EMI – TEST REPORT

- FCC Part 15.249, RSS210 -

Type / Model Name	:	hmbox, bmonc
Product Description	:	Bluetooth low energy 4.0 device with GSM
Applicant	:	fp floor protector GmbH
Address	:	Waldgasse 2
		2700 WIENER NEUSTADT - AUSTRIA
Manufacturer	:	fp floor protector GmbH
Address	:	Waldgasse 2
		2700 WIENER NEUSTADT - AUSTRIA
Licence holder	:	fp floor protector GmbH
Address	:	Waldgasse 2
		2700 WIENER NEUSTADT - AUSTRIA

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

Test Report No. : T40676-00-01TK	01. July 2016 Date of issue

Deutsche Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

Contents

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September, 2015)

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, 2015)

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 15.249	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz
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
CISPR 22: 2008 EN 55022: 2010	Information technology equipment

2 EQUIPMENT UNDER TEST

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

2.2 Equipment category

Bluetooth Low Energy device, fixed equipment.

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 uses serial production firmware that allows to be connected with a companian device. Else the advertising sequence can be started manually. During Bluetooth LE test the device is connected with the ccDebugger device using a wired test connection. The output power is set to +4 dBm representing the maximum output power of the chipset. The EUT has only one integrated antenna, no temporary connector and no external antenna can be connected. The EUT is run with four 1.5V Lithium cell batteries. There are no external connectors. Else a GSM module is mounted within the EUT´s enclosure.

Number of tested samples:	1		
MAC address:	-		
Serial number:	N/A		
Firmware version:	Test Software	Smart RF Studio 7	Version 2.3.1
GSM - IMEI	359568051024498		

Items	Description
BT type	4.0 Low Energy
BT chipset type	Texas Instruments CC2541
Modulation	GFSK
Frequency range	2400 MHz to 2483.5 MHz
Channel numbers	40
Data rate (kbps)	1000
Antenna type	PCB
GSM module type	Sierra Wireless HL6528
GSM FCC ID	N7NHL6528
GSM IC	2417C-HL6528

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 plan:

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

Note: the marked frequencies are determined for final testing.

2.6 Transmit operating modes

The EUT uses GFSK and provide following data rate:

1000 kbps (kbps = *kilobits per second)*

2.7 Antenna

The following antennas shall be used with the EUT:

Number	Characteristic	Certification name or Part number	Plug	Frequency range (GHz)	Gain (dBi)	Device section
1	Omni	PCB antenna	none	2.4 - 2.4835	N/A	BLE
2	Omni	ZL-PB350B2-PEX35B	U.FL	GSM 850	2.0	GSM 850
2	Omni	ZL-PB350B2-PEX35B	U.FL	PCS1900	2.0	PCS1900

2.8 Power supply system utilised

Power supply voltage, V_{nom} : 6 VDC battery powered (4 x L91 – FR6 1.5 V, Size AA)

2.9 Peripheral devices and interface cables

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

- Laptop computer Model : Toshiba TECRA A11-127
- Debug adaptor Model : Texas Instruments, ccDebugger
- _____ Model : _____

2.10 Determination of worst case conditions for final measurement

Measurements have been made in all three orthogonal axes and the settings of the EUT were 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 with the following settings:

IEEE Standard	Available channels	Tested channels	Power setting	Modulation	Data rate
802.15.1	00 to 39	37, 18, 39	+4 dBm	GFSK	1000 kbps

1000 kbps, GFSK with TX continuous modulated.

2.10.1 Test jig

No Test jig was used for test.

2.10.2 Test software

The EUT was tested with TI´s test software platform SmartRF™ Studio 7 . This software allows to set the parameters for channel frequency, TX continuous modulated and output power. The output power is set to +4 dBm representing the highest output power being used in the end application.

2.10.3 General remarks

The EUT consists of a Bluetooth Low Energy (BLE) wireless section and includes a GSM (GSM 850 /PCS 1900). The firmware of the device prohibits the two sections being active simultaneously. During the data acquisition mode only BLE is active and the GSM section is disabled. After a completed data acquisition period the BLE is going to be disabled and the GSM section is enabled for a transmission of data. An activated GSM prohibits data transmission by the BLE part. As a conclusion of this EUT behaviour is that a co-transmission is impossible. A co-location consideration in that case is not necessary because the stacked activity of the different wireless parts shows a behaviour like two separate devices.
The GSM part is not tested separately because this device is tested and certified by the responsible party. Accordingly the ID numbers for FCC and IC are listed within the present document under section 2.3 .

3 TEST RESULT SUMMERY

Operating in the 2400 MHz – 2483.5 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.35(c)	RSS-Gen, 6.10	Pulsed operation	passed
15.203	RSS Gen, 8.3	Antenna requirement	passed
15.204	RSS Gen, 8.2	External radio frequency power amplifiers	passed
15.205(a)	RSS Gen, 8.1	Emissions in restricted bands	passed
15.207(a)	RSS Gen, 8.8	AC power line conducted emissions	not applicable
15.215(c)	-	EBW	passed
-	RSS-Gen, 6.6	OBW	passed
15.249(a)	RSS-210, A2.9(a)	Field strength of fundamental	passed
15.249(d)	RSS-210, A2.9(b)	Out-of-band emission, radiated	passed
-	RSS-Gen, 6.11	Transmitter frequency stability	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

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 : 03 May 2016

Testing concluded on : 10 June 2016

Checked by:

Klaus Gegenfurtner
I confirm the correctness and Integrity of this document
2016.07.01 13:34:47 +02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Tobias Kammerer
I´m the author of this document
2016.07.01 13:23:56 +02'00'

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

4.4.1.1 Test methodology

Conducted and radiated disturbance testing is performed according to the procedures set out by the International Special Committee on Radio Interference (CISPR) Publication 22, European Standard EN 55022 as shown under section 1 of this report.

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

IC 3009A-1

The anechoic chamber site is a listed chamber under the Canadian Test-Sites File-No:

IC 3009A-2

In compliance with RSS 210 testing for RSS compliance may be achieved by following the procedures set out in ANSI C63.10 and applying the CISPR 22 limits.

4.4.1.2 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.

4.4.1.3 General Standard information

The test methods used comply with CISPR Publication 22, EN 55022 - " Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement" and with ANSI C63.10 “Testing Unlicensed Wireless Devices ". 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 C63.10 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

Remarks: Not applicable, the EUT is battery powered and has no externally connectable cables.

