



DATE: 18 December 2018

**I.T.L. (PRODUCT TESTING) LTD.
FCC/IC Radio Test Report**

for

Intellithings Ltd.

Equipment under test:

Occupancy Sensor

RoomMe

Tested by:

M. Zohar

Approved by:

D. Shidlow

This report must not be reproduced, except in full, without the written permission of I.T.L. (Product Testing) Ltd.

This report relates only to items tested.



Measurement/Technical Report for Intellithings Ltd.

Occupancy Sensor

RoomMe

FCC ID: 2ARHGROOMME
IC: 24430-ROOMME

This report concerns:	Original Grant:	X
	Class I Change:	
	Class II Change:	
Equipment type:	FCC: DTS Digital Transmission System	
	IC: Spread Spectrum Digital Device (2400-2483.5)	
Limits used:	47CFR15 Section 15.247	
	RSS 247, Issue 2, February 2017, Section 5	
	RSS-Gen, Issue 5, April 2018	

Measurement procedure used is KDB 558074 D01 v05 and ANSI C63.10:2013

Application for Certification	Applicant for this device:
prepared by:	(different from "prepared by")
R. Pinchuck	Intellithings Ltd.
ITL (Product Testing) Ltd.	Oren Kotlicki
1 Bat Sheva St.	39 Lechi St.
Lod 7116002	Ramat Hasharon, Israel, 4704128
e-mail Rpinchuck@itlglobal.org	Tel: +972722211692
	Fax: +972722211690
	Email: oren@intellithings.net

TABLE OF CONTENTS

1.	GENERAL INFORMATION -----	5
1.1	Administrative Information	5
1.2	List of Accreditations	6
1.3	Product Description	7
1.4	Test Methodology	7
1.5	Test Facility	7
1.6	Measurement Uncertainty	7
2.	SYSTEM TEST CONFIGURATION -----	9
2.1	Justification	9
2.2	EUT Exercise Software	9
2.3	Special Accessories	9
2.4	Equipment Modifications	9
2.5	Configuration of Tested System	9
3.	CONDUCTED & RADIATED MEASUREMENT TEST SET-UP PHOTOS -----	10
4.	6 DB MINIMUM BANDWIDTH -----	12
4.1	Test Specification	12
4.2	Test Procedure	12
4.3	Test Limit	12
4.4	Test Results.....	12
4.5	Test Equipment Used; 6dB Bandwidth	14
5.	MAXIMUM CONDUCTED OUTPUT POWER -----	15
5.1	Test Specification	15
5.2	Test Procedure	15
5.3	Test Limit	15
5.4	Test Results.....	16
5.5	Test Equipment Used; Maximum Conducted Output Power	18
6.	BAND EDGE SPECTRUM -----	19
6.1	Test Specification	19
6.2	Test Procedure	19
6.3	Test Limit	19
6.4	Test Results.....	19
6.5	Test Equipment Used; Band Edge	21
7.	TRANSMITTED POWER DENSITY -----	22
7.1	Test Specification	22
7.2	Test Procedure	22
7.3	Test Limit	22
7.4	Test Results.....	23
7.5	Test Equipment Used; Transmitted Power Density	25
8.	OCCUPIED BANDWIDTH -----	26
8.1	Test Specification	26
8.2	Test Procedure	26
8.3	Test Limit	26
8.4	Test Results.....	26
8.5	Test Equipment Used; Occupied Bandwidth.....	28
9.	EMISSIONS IN NON-RESTRICTED FREQUENCY BANDS -----	29
9.1	Test Specification	29
9.2	Test Procedure	29
9.3	Test Limit	29
9.4	Test Results.....	29
9.5	Test Instrumentation Used, Emission in Non- Restricted Frequency Bands	30
9.6	Field Strength Calculation	31



10.	EMISSIONS IN RESTRICTED FREQUENCY BANDS	32
10.1	Test Specification	32
10.2	Test Procedure	32
10.3	Test Limit	33
10.4	Test Results.....	33
10.5	Test Instrumentation Used; Emissions in Restricted Frequency Bands ...	35
11.	ANTENNA GAIN/INFORMATION.....	36
12.	R.F EXPOSURE/SAFETY.....	37
13.	APPENDIX A - CORRECTION FACTORS	38
13.1	Correction factors for RF OATS Cable 35m ITL #1879	38
13.2	Correction factor for RF CABLE for Semi Anechoic Chamber.....	39
13.3	Correction factors for Active Loop Antenna	40
13.4	Correction factors for biconical antenna – ITL # 1356	41
13.5	Correction factors for log periodic antenna – ITL # 1349.....	42
13.6	Correction factors for Double –Ridged Waveguide Horn ANTENNA.....	43
13.7	Correction factors for Horn Antenna	44



1. General Information

1.1 Administrative Information

Manufacturer:	Intellithings Ltd.
Manufacturer's Address:	39 Lechi St. Ramat Hasharon, Israel, 4704128 Tel: +972722211692 Fax: +972722211690
Manufacturer's Representative:	Oren Kotlicki
Equipment Under Test (E.U.T):	Occupancy Sensor
PMN:	RoomMe
HVIN:	RoomMe Sensor
Equipment Serial No.:	Not designated
Date of Receipt of E.U.T:	October 15, 2018
Start of Test:	October 15, 2018
End of Test:	November 1, 2018
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod ISRAEL 7120101
Test Specifications:	47CFR15 Section 15.247 RSS 247, Issue 2, February 2017, Section 5 RSS-Gen, Issue 5, April 2018



1.2 List of Accreditations

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), FCC Designation No. IL1005.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. Industry Canada (Canada), IC File No.: 46405-4025; Site Nos. IC 4025A-1, IC 4025A-2.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

1.3 **Product Description**

Personalized Room-Level Automation for Smart Homes.

RoomMe identifies who is in a room by Smart Phones and automates lights, temperature and other room settings to the people in it.

RoomMe is a combination of an intelligent Occupancy Sensor and a mobile App. The RoomMe Sensor knows who is in a room by tracking Smart Phones. The RoomMe App then sets the Smart Devices in a room to the pre-defined preferences of the actual people in it.

Working voltage	3.0VDC battery operated
Mode of operation	BLE Transceiver
Modulations	GFSK
Assigned Frequency Range	2400.0-2483.5MHz
Operating Frequency Range	2402.0-2480.0MHz
Antenna Gain	7 dBi
Modulation BW	2MHz
Bit rate (Mbit/s)	1, 2, 3

1.4 **Test Methodology**

Both conducted and radiated testing was performed according to the procedures in KDB 558074 D01 v05, ANSI C63.10: 2013 and RSS Gen Issue 5. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 **Test Facility**

Emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is IL1005.

1.6 **Measurement Uncertainty**

Conducted Emission

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)

0.15 – 30 MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 3.44 dB



Radiated Emission

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)
for open site:

30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):
 ± 4.96 dB

1 GHz to 6 GHz

Expanded Uncertainty (95% Confidence, K=2):
 ± 5.19 dB

>6 GHz

Expanded Uncertainty (95% Confidence, K=2):
 ± 5.51 dB

2. System Test Configuration

2.1 Justification

1. The E.U.T contains an IEEE 802.15.1 standard (BLE) transceiver.
2. The unit was evaluated while transmitting at the low channel (2402MHz), the mid channel (2440MHz) and the high channel (2480MHz).
3. The evaluation was performed with the E.U.T mounted in ceiling installation position.

2.2 EUT Exercise Software

No special exercise software was used.

