

FCC §1.1307 (b) (1) & §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 1.1307 (b)(1), 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

MPE 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)

MPE Results

Tune-Up Power Including Tolerance:

| Mode | Frequency band (MHz) | Antenna Gain | | Max Tune-up Power | Cable loss (dB) | Evaluation Distance (cm) | Power Density (mW/cm ²) | MPE Limit (mW/cm ²) |
|----------|----------------------|--------------|-----------|-------------------|-----------------|--------------------------|-------------------------------------|---------------------------------|
| | | (dBi) | (numeric) | (dBm) | | | | |
| uplink | 698-716 | 5 | 3.16 | 20.5 | 1.20 | 20 | 0.054 | 0.465 |
| | 776-787 | 5 | 3.16 | 19.0 | 1.20 | 20 | 0.038 | 0.517 |
| | 824-849 | 6 | 3.98 | 20.5 | 1.20 | 20 | 0.067 | 0.549 |
| | 1710-1755 | 7 | 5.01 | 19.0 | 1.25 | 20 | 0.059 | 1.0 |
| | 1850-1915 | 7 | 5.01 | 19.5 | 1.25 | 20 | 0.067 | 1.0 |
| downlink | 728-746 | 6 | 3.98 | 16.5 | 5.2 | 20 | 0.011 | 0.485 |
| | 746-757 | 6 | 3.98 | 16.0 | 5.3 | 20 | 0.009 | 0.497 |
| | 869-894 | 6 | 3.98 | 16.5 | 5.3 | 20 | 0.010 | 0.579 |
| | 2110-2155 | 8 | 6.31 | 17.0 | 8 | 20 | 0.010 | 1.0 |
| | 1930-1995 | 8 | 6.31 | 16.5 | 7.6 | 20 | 0.010 | 1.0 |

Note:

This EUT contains FCC ID: 2AC7Z-ESP32WROVERB, and the power density is

Wi-Fi=0.1182mW/cm²,BLE=0.0007 mW/cm²,Bluetooth =0.0017 mW/cm²,

According to the MPE of FCC ID: 2AC7Z-ESP32WROVERB, Wi-Fi and Bluetooth can't transmit simultaneously, so consider the booster and Wi-Fi transmitting simultaneously is the worst case:

The ratio= MPE/Limit_{Booster}+ MPE/Limit_{WIFI}=0.067/0.549+0.1182/1=0.2402<1.0

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

Result: Compliance