

EMF TEST REPORT

Test Report No. : OT-21O-RWD-035

Reception No. : 2110004558

Applicant : Samsung Electronics Co Ltd

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

Manufacturer : Samsung Electronics Co Ltd

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

Type of Equipment : Wi-Fi/BT Transceiver

FCC ID. : A3LWCB731M

Model Name : WCB731M

Multiple Model Name : WCB730M, WCB737M, WCB736M

Serial number : N/A

Total page of Report : 17 pages (including this page)

Date of Incoming : October 07, 2021

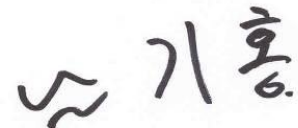
Date of issue : October 25, 2021

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.



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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-21O-RWD-035	October 25, 2021	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
 Contact Person : Jenni Chun / General Manager
 Telephone No. : 973-808-6375
 FCC ID : A3LWCB731M
 Model Name : WCB731M
 Brand Name : 
 Serial Number : N/A
 Date : October 25, 2021

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM Unlicensed National Information infrastructure(UNII)
E.U.T. DESCRIPTION	Modular Transmitter, Wi-Fi/BT Transceiver
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2020
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 15.247 Meas Guidance v05r02 FCC PART 15 SUBPART E Section 15.407 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 WCB731M (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))
	WLAN 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))
	WLAN 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))
	WLAN 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 ~ 5 690 MHz (802.11ac(VHT80))
	WLAN 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 for 1 Mbps / 2 Mbps
	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)

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OTC-TRF-RF-001(0)

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

RF OUTPUT POWER	Bluetooth LE	1 Mbps	11.26 dBm
		2 Mbps	11.25 dBm
	Bluetooth	1 Mbps	11.26 dBm
		2 Mbps	10.89 dBm
		3 Mbps	11.19 dBm
	WLAN 2.4 GHz	Antenna 0	17.30 dBm(802.11b) 11.15 dBm(802.11g) 10.75 dBm(802.11n_HT20) 9.49 dBm(802.11n_HT40)
		Antenna 1	17.32 dBm(802.11b) 14.60 dBm(802.11g) 14.31 dBm(802.11n_HT20) 13.54 dBm(802.11n_HT40)
		Multiple Antenna	16.22 dBm(802.11g) 15.90 dBm(802.11n_HT20) 14.98 dBm(802.11n_HT40)
	WLAN 5 150 MHz ~ 5 250 MHz Band	Antenna 0	8.73 dBm(802.11a) 8.77 dBm(802.11n_HT20) 10.33 dBm(802.11n_HT40) 8.88 dBm(802.11ac_VHT80)
		Antenna 1	9.02 dBm(802.11a) 8.88 dBm(802.11n_HT20) 10.46 dBm(802.11n_HT40) 9.22 dBm(802.11ac_VHT80)
		Multiple Antenna	11.79 dBm(802.11a) 11.69 dBm(802.11n_HT20) 13.27 dBm(802.11n_HT40) 12.06 dBm(802.11ac_VHT80)

RF OUTPUT POWER	WLAN 5 250 MHz ~ 5 350 MHz Band	Antenna 0	9.82 dBm(802.11a) 9.67 dBm(802.11n_HT20) 9.69 dBm(802.11n_HT40) 10.53 dBm(802.11ac_VHT80)
		Antenna 1	9.12 dBm(802.11a) 9.05 dBm(802.11n_HT20) 8.95 dBm(802.11n_HT40) 10.35 dBm(802.11ac_VHT80)
		Multiple Antenna	12.40 dBm(802.11a) 12.27 dBm(802.11n_HT20) 12.35 dBm(802.11n_HT40) 13.45 dBm(802.11ac_VHT80)
	WLAN 5 470 MHz ~ 5 725 MHz Band	Antenna 0	9.83 dBm(802.11a) 9.80 dBm(802.11n_HT20) 10.16 dBm(802.11n_HT40) 10.28 dBm(802.11ac_VHT80)
		Antenna 0_Straddle	8.38 dBm(802.11a) 8.23 dBm(802.11n_HT20) 9.65 dBm(802.11n_HT40) 10.80 dBm(802.11ac_VHT80)
		Antenna 1	10.68 dBm(802.11a) 11.18 dBm(802.11n_HT20) 11.77 dBm(802.11n_HT40) 10.50 dBm(802.11ac_VHT80)
		Antenna 1_Straddle	11.29 dBm(802.11a) 11.07 dBm(802.11n_HT20) 12.29 dBm(802.11n_HT40) 14.30 dBm(802.11ac_VHT80)