2.3 Special Accessories

Equipment	Manufacturer	Part #	Serial #
Laptop	Lenovo	T410	N/A
AC/DC adapter	Lenovo	42T4431	N/A
Debugger	Intellithings	N/A	N/A

2.4 Equipment Modifications

No modifications were necessary in order to achieve compliance.

2.5 Configuration of Tested System

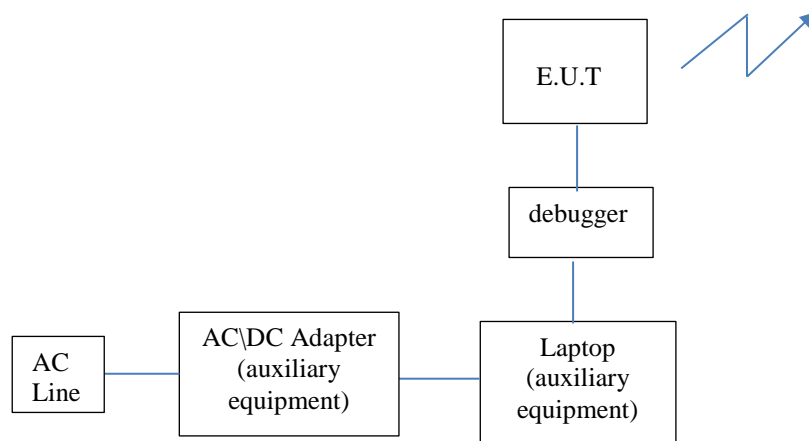


Figure 1. Configuration of Tested System

3. Conducted & Radiated Measurement Test Set-Up Photos

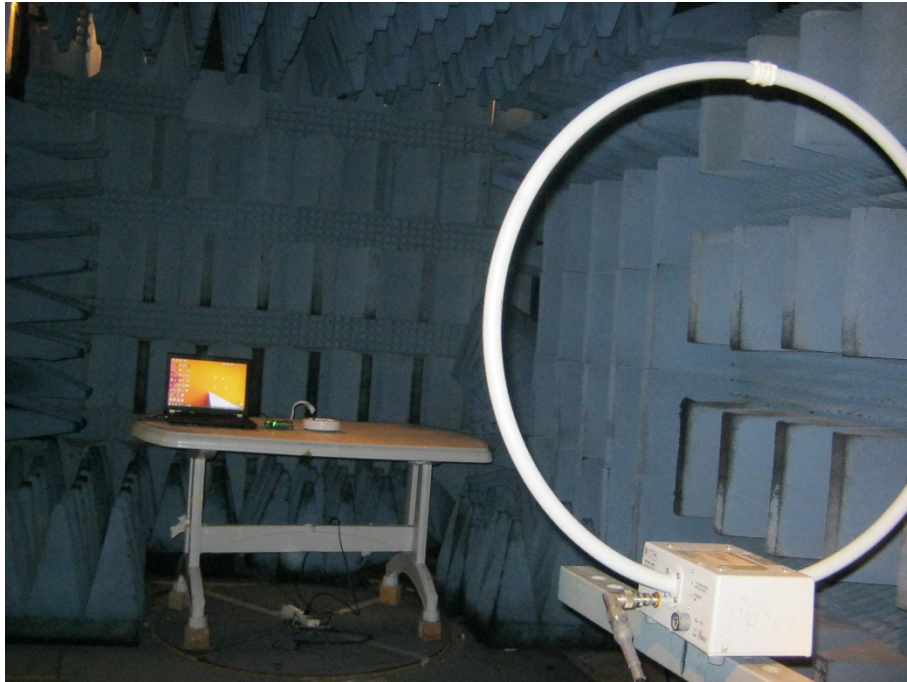


Figure 2. Radiated Emission Test, 0.009-30MHz

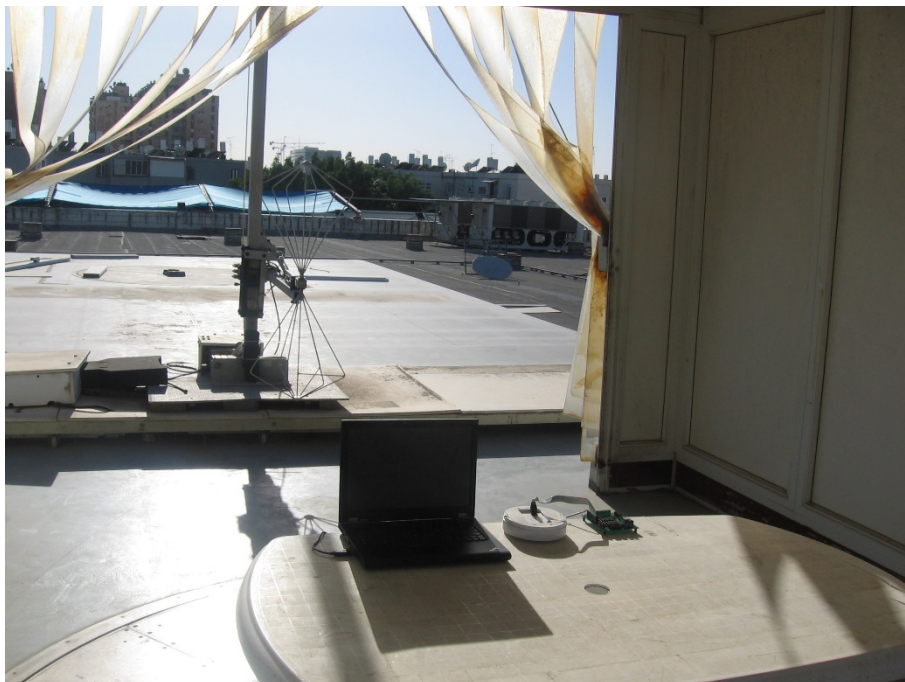


Figure 3. Radiated Emission Test, 30-200MHz



Figure 4. Radiated Emission Test, 200-1000MHz



Figure 5. Radiated Emission Test, 1-18GHz

4. 6 dB Minimum Bandwidth

4.1 Test Specification

FCC Part 15, Subpart C, Section 247(a)(2)

RSS 247, Issue 2, section 5.2(a)

4.2 Test Procedure

(Temperature (22°C)/ Humidity (60%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T was tested in the chamber, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The emissions were measured at a distance of 3 meters.

The spectrum bandwidth of the E.U.T. at the point of 6 dB below maximum peak power was measured and recorded. The RBW was set to 100 kHz.

4.3 Test Limit

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.

4.4 Test Results

Protocol Type	Operation Frequency	Reading	Limit
	(MHz)	(kHz)	(kHz)
BLE	2402.0	659.0	>500.0
	2440.0	679.0	>500.0
	2480.0	679.0	>500.0

Figure 6 6 dB Minimum Bandwidth

JUDGEMENT: Passed

For additional information see *Figure 7* to *Figure 9*.

