

RF Exposure Evaluation Report

Date of Report	25/07/2018	Client's Contact person:	Juha Pikkarainen
Number of pages:	8	Responsible Test engineer:	Kirsi Kyllönen
Testing laboratory:	Verkotan Oy Elektroniikkatie 17 90590 Oulu Finland	Client:	Haltian Products Oy Yrttipellontie 1D 90230 Oulu, Finland

Tested devices Thingsee PRESENCE

Related reports: -

Testing has been carried out in accordance with:

47CFR §2.1093
Radiofrequency Radiation Exposure Evaluation: Portable Devices

47CFR § 2.1091
Radiofrequency radiation exposure evaluation: Mobile devices.

FCC published RF exposure KDB procedures

RSS-102
Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

Documentation: The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory

Test Results: **The DUT complies with the requirements in respect of all parameters subject to the test.**
The test results relate only to devices specified in this document

Date and signatures: 25.07.2018

For the contents:

Laboratory Manager

TABLE OF CONTENTS

1. SUMMARY OF SAR TEST REPORT 4

1.1 TEST DETAILS 4

1.2 EVALUATION RESULTS..... 4

2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT) 5

2.1 SUPPORTED FREQUENCY BANDS AND OPERATIONAL MODES 5

2.2 TEST EXCLUSIONS..... 5

3. OUTPUT POWER 7

3.1 MAXIMUM DEFINED OUTPUT POWER..... 7

4. RESULTS 7

4.1 FCC RESULTS 7

4.1.1 SAR test exclusion for separation distance $\leq 200\text{mm}$ for portable device 7

4.1.2 RF exposure compliance for separation distance $> 200\text{mm}$ for mobile device..... 7

4.2 ISED RESULTS..... 8

4.2.1 SAR test exclusion for separation distance $\leq 200\text{mm}$ for portable device 8

4.2.2 RF exposure compliance for separation distance $> 200\text{mm}$ for mobile device..... 8

APPENDIX A: PHOTO OF THE DUT 9

1. SUMMARY OF SAR TEST REPORT

1.1 Test Details

Device under Test (DUT):

Product:	Thingsee PRESENCE
Manufacturer:	Haltian Products Oy
Model:	TRP
Hardware Version:	TPR_03
FCC ID:	2AEU3TSPRE
IC ID:	20236-TSPRE
Document ID:	RF exposure evaluation report_Thingsee Presence_ID2878_250718.docx

1.2 Evaluation Results

The device conforms to the requirements of the standards when the maximum output power is less than or equal to the Test Exclusion Threshold /Exemption Limit /Power Density.

SAR test exclusion results for separation distance ≤ 200 mm:

Regulator	System	Equipment Class	Test Exclusion Threshold/ Exemption Limit [mW]	Maximum Output Power [mW]	Result
FCC	BLE	DTS	10	2.5	PASS

Regulator	System	Equipment Class	Test Exclusion Threshold/ Exemption Limit [mW]	Maximum Output Power [mW]	Result
ISED	BLE	NA	4	2.5	PASS

RF exposure compliance results for separation distance > 200 mm:

Regulator	System	Equipment Class	Power Density, Limit [mW/cm ²]	Power Density, S, [mW/cm ²]	Result
FCC	BLE	DTS	1	0.0009	PASS

Regulator	System	Equipment Class	Power Density, Limit [W/m ²]	Power Density, S, [W/m ²]	Result
ISED	BLE	NA	5.47	0.009	PASS

2. DESCRIPTION OF THE DEVICE UNDER TEST (DUT)

EUT is an IoT device for various facility management applications. It is equipped with a Wirepas transmitter.

Exposure Environment	General population, uncontrolled
-----------------------------	----------------------------------

2.1 Supported Frequency Bands and Operational Modes

Bands	Modes of Operation	Transmitter Frequency Range (MHz)
2.4	Wirepas	2402- 2480

2.2 Test Exclusions

FCC SAR test exclusion thresholds in 447498D01 and Maximum Permissible Exposure limits are shown in tables below.

