FCC §15.247 (I) & §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

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);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Calculated Data:

2.4G WiFi:

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)			
802.11b	2412-2462	3.58	2.28	26.50	446.68	20	0.2026	1.0
802.11g		3.58	2.28	27.00	501.19	20	0.2273	1.0
802.11n-HT20		3.58	2.28	26.00	398.11	20	0.1806	1.0
802.11n-HT40	2422-2452	3.58	2.28	20.00	100.00	20	0.0454	1.0

5G Wi-Fi/WCDMA/LTE:

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
802.11a	5150~5250	4.97	3.14	25.0	316.23	20	0.1975	1.0
	5725~5850	4.98	3.15	24.0	251.19	20	0.1573	1.0
802.11ac20	5150~5250	4.97	3.14	24.0	251.19	20	0.1569	1.0
	5725~5850	4.98	3.15	25.5	354.81	20	0.2222	1.0
802.11n20	5150~5250	4.97	3.14	22.0	158.49	20	0.0990	1.0
	5725~5850	4.98	3.15	25.5	354.81	20	0.2222	1.0
802.11ac40	5150~5250	4.97	3.14	24.5	281.84	20	0.1760	1.0
	5725~5850	4.98	3.15	26.0	398.11	20	0.2493	1.0
802.11n40	5150~5250	4.97	3.14	24.0	251.19	20	0.1569	1.0
	5725~5850	4.98	3.15	25.5	354.81	20	0.2222	1.0
802.11ac80	5210	4.97	3.14	21.0	125.89	20	0.0786	1.0
	5775	4.98	3.15	25.0	316.23	20	0.1980	1.0
WCDMA Band II	1850-1910	2.32	1.71	22.5	177.83	20	0.0603	1.0
WCDMA Band IV	1710-1755	3.53	2.25	22.5	177.83	20	0.0796	1.0
WCDMA Band V	824-849	2.61	1.82	22.5	177.83	20	0.0645	0.55
LTE Band 2	1850-1910	2.32	1.71	23.0	199.53	20	0.0679	1.0
LTE Band 4	1710-1755	3.53	2.25	22.5	177.83	20	0.0796	1.0
LTE Band 12	699-716	1.34	1.36	22.5	177.83	20	0.0482	0.47
LTE Band 13	777-787	2.25	1.68	22.5	177.83	20	0.0594	0.52
LTE Band 14	788-798	2.25	1.68	22.5	177.83	20	0.0594	0.53
LTE Band 66	1710-1780	3.53	2.25	23.0	199.53	20	0.0893	1.0
LTE Band 71	663-698	1.93	1.56	22.5	177.83	20	0.0552	0.44

Note:
1. For the above tune up power were declared by the manufacturer.
2. 2.4G Wi-Fi, 5G Wi-Fi and LTE can transmit simultaneously, The worst condition is 802.11g of 2.4G Wi-Fi, 802.11ac 40 of 5G Wi-Fi Band 4 & LTE Band 71, as below:

$$\sum_i \frac{S_i}{S_{Limit,i}} = 0.2273/1.00+0.2493/1.0+0.0552/0.44=0.6021< 1.0$$

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