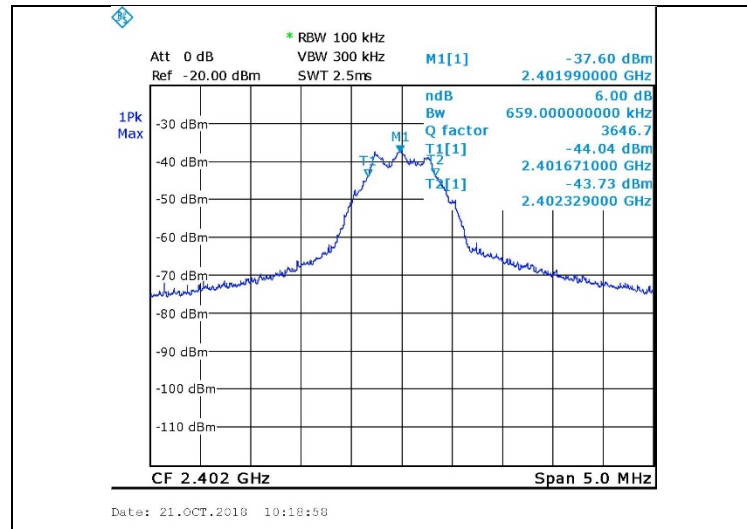


Figure 7. 2402.0 MHz, BLE

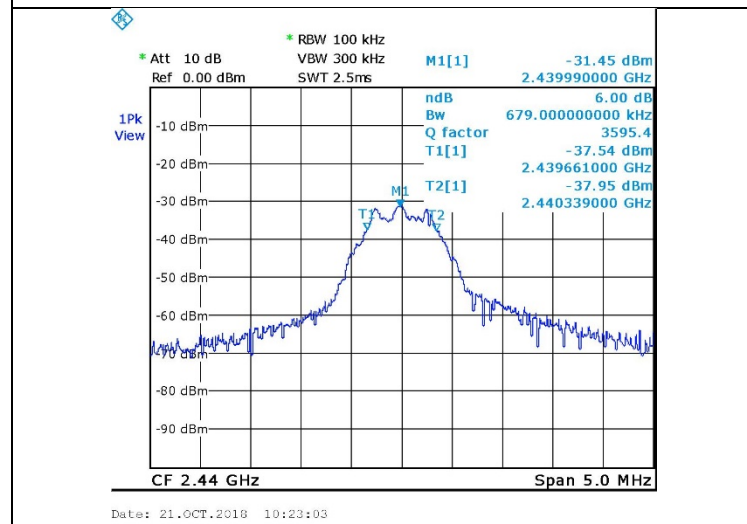


Figure 8. 2440.0 MHz, BLE

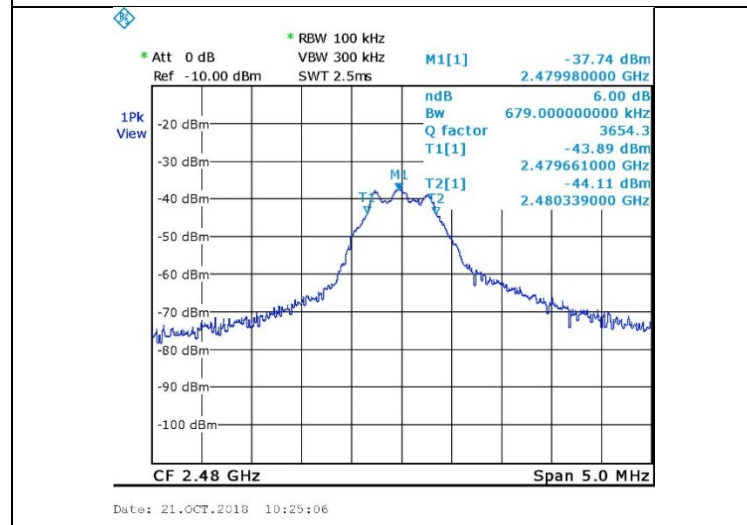


Figure 9. 2480.0 MHz, BLE



4.5 Test Equipment Used; 6dB Bandwidth

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
Spectrum Analyzer	R&S	FSL6	100194	February 19, 2018	February 19, 2019
Horn Antenna	ETS	3115	6142	May 31, 2018	May 31, 2021
RF Cable	Commscope ORS	0623 WBC-400	G020132	October 1, 2017	October 31, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 10 Test Equipment Used

5. Maximum Conducted Output Power

5.1 Test Specification

FCC, Part 15, Subpart C, Section 247(b)(3)

RSS 247, Issue 2, section 5.4(d)

5.2 Test Procedure

(Temperature (22°C)/ Humidity (60%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T was tested in the chamber, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The emissions were measured at a distance of 3 meters.

Radiated output power levels were measured at selected operation frequencies and the results were converted to power level according to the formula as shown below:

$$P = \frac{(E_{V/m} \times d)^2}{(30 \times G)} \quad [W]$$

E - Field Strength (V/m)

d – Distance from transmitter (m)

G – Antenna gain

P – Peak power (W)

5.3 Test Limit

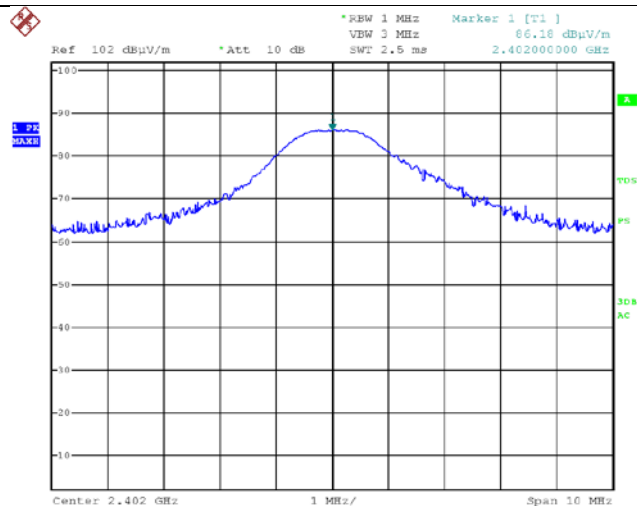
The maximum peak conducted output power of the intentional radiator for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

5.4 Test Results

Protocol Type	Operation Frequency	Pol.	Field Strength	EIRP	Ant. Gain	Power	Power	Limit	Margin
	(MHz)	(V/H)	(dBuV/m)	(dBm)	(dBi)	(dBm)	(mW)	(mW)	(mW)
BLE	2402.0	V	86.2	-9.0	+7.0	-16.0	0.025	1000.0	-999.975
		H	82.9	-12.3	+7.0	-19.3	0.012	1000.0	-999.988
	2440.0	V	87.1	-8.1	+7.0	-15.1	0.031	1000.0	-999.969
		H	82.5	-12.7	+7.0	-19.7	0.011	1000.0	-999.989
	2480.0	V	87.6	-7.6	+7.0	-14.6	0.035	1000.0	-999.965
		H	81.9	-13.3	+7.0	-20.3	0.009	1000.0	-999.991

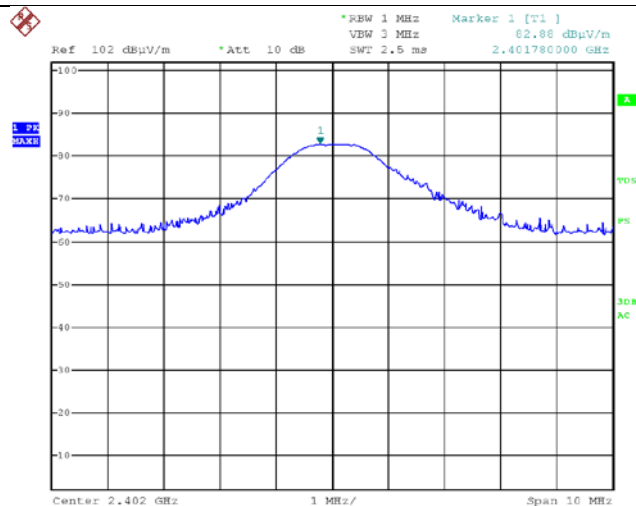
Figure 11 Maximum Peak Power Output

JUDGEMENT: Passed by 999.965 mW
For additional information see *Figure 12* to *Figure 17*.