Appendix A

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table. The equation and threshold in 4.3.1 must be applied to determine SAR test exclusion.

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	<i>SAR Test Exclusion Threshold (mW)</i>
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

For devices that operate at larger distances from persons, where there are minimal RF coupling interactions between a device and the user or nearby persons, the more complex SAR evaluation can be avoided by evaluating RF exposure compliance using MPE (Maximum Permissible Exposure) limits. When these limits are used, a minimum separation distance of ≥ 20 cm is required between the antenna and radiating structures of the device and nearby persons. The limits are presented in table below.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* 100	30
1.34-30	824/f	2.19/f	* 180/f ²	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

ISED Test exclusion based on RSS-102 are shown in tables below.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance^{4,5}

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ f ^{0.5}	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ f ^{0.25}	0.1540/ f ^{0.25}	8.944/ f ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 f ^{0.3417}	0.008335 f ^{0.3417}	0.02619 f ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ f ^{1.2}
150000-300000	0.158 f ^{0.5}	4.21 x 10 ⁻⁴ f ^{0.5}	6.67 x 10 ⁻⁵ f	616000/ f ^{1.2}

Note: f is frequency in MHz.
 *Based on nerve stimulation (NS).
 ** Based on specific absorption rate (SAR).

3. OUTPUT POWER

3.1 Maximum defined Output Power

Transmission mode	Output power [dBm]	Output power [mW]
Wirepas	4	2.5

4. RESULTS

4.1 FCC results

4.1.1 SAR test exclusion for separation distance ≤ 200 mm for portable device

According Appendix A in 447498D01 the SAR test exclusion power threshold for 2450MHz is 10mW at ≤ 5 mm separation distance.

The maximum output power of the DUT is 2.51mW thus it is below the test exclusion threshold.

4.1.2 RF exposure compliance for separation distance > 200 mm for mobile device

RF exposure compliance is demonstrated by power density.

Power Density is calculated by equation:

$$S = \frac{P \cdot G}{4 \cdot \pi \cdot R^2}$$

Where,

S = Power Density

P = Power Input to Antenna

G = Gain of Antenna

R = Distance from transmitting Antenna

For Thingsee PRESENCE power density is:

Modes of Operation	Frequency [MHz]	Distance, R [cm]	Maximum power input to Antenna, P [dBm]	Power Input to Antenna, P [mW]	Power Gain of Antenna, G [dBi]	Power Density, S [mW/cm ²]	Limit [mW/cm ²]
Wirepas	2402- 2480	20	4	2.5	2.35	0.0009	1.0

The maximum power density of the DUT is 0.0009 mW/cm² thus it is below the limit 1.0 mW/cm².

4.2 ISED results

4.2.1 SAR test exclusion for separation distance $\leq 200\text{mm}$ for portable device

According Table 1 in RSS-102, the SAR test exclusion power threshold for 2450MHz is 4mW at $\leq 5\text{mm}$ separation distance.

The maximum output power of the DUT is 2.51mW thus it is below the test exclusion threshold.

4.2.2 RF exposure compliance for separation distance $> 200\text{mm}$ for mobile device

RF exposure compliance is demonstrated by power density.

Power Density is calculated by equation:

$$S = \frac{P \cdot G}{4 \cdot \pi \cdot R^2}$$

Where,

S = Power Density

P = Power Input to Antenna

G = Gain of Antenna

R = Distance from transmitting Antenna

ISED limit for power density is: $0.02619 f^{0.6834} = 0.02619 \cdot 2480^{0.6834} = 5.47 \text{ W/m}^2$

For Thingsee PRESENCE power density is:

Modes of Operation	Frequency [MHz]	Distance, R [cm]	Maximum power input to Antenna, P [dBm]	Power Input to Antenna, P [mW]	Power Gain of Antenna, G [dBi]	Power Density, S [W/m ²]	Limit [W/m ²]
Wirepas	2402- 2480	20	4	2.5	2.35	0.009	5.47

The maximum power density of the DUT is 0.009 W/m² thus it is below the limit 5.47 W/m².

APPENDIX A: PHOTO OF THE DUT

