

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

**Test Report No.** : W156R-D035  
**AGR No.** : A154A-165  
**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 module  
**FCC ID.** : YZP-TWCMB202D  
**IC Certification No.** : 7414C-TWCMB202D  
**Model Name** : TWCM-B202D  
**Serial number** : N/A  
**Total page of Report** : 21 pages (including this page)  
**Date of Incoming** : February 13, 2015  
**Date of issue** : June 24, 2015

## SUMMARY

The equipment complies with the regulation; *FCC PART 15 SUBPART C Section 15.247 and FCC PART 15 SUBPART E Section 15.407, IC RSS-Gen Issue 4 Nov 2014 and RSS-247 Issue 1 May 2015*

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:   
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 ONETECH Corp.

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### Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
W156R-D035	June 24, 2015	Initial Issue	All

## 1. VERIFICATION OF COMPLIANCE

Applicant : LG Innotek Co., Ltd.  
 Address : 978-1, Jangduk-dong, Gwangsan-gu, Gwangju, 506-731 Korea  
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 Telephone No. : +82-62-950-0332  
 FCC ID : YZP-TWCMB202D  
 IC Certification No. : 7414C-TWCMB202D  
 Model Name : TWCM-B202D  
 Serial Number : N/A  
 Date : June 24, 2015

EQUIPMENT CLASS	FCC : DTS – DIGITAL TRNSMISSION SYSTEM FCC : DSS – PART 15 SPREAD SPECTRUM TRANSMITTER FCC : Unlicensed National Information infrastructure(UNII) IC : Low Power License-Exempt Radio-communication Device
E.U.T. DESCRIPTION	Modular Transmitter, Wi-Fi 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, FCC PART 15 SUBPART E Section 15.407, IC RSS-Gen Issue 4 Nov 2014 and RSS-247 Issue 1 May 2015
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&IC 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-B202D (referred to as the EUT in this report) is a Wi-Fi module. Product specification information described herein was obtained from product data sheet or user’s manual.

DEVICE TYPE	Wi-Fi module		
OPERATING FREQUENCY	WLAN	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))	
		2 422 MHz ~ 2 452 MHz (802.11n(HT40))	
	Bluetooth	2 402 MHz ~ 2 480 MHz	
	Bluetooth LE	2 402 MHz ~ 2 480 MHz	
	5 150 MHz ~ 5 250 MHz Band	5 180 MHz ~ 5 240 MHz (802.11a/n(HT20)/ac(HT20))	
		5 190 MHz ~ 5 230 MHz (802.11n(HT40)/ac(HT40))	
		5 210 MHz (802.11n(HT80))	
	5 250 MHz ~ 5 350 MHz Band	5 260 MHz ~ 5 320 MHz (802.11a/n(HT20)/ac(HT20))	
		5 270 MHz ~ 5 310 MHz (802.11n(HT40)/ac(HT40))	
		5 290 MHz (802.11n(HT80))	
	5 470 MHz ~ 5 725 MHz Band	5 500 MHz ~ 5 700 MHz (802.11a/n(HT20)/ac(HT20))	
		5 510 MHz ~ 5 670 MHz (802.11n(HT40)/ac(HT40))	
		5 530 MHz (802.11n(HT80))	
	5 725 MHz ~ 5 850 MHz Band	5 745 MHz ~ 5 825 MHz (802.11a/n(HT20)/ac(HT20))	
		5 755 MHz ~ 5 795 MHz (802.11n(HT40)/ac(HT40))	
		5 775 MHz (802.11n(HT80))	
MAX. RF OUTPUT POWER	WLAN	Antenna 0	Wi-Fi 802.11b (13.85 dBm)
			Wi-Fi 802.11g (13.37 dBm)
			Wi-Fi 802.11n_20 MHz (11.32 dBm)
			Wi-Fi 802.11n_40 MHz (11.52 dBm)
		Antenna 1	Wi-Fi 802.11b (14.08 dBm)
			Wi-Fi 802.11g (13.75 dBm)
			Wi-Fi 802.11n_20 MHz (11.65 dBm)
			Wi-Fi 802.11n_40 MHz (11.86 dBm)
		Multiple transmit	Wi-Fi 802.11g (16.57 dBm)
			Wi-Fi 802.11n_20 MHz (14.50 dBm)
			Wi-Fi 802.11n_40 MHz (14.70 dBm)