RF OUTPUT POWER	WLAN 5 470 MHz ~ 5 725 MHz Band	Multiple Antenna	13.00 dBm(802.11a) 13.47 dBm(802.11n_HT20) 13.89 dBm(802.11n_HT40) 13.40 dBm(802.11ac_VHT80)
		Multiple Antenna _Straddle	13.08 dBm(802.11a) 12.89 dBm(802.11n_HT20) 14.18 dBm(802.11n_HT40) 15.90 dBm(802.11ac_VHT80)
	WLAN 5 725 MHz ~ 5 850 MHz Band	Antenna 0	8.85 dBm(802.11a) 8.93 dBm(802.11n_HT20) 7.67 dBm(802.11n_HT40) 7.83 dBm(802.11ac_VHT80)
		Antenna 0_Straddle	0.54 dBm(802.11a) 0.90 dBm(802.11n_HT20) -2.66 dBm(802.11n_HT40) -4.53 dBm(802.11ac_VHT80)
		Antenna 1	10.67 dBm(802.11a) 10.78 dBm(802.11n_HT20) 10.94 dBm(802.11n_HT40) 10.77 dBm(802.11ac_VHT80)
		Antenna 1_Straddle	3.53 dBm(802.11a) 3.78 dBm(802.11n_HT20) 0.13 dBm(802.11n_HT40) -0.95 dBm(802.11ac_VHT80)
		Multiple Antenna	12.86 dBm(802.11a) 12.77 dBm(802.11n_HT20) 12.62 dBm(802.11n_HT40) 12.55 dBm(802.11ac_VHT80)
		Multiple Antenna _Straddle	5.30 dBm(802.11a) 5.58 dBm(802.11n_HT20) 1.97 dBm(802.11n_HT40) 0.63 dBm(802.11ac_VHT80)

ANTENNA TYPE	Chip Antenna		
ANTENNA GAIN	Bluetooth LE	-0.44 dBi	
	Bluetooth	-0.44 dBi	
	WLAN 2.4 GHz	Antenna 0	1.54 dBi
		Antenna 1	1.35 dBi
		Multiple Antenna	4.46 dBi
	5 150 MHz ~ 5 250 MHz Band	Antenna 0	1.00 dBi
		Antenna 1	1.25 dBi
		Multiple Antenna	4.14 dBi
	5 250 MHz ~ 5 350 MHz Band	Antenna 0	1.53 dBi
		Antenna 1	1.42 dBi
		Multiple Antenna	4.49 dBi
	5 470 MHz ~ 5 725 MHz Band	Antenna 0	1.51 dBi
		Antenna 1	1.50 dBi
		Multiple Antenna	4.52 dBi
	5 725 MHz ~ 5 850 MHz Band	Antenna 0	0.86 dBi
		Antenna 1	1.51 dBi
		Multiple Antenna	4.21 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.

-. The following lists consist of the added model and their differences.

Model Name	Differences	Tested
WCB731M	Basic Model (2 MIC, IRB at the Top)	☒
WCB730M	This model is identical to the basic model except for the removal of MIC.	☐
WCB737M	This model is identical to the basic model except for the IRB at the Bottom	☐
WCB736M	This model is identical to the basic model except for IRB at the Bottom and the removal of MIC	☐

Note: 1. Applicant consigns only basic model to test. Therefore this test report just guarantees the units, which have been tested.

