

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

Operation Frequency: 2402MHz-2480MHz; 5180MHz-5240MHz; 5745MHz-5825MHz;
 Antenna Type: External Antenna
 Antenna gain: 5dBi
 R=20cm

Max. SISO MPE for Wi-Fi 1 Module

Band	Max EIRP	Antenna	Separation distance (cm)	Evaluation result	Power density	Verdict
	(dBm)	Gain (dBi)		(mW/cm ²)	(mW/cm ²)	
Wi-Fi 2.4G	14.49	5	20	0.01769	1	PASS
Wi-Fi 5.2G	9.81	5	20	0.006022	1	PASS
Wi-Fi 5.8G	10.76	5	20	0.007494	1	PASS

Max. SISO MPE for Wi-Fi 2 Module

Band	Max EIRP	Antenna	Separation distance (cm)	Evaluation result	Power density	Verdict
	(dBm)	Gain (dBi)		(mW/cm ²)	(mW/cm ²)	
Wi-Fi 5.2G	6.29	5	20	0.002677	1	PASS
Wi-Fi 5.8G	11.05	5	20	0.008012	1	PASS

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. MIMO MPE for Wi-Fi 1 Module

Band	ANT	SISO					MIMO		Verdict
		Max EIRP	Antenna	Separation distance (cm)	Evaluation result	Power density	Evaluation result	Power density	
		(dBm)	Gain (dBi)		(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	
Wi-Fi 2.4G	Ant 1	12.74	5	20	0.011823	1	0.023646	1	PASS
	Ant 2	12.74	5	20	0.011823	1			
Wi-Fi 5.2G	Ant 1	9.38	5	20	0.005454	1	0.011325	1	PASS
	Ant 2	9.7	5	20	0.005871	1			
Wi-Fi 5.8G	Ant 1	10.63	5	20	0.007273	1	0.013393	1	PASS
	Ant 2	9.88	5	20	0.00612	1			

Max. MIMO MPE for Wi-Fi 2 Module

Band	ANT	SISO					MIMO		Verdict
		Max EIRP	Antenna	Separation distance (cm)	Evaluation result	Power density	Evaluation result	Power density	
		(dBm)	Gain (dBi)		(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	
Wi-Fi 5.2G	Ant 1	6.28	5	20	0.000845	1	0.002537	1	PASS
	Ant 2	6.28	5	20	0.000845	1			
	Ant 3	6.29	5	20	0.000847	1			
Wi-Fi 5.8G	Ant 1	10.54	5	20	0.002253	1	0.006998	1	PASS
	Ant 2	10.97	5	20	0.002487	1			
	Ant 3	10.55	5	20	0.002258	1			

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

Band	ANT	Standalone					Simultaneous		Verdict
		Max EIRP	Antenna	Separation distance (cm)	Evaluation result	Power density	Evaluation result	Power density	
		(dBm)	Gain (dBi)		(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	
LTE Module + Wi-Fi 1 Module	Wi-Fi 2.4G Ant 1	12.74	5	20	0.011823	1	0.434720	1	PASS
	Wi-Fi 2.4G Ant 2	12.74	5	20	0.011823	1			
	LTE Band 26 Ant	30.5	5	20	0.223213	0.543			
LTE Module + Wi-Fi 2 Module	Wi-Fi 5.8G Ant	11.05	5	20	0.008012	1	0.419086	1	PASS
	LTE Band 26 Ant	30.5	5	20	0.223213	0.543			

Note: 1. LTE Band 26 Test data reference to IC: 10224A-201901EM12G.

2. NO simultaneous transmissions are possible for this device of LTE1 Module + LTE2 Module.

3. NO simultaneous transmissions are possible for this device of Wi-Fi 5G + Wi-Fi 2.4G.

4. NO simultaneous transmissions are possible for this device of Wi-Fi 1 Module + Wi-Fi 2 Module.

Signature:

Date: 2020-12-30



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