

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

Test Report No. : W161R-D016
AGR No. : A15DA-264
Applicant : LG Innotek Co., Ltd.
Address : 978-1, Jangduk-dong, Gwangsan-gu, Gwangju, 506-731 Korea
Manufacturer : LG Innotek Co., Ltd.
Address : 978-1, Jangduk-dong, Gwangsan-gu, Gwangju, 506-731 Korea
Type of Equipment : Wi-Fi/BT Combo module
FCC ID. : YZP-TWCMK007D
Model Name : TWCM-K007D
Serial number : N/A
Total page of Report : 12 pages (including this page)
Date of Incoming : December 28, 2015
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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: 

 Ki-Hong, Nam / Asst, Chief Engineer
 ONETECH Corp.

Approved by: 

 Sung-Ik, Han / Managing Director
 ONETECH Corp.

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
W161R-D016	January 25, 2016	Initial Issue	All

1. VERIFICATION OF COMPLIANCE

Applicant : LG Innotek Co., Ltd.
 Address : 978-1, Jangduk-dong, Gwangsan-gu, Gwangju, 506-731 Korea
 Contact Person : IC Jeong / Senior engineer
 Telephone No. : +82-62-950-0332
 FCC ID : YZP-TWCMK007D
 Model Name : TWCM-K007D
 Serial Number : N/A
 Date : January 25, 2016

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Modular Transmitter, Wi-Fi/BT Combo 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
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 Innotek Co., Ltd., Model TWCM-K007D (referred to as the EUT in this report) is a Wi-Fi/BT Combo module. Product specification information described herein was obtained from product data sheet or user’s manual.

DEVICE TYPE	Wi-Fi/BT Combo module			
FREQUENCY RANGE	Bluetooth	2 402 MHz ~ 2 480 MHz		
	Bluetooth LE	2 402 MHz ~ 2 480 MHz		
	WLAN 2.4 GHz Band	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20)) 2 422 MHz ~ 2 452 MHz (802.11n(HT40))		
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	5 180 MHz ~ 5 240 MHz (802.11n(HT20)/ac20)	
			5 190 MHz ~ 5 230 MHz (802.11n(HT40)/ac40)	
			5 210 MHz (802.11ac80)	
		5 725 MHz ~ 5 850 MHz Band	5 745 MHz ~ 5 825 MHz (802.11n(HT20)/ac20)	
			5 755 MHz ~ 5 795 MHz (802.11n(HT40)/ac40)	
5 775 MHz (802.11ac80)				

MAX. RF OUTPUT POWER	Bluetooth		1 Mbps	5.94 dBm	
			2 Mbps	6.77 dBm	
			3 Mbps	7.07 dBm	
	Bluetooth LE		1.43 dBm		
	WLAN 2.4 GHz Band		Ant.0	Wi-Fi 802.11b (12.72 dBm) Wi-Fi 802.11g (11.75 dBm) Wi-Fi 802.11n_20 MHz (10.54 dBm) Wi-Fi 802.11n_40 MHz (8.69 dBm)	
				Ant.1	Wi-Fi 802.11b (12.92 dBm) Wi-Fi 802.11g (11.75 dBm) Wi-Fi 802.11n_20 MHz (10.82 dBm) Wi-Fi 802.11n_40 MHz (8.50 dBm)
	WLAN 5 GHz Band		Ant.0		5 150 MHz ~ 5 250 MHz Band Wi-Fi 802.11a (10.00 dBm) Wi-Fi 802.11n_20 MHz (9.87 dBm) Wi-Fi 802.11n_40 MHz (8.56 dBm) Wi-Fi 802.11ac20 MHz (9.77 dBm) Wi-Fi 802.11ac40 MHz (9.49 dBm) Wi-Fi 802.11ac80 MHz (8.04 dBm)
				5 725 MHz ~ 5 850 MHz Band Wi-Fi 802.11a (9.22 dBm) Wi-Fi 802.11n_20 MHz (9.09 dBm) Wi-Fi 802.11n_40 MHz (7.00 dBm) Wi-Fi 802.11ac20 MHz (9.31 dBm) Wi-Fi 802.11ac40 MHz (8.12 dBm) Wi-Fi 802.11ac80 MHz (7.40 dBm)	
			Ant.1	5 150 MHz ~ 5 250 MHz Band Wi-Fi 802.11a (9.32 dBm) Wi-Fi 802.11n_20 MHz (9.01 dBm) Wi-Fi 802.11n_40 MHz (7.57 dBm) Wi-Fi 802.11ac20 MHz (9.18 dBm) Wi-Fi 802.11ac40 MHz (8.83 dBm) Wi-Fi 802.11ac80 MHz (7.16 dBm)	
				5 725 MHz ~ 5 850 MHz Band Wi-Fi 802.11a (8.49 dBm) Wi-Fi 802.11n_20 MHz (8.45 dBm) Wi-Fi 802.11n_40 MHz (7.12 dBm) Wi-Fi 802.11ac20 MHz (8.49 dBm) Wi-Fi 802.11ac40 MHz (7.39 dBm) Wi-Fi 802.11ac80 MHz (6.54 dBm)	

MODULATION TYPE	Bluetooth	GFSK for 1 Mbps, DQPSK for 2 Mbps, 8-DPSK for 3 Mbps
	Bluetooth LE	GFSK
	WLAN 2.4 GHz Band	DSSS Modulation(DBPSK/DQPSK/CCK)
	WLAN 5 GHz Band	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)
Antenna Gain	2.4 GHz Band [BT(BDR / EDR / LE)]	0.42 dBi
	2.4 GHz Band [WLAN]	Antenna 0 : 1.23 dBi
		Antenna 1 : 1.21 dBi
	5 GHz Band [5 150 MHz ~ 5 250 MHz Band]	Antenna 0 : 1.71 dBi
		Antenna 1 : 1.39 dBi
	5 GHz Band [5 725 MHz ~ 5 850 MHz Band]	Antenna 0 : 1.10 dBi
		Antenna 1 : 0.71 dBi
	List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	40 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

