

FCC §1.1307& §2.1091 –MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart §2.1091 and subpart §1.1307, 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) (§1.1307, §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/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;

According to §1.1307 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);

Calculated Data:

Mode	Max Turn-up power (dBm)	ERP/EIRP Limit (dBm)	Max Antenna Gain (dBi)
GSM 850/GPRS 850	33.0	38.45	5.45
EGPRS 850	26.0	38.45	12.45
GSM 1900/GPRS 1900	30.5	33	2.5
EGPRS 1900	25.0	33	8.0
WCDMA Band V	24.0	38.45	14.45
WCDMA Band II	22.5	33	10.5
LTE Band 2	22.0	33	11.0
LTE Band 4	23.0	30	7.0
LTE Band 5	23.0	38.45	15.45
LTE Band 7	22.5	33	10.5

Mode	Frequency	Antenna Gain		Target Output Power		Evaluation Distance	Power Density	MPE Limit
	(MHz)	(dBi)	(numeric)	(dBm)	(mW)	(cm)	(mW/cm ²)	(mW/cm ²)
GSM 850 /GPRS 850	824.2	5.41	3.48	29.0	794.33	20	0.549	0.549
EGPRS 850	824.2	11.41	13.84	23.0	199.53	20	0.549	0.549
GSM 1900 /GPRS 1900	1909.8	10.01	10.03	27.0	501.19	20	1.000	1.000
EGPRS 1900	1850.2	15.01	31.71	22.0	158.49	20	1.000	1.000
WCDMA Band V	826.4	10.43	11.03	24	251.19	20	0.551	0.551
WCDMA Band II	1880.0	14.51	28.26	22.5	177.83	20	1.000	1.000
LTE Band 2	1880.0	15.01	31.71	22.0	158.49	20	1.000	1.000
LTE Band 4	1732.5	14.01	25.19	23.0	199.53	20	1.000	1.000
LTE Band 5	824.7	11.42	13.87	23	199.53	20	0.550	0.550
LTE Band 7	2535.0	14.51	28.26	22.5	177.83	20	1.000	1.000

Note 1:

The target output power:

GSM 850: Maximum output power with 1 slot is 33.0dBm, time based Ave. power is 24.0dBm;
GPRS 850: Maximum output power with 4 slots is 32.0dBm, time based Ave. power is 29.0dBm;
EGPRS 850: Maximum output power with 4 slots is 26.0dBm, time based Ave. power is 23.0dBm;
GSM 1900: Maximum output power with 1 slot is 30.5dBm, time based Ave. power is 21.5dBm;
GPRS 1900: Maximum output power with 4 slots is 30.0dBm, time based Ave. power is 27.0dBm;
EGPRS 1900: Maximum output power with 4 slots is 25.0dBm, time based Ave. power is 22.0dBm;
WCDMA Band V: 24.0dBm;
WCDMA Band II: 22.5dBm;
LTE Band2: 22.0dBm;
LTE Band4: 23.0dBm;
LTE Band5: 23.0dBm;
LTE Band7: 22.5dBm,

which was declared by the manufacturer.

Number of Time slot	1	2	3	4
Duty Cycle	1:8.3	1:4.15	1:2.77	1:2.08
Time based Ave. power compared to slotted Ave. power	-9 dB	-6 dB	-4.26 dB	-3 dB

Mode	Max Allow Antenna Gain (dBi)
GSM 850/GPRS 850	5.41
EGPRS 850	11.41
GSM 1900/GPRS 1900	2.5
EGPRS 1900	8.0
WCDMA Band V	10.43
WCDMA Band II	10.50
LTE Band 2	11.0
LTE Band 4	7.0
LTE Band 5	11.42
LTE Band 7	10.50

Note 2:

To meet RF exposure & ERP/ERIP, the maximum net gain of antennas allowed are 5.41dBi @ GSM 850/ GPRS 850 , 11.41dBi @ EGPRS 850 , 2.5dBi @ GSM 1900/GPRS 1900 , 8.0dBi @ EGPRS 1900 , 10.43dBi @ WCDMA Band V , 10.50dBi @ WCDMA Band II , 11.0dBi @ LTE Band 2 , 7.0dBi @ LTE Band 4 , 11.42dBi @ LTE Band 5, 10.50dBi @ LTE Band 7. The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.