2. The Applicant/manufacture is responsible for the compliance of all variants.

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 $f/1500$ mW/cm² for the frequency range between 300 MHz and 1 500 MHz and 1.0 mW/cm² for the frequency range between 1 500 MHz and 100 000 MHz.

The electric field generated for a 1 mW/cm² 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/cm², Z = Impedance of free space, 377 Ω

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/cm²

4.2 EUT Description

Kind of EUT	Wi-Fi/BT Transceiver
Device Category	☐ Portable (< 20 cm separation) ☐ Mobile (> 20 cm separation) ☒ Others
Exposure Evaluation Applied	☒ MPE ☐ SAR ☐ 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 (dBm)	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
			(dBm)	(mW)	Log	Linear			
2 400 ~ 2 483.5	802.11b	17.30 ± 1.0	18.30	67.61	1.54	1.43	2.77	0.019 2	1
	802.11g	11.15 ± 1.0	12.15	16.41			1.36	0.004 7	1
	802.11n_HT20	10.75 ± 1.0	11.75	14.96			1.30	0.004 2	1
	802.11n_HT40	9.49 ± 1.0	10.49	11.19			1.13	0.003 2	1
5 150 ~ 5 250	802.11a	8.73 ± 1.0	9.73	9.40	1.00	1.26	0.97	0.002 4	1
	802.11n_HT20	8.77 ± 1.0	9.77	9.48			0.97	0.002 4	1
	802.11n_HT40	10.33 ± 1.0	11.33	13.58			1.17	0.003 4	1
	802.11ac80	8.88 ± 1.0	9.88	9.73			0.99	0.002 4	1
5 250 ~ 5 350	802.11a	9.82 ± 1.0	10.82	12.08	1.53	1.42	1.17	0.003 4	1
	802.11n_HT20	9.67 ± 1.0	10.67	11.67			1.15	0.003 3	1
	802.11n_HT40	9.69 ± 1.0	10.69	11.72			1.15	0.003 3	1
	802.11ac80	10.53 ± 1.0	11.53	14.22			1.27	0.004 0	1
5 470 ~ 5 725	802.11a	9.83 ± 1.0	10.83	12.11	1.51	1.42	1.17	0.003 4	1
	802.11n_HT20	9.80 ± 1.0	10.80	12.02			1.16	0.003 4	1
	802.11n_HT40	10.16 ± 1.0	11.16	13.06			1.21	0.003 7	1
	802.11ac80	10.28 ± 1.0	11.28	13.43			1.23	0.003 8	1
5 725 ~ 5 850	802.11a	8.85 ± 1.0	9.85	9.66	0.86	1.22	0.97	0.002 3	1
	802.11n_HT20	8.93 ± 1.0	9.93	9.84			0.98	0.002 4	1
	802.11n_HT40	7.67 ± 1.0	8.67	7.36			0.84	0.001 8	1
	802.11ac80	7.83 ± 1.0	8.83	7.64			0.86	0.001 9	1

