## 7.4 MAXIMUM PERMISSIBLE EXPOSURE

According to FCC 1.1310 : The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density ($mW/cm^2$) | Average Time |
|---|---|---|---|---|
| (A) Limits for Occupational / Control Exposures | | | | |
| 300-1,500 | -- | -- | F/300 | 6 |
| 1,500-100,000 | -- | -- | 5 | 6 |
| (B) Limits for General Population / Uncontrol Exposures | | | | |
| 300-1,500 | -- | -- | F/1500 | 6 |
| 1,500-100,000 | -- | -- | 1 | 30 |

**CALCULATIONS**

Given $E = \frac{\sqrt{30 \times P \times G}}{d}$ & $S = \frac{E^2}{3770}$

*Where* *E = Field strength in Volts / meter*

*P = Power in Watts*

*G = Numeric antenna gain*

*d = Distance in meters*

*S = Power density in milliwatts / square centimeter*

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

*P (mW) = P (W) / 1000 and*

*d (cm) = d(m) / 100*

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2}$$

*Where* *d = Distance in cm*

*P = Power in mW*

*G = Numeric antenna gain*

*S = Power density in mW / $cm^2$*

## LIMIT

Power Density Limit, S=1.0mW/cm$^2$

## TEST RESULTS

No non-compliance noted.

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2}$$

Antenna Gain (2.4G): 2.31 dBi = 1.70215851 mW

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| IEEE 802.11b | = | 0.0796 * | 70.7946 | * | 1.70215851 | ÷ 400 = | 0.02398 |
| IEEE 802.11g | = | 0.0796 * | 37.9315 | * | 1.70215851 | ÷ 400 = | 0.01285 |
| IEEE 802.11n HT20 | = | 0.0796 * | 27.5423 | * | 1.70215851 | ÷ 400 = | 0.00933 |
| IEEE 802.11n HT40 | = | 0.0796 * | 20.4644 | * | 1.70215851 | ÷ 400 = | 0.00693 |

| Mode | Minimum separation distance (cm) | Output Power (dBm) | Output Power (mw) | Antenna Gain (dBi) | Power Density Limit (mW/cm$^2$) | Power Density at 20cm (mW/cm$^2$) |
|---|---|---|---|---|---|---|
| IEEE 802.11b | 20.0 | 18.50 | 70.79 | 2.31 | 1 | 0.023980 |
| IEEE 802.11g | 20.0 | 15.79 | 37.93 | 2.31 | 1 | 0.012849 |
| IEEE 802.11n HT20 | 20.0 | 14.40 | 27.54 | 2.31 | 1 | 0.009329 |
| IEEE 802.11n HT40 | 20.0 | 13.11 | 20.46 | 2.31 | 1 | 0.006932 |

**REMARK:** For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm$^2$ even if the calculation indicates that the power density would be larger.