 15.247(a)(2)    | RSS210, A8.2(a)  | -6 dB EBW                         | passed         |
|                 | RSS-Gen, 6.6     | 99 % Bandwidth                    | passed         |
| 15.247(b)(3)    | RSS-210, A8.4(4) | Maximum peak power                | passed         |
| 15.247(e)       | RSS-210, A8.2(b) | Power spectral density            | passed         |
| 15.247(d)       | RSS-Gen, 8.10    | Emissions in restricted bands     | passed         |
| 15.247(d)       | RSS-210, A8.5    | Out-of-band emissions, radiated   | passed         |
| 15.35(c)        | RSS-Gen, 6.10    | Pulsed operation                  | not applicable |
| 15.247(b)(4)    | RSS-210, A8.4(4) | Antenna requirement               | passed         |
|                 | RSS-Gen, 6.11    | Transmitter frequency stability   | not applicable |
| 15.247(i)       | RSS 102, 2.5.2   | MPE                               | passed         |
| OET Bulletin 65 | RSS102, 3.2      | Co-location, Co-transmission      | not applicable |

The mentioned RSS Rule Parts in the above table are related to:

RSS Gen, Issue 4, November 2014

RSS 210, Issue 8, December 2010

RSS 102, Issue 4, March 2010

#### **3.1 Final assessment**

The equipment under test fulfills the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 12 December 2014

Testing concluded on : 13 January 2015

Checked by:

Tested by:

\_\_\_\_\_  
Klaus Gegenfurtner  
Teamleader Radio

\_\_\_\_\_  
Tobias Kammerer  
Radio Team

## 4 TEST ENVIRONMENT

### 4.1 Address of the test laboratory

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

### 4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature: 15-35 °C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

### 4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor  $k = 2$ . The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 11.2003 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.



## 4.4 Measurement protocol for FCC and IC

### 4.4.1 General information

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

**IC 3009A**

In compliance with RSS 210 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

#### 4.4.1.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

#### 4.4.1.2 Details of test procedures

In compliance with 47 CFR Part 15 Subpart A, Section 15.38 testing for FCC compliance may be achieved by following the procedures set out in ANSI C63.4 and applying the CISPR 22 limits.

## 5 TEST CONDITIONS AND RESULTS

### 5.1 AC power line conducted emissions

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

#### 5.1.1 Description of the test location

Test location: NONE

The requirements are **FULFILLED**.

**Remarks:** Not applicable because the EUT is battery powered and has no ancillary equipment.

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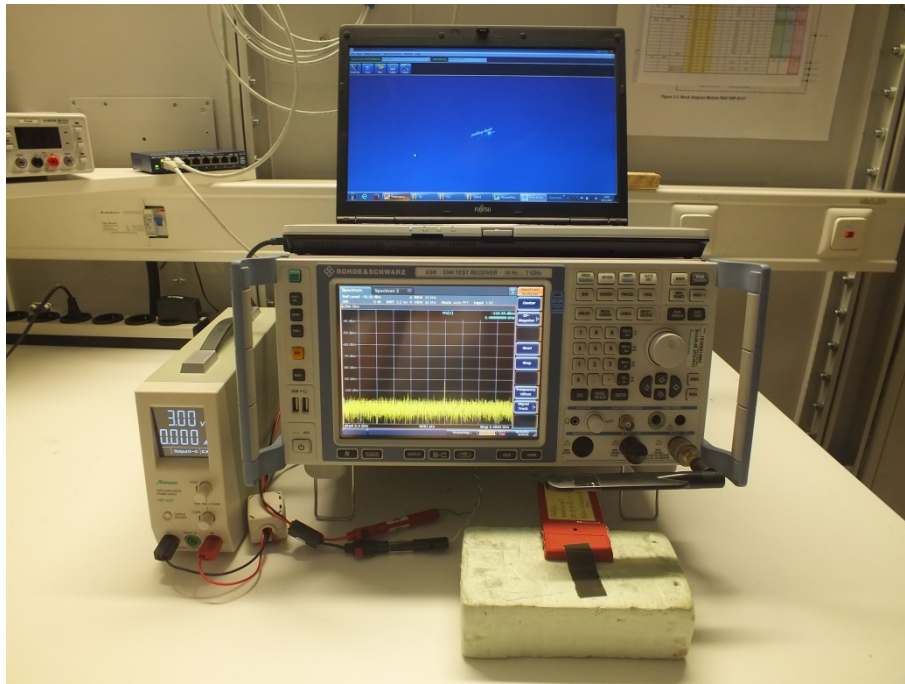
## 5.2 EBW and OBW

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

### 5.2.1 Description of the test location

Test location: AREA4

### 5.2.2 Photo documentation of the test set-up



### 5.2.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(2):

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 5.2.4 Description of Measurement

The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -6 dB. The reference level is the level of the highest signal amplitude observed at the transmitter at either the fundamental frequency or the first order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. An alternative is to use the bandwidth measurement of the analyser.

Spectrum analyser settings for EBW:

RBW: 100 kHz, VBW: 300 kHz, Detector: Max peak, Sweep time: Auto sweep, Span: 2 EBW;

Spectrum analyser settings for OBW:

RBW: 1-5% OBW, VBW: 3 RBW, Detector: Max peak, Sweep time: Auto sweep, Span: 2 OBW;

**5.2.5 Test result**

Standard 802.15.1

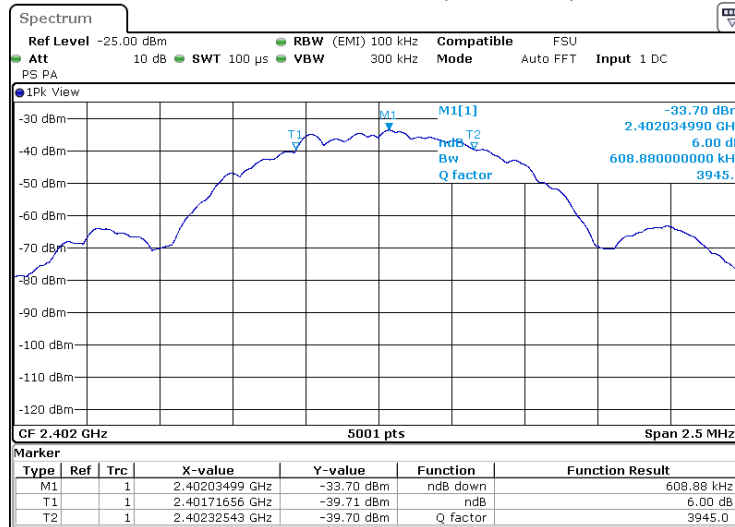
| Channel | Centre frequency<br>(MHz) | 6 dB bandwidth<br>(kHz) | Minimum limit<br>(MHz) |
|---------|---------------------------|-------------------------|------------------------|
| 37      | 2402                      | 608.87                  | 0.5                    |
| 38      | 2426                      | 625.88                  | 0.5                    |
| 39      | 2480                      | 607.38                  | 0.5                    |

| Channel | Centre frequency<br>(MHz) | 99 % bandwidth<br>(kHz) |
|---------|---------------------------|-------------------------|
| 37      | 2402                      | 1089.28                 |
| 38      | 2426                      | 1079.78                 |
| 39      | 2480                      | 1087.78                 |

