

## 6 FCC §2.1091, §15.247(i) & ISED RSS-102 - RF Exposure

### 6.1 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

According to ISED RSS-102 Issue 5:

### 2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz<sup>6</sup> and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $4.49/f^{0.5}$  W (adjusted for tune-up tolerance), where  $f$  is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $1.31 \times 10^{-2} f^{0.6834}$  W (adjusted for tune-up tolerance), where  $f$  is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

## 6.2 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

## 6.3 MPE Results for FCC

### BLE:

<u>Maximum average output power at antenna input terminal (dBm):</u>	<u>5.52</u>
<u>Maximum average output power at antenna input terminal (mW):</u>	<u>3.56</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>2440</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>2.5</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.78</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.0013</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>16.15</u>
<u>Maximum average output power at antenna input terminal (mW):</u>	<u>41.21</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5240</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>2.5</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.78</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.0146</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>

### 5.8 GHz band:

<u>Maximum average output power at antenna input terminal (dBm):</u>	<u>15.47</u>
<u>Maximum average output power at antenna input terminal (mW):</u>	<u>35.24</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5745</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>2.5</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.78</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.0125</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 + 5 GHz Wi-Fi:

$$0.0013/1 + 0.0146/1 = 0.0159 < 1$$

**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 **20** cm from all persons.

**6.4 RF exposure evaluation exemption for IC**

Frequency Band	Channel Frequency (MHz)	Maximum e.i.r.p. (dBm)	Maximum e.i.r.p. (W)	ISED RF Exposure Exemption Threshold (W)	Result
BLE	2440	8.02	0.006	2.705	Exempt
U-NII-1	5240	18.65	0.073	4.561	Exempt
U-NII-3	5745	17.97	0.063	4.857	Exempt

**Conclusion**

The RF exposure evaluation is not required.