

1. MAXIMUM PERMISSIBLE EXPOSURE (MPE)

1.1 Standard Applicable

According to § 1.1307(b)(1), system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

(a) Limits for Occupational / Controlled Exposure

Frequency range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Times E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f)*	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	F/300	6
1500-100000	/	/	5	6

(b) Limits for General Population / Uncontrolled Exposure

Frequency range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Times E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-100000	/	/	1	30

Note: f = frequency in MHz: * = Plane-wave equivalents power density

1.2 MPE Calculation Method

$$S = (30 \cdot P \cdot G) / (377 \cdot R^2)$$

S = power density (in appropriate units, e.g., mw/cm²)

P = power input to the antenna (in appropriate units, e.g., mw)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator,
the power gain factor is normally numeric gain.

R = distance to the center of radiation of the antenna (in appropriate units, e.g., cm)

1.3 MPE Calculation Result

For Wi-Fi

Maximum peak output power: 11.15 (dBm)

Maximum peak output power at antenna input terminal: 13.03 (mW)

Prediction distance: >20(cm)

Prediction frequency: 2412 (MHz)

Antenna gain: 2(dBi)

Directional gain: 1.58 (numeric)

The worst case is power density at prediction frequency at 20cm: 0.004(mw/cm²)

MPE limit for general population exposure at prediction frequency: 1 (mw/cm²)

$$0.004(\text{mw/cm}^2) < 1 (\text{mw/cm}^2)$$

For Zigbee

Maximum peak output power: 11.96 (dBm)

Maximum peak output power at antenna input terminal: 15.70 (mW)

Prediction distance: >20(cm)

Prediction frequency: 2480 (MHz)

Antenna gain: 2(dBi)

Directional gain: 1.58 (numeric)

The worst case is power density at prediction frequency at 20cm: 0.005(mw/cm²)

MPE limit for general population exposure at prediction frequency: 1 (mw/cm²)

$$0.005(\text{mw/cm}^2) < 1 (\text{mw/cm}^2)$$

Result: Pass