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DATE: 17 January 2016

I.T.L. (PRODUCT TESTING) LTD.

FCC Radio Test Report

for

Galcon Bakarim Agricultural Cooperative Society Ltd.

Equipment under test:

Bluetooth Controller

7101BT-SN, 7101BT*, 7001BT-SN*, 7001BT*

*See customer's Declaration on page 6

Tested by: _____
M. Zohar

Approved by: _____
D. Shidlowsky

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This report relates only to items tested.

Measurement/Technical Report for

Galcon Bakarim Agricultural Cooperative Society Ltd.

Bluetooth Controller

7101BT-SN

FCC ID: SZ871BT

This report concerns:	Original Grant: X Class I Change: Class II Change:
Equipment type:	Digital Transmission System
Limits used:	47CFR15 Section 15.247

Measurement procedure used is KDB 558074 D01 v03r03 and ANSI C63.10:2013.

Application for Certification prepared by:

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Applicant for this device:
(different from "prepared by")
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1. General Information

1.1 *Administrative Information*

Manufacturer:	Galcon Bakarim Agricultural Cooperative Society Ltd.
Manufacturer's Address:	Kibbutz Kfar Blum D.N. Upper Galilee 12150 Israel Tel: +972-4-690-0222 Fax: +972-4-690-2727
Manufacturer's Representative:	Dvora Zilberas Fine
Equipment Under Test (E.U.T):	Bluetooth Controller
Equipment Model No.:	7101BT-SN, 7101BT* 7001BT-SN*, 7001BT*
Equipment Serial No.:	Not designated
Date of Receipt of E.U.T:	November 22, 2015
Start of Test:	November 22, 2015
End of Test:	November 24, 2015
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St., Lod ISRAEL 7120101
Test Specifications:	FCC Part 15, Subpart C

*See customer's Declaration on following page.

DECLARATION

I HEREBY DECLARE THAT:

MODEL No. 7101BT-SN

IS A FULL CONFIGURATION MODEL,

OTHER MODELS No. WHICH INCLUDE ARE:

7001BT

7001BT-SN

7101BT

DIFFER FROM THE 7101BT-SN ONLY BY EXTRACTED COMPONENTS.

Please relate to them all (from a RF/EMC point of view) as the same product.

Thank you,

Full Name: Dvora Zilberas Fine **Position: Engineering Manager** **Date: 03.08.2015**

Signature: DVORA Z **Place: Kfar Blum**

Galcon Tel. 972-4-6900222 **Fax.** 972-4-6902727
Address. Kfar Blum 1215000 Israel **Email.** info@galconc.com **Web.** www.galconc.com

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. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-3006, R-2729, T-1877, G-245.
5. 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*

EUT is a Bluetooth operated Single station irrigation controller with an integrated inline valve.
The controller is waterproof (IP68), works on 9V alkaline battery with optional rain sensor connector.

Model name	7101BT-SN
Working voltage	9VDC battery operated
Mode of operation	Transceiver BLE
Modulations	GFSK
Frequency Range	2402MHz-2480MHz
Transmit power	8dBm
Antenna Gain	-5.0 dBi
Modulation BW	>500kHz
Temperature (°C)/ Humidity (%RH)	25°C /44%

1.4 Test Methodology

Both conducted and radiated testing was performed according to the procedures in KDB 558074 D01 v03r03 and ANSI C63.10: 2013. 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*

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):

± 4.98 dB

2. System Test Configuration

2.1 *Justification*

Exploratory emission testing was performed in 3 orthogonal polarities to determine the worst case.

The fundamental results are shown in the below table:

Frequency (MHz)	**Y axis** (dBuV/m)	**X axis** (dBuV/m)	**Z axis** (dBuV/m)
2402.0	91.7	90.7	84.6
2440.0	92.0	86.4	82.8
2480.0	91.0	84.5	84.2

Figure 1. Screening Results

According to above results the worst case was the Y axis.

The unit was evaluated while transmitting at the low channel (2402MHz), the mid channel (2440MHz) and the high channel (2480MHz) in BLE technology.

2.2 *EUT Exercise Software*

No special exercise software was used.

2.3 *Special Accessories*

No special accessories were needed to achieve compliance.

2.4 *Equipment Modifications*

No modifications were necessary in order to achieve compliance.

