

## FCC §2.1091, §15.407(f), LP0002-2018 §5.20.2 - RF Exposure

### 1.1 Applicable Standards

According to FCC §15.247(i), §15.407(f) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

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) |
|---|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Limits for General Population/Uncontrolled Exposure |                               |                               |                                     |                          |
| 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

Before equipment certification is granted, the procedure of ISED RSS-102 must be followed concerning the exposure of humans to RF field

### 1.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

### 1.3 MPE Results

#### BLE:

|   |               |
|---|---------------|
| <u>Maximum average output power at antenna input terminal (dBm):</u>                        | <u>4.21</u>   |
| <u>Maximum average output power at antenna input terminal (mW):</u>                         | <u>2.64</u>   |
| <u>Prediction distance (cm):</u>  | <u>30</u>     |
| <u>Prediction frequency (MHz):</u>  | <u>2402</u>   |
| <u>Maximum Antenna Gain, typical (dBi):</u>   | <u>2</u>      |
| <u>Maximum Antenna Gain (numeric):</u>  | <u>1.58</u>   |
| <u>Power density of prediction frequency at 30.0 cm (mW/cm<sup>2</sup>):</u>                | <u>0.0004</u> |
| <u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u> | <u>1.0</u>    |

#### 2.4 GHz Wi-Fi:

|   |               |
|---|---------------|
| <u>Maximum average output power at antenna input terminal (dBm):</u>                        | <u>24.3</u>   |
| <u>Maximum average output power at antenna input terminal (mW):</u>                         | <u>269.15</u> |
| <u>Prediction distance (cm):</u>  | <u>30</u>     |
| <u>Prediction frequency (MHz):</u>  | <u>2437</u>   |
| <u>Maximum Antenna Gain, typical (dBi):</u>   | <u>10</u>     |
| <u>Maximum Antenna Gain (numeric):</u>  | <u>10</u>     |
| <u>Power density of prediction frequency at 30.0 cm (mW/cm<sup>2</sup>):</u>                | <u>0.238</u>  |
| <u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u> | <u>1.0</u>    |

#### 5.2 GHz band:

|   |               |
|---|---------------|
| <u>Maximum average output power at antenna input terminal (dBm):</u>                        | <u>21.04</u>  |
| <u>Maximum average output power at antenna input terminal (mW):</u>                         | <u>127.06</u> |
| <u>Prediction distance (cm):</u>  | <u>30</u>     |
| <u>Prediction frequency (MHz):</u>  | <u>5200</u>   |
| <u>Maximum Antenna Gain, typical (dBi):</u>   | <u>14.45</u>  |
| <u>Maximum Antenna Gain (numeric):</u>  | <u>27.86</u>  |
| <u>Power density of prediction frequency at 30.0 cm (mW/cm<sup>2</sup>):</u>                | <u>0.313</u>  |
| <u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u> | <u>1.0</u>    |

### Radio Co-location

BLE + 2.4 GHz Wi-Fi + 5 GHz Wi-Fi:

$$0.0004/1 + 0.238/1 + 0.313/1 = 0.551 < 1$$

### Conclusion

The device is compliant with the requirement MPE limit for uncontrolled exposure. All transceiver modules must be installed with a separation distance of no less than **30** cm from all persons.