



### 8.3 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 <sup>2</sup> )	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:

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

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = d \text{ (m)} / 100$$

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<sup>2</sup>



**LIMIT**

Power Density Limit, S=1.0mW/cm<sup>2</sup>

**TEST RESULTS**

No non-compliance noted.

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

G=3.79dBi=2.393316 mW

- IEEE 802.11b = 0.0796 \* 59.4292 \* 2.39331576 ÷ 400 = 0.0283
- IEEE 802.11g = 0.0796 \* 288.4032 \* 2.39331576 ÷ 400 = 0.13736
- IEEE 802.11n HT20 = 0.0796 \* 301.3006 \* 2.39331576 ÷ 400 = 0.1435
- IEEE 802.11n HT40 = 0.0796 \* 299.2265 \* 2.39331576 ÷ 400 = 0.14251

Mode	Minimum separation distance (cm)	Output Power (dBm)	Output Power (mw)	Antenna Gain (dBi)	Power Density Limit (mW/cm <sup>2</sup> )	Power Density at 20cm (mW/cm <sup>2</sup> )
IEEE 802.11b	20	17.74	59.43	3.79	1.00	0.028304
IEEE 802.11g	20	24.60	288.40	3.79	1.00	0.137358
IEEE 802.11n HT20	20	24.79	301.30	3.79	1.00	0.143500
IEEE 802.11n HT40	20	24.76	299.23	3.79	1.00	0.142513

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



**Co-Location Mode**

WWAN MPE

Channel NO	Channel Frequency (MHz)	Output Power (mW)	Antenna Gain (dBi)	Antenna Gain (mW)	Power Density (S) (mW/cm2)	Limit of Power Density (S) (mW/cm2)
189	836.4	1729.82	1.21	1.32	0.4548	0.558
661	1880	993.12	2	1.59	0.3132	1

Collocated MPE Calculations

WLAN Band	(WLAN Pd)/(MPE Limit)	(WWAN 850MHz)/(MPE Limit)	(850 MHz WWAN fraction) + (WLAN fraction)	Limit	Pass/Fail
2412 - 2462	0.1435	0.8151	0.9586	1	Pass

WLAN Band	(WLAN Pd)/(MPE Limit)	(WWAN 1900MHz)/(MPE Limit)	(1900 MHz WWAN fraction) + (WLAN fraction)	Limit	Pass/Fail
2412 - 2462	0.1435	0.3132	0.4567	1	Pass