

MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart §1.1310,15.247(i) and 15.407(f) 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)

TABLE 1 TO § 1.1310(E)(1)—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)
(i) 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
(ii) 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.*

Calculated Formulary:

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

- Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

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 (appropriate units, e.g., cm)

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

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

Result:

Operation Modes	Frequency (MHz)	Antenna Gain [#]		Conducted output power including Tune-up Tolerance [#]		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2402-2480	5.08	3.22	1.0	1.26	20.00	0.001	1.0
2.4G WIFI	2412-2462	4.92	3.10	22.5	177.83	20.00	0.110	1.0
5G WIFI	5150-5250	4.98	3.15	21.0	125.89	20.00	0.079	1.0
	5250-5350	4.98	3.15	20.5	112.20	20.00	0.070	1.0
	5470-5725	4.98	3.15	18.5	70.79	20.00	0.044	1.0
	5725-5850	4.98	3.15	20.5	112.20	20.00	0.070	1.0
6G WIFI	5925-6425	4.98	3.15	20.5	112.20	20.00	0.070	1.0
	6425-6525	4.98	3.15	20.0	100.00	20.00	0.063	1.0
	6525-6875	4.98	3.15	20.5	112.20	20.00	0.070	1.0
	6875-7125	4.98	3.15	20.5	112.20	20.00	0.070	1.0

Note 1: The Antenna Gain and Conducted output power including Tune-up Tolerance provided by manufacturer.

Note 2: The BLE, 2.4G WIFI, 5G WIFI, 6G WIFI can transmit simultaneously.

Simultaneous transmitting consideration (worst case):

$$\begin{aligned} \text{The ratio} &= S_{BLE} / S_{limit-BLE} + S_{2.4G\ Wifi} / S_{limit-2.4G\ Wifi} + S_{5G\ Wifi} / S_{limit-5G\ Wifi} + S_{6G\ Wifi} / S_{limit-6G\ Wifi} \\ &= 0.001/1.0 + 0.11/1.0 + 0.079/1.0 + 0.07/1.0 \\ &= 0.26 \\ &< 1.0 \end{aligned}$$

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliance