
FCC §15.247 (I) & §1.1310 & §2.1091 - MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 1.1310 (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				
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

Calculated Formulary:

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = 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)

Calculated Data:

Test Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
11b	2412	4.98	3.148	18.93	78.16	20	0.0489	1.0000
	2437	4.98	3.148	18.57	71.94	20	0.0451	1.0000
	2462	4.98	3.148	18.32	67.92	20	0.0425	1.0000
11g	2412	4.98	3.148	13.47	22.23	20	0.0139	1.0000
	2437	4.98	3.148	13.12	20.51	20	0.0128	1.0000
	2462	4.98	3.148	12.92	19.59	20	0.0123	1.0000
11n HT20	2412	4.98	3.148	12.34	17.14	20	0.0107	1.0000
	2437	4.98	3.148	12.12	16.29	20	0.0102	1.0000
	2462	4.98	3.148	12.09	16.18	20	0.0101	1.0000
11n HT40	2422	4.98	3.148	11.95	15.67	20	0.0098	1.0000
	2437	4.98	3.148	11.61	14.49	20	0.0091	1.0000
	2452	4.98	3.148	11.76	15	20	0.0094	1.0000
GFSK-1Mbps	2402	4.98	3.148	9.94	9.86	20	0.0062	1.0000
	2440	4.98	3.148	9.97	9.93	20	0.0062	1.0000
	2480	4.98	3.148	10.56	11.38	20	0.0071	1.0000

Conclusion: The EUT meets exemption requirement - RF exposure evaluation greater than 20cm distance specified in § 2.1091. If the device built into a host as a portable usage, the additional RF exposure evaluation may be required as specified by § 2.1093.

Simultaneous Transmission SAR Test Exemption with Respect to Multiple Exemption Criteria

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

Either SAR-based or MPE-based exemption may be considered for test exemption for fixed, mobile, or portable device exposure conditions; therefore, the contributions from each exemption in conjunction with the measured SAR (Evaluated_k term) shall be used to determine exemption for simultaneous transmission according to Formula (C.1) [repeated from § 1.1307(b)(3)(ii)(B)].

TEST RESULT

☒ Pass ☐ Not Applicable

Model	Mode	MAX Power Density (mW/cm ²)	Thershold Limit (mW/cm ²)	Result
ESP32-WROOM-32UE	WIFI 2.4G	0.0489	1.000	0.0719
ESP32-MINI-1	WIFI 2.4G	0.023	1.000	