

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/cm²)	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/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		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2402-2480	3.28	2.13	-7.00	0.20	20	0.0001	1.00
GPRS/EGPRS 850	824-849	1.79	1.51	27.50	562.34	20	0.1689	0.55
GPRS/EGPRS 1900	1850~1910	1.44	1.39	26.50	446.68	20	0.1238	1.00
LTE Band 2	1850~1910	1.44	1.39	25.00	316.23	20	0.0876	1.00
LTE Band 4	1710~1755	1.58	1.44	25.00	316.23	20	0.0905	1.00
LTE Band 5	824-849	1.79	1.51	25.00	316.23	20	0.0950	0.55
LTE Band 12	699~716	2.12	1.63	25.00	316.23	20	0.1025	0.47
LTE Band 13	777~787	2.79	1.90	25.00	316.23	20	0.1196	0.52
LTE Band 25	1850~1915	1.44	1.39	25.00	316.23	20	0.0876	1.00
LTE Band 26	814-849	1.79	1.51	25.00	316.23	20	0.0950	0.54
LTE Band 66	1710-1780	1.58	1.44	25.00	316.23	20	0.0905	1.00
LTE Band 85	698-716	2.12	1.63	25.00	316.23	20	0.1025	0.47
NB-IOT Band 2	1850~1910	1.44	1.39	25.00	316.23	20	0.0876	1.00
NB-IOT Band 4	1710~1755	1.58	1.44	25.00	316.23	20	0.0905	1.00
NB-IOT Band 5	824-849	1.79	1.51	25.00	316.23	20	0.0950	0.55
NB-IOT Band 12	699~716	2.12	1.63	25.00	316.23	20	0.1025	0.47
NB-IOT Band 13	777~787	2.79	1.90	25.00	316.23	20	0.1196	0.52
NB-IOT Band 25	1850~1915	1.44	1.39	25.00	316.23	20	0.0876	1.00
NB-IOT Band 66	1710-1780	1.58	1.44	25.00	316.23	20	0.0905	1.00
NB-IOT Band 71	663-698	1.47	1.40	25.00	316.23	20	0.0882	0.44
NB-IOT Band 85	698-716	2.12	1.63	25.00	316.23	20	0.1025	0.47

Note:

- 1). For the above tune up power were declared by the manufacturer.
- 2) The LTE module FCC ID: XMR202005BG95M5
- 3) BLE and GSM/LTE can transmit simultaneously, the worst condition is BLE & GSM850 as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0001/1.00 + 0.1689/0.55 = 0.0001 + 0.3071 = 0.3072 < 1.0$$

(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

Note 1:

The target output power:

GPRS 850: Tune-up maximum power: 1 slot 32.5dBm, 2 slots 32.5dBm, 3 slots 31.5dBm, 4 slots 30.5dBm, tune-up max time based Ave. power 27.5dBm;

GPRS 1900: Tune-up maximum power: 1 slot 30.0dBm, 2 slots 30.0dBm, 3 slots 30.0dBm, 4 slots 29.50dBm, tune-up max time based Ave. power 26.50dBm.

EGPRS 850: Tune-up maximum power: 1 slot 27.0dBm, 2 slots 27.0dBm, 3 slots 26.5dBm, 4 slots 26.5dBm, tune-up max time based Ave. power 23.5dBm;

EGPRS 1900: Tune-up maximum power: 1 slot 26.5dBm, 2 slots 26.0dBm, 3 slots 26.0dBm, 4 slots 26.0dBm, tune-up max time based Ave. power 23dBm;

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