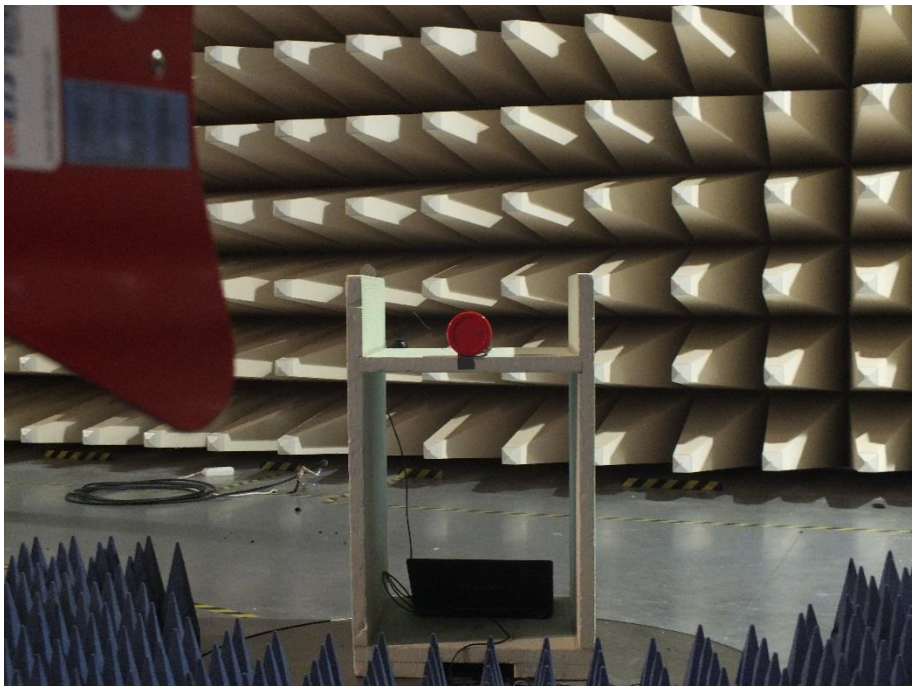
5.2 Field strength of fundamental

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

5.2.1 Description of the test location

Test location: Anechoic chamber 1
Test distance: 3 m

5.2.2 Photo documentation of the test set-up



5.2.1 Applicable standard

According to FCC Part 15C, Section 15.249(a):
The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the effective limits.

5.2.2 Description of Measurement

The radiated emission of the fundamental wave from the EUT is measured using a spectrum analyser and appropriate linear polarized antennas. The set up of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 6.5. The EUT is measured in TX continuous mode modulated under normal conditions.

Analyser settings:

Peak measurement:	RBW:	1 MHz	VBW:	3 MHz	Detector:	Max peak
AV measurement:	RBW:	1 MHz	VBW:	10 Hz	Detector:	Max peak

5.2.3 Test result

Frequency	Reading level PK	Bandwidth	Correction factor	Corrected level PK	Limit PK	Duty cycle correction factor K_E	Corrected level AV	Limit AV
(MHz)	(dBµV)	(kHz)	(dB)	dB(µV/m)	dB(µV/m)	(dB)	dB(µV/m)	dB(µV/m)
2405	112.8	1000	-14.8	98.0	114	-48.5	49.5	94
2450	111.0	1000	-14.6	96.4	114	-48.5	47.9	94
2480	108.9	1000	-14.2	94.7	114	-48.5	46.2	94

Note: The correction factor includes cable loss and antenna factor.

Average-Limit according to FCC Part 15C, Section 15.249(a):

Frequency	Field strength of fundamental	
(MHz)	(mV/m)	dB(µV/m)
902 - 928	50	94
2400 - 2483.5	**50**	**94**
5725-5875	50	94
24000 - 24250	250	108

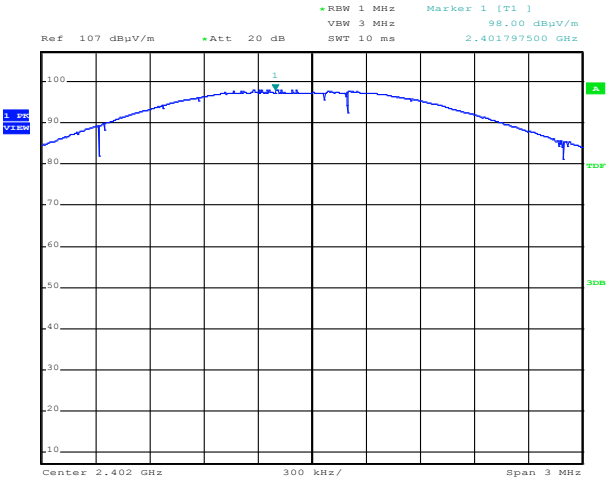
Peak-Limit according to FCC Part 15C, Section 15.249(e):
However the peak fieldstrength shall not exceed the maximum permitted average limit by more than 20 dB.

The requirements are **FULFILLED.**

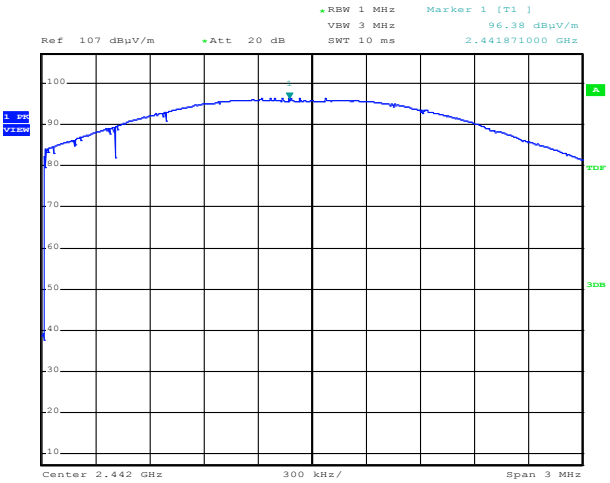
Remarks: For detailed test result please refer to the following test protocols.

