

FCC ID: WA5WS6210

Maximum Permissible Exposure (MPE)

According to KDB 447498 D01 General RF Exposure Guidance v06 & 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

2.4G WIFI:

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,
WIFI 802.11n HT40:2422-2452MHz
Power density limited: 1mW/ cm²

Antenna Type: PCB antenna

WIFI antenna gain: 3.37dBi;

R=20cm

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

antenna gain Numeric= $10^{(dBi/10)}=10^{(3.37/10)}=2.17$

Channel Freq. (MHz)	modulation	conducted power	Tune-up power	Max		Antenna	Evaluation result at 20cm	Power density Limits
		(dBm)	(dBm)	tune-up power		Gain	Power density(mW/cm2)	(mW/cm2)
				(dBm)	(mW)	Numeric		
2412	802.11b	9.25	9±1	10	10.00	2.17	0.00432	1
2437		9.06	9±1	10	10.00	2.17	0.00432	1
2462		8.95	9±1	10	10.00	2.17	0.00432	1
2412	802.11g	9.21	9±1	10	10.00	2.17	0.00432	1
2437		9.09	9±1	10	10.00	2.17	0.00432	1
2462		8.84	9±1	10	10.00	2.17	0.00432	1
2412	802.11n H20	9.11	9±1	10	10.00	2.17	0.00432	1
2437		9.29	9±1	10	10.00	2.17	0.00432	1
2462		8.07	9±1	10	10.00	2.17	0.00432	1
2422	802.11n H40	8.93	8±1	9	7.94	2.17	0.00343	1
2437		8.68	8±1	9	7.94	2.17	0.00343	1
2452		8.93	8±1	9	7.94	2.17	0.00343	1

Operation Frequency: 915MHz

Antenna Type: Spring antenna

Antenna gain: -2.1dBi,

R=20cm

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

Transmit power

Frequency (MHz)	EIRP power (dBuV/m)	EIRP power (dBm)	EIRP power (mW)
915	90.92	-4.34	0.3683

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

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)
915	FSK	-4.34	0.3683	-4±1	-3	0.000061	0.61

LTE

Operating Mode	Max power	Antenna		Maximum measured EIRP(ERP)	Evaluation result	Power density Limits
	(dBm)	Gain		(mW)	(mW/cm2)	(mW/cm2)
		(dBi)	Numeric			
LTE Band 2	25	0.7	1.17	316.228	0.0739	1.00
LTE Band 4	25	-0.4	0.91	316.228	0.0574	1.00
LTE Band 5	25	-3.2	0.48	316.228	0.0301	0.55
LTE Band 7	25	1.2	1.32	316.228	0.0829	1.00
LTE Band 12	25	-6.1	0.25	316.228	0.0154	0.47
LTE Band 13	25	-6.1	0.25	316.228	0.0154	0.52
LTE Band 25	25	0.7	1.17	316.228	0.0739	1.00
LTE Band 26A	25	-3.2	0.48	316.228	0.0301	0.54
LTE Band 26B	25	-3.2	0.48	316.228	0.0301	0.55
LTE Band 38	25	1.2	1.32	316.228	0.0829	1.00
LTE Band 41	25	1.2	1.32	316.228	0.0829	1.00
LTE Band 66	25	0	1.00	316.228	0.0629	1.00

Note:

LTE Test data reference to FCC ID: XMR2023EG916QGL

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 E², H² (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 WIFI2.4G + 915MHz+LTE

Mode	Evaluation result (mW/cm2)	Limits (mW/cm2)	Calculation result
WIFI2.4G	0.00432	1	0.08732
915MHz	0.000061	0.61	
LTE	0.0829	1	

Conclusion:

For the max result : 0.08732≤1 for Max Power Density, compliance RF exposure.

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