

FCC ID: 2BBDIVBK30C21

KDB 447498 D04 interim General RF Exposure Guidance v01

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: 1mW/ cm²

Antenna Type: Internal antenna

antenna gain: 1.71 dBi;

R=20cm

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

antenna gain Numeric=10^{^(dBi/10)}= 10^{^(1.71/10)}=1.48

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	DH5	0.37	0±1	1	1.259	1.71	1.48	0.0004	1
2441		0.01	0±1	1	1.259	1.71	1.48	0.0004	1
2480		0.67	0±1	1	1.259	1.71	1.48	0.0004	1
2402	2DH5	-1.25	-1±1	0	1.000	1.71	1.48	0.0003	1
2441		-1.87	-1±1	0	1.000	1.71	1.48	0.0003	1
2480		-1.24	-1±1	0	1.000	1.71	1.48	0.0003	1
2402	3DH5	-0.95	-1±1	0	1.000	1.71	1.48	0.0003	1
2441		-1.42	-1±1	0	1.000	1.71	1.48	0.0003	1
2480		-0.76	-1±1	0	1.000	1.71	1.48	0.0003	1

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		
2402	GFSK(1M)	10.32	10±1	11	12.589	1.71	1.48	0.0037	1
2440		10.1	10±1	11	12.589	1.71	1.48	0.0037	1
2480		10.53	10±1	11	12.589	1.71	1.48	0.0037	1

2.4G WIFI:

Operation Frequency: WIFI 802.11b/g/n20: 2412-2462MHz,
802.11n40: 2422-2452MHz,
Power density limited: $1\text{mW}/\text{cm}^2$

Antenna Type: Internal antenna

antenna gain: 2.79 dBi;

R=20cm

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

antenna gain Numeric= $10^{(\text{dBi}/10)}=10^{(2.79/10)}=1.90$

Antenna	Channel Freq. (MHz)	modulation	conducted pow er	Tune-up pow er (dBm)	Max		Antenna		Evaluation result (mW/cm2)	Pow er density Limits (mW/cm2)
			(dBm)		tune-up power		Gain			
					(dBm)	(mW)	(dBi)	Numeric		
Ant 1	2412	802.11b	14.86	15±1	16	39.811	2.79	1.90	0.0151	1
Ant 1	2437		15.22	15±1	16	39.811	2.79	1.90	0.0151	1
Ant 1	2462		15.03	15±1	16	39.811	2.79	1.90	0.0151	1
Ant 1	2412	802.11g	12.01	12±1	13	19.953	2.79	1.90	0.0075	1
Ant 1	2437		15.24	15±1	16	39.811	2.79	1.90	0.0151	1
Ant 1	2456		12.25	12±1	13	19.953	2.79	1.90	0.0075	1
Ant 1	2412	802.11n H20	12.44	12±1	13	19.953	2.79	1.90	0.0075	1
Ant 1	2437		12.49	12±1	13	19.953	2.79	1.90	0.0075	1
Ant 1	2462		12.55	12±1	13	19.953	2.79	1.90	0.0075	1

5G WIFI:

