

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

Test Report No. : OT-18O-RWD-080
AGR No. : A188A-336
Applicant : Samsung Electronics Co Ltd
Address : 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058, United States
Manufacturer : Samsung Electronics Co Ltd
Address : Maetan dong 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 16677, Korea
Type of Equipment : Wi-Fi/BT Transceiver
FCC ID. : A3LWCP730M
Model Name : WCP730M
Serial number : N/A
Total page of Report : 20 pages (including this page)
Date of Incoming : September 28, 2018
Date of issue : October 31, 2018

SUMMARY


The equipment complies with the regulation; *FCC PART 15 SUBPART C Section 15.247 and 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 / Chief Engineer
 ONETECH Corp.

Approved by: 

 Keun-Young, Choi / Vice President
 ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-18O-RWD-080	2018.10.31	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : Samsung Electronics Co Ltd

Address : 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058, United States

Manufacturer : Samsung Electronics Co Ltd

Address : Maetan dong 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 16677, Korea

Factory 1 : WISOL HA NOI COMPANY LIMITED

Address : No. 26, Street 05, Vsip Bac Ninh Industrial Park, Phu Chan Communt, Tu Son Town, Bac Ninh Province, Viet Nam.

Factory 2 : Shenzhen Zowee Technology Co., Ltd.

Address : Floor5 & 6, Block 5, Science & Technology Park of Privately Owned Enterprises, Pingshan, Xili, Nanshan District, Shenzhen, Guangdong Province, P.R. China

Contact Person : minhyung, cho / Senior Engineer

Telephone No. : +82-31-277-2688

FCC ID : A3LWCP730M

Model Name : WCP730M

Brand Name : 

Serial Number : N/A

Date : October 31, 2018

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Modular Transmitter, Wi-Fi/BT Transceiver
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 KDB 558074 D01 DTS Meas Guidance v04 FCC PART 15 SUBPART E Section 15.407 KDB 789033 D02 General UNII Test Procedures New Rules V02r01
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 Samsung Electronics Co Ltd, Model WCP730M (referred to as the EUT in this report) is a Wi-Fi/BT Transceiver. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Wi-Fi/BT Transceiver	
Temperature Range	-20 °C ~ 50 °C	
OPERATING FREQUENCY	Bluetooth LE	2 402 MHz ~ 2 480 MHz
	Bluetooth	2 402 MHz ~ 2 480 MHz
	WLAN 2.4 GHz	2 412 MHz ~ 2 472 MHz (802.11b/g/n(HT20))
		2 422 MHz ~ 2 462 MHz (802.11n(HT40))
	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 ~ 5 700 MHz (802.11a/n(HT20)/ac(VHT20))
		5 510 MHz ~ 5 670 MHz (802.11n(HT40)/ac(VHT40))
		5 530 MHz (802.11ac(VHT80))
	5 725 MHz ~ 5 850 MHz Band	5 745 MHz ~ 5 825 MHz (802.11a/n(HT20)/ac(VHT20))
5 755 MHz ~ 5 795 MHz (802.11n(HT40)/ac(VHT40))		
5 775 MHz (802.11ac(VHT80))		
MODULATION TYPE	Bluetooth LE	GFSK
	Bluetooth	GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8-DPSK for 3Mbps
	WLAN 2.4 GHz	802.11b: DSSS Modulation(DBPSK/DQPSK/CCK)
		802.11g/n(HT20)/n(HT40): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)
WLAN 5 GHz	802.11a/n(HT20)/n(HT40)/ac(VHT80): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	

RF OUTPUT POWER'	Bluetooth LE	1 Mbps	10.50 dBm
		2 Mbps	10.33 dBm
	Bluetooth	1 Mbps	10.43 dBm
		2 Mbps	10.09 dBm
		3 Mbps	10.47 dBm
	WLAN 2.4 GHz	Antenna 0	19.96 dBm(802.11b)
			16.85 dBm(802.11g)
			15.62 dBm(802.11n_HT20)
			13.50 dBm(802.11n_HT40)
		Antenna 1	20.46 dBm(802.11b)
			17.04 dBm(802.11g)
Multiple Antenna	15.98 dBm(802.11n_HT20)		
	13.94 dBm(802.11n_HT40)		
	19.96 dBm(802.11g)		
		18.80 dBm(802.11n_HT20)	
		16.74 dBm(802.11n_HT40)	

