

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


Test Report No. : W174R-D006
AGR No. : A172A-372
Applicant : LG Innotek Co., Ltd.
Address : 26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, 506-731, South Korea
Manufacturer : LG Innotek Co., Ltd.
Address : 26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, 506-731, South Korea
Type of Equipment : BT(V4.2) + WLAN(802.11a/b/g/n/ac) 2x2 MIMO Module
FCC ID. : YZP-RBHP-B216C
Model Name : RBHP-B216C
Serial number : N/A
Total page of Report : 16 pages (including this page)
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SUMMARY

The equipment complies with the regulation; *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: 

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

Approved by: 

 Keun-Young, Choi / Vice President
 ONETECH Corp.

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REVISION HISTORY

Issued Report No.	Issued Date	Revisions	Effect Section
W174R-D006	April 05, 2017	Initial Issue	All

DOCUMENT HISTORY

Revision No.	Issued Date	Revisions	Effect Section
Original	April 05, 2017	Initial Issue	-
Revision 01	April 11, 2017	The add FCC ID/IC information and DFS function.	8 Page
Revision 02	April 13, 2017	Delete for the FCC ID/IC information.	8 Page

1. VERIFICATION OF COMPLIANCE

Applicant : LG Innotek Co., Ltd.
 Address : 26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, 506-731, South Korea
 Contact Person : Jeong Inchang / Senior Research Engineer
 Telephone No. : +82-62-950-0332
 FCC ID : YZP-RBHP-B216C
 Model Name : RBHP-B216C
 Serial Number : N/A
 Date : April 05, 2017

EQUIPMENT CLASS	Unlicensed National Information infrastructure(UNII)
E.U.T. DESCRIPTION	Modular Transmitter, BT(V4.2) + WLAN(802.11a/b/g/n/ac) 2x2 MIMO 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 E Section 15.407
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 RBHP-B216C (referred to as the EUT in this report) is a BT(V4.2) + WLAN(802.11a/b/g/n/ac) 2x2 MIMO Module. Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	BT(V4.2) + WLAN(802.11a/b/g/n/ac) 2x2 MIMO Module		
FREQUENCY RANGE	Bluetooth	2 402 MHz ~ 2 480 MHz	
	WLAN 2.4 GHz Band	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))	
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	5 180 MHz ~ 5 240 MHz (802.11a/n(HT20)/ac(VHT20))
			5 190 MHz ~ 5 230 MHz (802.11n(HT40)/ac(VHT40))
			5 210 MHz (802.11ac(VHT80))
		5 250 MHz ~ 5 350 MHz Band	5 260 MHz ~ 5 320 MHz (802.11a/n(HT20)/ac(VHT20))
			5 270 MHz ~ 5 310 MHz (802.11n(HT40)/ac(VHT40))
			5 290 MHz (802.11ac(VHT80))
		5 470 MHz ~ 5 725 MHz Band	5 500 MHz ~ 5 720 MHz (802.11a/n(HT20)/ac(VHT20))
			5 510 MHz ~ 5 710 MHz (802.11n(HT40)/ac(VHT40))
			5 530 MHz (802.11ac(VHT80))
			5 745 MHz ~ 5 825 MHz (802.11a/n(HT20)/ac(VHT20))
5 725 MHz ~ 5 850 MHz Band	5 755 MHz ~ 5 795 MHz (802.11n(HT40)/ac(VHT40))		
	5 775 MHz (802.11ac(VHT80))		

MAX. RF OUTPUT POWER	Bluetooth	1 Mbps	0.97 dBm	
		2 Mbps	-1.67 dBm	
		3 Mbps	-1.24 dBm	
	WLAN 2.4 GHz Band	Wi-Fi 802.11b (16.40 dBm) Wi-Fi 802.11g (15.84 dBm) Wi-Fi 802.11n(HT20) (15.05 dBm)		
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	Antenna 0	Wi-Fi 802.11a (13.96 dBm) Wi-Fi 802.11n(HT20) (11.80 dBm) Wi-Fi 802.11n(HT40) (10.14 dBm) Wi-Fi 802.11ac(HT80) (12.61 dBm)
			Antenna 1	Wi-Fi 802.11a (13.92 dBm) Wi-Fi 802.11n(HT20) (10.62 dBm) Wi-Fi 802.11n(HT40) (10.54 dBm) Wi-Fi 802.11ac(HT80) (12.66 dBm)
			Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (14.24 dBm) Wi-Fi 802.11n(HT40) (13.29 dBm) Wi-Fi 802.11ac(HT80) (12.96 dBm)
		5 250 MHz ~ 5 350 MHz Band	Antenna 0	Wi-Fi 802.11a (14.42 dBm) Wi-Fi 802.11n(HT20) (14.61 dBm) Wi-Fi 802.11n(HT40) (14.10 dBm) Wi-Fi 802.11ac(HT80) (12.51 dBm)
			Antenna 1	Wi-Fi 802.11a (14.41 dBm) Wi-Fi 802.11n(HT20) (14.54 dBm) Wi-Fi 802.11n(HT40) (13.56 dBm) Wi-Fi 802.11ac(HT80) (13.21 dBm)
			Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (17.59 dBm) Wi-Fi 802.11n(HT40) (16.85 dBm) Wi-Fi 802.11ac(HT80) (15.88 dBm)