5.2.4 Test protocols

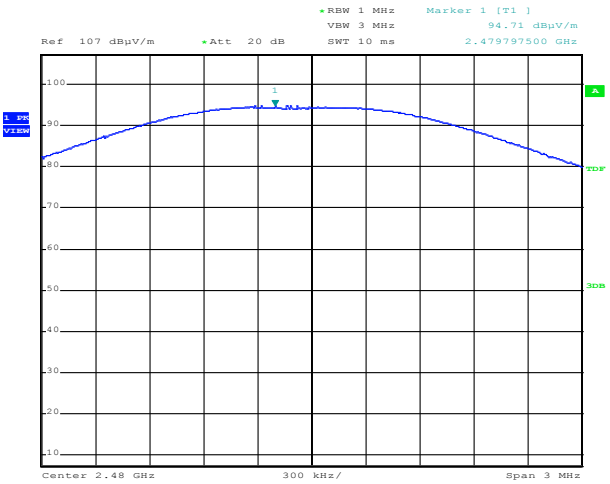
Channel 37, 2402 MHz



Channel 18, 2442 MHz



Channel 39, 2480 MHz



5.3 Out-of-band emission, radiated

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

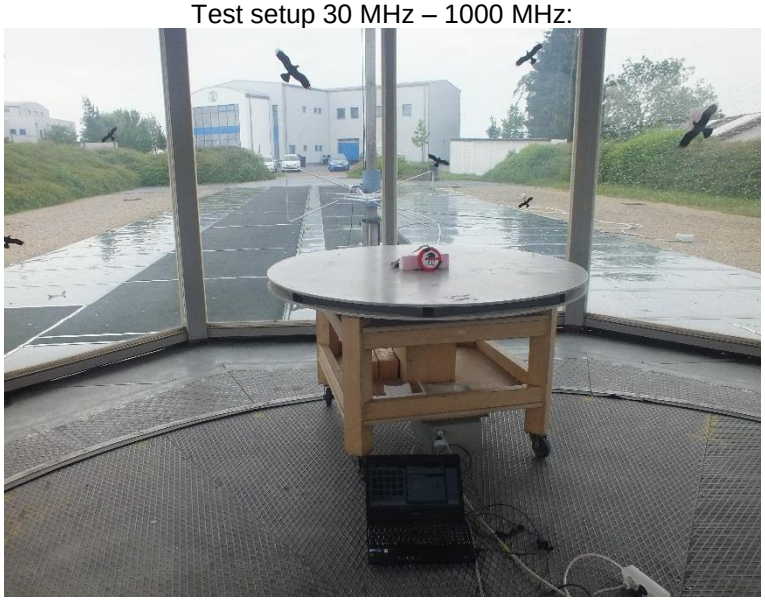
5.3.1 Description of the test location

Test location: OATS 1
Test distance: 3 m

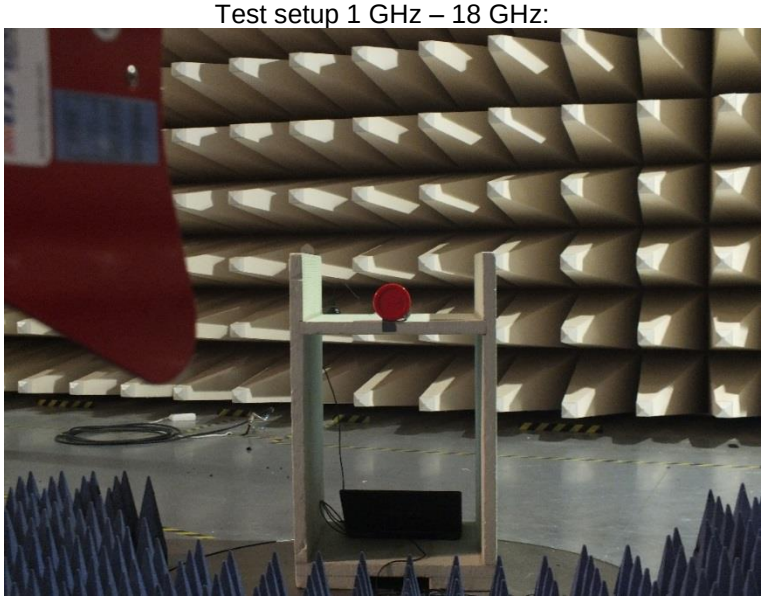
Test location: Anechoic chamber 1
Test distance: 3 m

5.3.2 Photo documentation of the test set-up

Test setup 30 MHz – 1000 MHz:



Test setup 1 GHz – 18 GHz:



5.3.3 Applicable standard

According to FCC Part 15C, Section 15.249 (d):
Emission radiated outside of the specified frequency bands, except harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated limit in FCC Part 15C, Section 15.209, whichever is the lesser attenuation.

5.3.4 Description of Measurement

The radiated emissions from the EUT are measured in the frequency range of 9 kHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarized antennas. The setup of the EUT and the measurement procedure is in accordance to ANSI C63.10, Item 6.3. In the frequency range above 1 GHz a spectrum analyser is used with appropriate linear polarized antennas. If the emission level in peak mode complies with the average limit testing is stopped and peak values will be reported, otherwise, the emission is measured in average mode again and reported. The EUT is measured in TX continuous mode modulated under normal conditions.

Instrument settings:

9 kHz – 150 kHz	RBW:	200 Hz
150 kHz - 30 MHz	RBW:	9 kHz
30 MHz – 1000 MHz:	RBW:	120 kHz
1000 MHz – 25 GHz	RBW:	1 MHz

5.3.1 Test result

Note:
Pre-measurements were performed in the frequency range 9 kHz to 30 MHz and 18 GHz to 25 GHz.
The EUT showed no detectable suspects.

5.3.2 Test result f 30 MHz - 1000 MHz

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
40.20	20.0	8.1	14.7	13.5	34.7	21.6	40.0	-5.3
63.20	13.1	4.8	14.5	13.7	27.6	18.5	40.0	-12.4
80.00	17.0	5.7	11.1	10.8	28.1	16.5	40.0	-11.9
85.00	17.3	6.0	10.0	10.2	27.3	16.2	40.0	-12.7
119.85	17.8	5.8	12.4	12.9	30.2	18.7	43.5	-13.3
127.48	15.2	5.4	12.8	13.4	28.0	18.8	43.5	-15.5
138.05	13.8	6.3	13.3	14.1	27.1	20.4	43.5	-16.4
150.00	12.6	8.4	13.9	14.8	26.5	23.2	43.5	-17.0
200.00	14.0	9.5	11.3	12.0	25.3	21.5	43.5	-18.2
600.00	6.0	6.2	25.5	25.3	31.5	31.5	46.0	-14.5
800.00	7.3	7.4	29.5	29.0	36.8	36.4	46.0	-9.2
900.00	7.7	7.6	31.1	30.7	38.8	38.3	46.0	-7.2

Note:
The correction factor includes cable loss and antenna factor. No emission difference could be detected for the intentional radiated frequencies 2402 MHz, 2442 MHz and 2480 MHz within the frequency range from 30 MHz to 1000 MHz.

5.3.3 Test result f > 1 GHz

CH37, 2402 MHz								
Test conditions:								
TX continuous, P = 4 dBm			Test results					
Start requency (MHz)	Stop frequency (MHz)	RBW (kHz)	Maximum emission (MHz)	Maximum emission (dBµV/m)	AV Limit (dBµV/m)	Duty cycle correction (dB)	Margin (dB)	Detector
1000	2400	1000	1858.90	45.1	54.0	0.0	-8.9	PK
1000	2400	100	2399.21	58.7	54.0	-49.8	-45.1	PK
2483.5	4000	1000	3723.62	43.8	54.0	0.0	-10.2	PK
4000	12000	1000	4878.00	51.1	54.0	0.0	-2.9	PK
12000	18000	1000	16116.00	51.8	54.0	0.0	-2.2	PK
Measurement uncertainty			±6 dB					

CH18, 2442 MHz								
Test conditions:								
TX continuous, P = 4 dBm			Test results					
Start requency (MHz)	Stop frequency (MHz)	RBW (kHz)	Maximum emission (MHz)	Maximum emission (dBµV/m)	AV Limit (dBµV/m)	Duty cycle correction (dB)	Margin (dB)	Detector
1000	2400	1000	1866.25	46.2	54.0	0.0	-7.8	PK
2483.5	4000	1000	3715.66	44.4	54.0	0.0	-9.6	PK
4000	12000	1000	4880.00	50.8	54.0	0.0	-3.2	PK
12000	18000	1000	16401.00	52.2	54.0	0.0	-1.8	PK
Measurement uncertainty			±6 dB					

CH39, 2480 MHz								
Test conditions:								
TX continuous, P = 4 dBm			Test results					
Start requency (MHz)	Stop frequency (MHz)	RBW (kHz)	Maximum emission (MHz)	Maximum emission (dBµV/m)	AV Limit (dBµV/m)	Duty cycle correction (dB)	Margin (dB)	Detector
1000	2400	1000	1947.10	46.8	54.0	0.0	-7.2	PK
2483.5	4000	1000	2483.50	55.6	54.0	-49.8	-48.2	PK
4000	12000	1000	4957.00	48.4	54.0	0.0	-5.7	PK
12000	18000	1000	16349.25	49.9	54.0	0.0	-4.1	PK
Measurement uncertainty			±6 dB					

Limit according to FCC Part 15C, Section 15.209:

Frequency (MHz)	15.209 Limits (µV/m)	Measurement distance (m)
0.009 - -0.49	2400/f(kHz)	300
0.49 – 1.705	24000/f(kHz)	30
1.705 – 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Average limit according to FCC Part 15C, Section 15.249(a):

