

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/4πR² = 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 (worst case):

Mode	Frequency Range (MHz)	Maximum Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
Wi-Fi 802.11b	2412-2462	-2.3	0.59	19.50	89.13	20	0.0105	1.00
Wi-Fi 802.11g		-2.3	0.59	23.00	199.53	20	0.0234	1.00
Wi-Fi 802.11n-HT20		-2.3	0.59	22.00	158.49	20	0.0186	1.00
BLE	2402-2480	-2.3	0.59	7.00	5.01	20	0.0006	1.00
BT 3.0	2402-2480	-2.3	0.59	7.00	5.01	20	0.0006	1.00
GSM850	824-849	2.0	1.58	26.00	398.11	20	0.1255	0.55
GSM1900	1850-1910	2.0	1.58	23.00	199.53	20	0.0629	1.00
WCDMA Band II	1850-1910	2.0	1.58	25.00	316.23	20	0.0997	1.00
WCDMA Band IV	1710-1755	2.0	1.58	25.00	316.23	20	0.0997	1.00
WCDMA Band V	824-849	2.0	1.58	25.00	316.23	20	0.0997	0.55
LTE Band2	1850-1910	2.0	1.58	25.00	316.23	20	0.0997	1.00
LTE Band4	1710-1755	2.0	1.58	25.00	316.23	20	0.0997	1.00
LTE Band5	824-849	2.0	1.58	25.00	316.23	20	0.0997	0.55
LTE Band7	2500-2570	2.0	1.58	25.00	316.23	20	0.0997	1.00
LTE Band12	699-716	2.0	1.58	25.00	316.23	20	0.0997	0.47
LTE Band13	777-787	2.0	1.58	25.00	316.23	20	0.0997	0.52
LTE Band25	1850-1915	2.0	1.58	25.00	316.23	20	0.0997	1.00
LTE Band26 (814-824)	814-824	2.0	1.58	25.00	316.23	20	0.0997	0.54
LTE Band26 (824-849)	824-849	2.0	1.58	25.00	316.23	20	0.0997	0.55
LTE Band38	2570-2620	2.0	1.58	25.00	316.23	20	0.0997	1.00
LTE Band41	2496-2690	2.0	1.58	25.00	316.23	20	0.0997	1.00

Mode	Frequency Range (MHz)	Maximum Antenna Gain		Tune-up EIRP		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
NFC	13.56	0	1.00	-8.50	0.14	20	0.000028	0.98

Note:

(1) Tune-up conducted power was declared by the Manufacturer.

(2) The LTE module FCC ID: XMR201903EG25G (Grant: 2019-03-29).

(3) For NFC ERP=84.27 dB μ V/m -95.2=-10.93dBm
EIRP=ERP+2.15=-8.78 dBm
Tune up EIRP=-8.5dBm

(4) 2.4G Wi-Fi/BT/BLE and GSM/WCDMA/LTE and NFC can transmit simultaneously; the worst condition as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0234/1.00 + 0.1255/0.55 + 0.000028/0.98 = 0.2516 < 1.0$$

Conclusion: The device meets MPE at distance 20cm.