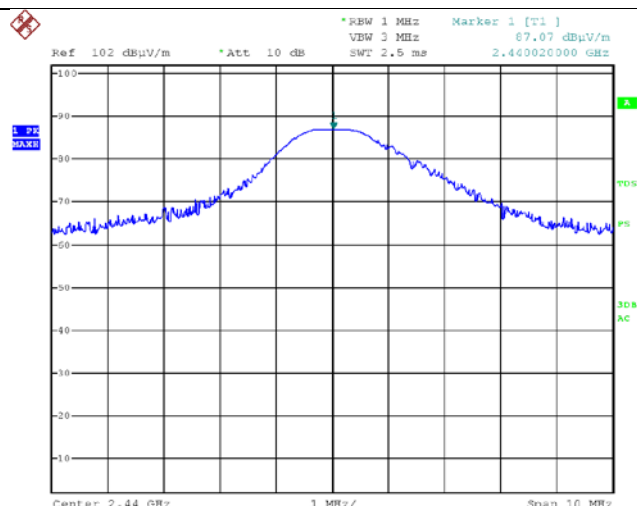
Date: 14.OCT.2018 14:21:55

Figure 12. 2402.0 MHz, BLE, Vertical



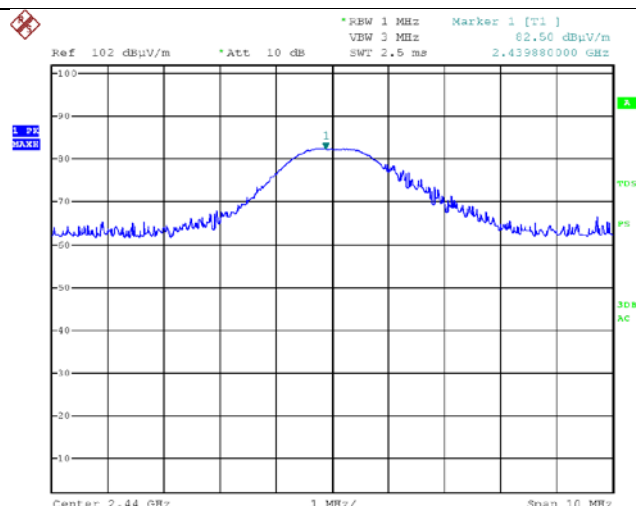
Date: 14.OCT.2018 13:37:16

Figure 13. 2402.0 MHz, BLE, Horizontal



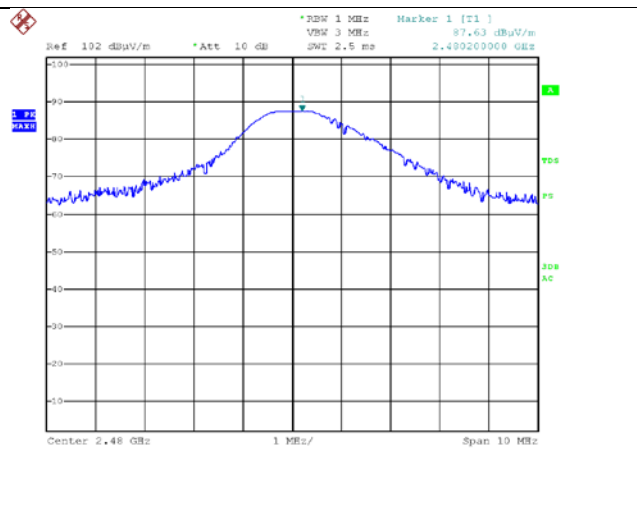
Date: 14.OCT.2018 14:11:45

Figure 14. 2440.0 MHz, BLE, Vertical



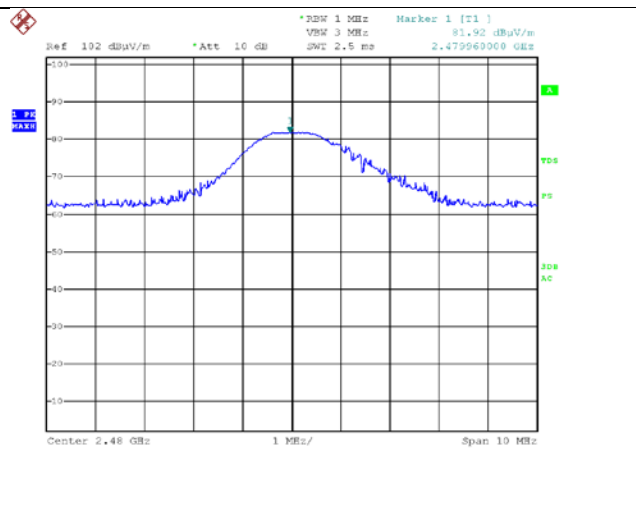
Date: 14.OCT.2018 13:48:28

Figure 15. 2440.0 MHz, BLE, Horizontal



Date: 14.OCT.2018 14:07:28

Figure 16. 2480.0 MHz, BLE, Vertical



Date: 14.OCT.2018 13:53:57

Figure 17. 2480.0 MHz, BLE, Horizontal



5.5 *Test Equipment Used; Maximum Conducted Output Power*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 19, 2018	February 19, 2019
Horn Antenna	ETS	3115	6142	May 31, 2018	May 31, 2021
RF Cable	Commscope ORS	0623 WBC- 400	G020132	October 1, 2017	October 31, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 18 Test Equipment Used

6. Band Edge Spectrum

6.1 Test Specification

FCC, Part 15, Subpart C, Section 247(d)

RSS 247, Issue 2, section 5.5

6.2 Test Procedure

(Temperature (22°C)/ Humidity (60%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T was tested in the chamber, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The emissions were measured at a distance of 3 meters.

The RBW was set to 100 kHz.

6.3 Test Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the 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.

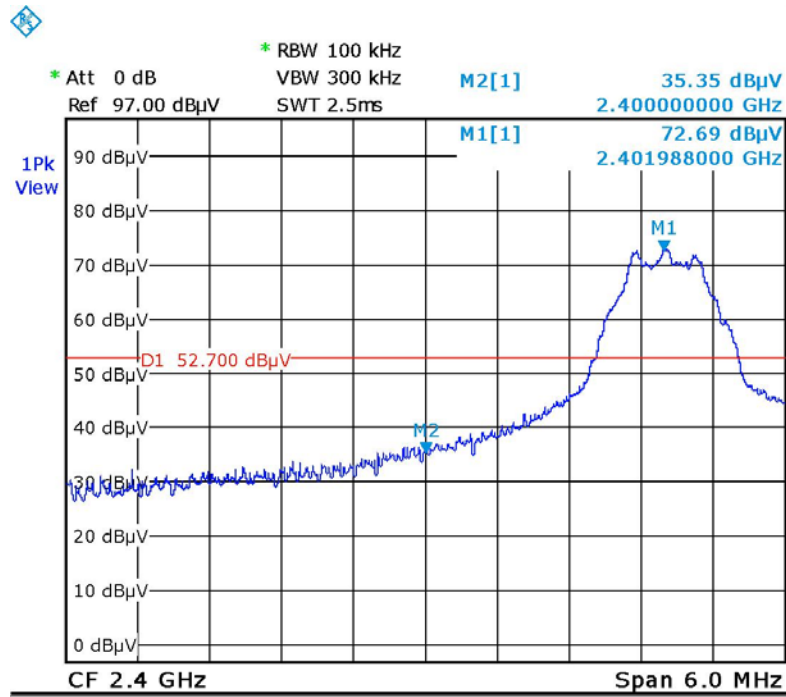
6.4 Test Results

Protocol Type	Operation Frequency	Band Edge Frequency	Spectrum Level	Limit	Margin
	(MHz)	(MHz)	(dBuV/m)	(dBuV/m)	(dB)
BLE	2402.0	2400.0	35.4	52.7	-17.3
	2480.0	2483.5	29.9	50.4	-20.5

