

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/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:

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

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)			
BLE	2402~2480	-7.15	0.19	7.00	5.01	20	0.0002	1.0
GPRS/EGPRS 850	824~849	4.0	2.51	27.50	562.34	20	0.2810	0.55
GPRS/EGPRS 1900	1850~1910	4.0	2.51	26.50	446.68	20	0.2232	1.00
LTE Band 2	1850~1910	4.00	2.51	24.00	251.19	20	0.1255	1.00
LTE Band 4	1710~1755	4.00	2.51	23.00	199.53	20	0.0997	1.00
LTE Band 5	824~849	4.00	2.51	24.00	251.19	20	0.1255	0.55
LTE Band 12	699~716	4.00	2.51	24.00	251.19	20	0.1255	0.47
LTE Band 13	777~787	4.00	2.51	24.00	251.19	20	0.1255	0.52
LTE Band 26	814~849	4.00	2.51	24.00	251.19	20	0.1255	0.54

Note:

- (1) The target output powers are all declared by the Manufacturer.
 (2) The GSM/LTE module FCC ID: XMR201707BG96.
 (3) BLE and GPRS/EGPRS or LTE can transmit simultaneously; the worst condition was as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0002/1.00 + 0.2810/0.55 = 0.0002 + 0.5109 = 0.5111 < 1.0$$

- (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 slotted Ave. power are 27.5 dBm@ GPRS/EGPRS850 and 26.5 dBm@GPRS/EGPRS1900

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