



RF exposure

According to FCC part 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 - 100000	--	--	5	6
(B) Limits for General Population / Uncontrol Exposures				
300 – 1 500	--	--	f/1500	6
1 500 – 100 000	--	--	1	30

f= frequency in MHz

Friis transmission formula: $P_d = (P_{out} \times G) / (4 \times \pi \times R^2)$

Where,

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

R = distance between observation point and center of the radiator in cm

P_d the limit of MPE, 1 mW/cm². If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

Results - Worst case

1) BLE (2.4G)

Operation mode		Max tune-up Average power (dBm)	Antenna gain (dBi)	Power density at 20 cm(mW/cm ²)	Limit (mW/cm ²)
BLE	SISO	5.00	3.94	0.00156	1

2) WIFI (2.4G)

Operation mode		Max tune-up Average power (dBm)	Antenna gain (dBi)	Power density at 20 cm(mW/cm ²)	Limit (mW/cm ²)
802.11b	SISO	16.00	3.50	0.01773	1
802.11g	SISO	13.00	3.50	0.00889	1
802.11n(HT20)	SISO	12.00	3.50	0.00706	1
802.11n(HT40)	SISO	12.00	3.50	0.00706	1



3) WIFI(5.2G)

Operation mode		Max tune-up Average power (dBm)	Antenna gain (dBi)	Power density at 20 cm(mW/cm ²)	Limit (mW/cm ²)
802.11a	SISO	11.00	3.94	0.00620	1
802.11an(HT20)	SISO	9.00	3.94	0.00391	1
802.11an(HT40)	SISO	8.00	3.94	0.00311	1
802.11ac(VHT20)	SISO	9.00	3.94	0.00391	1
802.11ac(VHT40)	SISO	8.00	3.94	0.00311	1
802.11ac(VHT80)	SISO	8.00	3.94	0.00311	1

4) WIFI(5.3G)

Operation mode		Max tune-up Average power (dBm)	Antenna gain (dBi)	Power density at 20 cm(mW/cm ²)	Limit (mW/cm ²)
802.11a	SISO	11.00	3.94	0.00620	1
802.11an(HT20)	SISO	9.00	3.94	0.00391	1
802.11an(HT40)	SISO	9.00	3.94	0.00391	1
802.11ac(VHT20)	SISO	9.00	3.94	0.00391	1
802.11ac(VHT40)	SISO	9.00	3.94	0.00391	1
802.11ac(VHT80)	SISO	9.00	3.94	0.00391	1

5) WIFI(5.5G)

Operation mode		Max tune-up Average power (dBm)	Antenna gain (dBi)	Power density at 20 cm(mW/cm ²)	Limit (mW/cm ²)
802.11a	SISO	14.00	3.94	0.01238	1
802.11an(HT20)	SISO	12.00	3.94	0.00781	1
802.11an(HT40)	SISO	12.00	3.94	0.00781	1
802.11ac(VHT20)	SISO	12.00	3.94	0.00781	1
802.11ac(VHT40)	SISO	12.00	3.94	0.00781	1
802.11ac(VHT80)	SISO	12.00	3.94	0.00781	1

6) WIFI(5.8G)

Operation mode		Max tune-up Average power (dBm)	Antenna gain (dBi)	Power density at 20 cm(mW/cm ²)	Limit (mW/cm ²)
802.11a	SISO	10.00	3.94	0.00493	1
802.11an(HT20)	SISO	7.00	3.94	0.00247	1
802.11an(HT40)	SISO	7.00	3.94	0.00247	1
802.11ac(VHT20)	SISO	7.00	3.94	0.00247	1
802.11ac(VHT40)	SISO	7.00	3.94	0.00247	1
802.11ac(VHT80)	SISO	7.00	3.94	0.00247	1