Figure 19 Band Edge Spectrum

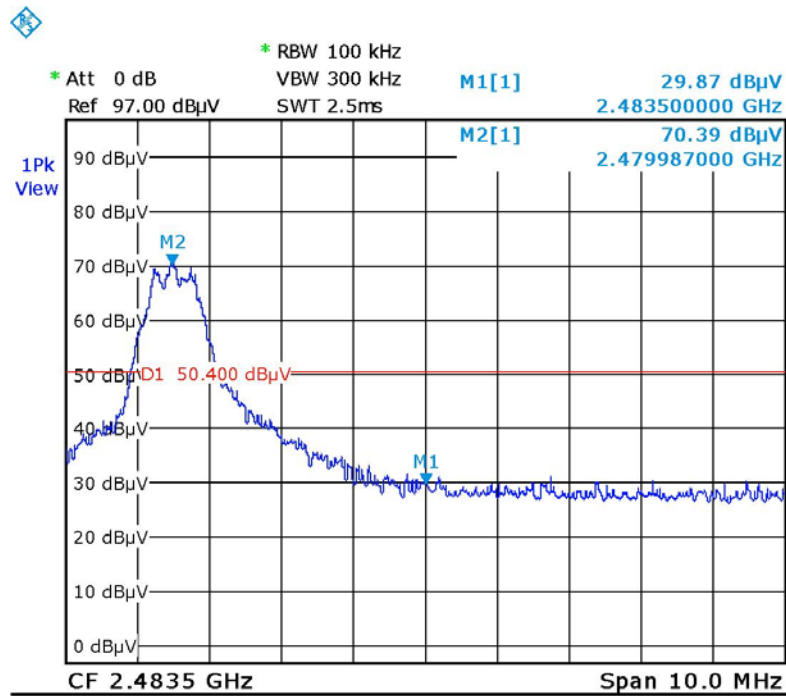
JUDGEMENT: Passed by 17.3 dB

For additional information see *Figure 20* and *Figure 21*.



Date: 21.OCT.2018 10:44:38

Figure 20 Band Edge Low, BLE



Date: 21.OCT.2018 10:48:23

Figure 21 Band Edge High, BLE



6.5 *Test Equipment Used; Band Edge*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 19, 2018	February 19, 2019
Horn Antenna	ETS	3115	6142	May 31, 2018	May 31, 2021
RF Cable	Commscope ORS	0623 WBC- 400	G020132	October 1, 2017	October 31, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 22 Test Equipment Used

7. Transmitted Power Density

7.1 Test Specification

FCC, Part 15, Subpart C, Section 247(e)

RSS 247, Issue 2, section 5.2(b)

7.2 Test Procedure

(Temperature (22°C)/ Humidity (60%RH))

The E.U.T operation mode and test set-up are as described in Section 2 of this report.

The E.U.T was tested in the chamber, and placed on a remote-controlled turntable.

The E.U.T was placed on a non-metallic table, 1.5 meters above the ground.

The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The emissions were measured at a distance of 3 meters.

The spectrum analyzer was set to 3 kHz RBW and VBW to 10 kHz.

Radiated output power levels were measured at selected operation frequencies and the results were converted to power level according to the formula as shown below:

$$P = \frac{(E_{V/m} \times d)^2}{(30 \times G)} \quad [\text{W}]$$

E - Field Strength (V/m)

d – Distance from transmitter (m)

G – Antenna gain

P – Peak power (W)

7.3 Test Limit

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

7.4 Test Results

Protocol Type	Operation Frequency	Reading Spectrum Analyzer	Reading Spectrum Analyzer	Specification	Margin
	(MHz)	(dBμV/m)	(dBm)	(dBm)	(dB)
BLE	2402.0	71.8	-23.4	8.0	-31.4
	2440.0	73.2	-22.0	8.0	-30.0
	2480.0	70.6	-24.6	8.0	-32.6

Figure 23 Test Results

JUDGEMENT: Passed by 30.0 dB

For additional information see *Figure 24* to *Figure 26*.

