

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

$S = PG/4\pi R^2$ = 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 (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	0.5	1.12	15.50	35.48	20	0.0079	1.00
Wi-Fi 802.11g		0.5	1.12	13.50	22.39	20	0.0050	1.00
Wi-Fi 802.11n-HT20		0.5	1.12	12.50	17.78	20	0.0040	1.00
Wi-Fi 802.11n-HT40	2422-2452	0.5	1.12	12.50	17.78	20	0.0040	1.00
BLE	2402-2480	1.2	1.32	4.50	2.82	20	0.0007	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)			
SRD	433	/	/	-33.00	0.001	20	0.0000	0.2887

Mode	Band	Frequency Range (MHz)	Maximum Antenna Gain		Tune-up Maximum Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
			(dBi)	(numeric)	(dBm)	(mW)			
NB-IoT	2	1850-1910	0.5	1.12	22.00	158.49	20	0.0353	1.00
	4	1710-1755	0.5	1.12	22.00	158.49	20	0.0353	1.00
	5	824-849	0.5	1.12	22.00	158.49	20	0.0353	0.55
	12	699-716	0.5	1.12	22.00	158.49	20	0.0353	0.47
	13	777-787	0.5	1.12	22.00	158.49	20	0.0353	0.52
	25	1850-1915	0.5	1.12	22.00	158.49	20	0.0353	1.00
	26	814-849	0.5	1.12	22.00	158.49	20	0.0353	0.54
	66	1710-1780	0.5	1.12	22.00	158.49	20	0.0353	1.00
	71	663-698	0.5	1.12	22.00	158.49	20	0.0353	0.44
	85	698-716	0.5	1.12	22.00	158.49	20	0.0353	0.47
eMTC	2	1850-1910	0.5	1.12	22.00	158.49	20	0.0353	1.00
	4	1710-1755	0.5	1.12	22.00	158.49	20	0.0353	1.00
	5	824-849	0.5	1.12	22.00	158.49	20	0.0353	0.55
	12	699-716	0.5	1.12	22.00	158.49	20	0.0353	0.47
	13	777-787	0.5	1.12	22.00	158.49	20	0.0353	0.52
	25	1850-1915	0.5	1.12	22.00	158.49	20	0.0353	1.00
	26	814-849	0.5	1.12	22.00	158.49	20	0.0353	0.54
	66	1710-1780	0.5	1.12	22.00	158.49	20	0.0353	1.00
	85	698-716	0.5	1.12	22.00	158.49	20	0.0353	0.47

Note:

(1) The LTE module FCC ID: RI7ME910G1W1.

(2) The SRD EIRP = 61.39dBμV/m-95.2 = -33.81dBm.

(3) Wi-Fi & BLE & SRD & LTE can transmit simultaneously; the worst condition is Wi-Fi & BLE & SRD & LTE as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0079/1.00 + 0.0007/1.00 + 0 + 0.0353/0.44 = 0.0888 < 1.0$$

Conclusion: The device meets MPE at distance 20cm.