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/5G WIFI:
Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,
WIFI 802.11n HT40:2422-2452MHz
Power density limited: 1mW/ cm^2

Operation Frequency:
WIFI 802.11a/ac/n(HT20): 5180-5240MHz; 5745-5825MHz;
WIFI 802.11ac/n(HT40): 5190-5230MHz; 5755-5795MHz;
WIFI 802.11ac80:5210-5210MHz; 5775-5775MHz

Power density limited: 1mW/cm
Antenna Type: External antenna
2.4G WIFI antenna1/2 gain: 5 dBi
5G WIFI antenna1/2 gain: 5 dBi

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

WLAN2.4G SISO MODE

Band	Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Conclusion
n20	Ant 1	12.29	5	17.29	53.58	20	0.0107	1	Pass
n20	Ant 2	13.06	5	18.06	63.97	20	0.0127	1	

WLAN5.2G SISO MODE

Band	Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Conclusion
ac40	Ant 1	9.78	5	14.78	30.06	20	0.0060	1	Pass
ac40	Ant 2	8.79	5	13.79	23.93	20	0.0048	1	

WLAN5.8G SISO MODE

Band	Antenna	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm2)	MPE Limit (mW/cm2)	Conclusion
HT20	Ant 1	9.16	5	14.16	26.06	20	0.0052	1	Pass
HT20	Ant 2	8.57	5	13.57	22.75	20	0.0045	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 for 2.4G Module + 5G Module

Band	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm2)	Calculation result	Conclusion
WIFI 2.4G	12.29	5	17.29	53.58	20	0.0107	1	0.034	Pass
	13.06	5	18.06	63.97	20	0.0127	1		
WIFI 5G	9.78	5	14.78	30.06	20	0.0060	1		
	8.79	5	13.79	23.93	20	0.0048	1		

Band	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm2)	Calculation result	Conclusion
WIFI 2.4G	15.7	8.01	23.71	234.96	20	0.0467	1	0.068	Pass
WIFI 5G	12.32	8.01	20.33	107.89	20	0.0215	1		

Conclusion:

The conclusion for MIMO mode should be 0.068＜1 for Max Power Density, Compliance the

Signature: **Date:** 2022-11-29

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