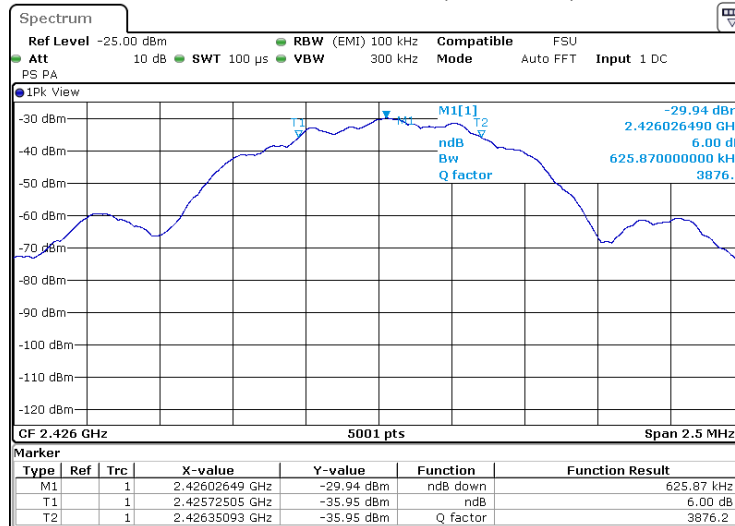
The requirements are **FULFILLED**.**Remarks:** For detailed test results please refer to the following test protocols.

## 5.2.6 Test protocols EBW

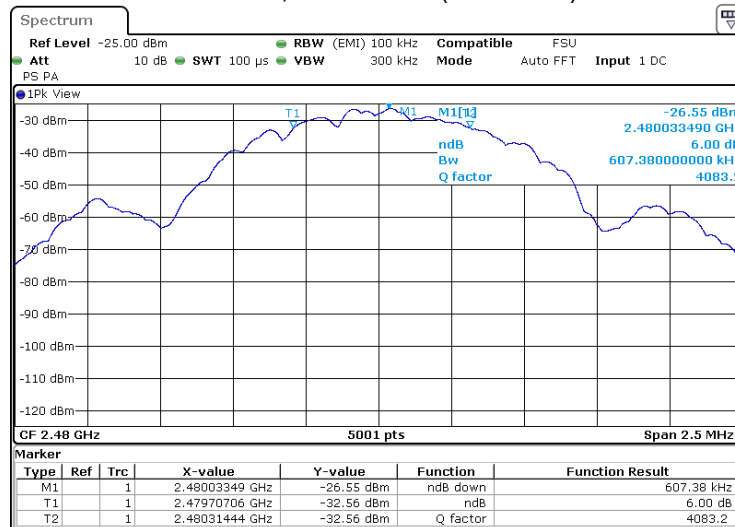
802.15.1, Channel 37 (2402 MHz)



802.15.1, Channel 38 (2426 MHz)

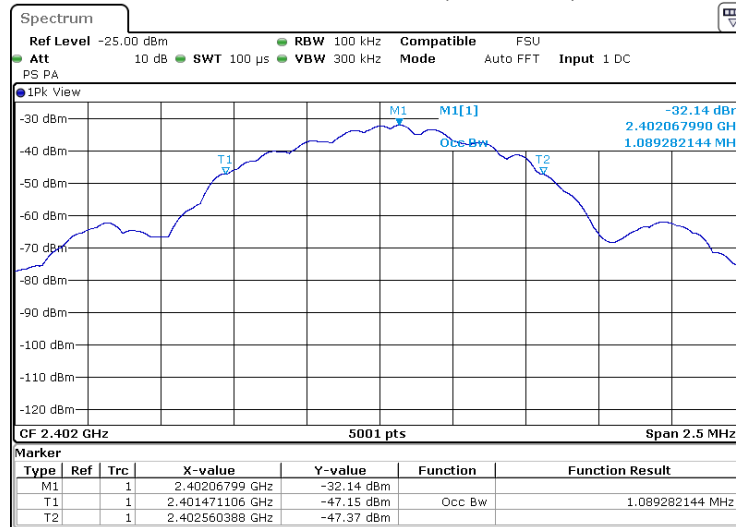


802.15.1, Channel 39 (2480 MHz)

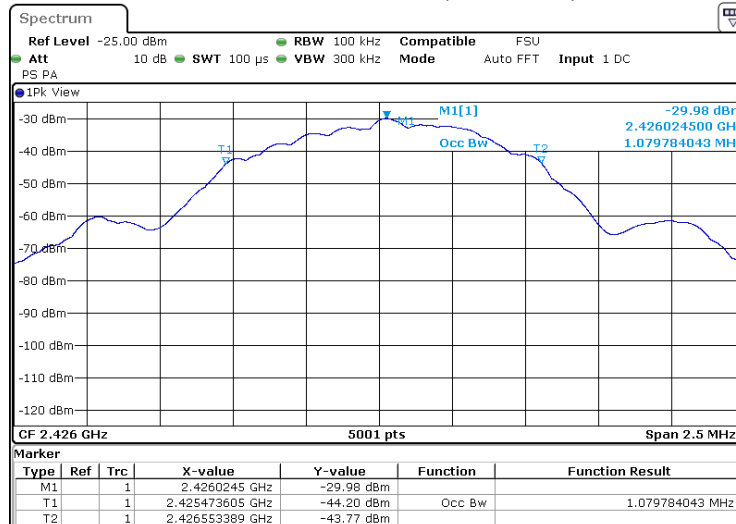


## 5.2.7 Test protocols OBW

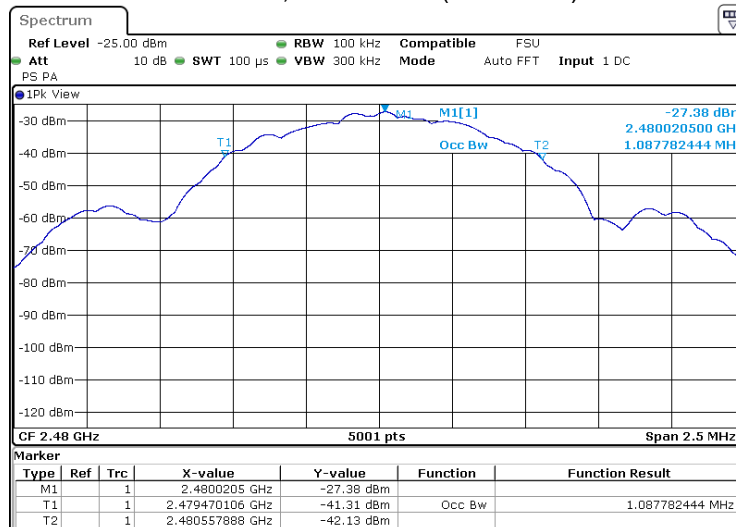
802.15.1, Channel 37 (2402 MHz)



