

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	1.11	1.29	1.5	1.41	20	0.0004	1.0
GSM850	824-849	-0.45	0.90	23.97	249.46	20	0.045	0.55
GSM1900	1850-1910	0.87	1.22	20.97	125.03	20	0.030	1.0
eMTC Band 2	1850-1910	0.87	1.22	24.0	251.19	20	0.061	1.0
eMTC Band 4	1710-1755	0.87	1.22	23.0	199.53	20	0.048	1.0
eMTC Band 5	824-849	-0.45	0.90	24.0	251.19	20	0.045	0.55
eMTC Band 12	699-716	-0.45	0.90	24.0	251.19	20	0.045	0.466
eMTC Band 13	777-787	-0.45	0.90	24.0	251.19	20	0.045	0.518
eMTC Band 26	814-824	-0.45	0.90	24.0	251.19	20	0.045	0.54
NB-IoT Band 2	1850-1910	0.87	1.22	25.0	316.23	20	0.077	1.0
NB-IoT Band 4	1710-1755	0.87	1.22	25.0	316.23	20	0.077	1.0
NB-IoT Band 5	824-849	-0.45	0.90	25.0	316.23	20	0.057	0.55
NB-IoT Band 12	699-716	-0.45	0.90	25.0	316.23	20	0.057	0.466
NB-IoT Band 13	777-787	-0.45	0.90	25.0	316.23	20	0.057	0.518

Note: 1. The tune up conducted power was declared 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: XMR201707BG96 for the GSM/NB-IoT/eMTC output power.

So the worst simultaneous transmitting consideration:

$$\text{The ratio} = \text{MPE}_{\text{BLE}}/\text{limit} + \text{MPE}_{\text{NB-IoT}}/\text{limit} = 0.0004/1.0 + 0.057/0.466 \\ = 0.1227 < 1.0$$

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

Result: Compliance