

# EMF TEST REPORT

Test Report No. : OT-21O-RWD-045

Reception No. : 2110004560

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. : A3LWCB735M

Model Name : WCB735M

Multiple Model Name : N/A

Serial number : N/A

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

Date of Incoming : October 07, 2021

Date of issue : October 28, 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.

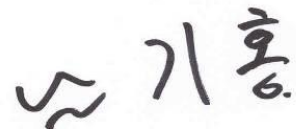
It is not a generally valid assessment of the features of the respective products of the mass-production.



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**Revision History**

| Rev. No. | Issue Report No. | Issued Date      | Revisions       | Section Affected |
|----------|------------------|------------------|-----------------|------------------|
| 0        | OT-21O-RWD-045   | October 28, 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 : A3LWCB735M  
 Model Name : WCB735M  
 Brand Name :   
 Serial Number : N/A  
 Date : October 28, 2021

|                                                         |                                                                                                                                                                                        |
|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EQUIPMENT CLASS                                         | DTS – DIGITAL TRNSMISSION SYSTEM<br>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<br>AUTHORIZATION REQUESTED            | Certification                                                                                                                                                                          |
| EQUIPMENT WILL BE OPERATED<br>UNDER FCC RULES PART(S)   | FCC PART 15 SUBPART C Section 15.247<br>KDB 558074 D01 15.247 Meas Guidance v05r02<br>FCC PART 15 SUBPART E Section 15.407<br>789033 D02 General UNII Test Procedures New Rules v02r01 |
| Modifications on the Equipment to<br>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 WCB735M (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<br>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<br>5 150 MHz ~<br>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<br>5 250 MHz ~<br>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<br>5 470 MHz ~<br>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<br>5 725 MHz ~<br>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<br>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:<br>DSSS Modulation(DBPSK/DQPSK/CCK)                                 |
|                        |                                       | 802.11g/n(HT20)/n(HT40):<br>OFDM Modulation(BPSK/QPSK/16QAM/64QAM)           |
|                        | WLAN 5 GHz                            | 802.11a/n(HT20)/n(HT40)/ac(VHT80):<br>OFDM Modulation(BPSK/QPSK/16QAM/64QAM) |

|                    |                                       |                  |                                                                                                       |
|--------------------|---------------------------------------|------------------|-------------------------------------------------------------------------------------------------------|
| RF OUTPUT<br>POWER | Bluetooth LE                          | 1 Mbps           | 11.26 dBm                                                                                             |
|                    |                                       | 2 Mbps           | 11.15 dBm                                                                                             |
|                    | Bluetooth                             | 1 Mbps           | 11.22 dBm                                                                                             |
|                    |                                       | 2 Mbps           | 11.05 dBm                                                                                             |
|                    |                                       | 3 Mbps           | 11.08 dBm                                                                                             |
|                    | WLAN 2.4 GHz                          | Antenna 0        | 16.69 dBm(802.11b)<br>12.83 dBm(802.11g)<br>12.70 dBm(802.11n_HT20)<br>10.93 dBm(802.11n_HT40)        |
|                    |                                       | Antenna 1        | 17.51 dBm(802.11b)<br>13.75 dBm(802.11g)<br>13.63 dBm(802.11n_HT20)<br>11.59 dBm(802.11n_HT40)        |
|                    |                                       | Multiple Antenna | 16.32 dBm(802.11g)<br>16.20 dBm(802.11n_HT20)<br>14.28 dBm(802.11n_HT40)                              |
|                    | WLAN<br>5 150 MHz ~<br>5 250 MHz Band | Antenna 0        | 12.39 dBm(802.11a)<br>12.48 dBm(802.11n_HT20)<br>10.15 dBm(802.11n_HT40)<br>8.75 dBm(802.11ac_VHT80)  |
|                    |                                       | Antenna 1        | 12.80 dBm(802.11a)<br>12.63 dBm(802.11n_HT20)<br>10.10 dBm(802.11n_HT40)<br>9.08 dBm(802.11ac_VHT80)  |
|                    |                                       | Multiple Antenna | 15.53 dBm(802.11a)<br>15.50 dBm(802.11n_HT20)<br>13.09 dBm(802.11n_HT40)<br>11.93 dBm(802.11ac_VHT80) |

