

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)				
2.4G WiFi	2412-2462	3.0	2.00	22.5	177.83	20	0.0707	1.0	0.0707
BLE	2402-2480	3.0	2.00	0.5	1.12	20	0.0004	1.0	0.0004
5G WiFi	5150-5250	0.02	1.00	13.0	19.95	20	0.0040	1.0	0.0040
	5725-5850	-1.6	0.69	15.0	31.62	20	0.0043	1.0	0.0043
WCDMA Band 2	1850-1910	2.94	1.97	25.0	316.23	20	0.1239	1.0	0.1239
WCDMA Band 4	1710-1755	2.94	1.97	25.0	316.23	20	0.1239	1.0	0.1239
WCDMA Band 5	824-849	1.25	1.33	25.0	316.23	20	0.0839	0.5493	0.1527
LTE Band 2	1850-1910	2.94	1.97	24.5	281.84	20	0.1104	1.0	0.1104
LTE Band 4	1710-1755	2.94	1.97	24.5	281.84	20	0.1104	1.0	0.1104
LTE Band 5	824-849	1.25	1.33	24.5	281.84	20	0.0748	0.5493	0.1362
LTE Band 7	2500-2570	2.4	1.74	24.0	251.19	20	0.0869	1.0	0.0869
LTE Band 12	699-716	0.33	1.08	24.5	281.84	20	0.0605	0.466	0.1298
LTE Band 13	777-787	0.33	1.08	24.5	281.84	20	0.0605	0.518	0.1168
LTE Band 14	788-798	0.33	1.08	24.5	281.84	20	0.0605	0.5253	0.1152
LTE Band 17	704-716	0.33	1.08	24.5	281.84	20	0.0605	0.4693	0.1289
LTE Band 25	1850-1915	2.94	1.97	24.5	281.84	20	0.1104	1.0	0.1104
LTE Band 26	814-849	1.25	1.33	24.5	281.84	20	0.0748	0.5427	0.1378
LTE Band 30	2305-2315	2.94	1.97	23.0	199.53	20	0.0782	1.0	0.0782
LTE Band 38	2570-2620	2.4	1.74	24.0	251.19	20	0.0869	1.0	0.0869
LTE Band 41	2496-2690	2.4	1.74	24.0	251.19	20	0.0869	1.0	0.0869
LTE Band 42	3450-3550	-2.00	0.63	22.0	158.49	20	0.0199	1.0	0.0199
LTE Band 43	3700-3800	-2.00	0.63	22.0	158.49	20	0.0199	1.0	0.0199
LTE Band 48	3550-3700	-2.00	0.63	22.0	158.49	20	0.0199	1.0	0.0199
LTE Band 66	1710-1780	2.94	1.97	24.5	281.84	20	0.1104	1.0	0.1104
LTE Band 71	663-698	0.33	1.08	24.5	281.84	20	0.0605	0.442	0.1369

Note:

1. For the above tune up power were declared by the manufacturer.
2. The EUT contains a certificated LTE-A Cat 6 M.2 Module, FCC ID: XMR2022EM060KGL, Date of Grant: 2023/11/01
3. Wi-Fi, BLE and WCDMA can be transmitting simultaneously, So

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0707 + 0.0004 + 0.1527 = 0.2238 < 1.0$$

Result: The device meet FCC MPE at 20 cm distance.