802.15.1, Channel 38 (2426 MHz)



802.15.1, Channel 39 (2480 MHz)



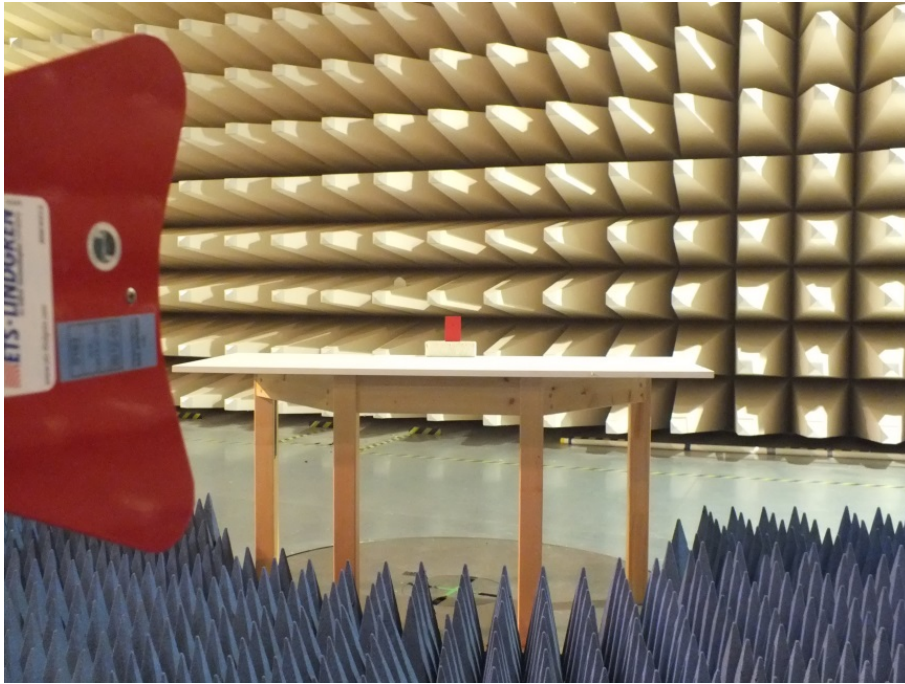
### 5.3 Maximum peak radiated output power

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

#### 5.3.1 Description of the test location

Test location: Anechoic chamber 1

#### 5.3.2 Photo documentation of the test set-up



#### 5.3.3 Applicable standard

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

For systems using digital modulation in the 2400-2483.5 MHz and 5725 – 5850 MHz bands, the maximum peak output power of the transmitter shall not exceed 1 Watt. The limit is based on transmitting antennas of directional gain that do not exceed 6 dBi.

#### 5.3.4 Description of Measurement

The maximum peak radiated output power is measured using a spectrum analyser following the procedure set out in KDB 558074, item 9.1.1. The EUT is set in TX continuous advertising mode while measuring. The radiated measurement was performed in a fieldstrength measurement. Therefore the formula set out in KDB 558074, item 12.2.2 e) is changed into the following term:

$$E = \text{EIRP} - (20 \cdot \log_{10} 3) + 104.8$$

**5.3.5 Test result**

| <b>802.15.1, 1000 kbps, TX</b> |           | Test results radiated       |               |                     |                |
|--------------------------------|-----------|-----------------------------|---------------|---------------------|----------------|
|                                |           | Fieldstrength E<br>(dBμV/m) | EIRP<br>(dBm) | EIRP Limit<br>(dBm) | Margin<br>(dB) |
| Lowest frequency: CH37         |           |                             |               |                     |                |
| $T_{nom}$                      | $V_{nom}$ | 72.4                        | -22.9         | 36.0                | -58.9          |
| Middle frequency: CH38         |           |                             |               |                     |                |
| $T_{nom}$                      | $V_{nom}$ | 70.3                        | -25.0         | 36.0                | -61.0          |
| Highest frequency: CH39        |           |                             |               |                     |                |
| $T_{nom}$                      | $V_{nom}$ | 69.8                        | -25.4         | 36.0                | -61.4          |

Peak Power Limit according to FCC Part 15, Section 15.247(b)(3):

| Frequency<br>(MHz) | Peak Power Limit |            |
|--------------------|------------------|------------|
|                    | (dBm)            | (Watt)     |
| 902-928            | 36               | 4.0        |
| <b>2400-2483.5</b> | <b>36</b>        | <b>4.0</b> |
| 5725-5850          | 36               | 4.0        |

The requirements are **FULFILLED**.

**Remarks:**

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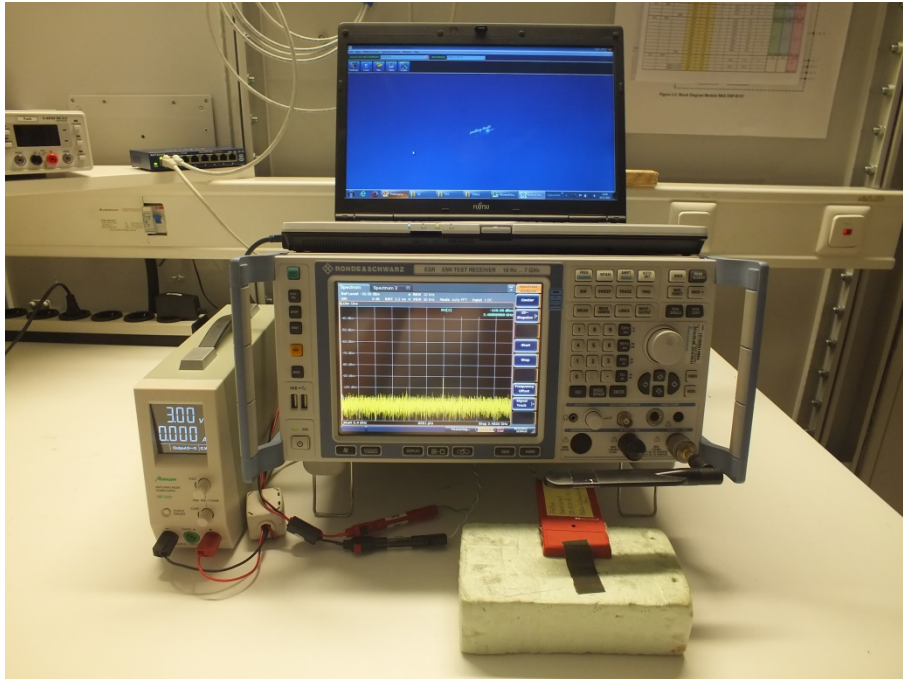
## 5.4 Power spectral density

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

### 5.4.1 Description of the test location

Test location: AREA4

### 5.4.2 Photo documentation of the test set-up



### 5.4.3 Applicable standard

According to FCC Part 15, Section 15.247(e):

For digitally modulated systems, the power spectral density radiated from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the radiated output power shall be used to determine the power spectral density.