2.5 *Configuration of Tested System*

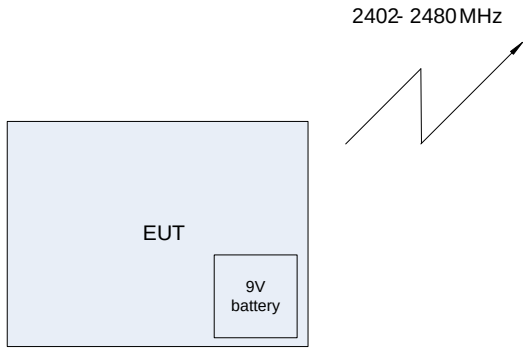

Figure 2. Configuration of Tested System

3. Radiated Measurement Test Set-Up Photos

Figure 3. Radiated Emission Test

Figure 4. Radiated Emission Test

Figure 5. Radiated Emission Test

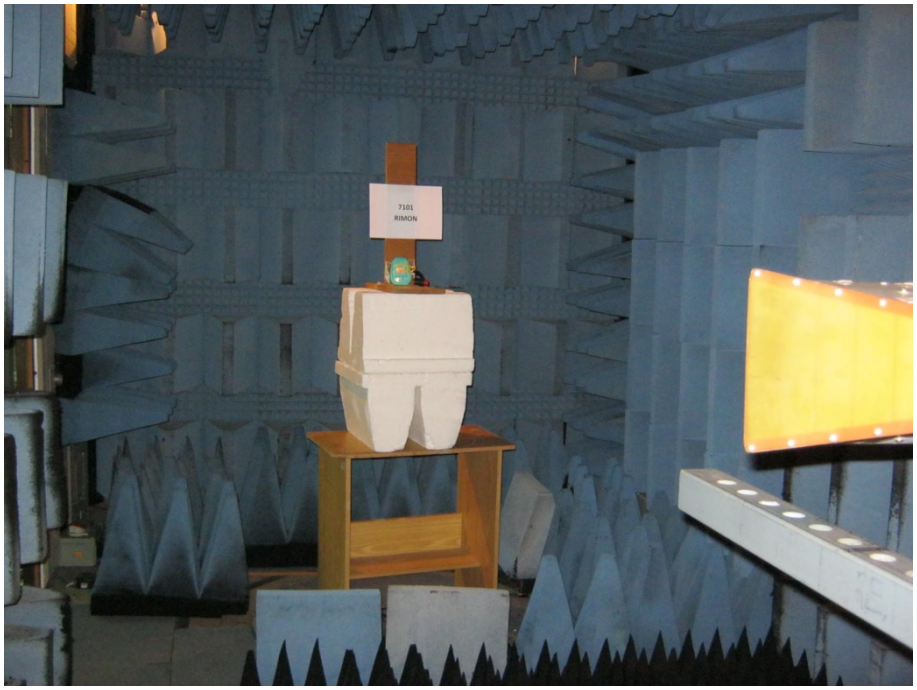

Figure 6. Radiated Emission Test

4. 6 dB Minimum Bandwidth

4.1 *Test Specification*

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

4.2 *Test Procedure*

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 configuration tested is shown in Figure 2.
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 Results*

Operation Frequency (MHz)	Reading (MHz)	Specification (MHz)
2402.0	0.709	>0.5
2440.0	0.729	>0.5
2480.0	0.749	>0.5

Figure 7 6 dB Minimum Bandwidth

JUDGEMENT: Passed

For additional information see *Figure 8* to *Figure 10.*

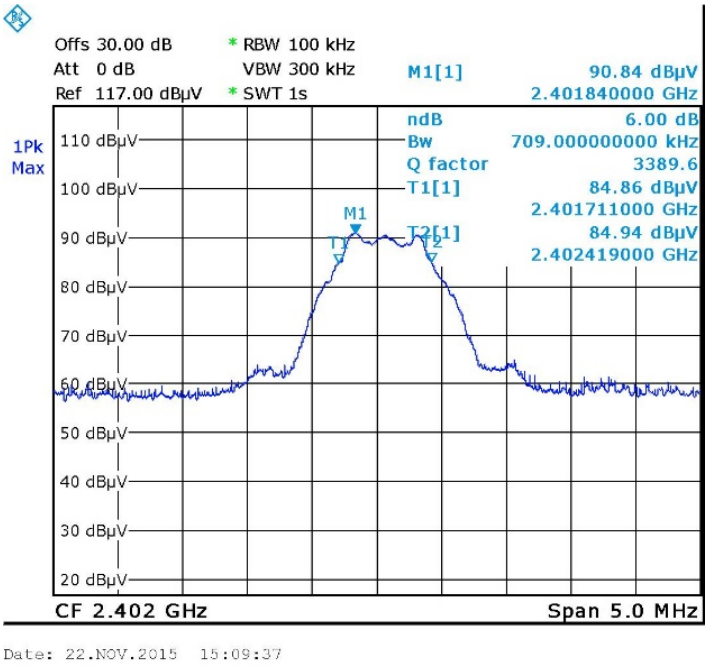

Figure 8. 2402.0 MHz

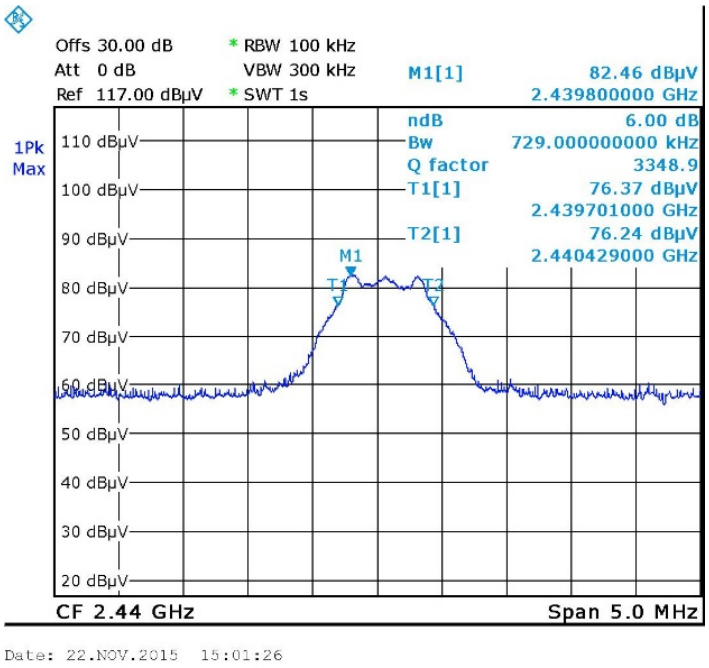

Figure 9. 2440.0 MHz

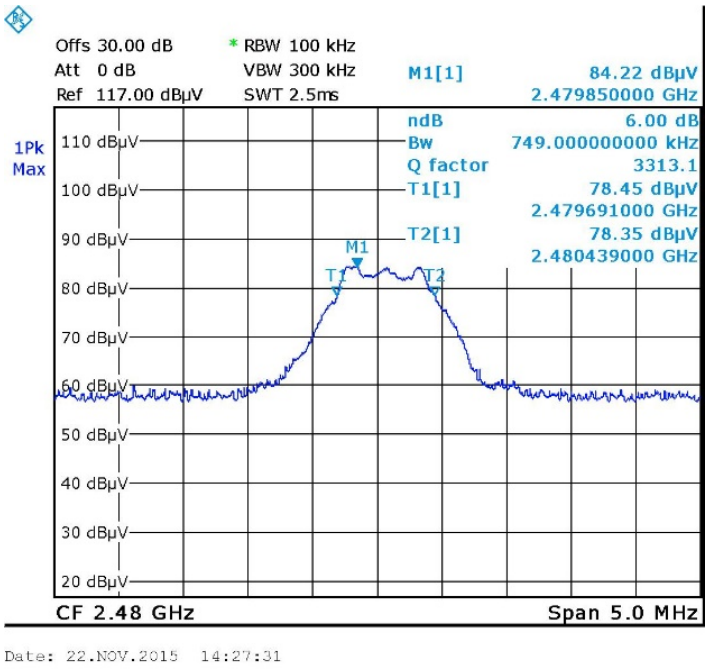

Figure 10. 2480.0 MHz

4.4 *Test Equipment Used; 6dB Bandwidth*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Date
Spectrum Analyzer	R&S	FSL6	100194	January 1, 2015	January 1, 2016
Horn Antenna	ETS	3115	6142	May 19, 2015	May 19, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	N/A	N/A

Figure 11 Test Equipment Used

5. Maximum Transmitted Peak Power Output

5.1 *Test Specification*

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

5.2 *Test Procedure*

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 configuration tested is shown in Figure 2.

