

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

- 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 | 2.92 | 0.02313 | 1 |
| 802.11g | SISO | 15.00 | 2.92 | 0.01837 | 1 |
| 802.11n(HT20) | SISO | 14.00 | 2.92 | 0.01459 | 1 |
| 802.11n(HT40) | SISO | 14.00 | 2.92 | 0.01459 | 1 |

- 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 | 13.00 | 5.08 | 0.02017 | 1 |
| 802.11an(HT20) | SISO | 10.00 | 5.08 | 0.01011 | 1 |
| 802.11an(HT40) | SISO | 10.00 | 5.08 | 0.01011 | 1 |
| 802.11ac(VHT20) | SISO | 10.00 | 5.08 | 0.01011 | 1 |
| 802.11ac(VHT40) | SISO | 10.00 | 5.08 | 0.01011 | 1 |
| 802.11ac(VHT80) | SISO | 9.00 | 5.08 | 0.00803 | 1 |

- 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 | 13.00 | 4.85 | 0.01925 | 1 |
| 802.11an(HT20) | SISO | 10.00 | 4.85 | 0.00965 | 1 |
| 802.11an(HT40) | SISO | 10.00 | 4.85 | 0.00965 | 1 |
| 802.11ac(VHT20) | SISO | 10.00 | 4.85 | 0.00965 | 1 |
| 802.11ac(VHT40) | SISO | 10.00 | 4.85 | 0.00965 | 1 |
| 802.11ac(VHT80) | SISO | 9.00 | 4.85 | 0.00766 | 1 |

- 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 | 12.00 | 6.89 | 0.02172 | 1 |
| 802.11an(HT20) | SISO | 9.00 | 6.89 | 0.01089 | 1 |
| 802.11an(HT40) | SISO | 9.00 | 6.89 | 0.01089 | 1 |
| 802.11ac(VHT20) | SISO | 9.00 | 6.89 | 0.01089 | 1 |
| 802.11ac(VHT40) | SISO | 9.00 | 6.89 | 0.01089 | 1 |
| 802.11ac(VHT80) | SISO | 9.00 | 6.89 | 0.01089 | 1 |

- 5.8G

| Operation mode | | Max tune-up Average power (dBm) | Antenna gain (dBi) | Power density at 20 cm(mW/cm²) | Limit (mW/cm²) |
|-----------------------|------|--|-------------------------------|--|--------------------------------------|
| 802.11a | SISO | 12.00 | 6.89 | 0.02172 | 1 |
| 802.11an(HT20) | SISO | 9.00 | 6.89 | 0.01089 | 1 |
| 802.11an(HT40) | SISO | 9.00 | 6.89 | 0.01089 | 1 |
| 802.11ac(VHT20) | SISO | 9.00 | 6.89 | 0.01089 | 1 |
| 802.11ac(VHT40) | SISO | 9.00 | 6.89 | 0.01089 | 1 |
| 802.11ac(VHT80) | SISO | 9.00 | 6.89 | 0.01089 | 1 |