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

(B) 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/cm^2);
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);

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

Calculation 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)				
2.4G Wi-Fi	2412-2462	-0.26	0.94	19.0	79.43	20	0.0149	1.00	0.0149
BLE	2402-2480	4.41	2.76	3.0	2.00	20	0.0011	1.00	0.0011
BT	2402-2480	4.41	2.76	2.5	1.78	20	0.0010	1.00	0.0010
5G Wi-Fi	5150-5250	2.18	1.65	13.5	22.39	20	0.0073	1.00	0.0073
	5725-5850	-1.37	0.73	11.0	12.59	20	0.0018	1.00	0.0018
GSM 850	824-849	-0.14	0.97	25.81	381.07	20	0.0734	0.55	0.1336
PCS 1900	1850-1910	1.62	1.45	22.81	190.99	20	0.0551	1.0	0.0551
WCDMA Band 2	1850-1910	1.62	1.45	25.00	316.23	20	0.0912	1.0	0.0912
WCDMA Band 4	1710-1755	0.32	1.08	25.00	316.23	20	0.0679	1.0	0.0679
WCDMA Band 5	824-849	-0.14	0.97	25.00	316.23	20	0.0609	0.55	0.1109
LTE Band 2	1850-1910	1.62	1.45	25.00	316.23	20	0.0912	1.0	0.0912
LTE Band 4	1710-1755	0.32	1.08	25.00	316.23	20	0.0679	1.0	0.0679
LTE Band 5	824-849	-0.14	0.97	25.00	316.23	20	0.0609	0.55	0.1109
LTE Band 7	2500-2570	3.78	2.39	25.00	316.23	20	0.1503	1.0	0.1503
LTE Band 12	699-716	-0.14	0.97	25.00	316.23	20	0.0609	0.47	0.1307
LTE Band 13	777-787	-0.14	0.97	25.00	316.23	20	0.0609	0.52	0.1176
LTE Band 25	1850-1915	1.62	1.45	25.00	316.23	20	0.0912	1.0	0.0912
LTE Band 26	814-849	-0.14	0.97	25.00	316.23	20	0.0609	0.54	0.1122
LTE Band 38	2570-2620	3.78	2.39	25.00	316.23	20	0.1503	1.0	0.1503
LTE Band 41	2496-2690	3.78	2.39	25.00	316.23	20	0.1503	1.0	0.1503

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	2.0	1.58	33.5	2238.72	20	0.7058	1.3667	0.5164

Note:

1. The target output powers are all declared by the Manufacturer.
2. The WWAN module FCC ID: XMR201903EG25G (Grant on: 03/29/2019).
3. Wi-Fi, BLE/BT, WWAN and UHF can transmit simultaneously, the worst condition is as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0149+0.0011+0.1503+0.5164=0.6827 < 1.0$$

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