The E.U.T was evaluated in 3 channels: Low (2402.0 MHz), Mid (2440.0 MHz) and High (2480 MHz).

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:

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

E - Field Strength (V/m)

d – Distance from transmitter (m)

G – Antenna gain

P – Peak power (W)

5.3 *Test Results*

Operation Frequency (MHz)	Polarization (V/H)	Power (dBuV/m)	Power (dBm)	Power (mW)	Specification (mW)	Margin (mW)
2402.0	V	94.7	-0.5	0.891	1000.0	-999.109
2402.0	H	90.0	-5.2	0.302	1000.0	-999.698
2440.0	V	92.8	-2.4	0.575	1000.0	-999.425
2440.0	H	87.8	-7.4	0.182	1000.0	-999.818
2480.0	V	91.1	-4.1	0.389	1000.0	-999.611
2480.0	H	86.3	-8.9	0.129	1000.0	-999.871

Figure 12 Maximum Peak Power Output

JUDGEMENT: Passed by 999.109 mW

For additional information see *Figure 13* to *Figure 18.*

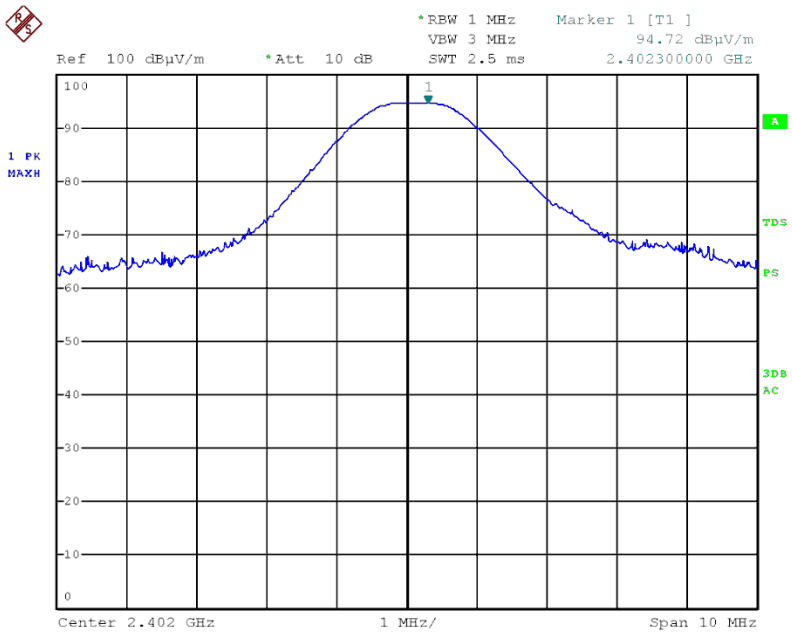

Figure 13 2402.0 MHz – Vertical

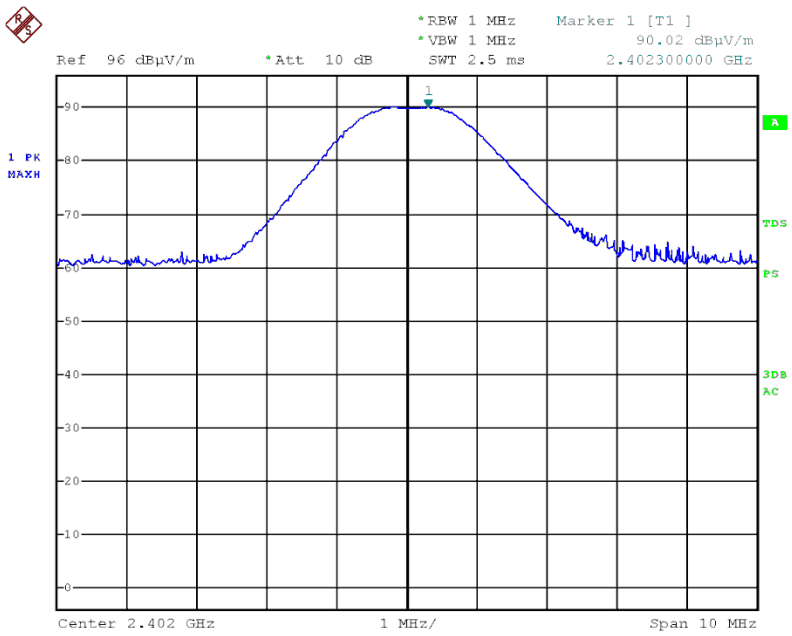

