

FCC ID:2BFTW-SPCF1

KDB447498 D01 General RF Exposure Guidance v06

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.

BT:

Measurement Result

Operation Frequency: 2402MHz~2480MHz

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

Antenna Type:PIFA antenna

Antenna gain:3.23 dBi;

R=20cm

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

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(3.23/10)}=2.10$

Channel Freq. (MHz)	modulation	conducted pow er	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density Limits
		(dBm)		tune-up pow er		Gain			
				(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)	(mW/cm2)
2402	DH5	3.31	3±1	4	2.512	3.23	2.10	0.0011	1
2441		3.34	3±1	4	2.512	3.23	2.10	0.0011	1
2480		2.73	3±1	4	2.512	3.23	2.10	0.0011	1
2402	2DH5	3.94	3±1	4	2.512	3.23	2.10	0.0011	1
2441		3.98	3±1	4	2.512	3.23	2.10	0.0011	1
2480		3.33	3±1	4	2.512	3.23	2.10	0.0011	1
2402	3DH5	4.9	4±1	5	3.162	3.23	2.10	0.0013	1
2441		4.91	4±1	5	3.162	3.23	2.10	0.0013	1
2480		4.32	4±1	5	3.162	3.23	2.10	0.0013	1

BLE:

Measurement Result

Operation Frequency: 2402MHz~2480MHz

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

Antenna Type:PIFA antenna

Antenna gain:3.23 dBi;

R=20cm

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

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(3.23/10)}=2.10$

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Pow er density Limits
		(dBm)		tune-up power		Gain		(mW/cm2)	(mW/cm2)
				(dBm)	(mW)	(dBi)	Numeric		
2402	BLE1M	3.38	3±1	4	2.512	3.23	2.10	0.0011	1
2440		3.37	3±1	4	2.512	3.23	2.10	0.0011	1
2480		2.71	3±1	4	2.512	3.23	2.10	0.0011	1
2402	BLE2M	3.34	3±1	4	2.512	3.23	2.10	0.0011	1
2440		3.34	3±1	4	2.512	3.23	2.10	0.0011	1
2480		2.7	3±1	4	2.512	3.23	2.10	0.0011	1

2.4GWIFI:

Measurement Result

Operation Frequency: 2412MHz~2462MHz

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

Antenna Type:PIFA antenna

Antenna gain:3.23 dBi;

R=20cm

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

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(3.23/10)}=2.10$

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density Limits
		(dBm)		tune-up power		Gain		(mW/cm ²)	(mW/cm ²)
				(dBm)	(mW)	(dBi)	Numeric		
2412	B	16.31	16±1	17	50.119	3.23	2.10	0.0210	1
2437		16.69	16±1	17	50.119	3.23	2.10	0.0210	1
2462		16.9	16±1	17	50.119	3.23	2.10	0.0210	1
2412	G	14.65	15±1	16	39.811	3.23	2.10	0.0167	1
2437		15.24	15±1	16	39.811	3.23	2.10	0.0167	1
2462		15.52	15±1	16	39.811	3.23	2.10	0.0167	1
2412	N20	12.43	13±1	14	25.119	3.23	2.10	0.0105	1
2437		12.91	13±1	14	25.119	3.23	2.10	0.0105	1
2462		13.02	13±1	14	25.119	3.23	2.10	0.0105	1
2422	N40	12.8	13±1	14	25.119	3.23	2.10	0.0105	1
2437		13	13±1	14	25.119	3.23	2.10	0.0105	1
2452		12.96	13±1	14	25.119	3.23	2.10	0.0105	1

5GWIFI:

Measurement Result

Operation Frequency: 5150MHz~5850MHz

Power density limited: 1mW/ cm²

Antenna Type:PIFA antenna

Antenna gain:3.64 dBi;

R=20cm

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

antenna gain Numeric=10^{^(dBi/10)}= 10^{^(3.64/10)}=2.31

modulation	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			
A20	12.547	15±1	16	39.811	3.64	2.31	0.0183	1	
A20	13.765	13±1	14	25.119	3.64	2.31	0.0116	1	
N20	13.421	13±1	14	25.119	3.64	2.31	0.0116	1	
A20	13.464	13±1	14	25.119	3.64	2.31	0.0116	1	

$$BT+BLE+2.4GWIFI+5GWIFI=0.0011+0.0011+0.0210+0.0183=0.0415<1$$

Conclusion:

For the max result : 0.0415≤ 1.0 for Max Power Density, compliance RF exposure..

Signature: 

Date: 2024-06-18

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