

ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test Report No. : OT-197-RWD-055
AGR No. : A195A-120
Applicant : LG Electronics USA
Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, 07632, United States
Manufacturer : LG Electronics Inc.
Address : 222 LG-ro, Jinwi-Myeon, Pyeongtaek -Si, Gyeonggi-Do, 451-713, Korea
Type of Equipment : Wireless module
FCC ID. : BEJRBHP-B213B
Model Name : RBHP-B213B
Multiple Model Name : N/A
Serial number : N/A
Total page of Report : 12 pages (including this page)
Date of Incoming : June 20, 2019
Date of issue : July 22, 2019

SUMMARY

The equipment complies with the regulation; *FCC PART 15 SUBPART C Section 15.247 and FCC PART 15 SUBPART E Section 15.407*

This test report only contains the result of a single test of the sample supplied for the examination.

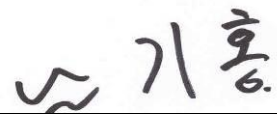
It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by:



Tae-Ho, Kim / Senior Manager
ONETECH Corp.

Approved by:



Ki-Hong, Nam / Chief Engineer
ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-197-RWD-055	July 22, 2019	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : LG Electronics USA
 Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, 07632, United States
 Contact Person : Kyung-Su, Han / Director, Standards & Compliance
 Telephone No. : +201-472-2623
 FCC ID : BEJRBHP-B213B
 Model Name : RBHP-B213B
 Brand Name : N/A
 Serial Number : N/A
 Date : July 22, 2019

EQUIPMENT CLASS	DSS – PART 15 SPREAD SPECTRUM TRANSMITTER DTS – DIGITAL TRNSMISSION SYSTEM Unlicensed National Information infrastructure(UNII)
E.U.T. DESCRIPTION	Wireless module
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 KDB 558074 D01 DTS Meas Guidance v04 FCC PART 15 SUBPART E Section 15.407 KDB 789033 D02 General UNII Test Procedures New Rules v02r01 KDB 662911 D01 Multiple Transmitter Output v02r01
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. GENERAL INFORMATION

2.1 Product Description

The LG Electronics USA, Model RBHP-B213B (referred to as the EUT in this report) is a Wireless module. The product specification described herein was obtained from product data sheet or user’s manual.

DEVICE TYPE	Wireless module			
Temperature Range	-20 °C ~ 55 °C			
OPERATING FREQUENCY	Bluetooth	2 402 MHz ~ 2 480 MHz		
	WLAN 2.4 GHz	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))		
	5 725 MHz ~ 5 850 MHz Band	5 745 MHz ~ 5 825 MHz (802.11a/n(HT20)/ac(VHT20))		
		5 755 MHz ~ 5 795 MHz (802.11n(HT40)/ac(VHT40))		
		5 775 MHz (802.11ac(VHT80))		
MODULATION TYPE	Bluetooth	GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8-DPSK for 3Mbps		
	WLAN 2.4 GHz	DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)		
	WLAN 5 GHz	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)		
RF OUTPUT POWER	Bluetooth	1 Mbps	1.03 dBm	
		2 Mbps	-2.27 dBm	
		3 Mbps	-1.91 dBm	
	WLAN 2.4 GHz	14.56 dBm(802.11b)		
		9.90 dBm(802.11g)		
		9.30 dBm(802.11n_HT20)		
	5 725 MHz ~ 5 850 MHz Band	Antenna 0	6.28 dBm(802.11a)	
			6.22 dBm(802.11n_HT20)	
			6.07 dBm(802.11n_HT40)	
		Antenna 1	5.74 dBm(802.11ac_VHT80)	
10.07 dBm(802.11a)				
9.99 dBm(802.11n_HT20)				
Multiple Antenna	10.29 dBm(802.11n_HT40)			
	9.62 dBm(802.11ac_VHT80)			
	11.51 dBm(802.11n_HT20)			
		11.68 dBm(802.11n_HT40)		
		11.11 dBm(802.11ac_VHT80)		

