

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

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

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

BT:

Operation Frequency: 2402MHz~2480MHz

Power density limited: 1mW/ cm²

Antenna Type: stamped metal Antenna

BT antenna gain: 1.43 dBi ;

R=20cm

mW=10^(dBm/10)

Mode	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
BDR EDR	4.4	1.43	5.83	3.83	20	0.00076	1	Pass
BLE	0.79	1.43	2.22	1.67	20	0.00021	1	Pass
Matter	6.24	1.43	7.67	5.85	20	0.00073	1	Pass

2.4G/5G WIFI:

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,

WIFI 802.11n HT40:2422-2452MHz

Power density limited: 1mW/ cm²

Operation Frequency:

WIFI 802.11a/ac/n(HT20): 5180-5320MHz; 5500MHz~5700MHz; 5745-5825MHz;

WIFI 802.11ac/n(HT40): 5190-5310MHz; 5510MHz~5670MHz ; 5755-5795MHz;

WIFI 802.11ac80:5210-5290MHz; 5530MHz~5610MHz 5775-5775MHz

Power density limited: 1mW/cm

Antenna Type: stamped metal Antenna

2.4G WIFI antenna gain: 1.43 dBi

5G WIFI antenna gain: 3.59 dBi

R=20cm

mW=10^(dBm/10)

WLAN2.4G MODE

Mode	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
2.4G	16.71	3.59	20.3	107.15	20	0.0213	1	Pass

WLAN5G MODE

Mode	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
5.2G	13.43	3.59	17.02	50.35	20	0.0100	1	Pass
5.3G	13.31	3.59	16.9	48.98	20	0.0097	1	
5.6G	13.49	3.59	17.08	51.05	20	0.0102	1	
5.8G	12.89	3.59	16.48	44.46	20	0.0088	1	

Z-wave

Antenna Type: stamped metal Antenna

antenna gain: -0.9 dBi

Transmit power

Frequency (MHz)	Max Output power (dBuV/m)	EIRP power (dBm)
908.40	91.9	-3.36
908.42	92.2	-3.06
912.00	91.8	-3.46
916.00	91.6	-3.66

$$EIRP=E-104.8+20\log(D)$$

Maximum Permissible Exposure:

Channel Freq. (MHz)	modulation	EIRP power (dBm)	EIRP power (mW)	Tune-up power (dBm)	Max tune-up power (dBm)	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
908.40	GFSK	-3.36	0.461	-4±1	-3	0.00009	0.606
908.42		-3.06	0.494	-4±1	-3	0.00010	0.606
912.00		-3.46	0.451	-4±1	-3	0.00009	0.608
916.00		-3.66	0.431	-4±1	-3	0.00009	0.611

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 + WIFI&BT Module+Z-wave

Band	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Calculation result	Conclusion
LTE						0.141	0.47	0.3221950	Pass
WIFI 2.4	16.71	3.59	20.3	107.15	20	0.0213	1		
Matter	6.24	1.43	7.67	5.85	20	0.00073	1		
Z-wave	-2.16	-0.9	-3.06	0.494	20	0.0001	0.606		

Note:

1. LTE Test data reference to FCC ID: XMR201807EG91NA.
2. NO simultaneous transmissions are possible for this device of BT+WIFI2.4G/5G

Signature:

Date: 2023-07-29



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