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

Applicable Standard

According to subpart 15.247 (i) and subpart 1.1310, 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				
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

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);

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

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

Calculated Data (worst case):

Mode	Frequency Range (MHz)	Maximum Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2402-2480	2.10	1.62	0.10	1.02	20	**0.0003**	**1.000**

Mode	Band	Frequency Range (MHz)	Maximum Antenna Gain		Tune-up Maximum Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
			(dBi)	(numeric)	(dBm)	(mW)			
GPRS/EGPRS 850		824-849	-2.34	0.58	27.50	562.34	20	**0.0653**	**0.549**
GPRS/EGPRS 1900		1850-1910	0.83	1.21	26.50	446.68	20	0.1076	1.000
eMTC	2	1850-1910	0.83	1.21	24.00	251.19	20	0.0605	1.000
	4	1710-1755	1.15	1.30	23.00	199.53	20	0.0517	1.000
	5	824-849	-2.34	0.58	24.00	251.19	20	0.0292	0.549
	12	699-716	-2.98	0.50	24.00	251.19	20	0.0252	0.466
	13	777-787	-3.06	0.49	24.00	251.19	20	0.0247	0.518
	26	814-849	-2.34	0.58	24.00	251.19	20	0.0292	0.543
NB-IoT	2	1850-1910	0.83	1.21	25.00	316.23	20	0.0762	1.000
	4	1710-1755	1.15	1.30	25.00	316.23	20	0.0820	1.000
	5	824-849	-2.34	0.58	25.00	316.23	20	0.0367	0.549
	12	699-716	-2.98	0.50	25.00	316.23	20	0.0317	0.466
	13	777-787	-3.06	0.49	25.00	316.23	20	0.0311	0.518

Note:
(1) The target output powers are all declared by the Manufacturer.
(2) The LTE module FCC ID: XMR201707BG96 (Grant on: 09/08/2020)
(3) BLE & GSM /LTE can transmit simultaneously; the worst condition as below:

$$\sum_i \frac{S_i}{S_{Limit,i}}$$ =0.0003/1.000+0.0653/0.549=0.1192< 1.0

(4) For GPRS/EGPRS Mode, the time based average power is relevant, the difference in between depends on the duty cycle of the TDMA signal.

Number of Time slot	1	2	3	4
Duty Cycle	1:8	1:4	1:2.66	1:2
Time based Ave. power compared to slotted Ave. power	-9 dB	-6 dB	-4.25 dB	-3 dB

GPRS/EGPRS:Maximum target output power with 4 slots are 30.5dBm@ GPRS/EGPRS850 and 29.5dBm@GPRS/EGPRS1900,so the time based Ave. power compared to sloted Ave. power are 27.5 dBm@ GPRS/EGPRS850 and 26.5 dBm@GPRS/EGPRS1900

Conclusion: The device meets MPE at distance 20cm.