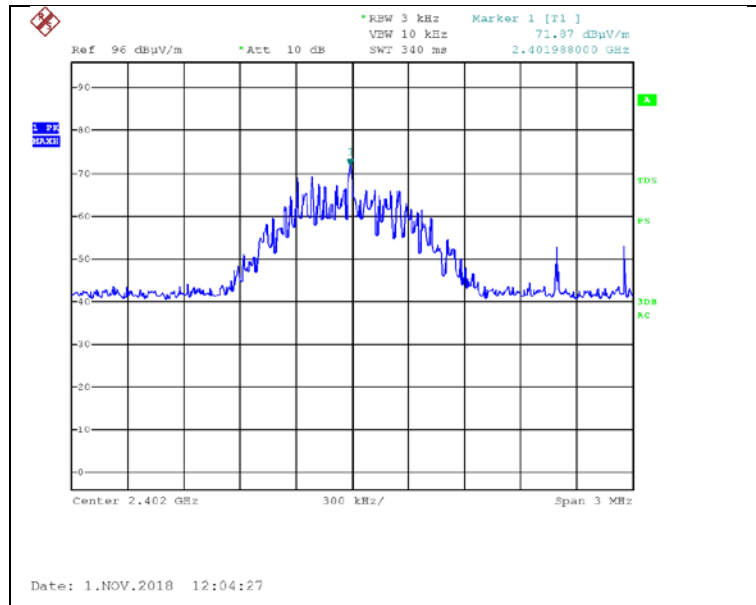


Figure 24. 2402.0 MHz, BLE

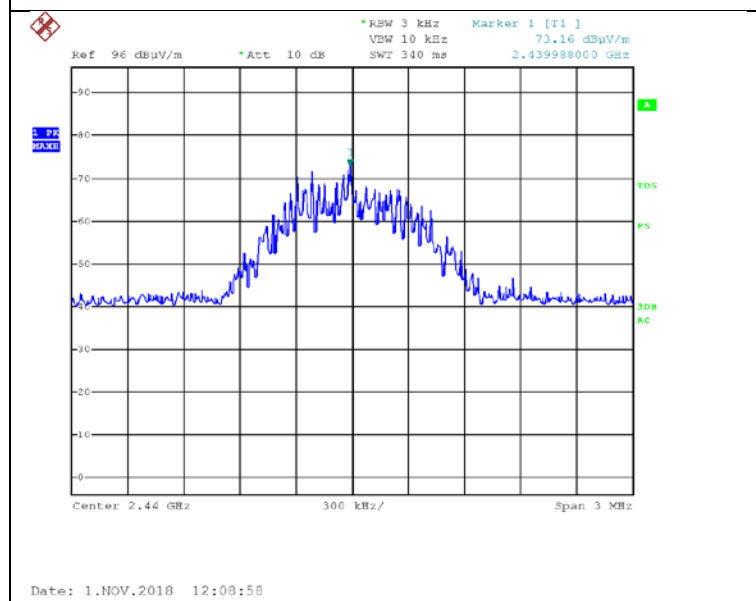


Figure 25. 2440.0 MHz, BLE

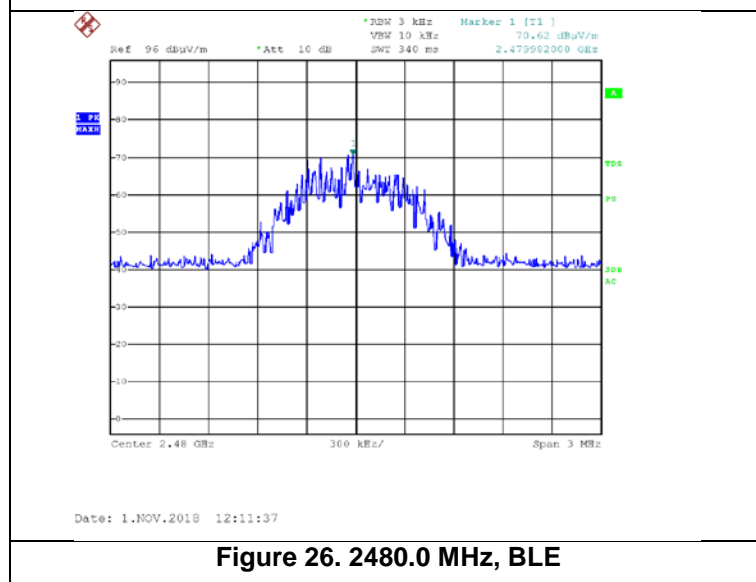


Figure 26. 2480.0 MHz, BLE



7.5 *Test Equipment Used; Transmitted Power Density*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 19, 2018	February 19, 2019
Horn Antenna	ETS	3115	29845	May 31, 2018	May 31 2021
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR
RF Cable Chamber	Commscope ORS	0623 WBC-400	G020132-	October 31, 2018	October 31, 2019

Figure 27 Test Equipment Used

8. Occupied Bandwidth

8.1 Test Specification

FCC, Part 2, Sub part J, Section 2.1049

RSS-Gen, Issue 5: 2018, Section 6.6

8.2 Test Procedure

(Temperature (22°C)/ Humidity (60%RH))

The E.U.T. operation mode and test set-up are as described in Section 2 of this report. The E.U.T. was placed in the chamber on a non-conductive table, 0.8 meters above the ground.

The distance between the E.U.T. and test antenna was 3 meters.

The transmitter unit was operated with normal modulation. The RBW set to the range of 1% to 5% of the OBW. The span was set to ~ 3 times the OBW.

99% occupied bandwidth function was set on.

8.3 Test Limit

N/A

8.4 Test Results

Protocol Type	Operation Frequency	Reading
	(MHz)	(kHz)
BLE	2402.0	1012.0
	2440.0	1036.0
	2480.0	1030.0

Figure 28. Bandwidth Test Results

JUDGEMENT: N/A

See additional information in *Figure 29* to *Figure 31*.

Occupied Bandwidth

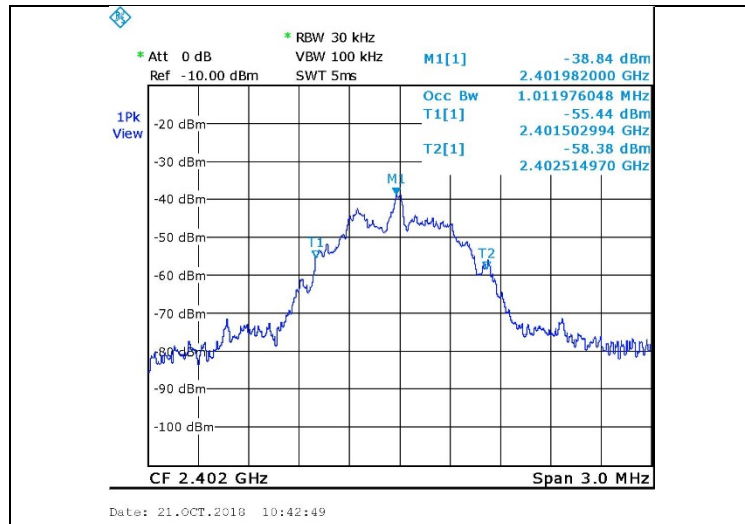


Figure 29. 2402.0 MHz, BLE

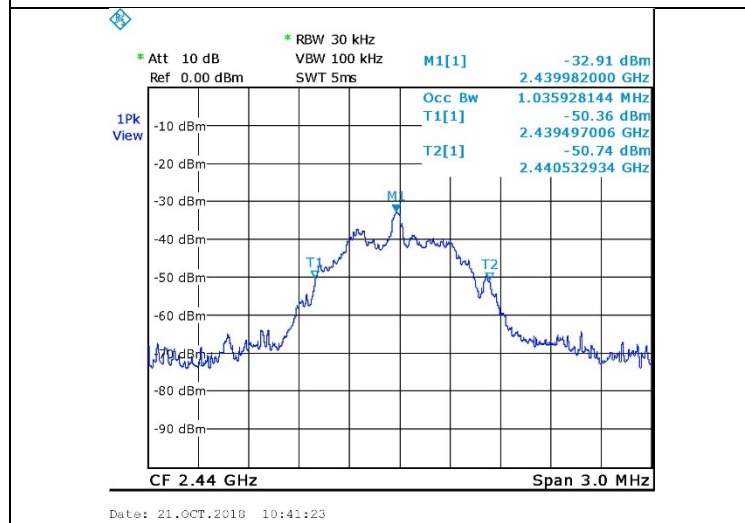


Figure 30. 2440.0 MHz, BLE

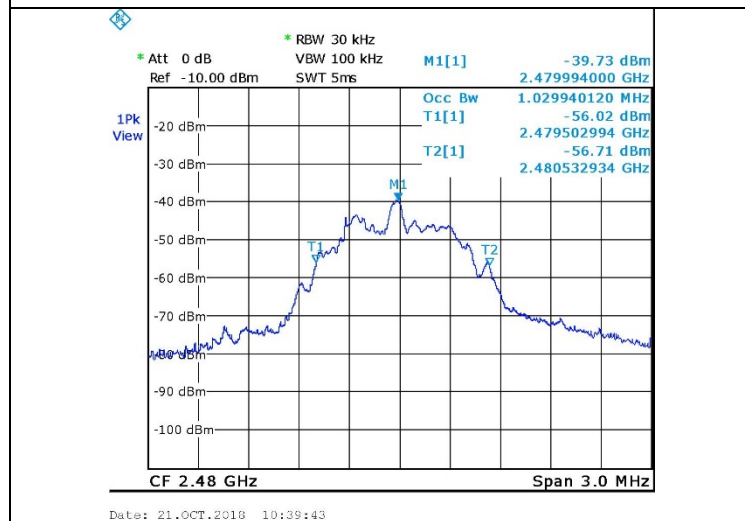


Figure 31. 2480.0 MHz, BLE



8.5 *Test Equipment Used; Occupied Bandwidth*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 19, 2018	February 19, 2019
Horn Antenna	ETS	3115	6142	May 31, 2018	May 31, 2021
RF Cable	Commscope ORS	0623 WBC- 400	G020132	October 1, 2017	October 31, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR

Figure 32 Test Equipment Used

9. Emissions in Non-Restricted Frequency Bands

9.1 Test Specification

FCC, Part 15, Subpart C, Section 247(d)

RSS 247, Issue 2, section 5.5

9.2 Test Procedure

(Temperature (22°C)/ Humidity (60%RH))

The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

For measurements between 0.009MHz-30MHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 0.009MHz-30MHz was scanned.

