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

Applicable Standard

According to subpart 15.247(i) 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)

(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);

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

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

Calculated Data:

Mode	Frequency Range (MHz)	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	4.97	3.14	-3.00	0.50	20	0.0003	1.00
GPRS/EGPRS 850	824~849	2.82	1.91	27.50	562.34	20	0.2141	0.55
GPRS/EGPRS 1900	1850~1910	2.16	1.64	26.50	446.68	20	0.1461	1.00
LTE Band 2	1850-1910	2.16	1.64	24.00	251.19	20	0.0822	1.00
LTE Band 4	1710-1755	1.32	1.36	23.00	199.53	20	0.0538	1.00
LTE Band 5	824-849	2.82	1.91	24.00	251.19	20	0.0956	0.55
LTE Band 12	699-716	0.34	1.08	24.00	251.19	20	0.0540	0.47
LTE Band 13	777-787	2.42	1.75	24.00	251.19	20	0.0872	0.52
LTE Band 25	1850-1910	2.16	1.64	25.00	316.23	20	0.1034	1.00

Note:
1) For the above tune up power were declared by the manufacturer.
2) The LTE module FCC ID: XMR201707BG96
3) BLE and GPRS/EGPRS or LTE can transmit simultaneously, the worst condition was as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0003/1.00+0.2141/0.55=0.0003+0.3893=0.3896< 1.0$$

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 850: Maximum Tune-up output power with 1 slot is 33.0 dBm, 2 slots is 32.5 dBm, 3 slots is 31.5 dBm, 4 slots is 30.5 dBm, so the max tune-up time based Ave. power compared to slot Ave. power are 27.5 dBm .
EGPRS 850: Maximum Tune-up output power with 1 slot is 27.0 dBm, 2 slots is 27.0 dBm, 3 slots is 26.5 dBm, 4 slots is 26.5 dBm, so the max tune-up time based Ave. power compared to slot Ave. power are 23.5 dBm .
GPRS 1900: Maximum Tune-up output power with 1 slot is 30.0 dBm, 2 slots is 30.0 dBm, 3 slots is 30.0 dBm, 4 slots is 29.5 dBm, so the max tune-up time based Ave. power compared to slot Ave. power are 26.5 dBm .
EGPRS 1900: Maximum Tune-up output power with 1 slot is 26.5 dBm, 2 slots is 26.0 dBm, 3 slots is 26.0 dBm, 4 slots is 26.0 dBm, so the max tune-up time based Ave. power compared to slot Ave. power are 23.0 dBm .

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