|                    |                                       |                    |                                                                                                       |
|--------------------|---------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------|
| RF OUTPUT<br>POWER | WLAN<br>5 250 MHz ~<br>5 350 MHz Band | Antenna 0          | 12.47 dBm(802.11a)<br>12.35 dBm(802.11n_HT20)<br>11.08 dBm(802.11n_HT40)<br>7.81 dBm(802.11ac_VHT80)  |
|                    |                                       | Antenna 1          | 13.15 dBm(802.11a)<br>13.18 dBm(802.11n_HT20)<br>11.86 dBm(802.11n_HT40)<br>8.48 dBm(802.11ac_VHT80)  |
|                    |                                       | Multiple Antenna   | 15.83 dBm(802.11a)<br>15.80 dBm(802.11n_HT20)<br>14.50 dBm(802.11n_HT40)<br>11.17 dBm(802.11ac_VHT80) |
|                    | WLAN<br>5 470 MHz ~<br>5 725 MHz Band | Antenna 0          | 12.40 dBm(802.11a)<br>12.32 dBm(802.11n_HT20)<br>11.38 dBm(802.11n_HT40)<br>8.18 dBm(802.11ac_VHT80)  |
|                    |                                       | Antenna 0_Straddle | 9.55 dBm(802.11a)<br>9.78 dBm(802.11n_HT20)<br>9.69 dBm(802.11n_HT40)<br>5.92 dBm(802.11ac_VHT80)     |
|                    |                                       | Antenna 1          | 13.23 dBm(802.11a)<br>13.26 dBm(802.11n_HT20)<br>11.56 dBm(802.11n_HT40)<br>8.66 dBm(802.11ac_VHT80)  |
|                    |                                       | Antenna 1_Straddle | 11.34 dBm(802.11a)<br>10.85 dBm(802.11n_HT20)<br>10.66 dBm(802.11n_HT40)<br>6.74 dBm(802.11ac_VHT80)  |

|                    |                                       |                               |                                                                                                       |
|--------------------|---------------------------------------|-------------------------------|-------------------------------------------------------------------------------------------------------|
| RF OUTPUT<br>POWER | WLAN<br>5 470 MHz ~<br>5 725 MHz Band | Multiple Antenna              | 15.77 dBm(802.11a)<br>15.73 dBm(802.11n_HT20)<br>14.48 dBm(802.11n_HT40)<br>11.44 dBm(802.11ac_VHT80) |
|                    |                                       | Multiple Antenna<br>_Straddle | 13.55 dBm(802.11a)<br>13.36 dBm(802.11n_HT20)<br>13.21 dBm(802.11n_HT40)<br>9.36 dBm(802.11ac_VHT80)  |
|                    | WLAN<br>5 725 MHz ~<br>5 850 MHz Band | Antenna 0                     | 11.78 dBm(802.11a)<br>11.93 dBm(802.11n_HT20)<br>11.13 dBm(802.11n_HT40)<br>10.55 dBm(802.11ac_VHT80) |
|                    |                                       | Antenna 0_Straddle            | 2.36 dBm(802.11a)<br>2.57 dBm(802.11n_HT20)<br>-2.23 dBm(802.11n_HT40)<br>-8.75 dBm(802.11ac_VHT80)   |
|                    |                                       | Antenna 1                     | 13.20 dBm(802.11a)<br>13.34 dBm(802.11n_HT20)<br>12.30 dBm(802.11n_HT40)<br>11.66 dBm(802.11ac_VHT80) |
|                    |                                       | Antenna 1_Straddle            | 3.84 dBm(802.11a)<br>3.43 dBm(802.11n_HT20)<br>-0.99 dBm(802.11n_HT40)<br>-7.34 dBm(802.11ac_VHT80)   |
|                    |                                       | Multiple Antenna              | 15.56 dBm(802.11a)<br>15.70 dBm(802.11n_HT20)<br>14.76 dBm(802.11n_HT40)<br>14.15 dBm(802.11ac_VHT80) |
|                    |                                       | Multiple Antenna<br>_Straddle | 6.17 dBm(802.11a)<br>6.03 dBm(802.11n_HT20)<br>1.44 dBm(802.11n_HT40)<br>-4.98 dBm(802.11ac_VHT80)    |

