

FCC ID: 2ALR4-WRTNODE7

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

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

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

WIFI:

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

Power density limited: 1mW/ cm²

Antenna Type: Ceramic Antenna& FPCB Antenna;

R=20cm

mW=10^(dBm/10)

antenna gain Numeric=10^(dBi/10)= 10^(1/10)=1.12

Ceramic Antenna gain: 0.5dBi:

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Ceramic 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	12.13	12.5±1	13.5	22.38721	1.12	0.00499	1
2437		11.79	12.5±1	13.5	22.38721	1.12	0.00499	1
2462		13.23	12.5±1	13.5	22.38721	1.12	0.00499	1
2412	802.11g	6.78	7±1	8	6.309573	1.12	0.00141	1
2437		7.18	7±1	8	6.309573	1.12	0.00141	1
2462		9.13	8±1	9	7.943282	1.12	0.00177	1
2412	802.11n H20	6.23	7±1	8	6.309573	1.12	0.00141	1
2437		8.68	8±1	9	7.943282	1.12	0.00177	1
2462		8.42	8±1	9	7.943282	1.12	0.00177	1
2422	802.11n H40	6.23	7±1	8	6.309573	1.12	0.00141	1
2437		8.68	8±1	9	7.943282	1.12	0.00177	1
2452		8.42	8±1	9	7.943282	1.12	0.00177	1

FPCB Antenna gain: 4.5dBi:

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		FPCB 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	12.13	12.5±1	13.5	22.38721	2.82	0.01256	1
2437		11.79	12.5±1	13.5	22.38721	2.82	0.01256	1
2462		13.23	12.5±1	13.5	22.38721	2.82	0.01256	1
2412	802.11g	6.78	7±1	8	6.309573	2.82	0.00354	1
2437		7.18	7±1	8	6.309573	2.82	0.00354	1
2462		9.13	8±1	9	7.943282	2.82	0.00446	1
2412	802.11n H20	6.23	7±1	8	6.309573	2.82	0.00354	1
2437		8.68	8±1	9	7.943282	2.82	0.00446	1
2462		8.42	8±1	9	7.943282	2.82	0.00446	1
2422	802.11n H40	6.23	7±1	8	6.309573	2.82	0.00354	1
2437		8.68	8±1	9	7.943282	2.82	0.00446	1
2452		8.42	8±1	9	7.943282	2.82	0.00446	1

BT:

Operation Frequency: BT3.0: 2402MHz~2480MHz

Power density limited: 1mW/ cm²

Antenna Type: Ceramic Antenna& FPCB Antenna;

R=20cm

Bluetooth DSS:

Ceramic Antenna gain: 0.5dBi:

Channel Freq. (MHz)	modulation	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		
2402	GFSK	3.15	4±1	5	3.162	0.50	1.12	0.00071	1
2441		4.63	4±1	5	3.162	0.50	1.12	0.00071	1
2480		4.82	4±1	5	3.162	0.50	1.12	0.00071	1
2402	π/4-DQPSK	2.66	3.5±1	4.5	2.818	0.50	1.12	0.00063	1
2441		4.13	3.5±1	4.5	2.818	0.50	1.12	0.00063	1
2480		4.3	3.5±1	4.5	2.818	0.50	1.12	0.00063	1
2402	8DPSK	3	4±1	5	3.162	0.50	1.12	0.00071	1
2441		4.5	4±1	5	3.162	0.50	1.12	0.00071	1
2480		4.68	4±1	5	3.162	0.50	1.12	0.00071	1

FPCB Antenna gain: 4.5dBi:

Channel Freq. (MHz)	modulation	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		
2402	GFSK	3.15	4±1	5	3.162	0.50	2.82	0.00177	1
2441		4.63	4±1	5	3.162	0.50	2.82	0.00177	1
2480		4.82	4±1	5	3.162	0.50	2.82	0.00177	1
2402	π/4-DQPSK	2.66	3.5±1	4.5	2.818	0.50	2.82	0.00158	1
2441		4.13	3.5±1	4.5	2.818	0.50	2.82	0.00158	1
2480		4.3	3.5±1	4.5	2.818	0.50	2.82	0.00158	1
2402	8DPSK	3	4±1	5	3.162	0.50	2.82	0.00177	1
2441		4.5	4±1	5	3.162	0.50	2.82	0.00177	1
2480		4.68	4±1	5	3.162	0.50	2.82	0.00177	1

BLE:

Operation Frequency: BT4.0: 2402MHz~2480MHz

Power density limited: 1mW/ cm²

Antenna Type: Ceramic Antenna& FPCB Antenna;

Antenna gain: 0.5dBi,

R=20cm

Bluetooth DTS;

Ceramic Antenna gain: 0.5dBi:

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
		(dBm)		tune-up power		Gain			
				(dBm)	(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)
2402	GFSK	-0.41	0.5±1	1.5	1.413	0.50	1.12	0.00032	1
2440		1.03	0.5±1	1.5	1.413	0.50	1.12	0.00032	1
2480		1.25	0.5±1	1.5	1.413	0.50	1.12	0.00032	1

FPCB Antenna gain: 4.5dBi:

Channel Freq. (MHz)	modulation	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		
2402	GFSK	-0.41	0.5±1	1.5	1.413	0.50	2.82	0.00079	1
2440		1.03	0.5±1	1.5	1.413	0.50	2.82	0.00079	1
2480		1.25	0.5±1	1.5	1.413	0.50	2.82	0.00079	1

Conclusion:

For the max result : 0.01256≤ 1.0 for Max Power Density, No SAR is required.

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Signature:

Date: 2017-06-02

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