

FCC §15.247 (i) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

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

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = 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)

For simultaneously transmit system, the calculated power density should comply with:

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

Mode	Frequency (MHz)	Antenna Gain		Max Tune Up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2402-2480	2.0	1.58	1.0	1.26	20	0.0004	1.0
GSM850	824-849	-1.1	0.78	23.31	214.29	20	0.0333	0.55
GSM1900	1850-1910	-1.53	0.70	20.81	120.50	20	0.0168	1.0
LTE NB1 Band 2	1850-1910	-1.53	0.70	21.0	125.89	20	0.0175	1.0
LTE NB1 Band 4	1710-1755	-2.62	0.55	21.0	125.89	20	0.0138	1.0
LTE NB1 Band 5	824-849	-1.1	0.78	21.0	125.89	20	0.0195	0.55
LTE NB1 Band 12	699-716	-4.1	0.39	21.0	125.89	20	0.0098	0.466
LTE NB1 Band 13	777-787	-4.1	0.39	21.0	125.89	20	0.0098	0.518
LTE NB1 Band 25	1850-1915	-1.53	0.70	21.0	125.89	20	0.0175	1.0
LTE NB1 Band 26 (Part 90)	814-823.9	-1.1	0.78	21.0	125.89	20	0.0195	0.543
LTE NB1 Band 26 (Part 22H)	824-849	-1.1	0.78	21.0	125.89	20	0.0195	0.55
LTE NB1 Band 66	1710-1780	-2.62	0.55	21.0	125.89	20	0.0138	1.0
LTE NB1 Band 71	663-698	-4.1	0.39	21.0	125.89	20	0.0098	0.442
LTE NB1 Band 85	698-716	-4.1	0.39	21.0	125.89	20	0.0098	0.465
LTE CatM1 Band 2	1850-1910	-1.53	0.70	22.0	158.49	20	0.0221	1.0
LTE CatM1 Band 4	1710-1755	-2.62	0.55	22.0	158.49	20	0.0173	1.0
LTE CatM1 Band 5	824-849	-1.1	0.78	22.0	158.49	20	0.0246	0.55
LTE CATM1 Band 12	699-716	-4.1	0.39	22.0	158.49	20	0.0123	0.466
LTE CATM1 Band 13	777-787	-4.1	0.39	22.0	158.49	20	0.0123	0.518
LTE CATM1 Band 14	788-798	-4.1	0.39	22.0	158.49	20	0.0123	0.525
LTE CATM1 Band 25	1850-1915	-1.53	0.70	22.0	158.49	20	0.0221	1.0
LTE CATM1 Band 26 (Part 90)	814-824	-1.1	0.78	22.0	158.49	20	0.0246	0.543
LTE CATM1 Band 26 (Part 22H)	824-849	-1.1	0.78	22.0	158.49	20	0.0246	0.55
LTE CATM1 Band 66	1710-1780	-2.62	0.55	22.0	158.49	20	0.0173	1.0
LTE CATM1 Band 85	698-716	-4.1	0.39	22.0	158.49	20	0.0123	0.465

- Note: 1. The antenna gain was provided by the applicant.
 2. The BLE function can transmit at the same time with the GSM/NB-IoT/eMTC.
 3. Please refer to the MPE report of the FCC ID: ZMOMA510GL grant on 2019-11-07 for the GSM/LTE output power.

So the worst simultaneous transmitting consideration:

$$\text{The ratio} = \text{MPE}_{\text{BLE}}/\text{limit} + \text{MPE}_{\text{wwan}}/\text{limit} = 0.0004/1.0 + 0.0333/0.55 = 0.061 < 1.0$$

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliance