

## 5 FCC §2.1091, §15.247(i) & ISEDC RSS-102- RF Exposure

### 5.1 Applicable Standards

According to FCC §15.247(i) 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

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.

## 5.2 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

## 5.3 MPE Results for the FCC

### Standalone

#### 900 MHz (FCC ID: 2AE5A-SRZEUS2)

<u>Maximum output power at antenna input terminal (dBm):</u>	<u>12.386</u>
<u>Maximum output power at antenna input terminal (mW):</u>	<u>17.322</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>927.8</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>-5.0</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>0.316</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.001090</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>0.6185</u>
<u>MPE Ratio(numeric):</u>	<u>0.002</u>

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.001090 mW/cm<sup>2</sup>. Limit is 0.6185 mW/cm<sup>2</sup>.

#### Wi-Fi Radio (FCC ID: 2ADHKATWINC1500)

<u>Maximum output power at antenna input terminal (dBm):</u>	<u>23.03</u>
<u>Maximum output power at antenna input terminal (mW):</u>	<u>200.9</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>2437</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>-6.16</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>0.242</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.010</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>
<u>MPE Ratio(numeric):</u>	<u>0.010</u>

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.02003 mW/cm<sup>2</sup>. Limit is 1.0 mW/cm<sup>2</sup>.

**Cellular Radio (FCC ID: XMR2020BG95M2)****Band 2:**

<u>Maximum output power at antenna input terminal (dBm):</u>	<u>22</u>
<u>Maximum output power at antenna input terminal (mW):</u>	<u>158.49</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>1850</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>2.76</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.89</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.0595</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>
<u>MPE Ratio(numeric):</u>	<u>0.0595</u>

**Band 4:**

<u>Maximum output power at antenna input terminal (dBm):</u>	<u>22</u>
<u>Maximum output power at antenna input terminal (mW):</u>	<u>158.49</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>1710</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>2.95</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.97</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.0622</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>
<u>MPE Ratio(numeric):</u>	<u><b>0.0622</b></u>

**Band 12:**

<u>Maximum output power at antenna input terminal (dBm):</u>	<u>22</u>
<u>Maximum output power at antenna input terminal (mW):</u>	<u>158.49</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>699</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>-1.05</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>0.79</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.0248</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>0.466</u>
<u>MPE Ratio(numeric):</u>	<u>0.0531</u>

**Co-location**

The 900 MHz radio can transmit with Wi-Fi simultaneously or with LTE cellular radio simultaneously. The combined MPE radio is  $0.002 + 0.010 = 0.012$  or  $0.002 + 0.0622 = 0.0642$  which are less than the limit of 1.0.

**5.4 RF exposure evaluation exemption for IC****900 MHz (IC: 20891-SRZEUS2)**

Maximum Conducted power = 12.386 dBm which is lesser than  $1.31 \times 10^{-2} f^{0.6834} = 1.3706 \text{ W} = 31.37 \text{ dBm}$

The RF exposure evaluation is exempt.

**2.4 GHz Wi-Fi (IC: 20266-WINC1500PB)**

Maximum Conducted power = 23.03 dBm which is lesser than  $1.31 \times 10^{-2} f^{0.6834} = 2.703014 \text{ W} = 34.32 \text{ dBm}$

The RF exposure evaluation is exempt.

**Cellular Radio (IC: 10224A-2020BG95M2)**

Maximum EIRP power = 22 dBm + 2.95 dBi = 24.95 dBm for LTE band 4 which is lesser than  $1.31 \times 10^{-2} f^{0.6834} = 2.121782 \text{ W} = 33.27 \text{ dBm}$

The RF exposure evaluation is exempt.