RF OUTPUT POWER	5 150 MHz ~ 5 250 MHz Band	Antenna 0	15.82 dBm(802.11a) 14.61 dBm(802.11n_HT20) 13.23 dBm(802.11n_HT40) 10.86 dBm(802.11ac_VHT80)
		Antenna 1	16.06 dBm(802.11a) 15.02 dBm(802.11n_HT20) 13.42 dBm(802.11n_HT40) 10.89 dBm(802.11ac_VHT80)
		Multiple Antenna	18.95 dBm(802.11a) 17.79 dBm(802.11n_HT20) 16.34 dBm(802.11n_HT40) 13.89 dBm(802.11ac_VHT80)
	5 250 MHz ~ 5 350 MHz Band	Antenna 0	16.01 dBm(802.11a) 14.93 dBm(802.11n_HT20) 13.31 dBm(802.11n_HT40) 11.24 dBm(802.11ac_VHT80)
		Antenna 1	15.89 dBm(802.11a) 14.88 dBm(802.11n_HT20) 13.08 dBm(802.11n_HT40) 10.58 dBm(802.11ac_VHT80)
		Multiple Antenna	18.96 dBm(802.11a) 17.92 dBm(802.11n_HT20) 16.21 dBm(802.11n_HT40) 13.93 dBm(802.11ac_VHT80)

RF OUTPUT POWER	5 470 MHz ~ 5 725 MHz Band	Antenna 0	16.35 dBm(802.11a) 15.41 dBm(802.11n_HT20) 13.81 dBm(802.11n_HT40) 11.57 dBm(802.11ac_VHT80)
		Antenna 1	16.02 dBm(802.11a) 15.08 dBm(802.11n_HT20) 13.06 dBm(802.11n_HT40) 10.82 dBm(802.11ac_VHT80)
		Multiple Antenna	18.97 dBm(802.11a) 18.07 dBm(802.11n_HT20) 16.46 dBm(802.11n_HT40) 14.22 dBm(802.11ac_VHT80)
	5 725 MHz ~ 5 850 MHz Band	Antenna 0	16.73 dBm(802.11a) 15.41 dBm(802.11n_HT20) 13.58 dBm(802.11n_HT40) 11.53 dBm(802.11ac_VHT80)
		Antenna 1	16.23 dBm(802.11a) 15.15 dBm(802.11n_HT20) 13.41 dBm(802.11n_HT40) 11.63 dBm(802.11ac_VHT80)
		Multiple Antenna	19.28 dBm(802.11a) 18.25 dBm(802.11n_HT20) 16.47 dBm(802.11n_HT40) 14.59 dBm(802.11ac_VHT80)
MODULATION TYPE	Bluetooth LE	GFSK	
	Bluetooth	GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8-DPSK for 3Mbps	
	WLAN 2.4 G	DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
	WLAN 5 G	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	

ANTENNA TYPE	Metal Antenna			
ANTENNA GAIN	Bluetooth LE	-4.60 dBi		
	Bluetooth	-4.60 dBi		
	WLAN 2.4 GHz	Antenna 0	0.71 dBi	
		Antenna 1	2.56 dBi	
		Multiple Antenna	4.74 dBi	
	5 150 MHz ~ 5 250 MHz Band	Antenna 0	3.47 dBi	
		Antenna 1	2.98 dBi	
		Multiple Antenna	6.24 dBi	
	5 250 MHz ~ 5 350 MHz Band	Antenna 0	1.64 dBi	
		Antenna 1	-0.67 dBi	
		Multiple Antenna	3.65 dBi	
	5 470 MHz ~ 5 725 MHz Band	Antenna 0	1.95 dBi	
		Antenna 1	-0.49 dBi	
		Multiple Antenna	3.91 dBi	
	5 725 MHz ~ 5 850 MHz Band	Antenna 0	0.14 dBi	
		Antenna 1	-0.92 dBi	
		Multiple Antenna	2.65 dBi	
	List of each Osc. or crystal Freq.(Freq. >= 1 MHz)		40 MHz	

