

FCC §1.1310 & §2.1091 - MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart §2.1091 and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

Limits for Occupational/Controlled Exposure				
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E , H or S (minutes)
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
300-1500	/	/	f/300	6
1500-100,000	/	/	5	6

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
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
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculated Formulary

Predication of MPE limit at a given distance

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Calculated Data:**General Population/Uncontrolled**

Mode	Frequency Range (MHz)	Antenna Gain		★Tune-up Output Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)	MPE ratio
		(dBi)	(numeric)	(dBm)	(mW)				
Classic BT	2402-2480	0.1	1.02	-1.5	0.71	20	0.0001	1.0	0.0001
2.4G Wi-Fi	2412-2462	1.34	1.36	10.5	11.22	20	0.0030	1.0	0.0030
GSM 850	824-849	-6.24	0.24	25.81	381.07	20	0.0182	0.55	0.0331
PCS 900	1850-1910	-2.95	0.51	22.81	190.99	20	0.0194	1.0	0.0194
WCDMA band 2	1850-1910	-2.95	0.51	25.00	316.23	20	0.0321	1.0	0.0321
WCDMA band 4	1710-1755	-5.48	0.28	25.00	316.23	20	0.0176	1.0	0.0176
WCDMA band 5	824-849	-6.24	0.24	25.00	316.23	20	0.0150	0.55	0.0273
LTE Band 2	1850-1910	-2.95	0.51	25.00	316.23	20	0.0321	1.0	0.0321
LTE Band 4	1710-1755	-5.48	0.28	25.00	316.23	20	0.0176	1.0	0.0176
LTE Band 5	824-849	-6.24	0.24	25.00	316.23	20	0.0150	0.55	0.0273
LTE Band 7	2500-2570	-4.89	0.32	25.00	316.23	20	0.0201	1.0	0.0201
LTE Band 12	699-716	-15.37	0.03	25.00	316.23	20	0.0018	0.47	0.0038
LTE Band 13	777-787	-10.27	0.09	25.00	316.23	20	0.0059	0.52	0.0113
LTE Band 25	1850-1915	-2.95	0.51	25.00	316.23	20	0.0321	1.0	0.0321
LTE Band 26	814-849	-6.24	0.24	25.00	316.23	20	0.0150	0.54	0.028
LTE Band 38	2570-2620	-6.40	0.23	25.00	316.23	20	0.0145	1.0	0.0145
LTE Band 41	2496-2690	-2.62	0.55	25.00	316.23	20	0.0346	1.0	0.0346

Occupational/Controlled

Mode	Frequency Range (MHz)	Antenna Gain		★Tune-up Output Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)	MPE ratio
		(dBi)	(numeric)	(dBm)	(mW)				
UHF	410-470	-3.33	0.46	30.5	1122.02	20	0.1027	1.3667	0.0751

Note:

1. For the above tune up power were declared by the manufacturer.
2. The WWAN module FCC ID: XMR201903EG25G (Grant on: 03/29/2019).
3. 2.4G Wi-Fi/BT, WWAN and UHF can transmit simultaneously; the worst condition as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0030 + 0.0346 + 0.0751 = 0.1127 < 1.0$$

Result: The device meet FCC MPE at 20 cm distance.