

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

Applicable Standard

According to subpart §2.1091 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 Output Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2402-2480	1.0	1.26	6.50	4.47	20	0.0011	1.00
GPRS/EGPRS 850	824.2-848.8	0.6	1.15	27.00	501.19	20	0.1145	0.55
GPRS/EGPRS 1900	1850.2-1909.8	0.6	1.15	23.50	223.87	20	0.0512	1.00
LTE Band 5	824.2-848.8	0.6	1.15	22.50	177.83	20	0.0406	0.55
LTE Band 41	2498.5-2687.5	3.7	2.34	23.50	223.87	20	0.1045	1.00

Note:

GPRS 850: Tune-up maximum output power with 4 slot is 30.00 dBm, so the tune-up time based Ave. power compared to slotted Ave. power is 27.00 dBm.

GPRS 1900: Tune-up Maximum output power with 4 slot is 26.50 dBm, so the tune-up time based Ave. power compared to slotted Ave. power is 23.50 dBm.

EGPRS 850: Tune-up maximum output power with 4 slot is 26.00 dBm, so the tune-up time based Ave. power compared to slotted Ave. power is 23.00 dBm.

EGPRS 1900: Tune-up Maximum output power with 4 slot is 23.00 dBm, so the tune-up time based Ave. power compared to slotted Ave. power is 20.00 dBm.

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	-4.26 dB	-3 dB

Note: BLE and GPRS/EGPRS or LTE can transmit simultaneously; the worst condition is below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.1145/0.55 + 0.0011/1.00 = 0.2093 < 1.0$$

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