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:

Mode	Frequency Range (MHz)	Antenna Gain		Target Output Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
GPRS 850	824~849	0.41	1.10	21.00	125.89	20	0.0275	0.55
GPRS 1900	1850~1910	2.69	1.86	21.00	125.89	20	0.0465	1.00
BLE	2402~2480	1.92	1.56	6.50	4.47	20	0.0014	1.00

Note:
1. Antenna Gain (numeric): 0.41dBi (1.10) for GPRS 850 mode.
   Antenna Gain (numeric): 2.69dBi (1.86) for GPRS 1900 mode.
   Antenna Gain (numeric): 1.92dBi (1.56) for BLE mode.
2. GPRS and BLE can transmit simultaneously, the worst condition was as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0275/0.55+0.0014/1.00=0.0500+0.0014=0.0514< 1.0$$

3. For GPRS 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
Duty Cycle	1:8
Time based Ave. power compared to slotted Ave. power	-9 dB

GPRS 850: Tune-up maximum output power is 30.00dBm, so the tune-up time based Ave. power compared to sloted Ave. power is 21.00dBm.
GPRS 1900: Tune-up Maximum output power is 30.00dBm, so the tune-up time based Ave. power compared to sloted Ave. power is 21.00dBm.

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