

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

Test Report No. : W156R-D031
AGR No. : A155A-050
Applicant : LG Electronics USA
Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, United States, 7632
Manufacturer : LG Electronics Inc.
Address : 222 LG-ro, Jinwi-Myeon, Pyeongtaek-Si, Gyeonggi-Do, 451-713, Korea
Type of Equipment : WLAN Module
FCC ID. : BEJ9QK-TWFMB008D
Model Name : TWFM-B008D
Multiple Model Name : N/A
Serial number : N/A
Total page of Report : 12 pages (including this page)
Date of Incoming : May 08, 2015
Date of issue : June 19, 2015

SUMMARY

The equipment complies with the regulation; *FCC PART 15 SUBPART C Section 15.247*
 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: 

 Jae-Ho, Lee / Chief Engineer
 ONETECH Corp.

Approved by: 

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 ONETECH Corp.

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
W156R-D031	June 19, 2015	Initial Issue	All

1. VERIFICATION OF COMPLIANCE

Applicant : LG Electronics USA
 Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, United States, 7632
 Contact Person : Yongduk Kwon / Research Engineer
 Telephone No. : +82-31-610-9606
 FCC ID : BEJ9QK-TWFMB008D
 Model Name : TWFM-B008D
 Serial Number : N/A
 Date : June 19, 2015

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Modular Transmitter, WLAN Module
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification, Modular Approval
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247
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 TWFM-B008D (referred to as the EUT in this report) is a WLAN Module. Product specification information described herein was obtained from product data sheet or user’s manual.

DEVICE TYPE	WLAN Module			
FREQUENCY RANGE	2 412 MHz ~ 2 462 MHz_20 MHz BW			
	2 422 MHz ~ 2 452 MHz_40 MHz BW			
	5 180 MHz ~ 5 240 MHz_20 MHz BW			
	5 190 MHz ~ 5 230 MHz_40 MHz BW			
	5 745 MHz ~ 5 825 MHz_20 MHz BW			
	5 755 MHz ~ 5 795 MHz_40 MHz BW			
MAX. RF OUTPUT POWER	2 400 MHz ~ 2 483.5 MHz Band	Antenna 0	Wi-Fi 802.11b(22.26 dBm) Wi-Fi 802.11g (23.11 dBm) Wi-Fi 802.11n_20 MHz (23.53 dBm) Wi-Fi 802.11n_40 MHz (24.78 dBm)	
		Antenna 1	Wi-Fi 802.11b(21.11 dBm) Wi-Fi 802.11g (22.26 dBm) Wi-Fi 802.11n_20 MHz (22.64 dBm) Wi-Fi 802.11n_40 MHz (23.55 dBm)	
	Ant.0	5 150 MHz ~ 5 250 MHz Band	Wi-Fi 802.11a (10.06 dBm) Wi-Fi 802.11n_20 MHz (10.58 dBm) Wi-Fi 802.11n_40 MHz (12.47 dBm)	
		5 725 MHz ~ 5 850 MHz Band	Wi-Fi 802.11a (13.48 dBm) Wi-Fi 802.11n_20 MHz (14.13 dBm) Wi-Fi 802.11n_40 MHz (13.84 dBm)	
	Ant.1	5 150 MHz ~ 5 250 MHz Band	Wi-Fi 802.11a (9.58 dBm) Wi-Fi 802.11n_20 MHz (9.44 dBm) Wi-Fi 802.11n_40 MHz (12.57 dBm)	
		5 725 MHz ~ 5 850 MHz Band	Wi-Fi 802.11a (13.33 dBm) Wi-Fi 802.11n_20 MHz (14.78 dBm) Wi-Fi 802.11n_40 MHz (13.89 dBm)	
	MODULATION TYPE	802.11b: DSSS Modulation(DBPSK/DQPSK/CCK) 802.11a/g/n(HT20)/n(HT40): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)		
	Antenna Gain	2.4 GHz Band	NP8350 V3_B : -0.79 dBi	
NP8350 V3 : -1.08 dBi				
5 GHz Band		NP8350 V3_B : 3.69 dBi		
		NP8350 V3 : 1.14 dBi		
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	20 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 $f/1500$ mW/cm² for the frequency range between 300 MHz and 1 500 MHz and 1.0 mW/cm² for the frequency range between 1 500 MHz and 100 000 MHz.

The electric field generated for a 1 mW/cm² 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/cm², Z = Impedance of free space, 377 Ω

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/cm²

4.2 EUT Description

Kind of EUT	WLAN Module		
Operating Frequency Band	<input type="checkbox"/> Wireless Microphone: 494.000 MHz ~ 501.000 MHz and 498.200 MHz ~ 505.200 MHz <input checked="" type="checkbox"/> WLAN: 2 412 MHz ~ 2 462 MHz <input checked="" type="checkbox"/> WLAN: 5 180 MHz ~ 5 320 MHz / 5 500 MHz ~ 5 700 MHz <input checked="" type="checkbox"/> WLAN: 5 745 MHz ~ 5 825 MHz <input type="checkbox"/> Bluetooth: 2 402 MHz ~ 2 480 MHz <input type="checkbox"/> GFSK Modulation: 2403 MHz , 2443 MHz , 2478 MHz		
Device Category	<input type="checkbox"/> Portable (< 20 cm separation) <input type="checkbox"/> Mobile (> 20 cm separation) <input checked="" type="checkbox"/> Others		
Max. Output Power	2.4 GHz Band	Ant.0	Wi-Fi 802.11b(22.26 dBm) Wi-Fi 802.11g (23.11 dBm) Wi-Fi 802.11n_20 MHz (23.53 dBm) Wi-Fi 802.11n_40 MHz (24.78 dBm)
		Ant.1	Wi-Fi 802.11b(21.11 dBm) Wi-Fi 802.11g (22.26 dBm) Wi-Fi 802.11n_20 MHz (22.64 dBm) Wi-Fi 802.11n_40 MHz (23.55 dBm)

