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

Applicable Standard

According to 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 (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)			
2.4G WiFi 802.11b	2412-2462	1.0	1.26	23.00	199.53	20	0.0500	1.0
2.4G WiFi 802.11g		1.0	1.26	24.00	251.19	20	**0.0630**	**1.0**
802.11n-HT20		1.0	1.26	23.50	223.87	20	0.0561	1.0
802.11n-HT40	2422-2452	1.0	1.26	22.00	158.49	20	0.0397	1.0
BLE(1Mbps)	2402-2480	1.0	1.26	2.50	1.78	20	**0.0004**	**1.0**
BLE(2Mbps)	2402-2480	1.0	1.26	1.50	1.41	20	0.0004	1.0
Zigbee	2405~2475	1.0	1.26	1.00	1.26	20	0.0003	1.0
5G WiFi	5180-5240	1.0	1.26	22.00	158.49	20	0.0397	1.0
5G WiFi	5745-5825	1.0	1.26	19.00	79.43	20	0.0199	1.0

Note: 2.4G Wi-Fi/5G Wi-Fi and BLE/Zigbee can transmit simultaneously; the worst condition as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.0630/1.00+0.0004/1.00=0.0634 < 1.0$$

Conclusion: The device meets MPE at distance 20cm.