MAX. RF OUTPUT POWER	Bluetooth	1 Mbps	4.13 dBm	
		2 Mbps	5.21 dBm	
		3 Mbps	5.86 dBm	
	Bluetooth LE	6.39 dBm		
	Antenna 0	5 150 MHz ~ 5 250 MHz Band	Wi-Fi 802.11a (12.09 dBm)	
			Wi-Fi 802.11n_20 MHz (12.11 dBm)	
			Wi-Fi 802.11n_40 MHz (12.31 dBm)	
			Wi-Fi 802.11ac_20 MHz (12.15 dBm)	
			Wi-Fi 802.11ac_40 MHz (12.65 dBm)	
			Wi-Fi 802.11ac_80 MHz (9.81 dBm)	
	5 250 MHz ~ 5 350 MHz Band	Wi-Fi 802.11a (13.44 dBm)		
		Wi-Fi 802.11n_20 MHz (13.66 dBm)		
		Wi-Fi 802.11n_40 MHz (13.50 dBm)		
		Wi-Fi 802.11ac_20 MHz (13.35 dBm)		
		Wi-Fi 802.11ac_40 MHz (13.82 dBm)		
		Wi-Fi 802.11ac_80 MHz (9.74 dBm)		
	5 470 MHz ~ 5 725 MHz Band	Wi-Fi 802.11a (13.94 dBm)		
		Wi-Fi 802.11n_20 MHz (13.73 dBm)		
		Wi-Fi 802.11n_40 MHz (14.06 dBm)		
		Wi-Fi 802.11ac_20 MHz (13.97 dBm)		
		Wi-Fi 802.11ac_40 MHz (14.34 dBm)		
		Wi-Fi 802.11ac_80 MHz (11.40 dBm)		
	5 725 MHz ~ 5 850 MHz Band	Wi-Fi 802.11a (12.90 dBm)		
		Wi-Fi 802.11n_20 MHz (12.69 dBm)		
		Wi-Fi 802.11n_40 MHz (13.09 dBm)		
		Wi-Fi 802.11ac_20 MHz (12.74 dBm)		
		Wi-Fi 802.11ac_40 MHz (13.24 dBm)		
		Wi-Fi 802.11ac_80 MHz (10.32 dBm)		

MAX. RF OUTPUT POWER	Antenna 1	5 150 MHz ~ 5 250 MHz Band	Wi-Fi 802.11a (13.15 dBm) Wi-Fi 802.11n_20 MHz (12.98 dBm) Wi-Fi 802.11n_40 MHz (13.08 dBm) Wi-Fi 802.11ac_20 MHz (12.83 dBm) Wi-Fi 802.11ac_40 MHz (13.37 dBm) Wi-Fi 802.11ac_80 MHz (10.82 dBm)
		5 250 MHz ~ 5 350 MHz Band	Wi-Fi 802.11a (12.07 dBm) Wi-Fi 802.11n_20 MHz (12.42 dBm) Wi-Fi 802.11n_40 MHz (12.26 dBm) Wi-Fi 802.11ac_20 MHz (12.14 dBm) Wi-Fi 802.11ac_40 MHz (12.73 dBm) Wi-Fi 802.11ac_80 MHz (10.59 dBm)
		5 470 MHz ~ 5 725 MHz Band	Wi-Fi 802.11a (13.60 dBm) Wi-Fi 802.11n_20 MHz (13.22 dBm) Wi-Fi 802.11n_40 MHz (13.44 dBm) Wi-Fi 802.11ac_20 MHz (13.34 dBm) Wi-Fi 802.11ac_40 MHz (13.79 dBm) Wi-Fi 802.11ac_80 MHz (10.59 dBm)
		5 725 MHz ~ 5 850 MHz Band	Wi-Fi 802.11a (13.72 dBm) Wi-Fi 802.11n_20 MHz (13.56 dBm) Wi-Fi 802.11n_40 MHz (13.69 dBm) Wi-Fi 802.11ac_20 MHz (13.54 dBm) Wi-Fi 802.11ac_40 MHz (14.22 dBm) Wi-Fi 802.11ac_80 MHz (11.30 dBm)