|                                                       |                               |                  |           |
|-------------------------------------------------------|-------------------------------|------------------|-----------|
| ANTENNA TYPE                                          | Chip Antenna                  |                  |           |
| ANTENNA GAIN                                          | Bluetooth LE                  | 0.62 dBi         |           |
|                                                       | Bluetooth                     | 0.62 dBi         |           |
|                                                       | WLAN 2.4 GHz                  | Antenna 0        | -0.42 dBi |
|                                                       |                               | Antenna 1        | -1.71 dBi |
|                                                       |                               | Multiple Antenna | 1.99 dBi  |
|                                                       | 5 150 MHz ~<br>5 250 MHz Band | Antenna 0        | -0.72 dBi |
|                                                       |                               | Antenna 1        | 1.83 dBi  |
|                                                       |                               | Multiple Antenna | 3.75 dBi  |
|                                                       | 5 250 MHz ~<br>5 350 MHz Band | Antenna 0        | -0.80 dBi |
|                                                       |                               | Antenna 1        | 0.37 dBi  |
|                                                       |                               | Multiple Antenna | 2.83 dBi  |
|                                                       | 5 470 MHz ~<br>5 725 MHz Band | Antenna 0        | -1.33 dBi |
|                                                       |                               | Antenna 1        | -0.17 dBi |
|                                                       |                               | Multiple Antenna | 2.30 dBi  |
|                                                       | 5 725 MHz ~<br>5 850 MHz Band | Antenna 0        | -1.43 dBi |
|                                                       |                               | Antenna 1        | 0.26 dBi  |
|                                                       |                               | Multiple Antenna | 2.51 dBi  |
| List of each Osc. or crystal<br>Freq.(Freq. >= 1 MHz) |                               | 40 MHz           |           |

**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  $f/1500$  mW/cm<sup>2</sup> for the frequency range between 300 MHz and 1 500 MHz and 1.0 mW/cm<sup>2</sup> for the frequency range between 1 500 MHz and 100 000 MHz.

The electric field generated for a 1 mW/cm<sup>2</sup> 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<sup>2</sup>, 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 mW/cm<sup>2</sup>

### 4.2 EUT Description

|                             |                                                                                                                                                              |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Kind of EUT                 | Wi-Fi/BT Transceiver                                                                                                                                         |
| Device Category             | <input type="checkbox"/> Portable (< 20 cm separation)<br><input type="checkbox"/> Mobile (> 20 cm separation)<br><input checked="" type="checkbox"/> Others |
| Exposure Evaluation Applied | <input checked="" type="checkbox"/> MPE<br><input type="checkbox"/> SAR<br><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 (dBm) | 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)             | (mW)  | Log          | Linear |                    |                                                        |                             |
| 2 400 ~ 2 483.5            | 802.11b        | 16.69 ± 1.0                    | 17.69             | 58.75 | -0.42        | 0.91   | 2.06               | 0.010 6                                                | 1                           |
|                            | 802.11g        | 12.83 ± 1.0                    | 13.83             | 24.15 |              |        | 1.32               | 0.004 4                                                | 1                           |
|                            | 802.11n_HT20   | 12.70 ± 1.0                    | 13.70             | 23.44 |              |        | 1.30               | 0.004 2                                                | 1                           |
|                            | 802.11n_HT40   | 10.93 ± 1.0                    | 11.93             | 15.60 |              |        | 1.06               | 0.002 8                                                | 1                           |
| 5 150 ~ 5 250              | 802.11a        | 12.39 ± 1.0                    | 13.39             | 21.83 | -0.72        | 0.85   | 1.21               | 0.003 7                                                | 1                           |
|                            | 802.11n_HT20   | 12.48 ± 1.0                    | 13.48             | 22.28 |              |        | 1.23               | 0.003 8                                                | 1                           |
|                            | 802.11n_HT40   | 10.15 ± 1.0                    | 11.15             | 13.03 |              |        | 0.94               | 0.002 2                                                | 1                           |
|                            | 802.11ac80     | 8.75 ± 1.0                     | 9.75              | 9.44  |              |        | 0.80               | 0.001 6                                                | 1                           |
| 5 250 ~ 5 350              | 802.11a        | 12.47 ± 1.0                    | 13.47             | 22.23 | -0.80        | 0.83   | 1.21               | 0.003 7                                                | 1                           |
|                            | 802.11n_HT20   | 12.35 ± 1.0                    | 13.35             | 21.63 |              |        | 1.20               | 0.003 6                                                | 1                           |
|                            | 802.11n_HT40   | 11.08 ± 1.0                    | 12.08             | 16.14 |              |        | 1.03               | 0.002 7                                                | 1                           |
|                            | 802.11ac80     | 7.81 ± 1.0                     | 8.81              | 7.60  |              |        | 0.71               | 0.001 3                                                | 1                           |
| 5 470 ~ 5 725              | 802.11a        | 12.40 ± 1.0                    | 13.40             | 21.88 | -1.33        | 0.74   | 1.13               | 0.003 2                                                | 1                           |
|                            | 802.11n_HT20   | 12.32 ± 1.0                    | 13.32             | 21.48 |              |        | 1.12               | 0.003 1                                                | 1                           |
|                            | 802.11n_HT40   | 11.38 ± 1.0                    | 12.38             | 17.30 |              |        | 1.01               | 0.002 5                                                | 1                           |
|                            | 802.11ac80     | 8.18 ± 1.0                     | 9.18              | 8.28  |              |        | 0.70               | 0.001 2                                                | 1                           |
| 5 725 ~ 5 850              | 802.11a        | 11.78 ± 1.0                    | 12.78             | 18.97 | -1.43        | 0.72   | 1.04               | 0.002 7                                                | 1                           |
|                            | 802.11n_HT20   | 11.93 ± 1.0                    | 12.93             | 19.63 |              |        | 1.06               | 0.002 8                                                | 1                           |
|                            | 802.11n_HT40   | 11.13 ± 1.0                    | 12.13             | 16.33 |              |        | 0.97               | 0.002 3                                                | 1                           |
|                            | 802.11ac80     | 10.55 ± 1.0                    | 11.55             | 14.29 |              |        | 0.90               | 0.002 0                                                | 1                           |