### 5.4.4 Description of Measurement

The measurement is performed using the procedure 10.2 set out in KDB-558074. Therefore the PKPSD is measured conducted. The max peak was located and measured with the spectrum analyser and the marker set to peak. An offset was set to compensate the substitution antenna mis-match.

Spectrum analyser settings:

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

**5.4.5 Test result**
**Standard 802.15.1**

| <b>802.15.1, 1000 kbps, 1 TX</b> |           | Test results radiated |                          |                |
|----------------------------------|-----------|-----------------------|--------------------------|----------------|
|                                  |           | PD<br>(dBm/3kHz)      | EIRP Limit<br>(dBm/3kHz) | Margin<br>(dB) |
| Lowest frequency: 2402 MHz       |           |                       |                          |                |
| $T_{nom}$                        | $V_{nom}$ | -39.0                 | 14.0                     | -53.0          |
| Middle frequency: 2426 MHz       |           |                       |                          |                |
| $T_{nom}$                        | $V_{nom}$ | -42.8                 | 14.0                     | -56.8          |
| Highest frequency: 2480 MHz      |           |                       |                          |                |
| $T_{nom}$                        | $V_{nom}$ | -41.8                 | 14.0                     | -55.8          |

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

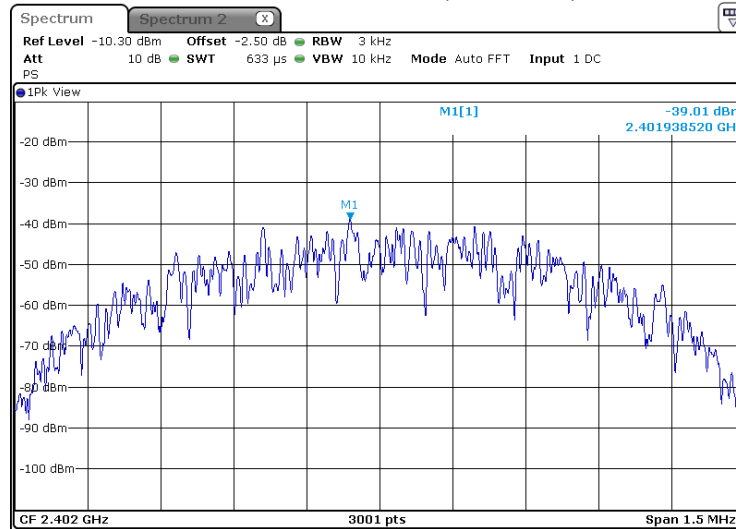
| Frequency<br>(MHz) | Power spectral density limit (EIRP) |
|--------------------|-------------------------------------|
|                    | (dBm/3 kHz)                         |
| 2400 - 2483.5      | 14                                  |

The requirements are **FULFILLED**.

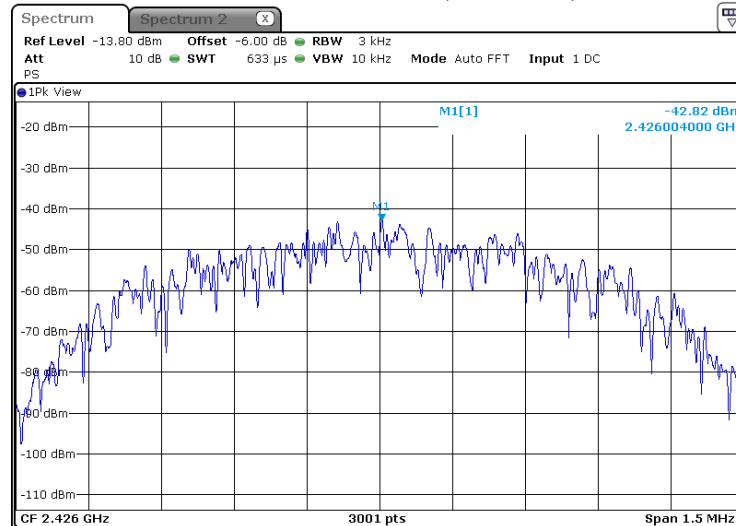
**Remarks:** For detailed test results please refer to the following test protocols.

#### 5.4.6 Test protocols

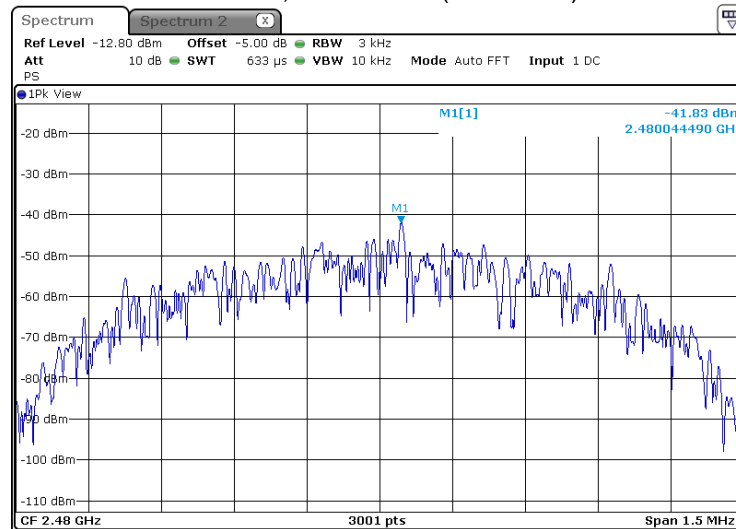
802.15.1, Channel 37 (2402 MHz)



802.15.1, Channel 38 (2426 MHz)



802.15.1, Channel 39 (2480 MHz)



