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 (V/m) = $\frac{\sqrt{30 * P * G}}{d}$ Power Density: *Pd* (W/m²) = $\frac{E^2}{377}$

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/ cm^2

Power density limited: 1mW/cm
Antenna Type: Antenna 1: External Antenna
Antenna 2: External Antenna
2.4G WIFI Antenna 1:4.03dBi; Antenna 2:4.03dBi

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

WLAN2.4G SISO Max power MODE

Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Conclusion
Ant 1	18.23	4.03	22.26	168.27	20	0.033475	1	Pass
Ant 2	18.63	4.03	22.66	184.50	20	0.036705	1	

For WCDMA/LTE
Antenna Type: FPC antenna

Operating Mode	Maximum measured EIRP(ERP)	Maximum measured EIRP(ERP)	Evaluation result	Power density Limits
	(dBm)	(mW)	(mW/cm2)	(mW/cm2)
WCDMA Band II	20.16	103.75	0.0206	1.0000
WCDMA Band V	21.52	141.91	0.0282	0.5509
LTE Band 2	22.63	183.23	0.0365	1.0000
LTE Band 4	22.11	162.55	0.0323	1.0000
LTE Band 5	22.35	171.79	0.0342	0.5498
LTE Band 7	22.14	163.68	0.0326	1.0000
LTE Band 12	24.13	258.82	0.0515	0.4465
LTE Band 13	22.16	164.44	0.0327	0.5197
LTE Band 17	22.99	199.07	0.0396	0.4710
LTE Band 38	24.97	314.05	0.0625	1.0000
LTE Band Band 40 (2305-2315)	23.81	240.44	0.0478	0.5431
LTE Band Band 40(2350-2360)	22.74	187.93	0.0374	0.5498

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

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

WLAN2.4G MIMO Max power MODE

Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Calculation result	Conclusion
Ant 1	13.93	4.03	17.96	62.52	20	0.012437	1	0.024152	Pass
Ant 2	13.67	4.03	17.7	58.88	20	0.011714	1		

Max. SIMULTANEOUS TRANSMISSIONS for LTE Module + Wi-Fi Module

Band	ANT	EIRP (mW)	EIRP (mW)	Standalone	Standalone	Simultaneous		Verdict
				Evaluation result	Power density	Evaluation result	Power density	
				(mW/cm2)	(mW/cm2)	(mW/cm2)	(mW/cm2)	
LTE Module + Wi-Fi Module	Wi-Fi 2.4G Ant 2	22.66	184.5	0.036705	1	0.131530	1	PASS
	LTE Band 12	24.13	258.82	0.05149	0.543			

Signature: **Date:** 2024-08-05

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