

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) | Averaging time (minutes) |
|----------------------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| (A) Limits for Occupational/Controlled Exposure | | | | |
| 0.3-3.0 | 614 | 1.63 | *100 | 6 |
| 3.0-30 | 1842/f | 4.89/f | *900/f ² | 6 |
| 30-300 | 61.4 | 0.163 | 1.0 | 6 |
| 300-1,500 | | | f/300 | 6 |
| 1,500-100,000 | | | 5 | 6 |
| (B) Limits for General Population/Uncontrolled Exposure | | | | |
| 0.3-1.34 | 614 | 1.63 | *100 | 30 |
| 1.34-30 | 824/f | 2.19/f | *180/f ² | 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1,500 | | | f/1500 | 30 |
| 1,500-100,000 | | | 1.0 | 30 |

f = frequency in MHz * = Plane-wave equivalent power density

MPE Calculation Method

Calculation

$$\text{Given } E = \sqrt{\frac{30 \times P \times G}{d}} \quad \& \quad S = \frac{E^2}{3770}$$

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

For 2.4G WIFI

- 1) The maximum output power for ANT 1 is 13.90 dBm (24.55mW) at 2462MHz (802.11n(HT20)), (with 2.0 dBi antenna gain (1.58 numeric antenna gain))
- 2) The maximum output power for ANT 2 is 12.32 dBm (17.06mW) at 2462MHz (802.11g), (with 2.0 dBi antenna gain (1.58 numeric antenna gain))
- 3) For mobile or fixed location transmitters, no SAR consideration applied. The minimum separation generally be used is at least 20cm, even if the calculation indicate that the MPE distance would be lesser.

Maximum Permissible Exposure

ANT 1(Module RTL8821CU) output power=24.55mW

ANT 2(Module RTL8822CU) output power=17.06mW

Numeric Antenna gain=1.58 Substituting the MPE safe distance using d=20cm into above equation.

Yields: S=0.000199*P*G

Where P=Power in mW

G=Numeric antenna gain

S=Power density in mW/cm²

ANT 1 Power density=0.008mW/cm² <1mW/cm²

ANT 2 Power density=0.005mW/cm² <1mW/cm²

Two antennas operate simultaneously

Total Power density=0.008/1+0.005/1=0.013 <1

For 5G WIFI

U-NII-1 Band

- 1) The maximum output power for ANT 1 is 12.66dBm (18.45mW) at 5200MHz(802.11a) (with 3.0dBi antenna gain (2.0 numeric antenna gain))
- 2) The maximum output power for ANT 2 is 11.47dBm (14.03mW) at 5240MHz(802.11a), (with 3.0 dBi antenna gain (2.0 numeric antenna gain))

Maximum Permissible Exposure

ANT 1 output power=18.45mW

ANT 2 output power=14.03mW

Numeric Antenna gain=2.0 Substituting the MPE safe distance using $d=20\text{cm}$ into above equation.

Yields: $S=0.000199*P*G$

Where P =Power in mW

G =Numeric antenna gain

S =Power density in mW/cm^2

ANT 1 Power density=0.007 $\text{mW}/\text{cm}^2 < 1\text{mW}/\text{cm}^2$

ANT 2 Power density=0.006 $\text{mW}/\text{cm}^2 < 1\text{mW}/\text{cm}^2$

Two antennas operate simultaneously

Total Power density=0.007/1+0.006/1=0.013 <1

U-NII-3 Band

- 3) The maximum output power for ANT 1 is 12.33dBm(17.10mW) at 5825MHz(802.11a), (with 3.0 dBi antenna gain (2.0 numeric antenna gain))
- 4) The maximum output power for ANT 2 is 11.19dBm(13.15mW) at 5825MHz(802.11a), (with 3.0 dBi antenna gain (2.0 numeric antenna gain))

Maximum Permissible Exposure

ANT1 output power=17.10mW

ANT 2 output power=13.15mW

Numeric Antenna gain=2.0 Substituting the MPE safe distance using $d=20\text{cm}$ into above equation.

Yields: $S=0.000199*P*G$

Where P =Power in mW

G =Numeric antenna gain

S =Power density in mW/cm^2

ANT 1Power density=0.007 $\text{mW}/\text{cm}^2 < 1\text{mW}/\text{cm}^2$

ANT 2 Power density=0.005 $\text{mW}/\text{cm}^2 < 1\text{mW}/\text{cm}^2$

Two antennas operate simultaneously

Total Power density=0.007/1+0.005/1=0.012 <1

If 2.4G wifi and 5G wifi operate simultaneously,

Total power density=0.008/1+0.005/1+0.007/1+0.006/1=0.026 <1