MAX. RF OUTPUT POWER	Multiple transmit	5 150 MHz ~ 5 250 MHz Band	Wi-Fi 802.11a (15.63 dBm) Wi-Fi 802.11n_20 MHz (15.52 dBm) Wi-Fi 802.11n_40 MHz (15.68 dBm) Wi-Fi 802.11ac_20 MHz (15.47 dBm) Wi-Fi 802.11ac_40 MHz (16.04 dBm) Wi-Fi 802.11ac_80 MHz (13.35 dBm)
		5 250 MHz ~ 5 350 MHz Band	Wi-Fi 802.11a (15.82 dBm) Wi-Fi 802.11n_20 MHz (16.09 dBm) Wi-Fi 802.11n_40 MHz (15.93 dBm) Wi-Fi 802.11ac_20 MHz (15.80 dBm) Wi-Fi 802.11ac_40 MHz (16.26 dBm) Wi-Fi 802.11ac_80 MHz (13.20 dBm)
		5 470 MHz ~ 5 725 MHz Band	Wi-Fi 802.11a (16.78 dBm) Wi-Fi 802.11n_20 MHz (16.49 dBm) Wi-Fi 802.11n_40 MHz (16.77 dBm) Wi-Fi 802.11ac_20 MHz (16.68 dBm) Wi-Fi 802.11ac_40 MHz (17.08 dBm) Wi-Fi 802.11ac_80 MHz (14.02 dBm)
		5 725 MHz ~ 5 850 MHz Band	Wi-Fi 802.11a (16.34 dBm) Wi-Fi 802.11n_20 MHz (16.16 dBm) Wi-Fi 802.11n_40 MHz (16.41 dBm) Wi-Fi 802.11ac_20 MHz (16.17 dBm) Wi-Fi 802.11ac_40 MHz (16.77 dBm) Wi-Fi 802.11ac_80 MHz (13.85 dBm)
MODULATION TYPE	WLAN 2.4 G	DSSS Modulation(DBPSK/DQPSK/CCK)	
	WLAN 5 G	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
	Bluetooth	GFSK for 1 Mbps, DQPSK for 2 Mbps, 8-DPSK for 3 Mbps	
	Bluetooth LE	GFSK	
ANTENNA TYPE	WLAN : PIFA Antenna		
	Bluetooth / Bluetooth LE : PIFA Antenna		
ANTENNA GAIN	WLAN : 2.9 dBi		
	Bluetooth / Bluetooth LE : 0.42 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. MAXIMUM PERMISSIBLE EXPOSURE

#### 3.1 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  $1.0 \text{ mW/cm}^2$  for the frequency range between 1 500 MHz and 100 000 MHz.

The electric field generated for a  $1 \text{ mW/cm}^2$  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  $\text{mW/cm}^2$ , Z = Impedance of free space,  $377 \Omega$

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  $\text{mW/cm}^2$

### 3.2 EUT Description

Kind of EUT	Wi-Fi 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 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	WLAN	Antenna 0	Wi-Fi 802.11b (13.85 dBm)
			Wi-Fi 802.11g (11.92 dBm)
			Wi-Fi 802.11n_20 MHz (11.32 dBm)
			Wi-Fi 802.11n_40 MHz (11.52 dBm)
		Antenna 1	Wi-Fi 802.11b (14.08 dBm)
			Wi-Fi 802.11g (13.75 dBm)
			Wi-Fi 802.11n_20 MHz (11.65 dBm)
			Wi-Fi 802.11n_40 MHz (11.86 dBm)
		Multiple transmit	Wi-Fi 802.11g (16.57 dBm)
			Wi-Fi 802.11n_20 MHz (14.50 dBm)
			Wi-Fi 802.11n_40 MHz (14.70 dBm)