## 5.5 Radiated emissions in restricted bands

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

### 5.5.1 Description of the test location

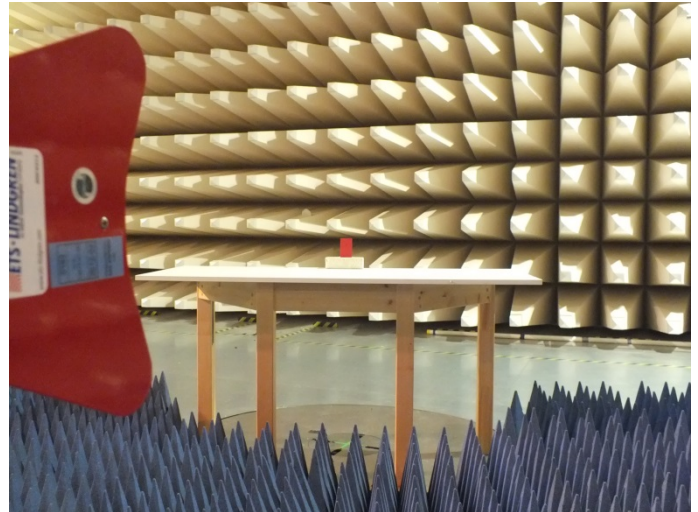
Test location: OATS 1  
 Test location: Anechoic Chamber 1  
 Test distance: 3 m

### 5.5.2 Photo documentation of the test set-up

Open area test site



Anechoic chamber



According to FCC Part 15, Section 15.205(a):

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

### 5.5.3 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser is set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The restricted bands are measured falling emissions into it and the nearest restricted band are checked for emissions also the restricted band for the harmonics of the carrier. To show compliance the FCC Part 15, section 15.35(c) was used.

Test receiver settings for SER2:

RBW: 120 MHz, Detector: Quasi peak, Mes. Time: 1 s,

Spectrum analyser settings for SER3:

RBW: 1 MHz, VBW: 3 MHz, Detector: Max. peak, Trace: Max. hold, Sweep: Auto

Spectrum analyser settings for SER3:

RBW: 1 MHz, VBW: 3 MHz, Detector: RMS, Trace: Max. hold, Sweep: Auto

**5.5.1 Test result**
**Standard 802.15.1**

Emissions 30 MHz – 1000 MHz, SER2

| Advertising mode with CH37, CH38, CH39 |               |       |                  |          |          |        |          |
|--|---------------|-------|------------------|----------|----------|--------|----------|
| Test conditions: TX, Pmin, 1000 kbps   |               |       |                  |          |          |        |          |
|  |               |       | Test results     |          |          |        |          |
| Start <i>f</i>                         | Stop <i>f</i> | RBW   | Maximum emission |          | Limit    | Margin | Detector |
| (MHz)                                  | (MHz)         | (kHz) | (MHz)            | (dBμV/m) | (dBμV/m) | (dB)   |          |
| 30                                     | 1000          | 120   | 150.00           | 13.5     | 43.5     | -30.0  | QP       |
| 30                                     | 1000          | 120   | 300.00           | 15.1     | 46.0     | -30.9  | QP       |
| 30                                     | 1000          | 120   | 450.00           | 18.9     | 46.0     | -27.2  | QP       |
| 30                                     | 1000          | 120   | 600.00           | 21.8     | 46.0     | -24.2  | QP       |
| 30                                     | 1000          | 120   | 750.00           | 25.8     | 46.0     | -20.2  | QP       |
| 30                                     | 1000          | 120   | 900.00           | 28.1     | 46.0     | -17.9  | QP       |
| Measurement uncertainty                |               |       |                  | ±6 dB    |          |        |          |

Emissions 1 GHz – 25 GHz

| Advertising mode with CH37, CH38, CH39 |               |       |                  |          |          |        |          |
|--|---------------|-------|------------------|----------|----------|--------|----------|
| Test conditions: TX, Pmin, 1000 kbps   |               |       |                  |          |          |        |          |
| Peak pre-scan                          |               |       | Test results     |          |          |        |          |
| Start <i>f</i>                         | Stop <i>f</i> | RBW   | Maximum emission |          | AVLimit  | Margin | Detector |
| (MHz)                                  | (MHz)         | (kHz) | (MHz)            | (dBμV/m) | (dBμV/m) | (dB)   |          |
| 1000                                   | 2400          | 1000  | 1767.55          | 44.1     | 54.0     | -9.9   | Pk       |
| 2483.5                                 | 4000          | 1000  | 3867.87          | 43.2     | 54.0     | -10.8  | Pk       |
| 4000                                   | 8000          | 1000  | 4855.75          | 52.3     | 54.0     | -1.7   | Pk       |
| 8000                                   | 12000         | 1000  | 11873.50         | 51.4     | 54.0     | -2.7   | Pk       |
| 12000                                  | 18000         | 1000  | 16920.00         | 52.4     | 54.0     | -1.6   | Pk       |
| 18000                                  | 25000         | 1000  | 24070.00         | 49.1     | 54.0     | -4.9   | RMS      |
| Measurement uncertainty                |               |       |                  | ±6 dB    |          |        |          |

Radiated limits according to FCC Part 15 Section 15.209(a) for spurious emissions which fall in restricted bands:

| Frequency   | Field strength of spurious emissions |          | Measurement distance |
|-------------|--------------------------------------|----------|----------------------|
| (MHz)       | (μV/m)                               | dB(μV/m) | (metres)             |
| 0.009-0.490 | 2400/F (kHz)                         |          | 300                  |
| 0.490-1.705 | 24000/F (kHz)                        |          | 30                   |
| 1.705-30    | 30                                   | 29.5     | 30                   |
| 30-88       | 100                                  | 40       | 3                    |
| 88-216      | 150                                  | 43.5     | 3                    |
| 216-960     | 200                                  | 46       | 3                    |
| Above 960   | 500                                  | 54       | 3                    |

**Restricted bands of operation:**

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

| MHz                 | MHz                   | MHz             | GHz           |
|---------------------|-----------------------|-----------------|---------------|
| 0.090 – 0.110       | 16.42 – 16.423        | 399.9 – 410     | 4.5 – 5.15    |
| 0.495 – 0.505       | 16.69475 – 16.69525   | 608 – 614       | 5.35 – 5.46   |
| 2.1735 – 2.1905     | 16.80425 – 16.80475   | 960 – 1240      | 7.25 – 7.75   |
| 4.125 – 4.128       | 25.5 – 25.67          | 1300 – 1427     | 8.025 – 8.5   |
| 4.17725 – 4.17775   | 37.5 – 38.25          | 1435 – 1626.5   | 9.0 – 9.2     |
| 4.20725 – 4.20775   | 73 – 74.6             | 1645.5 – 1646.5 | 9.3 – 9.5     |
| 6.215 – 6.218       | 74.8 – 75.2           | 1660 – 1710     | 10.6 – 12.7   |
| 6.26775 – 6.26825   | 108 – 121.94          | 1718.8 – 1722.2 | 13.25 – 13.4  |
| 6.31175 – 6.31225   | 123 – 138             | 2200 – 2300     | 14.47 – 14.5  |
| 8.291 – 8.294       | 149.9 – 150.05        | 2310 – 2390     | 15.35 – 16.2  |
| 8.362 – 8.366       | 156.52475 – 156.52525 | 2483.5 – 2500   | 17.7 – 21.4   |
| 8.37625 – 8.38675   | 156.7 – 156.9         | 2690 – 2900     | 22.01 – 23.12 |
| 8.41425 – 8.41475   | 162.0125 – 167.17     | 3260 – 3267     | 23.6 – 24.0   |
| 12.29 – 12.293      | 167.72 – 173.2        | 3332 – 3339     | 31.2 – 31.8   |
| 12.51975 – 12.52025 | 240 – 285             | 3345.8 – 3358   | 36.43 – 36.5  |
| 12.57675 – 12.57725 | 322 – 335.4           | 3600 – 4400     | Above 38.6    |

The requirements are **FULFILLED**.