3.2 Alternative type(s)/model(s); also covered by this test report.

-. None

4. 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 Transceiver
Device Category	<input type="checkbox"/> Portable (< 20 cm separation) <input type="checkbox"/> Mobile (> 20 cm separation) <input checked="" type="checkbox"/> Others
Exposure Evaluation Applied	<input checked="" type="checkbox"/> MPE <input type="checkbox"/> SAR <input type="checkbox"/> N/A

4.3 Calculated MPE Safe Distance for WLAN

4.3.1 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	20.0 ± 0.5	20.50	112.20	0.71	1.18	3.24	0.026 3	1.00
	802.11g	17.0 ± 0.5	17.50	56.23			2.29	0.013 2	1.00
	802.11n_HT20	15.5 ± 0.5	16.00	39.81			1.93	0.009 3	1.00
	802.11n_HT40	13.5 ± 0.5	14.00	25.12			1.53	0.005 9	1.00
5 150 ~ 5 250	802.11a	16.0 ± 0.5	16.50	44.67	3.47	2.22	2.81	0.019 8	1.00
	802.11n_HT20	14.5 ± 0.5	15.00	31.62			2.36	0.014 0	1.00
	802.11n_HT40	13.0 ± 0.5	13.50	22.39			1.99	0.009 9	1.00
	802.11ac80	11.0 ± 0.5	11.50	14.13			1.58	0.006 3	1.00
5 250 ~ 5 350	802.11a	16.0 ± 0.5	16.50	44.67	1.64	1.46	2.28	0.013 0	1.00
	802.11n_HT20	15.0 ± 0.5	15.50	35.48			2.03	0.010 3	1.00
	802.11n_HT40	13.0 ± 0.5	13.50	22.39			1.61	0.006 5	1.00
	802.11ac80	11.0 ± 0.5	11.50	14.13			1.28	0.004 1	1.00

5 470 ~ 5 725	802.11a	16.5 ± 0.5	17.00	50.12	1.95	1.57	2.50	0.015 6	1.00
	802.11n_HT20	15.5 ± 0.5	16.00	39.81			2.23	0.012 4	1.00
	802.11n_HT40	14.0 ± 0.5	14.50	28.18			1.87	0.008 8	1.00
	802.11ac80	11.5 ± 0.5	12.00	15.85			1.41	0.004 9	1.00
5 725 ~ 5 850	802.11a	16.5 ± 0.5	17.00	50.12	0.14	1.03	2.03	0.010 3	1.00
	802.11n_HT20	15.5 ± 0.5	16.00	39.81			1.81	0.008 2	1.00
	802.11n_HT40	13.5 ± 0.5	14.00	25.12			1.44	0.005 2	1.00
	802.11ac80	11.5 ± 0.5	12.00	15.85			1.14	0.003 3	1.00

According to above table, for 2 400 ~ 2483.5 MHz Band, safe distance,

$$D = 0.282 * \sqrt{(112.20 * 1.18)/1.00} = 3.24 \text{ cm.}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 112.20 * 1.18 / (4 * 3.14 * 20^2) = 0.026 3$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna



Tested by: Tae-Ho, Kim / Senior Manager

4.3.2 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	20.5 ± 0.5	21.00	125.89	2.56	1.80	4.25	0.045 2	1.00
	802.11g	17.0 ± 0.5	17.50	56.23			2.84	0.020 2	1.00
	802.11n_HT20	16.0 ± 0.5	16.50	44.67			2.53	0.016 0	1.00
	802.11n_HT40	14.0 ± 0.5	14.50	28.18			2.01	0.010 1	1.00
5 150 ~ 5 250	802.11a	16.0 ± 0.5	16.50	44.67	2.98	1.99	2.66	0.017 7	1.00
	802.11n_HT20	15.0 ± 0.5	15.50	35.48			2.37	0.014 0	1.00
	802.11n_HT40	13.5 ± 0.5	14.00	25.12			1.99	0.009 9	1.00
	802.11ac80	11.0 ± 0.5	11.50	14.13			1.49	0.005 6	1.00
5 250 ~ 5 350	802.11a	16.0 ± 0.5	16.50	44.67	-0.67	0.86	1.74	0.007 6	1.00
	802.11n_HT20	15.0 ± 0.5	15.50	35.48			1.56	0.006 1	1.00
	802.11n_HT40	13.0 ± 0.5	13.50	22.39			1.24	0.003 8	1.00
	802.11ac80	10.5 ± 0.5	11.00	12.59			0.93	0.002 1	1.00