MAX. RF OUTPUT POWER	Bluetooth	1 Mbps	4.13 dBm	
		2 Mbps	5.21 dBm	
		3 Mbps	5.86 dBm	
	Bluetooth LE	6.39 dBm		
	Antenna 0	5 150 MHz ~ 5 250 MHz Band	Wi-Fi 802.11a (12.09 dBm)	
			Wi-Fi 802.11n_20 MHz (12.11 dBm)	
			Wi-Fi 802.11n_40 MHz (12.31 dBm)	
			Wi-Fi 802.11ac_20 MHz (12.15 dBm)	
			Wi-Fi 802.11ac_40 MHz (12.65 dBm)	
			Wi-Fi 802.11ac_80 MHz (9.81 dBm)	
	5 250 MHz ~ 5 350 MHz Band	Wi-Fi 802.11a (13.44 dBm)		
		Wi-Fi 802.11n_20 MHz (13.66 dBm)		
		Wi-Fi 802.11n_40 MHz (13.50 dBm)		
		Wi-Fi 802.11ac_20 MHz (13.35 dBm)		
		Wi-Fi 802.11ac_40 MHz (13.82 dBm)		
		Wi-Fi 802.11ac_80 MHz (9.74 dBm)		
	5 470 MHz ~ 5 725 MHz Band	Wi-Fi 802.11a (13.94 dBm)		
		Wi-Fi 802.11n_20 MHz (13.73 dBm)		
		Wi-Fi 802.11n_40 MHz (14.06 dBm)		
		Wi-Fi 802.11ac_20 MHz (13.97 dBm)		
		Wi-Fi 802.11ac_40 MHz (14.34 dBm)		
		Wi-Fi 802.11ac_80 MHz (11.40 dBm)		
	5 725 MHz ~ 5 850 MHz Band	Wi-Fi 802.11a (12.90 dBm)		
		Wi-Fi 802.11n_20 MHz (12.69 dBm)		
		Wi-Fi 802.11n_40 MHz (13.09 dBm)		
		Wi-Fi 802.11ac_20 MHz (12.74 dBm)		
		Wi-Fi 802.11ac_40 MHz (13.24 dBm)		
		Wi-Fi 802.11ac_80 MHz (10.32 dBm)		

MAX. RF OUTPUT POWER	Antenna 1	5 150 MHz ~ 5 250 MHz Band	Wi-Fi 802.11a (13.15 dBm) Wi-Fi 802.11n_20 MHz (12.98 dBm) Wi-Fi 802.11n_40 MHz (13.08 dBm) Wi-Fi 802.11ac_20 MHz (12.83 dBm) Wi-Fi 802.11ac_40 MHz (13.37 dBm) Wi-Fi 802.11ac_80 MHz (10.82 dBm)
		5 250 MHz ~ 5 350 MHz Band	Wi-Fi 802.11a (12.07 dBm) Wi-Fi 802.11n_20 MHz (12.42 dBm) Wi-Fi 802.11n_40 MHz (12.26 dBm) Wi-Fi 802.11ac_20 MHz (12.14 dBm) Wi-Fi 802.11ac_40 MHz (12.73 dBm) Wi-Fi 802.11ac_80 MHz (10.59 dBm)
		5 470 MHz ~ 5 725 MHz Band	Wi-Fi 802.11a (13.60 dBm) Wi-Fi 802.11n_20 MHz (13.22 dBm) Wi-Fi 802.11n_40 MHz (13.44 dBm) Wi-Fi 802.11ac_20 MHz (13.34 dBm) Wi-Fi 802.11ac_40 MHz (13.79 dBm) Wi-Fi 802.11ac_80 MHz (10.59 dBm)
		5 725 MHz ~ 5 850 MHz Band	Wi-Fi 802.11a (13.72 dBm) Wi-Fi 802.11n_20 MHz (13.56 dBm) Wi-Fi 802.11n_40 MHz (13.69 dBm) Wi-Fi 802.11ac_20 MHz (13.54 dBm) Wi-Fi 802.11ac_40 MHz (14.22 dBm) Wi-Fi 802.11ac_80 MHz (11.30 dBm)

