

FCC ID: 2ALUW-F3836

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.

Measurement Result

WIFI:

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,
802.11 HT40: 2422-2452MHz;

Power density limited: 1mW/ cm²

Antenna Type: External Antenna;

WIFI antenna gain: 5dBi;

R=20cm

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

antenna gain Numeric=10^{^(dBi/10)}= 10^{^(1/10)}=3.16

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/cm ²)	(mW/cm ²)
				(dBm)	(mW)	Numeric		
2412	802.11b	10.4	11±1	12	15.84893	3.16	0.00996	1
2437		10.8	11±1	12	15.84893	3.16	0.00996	1
2462		11.4	11±1	12	15.84893	3.16	0.00996	1
2412	802.11g	8.1	9±1	10	10	3.16	0.00629	1
2437		10.7	11±1	12	15.84893	3.16	0.00996	1
2462		11.2	11±1	12	15.84893	3.16	0.00996	1
2412	802.11n H20	8.2	9±1	10	10	3.16	0.00629	1
2437		10.6	11±1	12	15.84893	3.16	0.00996	1
2462		11.2	11±1	12	15.84893	3.16	0.00996	1
2422	802.11n H40	9.5	10±1	11	12.58925	3.16	0.00791	1
2437		9.8	10±1	11	12.58925	3.16	0.00791	1
2452		10.1	10±1	11	12.58925	3.16	0.00791	1

WCDMA/LTE:

Antenna Type: External Antenna;

WIFI antenna gain: 5dBi;

Operating Mode	TX Freq Range		Maximum Burst-Average Output Power	Max Time-Avg Cond Power (W)	Antenna Gain	Antenna Gain	Evaluation result	Power density Limits
	(MHz)		(dBm)	(mW)	(dBi)	Numeric	(mW/cm ²)	(mW/cm ²)
WCDMA Band II LTE Band 2	1850	1910	24	251.189	5	3.16	0.15802	1
WCDMA Band IV LTE Band 4	1710	1755	24	251.189	5	3.16	0.15802	1
WCDMA Band V LTE Band 5	824	849	24	251.189	5	3.16	0.15802	0.56
LTE Band 7	2500	2570	23	199.526	5	3.16	0.12552	1
LTE Band 12	699	716	24	251.189	5	3.16	0.15802	0.47
LTE Band 13	777	787	24	251.189	5	3.16	0.15802	0.52
LTE Band 25	1850	1915	24	251.189	5	3.16	0.15802	1
LTE Band 26	814	849	24	251.189	5	3.16	0.15802	0.55
LTE Band 30	2305	2315	23	199.526	5	3.16	0.12552	1
LTE Band 41	2496	2690	23	199.526	5	3.16	0.12552	1

Synchronous transmission:

According KDB 447498 D01, simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0 .

The evaluation here considers a LTE/WCDMA transmitter & a WIFI transmitter. The MPE ratio is defined by the ratio of power density to MPE limit. The sum of the MPE ratios is calculated as follows:

$$\Sigma MPE \text{ Ratio} = \text{Max (LTE/WCDMA MPE ratio)} + \text{Max (WIFI MPE ratio)}$$

The result below:

Operating Mode	TX Freq Range		Maximum Burst-Average Output Power	Max Time-Avg Cond Power (W)	Antenna Gain	Antenna Gain	Evaluation result	Power density Limits
	(MHz)		(dBm)	(mW)	(dBi)	Numeric	(mW/cm ²)	(mW/cm ²)
WCDMA Band II LTE Band 2	1850	1910	24	251.189	5	3.16	0.15802	1
WCDMA Band IV LTE Band 4	1710	1755	24	251.189	5	3.16	0.15802	1
WCDMA Band V LTE Band 5	824	849	24	251.189	5	3.16	0.15802	0.56
LTE Band 7	2500	2570	23	199.526	5	3.16	0.12552	1
LTE Band 12	699	716	24	251.189	5	3.16	0.15802	0.47
LTE Band 13	777	787	24	251.189	5	3.16	0.15802	0.52
LTE Band 25	1850	1915	24	251.189	5	3.16	0.15802	1
LTE Band 26	814	849	24	251.189	5	3.16	0.15802	0.55
LTE Band 30	2305	2315	23	199.526	5	3.16	0.12552	1
LTE Band 41	2496	2690	23	199.526	5	3.16	0.12552	1
802.11b	2412	2462	12	15.849	5	3.16	0.00996	1
802.11g	2412	2462	12	15.849	5	3.16	0.00996	1
802.11n20	2412	2462	12	15.849	5	3.16	0.00996	1
802.11n40	2422	2452	11	12.589	5	3.16	0.00791	1

Conclusion:

For the max result : $0.00996+0.15802=0.16798 \leq 1.0$ for Max Power Density, No SAR is required.

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Signature:

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