5 470 ~ 5 725	802.11a	16.0 ± 0.5	16.50	44.67	-0.49	0.89	1.78	0.007 9	1.00
	802.11n_HT20	15.0 ± 0.5	16.00	39.81			1.68	0.007 1	1.00
	802.11n_HT40	13.0 ± 0.5	13.50	22.39			1.26	0.004 0	1.00
	802.11ac80	11.0 ± 0.5	11.50	14.13			1.00	0.002 5	1.00
5 725 ~ 5 850	802.11a	16.0 ± 0.5	16.50	44.67	-0.92	0.81	1.70	0.007 2	1.00
	802.11n_HT20	15.0 ± 0.5	15.50	35.48			1.51	0.005 7	1.00
	802.11n_HT40	13.5 ± 0.5	14.00	25.12			1.27	0.004 0	1.00
	802.11ac80	11.5 ± 0.5	12.00	15.85			1.01	0.002 6	1.00

According to above table, for 2 400 ~ 2483.5 MHz Band, safe distance,

$$D = 0.282 * \sqrt{(125.89 * 1.80)/1.00} = 4.25 \text{ cm.}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 125.89 * 1.80 / (4 * 3.14 * 20^2) = 0.045 2$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna



Tested by: Tae-Ho, Kim / Senior Manager


4.3.3 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		Power Density (mW/cm ²) @ 20 cm Separation	Sum Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)			
2 400 ~ 2 483.5	802.11g	17.0 ± 0.5	17.50	56.23	0.013 2	0.033 4	1.00
		17.0 ± 0.5	17.50	56.23	0.020 2		
	802.11n_HT20	15.5 ± 0.5	16.00	39.81	0.009 3	0.025 3	1.00
		16.0 ± 0.5	16.50	44.67	0.016 0		
	802.11n_HT40	13.5 ± 0.5	14.00	25.12	0.005 9	0.016 0	1.00
		14.0 ± 0.5	14.50	28.18	0.010 1		
5 150 ~ 5 250	802.11a	16.0 ± 0.5	16.50	44.67	0.019 8	0.037 5	1.00
		16.0 ± 0.5	16.50	44.67	0.017 7		
	802.11n_HT20	14.5 ± 0.5	15.00	31.62	0.014 0	0.028 0	1.00
		15.0 ± 0.5	15.50	35.48	0.014 0		
	802.11n_HT40	13.0 ± 0.5	13.50	22.39	0.009 9	0.019 8	1.00
		13.5 ± 0.5	14.00	25.12	0.009 9		
	802.11ac80	11.0 ± 0.5	11.50	14.13	0.006 3	0.011 9	1.00
		11.0 ± 0.5	11.50	14.13	0.005 6		
5 250 ~ 5 350	802.11a	16.0 ± 0.5	16.50	44.67	0.013 0	0.020 6	1.00
		16.0 ± 0.5	16.50	44.67	0.007 6		
	802.11n_HT20	15.0 ± 0.5	15.50	35.48	0.010 3	0.016 4	1.00
		15.0 ± 0.5	15.50	35.48	0.006 1		
	802.11n_HT40	13.0 ± 0.5	13.50	22.39	0.006 5	0.010 3	1.00
		13.0 ± 0.5	13.50	22.39	0.003 8		
	802.11ac80	11.0 ± 0.5	11.50	14.13	0.004 1	0.006 2	1.00
		10.5 ± 0.5	11.00	12.59	0.002 1		