According to above table, for 2 400 ~ 2483.5 MHz Band(802.11 b), safe distance,

$$D = 0.282 * \sqrt{(67.61 * 1.43)/1.00} = 2.77 \text{ cm.}$$

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

$$S = P * G / (4\pi * R^2) = 67.61 * 1.43 / (4 * \pi * 20^2) = 0.019 2$$

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

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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 (dBm)	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
			(dBm)	(mW)	Log	Linear			
2 400 ~ 2 483.5	802.11b	17.32 ± 1.0	18.32	67.92	1.35	1.36	2.71	0.018 4	1
	802.11g	14.60 ± 1.0	15.60	36.31			1.98	0.009 9	1
	802.11n_HT20	14.31 ± 1.0	15.31	33.96			1.92	0.009 2	1
	802.11n_HT40	13.54 ± 1.0	14.54	28.44			1.76	0.007 7	1
5 150 ~ 5 250	802.11a	9.02 ± 1.0	10.02	10.05	1.25	1.33	1.03	0.002 7	1
	802.11n_HT20	8.88 ± 1.0	9.88	9.73			1.02	0.002 6	1
	802.11n_HT40	10.46 ± 1.0	11.46	14.00			1.22	0.003 7	1
	802.11ac80	9.22 ± 1.0	10.22	10.52			1.06	0.002 8	1
5 250 ~ 5 350	802.11a	9.12 ± 1.0	10.12	10.28	1.42	1.39	1.06	0.002 8	1
	802.11n_HT20	9.05 ± 1.0	10.05	10.12			1.06	0.002 8	1
	802.11n_HT40	8.95 ± 1.0	9.95	9.89			1.04	0.002 7	1
	802.11ac80	10.35 ± 1.0	11.35	13.65			1.23	0.003 8	1
5 470 ~ 5 725	802.11a	10.68 ± 1.0	11.68	14.72	1.50	1.41	1.29	0.004 1	1
	802.11n_HT20	11.18 ± 1.0	12.18	16.52			1.36	0.004 6	1
	802.11n_HT40	11.77 ± 1.0	12.77	18.92			1.46	0.005 3	1
	802.11ac80	10.50 ± 1.0	11.50	14.13			1.26	0.004 0	1
5 725 ~ 5 850	802.11a	10.67 ± 1.0	11.67	14.69	1.51	1.42	1.29	0.004 1	1
	802.11n_HT20	10.78 ± 1.0	11.78	15.07			1.30	0.004 2	1
	802.11n_HT40	10.94 ± 1.0	11.94	15.63			1.33	0.004 4	1
	802.11ac80	10.77 ± 1.0	11.77	15.03			1.30	0.004 2	1

According to above table, for 2 400 ~ 2483.5 MHz Band(802.11 b), safe distance,

$$D = 0.282 * \sqrt{(67.92 * 1.36)/1.00} = 2.71 \text{ cm.}$$

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

$$S = P * G / (4\pi * R^2) = 67.92 * 1.36 / (4 * \pi * 20^2) = 0.018 4$$

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

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 (dBm)	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)	(mW)			
2 400 ~ 2 483.5	802.11g	11.15 ± 1.0	12.15	16.41	0.004 7	0.014 6	1.00
		14.60 ± 1.0	15.60	36.31	0.009 9		
	802.11n_ HT20	10.75 ± 1.0	11.75	14.96	0.004 2	0.013 4	1.00
		14.31 ± 1.0	15.31	33.96	0.009 2		
	802.11n_ HT40	9.49 ± 1.0	10.49	11.19	0.003 2	0.010 9	1.00
		13.54 ± 1.0	14.54	28.44	0.007 7		
5 150 ~ 5 250	802.11a	8.73 ± 1.0	9.73	9.4	0.002 4	0.005 1	1.00
		9.02 ± 1.0	10.02	10.05	0.002 7		
	802.11n_ HT20	8.77 ± 1.0	9.77	9.48	0.002 4	0.005 0	1.00
		8.88 ± 1.0	9.88	9.73	0.002 6		
	802.11n_ HT40	10.33 ± 1.0	11.33	13.58	0.003 4	0.007 1	1.00
		10.46 ± 1.0	11.46	14	0.003 7		
	802.11ac80	8.88 ± 1.0	9.88	9.73	0.002 4	0.005 2	1.00
		9.22 ± 1.0	10.22	10.52	0.002 8		
5 250 ~ 5 350	802.11a	9.82 ± 1.0	10.82	12.08	0.003 4	0.006 2	1.00
		9.12 ± 1.0	10.12	10.28	0.002 8		
	802.11n_ HT20	9.67 ± 1.0	10.67	11.67	0.003 3	0.006 1	1.00
		9.05 ± 1.0	10.05	10.12	0.002 8		
	802.11n_ HT40	9.69 ± 1.0	10.69	11.72	0.003 3	0.006 0	1.00
		8.95 ± 1.0	9.95	9.89	0.002 7		
	802.11ac80	10.53 ± 1.0	11.53	14.22	0.004 0	0.007 8	1.00
		10.35 ± 1.0	11.35	13.65	0.003 8		

