

FCC §15.407(f) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.407(f) and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
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
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

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

According to §1.1310 and §2.1091 RF exposure is calculated.

Per 447498 D01 General RF Exposure Guidance v05r02, simultaneous transmission MPE test exclusion applies when the sum of the MPE for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0.

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where:

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 (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

The rated tune-up output power and antenna gain in the below table:

Calculated Data:

MPE evaluation for single transmission:

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
WLAN	2412-2462	2.81	1.91	25.0	316.23	20	0.120	1.0
	5180-5240	3.66	2.32	15.0	31.62	20	0.015	1.0
	5745-5825	3.66	2.32	15.0	31.62	20	0.015	1.0
Bluetooth	2402-2480	2.55	1.80	5.0	3.16	20	0.001	1.0

Note: Wi-Fi (2.4G) & Bluetooth or Wi-Fi (5G) & Bluetooth can transmit simultaneously.

MPE evaluation for simultaneous transmission:

The MPE evaluation is as below formula:

$$PD1/Limit1 + PD2/Limit2 + \dots < 1, \text{ PD (Power Density)}$$

MPE evaluation (Worst case):

Wi-Fi (2.4G) & Bluetooth:

$$\text{Max MPE of Wi-Fi (2.4G)} + \text{Max MPE of Bluetooth} = 0.12/1 + 0.001/1 = 0.121 < 1.0$$

Result: MPE evaluation of single and simultaneous transmission meet the requirement of standard.