Figure 14 2402.0 MHz – Horizontal

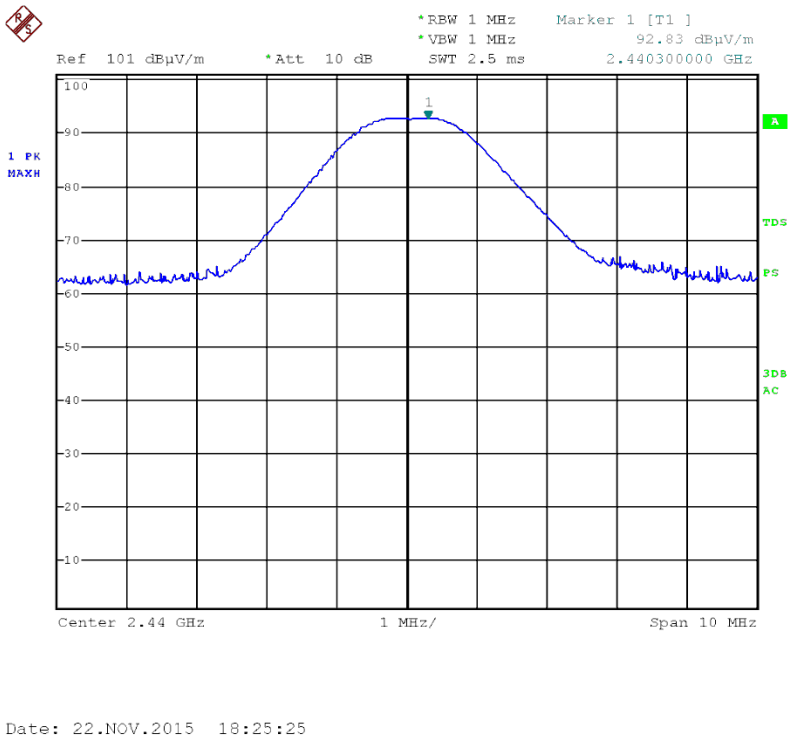

Figure 15 2440.0 MHz – Vertical

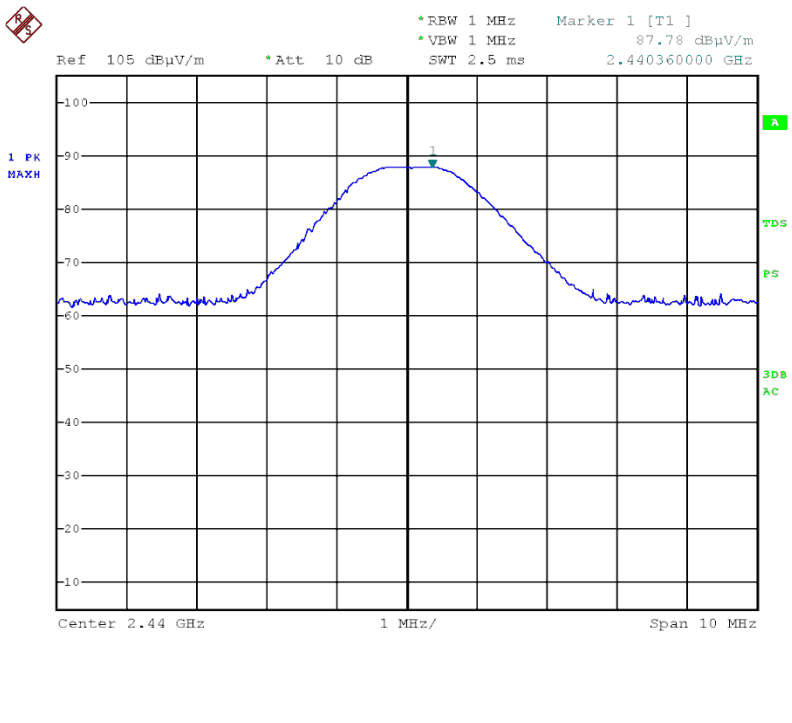

Figure 16 2440.0 MHz – Horizontal

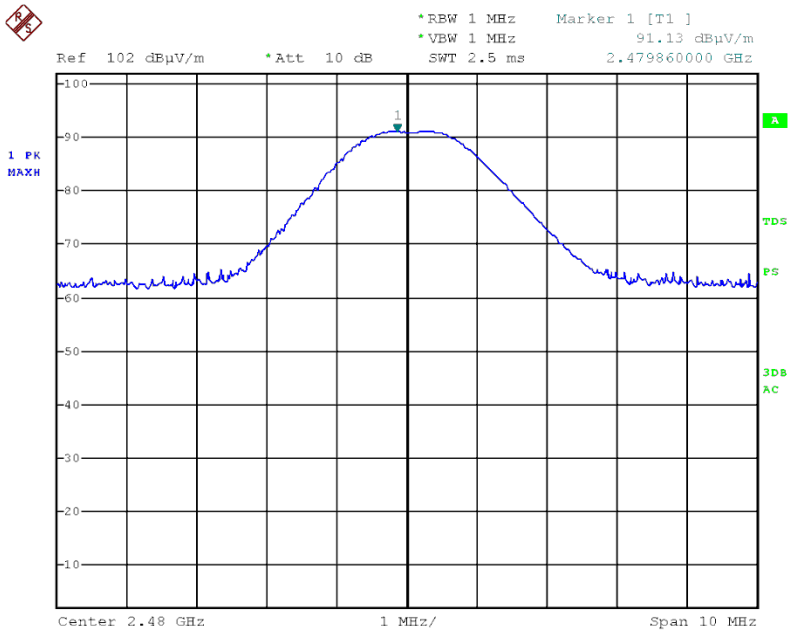

Figure 17 2480.0 MHz – Vertical

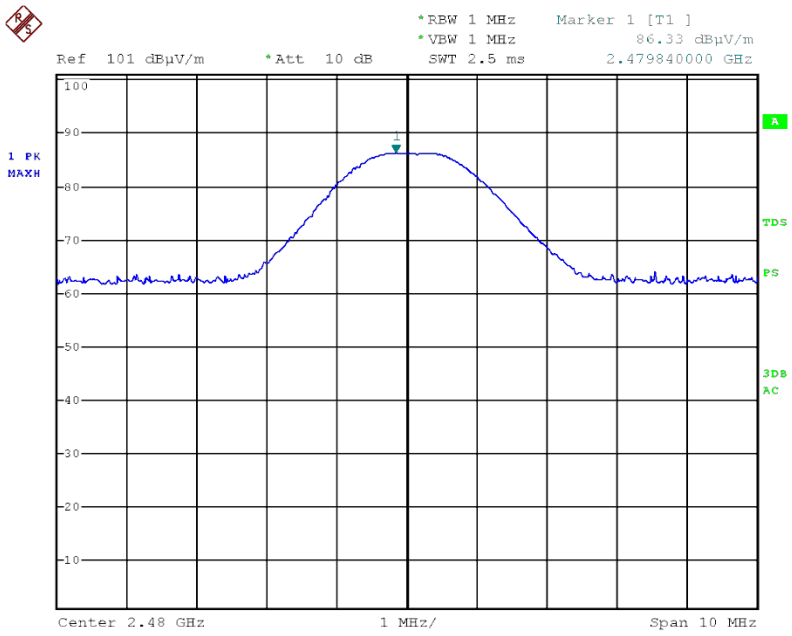

Figure 18 2480.0 MHz – Horizontal

5.4 *Test Equipment Used; Maximum Peak Power Output*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Date
EMI Receiver	R&S	ESCI7	100724	January 4, 2015	January 31, 2016
Horn Antenna	ETS	3115	6142	May 19, 2015	May 19, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	N/A	N/A

Figure 19 Test Equipment Used

6. Band Edge Spectrum

6.1 *Test Specification*

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

6.2 *Test Procedure*

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

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 configuration tested is shown in Figure 2.