For measurements between 30.0MHz-1.0GHz:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.

For measurements between 1.0GHz-25.0GHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 1.5 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 1.0GHz -25.0GHz was scanned.

RBW was set to 100kHz, detector set to max peak and trace to “max hold”.

9.3 Test Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the 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.

9.4 Test Results

JUDGEMENT: Passed

All detected emissions were greater than 20dBc below the fundamental level.

The EUT met the requirements of the F.C.C. Part 15, Subpart C, Section 247(d) specification.

9.5 Test Instrumentation Used, Emission in Non- Restricted Frequency Bands

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 19, 2018	February 19, 2019
EMI Receiver	HP	8542E	3906A00276	February 19, 2018	February 19, 2019
RF Filter Section	HP	85420E	3705A00248	February 19, 2018	February 19, 2019
Spectrum Analyzer	HP	8593EM	3536A00120 ADI	February 20, 2018	February 20, 2019
Biconical Antenna	EMCO	3110B	9912-3337	May 15, 2017	May 15, 2019
Log Periodic Antenna	EMCO	3146	9505-4081	May 31, 2018	May 31, 2019
Horn Antenna	ETS	3115	29845	May 31, 2018	May 31 2021
Horn Antenna	ARA	SWH-28	1007	December 13, 2017	December 13, 2020
Active Loop Antenna	EMCO	6502	9506-2950	October 19, 2017	October 31, 2018
MicroWave System Amplifier	HP	83006A	3104A00589	October 1, 2017	October 31, 2018
Low noise amplifier 1GHz-18GHz	Miteq	AFSX4-02001800-50-8P	-	October 1, 2018	October 31, 2018
RF Cable Chamber	Commscope ORS	0623 WBC-400	G020132-	October 1, 2017	October 31, 2018
RF Cable Oats	EIM	RG214-11N(X2)	-	August 13, 2018	August 31, 2019
High Pass Band Filter	Meuro	MFL040120H50	902252	October 1, 2017	October 31, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR
Antenna Mast	ETS	2070-2	9608-1497	NCR	NCR
Turntable	ETS	2087	-	NCR	NCR
Mast & Table Controller	ETS/EMCO	2090	9608-1456	NCR	NCR

Figure 33 Test Equipment Used

9.6 **Field Strength Calculation**

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors", using the following equation:

$$FS = RA + AF + CF$$

FS: Field Strength [dB μ V/m]
 RA: Receiver Amplitude [dB μ V]
 AF: Receiving Antenna Correction Factor [dB/m]
 CF: Cable Attenuation Factor [dB]

Example: $FS = 30.7 \text{ dB}\mu\text{V (RA)} + 14.0 \text{ dB (AF)} + 0.9 \text{ dB (CF)} = 45.6 \text{ dB}\mu\text{V}$

No external pre-amplifiers are used.

10. Emissions in Restricted Frequency Bands

10.1 Test Specification

FCC Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)

RSS 247, Issue 2, section 3.3

RSS Gen, Issue 5, section 8.10

10.2 Test Procedure

(Temperature (22°C)/ Humidity (60%RH))

The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

For measurements between 0.009-30MHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 0.009MHz-30MHz was scanned.

For measurements between 30-1000MHz:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. The frequency range 30MHz -1000MHz was scanned and the list of the highest emissions was verified and updated accordingly.

For measurements between 1GHz-25GHz:

The E.U.T was tested inside the shielded room and placed on a non-metallic table, 1.5 meters above the ground. The emissions were measured at a distance of 3 meters. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The frequency range 1GHz -25GHz was scanned.

Tests done for all “worst case”, each protocol type. The highest radiation is described in the tables below.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

10.3 Test Limit

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)	Field strength* (dBµV/m)	Field strength* (dBµV/m)@3m
0.009-0.490	2400/F(kHz)	300	48.5-13.8	128.5-73.8
0.490-1.705	24000/F(kHz)	30	33.8-23.0	73.8-63.0
1.705-30.0	30	30	29.5	69.5
30-88	100	3	40.0	40.0
88-216	150	3	43.5	43.5
216-960	200	3	46.0	46.0
Above 960	500	3	54.0	54.0

*The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

Figure 34 Table of Limits

10.4 Test Results

JUDGEMENT: Passed by 4.5 dB

For the operation frequency of 2402 MHz, the margin between the emission level and the specification limit is in the worst case 5.4 dB at the frequency of 7206.0 MHz, horizontal polarization.

For the operation frequency of 2440 MHz, the margin between the emission level and the specification limit is in the worst case 9.0 dB at the frequency of 7320.0 MHz, vertical polarization.

For the operation frequency of 2480 MHz, the margin between the emission level and the specification limit is in the worst case 4.5 dB at the frequency of 2483.5 MHz, vertical polarization.

The EUT met the requirements of the F.C.C. Part 15, Subpart C Sections 15.209, 15.205, 15.247(d) specifications.

The details of the highest emissions are given in *Figure 35*.

Radiated Emission

E.U.T Description Occupancy Sensor
Type RoomMe
Serial Number: Not designated

Specifications: FCC, Part 15, Subpart C, Sections 15.209, 15.205, 15.247(d)
RSS 247, Issue 2, section 3.3 RSS Gen, Issue 5, section 8.10

Antenna Polarization: Horizontal/Vertical Frequency Range: 9KHz to 25.0 GHz
Protocol type: BLE Detector: Peak, Average

Operation Frequency	Freq.	Pol	Peak Reading	Peak Limit	Peak Margin	Average Reading	Average Limit	Average Margin
(MHz)	(MHz)	(H/V)	(dB μ V/m)	(dB μ V/m)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)
2402.0	2390.0	V	56.3	74.0	-17.7	44.2	54.0	-9.8
	2390.0	H	54.2	74.0	-19.8	44.2	54.0	-9.8
	7206.0	V	54.2	74.0	-19.8	45.2	54.0	-8.8
	7206.0	H	58.8	74.0	-15.2	48.6	54.0	-5.4
2440.0	4880.0	V	52.9	74.0	-21.1	-	54.0	-
	4880.0	H	53.1	74.0	-20.9	-	54.0	-
	7320.0	V	55.5	74.0	-18.5	45.0	54.0	-9.0
	7320.0	H	54.8	74.0	-19.2	43.9	54.0	-10.1
2480.0	7440.0	V	54.9	74.0	-19.1	45.7	54.0	-8.3
	7440.0	H	50.2	74.0	-23.8	-	54.0	-
	2483.5	V	68.6	74.0	-5.4	49.5	54.0	-4.5
	2483.5	H	59.2	74.0	-14.8	48.2	54.0	-5.8

Figure 35. Radiated Emission Results

Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

“Peak Amp” includes correction factor.