Fundamental frequency	Field strength of harmonics	
(MHz)	(µV/m)	dB(µV/m)
902 - 928	500	54
2400 - 2483.5	500	54
5725 - 5875	500	54
24000 - 24250	2500	68

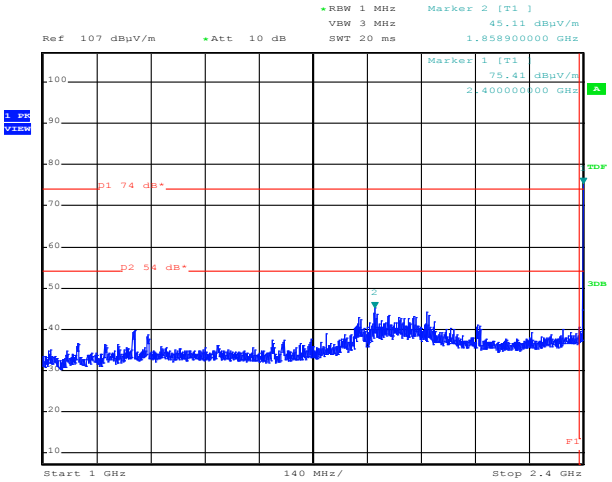
The requirements are **FULFILLED.**

Remarks: The measurement was performed up to the 10th harmonic (25000 MHz). For detailed test result please refer to the following test protocols.

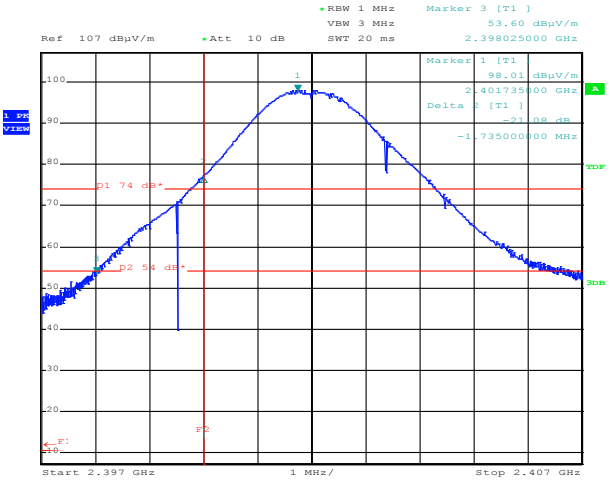
5.3.4 Test protocols

Channel 37, 2402 MHz

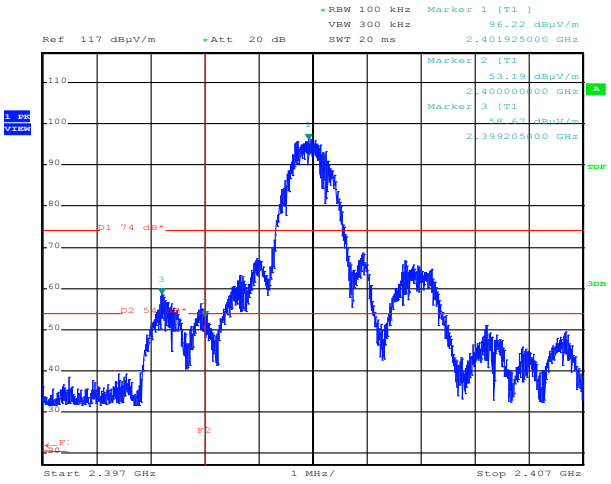
Spurious emissions from 1 to 2.4 GHz



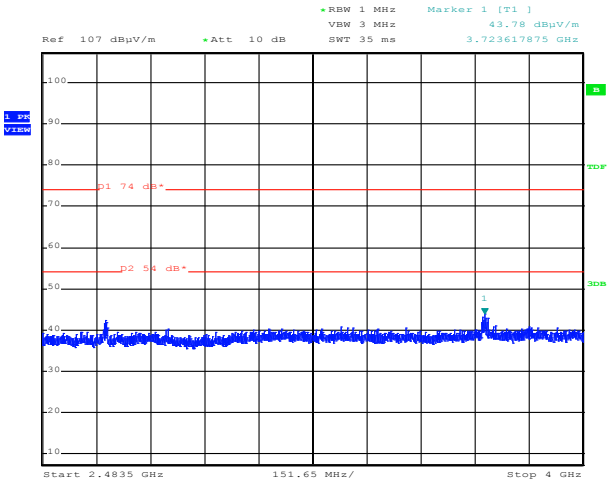
Spurious emissions from 2.397 to 2.407 GHz



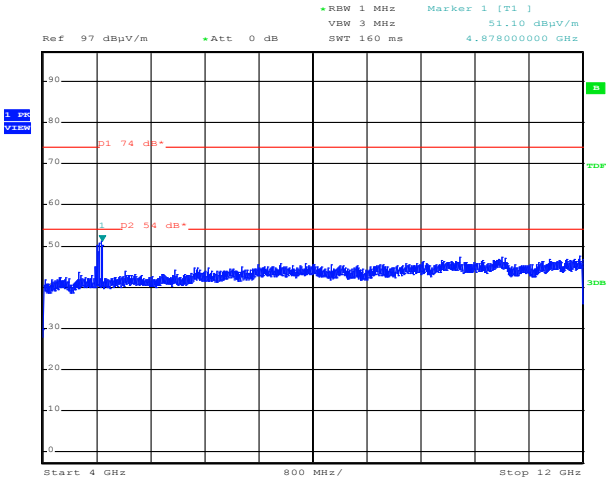
SER from 2.397 to 2.407 GHz,(RBW = 100 kHz)



