FCC §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247 (i) and subpart 1.1310, 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 (worst case):

Mode	Frequency Range (MHz)	Maximum Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
Wi-Fi	2412-2462	2.00	1.58	21.50	141.25	20	0.0444	1.00
BLE	2402-2480	2.00	1.58	4.00	2.51	20	0.0008	1.00
Bluetooth	2402-2480	2.00	1.58	6.00	3.98	20	0.0013	1.00
Zigbee	2405~2480	2.00	1.58	4.50	2.82	20	0.0009	1.00

Note:
Wi-Fi and BT/BLE cannot transmit simultaneously.
Wi-Fi & Zigbee or BT/BLE & Zigbee can transmit simultaneously; the worst condition is Wi-Fi & Zigbee as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0444/1.00+0.0009/1.00=0.0453 < 1.0$$

Conclusion: The device meets MPE at distance 20cm.