4.2 EUT Description

Kind of EUT	Wi-Fi/BT Combo 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 ~ 5 240 MHz <input checked="" type="checkbox"/> WLAN: 5 745 MHz ~ 5 825 MHz <input checked="" type="checkbox"/> Bluetooth: 2 402 MHz ~ 2 480 MHz <input checked="" type="checkbox"/> Bluetooth BLE: 2 402 MHz ~ 2 480 MHz			
Device Category	<input type="checkbox"/> Portable (< 20 cm separation) <input type="checkbox"/> Mobile (> 20 cm separation) <input checked="" type="checkbox"/> Others			
MAX. RF OUTPUT POWER	Bluetooth		1 Mbps	5.94 dBm
			2 Mbps	6.77 dBm
			3 Mbps	7.07 dBm
	Bluetooth LE	1.43 dBm		
	WLAN 2.4 GHz Band	Ant.0	Wi-Fi 802.11b (12.72 dBm) Wi-Fi 802.11g (11.75 dBm) Wi-Fi 802.11n_20 MHz (10.54 dBm) Wi-Fi 802.11n_40 MHz (8.69 dBm)	
	Ant.1	Wi-Fi 802.11b (12.92 dBm) Wi-Fi 802.11g (11.75 dBm) Wi-Fi 802.11n_20 MHz (10.82 dBm) Wi-Fi 802.11n_40 MHz (8.50 dBm)		

	WLAN 5 GHz Band	Ant.0	5 150 MHz ~ 5 250 MHz Band	Wi-Fi 802.11a (10.00 dBm) Wi-Fi 802.11n_20 MHz (9.87 dBm) Wi-Fi 802.11n_40 MHz (8.56 dBm) Wi-Fi 802.11ac20 MHz (9.77 dBm) Wi-Fi 802.11ac40 MHz (9.49 dBm) Wi-Fi 802.11ac80 MHz (8.04 dBm)
			5 725 MHz ~ 5 850 MHz Band	Wi-Fi 802.11a (9.22 dBm) Wi-Fi 802.11n_20 MHz (9.09 dBm) Wi-Fi 802.11n_40 MHz (7.00 dBm) Wi-Fi 802.11ac20 MHz (9.31 dBm) Wi-Fi 802.11ac40 MHz (8.12 dBm) Wi-Fi 802.11ac80 MHz (7.40 dBm)
		Ant.1	5 150 MHz ~ 5 250 MHz Band	Wi-Fi 802.11a (9.32 dBm) Wi-Fi 802.11n_20 MHz (9.01 dBm) Wi-Fi 802.11n_40 MHz (7.57 dBm) Wi-Fi 802.11ac20 MHz (9.18 dBm) Wi-Fi 802.11ac40 MHz (8.83 dBm) Wi-Fi 802.11ac80 MHz (7.16 dBm)
			5 725 MHz ~ 5 850 MHz Band	Wi-Fi 802.11a (8.49 dBm) Wi-Fi 802.11n_20 MHz (8.45 dBm) Wi-Fi 802.11n_40 MHz (7.12 dBm) Wi-Fi 802.11ac20 MHz (8.49 dBm) Wi-Fi 802.11ac40 MHz (7.39 dBm) Wi-Fi 802.11ac80 MHz (6.54 dBm)
Antenna Gain	2.4 GHz Band [BT(BDR / EDR / LE)]	0.42 dBi		
	2.4 GHz Band [WLAN]	Antenna 0 : 1.23 dBi		
		Antenna 1 : 1.21 dBi		
	5 GHz Band [5 150 MHz ~ 5 250 MHz Band]	Antenna 0 : 1.71 dBi		
Antenna 1 : 1.39 dBi				
5 GHz Band [5 725 MHz ~ 5 850 MHz Band]	Antenna 0 : 1.10 dBi			
	Antenna 1 : 0.71 dBi			
Exposure Evaluation Applied	<input checked="" type="checkbox"/> MPE <input type="checkbox"/> SAR <input type="checkbox"/> N/A			

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

4.3 Calculated MPE Safe Distance

4.3.1 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	12.50 ± 0.5	13.00	19.95	1.23	1.33	1.45	0.0053	1.00
	802.11g	11.50 ± 0.5	12.00	15.86			1.29	0.0042	1.00
	802.11n_HT20	10.50 ± 0.5	11.00	12.59			1.15	0.0033	1.00
	802.11n_HT40	8.50 ± 0.5	9.00	7.94			0.92	0.0021	1.00

4.3.2 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	12.50 ± 0.5	13.00	19.95	1.21	1.32	1.45	0.0052	1.00
	802.11g	11.50 ± 0.5	12.00	15.86			1.29	0.0042	1.00
	802.11n_HT20	10.50 ± 0.5	11.00	12.59			1.15	0.0033	1.00
	802.11n_HT40	8.5 ± 0.5	9.00	7.94			0.91	0.0021	1.00

4.3.3 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	15.50 ± 0.5	16.00	39.81	1.23	1.33	2.05	0.0105	1.00
	802.11g	14.50 ± 0.5	15.00	31.62			1.83	0.0084	1.00
	802.11n_HT20	13.50 ± 0.5	14.00	25.12			1.63	0.0066	1.00
	802.11n_HT40	11.00 ± 0.5	12.00	15.85			1.29	0.0042	1.00