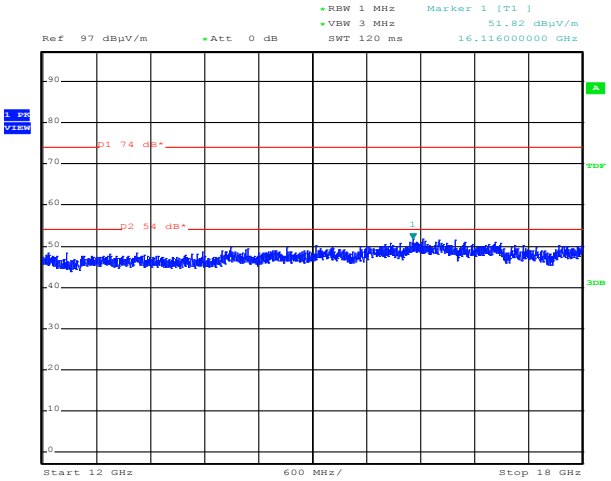
Spurious emissions from 2.4835 to 4 GHz



Spurious emissions from 4 to 12 GHz

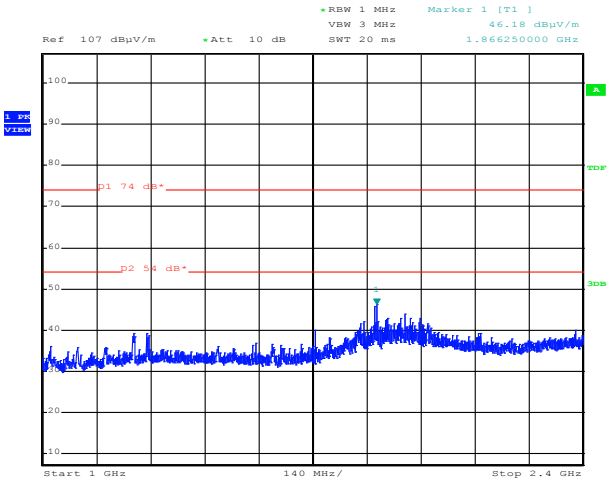


Spurious emissions from 12 to 18 GHz

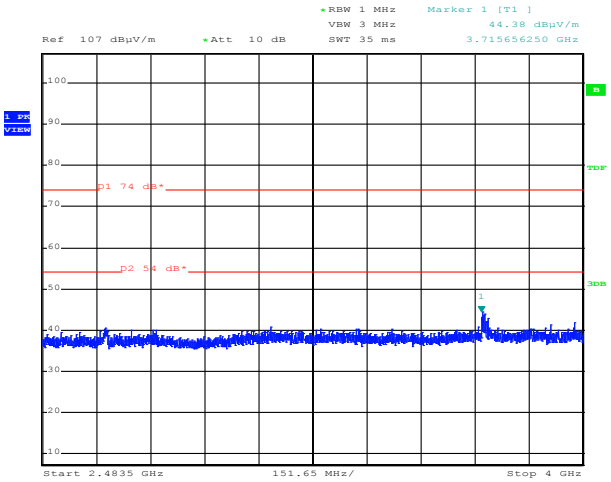


Channel 18, 2442 MHz

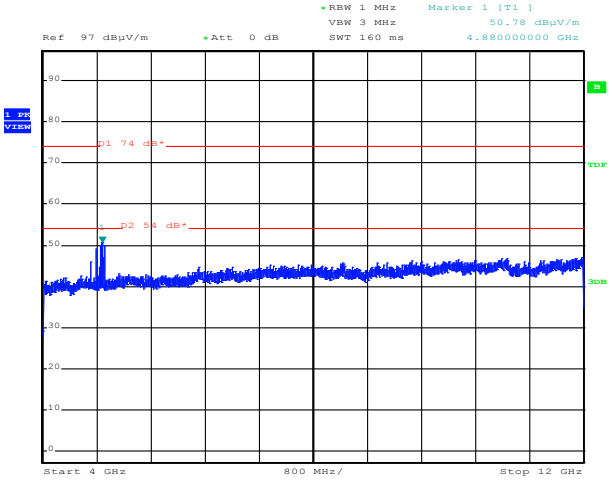
Spurious emissions from 1 to 2.4 GHz



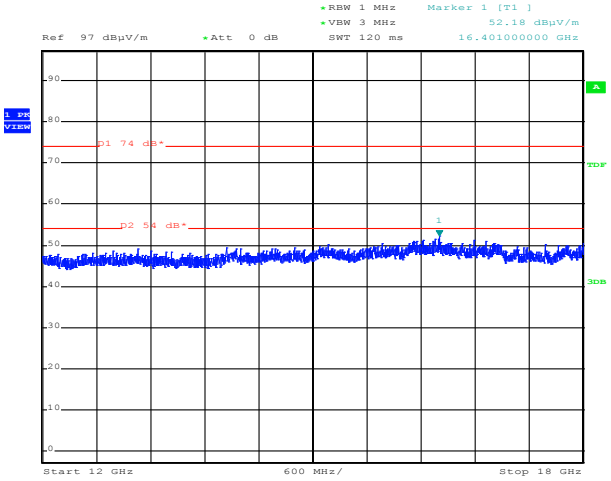
Spurious emissions from 2.4835 to 4 GHz



Spurious emissions from 4 to 12 GHz

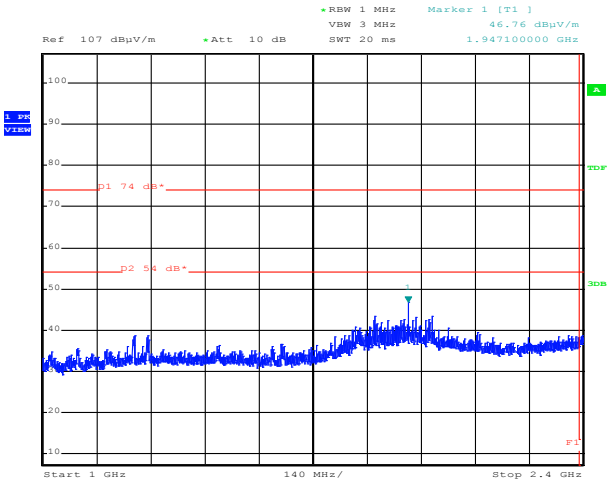


Spurious emissions from 12 to 18 GHz

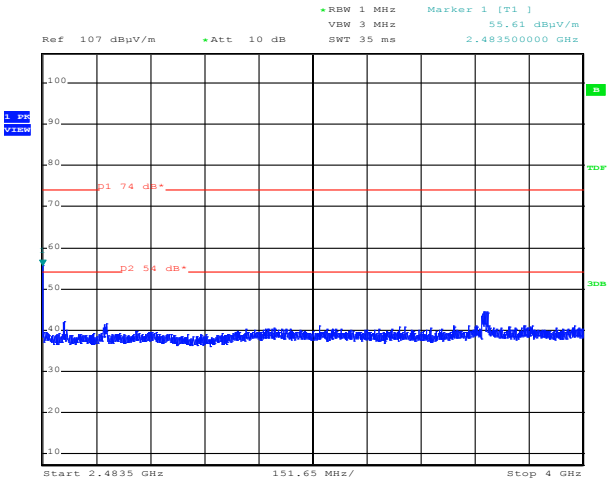


Channel 39, 2480 MHz

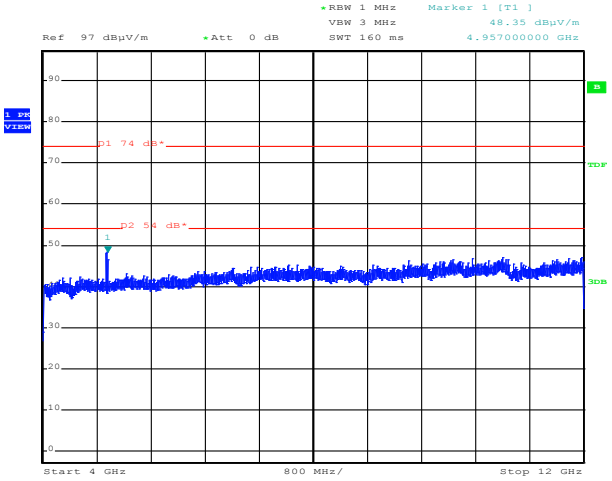
Spurious emissions from 1 to 2.4 GHz



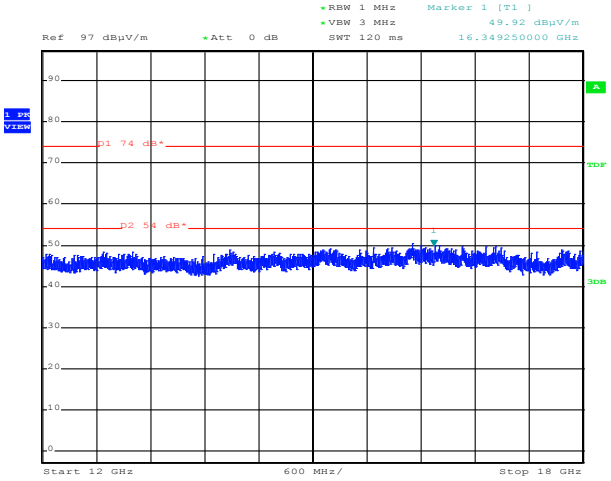
Spurious emissions from 2.4835 to 4 GHz



Spurious emissions from 4 to 12 GHz



Spurious emissions from 12 to 18 GHz



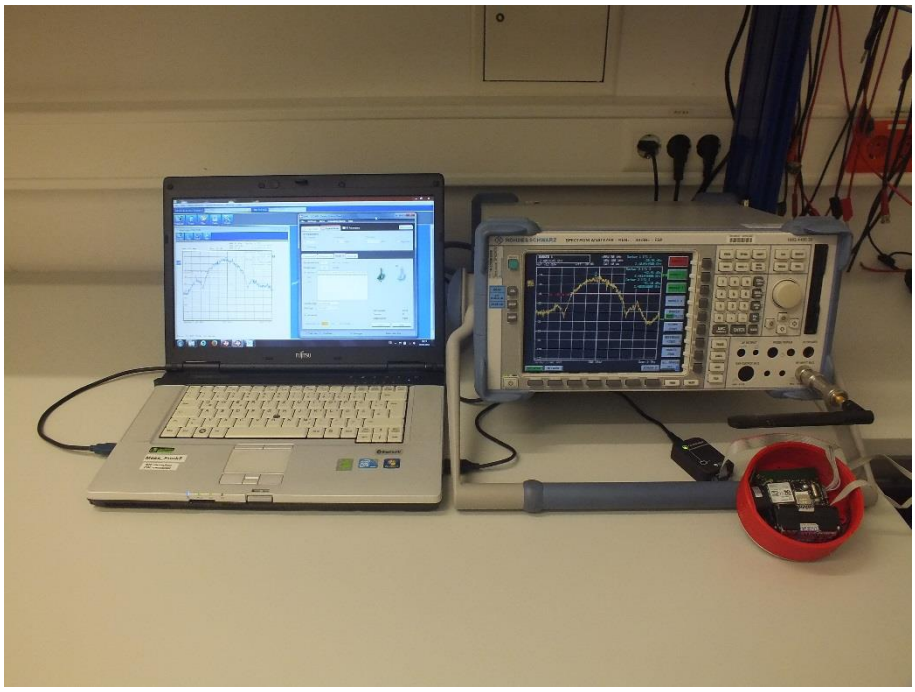
5.4 EBW and OBW

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 15.215(c):
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in Section 15.217 through Section 15.257, must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated.

5.4.4 Description of Measurement

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio of -20 dB (99%). The x-dB-down (OBW) function of the analyser is used. The measurement is performed with normal modulation in TX continuous mode.