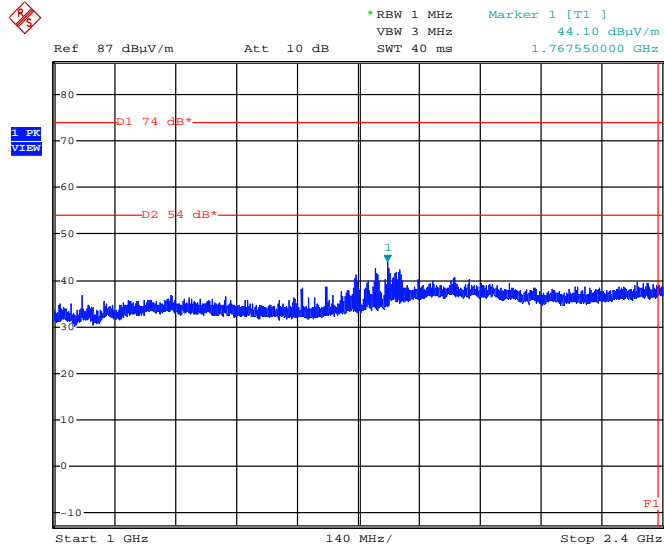
**Remarks:** The measurement was performed up to the 10<sup>th</sup> harmonic.

For detailed test results please refer to the following test protocols.

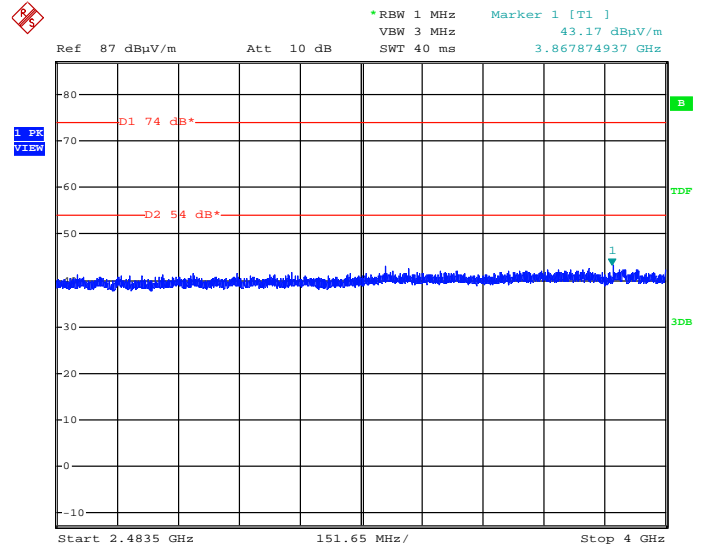
## 5.5.2 Test protocols radiated emissions SER3