MAX. RF OUTPUT POWER	Multiple transmit	5 150 MHz ~ 5 250 MHz Band	Wi-Fi 802.11a (15.63 dBm) Wi-Fi 802.11n_20 MHz (15.52 dBm) Wi-Fi 802.11n_40 MHz (15.68 dBm) Wi-Fi 802.11ac_20 MHz (15.47 dBm) Wi-Fi 802.11ac_40 MHz (16.04 dBm) Wi-Fi 802.11ac_80 MHz (13.35 dBm)
		5 250 MHz ~ 5 350 MHz Band	Wi-Fi 802.11a (15.82 dBm) Wi-Fi 802.11n_20 MHz (16.09 dBm) Wi-Fi 802.11n_40 MHz (15.93 dBm) Wi-Fi 802.11ac_20 MHz (15.80 dBm) Wi-Fi 802.11ac_40 MHz (16.26 dBm) Wi-Fi 802.11ac_80 MHz (13.20 dBm)
		5 470 MHz ~ 5 725 MHz Band	Wi-Fi 802.11a (16.78 dBm) Wi-Fi 802.11n_20 MHz (16.49 dBm) Wi-Fi 802.11n_40 MHz (16.77 dBm) Wi-Fi 802.11ac_20 MHz (16.68 dBm) Wi-Fi 802.11ac_40 MHz (17.08 dBm) Wi-Fi 802.11ac_80 MHz (14.02 dBm)
		5 725 MHz ~ 5 850 MHz Band	Wi-Fi 802.11a (16.34 dBm) Wi-Fi 802.11n_20 MHz (16.16 dBm) Wi-Fi 802.11n_40 MHz (16.41 dBm) Wi-Fi 802.11ac_20 MHz (16.17 dBm) Wi-Fi 802.11ac_40 MHz (16.77 dBm) Wi-Fi 802.11ac_80 MHz (13.85 dBm)
Used Antenna Gain	WLAN : 2.9 dBi		
	Bluetooth / Bluetooth LE : 0.42 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.

### 3.3 Calculated MPE Safe Distance

#### 3.3.1 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 <sup>2</sup> ) @ 20 cm Separation	Limit (mW/cm <sup>2</sup> )
		(dBm)	(dBm)	(mW)	Log	Linear			
2 400 ~ 2 483.5	802.11b	13.5 ± 1.0	14.5	28.18	2.90	1.95	2.09	0.0109	1.00
	802.11g(L)	9.0 ± 0.5	9.5	8.91			1.18	0.0035	1.00
	802.11g(M)	13.0 ± 0.5	13.5	22.39			1.86	0.0087	1.00
	802.11g(H)	9.0 ± 0.5	9.5	8.91			1.18	0.0035	1.00
	802.11n_HT20(L)	7.5 ± 0.5	8.0	6.31			0.99	0.0024	1.00
	802.11n_HT20(M)	11.0 ± 0.5	11.5	14.13			1.48	0.0055	1.00
	802.11n_HT20(H)	9.0 ± 0.5	9.5	8.91			1.18	0.0035	1.00
	802.11n_HT40(L)	4.0 ± 0.5	4.5	2.82			0.66	0.0011	1.00
	802.11n_HT40(M)	12.5 ± 0.5	13.0	19.95			1.76	0.0077	1.00
	802.11n_HT40(H)	6.0 ± 0.5	6.5	4.47			0.83	0.0017	1.00