Spectrum analyser settings:
RBW: 30 kHz, VBW: 100 kHz, Span: 3 MHz, Trace mode: max. hold, Detector: max. peak;

5.4.5 Test result

Centre *f*	20dB bandwidth	20dB bandwidth	Measured EBW
(MHz)	f_1	f_2	(MHz)
2401.925750	2401.33250	2402.51900	1.186500
2441.946000	2441.34600	2442.54600	1.200000
2479.934000	2479.33400	2480.53400	1.200000

Centre *f*	99% bandwidth	99% bandwidth	Measured OBW
(MHz)	f_1	f_2	(MHz)
2401.934750	2401.40000	2402.46950	1.069500
2441.945250	2441.40150	2442.48900	1.087500
2479.937000	2479.40900	2480.46500	1.056000

Operating frequency band	20 dB Bandwidth
(MHz)	(MHz)
f_{low} > 2400	f_{low} = 2401.333
f_{high}< 2483.5	f_{high} = 2480.534
Operating Band occupancy	79.20
Operating channel occupancy percentage	60.00 %

Limit according to FCC Part 15C, Section 15.215(c):
If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.Due to the channelising of the operating band into 39 channels with 20 dB channel bandwidth of 1.22 MHz within a channel pattern of 2 MHz the limit central 80% of the permitted band can not be applied. Therefore the stability of the EUT will be shown staying within the central 80% of the operating channel.

The requirements are **FULFILLED.**

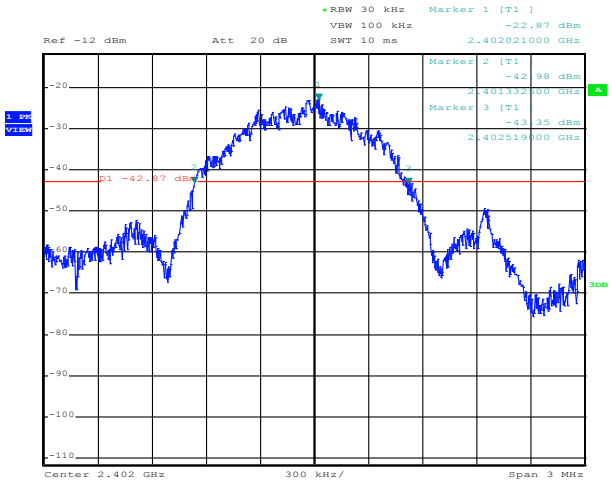
Remarks: For detailed test result please refer to following test protocols.

The OBW99 is measured for RSS only.

