



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

TEST RESULTS

Antenna Gain 1 (2.4G): 2.28 dBi = 1.690441 mW
 Antenna Gain 2 (2.4G): 5.29 dBi = 3.380648 mW
 Antenna Gain (5G): 4.13 dBi = 2.5882129 mW
 Total Antenna Gain (5G): 8.9 dBi = 7.762471 mW

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

IEEE 802.11b (2.4G)	=	0.0796 *	88.3080	*	1.69044093	÷ 400 =	0.02971
IEEE 802.11g (2.4G)	=	0.0796 *	135.2073	*	1.69044093	÷ 400 =	0.04548
IEEE 802.11n HT20 (2.4G)=		0.0796 *	149.8666	*	3.38064836	÷ 400 =	0.10082
IEEE 802.11n HT40 (2.4G)=		0.0796 *	143.2667	*	3.38064836	÷ 400 =	0.09638
IEEE 802.11a (5G)	=	0.0796 *	41.9759	*	2.58821292	÷ 400 =	0.02162
IEEE 802.11n HT20 (5G)=		0.0796 *	57.1325	*	7.76247117	÷ 400 =	0.08825
IEEE 802.11n HT40 (5G)=		0.0796 *	73.5073	*	7.76247117	÷ 400 =	0.11355

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)	2.28	20.0	19.46	88.31	1.00	0.029707
IEEE 802.11g (2.4G)	2.28	20.0	21.31	135.21	1.00	0.045483
IEEE 802.11n HT20 (2.4G)	5.29	20.0	21.76	149.87	1.00	0.100823
IEEE 802.11n HT40 (2.4G)	5.29	20.0	21.56	143.27	1.00	0.096383
IEEE 802.11a (5G)	4.13	20.0	16.23	41.98	1.00	0.021620
IEEE 802.11n HT20 (5G)	8.9	20.0	17.57	57.13	1.00	0.088254
IEEE 802.11n HT40 (5G)	8.9	20.0	18.66	73.51	1.00	0.113549

Remark: For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm² even if the calculation indicates that the power density would be larger.