

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

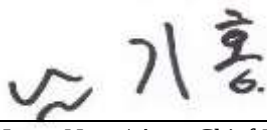
Date of issue : June 24, 2015

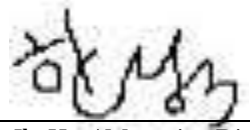
SUMMARY

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: 
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
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
 Contact Person : Inchang, Jeong / Director
 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)
			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)
			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)
			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 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

3.2 EUT Description

Kind of EUT	Wi-Fi module		
Operating Frequency Band	☐ Wireless Microphone: 494.000 MHz ~ 501.000 MHz and 498.200 MHz ~ 505.200 MHz ☒ WLAN: 2 412 MHz ~ 2 462 MHz ☒ WLAN: 5 180 MHz ~ 5 320 MHz / 5 500 MHz ~ 5 700 MHz ☒ WLAN: 5 745 MHz ~ 5 825 MHz ☒ Bluetooth: 2 402 MHz ~ 2 480 MHz ☒ Bluetooth BLE: 2 402 MHz ~ 2 480 MHz		
Device Category	☐ Portable (< 20 cm separation) ☐ Mobile (> 20 cm separation) ☒ 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)
			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)
			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)
			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)
		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)
			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)
		5 470 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)
			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	☒ MPE ☐ SAR ☐ 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 ²) @ 20 cm Separation	Limit (mW/cm ²)
		(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 ²) @ 20 cm Separation	Limit (mW/cm ²)
		(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 ²) @ 20 cm Separation	Limit (mW/ cm ²)
		(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 ²) @ 20 cm Separation	Limit (mW/cm ²)
		(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 ²) @ 20 cm Separation	Limit (mW/ cm ²)
		(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 ²) @ 20 cm Separation	Limit (mW/ cm ²)
		(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

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

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

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

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

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

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