* “Correction Factor” = Antenna Factor + Cable Loss- Low Noise Amplifier Gain

10.5 Test Instrumentation Used; Emissions in Restricted Frequency Bands

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Due
EMI Receiver	R&S	ESCI7	100724	February 19, 2018	February 19, 2019
EMI Receiver	HP	8542E	3906A00276	February 19, 2018	February 19, 2019
RF Filter Section	HP	85420E	3705A00248	February 19, 2018	February 19, 2019
Spectrum Analyzer	HP	8593EM	3536A00120 ADI	February 20, 2018	February 20, 2019
Biconical Antenna	EMCO	3110B	9912-3337	May 15, 2017	May 15, 2019
Log Periodic Antenna	EMCO	3146	9505-4081	May 31, 2018	May 31, 2019
Horn Antenna	ETS	3115	29845	May 31, 2018	May 31 2021
Horn Antenna	ARA	SWH-28	1007	December 13, 2017	December 13, 2020
Active Loop Antenna	EMCO	6502	9506-2950	October 19, 2017	October 31, 2018
MicroWave System Amplifier	HP	83006A	3104A00589	October 1, 2017	October 31, 2018
Low noise amplifier 1GHz-18GHz	Miteq	AFSX4-02001800-50-8P	-	October 1, 2018	October 31, 2018
RF Cable Chamber	Commscope ORS	0623 WBC-400	G020132-	October 1, 2017	October 31, 2018
RF Cable Oats	EIM	RG214-11N(X2)	-	August 13, 2018	August 31, 2019
High Pass Band Filter	Meuro	MFL040120H50	902252	October 1, 2017	October 31, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	NCR	NCR
Antenna Mast	ETS	2070-2	9608-1497	NCR	NCR
Turntable	ETS	2087	-	NCR	NCR
Mast & Table Controller	ETS/EMCO	2090	9608-1456	NCR	NCR

Figure 36 Test Equipment Used

11. Antenna Gain/Information

The antenna gain is 7dBi

INTELLITHINGS

RoomMe Sensor – Antenna Gain Statement

We hereby declare that in RoomMe sensor we've implemented a built-in custom Bi-Quad antenna based on various reference designs found on the internet with some custom modifications.

Our calculations show that Antenna gain including the matching circuit is 7db.

Oren Kotlicki, CEO
Intellithings Ltd.

 **Intellithings LTD.**
אינטליטינגס בע"מ
51-505072-2 .ד.ח

12. R.F Exposure/Safety

Typical use of the E.U.T. is as a ceiling mounted occupancy sensor.
The typical distance between the E.U.T. and the user is at least 20 cm.

Calculation of Maximum Permissible Exposure (MPE) Based on Section 1.1310 Requirements

(a) FCC limits at 2402 MHz is: $1 \frac{mW}{cm^2}$

Using table 1 of Section 1.1310 limit for general population/uncontrolled exposures, the above level is an average over 30 minutes.

(b) The power density produced by the E.U.T. is

$$S = \frac{P_t G_t}{4\pi R^2}$$

P_t- Transmitted Conducted Power: -14.6dBm = 0.035 mW

G_T- Antenna Gain, +7.0 dBi= 5 (numeric)

R- Distance from Transmitter using 20cm worst case

(c) The peak power density is:

$$S = (0.035 * 5) / (4\pi(20^2)) = 3.48 \times 10^{-5} \text{ mW/cm}^2$$

(d) This is below the FCC limit.

13. APPENDIX A - CORRECTION FACTORS

13.1 Correction factors for

RF OATS Cable 35m ITL #1879

Frequency (MHz)	Cable loss (dB)
30.0	1.1
50.0	1.1
100.0	1.7
150.0	2.1
200.0	2.5
250.0	2.7
300.0	2.9
350.0	3.1
400.0	3.5
450.0	3.7
500.0	3.9
550.0	4.0
600.0	4.2
650.0	4.4
700.0	4.9
750.0	5.0
800.0	5.0
850.0	4.9
900.0	5.0
950.0	5.1
1000.0	5.4

13.2 Correction factor for RF CABLE for Semi Anechoic Chamber

ITL # 1841

FREQ (MHz)	LOSS (dB)
1000.0	1.5
2000.0	2.1
3000.0	2.7
4000.0	3.1
5000.0	3.5
6000.0	4.1
7000.0	4.6
8000.0	4.9
9000.0	5.7
10000.0	5.7
11000.0	6.1
12000.0	6.1
13000.0	6.2
14000.0	6.7
15000.0	7.4
16000.0	7.5
17000.0	7.9
18000.0	8.1
19000.0	8.8
20000.0	9.1

NOTES:

1. The cable is manufactured by Commscope
2. The cable type is 0623 WBC-400, serial # G020132 and 10m long



13.3 Correction factors for Active Loop Antenna

Model 6502 S/N 9506-2950

ITL # 1075:

f(MHz)	MAF(dBs/m)	AF(dB/m)
0.01	-33.1	18.4
0.02	-37.2	14.3
0.03	-38.2	13.3
0.05	-39.8	11.7
0.1	-40.1	11.4
0.2	-40.3	11.2
0.3	-40.3	11.2
0.5	-40.3	11.2
0.7	-40.3	11.2
1	-40.1	11.4
2	-40	11.5
3	-40	11.5
4	-40.1	11.4
5	-40.2	11.3
6	-40.4	11.1
7	-40.4	11.1
8	-40.4	11.1
9	-40.5	11
10	-40.5	11
20	-41.5	10
30	-43.5	8



13.4 Correction factors for biconical antenna – ITL # 1356

Model: EMCO 3110B

Serial No.:9912-3337

Frequency	ITL 1356 AF
[MHz]	[dB/m]
30	13.00
35	10.89
40	10.59
45	10.63
50	10.12
60	9.26
70	7.74
80	6.63
90	8.23
100	11.12
120	13.16
140	13.07
160	14.80
180	16.95
200	17.17



13.5 Correction factors for log periodic antenna – ITL # 1349

Model: EMCO 3146

Serial No.:9505-4081

Frequency	ITL 1349 AF
[MHz]	[dB/m]
200	11.58
250	12.04
300	14.76
400	15.55
500	17.85
600	18.66
700	20.87
800	21.15
900	22.32
1000	24.22



13.6 Correction factors for Double –Ridged Waveguide Horn ANTENNA

Model: 3115

Serial number:29845

3 meter range; ITL # 1352

FREQUENCY	AFE	FREQUENCY	AFE
(GHz)	(dB/m)	(GHz)	(dB/m)
0.75	25	9.5	38
1.0	23.5	10.0	38.5
1.5	26.0	10.5	38.5
2.0	29.0	11.0	38.5
2.5	27.5	11.5	38.5
3.0	30.0	12.0	38.0
3.5	31.5	12.5	38.5
4.0	32.5	13.0	40.0
4.5	32.5	13.5	41.0
5.0	33.0	14.0	40.0
5.5	35.0	14.5	39.0
6.0	36.5	15.0	38.0
6.5	36.5	15.5	37.5
7.0	37.5	16.0	37.5
7.5	37.5	16.5	39.0
8.0	37.5	17.0	40.0
8.5	38.0	17.5	42.0
9.0	37.5	18.0	42.5



13.7 Correction factors for

Horn Antenna

Model: SWH-28
at 3 meter range.
ITL #:1353

CALIBRATION DATA

3 m distance

Frequency, MHz	Measured antenna factor, dB/m ¹⁾
18000	32.4
18500	32.0
19000	32.3
19500	32.4
20000	32.3
20500	32.8
21000	32.8
21500	32.7
22000	33.1
22500	33.0
23000	33.1
23500	33.8
24000	33.5
24500	33.5
25000	33.8
25500	33.9
26000	34.2
26500	34.7

¹⁾ The antenna factor shall be added to receiver reading in dB μ V to obtain field strength in dB μ V/m.