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm <sup>2</sup> ) @ 20 cm Separation	Limit (mW/cm <sup>2</sup> )
		(dBm)	(dBm)	(mW)	Log	Linear			
5 150 ~ 5 250	802.11a	12.0 ± 0.5	12.5	17.78	2.90	1.95	1.66	0.0069	1.00
	802.11n_HT20	12.0 ± 0.5	12.5	17.78			1.66	0.0069	1.00
	802.11n_HT40	12.0 ± 0.5	12.5	17.78			1.66	0.0069	1.00
	802.11ac_HT20	12.0 ± 0.5	12.5	17.78			1.66	0.0069	1.00
	802.11ac_HT40	12.5 ± 0.5	13.0	19.95			1.76	0.0077	1.00
	802.11ac_HT80	9.5 ± 0.5	10.0	10.00			1.25	0.0039	1.00
5 250 ~ 5 350	802.11a	13.0 ± 1.0	14.0	25.12			1.97	0.0097	1.00
	802.11n_HT20	13.0 ± 1.0	14.0	25.12			1.97	0.0097	1.00
	802.11n_HT40	13.0 ± 1.0	14.0	25.12			1.97	0.0097	1.00
	802.11ac_HT20	13.0 ± 1.0	14.0	25.12			1.97	0.0097	1.00
	802.11ac_HT40	13.0 ± 1.0	14.0	25.12			1.97	0.0097	1.00
	802.11ac_HT80	9.0 ± 1.0	10.0	10.00			1.25	0.0039	1.00
5 470 ~ 5 725	802.11a	13.5 ± 1.0	14.5	28.18			2.09	0.0109	1.00
	802.11n_HT20	13.0 ± 1.0	14.0	25.12			1.97	0.0097	1.00
	802.11n_HT40	13.5 ± 1.0	14.5	28.18			2.09	0.0109	1.00
	802.11ac_HT20	13.5 ± 1.0	14.5	28.18			2.09	0.0109	1.00
	802.11ac_HT40	13.5 ± 1.0	14.5	28.18			2.09	0.0109	1.00
	802.11ac_HT80	11.0 ± 1.0	12.0	15.85			1.57	0.0061	1.00
5 725 ~ 5 825	802.11a	12.5 ± 1.0	13.5	22.39	1.86	0.0087	1.00		
	802.11n_HT20	12.5 ± 1.0	13.5	22.39	1.86	0.0087	1.00		
	802.11n_HT40	12.5 ± 1.0	13.5	22.39	1.86	0.0087	1.00		
	802.11ac_HT20	12.5 ± 1.0	13.5	22.39	1.86	0.0087	1.00		
	802.11ac_HT40	12.5 ± 1.0	13.5	22.39	1.86	0.0087	1.00		
	802.11ac_HT80	10.0 ± 1.0	11.0	12.59	1.40	0.0049	1.00		



### 3.3.2 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 <sup>2</sup> ) @ 20 cm Separation	Limit (mW/cm <sup>2</sup> )
		(dBm)	(dBm)	(mW)	Log	Linear			
2 400 ~ 2 483.5	802.11b	13.5 ± 1.0	14.5	28.18	2.90	1.95	2.09	0.0109	1.00
	802.11g(L)	10.0 ± 0.5	10.5	11.22			1.32	0.0044	1.00
	802.11g(M)	13.5 ± 0.5	14.0	25.12			1.97	0.0097	1.00
	802.11g(H)	10.0 ± 0.5	10.5	11.22			1.32	0.0044	1.00
	802.11n_HT20(L)	9.0 ± 0.5	9.5	8.91			1.18	0.0035	1.00
	802.11n_HT20(M)	11.5 ± 0.5	12.0	15.85			1.57	0.0061	1.00
	802.11n_HT20(H)	9.5 ± 0.5	10.0	10.00			1.25	0.0039	1.00
	802.11n_HT40(L)	7.0 ± 0.5	7.5	5.62			0.93	0.0022	1.00
	802.11n_HT40(M)	11.5 ± 0.5	12.0	15.85			1.57	0.0061	1.00
	802.11n_HT40(H)	8.0 ± 0.5	8.5	7.08			1.05	0.0027	1.00