5 470 ~ 5 725	802.11a	16.5 ± 0.5	17.00	50.12	0.015 6	0.023 5	1.00
		16.0 ± 0.5	16.50	44.67	0.007 9		
	802.11n_HT20	15.5 ± 0.5	16.00	39.81	0.012 4	0.019 5	1.00
		15.0 ± 0.5	16.00	39.81	0.007 1		
	802.11n_HT40	14.0 ± 0.5	14.50	28.18	0.008 8	0.012 8	1.00
		13.0 ± 0.5	13.50	22.39	0.004 0		
	802.11ac80	11.5 ± 0.5	12.00	15.85	0.004 9	0.007 4	1.00
		11.0 ± 0.5	11.50	14.13	0.002 5		
5 725 ~ 5 850	802.11a	16.5 ± 0.5	17.00	50.12	0.010 3	0.017 5	1.00
		16.0 ± 0.5	16.50	44.67	0.007 2		
	802.11n_HT20	15.5 ± 0.5	16.00	39.81	0.008 2	0.013 9	1.00
		15.0 ± 0.5	15.50	35.48	0.005 7		
	802.11n_HT40	13.5 ± 0.5	14.00	25.12	0.005 2	0.009 2	1.00
		13.5 ± 0.5	14.00	25.12	0.004 0		
	802.11ac80	11.5 ± 0.5	12.00	15.85	0.003 3	0.005 9	1.00
		11.5 ± 0.5	12.00	15.85	0.002 6		

WLAN 5 GHz(802.11 a_UNII 1) = (0.019 8/1) + (0.017 7/1) = 0.037 5



Tested by: Tae-Ho, Kim / Senior Manager

4.4 Calculated MPE Safe Distance for Bluetooth LE

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			
2 402 ~ 2 480	1 Mbps	10.5 ± 0.5	11.00	12.59	-4.60	0.35	0.59	0.000 9	1.00
	2 Mbps	10.0 ± 0.5	10.50	11.22			0.56	0.000 8	1.00

According to above table, for 2 402 ~ 2480 MHz Band(1 Mbps), safe distance,

$$D = 0.282 * \sqrt{(12.59 * 0.35)/1.00} = 0.59 \text{ cm.}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 12.59 * 0.35 / (4 * 3.14 * 20^2) = 0.000 9$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna



Tested by: Tae-Ho, Kim / Senior Manager

4.5 Calculated MPE Safe Distance for Bluetooth

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			
2 402 ~ 2 480	1 Mbps	10.5 ± 0.5	11.00	12.59	-4.60	0.35	0.59	0.000 9	1.00
	2 Mbps	10.0 ± 0.5	10.50	11.22			0.56	0.000 8	1.00
	3 Mbps	10.5 ± 0.5	11.00	12.59			0.59	0.000 9	1.00

According to above table, for 2 402 ~ 2480 MHz Band(1 Mbps), safe distance,

$$D = 0.282 * \sqrt{(12.59 * 0.35)/1.00} = 0.59 \text{ cm.}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 12.59 * 0.35 / (4 * 3.14 * 20^2) = 0.000 9$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna



Tested by: **Tae-Ho, Kim** / Senior Manager

4.6 DATA for Intermodulation Transmit

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power	Max tune up power		Power Density (mW/cm ²) @ 20 cm Separation	Sum Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		W/tolerance (dBm)	(dBm)	(mW)			
Bluetooth + WLAN 2 G + WLAN 5 G	Bluetooth (1 Mbps)	10.5 ± 0.5	11.00	12.59	0.000 9	0.044 9	1.00
	WLAN 2 G (802.11 b_Ant 0)	20.0 ± 0.5	20.50	112.20	0.026 3		
	WLAN 5 G (UNII 1 802.11 a Ant 1)	16.0 ± 0.5	16.50	44.67	0.017 7		
Bluetooth LE + WLAN 2 G + WLAN 5 G	Bluetooth LE (1 Mbps)	10.5 ± 0.5	11.00	12.59	0.000 9	0.044 9	1.00
	WLAN 2 G (802.11 b_Ant 0)	20.0 ± 0.5	20.50	112.20	0.026 3		
	WLAN 5 G (UNII 1 802.11 a Ant 1)	16.0 ± 0.5	16.50	44.67	0.017 7		



Tested by: Tae-Ho, Kim / Senior Manager