

RF EXPOSURE EVALUATION

According to FCC 1.1310 and KDB 447498 D01 V06, 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)

According to FCC2.1091

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: 1mW/ cm²

Antenna Type: FPC Antenna

Antenna gain: 2.98 dBi;

R=20cm

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

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

BLE

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density Limits
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)	(mW/cm2)
2402	BLE 1M	5.55	5±1	6	3.981	2.98	1.99	0.0016	1
2440		4.99	5±1	6	3.981	2.98	1.99	0.0016	1
2480		4.72	5±1	6	3.981	2.98	1.99	0.0016	1

2.4G WIFI

Operation Frequency:

WIFI 802.11b/g/n HT20: 2412-2462MHz,

Power density limited: 1mW/ cm²

Antenna Type: FPC Antenna

Antenna 0 gain/Antenna 1 gain: 2.98 dBi;

R=20cm

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

Antenna gain Numeric=10^{^(dBi/10)}

Antenna	Channel Freq. (MHz)	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		
Ant 1	2412	b	15.34	15±1	16	39.811	2.98	1.99	0.0157	1
Ant 1	2437		15.68	15±1	16	39.811	2.98	1.99	0.0157	1
Ant 1	2462		15.94	15±1	16	39.811	2.98	1.99	0.0157	1
Ant 1	2412	g	14.34	14±1	15	31.623	2.98	1.99	0.0125	1
Ant 1	2437		14.02	14±1	15	31.623	2.98	1.99	0.0125	1
Ant 1	2462		14.53	14±1	15	31.623	2.98	1.99	0.0125	1
Ant 1	2412	802.11n H20	12.29	12±1	13	19.953	2.98	1.99	0.0079	1
Ant 1	2437		11.98	12±1	13	19.953	2.98	1.99	0.0079	1
Ant 1	2462		13.7	13±1	14	25.119	2.98	1.99	0.0099	1

5G WIFI

Operation Frequency: WIFI 802.11a/ac/n(HT20): 5180-5240MHz;5260-5320MHz,5500-5700MHz,5745-5825MHz;WIFI 802.11ac/n(HT40): 5190-5230MHz;5270-5310MHz,5510-5670MHz5755-5795MHz; WIFI 802.11ac80:5210-5210MHz;5290-5290MHz;5530-5610MHz; 5775-5775MHz

Power density limited: 1mW/cm

Antenna Type: FPC Antenna

Antenna Gain: 2.91 dBi

R=20cm

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

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

5.2G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density Limits
		(dBm)		tune-up power		Gain			
				(dBm)	(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)
5180	802.11a	11.75	12±1	13	19.953	2.91	1.95	0.0078	1
5200		11.66	12±1	13	19.953	2.91	1.95	0.0078	1
5240		12.49	12±1	13	19.953	2.91	1.95	0.0078	1
5180	802.11n H20	11.51	12±1	13	19.953	2.91	1.95	0.0078	1
5200		11.55	12±1	13	19.953	2.91	1.95	0.0078	1
5240		12.28	12±1	13	19.953	2.91	1.95	0.0078	1

5.3G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density Limits
		(dBm)		tune-up power		Gain			
				(dBm)	(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)
5260	802.11a	12.68	13±1	14	25.119	2.91	1.95	0.0098	1
5280		12.98	13±1	14	25.119	2.91	1.95	0.0098	1
5320		13.72	13±1	14	25.119	2.91	1.95	0.0098	1
5260	802.11n20	12.52	13±1	14	25.119	2.91	1.95	0.0098	1
5280		13.26	13±1	14	25.119	2.91	1.95	0.0098	1
5320		13.69	13±1	14	25.119	2.91	1.95	0.0098	1

5.6G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density Limits
		(dBm)		tune-up power		Gain			
				(dBm)	(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)
5260	802.11a	13.53	13±1	14	25.119	2.91	1.95	0.0098	1
5280		13.86	13±1	14	25.119	2.91	1.95	0.0098	1
5320		13.56	13±1	14	25.119	2.91	1.95	0.0098	1
5260	802.11n20	13.27	13±1	14	25.119	2.91	1.95	0.0098	1
5280		13.72	13±1	14	25.119	2.91	1.95	0.0098	1
5320		13.34	13±1	14	25.119	2.91	1.95	0.0098	1

5.8G

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density Limits
		(dBm)		tune-up power		Gain			
				(dBm)	(dBm)	(mW)	(dBi)	Numeric	(mW/cm ²)
5260	802.11a	12.45	13±1	14	25.119	2.91	1.95	0.0098	1
5280		13.26	13±1	14	25.119	2.91	1.95	0.0098	1
5320		13.28	13±1	14	25.119	2.91	1.95	0.0098	1
5260	802.11n20	12.49	13±1	14	25.119	2.91	1.95	0.0098	1
5280		12.99	13±1	14	25.119	2.91	1.95	0.0098	1
5320		13.38	13±1	14	25.119	2.91	1.95	0.0098	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

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

Worst case is Simultaneous Transmissions for 2.4G Wi-Fi +BLE

Band	Mode	Standalone	Standalone	Simultaneous		Verdict
		Evaluation result	Power density Limits	Evaluation result	Limit	
		(mW/cm2)	(mW/cm2)	raio		
2.4G Wi-Fi+BLE	BT	0.0016	1	0.0173	1	PASS
	2.4G WIFI	0.0157	1			

Conclusion:

For the max result : $0.0173 \leq 1.0$, SAR is not required.

Signature:

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NAME AND TITLE (Please print or type): Judson Jia /Manager

COMPANY (Please print or type): Shenzhen NTEK Testing Technology Co., Ltd./ No. 24 Xinfu East Road, Xiangshan Community, Xinqiao Street, Baoan District, Shenzhen, Guangdong, People's Republic of China