### 802.15.1, Channel 37, 38, 39 (Advertising mode)

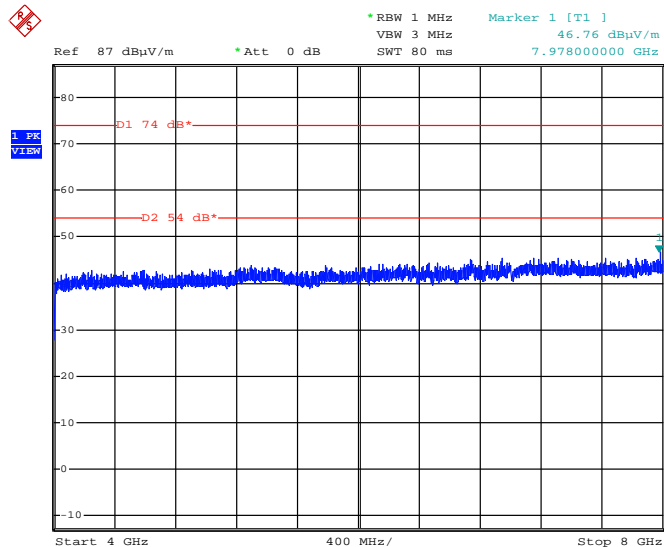
1 GHz – 2.4 GHz



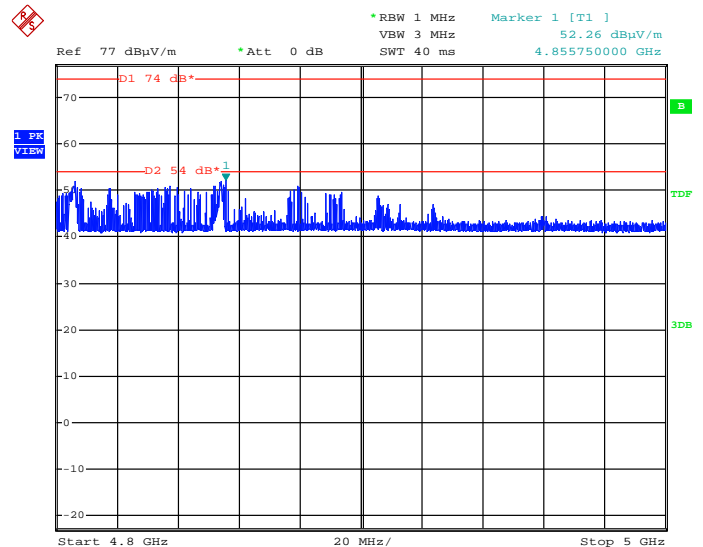
2.4835 GHz - 4 GHz



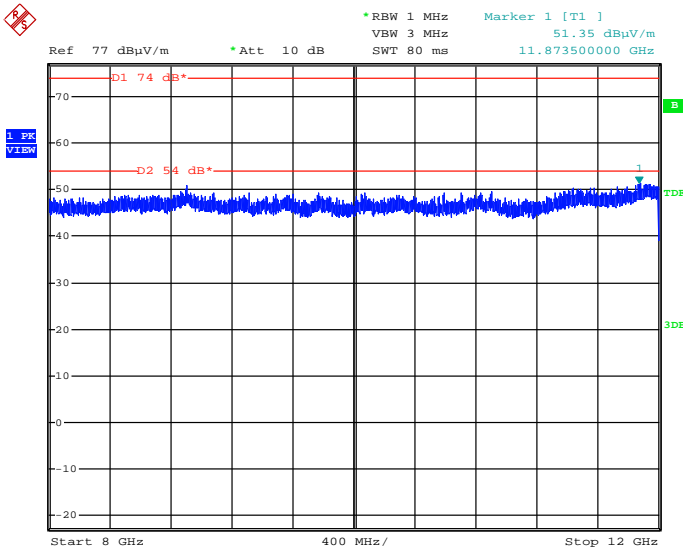
4 GHz - 8 GHz



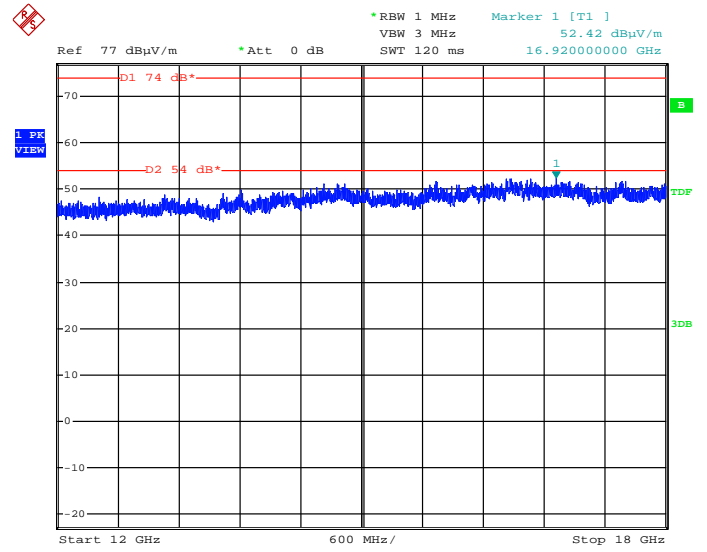
4.8 GHz – 5 GHz



8 GHz – 12 GHz



12 GHz – 18 GHz





## 5.6 Spurious emissions radiated

For test instruments and accessories used see section 6 Part **SER1**, **SER 2**, **SER 3**.

### 5.6.1 Description of the test location

Test location: NONE

Test distance: -

### 5.6.2 Applicable standard

According to FCC Part 15, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.50 MHz and 5725 – 5850 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a) (see Section 15.205(c)).

### 5.6.3 Description of Measurement

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI C63.4. If the emission level of the EUT in peak mode complies with the average limit is 20 dB lower, then testing will be stopped and peak values of the EUT will be reported, otherwise the emission will be measured in average mode again and reported.

Test receiver settings for SER2:

RBW: 120 MHz, Detector: Quasi peak, Mes. Time: 1 s,

Spectrum analyser settings for SER3:

RBW: 100 kHz, VBW: 300 kHz, Detector: Max. peak, Trace: Max. hold, Sweep: Auto

#### 5.6.4 Test result

**Note:**

Measurements were performed in the frequency range from 1 GHz up to 25 GHz with the analyser settings for restricted band measurements to show compliance for emissions falling into restricted bands, else the band edge compliance is fulfilled. In the frequency ranges from 9 kHz up to 30 MHz and from 18 GHz up to 25 GHz no emission can be detected.

According to FCC Part 15, Section 15.205(a):

In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limit specified in Section 15.209(a).

Limit according to FCC Part 15, Section 15.247(d) for emissions falling not in restricted bands:

In any 100 kHz bandwidth outside the frequency bands 2400 – 2483.50 MHz and 5725 – 5850 MHz, the digitally modulated radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or an radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

| Frequency<br>(MHz) | Spurious emission limit                            |
|--------------------|--|
| Below 1000         | 20 dB below the highest level of the desired power |
| Above 1000         | 20 dB below the highest level of the desired power |

The requirements are **FULFILLED**.

**Remarks:**

The general requirements for radiated emission limits are already fulfilled in section 5.5 .

Therefore the measurement for spurious emissions was not performed separately.

Also see note in section 5.6.4 .

## 5.7 Antenna application

For test instruments and accessories used see section 6 Part **CPR3**.

### 5.7.1 Applicable standard

According to FCC Part 15C, Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT has an integrated antenna. No other antenna can be used with the device. Instead of a conducted measurement the output power given by the chip manufacturer is used to calculate the antenna gain. According to the following formula the maximum gain of the antenna was calculated.

$$G = \text{EIRP} - P$$

Where:

EIRP = Equivalent isotropic radiated power

P = Conducted output power (equal to the lowest power setting of the chip, given by manufacturer)

G = Calculated gain of the antenna

Result:

| 802.15.1, 1000 kbps, TX |                  | Test results radiated |            |            |
|-------------------------|------------------|-----------------------|------------|------------|
|                         |                  | EIRP<br>(dBm)         | P<br>(dBm) | G<br>(dBi) |
| Lowest frequency: CH37  |                  |                       |            |            |
| $T_{\text{nom}}$        | $V_{\text{nom}}$ | -22.9                 | -23.0      | 0.1        |
| Middle frequency: CH38  |                  |                       |            |            |
| $T_{\text{nom}}$        | $V_{\text{nom}}$ | -25.0                 | -23.0      | -2.0       |
| Highest frequency: CH39 |                  |                       |            |            |
| $T_{\text{nom}}$        | $V_{\text{nom}}$ | -25.4                 | -23.0      | -2.4       |

The supplied antenna meets the requirements of part 15.203 and 15.204.

### 5.7.2 Antenna requirements

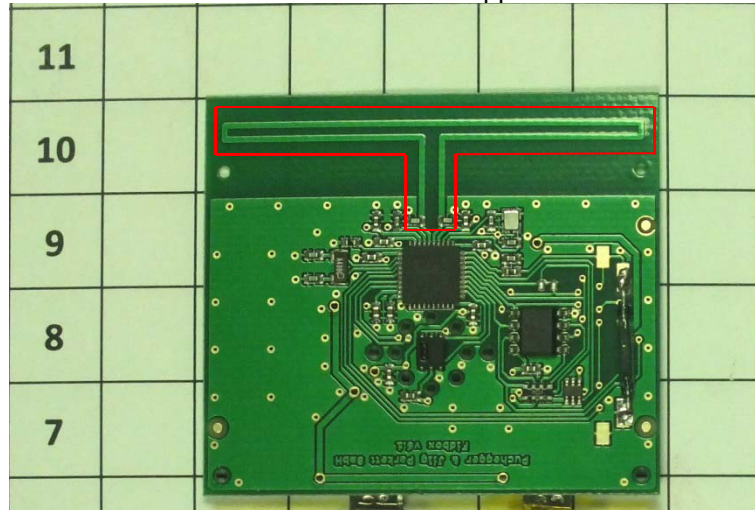
According to FCC Part 15C, Section 15.247(b)(4):

The conducted output power limit specified in paragraph (b) of 15.247 is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from intentional radiator shall be reduced below the stated values in paragraph (b)(1), (b)(2) and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The output power has not to be reduced.

