

4 FCC §15.407(f), §2.1091 & IC RSS-102 - RF Exposure

4.1 Applicable Standard

According to FCC §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 ²)	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 ²)	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 IC RSS-102 must be followed concerning the exposure of humans to RF fields.

According to IC RSS-102 Issue 2 section 4.1, RF limits used for general public will be applied to the EUT.

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Time Averaging (minutes)
0.003 - 1	280	2.19	-	6
1 - 10	280 / f	2.19 / f	-	6
10 - 30	28	2.19 / f	-	6
30 - 300	28	0.073	2*	6
300 - 1 500	1.585 f ^{0.5}	0.0042 f ^{0.5}	f / 150	6
1 500 - 15 000	61.4	0.163	10	6
15 000 - 150 000	61.4	0.163	10	616000 / f ^{1.2}
150 000- 300 000	0.158 f ^{0.5}	4.21 x 10 -4 f ^{0.5}	6.67 x 10 ⁻⁵ f	616000 / f ^{1.2}

Note: f is frequency in MHz

* = Power density limit is applicable at frequencies greater than 100 MHz

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 MPE Results

5250-5350 MHz, Dipole Antennas

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>21.67</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>146.89</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5320</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>3.7</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>2.34</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.068</u>
<u>Power density of prediction frequency at 20.0 cm (W/m²):</u>	<u>0.68</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (W/m²):</u>	<u>10</u>

5250-5350 MHz, 5 dBi Patch Antenna

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>21.67</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>146.89</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5320</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>5</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>3.16</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.092</u>
<u>Power density of prediction frequency at 20.0 cm (W/m²):</u>	<u>0.92</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (W/m²):</u>	<u>10</u>

5250-5350 MHz, 7.5 dBi Patch Antenna

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>20.99</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>125.60</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5270</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>7.5</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>5.62</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.141</u>
<u>Power density of prediction frequency at 20.0 cm (W/m²):</u>	<u>1.41</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (W/m²):</u>	<u>10</u>

5470-5725 MHz, Dipole Antennas

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>20.77</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>119.40</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5500</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>3.6</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>2.29</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.054</u>
<u>Power density of prediction frequency at 20.0 cm (W/m²):</u>	<u>0.54</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (W/m²):</u>	<u>10</u>

5470-5725 MHz, 5 dBi Patch Antenna

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>20.77</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>119.40</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5500</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>5</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>3.16</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.075</u>
<u>Power density of prediction frequency at 20.0 cm (W/m²):</u>	<u>0.75</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (W/m²):</u>	<u>10</u>

5470-5725 MHz, 7.5 dBi Patch Antenna

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>20.77</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>119.40</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5500</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>7.5</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>5.62</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.134</u>
<u>Power density of prediction frequency at 20.0 cm (W/m²):</u>	<u>1.34</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1.0</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (W/m²):</u>	<u>10</u>

The device meets FCC/IC MPE requirement for uncontrolled exposure environment at 20 cm distance.