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

$$D = 0.282 * \sqrt{(58.75 * 0.91)/1.00} = 2.06 \text{ cm.}$$

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

$$S = P * G / (4\pi * R^2) = 58.75 * 0.91 / (4 * \pi * 20^2) = 0.010 6$$

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 <sup>2</sup> ) @ 20 cm Separation | Limit (mW/cm <sup>2</sup> ) |
|----------------------------|----------------|--------------------------------|-------------------|-------|--------------|--------|--------------------|--------------------------------------------------------|-----------------------------|
|                            |                |                                | (dBm)             | (mW)  | Log          | Linear |                    |                                                        |                             |
| 2 400 ~ 2 483.5            | 802.11b        | 17.51 ± 1.0                    | 18.51             | 70.96 | -1.71        | 0.67   | 1.95               | 0.009 5                                                | 1                           |
|                            | 802.11g        | 13.75 ± 1.0                    | 14.75             | 29.85 |              |        | 1.27               | 0.004 0                                                | 1                           |
|                            | 802.11n_HT20   | 13.63 ± 1.0                    | 14.63             | 29.04 |              |        | 1.25               | 0.003 9                                                | 1                           |
|                            | 802.11n_HT40   | 11.59 ± 1.0                    | 12.59             | 18.16 |              |        | 0.99               | 0.002 4                                                | 1                           |
| 5 150 ~ 5 250              | 802.11a        | 12.80 ± 1.0                    | 13.80             | 23.99 | 1.83         | 1.52   | 1.71               | 0.007 3                                                | 1                           |
|                            | 802.11n_HT20   | 12.63 ± 1.0                    | 13.63             | 23.07 |              |        | 1.67               | 0.007 0                                                | 1                           |
|                            | 802.11n_HT40   | 10.10 ± 1.0                    | 11.10             | 12.88 |              |        | 1.25               | 0.003 9                                                | 1                           |
|                            | 802.11ac80     | 9.08 ± 1.0                     | 10.08             | 10.19 |              |        | 1.11               | 0.003 1                                                | 1                           |
| 5 250 ~ 5 350              | 802.11a        | 13.15 ± 1.0                    | 14.15             | 26.00 | 0.37         | 1.09   | 1.50               | 0.005 6                                                | 1                           |
|                            | 802.11n_HT20   | 13.18 ± 1.0                    | 14.18             | 26.18 |              |        | 1.51               | 0.005 7                                                | 1                           |
|                            | 802.11n_HT40   | 11.86 ± 1.0                    | 12.86             | 19.32 |              |        | 1.29               | 0.004 2                                                | 1                           |
|                            | 802.11ac80     | 8.48 ± 1.0                     | 9.48              | 8.87  |              |        | 0.88               | 0.001 9                                                | 1                           |
| 5 470 ~ 5 725              | 802.11a        | 13.23 ± 1.0                    | 14.23             | 26.49 | -0.17        | 0.96   | 1.42               | 0.005 1                                                | 1                           |
|                            | 802.11n_HT20   | 13.26 ± 1.0                    | 14.26             | 26.67 |              |        | 1.43               | 0.005 1                                                | 1                           |
|                            | 802.11n_HT40   | 11.56 ± 1.0                    | 12.56             | 18.03 |              |        | 1.17               | 0.003 4                                                | 1                           |
|                            | 802.11ac80     | 8.66 ± 1.0                     | 9.66              | 9.25  |              |        | 0.84               | 0.001 8                                                | 1                           |
| 5 725 ~ 5 850              | 802.11a        | 13.20 ± 1.0                    | 14.20             | 26.30 | 0.26         | 1.06   | 1.49               | 0.005 6                                                | 1                           |
|                            | 802.11n_HT20   | 13.34 ± 1.0                    | 14.34             | 27.16 |              |        | 1.51               | 0.005 7                                                | 1                           |
|                            | 802.11n_HT40   | 12.30 ± 1.0                    | 13.30             | 21.38 |              |        | 1.34               | 0.004 5                                                | 1                           |
|                            | 802.11ac80     | 11.66 ± 1.0                    | 12.66             | 18.45 |              |        | 1.25               | 0.003 9                                                | 1                           |

