

FCC ID:2ATW5-R3

Maximum Permissible Exposure (MPE)

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

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

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.

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Measurement Result

Operation Frequency: 2402MHz~2480MHz

Power density limited: 1mW/ cm²

Antenna Type: PCB Antenna

Antenna gain:-3.2 dBi

R=20cm

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

antenna gain Numeric=10^{^(dBi/10)}= 10^{^(-3.2/10)}=0.48

Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density Limits
		(dBm)		tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)	(mW/cm2)
2402	GFSK(1M)	-1.11	-1±1	0	1.000	-3.2	0.48	0.0001	1
2440		-0.98	-1±1	0	1.000	-3.2	0.48	0.0001	1
2480		-0.95	-1±1	0	1.000	-3.2	0.48	0.0001	1

GSM/LTE

GSM850: TX824.2MHz~848.8MHz /RX869.2MHz~893.8MHz;

PCS1900: TX1850.2MHz~1909.8MHz /RX1930.2MHz~1989.8MHz;

LTE FDD Band 2 Uplink: 1850MHz-1910MHz, Downlink: 1930MHz-1990MHz;

LTE FDD Band 4 Uplink: 1710MHz-1755MHz, Downlink: 2110MHz-2155MHz;

LTE FDD Band 5 Uplink: 824MHz-849MHz, Downlink: 869MHz-894MHz;

Antenna Type: FPC Antenna

Antenna gain: GSM 850:2.78dBi, GSM 1900:-0.85dBi

Band 2: -0.85 dBi; Band 4: 0.95 dBi; Band 5: 2.78 dBi

Maximum Permissible Exposure:

Channel Freq. (MHz)	mode	EIRP power (dBm)	EIRP power (mW)	Tune-up power (dBm)	Max tune-up power (dBm)	Evaluation result (mW/cm ²)	Power density Limits mW/cm ²)
824.2	GSM 850	30.12	1028.016	31±1	32	0.2045	0.5495
1880	GSM 1900	28.23	665.273	29±1	30	0.1323	1.0000
1880	LTE B2	22.81	190.985	23±1	24	0.0380	1.0000
1745	LTE B4	22.96	197.6970	23±1	24	0.03933	1.0000
836.5	LTE B5	22.96	197.697	23±1	24	0.03933	0.5577

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

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

Worst case is Simultaneous Transmissions for GSM + WIFI2.4G

Band	Mode	Tune up (dBm)	Tune up (mW)	Standalone	Standalone	Simultaneous		Verdict
				Evaluation result	Power density Limits	Evaluation result	Limit	
				(mW/cm2)	(mW/cm2)	raio		
BLE+GSM	GSM	32	1584.89	0.2045	0.5495	0.3723	1	PASS
	2.4G WIFI	0	1.00	0.0001	1			



Signature:

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