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	*($180/f^2$)	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:

Mode	Frequency Range (MHz)	Antenna Gain		Tune-up Output Power*		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)	MPE ratio
		(dBi)	(numeric)	(dBm)	(mW)				
2.4G Wi-Fi	2412-2462	0.69	1.17	19.5	89.13	20	0.0207	1.00	0.0207
BLE	2402-2480	0.69	1.17	7.0	5.01	20	0.0012	1.00	0.0012
BT	2402-2480	0.69	1.17	10	10	20	0.0023	1.00	0.0023
5G Wi-Fi	5150-5250	0.96	1.25	17.0	50.12	20	0.0125	1.00	0.0125
	5725-5850	1.11	1.29	16.0	39.81	20	0.0102	1.00	0.0102
NFC	13.56	0	1.00	-20.5	0.0089	20	0.000002	0.98	0.000002

Note:
1. For the above tune up power were declared by the manufacturer.
2. For NFC, the power of EUT: E Field@3m is 74.35 dBuV/m = -20.85 dBm EIRP. That equal to antenna gain is 0 dBi and used the EIRP value as conducted power.
3. E[dBμV/m] = EIRP[dBm] + 95.2 for d = 3 m.
4. NFC and 2.4G Wi-Fi/5G WIFI/BT/BLE can transmit simultaneously.

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

$= S_{NFC}/S_{limitNFC} + S_{2.4G\ Wi\text{-}Fi}/S_{limit2.4G\ Wi\text{-}Fi}$

$=0.000002+0.0207$

$=0.020702$

< 1.0

Result: Compliant.