

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	-4.46	0.36	7.00	5.01	20	0.0004	1.0
GPRS 850	824~849	-1.24	0.75	27.50	562.34	20	0.0841	0.55
GPRS 1900	1850~1910	2.12	1.63	26.50	446.68	20	0.1448	1.00
EGPRS 850	824~849	-1.24	0.75	23.50	223.87	20	0.0335	0.55
EGPRS 1900	1850~1910	2.12	1.63	23.00	199.53	20	0.0647	1.00
LTE Band 2	1850~1910	2.12	1.63	24.00	251.19	20	0.0814	1.00
LTE Band 4	1710~1755	0.59	1.15	23.00	199.53	20	0.0455	1.00
LTE Band 5	824~849	-1.24	0.75	24.00	251.19	20	0.0376	0.55
LTE Band 12	699~716	-5.09	0.31	24.00	251.19	20	0.0155	0.47
LTE Band 13	777~787	-1.53	0.70	24.00	251.19	20	0.0351	0.52
LTE Band 26	814~849	-1.24	0.75	24.00	251.19	20	0.0376	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:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0004/1.00 + 0.0841/0.55 = 0.0004 + 0.1529 = 0.1533 < 1.0$$

- (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: Maximum target output power with 4 slots are 30.5dBm@ GPRS850 and 29.5dBm@GPRS1900, so the time based Ave. power compared to slotted Ave. power are 27.5 dBm@ GPRS and 26.5 dBm@GPRS1900

EGPRS: Maximum target output power with 4 slots are 26.5dBm@ EGPRS850 and 26.0dBm@EGPRS1900, so the time based Ave. power compared to slotted Ave. power are 23.5 dBm@ EGPRS850 and 23.0dBm@EGPRS1900

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