

FCC §1.1307(b)(1) & §2.1091 - RF EXPOSURE

1.1 Applicable Standard

According to §1.1310 and §2.1091 (Mobile Devices) RF exposure is calculated.

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 (minute)
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

Note: f = frequency in MHz

* = Plane-wave equivalent power density

1.2 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

850 MHz Cellular Band Uplink:

Maximum peak output power at antenna input terminal (dBm):	<u>25.05</u>
Maximum peak output power at antenna input terminal (mW):	<u>319.88</u>
Prediction distance (cm):	<u>50</u>
Prediction frequency (MHz):	<u>824.8</u>
Antenna Gain, typical (dBi):	<u>2</u>
Maximum Antenna Gain (numeric):	<u>1.58</u>
Power density at predication frequency and distance (mW/cm ²):	<u>0.016</u>
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	<u>0.549</u>

850 MHz Cellular Band Downlink:

Maximum peak output power at antenna input terminal (dBm):	<u>25.08</u>
Maximum peak output power at antenna input terminal (mW):	<u>322.11</u>
Prediction distance (cm):	<u>50</u>
Prediction frequency (MHz):	<u>881.52</u>
Antenna Gain, typical (dBi):	<u>12</u>
Maximum Antenna Gain (numeric):	<u>15.85</u>
Power density at predication frequency and distance (mW/cm ²):	<u>0.163</u>
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	<u>0.588</u>

PCS 1900 MHz Band Uplink:

Maximum peak output power at antenna input terminal (dBm):	<u>30.02</u>
Maximum peak output power at antenna input terminal (mW):	<u>1004.6</u>
Prediction distance (cm):	<u>50</u>
Prediction frequency (MHz):	<u>1880</u>
Antenna Gain, typical (dBi):	<u>2</u>
Maximum Antenna Gain (numeric):	<u>1.58</u>
Power density at predication frequency and distance (mW/cm ²):	<u>0.051</u>
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	<u>1.0</u>

PCS 1900 MHz Band Downlink:

Maximum peak output power at antenna input terminal (dBm):	<u>30.17</u>
Maximum peak output power at antenna input terminal (mW):	<u>1039.92</u>
Prediction distance (cm):	<u>50</u>
Prediction frequency (MHz):	<u>1960</u>
Antenna Gain, typical (dBi):	<u>12</u>
Maximum Antenna Gain (numeric):	<u>15.85</u>
Power density at predication frequency and distance (mW/cm ²):	<u>0.525</u>
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	<u>1.0</u>

DL: 746-757 MHz and 728-740 MHz

Maximum peak output power at antenna input terminal (dBm):	<u>25.32</u>
Maximum peak output power at antenna input terminal (mW):	<u>340.4</u>
Prediction distance (cm):	<u>50</u>
Prediction frequency (MHz):	<u>749</u>
Antenna Gain, typical (dBi):	<u>12</u>
Maximum Antenna Gain (numeric):	<u>15.85</u>
Power density at predication frequency and distance (mW/cm ²):	<u>0.171</u>
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	<u>0.499</u>

UL: 776-787 MHz and 698-710 MHz

Maximum peak output power at antenna input terminal (dBm):	<u>25.35</u>
Maximum peak output power at antenna input terminal (mW):	<u>342.76</u>
Prediction distance (cm):	<u>50</u>
Prediction frequency (MHz):	<u>782</u>
Antenna Gain, typical (dBi):	<u>2</u>
Maximum Antenna Gain (numeric):	<u>1.585</u>
Power density at predication frequency and distance (mW/cm ²):	<u>0.017</u>
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	<u>0.521</u>

DL: 2110-2155 MHz

Maximum peak output power at antenna input terminal (dBm):	<u>30.15</u>
Maximum peak output power at antenna input terminal (mW):	<u>1035.14</u>
Prediction distance (cm):	<u>50</u>
Prediction frequency (MHz):	<u>2154.6</u>
Antenna Gain, typical (dBi):	<u>12</u>
Maximum Antenna Gain (numeric):	<u>15.85</u>
Power density at predication frequency and distance (mW/cm ²):	<u>0.523</u>
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	<u>1.0</u>

UL: 1710-1755 MHz

Maximum peak output power at antenna input terminal (dBm):	<u>30.91</u>
Maximum peak output power at antenna input terminal (mW):	<u>1233.10</u>
Prediction distance (cm):	<u>50</u>
Prediction frequency (MHz):	<u>1754.6</u>
Antenna Gain, typical (dBi):	<u>2</u>
Maximum Antenna Gain (numeric):	<u>1.585</u>
Power density at predication frequency and distance (mW/cm ²):	<u>0.062</u>
MPE limit for uncontrolled exposure at predication frequency (mW/cm ²):	<u>1.0</u>

Test Result

For downlink, the outdoor antenna with 12 dBi gain should have at least 50 cm prediction distance to meet the MPE limit, the highest power density level at 50 cm is 0.525 mW/cm², which is below the uncontrolled exposure limit of 1.0 mW/cm².

For uplink, the indoor antenna with 2 dBi gain should have at least 50 cm prediction distance to meet the MPE limit, the highest power density level at 50 cm is 0.062 mW/cm², which is below the uncontrolled exposure limit of 1.0 mW/cm².