

FCC §1.1307 & §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)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm²)	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:

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

Calculated Data:

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)	MPE ratio
		(dBi)	(numeric)	(dBm)	(mW)				
802.11b	2412-2462	1.50	1.41	15.50	35.48	20	0.0100	1.0000	0.0100
802.11g		1.50	1.41	18.50	70.79	20	0.0199	1.0000	0.0199
802.11n-HT20		1.50	1.41	18.50	70.79	20	0.0199	1.0000	0.0199
802.11n-HT40	2422-2452	1.50	1.41	17.50	56.23	20	0.0158	1.0000	0.0158
BLE	2402-2480	1.50	1.41	-2.00	0.63	20	0.0002	1.0000	0.0002
BT 3.0	2402-2480	1.50	1.41	0.00	1.00	20	0.0003	1.0000	0.0003
WCDMA Band V	826.4-846.6	1.00	1.26	24.00	251.19	20	0.0630	0.5509	0.1144
WCDMA Band II	1852.4-1907.6	1.50	1.41	24.00	251.19	20	0.0705	1.0000	0.0705
FDD Band 2	1850.7-1909.3	1.50	1.41	23.00	199.53	20	0.0560	1.0000	0.0560
FDD Band 4	1710.7-1754.3	1.40	1.38	23.00	199.53	20	0.0548	1.0000	0.0548
FDD Band 5	824.7-848.3	1.00	1.26	23.00	199.53	20	0.0500	0.5498	0.0909
FDD Band 12	699.7-715.3	0.80	1.20	23.00	199.53	20	0.0476	0.4665	0.1020
FDD Band 17	706.5-713.5	0.80	1.20	23.00	199.53	20	0.0476	0.4710	0.1011

Note:

1. The tune-up conducted power was declared by the manufacturer.
2. Wi-Fi, BT and WCDMA/LTE can transmit simultaneously, and the worst condition is 802.11g of Wi-Fi, BT3.0 & WDCMA Band V as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0199/1.0 + 0.0003/1.0 + 0.0630/0.5509 = 0.0199 + 0.0003 + 0.1144 = 0.1346 < \mathbf{1.0}$$

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