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

$$D = 0.282 * \sqrt{(70.96 * 0.67)/1.00} = 1.95 \text{ cm.}$$

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

$$S = P * G / (4\pi * R^2) = 70.96 * 0.67 / (4 * \pi * 20^2) = 0.009 5$$

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 <sup>2</sup> ) @ 20 cm Separation | Sum Power Density (mW/cm <sup>2</sup> ) @ 20 cm Separation | Limit (mW/cm <sup>2</sup> ) |
|----------------------------|----------------|--------------------------------|-------------------|-------|--------------------------------------------------------|------------------------------------------------------------|-----------------------------|
|                            |                |                                | (dBm)             | (mW)  |                                                        |                                                            |                             |
| 2 400 ~ 2 483.5            | 802.11g        | 12.83 ± 1.0                    | 13.83             | 24.15 | 0.004 4                                                | 0.008 4                                                    | 1.00                        |
|                            |                | 13.75 ± 1.0                    | 14.75             | 29.85 | 0.004 0                                                |                                                            |                             |
|                            | 802.11n_ HT20  | 12.70 ± 1.0                    | 13.7              | 23.44 | 0.004 2                                                | 0.008 1                                                    | 1.00                        |
|                            |                | 13.63 ± 1.0                    | 14.63             | 29.04 | 0.003 9                                                |                                                            |                             |
|                            | 802.11n_ HT40  | 10.93 ± 1.0                    | 11.93             | 15.60 | 0.002 8                                                | 0.005 2                                                    | 1.00                        |
|                            |                | 11.59 ± 1.0                    | 12.59             | 18.16 | 0.002 4                                                |                                                            |                             |
| 5 150 ~ 5 250              | 802.11a        | 12.39 ± 1.0                    | 13.39             | 21.83 | 0.003 7                                                | 0.011 0                                                    | 1.00                        |
|                            |                | 12.80 ± 1.0                    | 13.8              | 23.99 | 0.007 3                                                |                                                            |                             |
|                            | 802.11n_ HT20  | 12.48 ± 1.0                    | 13.48             | 22.28 | 0.003 8                                                | 0.010 8                                                    | 1.00                        |
|                            |                | 12.63 ± 1.0                    | 13.63             | 23.07 | 0.007 0                                                |                                                            |                             |
|                            | 802.11n_ HT40  | 10.15 ± 1.0                    | 11.15             | 13.03 | 0.002 2                                                | 0.006 1                                                    | 1.00                        |
|                            |                | 10.10 ± 1.0                    | 11.1              | 12.88 | 0.003 9                                                |                                                            |                             |
|                            | 802.11ac80     | 8.75 ± 1.0                     | 9.75              | 9.44  | 0.001 6                                                | 0.004 7                                                    | 1.00                        |
|                            |                | 9.08 ± 1.0                     | 10.08             | 10.19 | 0.003 1                                                |                                                            |                             |
| 5 250 ~ 5 350              | 802.11a        | 12.47 ± 1.0                    | 13.47             | 22.23 | 0.003 7                                                | 0.009 3                                                    | 1.00                        |
|                            |                | 13.15 ± 1.0                    | 14.15             | 26.00 | 0.005 6                                                |                                                            |                             |
|                            | 802.11n_ HT20  | 12.35 ± 1.0                    | 13.35             | 21.63 | 0.003 6                                                | 0.009 3                                                    | 1.00                        |
|                            |                | 13.18 ± 1.0                    | 14.18             | 26.18 | 0.005 7                                                |                                                            |                             |
|                            | 802.11n_ HT40  | 11.08 ± 1.0                    | 12.08             | 16.14 | 0.002 7                                                | 0.006 9                                                    | 1.00                        |
|                            |                | 11.86 ± 1.0                    | 12.86             | 19.32 | 0.004 2                                                |                                                            |                             |
|                            | 802.11ac80     | 7.81 ± 1.0                     | 8.81              | 7.60  | 0.001 3                                                | 0.003 2                                                    | 1.00                        |
|                            |                | 8.48 ± 1.0                     | 9.48              | 8.87  | 0.001 9                                                |                                                            |                             |

