



APPENDIX I 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:

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

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

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 / cm²



LIMIT

Power Density Limit, $S=1.0\text{mW}/\text{cm}^2$

TEST RESULTS

Numeric antenna gain :

Antenna Gain 1 (2.4G):	8.00	dBi =	6.309573
Antenna Gain 2 (2.4G):	8.00	dBi =	6.309573
Array Gain (2.4G):	11.01	dBi =	12.61915
Antenna Gain 1 (5G):	7	dBi =	5.011872

No non-compliance noted: (MPE distance equals 20 cm)

IEEE 802.11b (2.4G)	=	0.0796 *	19.1867	*	6.30957344	÷ 400 =	0.02409
IEEE 802.11g (2.4G)	=	0.0796 *	36.2243	*	6.30957344	÷ 400 =	0.04548
IEEE 802.11n HT20 (2.4G)	=	0.0796 *	55.4736	*	12.61914689	÷ 400 =	0.13931
IEEE 802.11n HT40 (2.4G)	=	0.0796 *	44.6681	*	12.61914689	÷ 400 =	0.11217
IEEE 802.11a (5G)	=	0.0796 *	281.8383	*	5.01187234	÷ 400 =	0.28109
IEEE 802.11n HT20 (5G)	=	0.0796 *	284.4461	*	5.01187234	÷ 400 =	0.2837
IEEE 802.11n HT40 (5G)	=	0.0796 *	239.3316	*	5.01187234	÷ 400 =	0.2387
IEEE 802.11ac VHT80 (5G)	=	0.0796 *	220.8005	*	5.01187234	÷ 400 =	0.22022

Mode	Antenna Gain (dBi)	Minimum separation distance (cm)	Output Power (dBm)	Output Power (mW)	Power Density Limit (mW/cm ²)	Power Density at 20cm (mW/cm ²)
IEEE 802.11b (2.4G)	8.00	20.0	12.83	19.19	1.00	0.024091
IEEE 802.11g (2.4G)	8.00	20.0	15.59	36.22	1.00	0.045483
IEEE 802.11n HT20 (2.4G)	11.01	20.0	17.44	55.47	1.00	0.139306
IEEE 802.11n HT40 (2.4G)	11.01	20.0	16.50	44.67	1.00	0.112171
IEEE 802.11a (5G)	7.00	20.0	24.50	281.84	1.00	0.281095
IEEE 802.11n HT20 (5G)	7.00	20.0	24.54	284.45	1.00	0.283696
IEEE 802.11n HT40 (5G)	7.00	20.0	23.79	239.33	1.00	0.238700
IEEE 802.11ac VHT80 (5G)	7.00	20.0	23.44	220.80	1.00	0.220218

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