

FCC ID: 2AQ9Y-OPIZERO3

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.

BT:

Measurement Result

Operation Frequency: 2402MHz~2480MHz

Power density limited: $1\text{mW}/\text{cm}^2$

Antenna Type: Copper antenna

Antenna gain: 3.02dBi;

R=20cm

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

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(3.02/10)}=2$

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm ²)	Power density (mW/cm ²)
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2402	GFSK(1M)	3.69	3±1	4	2.512	3.02	2.00	0.0010	1
2440		2.6	3±1	4	2.512	3.02	2.00	0.0010	1
2480		3.39	3±1	4	2.512	3.02	2.00	0.0010	1
2402	GFSK(2M)	3.54	3±1	4	2.512	3.02	2.00	0.0010	1
2440		2.46	3±1	4	2.512	3.02	2.00	0.0010	1
2480		3.21	3±1	4	2.512	3.02	2.00	0.0010	1

2.4G WIFI:

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,
 WIFI 802.11n HT40:2422-2452MHz
 Power density limited: 1mW/ cm²

Antenna Type: Copper antenna

Antenna gain: 3.02dBi;

R=20cm

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

antenna gain Numeric= $10^{(dBi/10)}=10^{(3.02/10)}=2$

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	15.83	16±1	17	50.119	3.02	2.00	0.0200	1
2437		15.56	16±1	17	50.119	3.02	2.00	0.0200	1
2462		16.12	16±1	17	50.119	3.02	2.00	0.0200	1
2412	802.11g	15.12	15±1	16	39.811	3.02	2.00	0.0159	1
2437		14.98	15±1	16	39.811	3.02	2.00	0.0159	1
2462		15.43	15±1	16	39.811	3.02	2.00	0.0159	1
2412	802.11n H20	15.4	15±1	16	39.811	3.02	2.00	0.0159	1
2437		15.17	15±1	16	39.811	3.02	2.00	0.0159	1
2462		15.69	15±1	16	39.811	3.02	2.00	0.0159	1
2422	802.11n(H T40)	14.78	15±1	16	39.811	3.02	2.00	0.0159	1
2437		14.71	15±1	16	39.811	3.02	2.00	0.0159	1
2452		14.95	15±1	16	39.811	3.02	2.00	0.0159	1

5G WIFI:

Operation Frequency: WIFI 802.11a/ac/n(HT20): 5180-5240MHz; 5745-5825MHz;

WIFI 802.11ac/n(HT40): 5190-5230MHz;5755-5795MHz;

WIFI 802.11ac80:5210-5210MHz;5775-5775MHz

Power density limited: 1mW/cm

Antenna Type: Copper antenna

Antenna gain:2.76dBi;

R=20cm

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

antenna gain Numeric= $10^{(dBi/10)}=10^{(2.76/10)}=1.62$

5.2G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm ²)	Power density (mW/cm ²)
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
5180	a	11.94	12±1	13	19.953	2.76	1.89	0.0075	1
5200	a	11.58	12±1	13	19.953	2.76	1.89	0.0075	1
5240	a	11.41	12±1	13	19.953	2.76	1.89	0.0075	1
5180	n20	12.22	12±1	13	19.953	2.76	1.89	0.0075	1
5200	n20	11.9	12±1	13	19.953	2.76	1.89	0.0075	1
5240	n20	11.81	12±1	13	19.953	2.76	1.89	0.0075	1
5190	n40	12.09	12±1	13	19.953	2.76	1.89	0.0075	1
5230	n40	11.76	12±1	13	19.953	2.76	1.89	0.0075	1
5180	ac20	12.38	12±1	13	19.953	2.76	1.89	0.0075	1
5200	ac20	11.89	12±1	13	19.953	2.76	1.89	0.0075	1
5240	ac20	11.74	12±1	13	19.953	2.76	1.89	0.0075	1
5190	ac40	12.51	12±1	13	19.953	2.76	1.89	0.0075	1
5230	ac40	11.87	12±1	13	19.953	2.76	1.89	0.0075	1
5210	ac80	12.1	12±1	13	19.953	2.76	1.89	0.0075	1

5.8G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm ²)	Power density (mW/cm ²)
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
5745	a	12.83	12±1	13	19.953	2.76	1.89	0.0075	1
5785	a	12.84	12±1	13	19.953	2.76	1.89	0.0075	1
5825	a	12.77	12±1	13	19.953	2.76	1.89	0.0075	1
5745	n20	11.96	12±1	13	19.953	2.76	1.89	0.0075	1
5785	n20	12.01	12±1	13	19.953	2.76	1.89	0.0075	1
5825	n20	12.01	12±1	13	19.953	2.76	1.89	0.0075	1
5755	n40	11.94	12±1	13	19.953	2.76	1.89	0.0075	1
5795	n40	12.08	12±1	13	19.953	2.76	1.89	0.0075	1
5745	ac20	12.06	12±1	13	19.953	2.76	1.89	0.0075	1
5785	ac20	12.06	12±1	13	19.953	2.76	1.89	0.0075	1
5825	ac20	12	12±1	13	19.953	2.76	1.89	0.0075	1
5755	ac40	11.92	12±1	13	19.953	2.76	1.89	0.0075	1
5795	ac40	12	12±1	13	19.953	2.76	1.89	0.0075	1
5775	ac80	12.02	12±1	13	19.953	2.76	1.89	0.0075	1

SIMULTANEOUS TRANSMISSIONS

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE. To comply with the MPE, the fraction of the MPE in terms of E^2 , H^2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity. In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^n \frac{S_i}{MPE_i} \leq 1$$

Max. SIMULTANEOUS TRANSMISSIONS MODE

Band	Max conducted Power	Antenna	Separation distance (cm)	Evaluation result	Power density Limits	Evaluation result	Power density Limits	Verdict
	(dBm)	Gain		(mW/cm ²)	(mW/cm ²)			
		(dBi)						
Wi-Fi 2.4G + BT	3.69	3.02	20	0.001	1	0.021000	1	PASS
	16.12	3.02	20	0.02	1			

Signature:

Date: 2023-03-14



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