

# RF Exposure Evaluation

## 1.1 RF Exposure Compliance Requirement

### 1.1.1 Limits

According to FCC Part 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in part 1.1307(b)

Table 1-Limits for maximum permissible exposure (MPE)

| Frequency range (MHz)  | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density (mW/cm <sup>2</sup> ) | Averaging time (minutes) |
|--|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| <b>(A) Limits for Occupational/Controlled Exposures</b>        |                               |                               |                                     |                          |
| 0.3–3.0 .....  | 614                           | 1.63                          | *(100)                              | 6                        |
| 3.0–30 .....   | 1842/f                        | 4.89/f                        | *(900/f <sup>2</sup> )              | 6                        |
| 30–300 .....   | 61.4                          | 0.163                         | 1.0                                 | 6                        |
| 300–1500 .....   | .....                         | .....                         | f/300                               | 6                        |
| 1500–100,000 .....   | .....                         | .....                         | 5                                   | 6                        |
| <b>(B) Limits for General Population/Uncontrolled Exposure</b> |                               |                               |                                     |                          |
| 0.3–1.34 .....   | 614                           | 1.63                          | *(100)                              | 30                       |
| 1.34–30 .....  | 824/f                         | 2.19/f                        | *(180/f <sup>2</sup> )              | 30                       |
| 30–300 .....   | 27.5                          | 0.073                         | 0.2                                 | 30                       |
| 300–1500 .....   | .....                         | .....                         | f/1500                              | 30                       |
| 1500–100,000 .....   | .....                         | .....                         | 1.0                                 | 30                       |

F= Frequency in MHz

Friis Formula

Friis transmission formula:  $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where

$P_d$  = power density in mW/cm<sup>2</sup>

$P_{out}$  = output power to antenna in mW

G = gain of antenna in linear scale

$\pi$  = 3.1416

R = distance between observation point and center of the radiator in cm

$P_d$  is the limit of MPE, 1 mW/cm<sup>2</sup>. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

If we know the maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the MPE value at distance 20cm.

### 1.1.2 EUT Operating condition

The software provided by Manufacturer enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

### 1.1.3 Test Results

#### (1)For BT Module

**Antenna Gain:** The maximum Gain measured in Fully Anechoic Chamber is 2.81 dBi.

#### Classic mode

| Channel | Frequency (MHz) | Max Conducted Peak Output Power (dBm) | Output Power to Antenna (mW) | Power Density at R = 20 cm (mW/ cm <sup>2</sup> ) | Limit | Result |
|---------|-----------------|---------------------------------------|------------------------------|---|-------|--------|
| Highest | 2480            | 8.93                                  | 7.816                        | 0.00297   | 1.0   | Pass   |

**Note:** EUT test Max Conducted Peak Output Power value.

#### BLE mode

| Channel | Frequency (MHz) | Max Conducted Peak Output Power (dBm) | Output Power to Antenna (mW) | Power Density at R = 20 cm (mW/ cm <sup>2</sup> ) | Limit | Result |
|---------|-----------------|---------------------------------------|------------------------------|---|-------|--------|
| Highest | 2480            | 7.54                                  | 5.675                        | 0.002156  | 1.0   | Pass   |

**Note:** EUT test Max Conducted Peak Output Power value.

#### (2)For Wisa Module

**Antenna Gain:** The maximum Gain measured in Fully Anechoic Chamber is 1 dBi.

| Radio         | Antenna Type       | Antenna Manufacturer | Antenna Part No. | Transmit Frequency (MHz) | Max Peak Conducted Output Power (mW) | Duty Cycle | Duty Cycle Corrected Output Power (mW) | Antenna Gain (dBi) | Minimum Antenna Cable Loss (dB) | Power Density @ 20 Cm (mW/ cm <sup>2</sup> ) | General Population Exposure Limit from 1.1310 (mW/ cm <sup>2</sup> ) |
|---------------|--------------------|----------------------|------------------|--------------------------|--------------------------------------|------------|--|--------------------|---------------------------------|--|--|
| 802.11 a UNII | Embedded PCB Trace | Summit Semiconductor | None             | 5180                     | 15.26                                | 1          | 15.26                                  | 1.0                | 0                               | 0.0038                                       | 1.0  |
|               |                    |                      |                  | 5320                     | 15.02                                | 1          | 15.02                                  | 1.0                | 0                               | 0.0038                                       | 1.0  |
|               |                    |                      |                  | 5500                     | 18.80                                | 1          | 18.80                                  | 1.0                | 0                               | 0.0047                                       | 1.0  |
|               |                    |                      |                  | 5700                     | 12.80                                | 1          | 12.80                                  | 1.0                | 0                               | 0.0032                                       | 1.0  |
|               |                    |                      |                  | 5825                     | 11.79                                | 1          | 11.79                                  | 1.0                | 0                               | 0.0030                                       | 1.0  |

**Note:** EUT test Max Conducted Peak Output Power value.

$$\text{BT Module} + \text{Wisa Module} = 0.00297 + 0.0047 = 0.00767 < 1.0$$

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is  $\leq 1.0$