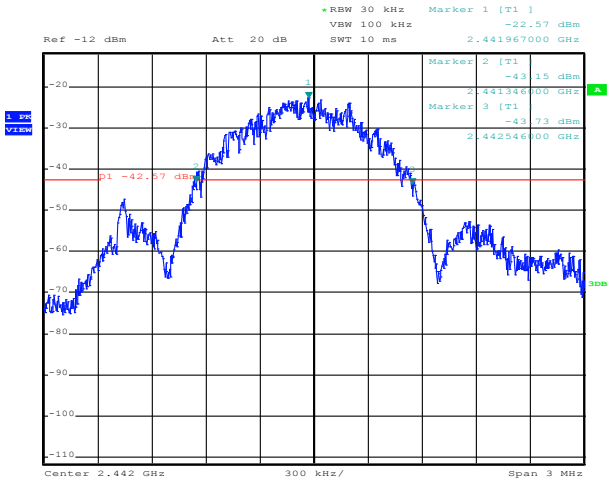
5.4.6 Test protocols

20 dB bandwidth

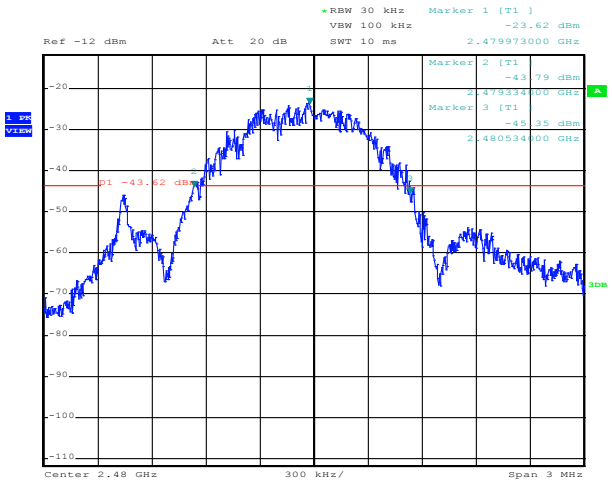
2402 MHz



2442 MHz

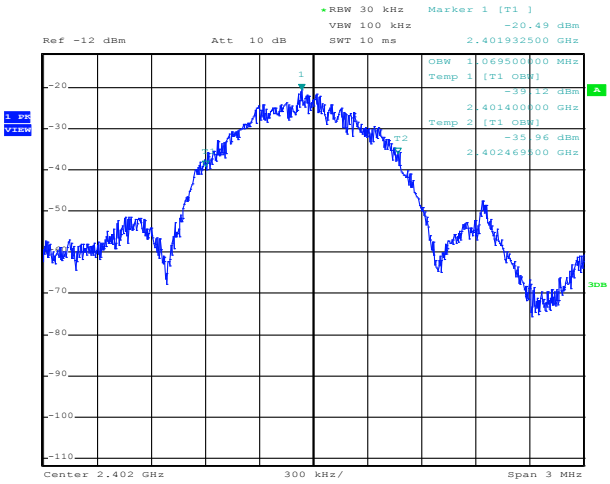


2480 MHz

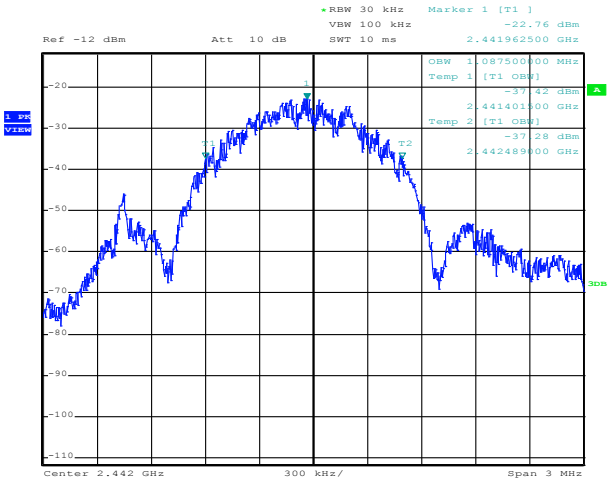


OBW 99%

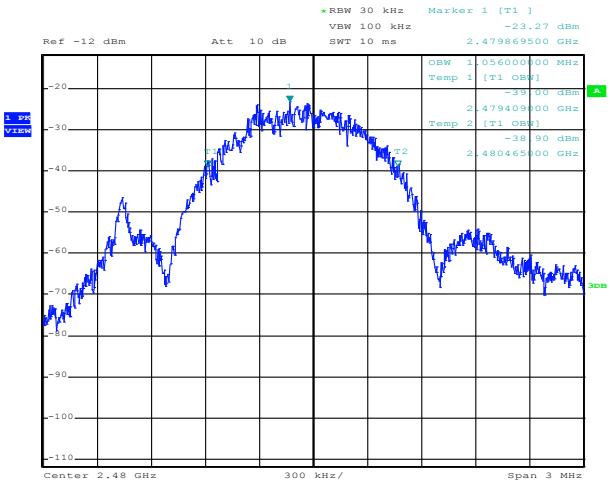
2402 MHz



2442 MHz



2480 MHz



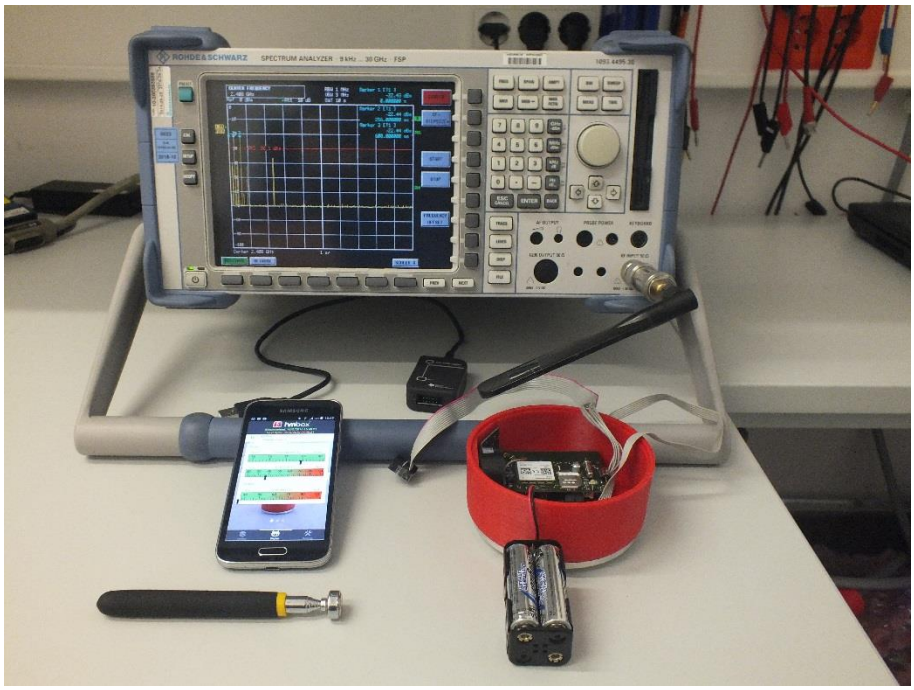
5.5 Correction for pulse operation (duty cycle)

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

5.5.1 Description of the test location

Test location: AREA4

5.5.2 Photo documentation of the test set-up



5.5.3 Applicable standard

According to FCC Part 15A, Section 15.35(c):
When the radiated emission limits are expressed in terms of average value and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete puls train, including blanking intervals, as long as the pulse train does not exceed 0.1s. In cases where the puls train exceeds 0.1s, the measured field strength shall be determined from the average absolute voltage during a 0.1s interval during which the field strength is at its maximum. The exact method of calculating the average field strength shall be submitted.

5.5.4 Description of Measurement

The duty cycle factor (dB) is calculated applying the following formula:

$$K_E = 20 \log \left((t_{iw}/T_w) * (t_{iB}/T_B) \right)$$

K_E: pulse operation correction factor
t_{iw} pulse duration for one complete pulse track
t_{iB} pulse duration for one pulse
T_w a period of the pulse track
T_B a period of one pulse

5.5.5 Test result

Active connection to companion device:

CH	t_{iw} (ms)	T_w (ms)	t_{iB} (ms)	T_B (ms)	K_E (dB)
37	100	100	0.304	100	-50.3

Advertising mode:

CH	t_{iw} (ms)	T_w (ms)	t_{iB} (ms)	T_B (ms)	K_E (dB)
2	100	100	0.324875	100	-49.8

Worst case by calculation of theorethical frequency occupation:

Remarks: The pulse train (*Tw*) exceeds 100 ms, therefore the duty cycle have been calculated by averaging the sum of the pulse widths over the 100 ms with the highest average value.

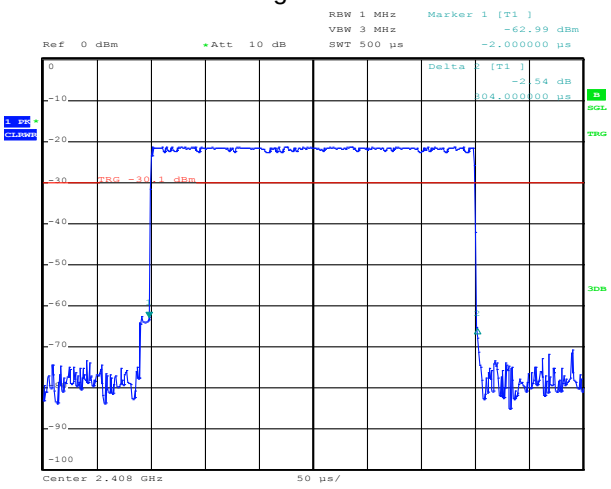
For detailed results, please see the test protocol below.