|                  |              |             |       |       |         |         |      |
|------------------|--------------|-------------|-------|-------|---------|---------|------|
| 5 470<br>~ 5 725 | 802.11a      | 12.40 ± 1.0 | 13.40 | 21.88 | 0.003 2 | 0.008 3 | 1.00 |
|                  |              | 13.23 ± 1.0 | 14.23 | 26.49 | 0.005 1 |         |      |
|                  | 802.11n_HT20 | 12.32 ± 1.0 | 13.32 | 21.48 | 0.003 1 | 0.008 2 | 1.00 |
|                  |              | 13.26 ± 1.0 | 14.26 | 26.67 | 0.005 1 |         |      |
|                  | 802.11n_HT40 | 11.38 ± 1.0 | 12.38 | 17.30 | 0.002 5 | 0.005 9 | 1.00 |
|                  |              | 11.56 ± 1.0 | 12.56 | 18.03 | 0.003 4 |         |      |
|                  | 802.11ac80   | 8.18 ± 1.0  | 9.18  | 8.28  | 0.001 2 | 0.003 0 | 1.00 |
|                  |              | 8.66 ± 1.0  | 9.66  | 9.25  | 0.001 8 |         |      |
| 5 725<br>~ 5 850 | 802.11a      | 11.78 ± 1.0 | 12.78 | 18.97 | 0.002 7 | 0.008 3 | 1.00 |
|                  |              | 13.20 ± 1.0 | 14.20 | 26.3  | 0.005 6 |         |      |
|                  | 802.11n_HT20 | 11.93 ± 1.0 | 12.93 | 19.63 | 0.002 8 | 0.008 5 | 1.00 |
|                  |              | 13.34 ± 1.0 | 14.34 | 27.16 | 0.005 7 |         |      |
|                  | 802.11n_HT40 | 11.13 ± 1.0 | 12.13 | 16.33 | 0.002 3 | 0.006 8 | 1.00 |
|                  |              | 12.30 ± 1.0 | 13.30 | 21.38 | 0.004 5 |         |      |
|                  | 802.11ac80   | 10.55 ± 1.0 | 11.55 | 14.29 | 0.002 0 | 0.005 9 | 1.00 |
|                  |              | 11.66 ± 1.0 | 12.66 | 18.45 | 0.003 9 |         |      |

