

FCC ID: 2A9CQ-P1

Maximum Permissible Exposure (MPE)

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency(RF) Radiation as specified in §1.1307(b)

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	*900/f ²	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
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
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 * P * G}}{d} \qquad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = Average RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 * P * G}{377 * D^2}$$

From the EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

2.4G WIFI:

Operation Frequency: WIFI 2412-2462MHz for 802.11b/g/11n(HT20);
Power density limited: $1\text{mW}/\text{cm}^2$

Antenna Type: Metal Antenna

antenna gain: 2.39dBi;

R=20cm

$\text{mW}=10^{(\text{dBm}/10)}$

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(2.39/10)}=1.73$

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm ²)	Power density (mW/cm ²)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2412	802.11b	16.5	16±1	17	50.119	2.39	1.73	0.0173	1
2437		15.51	16±1	17	50.119	2.39	1.73	0.0173	1
2462		15.98	16±1	17	50.119	2.39	1.73	0.0173	1
2412	802.11g	14.61	14±1	15	31.623	2.39	1.73	0.0109	1
2437		14.86	14±1	15	31.623	2.39	1.73	0.0109	1
2462		13.68	14±1	15	31.623	2.39	1.73	0.0109	1
2412	802.11n H20	13.48	13±1	14	25.119	2.39	1.73	0.0087	1
2437		13.93	13±1	14	25.119	2.39	1.73	0.0087	1
2462		13.38	13±1	14	25.119	2.39	1.73	0.0087	1

433.92

Transmit power:

Frequency (MHz)	EIRP power (dBuV/m)	EIRP power (dBm)	EIRP power (mW)
433.92	81.87	-13.39	0.0458

$$\text{EIRP}=\text{E}-104.8+20\log(\text{D})$$

EIRP=conducted power + antenna gain

antenna gain: 0.44dBi;

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
433.92	OOK	-13.83	-14±1	-13	0.050	0.44	1.11	0.0001	0.28928

Maximum Multiple sources

Band	Max tune-up power	Antenna	Separation distance (cm)	Evaluation result	Power density Limits	Evaluation result	Power density Limits	Verdict
	(dBm)	Gain (dBi)		(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	
2.4G +433.92M	17	2.39	20	0.0173	1	0.01765	1	PASS
	-13	0.44	20	0.0001	0.28928			

Conclusion:

For the max result : $0.01765 \leq 1\text{mW}/\text{cm}^2$ for Power density,
 $0.0001 \leq 0.28928\text{mW}/\text{cm}^2$ for Power density,
compliance with RF exposure.

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