

RF EXPOSURE EVALUATION

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.

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

Antenna Type: FPC antenna

Antenna gain: Ant1:1.31 dBi; Ant2:4.78dBi

R=20cm

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

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

Ant1

Antenna	Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
			(dBm)		tune-up power		Gain			
					(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)	(mW/cm2)
Ant 1	2412	802.11b	15.19	15±1	16	39.811	1.31	1.35	0.0107	1
Ant 1	2437		15.61	15±1	16	39.811	1.31	1.35	0.0107	1
Ant 1	2462		15.98	15±1	16	39.811	1.31	1.35	0.0107	1
Ant 1	2412	802.11g	15.22	15±1	16	39.811	1.31	1.35	0.0107	1
Ant 1	2437		15.53	15±1	16	39.811	1.31	1.35	0.0107	1
Ant 1	2462		15.77	15±1	16	39.811	1.31	1.35	0.0107	1
Ant 1	2412	802.11n H20	15.21	15±1	16	39.811	1.31	1.35	0.0107	1
Ant 1	2437		15.62	15±1	16	39.811	1.31	1.35	0.0107	1
Ant 1	2462		15.78	15±1	16	39.811	1.31	1.35	0.0107	1
Ant 1	2422	802.11n H40	14.13	14±1	15	31.623	1.31	1.35	0.0085	1
Ant 1	2437		14.35	14±1	15	31.623	1.31	1.35	0.0085	1
Ant 1	2452		14.58	14±1	15	31.623	1.31	1.35	0.0085	1

Ant2

Antenna	Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
			(dBm)		tune-up power		Gain			
					(dBm)	(mW)	(dBi)	Numeric		
Ant 1	2412	802.11b	14.21	13.5±1	14.5	28.184	4.78	3.01	0.0169	1
Ant 1	2437		14.24	13.5±1	14.5	28.184	4.78	3.01	0.0169	1
Ant 1	2462		13.98	13.5±1	14.5	28.184	4.78	3.01	0.0169	1
Ant 1	2412	802.11g	14.22	13.5±1	14.5	28.184	4.78	3.01	0.0169	1
Ant 1	2437		14.37	13.5±1	14.5	28.184	4.78	3.01	0.0169	1
Ant 1	2462		13.93	13.5±1	14.5	28.184	4.78	3.01	0.0169	1
Ant 1	2412	802.11n H20	14.24	13.5±1	14.5	28.184	4.78	3.01	0.0169	1
Ant 1	2437		13.95	13.5±1	14.5	28.184	4.78	3.01	0.0169	1
Ant 1	2462		14.24	13.5±1	14.5	28.184	4.78	3.01	0.0169	1
Ant 1	2422	802.11n H40	13.77	13±1	14	25.119	4.78	3.01	0.0150	1
Ant 1	2437		13.83	13±1	14	25.119	4.78	3.01	0.0150	1
Ant 1	2452		13.65	13±1	14	25.119	4.78	3.01	0.0150	1

For GSM/WCDMA/LTE
Antenna Type: FPC antenna

Operating Mode	Maximum measured Conducted Tune-up power	Maximum measured Conducted Tune-up power	Antenna gain	Evaluation result	Power density Limits
	(dBm)	(mW)	(dBi)	(mW/cm2)	(mW/cm2)
WCDMA Band IV	23	199.53	2.71	0.0741	1.0000
WCDMA Band V	24	251.19	2.20	0.0829	0.5509
WCDMA Band II	23	199.53	3.35	0.0858	1.0000
GPRS850	32	1584.89	2.20	0.5233	0.5577
EGPRS850	27.5	562.34	2.20	0.1857	0.5577
GPRS1900	30	1000.00	3.35	0.4302	1.0000
EGPRS1900	26.5	446.68	3.35	0.1922	1.0000
LTE Band II	23.5	223.87	3.35	0.0963	1.0000
LTE Band IV	23	199.53	2.71	0.0741	1.0000
LTE Band V	23.5	223.87	2.20	0.0739	0.5627
LTE Band VII	23.5	223.87	4.31	0.1201	1.0000
LTE Band XII	23	199.53	3.00	0.0792	0.4717
LTE Band XIII	21	125.89	3.20	0.0523	0.5213
LTE Band XXV	23.5	223.87	3.35	0.0963	1.0000
LTE Band XXVI a	24	251.19	2.20	0.0829	0.5431
LTE Band XXVI b	24	251.19	2.20	0.0829	0.5498
LTE Band XXXVIII	23.5	223.87	3.73	0.1051	1.0000
LTE Band XL a	23.5	223.87	3.75	0.1056	1.0000
LTE Band XL b	23.5	223.87	3.75	0.1056	1.0000
LTE Band XLI	23.5	223.87	4.24	0.1182	1.0000

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 LTE Module + Wi-Fi Module

Band	Mode	Max Conducted Tune-up power (dBm)	Max Conducted Tune-up power(mW)	Antenna gain	Standalone	Standalone	Simultz
					Evaluation result	Power density	Evaluation result
				dBi	(mW/cm2)	(mW/cm2)	(mW/cm2)
GPRS850 + 2.4G Wi-Fi	WIFI	14.5	28.18	4.78	0.0169	1	0.9551
	GPRS850	32	1584.89	2.20	0.5233	0.5577	

Signature: 

Date: 2024-12-25

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