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm <sup>2</sup> ) @ 20 cm Separation	Limit (mW/cm <sup>2</sup> )
		(dBm)	(dBm)	(mW)	Log	Linear			
5 150 ~ 5 250	802.11a	13.0 ± 0.5	13.5	22.39	2.90	1.95	1.86	0.0087	1.00
	802.11n_HT20	12.5 ± 0.5	13.0	19.95			1.76	0.0077	1.00
	802.11n_HT40	13.0 ± 0.5	13.5	22.39			1.86	0.0087	1.00
	802.11ac_HT20	12.5 ± 0.5	13.0	19.95			1.76	0.0077	1.00
	802.11ac_HT40	13.0 ± 0.5	13.5	22.39			1.86	0.0087	1.00
	802.11ac_HT80	10.5 ± 0.5	11.0	12.59			1.40	0.0049	1.00
5 250 ~ 5 350	802.11a	11.0 ± 1.0	12.0	15.85			1.57	0.0061	1.00
	802.11n_HT20	12.0 ± 1.0	13.0	19.95			1.76	0.0077	1.00
	802.11n_HT40	11.5 ± 1.0	12.5	17.78			1.66	0.0069	1.00
	802.11ac_HT20	12.0 ± 1.0	13.0	19.95			1.76	0.0077	1.00
	802.11ac_HT40	12.0 ± 1.0	13.0	19.95			1.76	0.0077	1.00
	802.11ac_HT80	10.0 ± 1.0	11.0	12.59			1.40	0.0049	1.00
5 470 ~ 5 725	802.11a	13.0 ± 1.0	14.0	25.12			1.97	0.0097	1.00
	802.11n_HT20	13.0 ± 1.0	14.0	25.12			1.97	0.0097	1.00
	802.11n_HT40	13.0 ± 1.0	14.0	25.12			1.97	0.0097	1.00
	802.11ac_HT20	13.0 ± 1.0	14.0	25.12			1.97	0.0097	1.00
	802.11ac_HT40	13.0 ± 1.0	14.0	25.12			1.97	0.0097	1.00
	802.11ac_HT80	9.0 ± 1.0	10.0	10.00			1.25	0.0039	1.00
5 725 ~ 5 825	802.11a	13.0 ± 1.0	14.0	25.12	1.97	0.0097	1.00		
	802.11n_HT20	13.0 ± 1.0	14.0	25.12	1.97	0.0097	1.00		
	802.11n_HT40	13.0 ± 1.0	14.0	25.12	1.97	0.0097	1.00		
	802.11ac_HT20	13.0 ± 1.0	14.0	25.12	1.97	0.0097	1.00		
	802.11ac_HT40	13.5 ± 1.0	14.5	28.18	2.09	0.0109	1.00		
	802.11ac_HT80	11.0 ± 1.0	12.0	15.85	1.57	0.0061	1.00		

### 3.3.3 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 <sup>2</sup> ) @ 20 cm Separation	Limit (mW/cm <sup>2</sup> )
		(dBm)	(dBm)	(mW)	Log	Linear			
2 400 ~ 2 483.5	802.11g(L)	12.5 ± 0.5	13.0	19.95	2.90	1.95	1.76	0.0077	1.00
	802.11g(M)	16.5 ± 0.5	17.0	50.12			2.79	0.0194	1.00
	802.11g(H)	12.5 ± 0.5	13.0	19.95			1.76	0.0077	1.00
	802.11n_HT20(L)	11.5 ± 0.5	12.0	15.85			1.57	0.0061	1.00
	802.11n_HT20(M)	14.5 ± 0.5	15.0	31.62			2.21	0.0123	1.00
	802.11n_HT20(H)	12.5 ± 0.5	13.0	19.95			1.76	0.0077	1.00
	802.11n_HT40(L)	9.0 ± 0.5	9.5	8.91			1.18	0.0035	1.00
	802.11n_HT40(M)	14.5 ± 0.5	15.0	31.62			2.21	0.0123	1.00
	802.11n_HT40(H)	10.0 ± 0.5	10.5	11.22			1.32	0.0044	1.00