MAX. RF OUTPUT POWER	WLAN 5 GHz Band	5 470 MHz ~ 5 725 MHz Band	Antenna 0	Wi-Fi 802.11a (14.91 dBm) Wi-Fi 802.11n(HT20) (14.94 dBm) Wi-Fi 802.11n(HT40) (14.81 dBm) Wi-Fi 802.11ac(HT80) (12.99 dBm)
			Antenna 1	Wi-Fi 802.11a (14.62 dBm) Wi-Fi 802.11n(HT20) (14.97 dBm) Wi-Fi 802.11n(HT40) (14.32 dBm) Wi-Fi 802.11ac(HT80) (13.44dBm)
			Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (17.88 dBm) Wi-Fi 802.11n(HT40) (17.58 dBm) Wi-Fi 802.11ac(HT80) (16.23 dBm)
		5 725 MHz ~ 5 850 MHz Band	Antenna 0	Wi-Fi 802.11a (14.58 dBm) Wi-Fi 802.11n(HT20) (14.27 dBm) Wi-Fi 802.11n(HT40) (13.88 dBm) Wi-Fi 802.11ac(HT80) (12.80 dBm)
			Antenna 1	Wi-Fi 802.11a (14.74 dBm) Wi-Fi 802.11n(HT20) (14.84 dBm) Wi-Fi 802.11n(HT40) (14.69 dBm) Wi-Fi 802.11ac(HT80) (13.88 dBm)
			Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (17.57 dBm) Wi-Fi 802.11n(HT40) (17.31 dBm) Wi-Fi 802.11ac(HT80) (16.38 dBm)
MODULATION TYPE	Bluetooth	GFSK for 1 Mbps, $\pi/4$ -DQPSK for 2 Mbps, 8-DPSK for 3 Mbps		
	WLAN 2.4 GHz Band	DSSS Modulation(DBPSK/DQPSK/CCK)		
	WLAN 5 GHz Band	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)		

ANTENNA TYPE & GAIN	Bluetooth (BDR/EDR)	2.2 dBi		
	WLAN 2.4 GHz Band (802.11b/g/n(HT20))	4.8 dBi		
	5 150 MHz ~ 5 250 MHz Band	Antenna 0	5.4 dBi	
		Antenna 1	5.7 dBi	
		Antenna 0 + Antenna 1	8.56 dBi	
	5 250 MHz ~ 5 350 MHz Band	Antenna 0	5.6 dBi	
		Antenna 1	4.8 dBi	
		Antenna 0 + Antenna 1	8.23 dBi	
	5 470 MHz ~ 5 725 MHz Band	Antenna 0	5.7 dBi	
		Antenna 1	5.3 dBi	
		Antenna 0 + Antenna 1	8.51 dBi	
	5 725 MHz ~ 5 850 MHz Band	Antenna 0	5.2 dBi	
		Antenna 1	5.4 dBi	
		Antenna 0 + Antenna 1	8.31 dBi	
	List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	37.4 MHz		
DFS FUNCTION	Slave without radar detection			

