FCC §1.1307 (b) (1) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 1.1307 (b)(1), 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/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);

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		Turn-up Conducted Output Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)	MPE ratio
		(dBi)	(numeric)	(dBm)	(mW)				
Zigbee	2405~2480	0	1.00	15.00	31.62	20	0.0063	1.0	0.0062
BT3.0	2402-2480	0	1.00	7.00	5.01	20	0.0010	1.0	0.0010
BLE	2402-2480	0	1.00	7.00	5.01	20	0.0010	1.0	0.0010
2.4G Wi-Fi	2412-2462	0	1.00	23.00	199.53	20	0.0397	1.0	0.0397
	2422-2452	0	1.00	20.00	100.00	20	0.0199	1.0	0.0199

Note: Zigbee and Wi-Fi can transmit simultaneously; the worst condition is Zigbee & 2.4G Wi-Fi as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0397/1.00+0.0063/1.00=0.0397+0.0063=0.046 < 1.0$$

Result: The device meet FCC MPE at 20 cm distance. MPE evaluation of single and simultaneous transmission meets the requirement of standard.