

FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

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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

Result

Calculated Formulary:

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:

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

Mode	Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
UHF	917~922.2	2.0	1.58	9.0	7.94	20	0.0025	0.61
BT	2402-2480	3.4	2.19	9.0	7.94	20	0.0035	1.0
BLE	2402-2480	3.4	2.19	7.0	5.01	20	0.0022	1.0
Wi-Fi	2412-2462	3.4	2.19	27.0	501.19	20	0.2183	1.0

Note: 1. EUT contains a certified BT/Wi-Fi module (FCC ID: 2AC7Z-ESP32WROVERE), the tune-up power of BT/BLE/Wi-Fi was refer to the module report.
 2. the UHF and BT/BLE/Wi-Fi can transmit at the same time, the BT/BLE/Wi-Fi cannot transmit at the same time

Simultaneous transmitting consideration:

The ratio= $MPE_{Wi-Fi}/limit + MPE_{UHF}/limit = 0.2183/1 + 0.0025/0.61 = 0.2224 < 1.0$

So simultaneous exposure comply with the limit.

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

Result: Compliance