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

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

WIFI 802.11ac (HT80):5210-5210MHz; 5775-5775MHz

Power density limited: 1mW/cm

Antenna Type: Internal antenna

Antenna 1 gain 5.2G:3.49dBi; 5.8G:1.47dBi

Antenna 2 gain 5.2G:0.93dBi; 5.8G:-0.32dBi

R=20cm

5.2G

Antenna	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)
Ant 1	5180	802.11a	16.4	16±1	17.00	50.119	3.49	2.23	0.0223	1
Ant 1	5200		16.38	16±1	17.00	50.119	3.49	2.23	0.0223	1
Ant 1	5240		16.35	16±1	17.00	50.119	3.49	2.23	0.0223	1
Ant 2	5180	802.11a	16	15±1	16.00	39.811	0.93	1.24	0.0098	1
Ant 2	5200		16	15±1	16.00	39.811	0.93	1.24	0.0098	1
Ant 2	5240		15.97	15±1	16.00	39.811	0.93	1.24	0.0098	1
Ant 1	5180	802.11n H20	13.09	13±1	14.00	25.119	3.49	2.23	0.0112	1
Ant 1	5200		12.82	12±1	13.00	19.953	3.49	2.23	0.0089	1
Ant 1	5240		12.93	12±1	13.00	19.953	3.49	2.23	0.0089	1
Ant 2	5180	802.11n H20	12.79	12±1	13.00	19.953	0.93	1.24	0.0049	1
Ant 2	5200		12.81	12±1	13.00	19.953	0.93	1.24	0.0049	1
Ant 2	5240		13.02	13±1	14.00	25.119	0.93	1.24	0.0062	1
Ant 1	5190	802.11n H40	10.44	10±1	11.00	12.589	3.49	2.23	0.0056	1
Ant 1	5230		10.37	10±1	11.00	12.589	3.49	2.23	0.0056	1
Ant 2	5190	802.11n H40	10.43	10±1	11.00	12.589	0.93	1.24	0.0031	1
Ant 2	5230		10.47	10±1	11.00	12.589	0.93	1.24	0.0031	1
Ant 1	5210	802.11ac80	4.00	3±1	4.00	2.512	3.49	2.23	0.0011	1
Ant 2	5210	802.11ac80	10.53	10±1	11.00	12.589	0.93	1.24	0.0031	1

5.8G

Antenna	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)
Ant 1	5745	802.11a	17.06	17±1	18.00	63.096	1.47	1.40	0.0176	1
Ant 1	5785		16.74	16±1	17.00	50.119	1.47	1.40	0.0140	1
Ant 1	5825		17.45	17±1	18.00	63.096	1.47	1.40	0.0176	1
Ant 2	5745	802.11a	15.53	15±1	16.00	39.811	-0.32	0.93	0.0074	1
Ant 2	5785		15.32	15±1	16.00	39.811	-0.32	0.93	0.0074	1
Ant 2	5825		16.03	16±1	17.00	50.119	-0.32	0.93	0.0093	1
Ant 1	5745	802.11n H20	13.08	13±1	14.00	25.119	1.47	1.40	0.0070	1
Ant 1	5785		12.79	12±1	13.00	19.953	1.47	1.40	0.0056	1
Ant 1	5825		13.57	13±1	14.00	25.119	1.47	1.40	0.0070	1
Ant 2	5745	802.11n H20	12.53	12±1	13.00	19.953	-0.32	0.93	0.0037	1
Ant 2	5785		12.25	12±1	13.00	19.953	-0.32	0.93	0.0037	1
Ant 2	5825		12.99	12±1	13.00	19.953	-0.32	0.93	0.0037	1
Ant 1	5755	802.11n H40	13.70	13±1	14.00	25.119	1.47	1.40	0.0070	1
Ant 1	5795		13.12	13±1	14.00	25.119	1.47	1.40	0.0070	1
Ant 2	5755	802.11n H40	12.69	8±1	9.00	7.943	-0.32	0.93	0.0015	1
Ant 2	5795		12.40	12±1	13.00	19.953	-0.32	0.93	0.0037	1
Ant 1	5775	802.11ac80	11.73	11±1	12.00	15.849	1.47	1.40	0.0044	1
Ant 2	5775	802.11ac80	11.91	11±1	12.00	15.849	-0.32	0.93	0.0029	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

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

Max. SIMULTANEOUS TRANSMISSIONS MODE

Band	Antenna	SISO					MIMO		Verdict
		tune-up power	Antenna	Separation distance (cm)	Evaluation result	Power density Limits	Evaluation result	Power density Limits	
		(dBm)	Gain		(mW/cm2)	(mW/cm2)			
			(dBi)						
BT	Ant1	11	1.71	20	0.003713	1	0.040113	1	PASS
Wi-Fi 2.4G 11b	Ant1	16	2.79	20	0.015056	1			
Wi-Fi 5G a20	Ant1	17	1.47	20	0.013987	1			
	Ant2	16	-0.32	20	0.007357	1			

Reference to power values in the report KSCR240400073801, KSCR240400073802, KSCR240400073803, KSCR240400073804.

Conclusion:

For the max result : $0.040113 \leq 1 \text{ mW/cm}^2$ for Power density, compliance with RF exposure.

Signature:

Date: 2025-01-17



NAME AND TITLE (Please print or type): alex li/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