Max. Output Power	5 GHz Band	Ant.0	5 150 MHz ~ 5 250 MHz Band	Wi-Fi 802.11a (10.06 dBm) Wi-Fi 802.11n_20 MHz (10.58 dBm) Wi-Fi 802.11n_40 MHz (12.47 dBm)
			5 725 MHz ~ 5 850 MHz Band	Wi-Fi 802.11a (13.48 dBm) Wi-Fi 802.11n_20 MHz (14.13 dBm) Wi-Fi 802.11n_40 MHz (13.84 dBm)
		Ant.1	5 150 MHz ~ 5 250 MHz Band	Wi-Fi 802.11a (9.58 dBm) Wi-Fi 802.11n_20 MHz (9.44 dBm) Wi-Fi 802.11n_40 MHz (12.57 dBm)
			5 725 MHz ~ 5 850 MHz Band	Wi-Fi 802.11a (13.33 dBm) Wi-Fi 802.11n_20 MHz (14.78 dBm) Wi-Fi 802.11n_40 MHz (13.89 dBm)
Used Antenna Gain	2.4 GHz Band	NP8350 V3_B : -0.79 dBi		
		NP8350 V3 : -1.08 dBi		
	5.15 GHz Band	NP8350 V3_B : 3.69 dBi		
		NP8350 V3 : 1.14 dBi		
5.8 GHz Band	NP8350 V3_B : 2.88 dBi			
	NP8350 V3 : 2.04 dBi			
Exposure Evaluation Applied	<input checked="" type="checkbox"/> MPE <input type="checkbox"/> SAR <input type="checkbox"/> N/A2.4GHz & 5GHz can not transmit at the same time.			

2.4 GHz & 5 GHz can not transmit at the same time.

5. Calculated MPE Safe Distance

5.1 Test 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			
2 400 ~ 2 483.5	802.11b	22.5 ± 0.5	23.0	199.53	-0.79	0.834	3.64	0.033 1	1.00
	802.11g	23.0 ± 0.5	23.5	223.87			3.85	0.037 1	1.00
	802.11n_HT20	23.5 ± 0.5	24.0	251.19			4.08	0.041 7	1.00
	802.11n_HT40	25.0 ± 0.5	25.5	354.81			4.85	0.058 8	1.00
5 150 ~ 5 250	802.11a	10.0 ± 0.5	10.5	11.22	3.69	2.339	1.44	0.005 2	1.00
	802.11n_HT20	10.5 ± 0.5	11.0	12.59			1.53	0.005 9	1.00
	802.11n_HT40	12.5 ± 0.5	13.0	19.95			1.93	0.009 3	1.00
5 725 ~ 5 825	802.11a	13.5 ± 0.5	14.0	25.12	2.88	1.941	1.97	0.009 7	1.00
	802.11n_HT20	14.0 ± 0.5	14.5	28.18			2.09	0.010 9	1.00
	802.11n_HT40	14.0 ± 0.5	14.5	28.18			2.09	0.010 9	1.00

5.2 Test 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	21.0 ± 0.5	21.5	141.25	-0.79	0.834	3.06	0.023 4	1.00
	802.11g	22.5 ± 0.5	23.0	199.53			3.64	0.033 1	1.00
	802.11n_HT20	22.5 ± 0.5	23.0	199.53			3.64	0.033 1	1.00
	802.11n_HT40	23.5 ± 0.5	24.0	251.19			4.08	0.041 7	1.00
5 150 ~ 5 250	802.11a	9.5 ± 0.5	10.0	10.00	3.69	2.339	1.36	0.004 7	1.00
	802.11n_HT20	9.5 ± 0.5	10.0	10.00			1.36	0.004 7	1.00
	802.11n_HT40	12.5 ± 0.5	13.0	19.95			1.93	0.009 3	1.00
5 725 ~ 5 825	802.11a	13.5 ± 0.5	14.0	25.12	2.88	1.941	1.97	0.009 7	1.00
	802.11n_HT20	15.0 ± 0.5	15.5	35.48			2.34	0.013 7	1.00
	802.11n_HT40	14.0 ± 0.5	14.5	28.18			2.09	0.010 9	1.00

5.3 Test 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		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	-	-	-	-0.79	0.834	-	-	-
	802.11g	25.5 ± 0.5	26.0	398.11			5.14	0.066 0	1.00
	802.11n_HT20	26.0 ± 0.5	26.5	446.68			5.44	0.074 1	1.00
	802.11n_HT40	27.0 ± 0.5	27.5	562.34			6.11	0.093 3	1.00
5 150 ~ 5 250	802.11a	12.5 ± 0.5	13.0	19.95	3.69	2.339	1.93	0.009 3	1.00
	802.11n_HT20	13.0 ± 0.5	13.5	22.39			2.04	0.010 4	1.00
	802.11n_HT40	15.5 ± 0.5	16.0	39.81			2.72	0.018 5	1.00
5 725 ~ 5 825	802.11a	16.5 ± 0.5	17.0	50.12	2.88	1.941	2.78	0.019 4	1.00
	802.11n_HT20	17.0 ± 0.5	17.5	56.23			2.95	0.021 7	1.00
	802.11n_HT40	17.0 ± 0.5	17.5	56.23			2.95	0.021 7	1.00