The RBW was set to 100 kHz.

6.3 *Test Results*

Operation Frequency (MHz)	Modulation	Band Edge Frequency (MHz)	Spectrum Level (dBuV/m)	Specification (dBuV/m)	Margin (dB)
Low	BLE	2400.0	58.1	70.7	-12.6
High	BLE	2483.5	58.4	66.4	-8.0

Figure 20 Band Edge Spectrum

JUDGEMENT: Passed by 8.0 dB

For additional information see *Figure 21* and *Figure 22.*

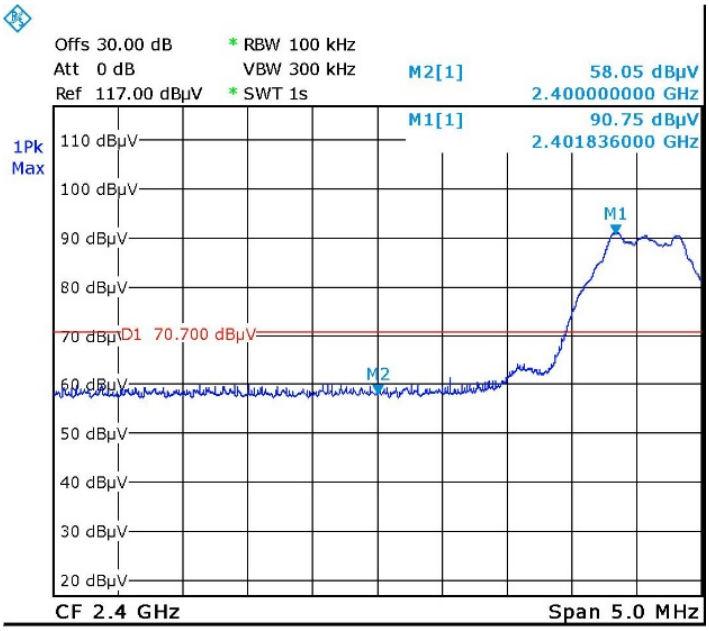

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Figure 21 —Lower Band Edge

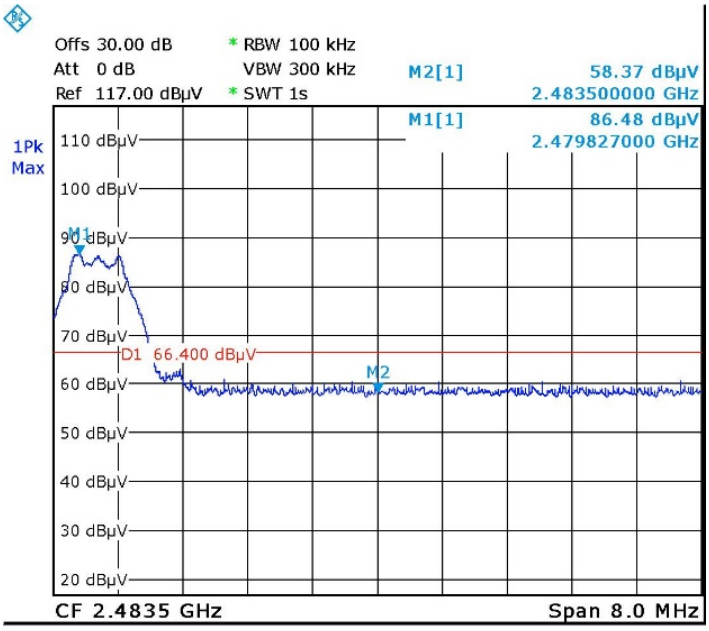

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Figure 22 —Upper Band Edge

6.4 *Test Equipment Used; Band Edge Spectrum*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Date
EMI Receiver	R&S	FSL6	100194	January 1, 2015	January 1, 2016
Horn Antenna	ETS	3115	6142	May 19, 2015	May 19, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	N/A	N/A

Figure 23 Test Equipment Used

7. Emissions in Non-Restricted Frequency Bands

7.1 *Test Specification*

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

7.2 *Test Procedure*

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

For 0.009MHz-1000MHz range:

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 loop/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 configuration tested is shown in Figure 2.

The frequency range 0.009 MHz-1000 MHz was scanned.

RBW was set to 100 kHz.

The emissions were measured using a computerized EMI receiver complying with CISPR 16 requirements.

In the frequency range of 9kHz-30MHz, the center of the loop antenna height was one meter above the ground.

In the frequency range of 30MHz-1000MHz, the readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

For 1000MHz-25000MHz range:

The E.U.T was placed 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 configuration tested is shown in Figure 2.

The frequency range 1000 MHz-25000 MHz was scanned.

RBW was set to 100 kHz.

In the frequency range 30-7000MHz, a computerized EMI receiver complying with CISPR 16 requirements was used.
In the frequency range 7000MHz-25000 MHz, a spectrum analyzer including a low noise amplifier was used.

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

For all final evaluations the distance was 3 meters.
The E.U.T. was operated at the low, mid and high channels (2402.0 MHz, 2440 MHz and 2480.0 MHz).

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, based on either an RF conducted or a radiated measurement.

7.3 *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.

