

**Maximum Permissible Exposure (MPE)**

According to FCC 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 §1.1307(b)

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 Exposure</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                        |
| 300-1,500                                                      |                               |                               | f/300                               | 6                        |
| 1,500-100,000                                                  |                               |                               | 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                       |
| 300-1,500                                                      |                               |                               | f/1500                              | 30                       |
| 1,500-100,000                                                  |                               |                               | 1.0                                 | 30                       |

f = frequency in MHz \* = Plane-wave equivalent power density

MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 * P * G}}{d}$$

$$\text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = Average RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 * P * G}{377 * D^2}$$

From the EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

BT:  
Measurement Result  
Operation Frequency: 2402MHz~2480MHz  
Power density limited: 1mW/ cm<sup>2</sup>  
Antenna Type: Ant1/2: PCB antenna,  
Antenna gain: Ant1/2: 6dBi,  
R=20cm  
mW=10<sup>^(dBm/10)</sup>  
Max antenna gain Numeric=10<sup>^(dBi/10)</sup>=10<sup>^(6/10)</sup>=3.98

#### BLE

| Channel Freq. (MHz) | modulation    | conducted power | Tune-up power (dBm) | Max           |       | Antenna |       | Evaluation result | Power density |
|---------------------|---------------|-----------------|---------------------|---------------|-------|---------|-------|-------------------|---------------|
|                     |               | (dBm)           |                     | tune-up power |       | Gain    |       |                   |               |
|                     |               |                 |                     | (dBm)         | (dBm) | (mW)    | (dBi) | Numeric           | (mW/cm2 )     |
| 2402                | GFSK(1M) ANT1 | -7.28           | -7±1                | -6            | 0.251 | 6.00    | 3.98  | 0.00020           | 1             |
| 2440                |               | -4.06           | -4±1                | -3            | 0.501 | 6.00    | 3.98  | 0.00040           | 1             |
| 2480                |               | -3.54           | -4±1                | -3            | 0.501 | 6.00    | 3.98  | 0.00040           | 1             |
| 2402                | GFSK(1M) ANT2 | -4.1            | -4±1                | -3            | 0.501 | 6.00    | 3.98  | 0.00040           | 1             |
| 2440                |               | -4.54           | -4±1                | -3            | 0.501 | 6.00    | 3.98  | 0.00040           | 1             |
| 2480                |               | -4.97           | -4±1                | -3            | 0.501 | 6.00    | 3.98  | 0.00040           | 1             |

| Channel Freq. (MHz) | modulation       | conducted power | Tune-up power (dBm) | Max           |       | Antenna |       | Evaluation result | Power density |
|---------------------|------------------|-----------------|---------------------|---------------|-------|---------|-------|-------------------|---------------|
|                     |                  | (dBm)           |                     | tune-up power |       | Gain    |       |                   |               |
|                     |                  |                 |                     | (dBm)         | (dBm) | (mW)    | (dBi) | Numeric           | (mW/cm2 )     |
| 2402                | GFSK(2M)<br>ANT1 | -5.03           | -5±1                | -4            | 0.398 | 6.00    | 3.98  | 0.00032           | 1             |
| 2440                |                  | -4.67           | -5±1                | -4            | 0.398 | 6.00    | 3.98  | 0.00032           | 1             |
| 2480                |                  | -4.65           | -5±1                | -4            | 0.398 | 6.00    | 3.98  | 0.00032           | 1             |
| 2402                | GFSK(2M)<br>ANT2 | -3.94           | -4±1                | -3            | 0.501 | 6.00    | 3.98  | 0.00040           | 1             |
| 2440                |                  | -4.43           | -4±1                | -3            | 0.501 | 6.00    | 3.98  | 0.00040           | 1             |
| 2480                |                  | -4.86           | -4±1                | -3            | 0.501 | 6.00    | 3.98  | 0.00040           | 1             |

**2.4G WIFI:**

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,

WIFI 802.11n HT40:2422-2452MHz

Power density limited: 1mW/ cm<sup>2</sup>

Antenna Type: Ant1/2: PCB antenna,

Antenna gain: Ant1/2: 6dBi,

R=20cm

mW=10^(dBm/10)

| ANT  | Channel Freq. (MHz) | modulation  | conducted power | Tune-up power | Max           |       | Antenna | Evaluation result at 20cm |
|------|---------------------|-------------|-----------------|---------------|---------------|-------|---------|---------------------------|
|      |                     |             | (dBm)           | (dBm)         | tune-up power |       | Gain    | Power                     |
|      |                     |             |                 |               | (dBm)         | (mW)  | Numeric | density(mW/cm2)           |
| ANT1 | 2412                | 802.11b     | 14.45           | 14±1          | 15            | 31.62 | 3.98    | 0.02504                   |
|      | 2437                |             | 13.01           | 14±1          | 15            | 31.62 | 3.98    | 0.02504                   |
|      | 2462                |             | 14.8            | 14±1          | 15            | 31.62 | 3.98    | 0.02504                   |
|      | 2412                | 802.11g     | 12.5            | 13±1          | 14            | 25.12 | 3.98    | 0.01989                   |
|      | 2437                |             | 12.1            | 13±1          | 14            | 25.12 | 3.98    | 0.01989                   |
|      | 2462                |             | 13.45           | 13±1          | 14            | 25.12 | 3.98    | 0.01989                   |
|      | 2412                | 802.11n H20 | 11.68           | 11±1          | 12            | 15.85 | 3.98    | 0.01255                   |
|      | 2437                |             | 10.85           | 11±1          | 12            | 15.85 | 3.98    | 0.01255                   |
|      | 2462                |             | 12.53           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |
|      | 2422                | 802.11n H40 | 12.53           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |
|      | 2437                |             | 12.07           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |
|      | 2452                |             | 12.99           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |
|      | 2412                | 802.11ax20  | 10.82           | 11±1          | 12            | 15.85 | 3.98    | 0.01255                   |
|      | 2437                |             | 11.11           | 11±1          | 12            | 15.85 | 3.98    | 0.01255                   |
|      | 2462                |             | 12.69           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |
| ANT2 | 2412                | 802.11b     | 14.44           | 14±1          | 15            | 31.62 | 3.98    | 0.02504                   |
|      | 2437                |             | 14.86           | 14±1          | 15            | 31.62 | 3.98    | 0.02504                   |
|      | 2462                |             | 16.01           | 16±1          | 17            | 50.12 | 3.98    | 0.03968                   |
|      | 2412                | 802.11g     | 12.9            | 13±1          | 14            | 25.12 | 3.98    | 0.01989                   |
|      | 2437                |             | 13.64           | 13±1          | 14            | 25.12 | 3.98    | 0.01989                   |
|      | 2462                |             | 14.7            | 14±1          | 15            | 31.62 | 3.98    | 0.02504                   |
|      | 2412                | 802.11n H20 | 11.98           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |
|      | 2437                |             | 12.58           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |
|      | 2462                |             | 13.56           | 13±1          | 14            | 25.12 | 3.98    | 0.01989                   |
|      | 2422                | 802.11n H40 | 12.35           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |
|      | 2437                |             | 11.77           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |
|      | 2452                |             | 12.23           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |
|      | 2412                | 802.11ax20  | 12.11           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |
|      | 2437                |             | 12.66           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |
|      | 2462                |             | 12.68           | 12±1          | 13            | 19.95 | 3.98    | 0.01580                   |

**Note: BT & WIFI do not support simultaneous transmission.****Conclusion:**

The conclusion for Max mode should be 0.02504&lt;1 for Max Power Density, Compliance the RF exposure.

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