

RF EXPOSURE EVALUATION

According to FCC 2.1091, 1.1310 and KDB 447498 D01 General RF Exposure Guidance 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)

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

BLE:

Antenna gain: 1.95dBi;
R=20cm

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	BLE 1M	4.33	4±1	5	3.162	1.95	1.57	0.0010	1
2440		4.12	4±1	5	3.162	1.95	1.57	0.0010	1
2480		2.90	2±1	3	1.995	1.95	1.57	0.0006	1
2402	BLE 2M	4.51	4±1	5	3.162	1.95	1.57	0.0010	1
2440		4.48	4±1	5	3.162	1.95	1.57	0.0010	1
2480		3.25	3±1	4	2.512	1.95	1.57	0.0008	1

2.4G WIFI

Antenna gain: 1.95dBi;
R=20cm

Antenna	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		
Ant 1	2412	802.11b	12.01	12±1	13	19.953	1.95	1.57	0.0062	1
Ant 1	2437		11.5	11±1	12	15.849	1.95	1.57	0.0049	1
Ant 1	2462		12.01	12±1	13	19.953	1.95	1.57	0.0062	1
Ant 1	2412	802.11g	12.39	12±1	13	19.953	1.95	1.57	0.0062	1
Ant 1	2437		12.74	12±1	13	19.953	1.95	1.57	0.0062	1
Ant 1	2462		12.84	12±1	13	19.953	1.95	1.57	0.0062	1
Ant 1	2412	802.11n H20	11.99	11±1	12	15.849	1.95	1.57	0.0049	1
Ant 1	2437		12.58	12±1	13	19.953	1.95	1.57	0.0062	1
Ant 1	2462		12.71	12±1	13	19.953	1.95	1.57	0.0062	1
Ant 1	2422	802.11n H40	10.75	10±1	11	12.589	1.95	1.57	0.0039	1
Ant 1	2437		9.53	9±1	10	10.000	1.95	1.57	0.0031	1
Ant 1	2452		10.61	10±1	11	12.589	1.95	1.57	0.0039	1

5G WIFI:

Antenna gain 1:2.64dBi
R=20cm

SISO-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	11.34	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5200	11.88	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5240	12.56	12±1	13.00	19.953	2.64	1.84	0.0073	1
802.11n20	Ant 1	5180	8.85	8±1	9.00	7.943	2.64	1.84	0.0029	1
	Ant 1	5200	9.63	9±1	10.00	10.000	2.64	1.84	0.0037	1
	Ant 1	5240	9.90	9±1	10.00	10.000	2.64	1.84	0.0037	1
802.11n40	Ant 1	5190	11.55	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5230	12.71	12±1	13.00	19.953	2.64	1.84	0.0073	1

SISO-5.3G

modulation	Antenna	Freq. (MHz)	(dBm)	power (dBm)	tune-up power		Gain		(mW/cm2)	(mW/cm2)
					(dBm)	(mW)	(dBi)	Numeric		
802.11a	Ant 1	5260	11.08	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5280	10.96	10±1	11.00	12.589	2.64	1.84	0.0046	1
	Ant 1	5320	11.5	11±1	12.00	15.849	2.64	1.84	0.0058	1
802.11n20	Ant 1	5260	10.99	10±1	11.00	12.589	2.64	1.84	0.0046	1
	Ant 1	5280	11.15	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5320	11.49	11±1	12.00	15.849	2.64	1.84	0.0058	1
802.11n40	Ant 1	5270	11.3	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5310	11.36	11±1	12.00	15.849	2.64	1.84	0.0058	1

SISO-5.6G

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	5500	10.39	10±1	11.00	12.589	2.64	1.84	0.0046	1
	Ant 1	5600	9.16	9±1	10.00	10.000	2.64	1.84	0.0037	1
	Ant 1	5700	9.71	9±1	10.00	10.000	2.64	1.84	0.0037	1
802.11n20	Ant 1	5500	11.66	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5600	11.20	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5700	11.83	11±1	12.00	15.849	2.64	1.84	0.0058	1
802.11n40	Ant 1	5510	11.77	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5590	11.68	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5670	11.47	11±1	12.00	15.849	2.64	1.84	0.0058	1

SISO-5.8G

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	5745	11.69	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5785	11.11	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5825	11.26	11±1	12.00	15.849	2.64	1.84	0.0058	1
802.11n20	Ant 1	5745	11.48	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5785	11.04	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5825	11.43	11±1	12.00	15.849	2.64	1.84	0.0058	1
802.11n40	Ant 1	5755	11.73	11±1	12.00	15.849	2.64	1.84	0.0058	1
	Ant 1	5795	11.51	11±1	12.00	15.849	2.64	1.84	0.0058	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

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

Note: BLE, WIFI 2.4G and WIFI 5G share the same antenna and cannot transmit simultaneously.

Conclusion: Pass

Signature:

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