### 5.7.3 Photo documentation of the used antenna

RF section and antenna application



## 5.8 Maximum permissible exposure (MPE)

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

### 5.8.1 Description of the test location

Test location: AREA4

### 5.8.2 Applicable standard

According to FCC Part 15, Section 15.247(i):

Systems operating under the provisions of this section shall be operated in a manner that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

The test methods used comply with ANSI/IEEE C95.1, "IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz".

This test report shows the compliance with the limits for Maximum Permissible Exposure (MPE) specified in FCC Part 1, Section 1.1310 and the criteria to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in FCC Part 1, Section 1.1307(b).

### 5.8.3 Description of Measurement

The maximum total power input to the antenna has been measured conducted as described in clause 5.3 of this document. Through the Friis transmission formula, the known maximum gain of the antenna and the maximum power, can be calculated the MPE in a defined distance away from the product.

Friis transmission formula:

$$P_d = \frac{P_{out} * G}{4 * \pi * r^2}$$

Where:

$P_d$  = power density (mW/cm<sup>2</sup>)

$P_{out}$  = output power to antenna (mW)

$G$  = gain of antenna (linear scale)

$r$  = distance between antenna and observation point (cm)

According to FCC Rules 47CFR 2.1093(b) the EUT is not a portable device. The EUT is designed to be used that radiating structures are 20 cm outside of the body of the user. ( $r = 20$  cm)

**5.8.4 Test result**

Standard 802.15.1

| Channel no. | Power setting    | A (dBm) | Antenna gain (dBi) | A (mW) | G (1) | P (W)     | S (mW/cm <sup>2</sup> ) | Limit S <sub>eq</sub> (mW/cm <sup>2</sup> ) |
|-------------|------------------|---------|--------------------|--------|-------|-----------|-------------------------|---|
| 37          | P <sub>min</sub> | -22.9   | 0.1                | 0.0051 | 1.02  | 0.0000053 | 0.0000010               | 1.0   |
| 38          | P <sub>min</sub> | -25.0   | 0.1                | 0.0032 | 1.02  | 0.0000033 | 0.0000006               | 1.0   |
| 39          | P <sub>min</sub> | -25.4   | 0.1                | 0.0029 | 1.02  | 0.0000029 | 0.0000006               | 1.0   |

Limits for maximum permissible exposure (MPE):

| Frequency range (MHz)  | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density (mW/cm <sup>2</sup> ) | Averaging time (minutes) |
|--|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| <b>(B) Limits for General Population / Uncontrolled Exposure</b> |                               |                               |                                     |                          |
| 0.3 – 3.0  | 614                           | 1.63                          | 100                                 | 30                       |
| 3.0 – 30   | 824/ <i>f</i>                 | 2.19/ <i>f</i>                | 180/ <i>f</i> <sup>2</sup>          | 30                       |
| 30 - 300   | 27.5                          | 0.073                         | 0.2                                 | 30                       |
| 300-1500   | ---                           | ---                           | <i>f</i> /1500                      | 30                       |
| <b>1500-100000</b>   | ---                           | ---                           | <b>1.0</b>                          | <b>30</b>                |

*f* = Frequency in MHz

The requirements are **FULFILLED**.

**Remarks:**


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## **6 USED TEST EQUIPMENT AND ACCESSORIES**

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

| <b>Test ID</b> | <b>Model Type</b>      | <b>Equipment No.</b> | <b>Next Calib.</b> | <b>Last Calib.</b> | <b>Next Verif.</b> | <b>Last Verif.</b> |
|----------------|------------------------|----------------------|--------------------|--------------------|--------------------|--------------------|
| CPR 3          | FSP 30                 | 02-02/11-05-001      | 20/10/2015         | 20/10/2014         |                    |                    |
|                | AFS4-01000400-10-10P-4 | 02-02/17-13-002      |                    |                    |                    |                    |
|                | BBHA 9120 E 251        | 02-02/24-05-006      | 15/05/2015         | 15/05/2014         | 08/07/2015         | 08/01/2015         |
|                | WHJS 1000-10EE         | 02-02/50-05-070      |                    |                    |                    |                    |
|                | Sucoflex N-2000-SMA    | 02-02/50-05-075      |                    |                    |                    |                    |
|                | SF104/11N/11N/1500MM   | 02-02/50-13-015      |                    |                    |                    |                    |
|                | SF104/11SMA/11N/1500MM | 02-02/50-13-016      |                    |                    |                    |                    |
| MB             | ESR 7                  | 02-02/03-13-001      | 03/06/2015         | 03/06/2014         |                    |                    |
|                | NSP 3630               | 02-02/50-14-015      |                    |                    |                    |                    |
| SER 2          | ESVS 30                | 02-02/03-05-006      | 03/07/2015         | 03/07/2014         |                    |                    |
|                | VULB 9168              | 02-02/24-05-005      | 08/04/2015         | 08/04/2014         | 04/03/2015         | 04/09/2014         |
|                | S10162-B               | 02-02/50-05-031      |                    |                    |                    |                    |
|                | NW-2000-NB             | 02-02/50-05-113      |                    |                    |                    |                    |
|                | KK-EF393/U-16N-21N20 m | 02-02/50-12-018      |                    |                    |                    |                    |
| SER 3          | FSP 30                 | 02-02/11-05-001      | 20/10/2015         | 20/10/2014         |                    |                    |
|                | AFS4-01000400-10-10P-4 | 02-02/17-13-002      |                    |                    |                    |                    |
|                | AMF-4F-04001200-15-10P | 02-02/17-13-003      |                    |                    |                    |                    |
|                | BBHA 9120 E 251        | 02-02/24-05-006      | 15/05/2015         | 15/05/2014         | 08/07/2015         | 08/01/2015         |
|                | WBH2-18NHG             | 02-02/24-08-002      | 15/05/2015         | 15/05/2014         | 08/07/2015         | 08/01/2015         |
|                | Sucoflex N-2000-SMA    | 02-02/50-05-075      |                    |                    |                    |                    |
|                | SF104/11N/11N/1500MM   | 02-02/50-13-015      |                    |                    |                    |                    |
|                | SF104/11SMA/11N/1500MM | 02-02/50-13-016      |                    |                    |                    |                    |
|                | SF104/11SMA/11N/1500MM | 02-02/50-13-017      |                    |                    |                    |                    |