

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 Conducted Output Power		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
Zigbee	2405~2480	2.0	1.58	9.5	8.91	20	0.0028	1.0
SRD	5770~5840.5	3.99	2.51	-5.5	0.28	20	0.0001	1.0

The Zigbee & 5.8G SRD can be transmitting simultaneously, So

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0028 + 0.0001 = 0.0029 < 1.0$$

Note:

1. For the above tune up power were declared by the manufacturer.
2. For 5.8G SRD, this maximum E-Field level is 93.65 dBμV/m at 3m, so the EIRP is -1.55 dBm.
The antenna gain is 3.99dBi . The conducted power is -5.54 dBm
3. EIRP (dBm) = Field Strength of Fundamental (dBuV/m)-95.2,
Conducted Power(dBm)=EIRP(dBm)-antenna gain(dBi)

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