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm <sup>2</sup> ) @ 20 cm Separation	Limit (mW/cm <sup>2</sup> )
		(dBm)	(dBm)	(mW)	Log	Linear			
5 150 ~ 5 250	802.11a	15.5 ± 0.5	16.0	39.81	2.90	1.95	2.48	0.0154	1.00
	802.11n_HT20	15.5 ± 0.5	16.0	39.81			2.48	0.0154	1.00
	802.11n_HT40	15.5 ± 0.5	16.0	39.81			2.48	0.0154	1.00
	802.11ac_HT20	15.0 ± 0.5	15.5	35.48			2.35	0.0138	1.00
	802.11ac_HT40	16.0 ± 0.5	16.5	44.67			2.63	0.0173	1.00
	802.11ac_HT80	13.0 ± 0.5	13.5	22.39			1.86	0.0087	1.00
5 250 ~ 5 350	802.11a	15.0 ± 1.0	16.0	39.81			2.48	0.0154	1.00
	802.11n_HT20	15.5 ± 1.0	16.5	44.67			2.63	0.0173	1.00
	802.11n_HT40	15.0 ± 1.0	16.0	39.81			2.48	0.0154	1.00
	802.11ac_HT20	15.0 ± 1.0	16.0	39.81			2.48	0.0154	1.00
	802.11ac_HT40	16.0 ± 1.0	17.0	50.12			2.79	0.0194	1.00
	802.11ac_HT80	13.0 ± 1.0	14.0	25.12			1.97	0.0097	1.00
5 470 ~ 5 725	802.11a	16.5 ± 1.0	17.5	56.23			2.95	0.0218	1.00
	802.11n_HT20	16.5 ± 1.0	17.5	56.23			2.95	0.0218	1.00
	802.11n_HT40	16.0 ± 1.0	17.0	50.12			2.79	0.0194	1.00
	802.11ac_HT20	16.0 ± 1.0	17.0	50.12			2.79	0.0194	1.00
	802.11ac_HT40	16.5 ± 1.0	17.5	56.23			2.95	0.0218	1.00
	802.11ac_HT80	13.5 ± 1.0	14.5	28.18			2.09	0.0109	1.00
5 725 ~ 5 825	802.11a	16.0 ± 1.0	17.0	50.12	2.79	0.0194	1.00		
	802.11n_HT20	16.0 ± 1.0	17.0	50.12	2.79	0.0194	1.00		
	802.11n_HT40	16.0 ± 1.0	17.0	50.12	2.79	0.0194	1.00		
	802.11ac_HT20	16.0 ± 1.0	17.0	50.12	2.79	0.0194	1.00		
	802.11ac_HT40	16.0 ± 1.0	17.0	50.12	2.79	0.0194	1.00		
	802.11ac_HT80	13.0 ± 1.0	14.0	25.12	1.97	0.0097	1.00		

### 3.3.4 Test Result for BLUETOOTH

According to the procedure, KDB 447498 D01, the standalone SAR test exclusion threshold is

$$[(\text{Max. Power of channel, including tune-up tolerance, mW})/(\text{Min. test separation distance, mm})] \times [\sqrt{f(\text{GHz})}] < 3$$

$$= (3.98/5) \times \sqrt{2.402} = 1.23$$

Conclusion: The SAR test exclusion threshold is less than 3, so the device meets the RF Exposure Requirement and excluded SAR Test.

	Frequency (MHz)	Target Power W/tolerance (dBm)	Max tune up power (dBm)	Max tune up power (mW)	Separation distance (mm)	RF exposure
1 Mbps	2 402	4.0 ± 0.5	4.5	2.82	5	0.87
2 Mbps	2 402	4.5 ± 1.0	5.5	3.55	5	1.10
3 Mbps	2 402	5.0 ± 1.0	6.0	3.98	5	1.23

### 3.3.5 Test Result for BLUETOOTH LE

According to the procedure, KDB 447498 D01, the standalone SAR test exclusion threshold is

$$[(\text{Max. Power of channel, including tune-up tolerance, mW})/(\text{Min. test separation distance, mm})] \times [\sqrt{f(\text{GHz})}] < 3$$

$$= (5.01/5) \times \sqrt{2.402} = 1.552$$

Conclusion: The SAR test exclusion threshold is less than 3, so the device meets the RF Exposure Requirement and excluded SAR Test.

	Frequency (MHz)	Target Power W/tolerance (dBm)	Max tune up power (dBm)	Max tune up power (mW)	Separation distance (mm)	RF exposure
BLE (GFSK)	2 402	6 ± 1.0	7.0	5.01	5	1.552