

## FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

#### Limits for General Population/Uncontrolled Exposure

| Limits for General Population/Uncontrolled Exposure |                               |                               |                                     |                          |
|---|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency Range (MHz)                               | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm <sup>2</sup> ) | Averaging Time (Minutes) |
| 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

\* = Plane-wave equivalent power density

### Result

#### Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

| Mode       | Frequency (MHz) | Antenna Gain |           | Max Tune-up Conducted Power |        | Evaluation Distance (cm) | Power Density (mW/cm <sup>2</sup> ) | MPE Limit (mW/cm <sup>2</sup> ) |
|------------|-----------------|--------------|-----------|-----------------------------|--------|--------------------------|-------------------------------------|---------------------------------|
|            |                 | (dBi)        | (numeric) | (dBm)                       | (mW)   |                          |                                     |                                 |
| ZigBee     | 2405-2480       | 0            | 1.00      | 19                          | 79.43  | 20                       | 0.016                               | 1                               |
| 2.4G Wi-Fi | 2412-2462       | 4.5          | 2.82      | 25                          | 316.23 | 20                       | 0.177                               | 1                               |
| 5G Wi-Fi   | 5150-5350       | 3.5          | 2.24      | 20.0                        | 100    | 20                       | 0.045                               | 1                               |
|            | 5725-5850       | 3.5          | 2.24      | 20.0                        | 100    | 20                       | 0.045                               | 1                               |

Note: 1. the tune up conducted power was declared by the applicant  
 2. the 2.4G Wi-Fi, 5.2G Wi-Fi, 5.8G Wi-Fi and ZigBee can transmit at the same time.

Simultaneous transmitting consideration:

The ratio= $MPE_{2.4GWi-Fi}/limit + MPE_{5.2GWi-Fi}/limit + MPE_{5.8GWi-Fi}/limit + MPE_{ZigBee}/limit$   
 $=0.177/1+0.045/1+0.045/1+0.016/1=0.283 < 1.0$

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

**Result: Compliance**