

4 FCC §15.407(f) - 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

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

3 dBi Antenna, 5.2 GHz

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>22.39</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>173.38</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5230</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>3</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.995262</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.068822</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1</u>

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

3 dBi Antenna, 5.8 GHz

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>21.55</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>142.89</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5785</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>3</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1.99526231</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.0567</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1</u>

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

5 dBi Antenna, 5.2GHz

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>23.42</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>219.786</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5230</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>5</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>3.162278</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.13827</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1</u>

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

5 dBi Antenna, 5.8 GHz

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>21.74</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>149.28</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>5</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>3.162278</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.094</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1</u>

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

8 dBi Antenna, 5.2 GHz

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>22.66</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>184.5015</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5230</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>8</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>6.309573</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.2316</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1</u>

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

8 dBi Antenna, 5.8 GHz

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>21.47</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>140.2814</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5785</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>8</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>6.309573</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.1761</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1</u>

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12 dBi Antenna, 5.2 GHz

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>18.42</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>25.35129</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5230</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>12</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>15.84893</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.219</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1</u>

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

12 dBi Antenna, 5.8 GHz

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>16.05</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>40.27</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>12</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>15.84893</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.127</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1</u>

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

15 dBi Antenna, 5.2 GHz

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>15.21</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>33.19</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5230</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>15</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>31.62278</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.2088</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1</u>

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

15 dBi Antenna, 5.8 GHz

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>15.71</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>37.24</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5755</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>15</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>31.62278</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.2343</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u>	<u>1</u>

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