7.4 *Test Instrumentation Used, Emission in Non Restricted Frequency Bands*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Date
EMI Receiver	R&S	ESCI7	100724	January 4, 2015	January 31, 2016
Spectrum Analyzer	HP	8592L	3826A01204	March 4, 2015	March 3, 2016
EMI Receiver	HP	8542E	3906A00276	March 11, 2015	March 31, 2016
RF Filter Section	HP	85420E	3705A00248	March 19, 2015	March 31, 2016
Spectrum Analyzer	HP	8564E	3442A00275	March 11, 2015	March 31, 2016
Biconical Antenna	EMCO	3104	2606	December 28, 2014	December 28, 2015
Active Loop Antenna	EMCO	6502	9506-2950	November 4, 2015	November 4, 2016
Log Periodic Antenna	EMCO	3146	9505-4081	December 28, 2014	December 28, 2015
Horn Antenna	ETS	3115	29845	May 19, 2015	May 19, 2018
Horn Antenna	ARA	SWH-28	1007	March 3, 2014	March 30, 2016
Low Noise Amplifier	Narda	DBS-0411N313	13	March 1, 2015	March 1, 2016
Low Noise Amplifier	Sophia Wireless	LNA28-B	232	March 1, 2015	March 1, 2016
Spectrum Analyzer	HP	8593EM	3536A00120ADI	February 24, 2015	February 28, 2016
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	N/A	March 1, 2016
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 24 Test Equipment Used

7.5 *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 [dBμv/m]
RA:	Receiver Amplitude [dBμv]
AF:	Receiving Antenna Correction Factor [dB/m]
CF:	Cable Attenuation Factor [dB]

Example: FS = 30.7 dBμV (RA) + 14.0 dB (AF) + 0.9 dB (CF) = 45.6 dBμV

No external pre-amplifiers are used.

8. Emissions in Restricted Frequency Bands

8.1 *Test Specification*

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

8.2 *Test Procedure*

For 0.009MHz-1000M range:

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 configuration tested is shown in Figure 2.

The frequency range 0.009 MHz-1000 MHz was scanned.

The emissions were measured using a computerized EMI receiver complying with CISPR 16 requirements.

In the frequency range of 9 kHz-30MHz, the center of the loop antenna height was one meter above the ground.

In the frequency range of 30MHz-1000 MHz, the readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

For 1000M-25000M range:

The E.U.T was placed 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 configuration tested is shown in Figure 2.

The frequency range 1000 MHz-25000 MHz was scanned.

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

During average measurements, the IF bandwidth was 1 MHz and the video bandwidth was 100Hz. During peak measurements, the IF bandwidth was 1 MHz and the video bandwidth was 3 MHz.

In the frequency range 30-7000MHz,. A computerized EMI receiver complying with CISPR 16 requirements was used.
In the frequency range 7000M-25000 MHz, a spectrum analyzer including a low noise amplifier was used.

For all final evaluations, the distance was 3 meters.

The E.U.T. was operated at the low, mid and high channels.
(2402, 2440, 2480 MHz).

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.
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 25 Table of Limits

8.3 *Test Results*

JUDGEMENT: Passed by 3.1 dB

For the operation frequency of 2402 MHz, the margin between the emission level and the specification limit is in the worst case 4.0 dB at the frequency of 2390.0 MHz, vertical polarization.

For the operation frequency of 2440 MHz, the margin between the emission level and the specification limit is in the worst case 9.3 dB at the frequency of 4880.0 MHz, horizontal polarization.

For the operation frequency of 2480 MHz, the margin between the emission level and the specification limit is in the worst case 3.1 dB at the frequency of 2483.5 MHz, vertical polarization.

The EUT met the requirements of the F.C.C. Part 15, Subpart C specification.

The details of the highest emissions are given in *Figure 26* to *Figure 27.*

Radiated Emission

E.U.T Description Bluetooth Controller
Type 7101BT-SN
Serial Number: Not designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical Frequency range: 0.009MHz to 25.0 GHz
Test Distance: 3 meters Detector: Peak

Operation Frequency (MHz)	Freq. (MHz)	Polarity (H/V)	Peak Reading (dBµV/m)	Peak. Specification (dB µV/m)	Peak. Margin (dB)
2402.0	2390.0	H	62.7	74.0	-11.3
2402.0	2390.0	V	63.4	74.0	-10.6
2402.0	4804.0	H	67.0	74.0	-7.0
2402.0	4804.0	V	66.2	74.0	-7.8
2440.0	4880.0	H	61.4	74.0	-12.6
2440.0	4880.0	V	60.1	74.0	-13.9
2480.0	4960.0	H	61.7	74.0	-12.3
2480.0	4960.0	V	60.5	74.0	-13.5
2480.0	2483.5	H	62.1	74.0	-11.9
2480.0	2483.5	V	63.7	74.0	-10.3

Figure 26. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL. Detector: Peak

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

Radiated Emission

E.U.T Description Bluetooth Controller
Type 7101BT-SN
Serial Number: Not designated

Specification: FCC, Part 15, Subpart C

Antenna Polarization: Horizontal/Vertical
Frequency range: 0.009MHz to 25.0 GHz
Test Distance: 3 meters
Detector: Average

Operation Frequency	Freq.	Polarity	Average Reading	Average Specification	Average Margin
(MHz)	(MHz)	(H/V)	(dBµV/m)	(dB µV/m)	(dB)
2402.0	2390.0	H	48.8	54.0	-5.2
2402.0	2390.0	V	50.0	54.0	-4.0
2402.0	4804.0	H	48.4	54.0	-5.6
2402.0	4804.0	V	48.0	54.0	-6.0
2440.0	4880.0	H	44.7	54.0	-9.3
2440.0	4880.0	V	44.3	54.0	-9.7
2480.0	4960.0	H	44.6	54.0	-9.4
2480.0	4960.0	V	43.5	54.0	-10.5
2480.0	2483.5	H	50.4	54.0	-3.6
2480.0	2483.5	V	50.9	54.0	-3.1

Figure 27. Radiated Emission. Antenna Polarization: HORIZONTAL / VERTICAL. Detector: Average

Notes:

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.

"Average Amp" includes correction factor.

