

FCC ID:2BCYS-QLYBOT-S2

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

$$E \text{ (V/m)} = \frac{\sqrt{30 * P * G}}{d}$$

$$\text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

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.

Measurement Result

BT:

Operation Frequency: 2402MHz~2480MHz

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

Antenna Type: PCB antenna

WIFI antenna gain: 1.82dBi;

R=20cm

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

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(1.82/10)}=1.52$

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Antenna	Evaluation result at 20cm	Power density Limits
		(dBm)	(dBm)	tune-up power		Gain	Power density(mW/cm^2)	(mW/cm ²)
				(dBm)	(mW)	Numeric		
2402	GFSK	5.94	5±1	6	3.98	1.52	0.00120	1
2441		5.37	5±1	6	3.98	1.52	0.00120	1
2480		4.72	5±1	6	3.98	1.52	0.00120	1
2402	π/4-DQPSK,	8.34	7±1	8	6.31	1.52	0.00191	1
2441		7.83	7±1	8	6.31	1.52	0.00191	1
2480		7.22	7±1	8	6.31	1.52	0.00191	1
2402	8DPSK	8.38	7±1	8	6.31	1.52	0.00191	1
2441		7.85	7±1	8	6.31	1.52	0.00191	1
2480		7.23	7±1	8	6.31	1.52	0.00191	1
2402	BLE(GFSK)-1M	6.02	5.5±1	6.5	4.47	1.52	0.00135	1
2440		5.45	5.5±1	6.5	4.47	1.52	0.00135	1
2480		4.71	5.5±1	6.5	4.47	1.52	0.00135	1
2402	BLE(GFSK)-2M	6.06	5.5±1	6.5	4.47	1.52	0.00135	1
2440		5.5	5.5±1	6.5	4.47	1.52	0.00135	1
2480		4.75	5.5±1	6.5	4.47	1.52	0.00135	1

2.4G WIFI:

Operation Frequency: WIFI 802.11b/g/n/ax HT20: 2412-2462MHz, HT40: 2422-2452MHz

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

Antenna Type: PCB antenna

WIFI antenna gain: 1.82dBi

R=20cm

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

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(1.82/10)}=1.52$

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Antenna	Evaluation result at 20cm	Power density Limits
		(dBm)	(dBm)	tune-up power		Gain	Power density(mW/cm^2)	(mW/cm ²)
				(dBm)	(mW)	Numeric		
2412	802.11b	16.04	16±1	17	50.11872	1.52	0.01516	1
2437		16.06	16±1	17	50.11872	1.52	0.01516	1
2462		16.21	16±1	17	50.11872	1.52	0.01516	1
2412	802.11g	13.44	13±1	14	25.11886	1.52	0.00760	1
2437		13.51	13±1	14	25.11886	1.52	0.00760	1
2462		13.76	13±1	14	25.11886	1.52	0.00760	1
2412	802.11n H20	13.42	13±1	14	25.11886	1.52	0.00760	1
2437		13.47	13±1	14	25.11886	1.52	0.00760	1
2462		13.66	13±1	14	25.11886	1.52	0.00760	1
2422	802.11n H40	12.99	13±1	14	25.11886	1.52	0.00760	1
2437		13.32	13±1	14	25.11886	1.52	0.00760	1
2452		13.46	13±1	14	25.11886	1.52	0.00760	1
2412	802.11ax 20	13.5	13±1	14	25.11886	1.52	0.00760	1
2437		13.52	13±1	14	25.11886	1.52	0.00760	1
2462		13.71	13±1	14	25.11886	1.52	0.00760	1
2422	802.11ax40	12.96	13±1	14	25.11886	1.52	0.00760	1
2437		13.41	13±1	14	25.11886	1.52	0.00760	1
2452		13.53	13±1	14	25.11886	1.52	0.00760	1

5G WIFI:

Operation Frequency: WIFI 802.11a/ac/ax/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: PCB antenna

WIFI antenna gain: 2.52dBi;

R=20cm

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

antenna gain Numeric= $10^{(dBi/10)}=10^{(2.52/10)}=1.79$

5.2G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Antenna	Evaluation result at 20cm	Power density Limits
		(dBm)	(dBm)	tune-up power		Gain	Power density(mW/cm2)	(mW/cm2)
				(dBm)	(mW)	Numeric		
5180	802.11a	11.92	12±1	13	19.95	1.79	0.00711	1
5200		11.88	12±1	13	19.95	1.79	0.00711	1
5240		12.25	12±1	13	19.95	1.79	0.00711	1
5180	802.11n 20	11.86	12±1	13	19.95	1.79	0.00711	1
5200		12.07	12±1	13	19.95	1.79	0.00711	1
5240		12.23	12±1	13	19.95	1.79	0.00711	1
5190	802.11n 40	12.15	12±1	13	19.95	1.79	0.00711	1
5230		12.25	12±1	13	19.95	1.79	0.00711	1
5180		11.83	12±1	13	19.95	1.79	0.00711	1
5200	802.11ac 20	11.93	12±1	13	19.95	1.79	0.00711	1
5240		12.1	12±1	13	19.95	1.79	0.00711	1
5190		11.97	12±1	13	19.95	1.79	0.00711	1
5230	802.11ac 40	12.42	12±1	13	19.95	1.79	0.00711	1
5180		12.12	12±1	13	19.95	1.79	0.00711	1
5200		12.26	12±1	13	19.95	1.79	0.00711	1
5240	802.11ax 20	12.36	12±1	13	19.95	1.79	0.00711	1
5190		12.07	12±1	13	19.95	1.79	0.00711	1
5230		12.66	12±1	13	19.95	1.79	0.00711	1

5.8G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Antenna	Evaluation result at 20cm	Power density Limits
		(dBm)	(dBm)	tune-up power		Gain	Power density(mW/cm2)	(mW/cm2)
				(dBm)	(mW)	Numeric		
5745	802.11a	13.81	13±1	14	25.12	1.79	0.00895	1
5785		13.36	13±1	14	25.12	1.79	0.00895	1
5825		12.89	13±1	14	25.12	1.79	0.00895	1
5745	802.11n20	13.62	13±1	14	25.12	1.79	0.00895	1
5785		13.42	13±1	14	25.12	1.79	0.00895	1
5825		12.94	13±1	14	25.12	1.79	0.00895	1
5755	802.11n40	13.65	13±1	14	25.12	1.79	0.00895	1
5795		13.45	13±1	14	25.12	1.79	0.00895	1
5745		13.57	13±1	14	25.12	1.79	0.00895	1
5785	802.11ac 20	13.3	13±1	14	25.12	1.79	0.00895	1
5825		12.82	13±1	14	25.12	1.79	0.00895	1
5755		13.89	13±1	14	25.12	1.79	0.00895	1
5795	802.11ac 40	13.43	13±1	14	25.12	1.79	0.00895	1
5745		13.97	13±1	14	25.12	1.79	0.00895	1
5785		13.48	13±1	14	25.12	1.79	0.00895	1
5825	802.11ax 20	12.93	13±1	14	25.12	1.79	0.00895	1
5755		13.81	13±1	14	25.12	1.79	0.00895	1
5795		13.59	13±1	14	25.12	1.79	0.00895	1

Conclusion:

The conclusion should be $0.01516 < 1$ for Max Power Density, Compliance the RF Exposure requirement.

Signature:

Date: 2023-09-22



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