

RF EXPOSURE EVALUATION

MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to 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/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 §1.1310 and §2.1091 RF exposure is calculated.

Result

Calculation formula:

Prediction of power density at the distance of the applicable MPE limit

$S = PG/4\pi R^2$ = 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:

For worst case:

Mode	Frequency (MHz)	Antenna Gain [#]		Max Tune-up Power [#]		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
BT	2402-2480	6.19	4.16	12.0	15.85	20	0.0131	1
BLE	2402-2480	6.19	4.16	-2.0	0.63	20	0.0005	1
2.4G Wi-Fi	2412-2462	6.19	4.16	22.0	158.49	20	0.1312	1
5.2G Wi-Fi	5180-5240	4.04	2.54	10.5	11.22	20	0.0057	1
5.3G Wi-Fi	5260-5320	4.04	2.54	10.5	11.22	20	0.0057	1
5.6G Wi-Fi	5500-5720	1.41	1.38	12.5	17.78	20	0.0049	1
5.8G Wi-Fi	5745-5825	3.20	2.09	13.0	19.95	20	0.0083	1
GSM850	824-849	-2.52	0.56	32.5	1778.28	20	0.1981	0.549
PCS1900	1850-1910	-0.20	0.95	30.0	1000.00	20	0.1890	1
WCDMA B2	1850-1910	-0.20	0.95	23.5	223.87	20	0.0423	1
WCDMA B5	824-849	-2.52	0.56	23.5	223.87	20	0.0249	0.549
LTE B2	1850-1910	-0.20	0.95	23.0	199.53	20	0.0377	1
LTE B5	824-849	-2.52	0.56	23.0	199.53	20	0.0222	0.549
LTE B7	2500-2570	2.19	1.66	23.0	199.53	20	0.0659	1

Note:

1) The tune up conducted power and antenna gain was declared by the applicant.

2) The BT and 5G Wi-Fi can simultaneous transmitting, BT/5G and 2.4G Wi-Fi cannot simultaneous transmitting.

Mode	Maximum E-Field (dBuV/m@3m)	Maximum EIRP		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBm)	(mW)			
NFC	70.15	-25.05	0.0031	20	0.00000062	0.979

Note: EIRP = E-Field – 95.2 @3m

Simultaneous transmitting consideration (worst case):

$$\text{The ratio} = \text{MPE}_{2.4\text{G Wi-Fi}}/\text{limit} + \text{MPE}_{\text{GSM850}}/\text{limit} + \text{MPE}_{\text{NFC}}/\text{limit} \\ = 0.1312/1 + 0.1981/0.549 + 0.00000062/0.979 = 0.492 < 1.0$$

So simultaneous exposure is compliant.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.