

## 5. RF EXPOSURE EVALUATION

### 5.1 FCC MAXIMUM PERMISSIBLE EXPOSURE (MPE)

#### 5.1.1 Applicable Standard

According to 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.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power(ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$ .
1.34-30	$3,450 R^2/f^2$ .
30-300	$3.83 R^2$ .
300-1,500	$0.0128 R^2f$ .
1,500-100,000	$19.2R^2$ .

$R$  is the minimum separation distance in meters

$f$  = frequency in MHz

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

### 5.1.2 MPE Results

Tune-Up Power Including Tolerance:

Mode	Frequency (MHz)	Tune up conducted power (dBm)	Cable Loss (dB)	Antenna Gain		ERP		Evaluation Distance (m)	ERP Limit (W)
				(dBi)	(dBd)	(dBm)	(W)		
UL	698-716	21.0	4.97	7.5	5.35	21.38	0.137	0.2	0.357
	776-787	21.5	4.97	7.5	5.35	21.88	0.154	0.2	0.397
	824-849	20.0	5.17	8	5.85	20.68	0.117	0.2	0.422
	1710-1755	21.0	7.51	9	6.85	20.34	0.108	0.2	0.768
	1850-1915	21.5	7.51	9	6.85	20.84	0.121	0.2	0.768
DL	728-746	13.0	4.97	6.5	4.35	12.38	0.017	0.2	0.373
	746-757	12.0	4.97	6.5	4.35	11.38	0.014	0.2	0.382
	869-894	14.0	5.17	6.5	4.35	13.18	0.021	0.2	0.445
	2110-2155	13.5	7.51	8.5	6.35	12.34	0.017	0.2	0.768
	1930-1995	14.0	7.51	8.5	6.35	12.84	0.019	0.2	0.768
BT	2402-2480	5.5	0	3.74	1.59	7.09	0.005	0.2	0.768
BLE	2402-2480	2	0	3.74	1.59	3.59	0.002	0.2	0.768
Wi-Fi	2412-2462	24	0	3.74	1.59	25.59	0.362	0.2	0.768

Note:

\*The EUT contains a certified module (FCC ID: 2AC7Z-ESP32WROVERB)

According to the MPE reports 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=  $ERP/Limit_{Booster} + ERP/Limit_{Wi-Fi} = 0.154/0.397 + 0.362/0.768 = 0.859 < 1.0$

The ERP was calculated base on the maximum value of antenna gain and cable loss combination.

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

**Result: Pass**