5.5.6 Test protocol

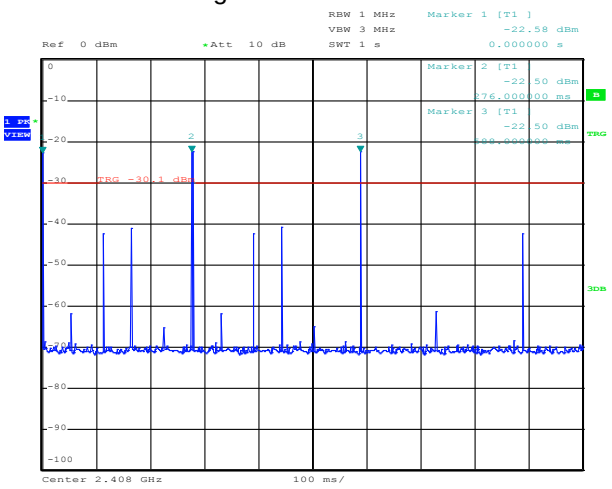
Correction for Pulse Operation (Duty Cycle)
FCC Part 15A, Section 15.35(c)

Active connection to companion device, data transmission:

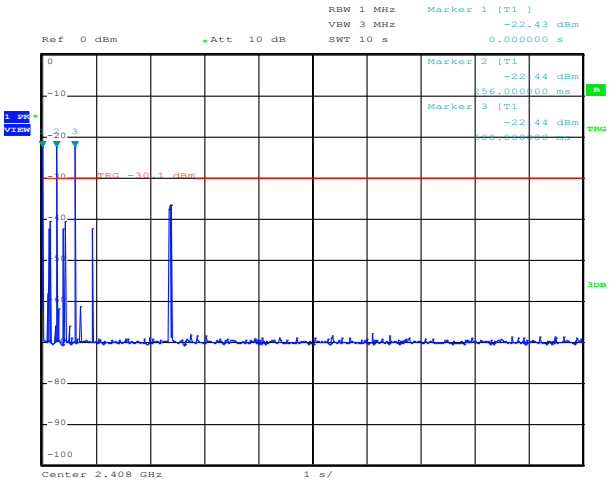
Single burst



Single burst within 1 s

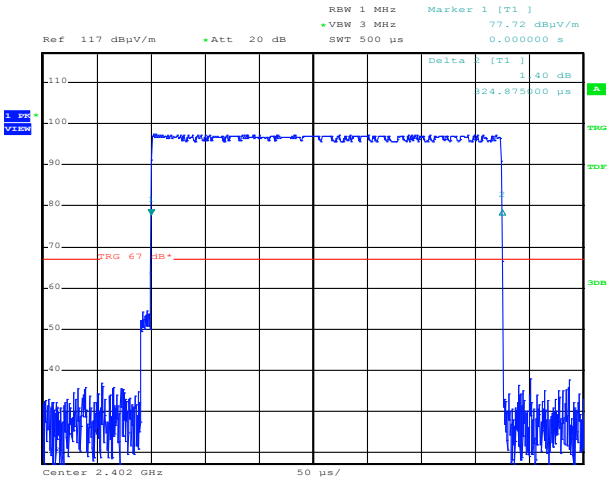


Pulse sequence within 10 seconds

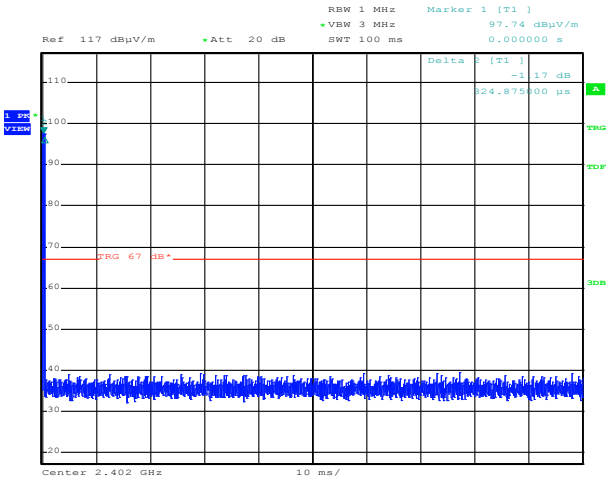


Advertising mode without connection to companion device:

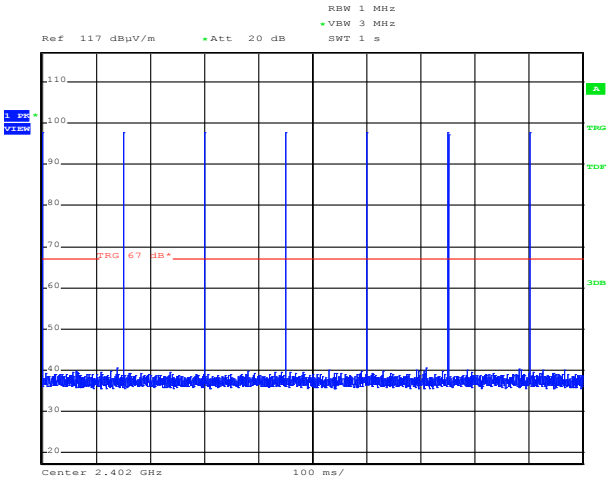
Single burst



Single burst within 100 ms



Pulse sequence within 1 second



5.6 Antenna application

5.6.1 Applicable standard

According to FCC Part 15C, Section 15.203(a):
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.

5.6.2 Result

The EUT uses an integrated PCB antenna within the Bluetooth Low Energy section. The antenna being connected to the cell phone modem is connected with a U.FL connector and is fixed within the enclosure. The applicable antenna is mounted by the manufacturer and cannot be removed or replaced easily by a customer. No other antenna than the furnished by the responsible party or external power amplifier can be applied by a customer.

The antenna of the EUT meets the requirement of FCC Part 15C, Section 15.203 and 15.204.

The requirements are **FULFILLED.**

Remarks: _____

_____

6 USED TEST EQUIPMENT AND ACCESSORIES

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

Test ID	Model Type	Equipment No.	Next Calib.	Last Calib	Next Verif.	Last Verif.
CPR 3	FSP 30	02-02/11-05-001	01/10/2016	01/10/2015		
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	BBHA 9120 E 251	02-02/24-05-006	19/04/2017	19/04/2016	19/10/2016	19/04/2016
	3117	02-02/24-05-009	24/05/2017	24/05/2016		
	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				
DC	FSP 30	02-02/11-05-001	01/10/2016	01/10/2015		
MB	FSP 30	02-02/11-05-001	01/10/2016	01/10/2015		
SER 2	ESVS 30	02-02/03-05-003	09/07/2016	09/07/2015		
	VULB 9168	02-02/24-05-005	20/04/2017	20/04/2016	20/10/2016	20/04/2016
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
SER 3	FSP 30	02-02/11-05-001	01/10/2016	01/10/2015		
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	3117	02-02/24-05-009	24/05/2017	24/05/2016		
	WHJS 1000-10EE	02-02/50-05-070				
	Sucoflex N-2000-SMA	02-02/50-05-075				
	WHK 3.0/18G-10EF	02-02/50-05-180				
	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				