



# EMI - T E S T R E P O R T

## - Human Exposure -

**Type / Model Name** : W012

**Product Description** : Chirp spread spectrum transceiver used for wireless  
localization

**Applicant** : Smartbow GmbH

Address : Jutogasse 3  
4675 WEIBERN, AUSTRIA

**Manufacturer** : Smartbow GmbH

Address : Jutogasse 3  
4675 WEIBERN, AUSTRIA

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

**POSITIVE**

**Test Report No. :** T43343-00-04KS 05. December 2017  
Date of issue



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 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 2.1091	Radiofrequency radiation exposure evaluation: <b>mobile devices</b> .
Part 1, Subpart 2, Section 2.1093	Radiofrequency radiation exposure evaluation: <b>portable devices</b> .

**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 v06	Mobile and portable devices RF Exposure procedures and equipment authorisation policies, October 23, 2015.
KDB 865664 D01 v01r04	SAR Measurement Requirements for 100 MHz to 6 GHz, August 7, 2015.
ANSI C95.1: 2005	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
ETSI TR 100 028 V1.3.1: 2001-03,	Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2

## 2 EQUIPMENT UNDER TEST

### 2.1 Photo documentation of the EUT – See ATTACHMENT A

### 2.2 Equipment type, category

Chirp Spread Spectrum

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

The EUT is a chirp spread spectrum (CSS) transceiver used for wireless localization. It uses the IEEE standard 802.15.4a in the 2.4 GHz ISM band and achieves a maximum data rate of 1 Mbps. The EUT has two identical transceivers which cannot transmit at the same time. It also has two external antennas which transmit alternating.

Number of tested samples: 2 (534C & 5345)  
Serial number: 180B5200534C, 180B52005345  
Firmware version: 2.0.11

#### 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. The tested middle frequency is 2441.75 MHz.

### 2.6 Transmit operating modes

The EUT uses CSS without modulation and has a maximum data rate of 1 Mbps.

### 2.7 Antennas

The following antennas shall be used with the EUT:

Number	Type	Characteristic	Plug	Frequency range (GHz)	Gain (dBi)
1	RP-SMA	Omni	male	2.4 - 2.4835	4
2	RP-SMA	Omni	male	2.4 - 2.4835	4

## 2.8 Power supply system utilised

Power supply voltage,  $V_{\text{nom}}$  : 115 VAC (Power over Ethernet)  
 Power supply voltage range : 110 VAC – 120 VAC

## 2.9 Peripheral devices and interface cables

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

- Ethernet cable Model : Supplied by manufacturer
- PoE Switch Model : Netgear GS110TP (supplied by manufacturer)
- \_\_\_\_\_ Model : \_\_\_\_\_

## 2.10 Final measurement conditions

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

Spreading	Tested Frequency range (GHz)	Tested Middle Frequency (MHz)	Number of transmit chains	Number of receive chains	Power setting	Modulation	Data rate
CSS	2.4 – 2.4835	2441.75	2	2	56	None	1 Mbps

- TX continuous mode

### 2.10.1 Test jig

No special test jig was used.

### 2.10.2 Test software

The test software for the EUT provides free power setting, the special test mode RX and the TX continuous mode for both chains. The power was set to a register value of 56 during testing.

### 3 TEST RESULT SUMMARY

Operating in the 2400 MHz – 2483.5 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.247(i)	RSS 102, 2.5.2	MPE	passed
KDB 447498	RSS 102, 2.5.1	SAR exclusion consideration	not applicable
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 102, Issue 5, March 2015

#### 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 : 13 November 2017

Testing concluded on : 13 November 2017

Checked by: \_\_\_\_\_ Tested by: \_\_\_\_\_

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Klaus Gegenfurtner  
Teamleader Radio

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Kathrin Schiebl  
Radio Team

## 4 TEST ENVIRONMENT

### 4.1 Address of the test laboratory

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

### 4.2 Measurement protocol for FCC and ISED

#### 4.2.1 General information

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

**IC 3009A-1**

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

**IC 3009A-2**

In compliance with RSS 247 testing for RSS 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 Maximum peak conducted output power

#### 5.1.1 Description of the test location

Test location: **NONE**

#### 5.1.2 Applicable standard

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

For systems using digital modulation in the 2400-2483.5 MHz band, 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.

#### 5.1.3 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 mode while measuring. The radiated measurement was performed as a fieldstrength measurement and converted afterwards into power according to the following term:

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

The conducted output power can be obtained by subtracting the antenna gain of 4.0 dBi.