WLAN 2 GHz(802.11 g) = (0.004 4/1) + (0.004 0/1) = 0.008 4

#### 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 <sup>2</sup> ) @ 20 cm Separation | Limit (mW/cm <sup>2</sup> ) |
|----------------------------|----------------|--------------------------------|-------------------|-------|--------------|--------|--------------------|--------------------------------------------------------|-----------------------------|
|                            |                |                                | (dBm)             | (mW)  | Log          | Linear |                    |                                                        |                             |
| 2 402 ~ 2 480              | 1 Mbps         | 11.26 ± 1.0                    | 12.26             | 16.83 | 0.62         | 1.15   | 1.24               | 0.003 9                                                | 1                           |
|                            | 2 Mbps         | 11.15 ± 1.0                    | 12.15             | 16.41 |              |        | 1.23               | 0.003 8                                                | 1                           |

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

$$D = 0.282 * \sqrt{(16.83 * 1.15)/1.00} = 1.24 \text{ cm.}$$

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

$$S = P * G / (4\pi * R^2) = 16.83 * 1.15 / (4 * \pi * 20^2) = 0.003 9$$

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

#### 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 <sup>2</sup> ) @ 20 cm Separation | Limit (mW/cm <sup>2</sup> ) |
|----------------------------|----------------|--------------------------------|-------------------|-------|--------------|--------|--------------------|--------------------------------------------------------|-----------------------------|
|                            |                |                                | (dBm)             | (mW)  | Log          | Linear |                    |                                                        |                             |
| 2 402 ~ 2 480              | 1 Mbps         | 11.22 ± 1.0                    | 12.22             | 16.67 | 0.62         | 1.15   | 1.24               | 0.003 8                                                | 1                           |
|                            | 2 Mbps         | 11.05 ± 1.0                    | 12.05             | 16.03 |              |        | 1.21               | 0.003 7                                                | 1                           |
|                            | 3 Mbps         | 11.08 ± 1.0                    | 12.08             | 16.14 |              |        | 1.22               | 0.003 7                                                | 1                           |

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

$$D = 0.282 * \sqrt{(16.67 * 1.15)/1.00} = 1.24 \text{ cm.}$$

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

$$S = P * G / (4\pi * R^2) = 16.67 * 1.15 / (4 * \pi * 20^2) = 0.003 8$$

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<br>Freq. Band<br>(MHz)         | Operating Mode                                 | Target<br>Power<br>W/tolerance<br>(dBm) | Max tune up<br>power |       | Power<br>Density<br>(mW/cm <sup>2</sup> )<br>@ 20 cm<br>Separation | Sum<br>Power Density<br>(mW/cm <sup>2</sup> )<br>@ 20 cm<br>Separation | Limit<br>(mW/cm <sup>2</sup> ) |
|------------------------------------------|------------------------------------------------|-----------------------------------------|----------------------|-------|--------------------------------------------------------------------|------------------------------------------------------------------------|--------------------------------|
|                                          |                                                |                                         | (dBm)                | (mW)  |                                                                    |                                                                        |                                |
| Bluetooth +<br>WLAN 2 G +<br>WLAN 5 G    | Bluetooth<br>(1 Mbps)                          | 11.22 ± 1.0                             | 12.22                | 16.67 | 0.003 8                                                            | 0.020 1                                                                | 1.00                           |
|                                          | WLAN 2 G<br>(802.11 b_Ant 0)                   | 16.69 ± 1.0                             | 17.69                | 58.75 | 0.010 6                                                            |                                                                        |                                |
|                                          | WLAN 5 G<br>(UNII 3<br>802.11 n_HT20<br>Ant 1) | 13.34 ± 1.0                             | 14.34                | 27.16 | 0.005 7                                                            |                                                                        |                                |
| Bluetooth LE +<br>WLAN 2 G +<br>WLAN 5 G | Bluetooth LE<br>(1 Mbps)                       | 11.26 ± 1.0                             | 12.26                | 16.83 | 0.003 9                                                            | 0.020 2                                                                | 1.00                           |
|                                          | WLAN 2 G<br>(802.11 b_Ant 0)                   | 16.69 ± 1.0                             | 17.69                | 58.75 | 0.010 6                                                            |                                                                        |                                |
|                                          | WLAN 5 G<br>(UNII 3<br>802.11 n_HT20<br>Ant 1) | 13.34 ± 1.0                             | 14.34                | 27.16 | 0.005 7                                                            |                                                                        |                                |