FCC RF Exposure Calculation

FCC Limits

Occupational : f / 300

General Public : f / 1500

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $|E|^2$, $|H|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $|E|^2$, $|H|^2$ or S (minutes)
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

Based on the frequency range of operation of the EUT, the following are the limits:

Frequency Of Operation	Occupational Limit	General Public Limit
450 MHz	1.50 mW/cm^2	0.300 mW/cm^2
460 MHz	1.53 mW/cm^2	0.307 mW/cm^2
470 MHz	1.57 mW/cm^2	0.313 mW/cm^2

When establishing the limit criteria, we use the lowest frequency of operation to ensure compliance is achieved in all modes. The lowest frequency of operation yields the lowest limit, ie. worst case.

EUT Details

Output power : 5 W or 5000 mW

Gain : Between 0 dBi and 13 dBi

Numeric Gain : Between 0 and 19.953

Distance : Variable

Calculation Of Power Density (S)

Based on an output power of 5 W with an antenna gain of 3 dBi at a distance of 20 cm:

$$S = \frac{P \times G}{4 \times \pi \times r^2} = \frac{5000 \times 1.995}{4 \times \pi \times 20^2} = 1.98 \text{ mW/cm}^2$$

The limit is exceeded in both Occupational and General Public Exposure cases.

Determination Of Distance To Meet General Public Exposure Limits

The limit is calculated as f/1500 = 450 / 1500 = 0.3mW/cm^2. Thus, a level of 0.28mW/cm^2 has been used as a basis for compliance.

To establish the distance at which compliance is achieved, the formula is re-arranged to give:

$$r = \sqrt{\frac{P \times G}{4 \times \pi \times S}} = \sqrt{\frac{5000 \times 1.995}{4 \times \pi \times 0.28}} = 53.24 \text{ cm}$$

Using the General Public Exposure Limit with 0.28 mW/cm^2 with a frequency of 450 MHz, the following table is calculated:

Radio Tx Power (W)	5	5	5	5	5
Gain (dBi)	0	3	7	10	13
Output Power (W EIRP)	5	10	25	50	100
Minimum Separation Distance (m)	0.38	0.54	0.85	1.20	1.69