MODULATION TYPE	Bluetooth	GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8-DPSK for 3Mbps			
	WLAN 2.4 G	DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)			
	WLAN 5 G	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)			
Antenna Type	PCB Antenna				
ANTENNA GAIN	2.4 GHz Band	Antenna 0 (Bluetooth + 5 GHz WiFi)		5.28 dBi	
		Antenna 1 (2.4 GHz WiFi + 5 GHz WiFi)		2.29 dBi	
	5 GHz Band	5 725 MHz ~ 5 850 MHz	Antenna 0 (Bluetooth + 5 GHz WiFi)		2.47 dBi
			Antenna 1 (2.4 GHz WiFi + 5 GHz WiFi)		2.28 dBi
			Antenna 0 + 1		5.39 dBi
	Intermodulation Mode	Bluetooth + 2.4 GHz WiFi (Antenna 0 + Antenna 1)		7.05 dBi	
		Bluetooth + 5 GHz WiFi (Antenna 0 + Antenna 1)		7.04 dBi	
List of each Osc. or crystal Freq. (Freq. \geq 1 MHz)		37.4 MHz			

2.2 Alternative type(s)/model(s); also covered by this test report.

-. None

3. EUT MODIFICATIONS

-. None

4. MAXIMUM PERMISSIBLE EXPOSURE

4.1 RF Exposure Calculation

According to the FCC rule 1.1310 table 1B, the limit for the maximum permissible RF exposure for an uncontrolled environment are $f/1500 \text{ mW/cm}^2$ for the frequency range between 300 MHz and 1 500 MHz and 1.0 mW/cm^2 for the frequency range between 1 500 MHz and 100 000 MHz.

The electric field generated for a 1 mW/cm^2 exposure is calculated as follows:

$$E = \sqrt{(30 * P * G) / d}, \text{ and } S = E^2 / Z = E^2 / 377, \text{ because } 1 \text{ mW/cm}^2 = 10 \text{ W/m}^2$$

Where

S = Power density in mW/cm^2 , Z = Impedance of free space, 377Ω

E = Electric field strength in V/m, G = Numeric antenna gain, and d = distance in meter

Combining equations and rearranging the terms to express the distance as a function of the remaining variable

$$d = \sqrt{(30 * P * G) / (377 * 10 S)}$$

Changing to units of mW and cm, using $P (\text{mW}) = P (\text{W}) / 1 000$, $d (\text{cm}) = 0.01 * d (\text{m})$

$$d = 0.282 * \sqrt{(P * G) / S}$$

Where

d = distance in cm, P = Power in mW, G = Numeric antenna gain, and S = Power density in mW/cm^2

Kind of EUT	Wireless module
Device Category	<input type="checkbox"/> Portable (< 20 cm separation) <input type="checkbox"/> Mobile (> 20 cm separation) <input checked="" type="checkbox"/> Others
Exposure Evaluation Applied	<input checked="" type="checkbox"/> MPE <input type="checkbox"/> SAR <input type="checkbox"/> N/A



Tested by: Hyung-Kwon, Oh / Assistant Manager

4.2 Test Result for Bluetooth

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
2 402 ~ 2 480	1 Mbps	1.0 ± 0.5	1.50	1.41	5.28	3.37	0.62	0.000 9	1.00
	2 Mbps	-2.0 ± 0.5	-1.50	0.71			0.44	0.000 5	1.00
	3 Mbps	-1.5 ± 0.5	-1.00	0.79			0.46	0.000 5	1.00

According to above table, for 2 402 MHz ~ 2 480 MHz Band(1 Mbps), safe distance,

$$D = 0.282 * \sqrt{(1.41 * 3.37) / 1.00} = 0.62 \text{ cm}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 1.41 * 3.37 / (4 * 3.14 * 20^2) = 0.000 9$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna