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

MAX. RF OUTPUT POWER	Bluetooth	1 Mbps	0.97 dBm		
		2 Mbps	-1.67 dBm		
		3 Mbps	-1.24 dBm		
	WLAN 2.4 GHz Band	Wi-Fi 802.11b (16.40 dBm) Wi-Fi 802.11g (15.84 dBm) Wi-Fi 802.11n(HT20) (15.05 dBm)			
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	Antenna 0	Wi-Fi 802.11a (13.96 dBm) Wi-Fi 802.11n(HT20) (11.80 dBm) Wi-Fi 802.11n(HT40) (10.14 dBm) Wi-Fi 802.11ac(HT80) (12.61 dBm)	
			Antenna 1	Wi-Fi 802.11a (13.92 dBm) Wi-Fi 802.11n(HT20) (10.62 dBm) Wi-Fi 802.11n(HT40) (10.54 dBm) Wi-Fi 802.11ac(HT80) (12.66 dBm)	
			Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (14.24 dBm) Wi-Fi 802.11n(HT40) (13.29 dBm) Wi-Fi 802.11ac(HT80) (12.96 dBm)	
		5 250 MHz ~ 5 350 MHz Band	Antenna 0	Wi-Fi 802.11a (14.42 dBm) Wi-Fi 802.11n(HT20) (14.61 dBm) Wi-Fi 802.11n(HT40) (14.10 dBm) Wi-Fi 802.11ac(HT80) (12.51 dBm)	
			Antenna 1	Wi-Fi 802.11a (14.41 dBm) Wi-Fi 802.11n(HT20) (14.54 dBm) Wi-Fi 802.11n(HT40) (13.56 dBm) Wi-Fi 802.11ac(HT80) (13.21 dBm)	
			Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (17.59 dBm) Wi-Fi 802.11n(HT40) (16.85 dBm) Wi-Fi 802.11ac(HT80) (15.88 dBm)	

MAX. RF OUTPUT POWER	WLAN 5 GHz Band	5 470 MHz ~ 5 725 MHz Band	Antenna 0	Wi-Fi 802.11a (14.91 dBm) Wi-Fi 802.11n(HT20) (14.94 dBm) Wi-Fi 802.11n(HT40) (14.81 dBm) Wi-Fi 802.11ac(HT80) (12.99 dBm)
			Antenna 1	Wi-Fi 802.11a (14.62 dBm) Wi-Fi 802.11n(HT20) (14.97 dBm) Wi-Fi 802.11n(HT40) (14.32 dBm) Wi-Fi 802.11ac(HT80) (13.44dBm)
			Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (17.88 dBm) Wi-Fi 802.11n(HT40) (17.58 dBm) Wi-Fi 802.11ac(HT80) (16.23 dBm)
		5 725 MHz ~ 5 850 MHz Band	Antenna 0	Wi-Fi 802.11a (14.58 dBm) Wi-Fi 802.11n(HT20) (14.27 dBm) Wi-Fi 802.11n(HT40) (13.88 dBm) Wi-Fi 802.11ac(HT80) (12.80 dBm)
			Antenna 1	Wi-Fi 802.11a (14.74 dBm) Wi-Fi 802.11n(HT20) (14.84 dBm) Wi-Fi 802.11n(HT40) (14.69 dBm) Wi-Fi 802.11ac(HT80) (13.88 dBm)
			Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (17.57 dBm) Wi-Fi 802.11n(HT40) (17.31 dBm) Wi-Fi 802.11ac(HT80) (16.38 dBm)

ANTENNA TYPE & GAIN	Bluetooth (BDR/EDR)	2.2 dBi		
	WLAN 2.4 GHz Band (802.11b/g/n(HT20))	4.8 dBi		
	5 150 MHz ~ 5 250 MHz Band	Antenna 0	5.4 dBi	
		Antenna 1	5.7 dBi	
		Antenna 0 + Antenna 1	8.56 dBi	
	5 250 MHz ~ 5 350 MHz Band	Antenna 0	5.6 dBi	
		Antenna 1	4.8 dBi	
		Antenna 0 + Antenna 1	8.23 dBi	
	5 470 MHz ~ 5 725 MHz Band	Antenna 0	5.7 dBi	
		Antenna 1	5.3 dBi	
		Antenna 0 + Antenna 1	8.51 dBi	
	5 725 MHz ~ 5 850 MHz Band	Antenna 0	5.2 dBi	
		Antenna 1	5.4 dBi	
		Antenna 0 + Antenna 1	8.31 dBi	

