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)**	**Ave.eraging 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.e 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:

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

MPE Results

Tune-Up Power Including Tolerance:

Mode	Frequency Range (MHz)	Antenna Gain		Maximum Tune-up Power	Cable Loss (dB)	Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)				
UL	663-698	7.5	5.62	25.0	4.97	26	0.067	0.442
	698-716	7.5	5.62	25.0	4.97	26	0.067	0.465
	776-787	7.5	5.62	25.0	4.97	26	0.067	0.517
	824-849	8	6.31	24.0	5.17	26	0.057	0.549
	1710-1755	9	7.94	24.0	7.51	26	0.042	1.0
	1850-1915	9	7.94	24.0	7.51	26	0.042	1.0
DL	617-652	6.5	4.47	28.5	4.97	26	0.119	0.411
	728-746	6.5	4.47	29.0	4.97	26	0.133	0.485
	746-757	6.5	4.47	28.5	4.97	26	0.119	0.497
	869-894	6.5	4.47	29.0	5.17	26	0.127	0.579
	2110-2155	8.5	7.08	29.0	7.51	26	0.118	1.0
	1930-1995	8.5	7.08	29.0	7.51	26	0.118	1.0
BT*	2402-2480	3.74	2.37	5.5	/	26	0.001	1.0
BLE*	2402-2480	3.74	2.37	2	/	26	0.0004	1.0
Wi-Fi*	2412-2462	3.74	2.37	24	/	26	0.070	1.0
WCDMA B2**	1850-1910	3.0	2.00	25.0	/	26	0.074	1.0
WCDMA B5**	824-849	2.5	1.78	25.0	/	26	0.066	0.549
LTE B2**	1850-1910	3.0	2.00	25.0	/	26	0.074	1.0
LTE B4**	1710-1755	3.0	2.00	25.0	/	26	0.074	1.0
LTE B5**	824-849	2.5	1.78	25.0	/	26	0.066	0.549
LTE B12**	698-716	2.5	1.78	25.0	/	26	0.066	0.465
LTE B13**	776-787	2.5	1.78	25.0	/	26	0.066	0.517
LTE B14**	788 – 798	2.5	1.78	25.0	/	26	0.066	0.525
LTE B66**	1710 – 1780	3.0	2.00	25.0	/	26	0.074	1.0
LTE B71**	663 – 698	2.5	1.78	25.0	/	26	0.066	0.442

Note:

The tune-up power, cable loss and antenna gain was provided by applicant
*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
**The EUT contains a certified module (FCC ID: XMR201808EC25AF)

Simultaneously transmit consideration, the worst case:

The ratio= $MPE/Limit_{Booster}$+ $MPE/Limit_{Wi-Fi}$+ $MPE/Limit_{WWAN}$
=0.119/0.411+0.070/1+0.066/0.442=0.509<1.0

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 26cm from nearby persons.

Result: Pass