#### 5.1.4 Test result

The output power of the device is taken from the power measurement in the test report according to T43343-00-03KS

Chain 1

1 Mbps, TX		Test results radiated			
Duty cycle: 100%		Fieldstrength E (dB $\mu$ V/m)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)
Chain 1					
2441.75 MHz					
$T_{\text{nom}}$	$V_{\text{nom}}$	118.4	23.1	36.0	-12.9

1 Mbps, TX		Test results conducted				
Duty cycle: 100%		EIRP (dBm)	P (dBm)	Antenna Gain (dBi)	EIRP Limit (dBm)	Margin (dB)
Chain 1						
2441.75 MHz						
$T_{\text{nom}}$	$V_{\text{nom}}$	23.1	19.1	4.0	30.0	-10.9

Chain 2

1 Mbps, TX		Test results radiated			
Duty cycle: 100%		Fieldstrength E (dB $\mu$ V/m)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)
Chain 2					
2441.75 MHz					
$T_{\text{nom}}$	$V_{\text{nom}}$	117.8	22.5	36.0	-13.5

1 Mbps, TX		Test results conducted			
Duty cycle: 100%		EIRP (dBm)	P (dBm)	Antenna Gain (dBi)	EIRP Limit (dBm)
Chain 2					
2441.75 MHz					
$T_{\text{nom}}$	$V_{\text{nom}}$	22.5	18.5	4.0	30.0
					-11.5

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

Frequency (MHz)	Peak Power Limit	
	(dBm)	(Watt)
902-928	30	1.0
<b>2400-2483.5</b>	<b>30</b>	<b>1.0</b>
5725-5850	30	1.0

The requirements are **FULFILLED**.

**Remarks:** The output power is not averaged over time.

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## 6 HUMAN EXPOSURE

### 6.1 Maximum permissible exposure (MPE)

#### 6.1.1 Description of the test location

Test location:                   NONE

#### 6.1.2 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).

#### 6.1.3 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)

**6.1.4 Test result**
**OET Bulletin 65**
**Chain 1**

Channel frequency	P <sub>EIRP</sub>	P	P	P <sub>d</sub>	Limit P <sub>d</sub>	Exposure ratio
(MHz)	(dBm)	(mW)	(W)	(mW/cm <sup>2</sup> )	(mW/cm <sup>2</sup> )	(%)
2441.75	23.1	204.174	0.204174	0.040619	1.00	4.06

**Chain 2**

Channel frequency	P <sub>EIRP</sub>	P	P	P <sub>d</sub>	Limit P <sub>d</sub>	Exposure ratio
(MHz)	(dBm)	(mW)	(W)	(mW/cm <sup>2</sup> )	(mW/cm <sup>2</sup> )	(%)
2441.75	22.5	177.828	0.177828	0.035378	1.00	3.54

**RSS 102**
**Chain 1**

Channel frequency	P <sub>EIRP</sub>	P	P	Limit P <sub>d</sub>	Exposure ratio
(MHz)	(dBm)	(mW)	(W)	W	(%)
2441.75	23.1	204.2	0.204	2.7	7.54

**Chain 2**

Channel frequency	P <sub>EIRP</sub>	P	P	Limit P <sub>d</sub>	Exposure ratio
(MHz)	(dBm)	(mW)	(W)	W	(%)
2441.75	22.5	177.8	0.178	2.7	6.57

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/f	2.19/f	180/f <sup>2</sup>	30
30 - 300	27.5	0.073	0.2	30
300-1500	---	---	f/1500	30
<b>1500-100000</b>	<b>---</b>	<b>---</b>	<b>1.0</b>	<b>30</b>

f = Frequency in MHz

Exemption Limits for Routine Evaluation – RF Exposure Evaluation according to RSS-102, issue 5, 2.5.2

Frequency Range (MHz)	time-averaged max. EIRP (W)
300-6000	1.31x10 <sup>-2</sup> f <sup>0.6834</sup>

Note: f is frequency in MHz.

The requirements are **FULFILLED**.

**Remarks:** The EUT is a fixed equipment and the distance between the antenna and the user is more than 20 cm. Therefore, the MPE is calculated.

## 6.2 Co-location and Co-transmission

**Applicable standard:**

OET Bulletin 65, Edition 97-01, Section 2: Multiple-transmitter sites and Complex Environments

The FCC's MPE limits vary with frequency. Therefore, in mixed or broadband RF fields where several sources and frequencies are involved, the fraction of the recommended limit (in terms of power density or square of the electric or magnetic field strength) incurred within each frequency interval should be determined, and the sum of all fractional contributions should not exceed 1.0, or 100 % in terms of percentage.

**Remarks:** Not tested, because the two transceiver cannot transmit at the same time.

## 6.3 SAR test exclusion considerations

### 6.3.1 Applicable standard

According to RF exposure guidance:

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.

**Remarks:** The EUT is a fixed equipment and the distance between the antenna and the user  
is more than 20 cm. Therefore, the MPE is calculated.

## 6.4 Exemption limits for routine evaluation - SAR evaluation

### 6.4.1 Applicable standard

According to RSS-102, item 2.5.1:

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

**Remarks:** The EUT is a fixed equipment and the distance between the antenna and the user

is more than 20 cm. Therefore, the MPE is calculated.