

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

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

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:

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

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)			
917.0-922.2	-1.0	0.79	10.00	10.00	20	0.002	0.61
802.11b 2412-2462	3.4	2.19	27.00	501.19	20	0.2183	1.0
802.11g 2412-2462	3.4	2.19	26.00	398.11	20	0.1734	1.0
802.11n20 2412-2462	3.4	2.19	26.00	398.11	20	0.1734	1.0
802.11n40 2422-2452	3.4	2.19	27.00	501.19	20	0.2183	1.0
BLE 2402-2480	3.4	2.19	7.00	5.01	20	0.0022	1.0
BT 2402-2480	3.4	2.19	9.00	7.94	20	0.0035	1.0

Note: 1. The tune up conducted power was declared by the applicant
 2. The BLE, Wi-Fi function can transmit at the same time with the 900 MHz radio.
 3. Please refer to the report of the FCC ID: 2AC7Z-ESP32WROVERE for the Bluetooth and Wi-Fi output power.

So the worst simultaneous transmitting consideration:

$$\text{The ratio} = \text{MPE}_{900\text{MHzRadio}} / \text{limit} + \text{MPE}_{\text{Wi-Fi}} / \text{limit} = 0.002 / 0.61 + 0.2183 / 1.0 = 0.2216 < 1.0$$

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

Result: Compliance