Tested by: Hyung-Kwon, Oh / Assistant Manager

4.3 Test Result for WLAN

4.3.1 DATA for Antenna 0

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
5 725 ~ 5 850	802.11a	6.0 ± 0.5	6.50	4.47	2.47	1.77	0.79	0.001 6	1.00
	802.11n_HT20	6.0 ± 0.5	6.50	4.47			0.79	0.001 6	1.00
	802.11n_HT40	6.0 ± 0.5	6.50	4.47			0.79	0.001 6	1.00
	802.11ac80	5.5 ± 0.5	6.00	3.98			0.75	0.001 4	1.00

According to above table, for 5 725 ~ 5 850 MHz Band(802.11 a), safe distance,

$$D = 0.282 * \sqrt{(4.47 * 1.77)/1.00} = 0.79 \text{ cm.}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 4.47 * 1.77 / (4 * 3.14 * 20^2) = 0.001 6$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna



Tested by: Hyung-Kwon, Oh / Assistant Manager

4.3.2 DATA for Antenna 1

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
2 400 ~ 2 483.5	802.11b	14.5 ± 0.5	15.00	31.62	2.29	1.69	2.06	0.010 7	1.00
	802.11g	10.0 ± 0.5	10.50	11.22			1.23	0.003 8	1.00
	802.11n_HT20	9.0 ± 0.5	9.50	8.91			1.10	0.003 0	1.00
5 725 ~ 5 850	802.11a	10.0 ± 0.5	10.50	11.22	2.28	1.69	1.23	0.003 8	1.00
	802.11n_HT20	10.0 ± 0.5	10.50	11.22			1.23	0.003 8	1.00
	802.11n_HT40	10.0 ± 0.5	10.50	11.22			1.23	0.003 8	1.00
	802.11ac80	9.5 ± 0.5	10.00	10.00			1.16	0.003 4	1.00

According to above table, for 2 400 ~ 2483.5 MHz Band(802.11 b), safe distance,

$$D = 0.282 * \sqrt{(31.62 * 1.69)/1.00} = 2.06 \text{ cm.}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 31.62 * 1.69 / (4 * 3.14 * 20^2) = 0.010 7$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna



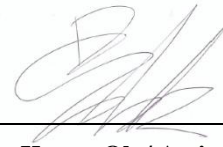
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4.3.3 DATA for Multiple Transmit

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Power Density (mW/cm ²) @ 20 cm Separation	Sum Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)			
5 725 ~ 5 850	802.11n_HT20	6.0 ± 0.5	6.50	4.47	0.001 6	0.005 4	1.00
		10.0 ± 0.5	10.50	11.22	0.003 8		
	802.11n_HT40	6.0 ± 0.5	6.50	4.47	0.001 6	0.005 4	1.00
		10.0 ± 0.5	10.50	11.22	0.003 8		
	802.11ac80	5.5 ± 0.5	6.00	3.98	0.001 4	0.004 8	1.00
		9.5 ± 0.5	10.00	10.00	0.003 4		

$$\text{WLAN 5 GHz}(802.11n_HT20) = (0.001\ 6/1) + (0.003\ 8/1) = 0.005\ 4$$



Tested by: Hyung-Kwon, Oh / Assistant Manager

4.4 DATA for Intermodulation Transmit

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Power Density (mW/cm ²) @ 20 cm Separation	Sum Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)			
Bluetooth + WLAN 2 G	Bluetooth (1 Mbps)_Ant 0	1.0 ± 0.5	1.50	1.41	0.000 9	0.011 6	1.00
	WLAN 2 G (802.11 b)_Ant 1	14.5 ± 0.5	15.00	31.62	0.010 7		
Bluetooth + WLAN 5 G	Bluetooth (1 Mbps)_Ant 0	1.0 ± 0.5	1.50	1.41	0.000 9	0.004 7	1.00
	WLAN 5 G (802.11a)_Ant 1	10.0 ± 0.5	10.50	11.22	0.003 8		



Tested by: Hyung-Kwon, Oh / Assistant Manager