

## 4 FCC §1.1307(b) (1), §2.1091 & §90.223 & ISEDC RSS-102 - RF Exposure

### 4.1 Applicable Standards

FCC §2.1091, (a) Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular §1.1307(b).

According to §1.1310 and §2.1091 RF exposure is calculated.

#### Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minute)
<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>				
0.3-3.0	614	1.63	*(100)	<30
3.0-30	824/f	2.19/f	*(900/f <sup>2</sup> )	<30
30-300	27.5	0.073	1.0	<30
300-1,500			f/1500	<30
1,500-100,000			1.0	<30

Note: f = frequency in MHz

\* = Plane-wave equivalent power density

According to ISSED RSS-102:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)				
Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m <sup>2</sup> )	Reference Period (minutes)
0.003-10 <sup>21</sup>	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ f <sup>0.5</sup>	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ f <sup>0.25</sup>	0.1540/ f <sup>0.25</sup>	8.944/ f <sup>0.5</sup>	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 f <sup>0.3417</sup>	0.008335 f <sup>0.3417</sup>	0.02619 f <sup>0.6834</sup>	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ f <sup>1.2</sup>
150000-300000	0.158 f <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> f <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> f	616000/f <sup>1.2</sup>

**Note:** f is frequency in MHz.  
 \* Based on nerve stimulation (NS).  
 \*\* Based on specific absorption rate (SAR).

## 4.2 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

### 4.3 RF exposure evaluation exemption for FCC and IC

Radio 1: 15dBi antenna gain

<u>Maximum tune up power at antenna input terminal (dBm):</u>	<u>15.5</u>
<u>Maximum tune up power at antenna input terminal (mW):</u>	<u>35.48</u>
<u>Prediction frequency (MHz):</u>	<u>4950</u>
<u>Antenna Gain, maximum (dBi):</u>	<u>15</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>31.6</u>
<u>Prediction distance (cm):</u>	<u>40</u>
<u>Power density of prediction frequency at 40 cm (mW/cm<sup>2</sup>):</u>	<u>0.056</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>

Radio 2: 15dBi antenna gain

<u>Maximum tune up power at antenna input terminal (dBm):</u>	<u>15.5</u>
<u>Maximum tune up power at antenna input terminal (mW):</u>	<u>35.48</u>
<u>Prediction frequency (MHz):</u>	<u>4950</u>
<u>Antenna Gain, maximum (dBi):</u>	<u>15</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>31.6</u>
<u>Prediction distance (cm):</u>	<u>40</u>
<u>Power density of prediction frequency at 40 cm (mW/cm<sup>2</sup>):</u>	<u>0.056</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>

## Radio 1: 15dBi antenna gain

Maximum tune up power at antenna input terminal (dBm): 15.5  
Maximum tune up power at antenna input terminal (W): 0.03548  
Prediction (minimum separation) distance (m): 0.4  
Prediction frequency (MHz): 4950  
Maximum Antenna Gain, typical (dBi): 15  
Maximum Antenna Gain (numeric): 31.6  
Power density of prediction frequency at 0.4m (W/m<sup>2</sup>): 0.558  
Limit for uncontrolled exposure at prediction frequency (W/m<sup>2</sup>): 8.77

## Radio 2: 15dBi antenna gain

Maximum tune up power at antenna input terminal (dBm): 15.5  
Maximum tune up power at antenna input terminal (W): 0.03548  
Prediction (minimum separation) distance (m): 0.4  
Prediction frequency (MHz): 4950  
Maximum Antenna Gain, typical (dBi): 15  
Maximum Antenna Gain (numeric): 31.6  
Power density of prediction frequency at 0.4m (W/m<sup>2</sup>): 0.558  
Limit for uncontrolled exposure at prediction frequency (W/m<sup>2</sup>): 8.77

## Radio 1: 3dBi antenna gain

Maximum tune up power at antenna input terminal (dBm): 15.5  
Maximum tune up power at antenna input terminal (mW): 35.48  
Prediction frequency (MHz): 4950  
Antenna Gain, maximum (dBi): 3  
Maximum Antenna Gain (numeric): 2  
Prediction distance (cm): 40  
Power density of prediction frequency at 40 cm (mW/cm<sup>2</sup>): 0.04  
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>): 1.0

## Radio 2: 3dBi antenna gain

Maximum tune up power at antenna input terminal (dBm): 20.5  
Maximum tune up power at antenna input terminal (mW): 112.2  
Prediction frequency (MHz): 4950  
Antenna Gain, maximum (dBi): 3  
Maximum Antenna Gain (numeric): 2  
Prediction distance (cm): 40  
Power density of prediction frequency at 40 cm (mW/cm<sup>2</sup>): 0.011  
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>): 1.0

## Radio 1: 3dBi antenna gain

<u>Maximum tune up power at antenna input terminal (dBm):</u>	<u>15.5</u>
<u>Maximum tune up power at antenna input terminal (W):</u>	<u>0.03548</u>
<u>Prediction (minimum separation) distance (m):</u>	<u>0.4</u>
<u>Prediction frequency (MHz):</u>	<u>4950</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>3</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>2</u>
<u>Power density of prediction frequency at 0.4m (W/m<sup>2</sup>):</u>	<u>0.035</u>
<u>Limit for uncontrolled exposure at prediction frequency (W/m<sup>2</sup>):</u>	<u>8.77</u>

## Radio 2: 3dBi antenna gain

<u>Maximum tune up power at antenna input terminal (dBm):</u>	<u>20.5</u>
<u>Maximum tune up power at antenna input terminal (W):</u>	<u>0.1122</u>
<u>Prediction (minimum separation) distance (m):</u>	<u>0.4</u>
<u>Prediction frequency (MHz):</u>	<u>4950</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>3</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>2</u>
<u>Power density of prediction frequency at 0.4m (W/m<sup>2</sup>):</u>	<u>0.1116</u>
<u>Limit for uncontrolled exposure at prediction frequency (W/m<sup>2</sup>):</u>	<u>8.77</u>

**4.4 RF exposure Simultaneous Transmission evaluation for FCC**

Total Power Densities (Percentages) = 5GHz Radio 1 Power Density % + 5GHz Radio 2 Power Density % + BLE Power Density % + 4.9GHz Radio 1

Total Relative Power Densities (Percentages) =  $(0.140/1.0) * 100 + (0.176/1.0) * 100 + (0.001/1) * 100 + (0.056/1.0) * 100 = 14 \% + 17.6 \% + 1\% + 5.6 \% = 38.2\%$