

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)	MPE Ratio
		(dBi)	(numeric)	(dBm)	(mW)				
BLE	2402-2480	2.54	1.79	8	6.31	20	0.0022	1.0	0.0022
GSM850 (GPRS/EGPRS)	824-849	-3.96	4.0	27	501.19	20	0.0399	0.5493	0.0399
PCS1900 (GPRS/EGPRS)	1850-1910	1.88	1.54	24	251.19	20	0.0769	1.0	0.0769
LTE NB-IOT	LTE Band 2	1850-1910	1.88	1.54	20.5	112.20	20	0.0344	0.0428
	LTE Band 4	1710-1755	1.87	1.54	21.0	125.89	20	0.0386	0.0391
	LTE Band 5	824-849	-3.96	1.54	21.0	125.89	20	0.0386	0.5493
	LTE Band 12	699-716	-2.69	0.54	21.0	125.89	20	0.0135	0.0296
	LTE Band 13	777-787	-0.2	0.95	21.0	125.89	20	0.0238	0.518
LTE CAT-M	LTE Band 2	1850-1910	1.88	1.54	22.5	177.83	20	0.0545	0.0679
	LTE Band 4	1710-1755	1.87	1.54	22.5	177.83	20	0.0545	0.0552
	LTE Band 5	824-849	-3.96	0.04	22.5	177.83	20	0.0141	0.5493
	LTE Band 12	699-716	-2.69	0.54	22.5	177.83	20	0.0191	0.0418
	LTE Band 13	777-787	-0.2	0.95	22.5	177.83	20	0.0336	0.518
NFC	13.56	0.00	1.00	-14.5	0.04	20	<0.0001	0.98	<0.0001
NFC field strength is 80.43 dBμV/m = -14.77 dBm (0.04mW) EIRP. That equal to antenna gain is 0 dBi and used the EIRP value as conducted power.									

1. The EUT Contains Transmitter FCC ID: 2A4GZ-NABE5 (Grant on: 07/18/2024).

2. Note: E[dBμV/m] = EIRP[dBm] + 95.2 for d = 3 m.

BLE, GSM/LTE and NFC can transmit simultaneously, as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0022 + 0.0769 + 0.0001 = 0.0792 < 1.0$$

3. The device meet FCC MPE at 20 cm distance.

Result: Compliant.