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/cm^2)**	**Averaging Time (minutes)**
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f²)	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/cm^2);
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);

Calculated Data:

Mode	Frequency Range (MHz)	Antenna Gain		Target Output Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)	MPE Ratio
		(dBi)	(numeric)	(dBm)	(mW)				
802.11b		2.00	1.58	13.5	22.39	20	0.0070	1.0	0.0070
802.11g	2412~2462	2.00	1.58	17.5	56.23	20	0.0177	1.0	0.0177
802.11n-HT20		2.00	1.58	18.0	63.10	20	0.0198	1.0	0.0198
Zigbee	2405~2480	2.00	1.58	11.0	12.59	20	0.0040	1.0	0.0040

Note:

1) The tune-up output power was declared by the manufacturer.
2) Wi-Fi and Zigbee can transmit simultaneously. The worst condition is 802.11n-HT20 of Wi-Fi & Zigbee, as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0040/1.0 + 0.0198/1.0 = 0.0238 < 1.0$$

Conclusion: The device meets FCC MPE at 20 cm distance.