

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

Applicable Standard

According to subpart §2.1091 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)

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 Time E , H or S (minutes)
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
300-1500	/	/	f/300	6
1500-100,000	/	/	5	6

(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.

Calculated Formulary:

Predication of MPE limit at a given distance

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

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

Calculation Data:

General Population/Uncontrolled

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Output Power*		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)	MPE ratio
		(dBi)	(numeric)	(dBm)	(mW)				
2.4G Wi-Fi	2412-2462	1.33	1.36	14.0	25.12	20	0.0068	1.00	0.0068
BT	2402-2480	1.33	1.36	9.0	7.94	20	0.0021	1.00	0.0021
5G Wi-Fi	5150-5250	-1.32	0.74	8.0	6.31	20	0.0009	1.00	0.0009
	5725-5850	-2.61	0.55	11.0	12.59	20	0.0014	1.00	0.0014
LTE band 2	1850-1910	1.93	1.56	22.5	177.83	20	0.0552	1.0	0.0552
LTE band 4	1710-1755	-2.87	0.52	24.5	281.84	20	0.0292	1.0	0.0292
LTE band 5	824-849	-0.03	0.99	24.5	281.84	20	0.0557	0.5493	0.1014
LTE band 7	2500-2570	0.74	1.19	23.0	199.53	20	0.0472	1.0	0.0472
LTE band 25	1850-1915	1.93	1.56	25.0	316.23	20	0.0981	1.0	0.0981
LTE band 38	2570-2620	0.74	1.19	22.5	177.83	20	0.0421	1.0	0.0421
LTE band 41	2496-2690	0.74	1.19	23.0	199.53	20	0.0472	1.0	0.0472

Occupational/Controlled

Mode	Frequency Range (MHz)	Antenna Gain		★Tune-up Output Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)	MPE ratio
		(dBi)	(numeric)	(dBm)	(mW)				
UHF	410-470	4.29	2.69	33.00	1995.26	20	1.0658	1.3667	0.7798

Note:

- The target output powers are all declared by the Manufacturer.
- Wi-Fi, BT, WWAN and UHF can transmit simultaneously, the worst condition is as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0068 + 0.0021 + 0.1014 + 0.7798 = 0.8901 < 1.0$$

Result: The device meet FCC MPE at 20 cm distance.