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

8.4 *Test Instrumentation Used; Emissions in Restricted Frequency Bands*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Date
EMI Receiver	R&S	ESCI7	100724	January 4, 2015	January 31, 2016
Spectrum Analyzer	HP	8592L	3826A01204	March 4, 2015	March 3, 2016
EMI Receiver	HP	8542E	3906A00276	March 11, 2015	March 31, 2016
RF Filter Section	HP	85420E	3705A00248	March 19, 2015	March 31, 2016
Spectrum Analyzer	HP	8564E	3442A00275	March 11, 2015	March 31, 2016
Biconical Antenna	EMCO	3104	2606	December 28, 2014	December 28, 2015
Active Loop Antenna	EMCO	6502	9506-2950	November 4, 2015	November 4, 2016
Log Periodic Antenna	EMCO	3146	9505-4081	December 28, 2014	December 28, 2015
Horn Antenna	ETS	3115	29845	May 19, 2015	May 19, 2018
Horn Antenna	ARA	SWH-28	1007	March 3, 2014	March 30, 2016
Low Noise Amplifier	Narda	DBS-0411N313	13	March 1, 2015	March 1, 2016
Low Noise Amplifier	Sophia Wireless	LNA28-B	232	March 1, 2015	March 1, 2016
Spectrum Analyzer	HP	8593EM	3536A00120ADI	February 24, 2015	February 28, 2016
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	N/A	March 1, 2016
Antenna Mast	ETS	2070-2	9608-1497	N/A	N/A
Turntable	ETS	2087	-	N/A	N/A
Mast & Table Controller	ETS/EMCO	2090	9608-1456	N/A	N/A

Figure 28 Test Equipment Used

9. Transmitted Power Density

9.1 *Test Specification*

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

9.2 *Test Procedure*

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 configuration tested is shown in Figure 2.

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

The E.U.T was evaluated in 3 channels: Low, Mid and High.

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:

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

E - Field Strength (V/m)

d – Distance from transmitter (m)

G – Antenna gain

P – Peak power (W)

9.3 *Test Results*

Operation Frequency (MHz)	Reading Spectrum Analyzer (dBµV/m)	Reading Spectrum Analyzer (dBm)	Specification (dBm)	Margin (dB)
2402.0	77.1	-18.1	8.0	-26.1
2440.0	76.8	-18.4	8.0	-26.4
2480.0	74.6	-20.6	8.0	-28.6

Figure 29 Test Results

JUDGEMENT: Passed by 26.1 dB

For additional information see *Figure 30* to *Figure 32.*

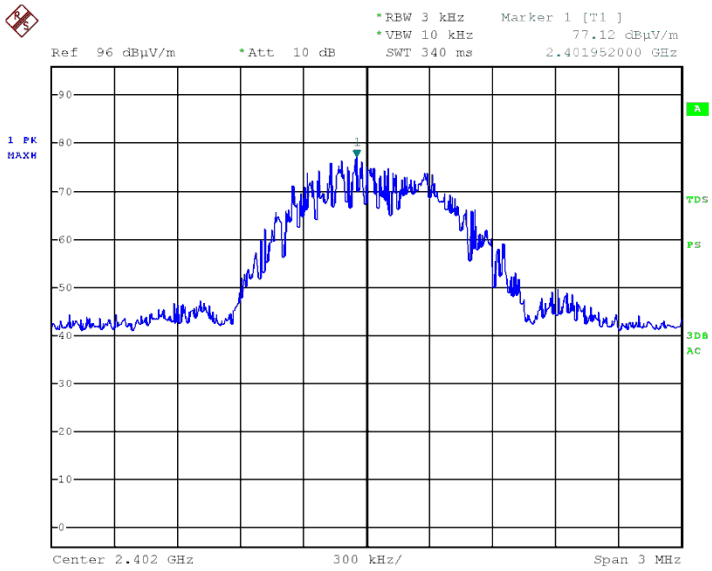

Figure 30 — 2402.0 MHz

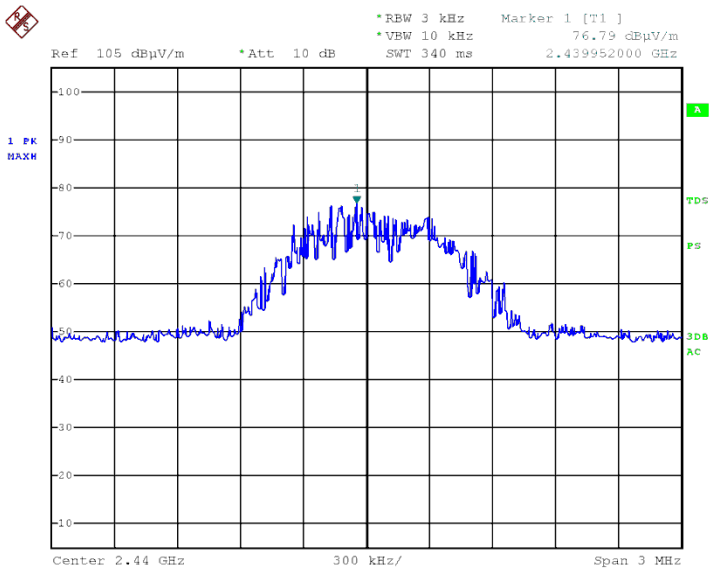

Figure 31 — 2440.0 MHz

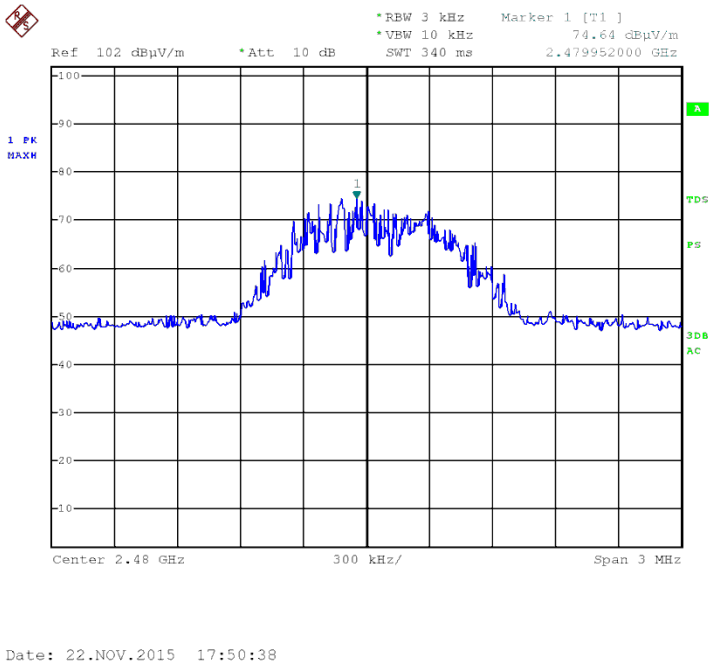

Figure 32 — 2480.0 MHz

9.4 *Test Equipment Used; Transmitted Power Density*

Instrument	Manufacturer	Model	Serial No.	Last Calibration Date	Next Calibration Date
EMI Receiver	R&S	ESCI7	100724	January 4, 2015	January 31, 2016
Horn Antenna	ETS	3115	6142	May 19, 2015	May 19, 2018
Semi Anechoic Civil Chamber	ETS	S81	SL 11643	N/A	N/A