5 470 ~ 5 725	802.11a	9.83 ± 1.0	10.83	12.11	0.003 4	0.007 5	1.00
		10.68 ± 1.0	11.68	14.72	0.004 1		
	802.11n_HT20	9.80 ± 1.0	10.8	12.02	0.003 4	0.008 0	1.00
		11.18 ± 1.0	12.18	16.52	0.004 6		
	802.11n_HT40	10.16 ± 1.0	11.16	13.06	0.003 7	0.009 0	1.00
		11.77 ± 1.0	12.77	18.92	0.005 3		
	802.11ac80	10.28 ± 1.0	11.28	13.43	0.003 8	0.007 8	1.00
		10.50 ± 1.0	11.5	14.13	0.004 0		
5 725 ~ 5 850	802.11a	8.85 ± 1.0	9.85	9.66	0.002 3	0.006 4	1.00
		10.67 ± 1.0	11.67	14.69	0.004 1		
	802.11n_HT20	8.93 ± 1.0	9.93	9.84	0.002 4	0.006 6	1.00
		10.78 ± 1.0	11.78	15.07	0.004 2		
	802.11n_HT40	7.67 ± 1.0	8.67	7.36	0.001 8	0.006 2	1.00
		10.94 ± 1.0	11.94	15.63	0.004 4		
	802.11ac80	7.83 ± 1.0	8.83	7.64	0.001 9	0.006 1	1.00
		10.77 ± 1.0	11.77	15.03	0.004 2		

WLAN 2 GHz(802.11 g) = (0.004 7/1) + (0.009 9/1) = 0.014 6

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 (dBm)	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
			(dBm)	(mW)	Log	Linear			
2 402 ~ 2 480	1 Mbps	11.26 ± 1.0	12.26	16.83	-0.44	0.90	1.10	0.003 0	1
	2 Mbps	11.25 ± 1.0	12.25	16.79			1.10	0.003 0	1

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

$$D = 0.282 * \sqrt{(16.83 * 0.90)/1.00} = 1.10 \text{ cm.}$$

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

$$S = P * G / (4\pi * R^2) = 16.83 * 0.90 / (4 * \pi * 20^2) = 0.003 0$$

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

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 (dBm)	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
			(dBm)	(mW)	Log	Linear			
2 402 ~ 2 480	1 Mbps	11.26 ± 1.0	12.26	16.83	-0.44	0.90	1.10	0.003 0	1
	2 Mbps	10.89 ± 1.0	11.89	15.45			1.05	0.002 8	1
	3 Mbps	11.19 ± 1.0	12.19	16.56			1.09	0.003 0	1

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

$$D = 0.282 * \sqrt{(16.83 * 0.90)/1.00} = 1.10 \text{ cm.}$$

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

$$S = P * G / (4\pi * R^2) = 16.83 * 0.90 / (4 * \pi * 20^2) = 0.003 0$$

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

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4.6 DATA for Intermodulation Transmit

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance (dBm)	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)	(mW)			
Bluetooth + WLAN 2 G + WLAN 5 G	Bluetooth (1 Mbps)	11.26 ± 1.0	12.26	16.83	0.003 0	0.027 5	1.00
	WLAN 2 G (802.11 b_Ant 0)	17.30 ± 1.0	18.30	67.61	0.019 2		
	WLAN 5 G (UNII 2C 802.11 n_HT40 Ant 1)	11.77 ± 1.0	12.77	18.92	0.005 3		
Bluetooth LE + WLAN 2 G + WLAN 5 G	Bluetooth LE (2 Mbps)	11.26 ± 1.0	12.26	16.83	0.003 0	0.027 5	1.00
	WLAN 2 G (802.11 b_Ant 0)	17.30 ± 1.0	18.30	67.61	0.019 2		
	WLAN 5 G (UNII 2C 802.11 n_HT40 Ant 1)	11.77 ± 1.0	12.77	18.92	0.005 3		