

FCC ID: 2A20VC02

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.

BLE:

Measurement Result

Operation Frequency: 2402MHz~2480MHz

Power density limited: 1mW/ cm²

Antenna Type: PCB antenna

Antenna gain:-0.56dBi;

R=20cm

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

antenna gain Numeric=10^{^(dBi/10)}= 10^{^(-0.56/10)}=0.88

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm2)	Power density (mW/cm2)
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2402	BLE 1M	-1.14	-1±1	0	1.000	-0.56	0.88	0.0002	1
2440		-1.46	-1±1	0	1.000	-0.56	0.88	0.0002	1
2480		-1.95	-1±1	0	1.000	-0.56	0.88	0.0002	1
2402	BLE 2M	-1.07	-1±1	0	1.000	-0.56	0.88	0.0002	1
2440		-1.41	-1±1	0	1.000	-0.56	0.88	0.0002	1
2480		-1.93	-1±1	0	1.000	-0.56	0.88	0.0002	1

Zigbee:

Measurement Result

Operation Frequency: 2402MHz~2480MHz

Power density limited: 1mW/ cm2

Antenna Type: PCB antenna

Antenna gain:-0.56dBi;

R=20cm

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

antenna gain Numeric=10^{^(dBi/10)}= 10^{^(-0.56/10)}=0.88

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm2)	Power density (mW/cm2)
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2405	Zigbee	-1.05	-1±1	0	1.000	-0.56	0.88	0.0002	1
2440		-1.34	-1±1	0	1.000	-0.56	0.88	0.0002	1
2480		-1.93	-1±1	0	1.000	-0.56	0.88	0.0002	1

2.4GWIFI:

Measurement Result

Operation Frequency: 2412MHz~2462MHz (20M)

2422MHz~2452MHz (40M)

Power density limited: 1mW/ cm²

Antenna Type: FPC antenna

Antenna gain:2.85dBi;

R=20cm

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

antenna gain Numeric=10^{^(dBi/10)}= 10^{^(2.85/10)}=1.93

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2412	11b	11.72	11±1	12	15.849	2.85	1.93	0.0061	1
2437		11.97	11±1	12	15.849	2.85	1.93	0.0061	1
2462		11.42	11±1	12	15.849	2.85	1.93	0.0061	1
2412	11g	12.12	11.5±1	12.5	17.783	2.85	1.93	0.0068	1
2437		12.44	11.5±1	12.5	17.783	2.85	1.93	0.0068	1
2462		10.98	11.5±1	12.5	17.783	2.85	1.93	0.0068	1
2412	11n20	12.06	13±1	14	25.119	2.85	1.93	0.0096	1
2437		12.41	13±1	14	25.119	2.85	1.93	0.0096	1
2462		13.05	13±1	14	25.119	2.85	1.93	0.0096	1
2422	11n40	12.21	12±1	13	19.953	2.85	1.93	0.0077	1
2437		11.79	12±1	13	19.953	2.85	1.93	0.0077	1
2452		11.8	12±1	13	19.953	2.85	1.93	0.0077	1

5G WIFI:

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

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

Power density limited: 1mW/cm

Antenna Type: FPC antenna

Antenna gain :5.76dBi

5.2G

modulation	Antenna	Channel Freq. (MHz)	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
			(dBm)		tune-up power		Gain		(mW/cm2)	(mW/cm2)
					(dBm)	(mW)	(dBi)	Numeric		
802.11a	Ant 1	5180	12.67	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5200	12.96	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5240	12.57	12±1	13.00	19.953	5.76	3.77	0.0150	1
802.11n20	Ant 1	5180	12.72	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5200	12.7	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5240	12.59	12±1	13.00	19.953	5.76	3.77	0.0150	1
802.11n40	Ant 1	5190	12.57	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5230	12.7	12±1	13.00	19.953	5.76	3.77	0.0150	1

5.3G

modulation	Antenna	Channel Freq. (MHz)	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
			(dBm)		tune-up power		Gain			
					(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)	(mW/cm2)
802.11a	Ant 1	5260	12.54	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5280	11.94	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5320	12.88	12±1	13.00	19.953	5.76	3.77	0.0150	1
802.11n20	Ant 1	5260	12.56	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5280	11.99	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5320	12.63	12±1	13.00	19.953	5.76	3.77	0.0150	1
802.11n40	Ant 1	5270	12.69	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5310	12.58	12±1	13.00	19.953	5.76	3.77	0.0150	1

5.6G

modulation	Antenna	Channel Freq. (MHz)	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density Limits
			(dBm)		tune-up power		Gain		(mW/cm2)	(mW/cm2)
					(dBm)	(mW)	(dBi)	Numeric		
802.11a	Ant 1	5500	11.99	11±1	12.00	15.849	5.76	3.77	0.0119	1
	Ant 1	5600	11.2	11±1	12.00	15.849	5.76	3.77	0.0119	1
	Ant 1	5700	11.93	11±1	12.00	15.849	5.76	3.77	0.0119	1
802.11n20	Ant 1	5500	11.93	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5600	11.1	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5700	12.03	12±1	13.00	19.953	5.76	3.77	0.0150	1
802.11n40	Ant 1	5510	11.48	11.5±1	12.50	17.783	5.76	3.77	0.0133	1
	Ant 1	5590	10.28	11.5±1	12.50	17.783	5.76	3.77	0.0133	1
	Ant 1	5670	12.26	11.5±1	12.50	17.783	5.76	3.77	0.0133	1

5.8G

modulation	Antenna	Channel Freq. (MHz)	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
			(dBm)		tune-up power		Gain			
					(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)	(mW/cm2)
802.11a	Ant 1	5745	12.16	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5785	11.82	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5825	11.66	12±1	13.00	19.953	5.76	3.77	0.0150	1
802.11n20	Ant 1	5745	11.9	11±1	12.00	15.849	5.76	3.77	0.0119	1
	Ant 1	5785	11.48	11±1	12.00	15.849	5.76	3.77	0.0119	1
	Ant 1	5825	11.97	11±1	12.00	15.849	5.76	3.77	0.0119	1
802.11n40	Ant 1	5755	12.16	12±1	13.00	19.953	5.76	3.77	0.0150	1
	Ant 1	5795	11.76	12±1	13.00	19.953	5.76	3.77	0.0150	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

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

Band	Antenna	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)			
BLE	Ant1	0	-0.56	20	0.000175	1	0.007826	1	PASS
Wi-Fi 5.2G	Ant1	13	2.85	20	0.007651	1			

Conclusion:

For the max result : $0.015 \leq 1.0$ for Max Power Density, compliance RF exposure.

Signature: 

Date: 2025-06-03

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