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			
5 150 ~ 5 250	802.11a	14.0 ± 0.5	14.5	28.18	5.70	3.72	2.89	0.020 8	1.00
	802.11n_HT20	14.5 ± 0.5	15.0	31.62	8.56	7.18	4.25	0.045 2	1.00
	802.11n_HT40	13.5 ± 0.5	14.0	25.12			3.79	0.035 9	1.00
	802.11ac80	13.0 ± 0.5	13.5	22.39			3.57	0.032 0	1.00
5 250 ~ 5 350	802.11a	14.5 ± 0.5	15.0	31.62			5.60	3.63	3.02
	802.11n_HT20	17.5 ± 0.5	18.0	63.10	8.23	6.65	5.78	0.083 6	1.00
	802.11n_HT40	17.0 ± 0.5	17.5	56.23			5.45	0.074 5	1.00
	802.11ac80	16.0 ± 0.5	16.5	44.67			4.86	0.059 1	1.00
5 470 ~ 5 725	802.11a	15.0 ± 0.5	15.5	35.48			5.70	3.72	3.24
	802.11n_HT20	18.0 ± 0.5	18.5	70.79	8.51	7.10	6.32	0.100 0	1.00
	802.11n_HT40	17.5 ± 0.5	18.0	63.10			5.97	0.089 1	1.00
	802.11ac80	16.5 ± 0.5	17.0	50.12			5.32	0.070 8	1.00
5 725 ~ 5 850	802.11a	15.0 ± 0.5	15.5	35.48			5.40	3.47	3.13
	802.11n_HT20	18.0 ± 0.5	18.5	70.79	8.31	6.78	6.18	0.095 5	1.00
	802.11n_HT40	17.5 ± 0.5	18.0	63.10			5.83	0.085 1	1.00
	802.11ac80	16.5 ± 0.5	17.0	50.12			5.20	0.067 6	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			
5 150 ~ 5 250	802.11a	10.0 ± 0.5	10.5	11.22	1.71	1.48	1.15	0.0033	1.00
	802.11n_HT20	9.5 ± 0.5	10.0	10.00			1.09	0.0029	1.00
	802.11n_HT40	8.0 ± 0.5	9.0	7.94			0.97	0.0023	1.00
	802.11ac80	8.0 ± 0.5	8.5	7.08			0.91	0.0021	1.00
5 250 ~ 5 350	802.11a	10.0 ± 0.5	9.5	8.91	1.10	1.29	0.96	0.0023	1.00
	802.11n_HT20	8.5 ± 0.6	9.1	8.13			0.91	0.0021	1.00
	802.11n_HT40	7.0 ± 0.5	7.5	5.62			0.76	0.0014	1.00
	802.11ac80	7.0 ± 0.5	7.5	5.62			0.76	0.0014	1.00
5 470 ~ 5 725	802.11a	10.0 ± 0.5	9.5	8.91	1.10	1.29	0.96	0.0023	1.00
	802.11n_HT20	8.5 ± 0.6	9.1	8.13			0.91	0.0021	1.00
	802.11n_HT40	7.0 ± 0.5	7.5	5.62			0.76	0.0014	1.00
	802.11ac80	7.0 ± 0.5	7.5	5.62			0.76	0.0014	1.00
5 725 ~ 5 850	802.11a	10.0 ± 0.5	9.5	8.91	1.10	1.29	0.96	0.0023	1.00
	802.11n_HT20	8.5 ± 0.6	9.1	8.13			0.91	0.0021	1.00
	802.11n_HT40	7.0 ± 0.5	7.5	5.62			0.76	0.0014	1.00
	802.11ac80	7.0 ± 0.5	7.5	5.62			0.76	0.0014	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			
5 150 ~ 5 250	802.11a	10.0 ± 0.5	10.5	11.22	1.71	1.48	1.15	0.0033	1.00
	802.11n_HT20	9.5 ± 0.5	10.0	10.00			1.09	0.0029	1.00
	802.11n_HT40	8.0 ± 0.5	9.0	7.94			0.97	0.0023	1.00
	802.11ac80	8.0 ± 0.5	8.5	7.08			0.91	0.0021	1.00
5 250 ~ 5 350	802.11a	10.0 ± 0.5	9.5	8.91	1.10	1.29	0.96	0.0023	1.00
	802.11n_HT20	8.5 ± 0.6	9.1	8.13			0.91	0.0021	1.00
	802.11n_HT40	7.0 ± 0.5	7.5	5.62			0.76	0.0014	1.00
	802.11ac80	7.0 ± 0.5	7.5	5.62			0.76	0.0014	1.00
5 470 ~ 5 725	802.11a	10.0 ± 0.5	9.5	8.91	1.10	1.29	0.96	0.0023	1.00
	802.11n_HT20	8.5 ± 0.6	9.1	8.13			0.91	0.0021	1.00
	802.11n_HT40	7.0 ± 0.5	7.5	5.62			0.76	0.0014	1.00
	802.11ac80	7.0 ± 0.5	7.5	5.62			0.76	0.0014	1.00
5 725 ~ 5 850	802.11a	10.0 ± 0.5	9.5	8.91	1.10	1.29	0.96	0.0023	1.00
	802.11n_HT20	8.5 ± 0.6	9.1	8.13			0.91	0.0021	1.00
	802.11n_HT40	7.0 ± 0.5	7.5	5.62			0.76	0.0014	1.00
	802.11ac80	7.0 ± 0.5	7.5	5.62			0.76	0.0014	1.00