Figure 33 Test Equipment Used

10. Antenna Gain/Information

The antenna gain is -5.0 dBi, integral.

11. R.F Exposure/Safety

Typical use of the E.U.T. is as a Bluetooth irrigation controller.

The typical placement of the E.U.T. is outside in field/garden. The typical distance between the E.U.T. and the user is 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 Power 94.7 dBuV/m (Peak) 0.891 mW (testing performed radiated; power results include antenna gain)

G_T- Antenna Gain, -5.0 dBi

R- Distance from Transmitter using 20cm worst case

(c) The peak power density is:

$$S = \frac{(0.891)}{4\pi(20)^2} = 1.77x10^{-4}\frac{mW}{cm^2}$$

(d) This is below the FCC limit.

12. APPENDIX A - CORRECTION FACTORS

12.1 *Correction factors for CABLE from EMI receiver* to test antenna at 3 meter range.

Frequency (MHz)	Cable Loss (dB)
0.010	0.4
0.015	0.2
0.020	0.2
0.030	0.3
0.050	0.3
0.075	0.3
0.100	0.2
0.150	0.2
0.200	0.3
0.500	0.4
1.00	0.4
1.50	0.5
2.00	0.5
5.00	0.6
10.00	0.8
15.00	0.9
20.00	0.8

Frequency (MHz)	Cable Loss (dB)
50.00	1.2
100.00	0.7
150.00	2.1
200.00	2.3
300.00	2.9
500.00	3.8
750.00	4.8
1000.00	5.4
1500.00	6.7
2000.00	9.0
2500.00	9.4
3000.00	9.9
3500.00	10.2
4000.00	11.2
4500.00	12.1
5000.00	13.1
5500.00	13.5
6000.00	14.5

NOTES:

1. The cable type is SPUMA400 RF-11N(X2) and 39m long

2. The cable is manufactured by Huber + Suhner

12.2 *Correction factors for* *Horn Antenna*

Model: SWH-28
at 1 meter range.

FREQUENCY (GHz)	AFE (dB /m)	Gain (dB1)
18.0	40.3	16.1
19.0	40.3	16.3
20.0	40.3	16.1
21.0	40.3	16.3
22.0	40.4	16.8
23.0	40.5	16.4
24.0	40.5	16.6
25.0	40.5	16.7
26.0	40.6	16.4

12.3 *Correction factors for* *Horn ANTENNA.*

Model: 3115

Antenna serial number: 6142

3 meter range

FREQUENCY (MHz)	Antenna Factor (dB/m)	FREQUENCY (MHz)	Antenna Factor (dB/m)
1000	23.9	10500	38.4
1500	25.4	11000	38.5
2000	27.3	11500	39.4
2500	28.5	12000	39.2
3000	30.4	12500	39.4
3500	31.6	13000	40.7
4000	33	14000	42.1
4500	32.7	15000	40.1
5000	34.1	16000	38.2
5500	34.5	17000	41.7
6000	34.9	17500	45.7
6500	35.1	18000	47.7
7000	35.9		
7500	37.5		
8000	37.6		
8500	38.3		
9000	38.5		
9500	38.1		
10000	38.6		

12.4 *Correction factors for Log Periodic Antenna EMCO, Model 3146, Serial #9505-4081*

CALIBRATION DATA

Frequency, MHz	Antenna factor, dB/m [1]
200	11.55
250	11.60
300	14.43
400	15.38
500	17.98
600	18.78
700	21.17
800	21.16
900	22.67
1000	24.09

[1] The antenna factor shall be added to receiver reading in dBμV to obtain field strength in dBμV/m.

12.5 *Correction factors for Biconical Antenna EMCO, Model 3104, Serial #2606*

CALIBRATION DATA

Frequency, MHz	Near free space antenna factor, dB/m	Geometry specific correction factor, dB	Free space antenna factor, dB/m [1)]
30	12.97	0.13	12.84
35	12.34	0.09	12.25
40	12.03	0.06	11.97
45	11.42	0.02	11.40
50	11.91	0.03	11.88
60	11.92	0.37	11.55
70	9.60	0.25	9.35
80	6.99	-0.45	7.44
90	10.87	-0.34	11.21
100	11.51	-0.06	11.57
120	13.30	0.20	13.10
140	12.56	-0.01	12.57
160	14.49	-0.12	14.61
180	16.53	0.05	16.48
200	15.30	0.15	15.15

[1)] The antenna factor shall be added to receiver reading in dBµV to obtain field strength in dBµV/m.

12.6 Correction factors for ACTIVE LOOP ANTENNA

Model 6502
S/N 9506-2950

FREQUENCY	Magnetic Antenna Factor	Electric Antenna Factor
(MHz)	(dB)	(dB)
.009	-35.1	16.4
.010	-35.7	15.8
.020	-38.5	13.0
.050	-39.6	11.9
.075	-39.8	11.8
.100	-40.0	11.6
.150	-40.0	11.5
.250	-40.0	11.6
.500	-40.0	11.5
.750	-40.1	11.5
1.000	-39.9	11.7
2.000	-39.5	12.0
3.000	-39.4	12.1
4.000	-39.7	11.9
5.000	-39.7	11.8
10.000	40.2	11.3
15.000	-40.7	10.8
20.000	-40.5	11.0
25.000	-41.3	10.2
30.000	42.3	9.2