

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)

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

2.4G WIFI:

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,
WIFI 802.11n HT40:2422-2452MHz
Power density limited: 1mW/ cm²

Power density limited: 1mW/cm
Antenna Type: PCB Antenna
2.4G WIFI Antenna :3.4dBi;

R=20cm
mW=10^{^(dBm/10)}

WLAN2.4G SISO Max power MODE

Antenna	Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	density
			(dBm)		tune-up power		Gain		(mW/cm2)	(mW/cm2)
					(dBm)	(mW)	(dBi)	Numeric		
Ant 1	2412	802.11b	15.56	15±1	16	39.811	3.40	2.19	0.0173	1
Ant 1	2437		15.51	15±1	16	39.811	3.40	2.19	0.0173	1
Ant 1	2462		15.06	15±1	16	39.811	3.40	2.19	0.0173	1
Ant 1	2412	802.11g	13.18	13±1	14	25.119	3.40	2.19	0.0109	1
Ant 1	2437		12.97	13±1	14	25.119	3.40	2.19	0.0109	1
Ant 1	2462		13.07	13±1	14	25.119	3.40	2.19	0.0109	1
Ant 1	2412	802.11n20	13.23	13±1	14	25.119	3.40	2.19	0.0109	1
Ant 1	2437		13.12	13±1	14	25.119	3.40	2.19	0.0109	1
Ant 1	2462		12.89	13±1	14	25.119	3.40	2.19	0.0109	1
Ant 1	2422	802.11n40	12.59	13±1	14	25.119	3.40	2.19	0.0109	1
Ant 1	2437		12.65	13±1	14	25.119	3.40	2.19	0.0109	1
Ant 1	2452		12.41	13±1	14	25.119	3.40	2.19	0.0109	1

For Lora

Antenna Type: FPC antenna
Antenna gain:1.36dBi
Operation Frequency:903-927MHz

Antenna	Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	density
			(dBm)		tune-up power		Gain		(mW/cm2)	(mW/cm2)
					(dBm)	(mW)	(dBi)	Numeric		
Ant 1	903	FSK	10.34	10±1	11	12.589	1.36	1.37	0.0034	0.602
Ant 1	915		9.93	10±1	11	12.589	1.36	1.37	0.0034	0.61
Ant 1	927		9.61	10±1	11	12.589	1.36	1.37	0.0034	0.618

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 for Lora Module + Wi-Fi Module

Band	ANT	Standalone	Standalone	Simultaneous		Verdict
		Evaluation result	Power density Limits	Evaluation Raio	Raio Limits	
		(mW/cm2)	(mW/cm2)			
Lora Module + Wi-Fi Module	Wi-Fi 2.4G	0.0173	1	0.022948	1	PASS
	Lora	0.0034	0.602			

Conclusion:

For the max result : $0.022948 \leq 1.0$, SAR is not required.

Signature:

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