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

Applicable Standard

According to subpart 15.247 (i) and subpart 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

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

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = 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:

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

Result

For worst case:

Mode	Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
BT	2402-2480	1.6	1.45	-8.0	0.16	20	0.00005	1
BLE	2402-2480	1.6	1.45	-9.0	0.13	20	0.00004	1
Wi-Fi	2412-2462	2.2	1.66	11.0	12.59	20	0.004	1
GSM850*	824-849	0.5	1.12	25.0	316.23	20	0.071	0.549
PCS1900*	1850-1910	3.0	2.00	24.0	251.19	20	0.100	1
WCDMA Band 2	1850-1910	3.0	2.00	24.5	281.84	20	0.112	1
WCDMA Band 4	1710-1755	3.0	2.00	23.5	223.87	20	0.089	1
WCDMA Band 5	824-849	0.5	1.12	23.5	223.87	20	0.050	0.549
LTE Band 2	1850-1910	3.0	2.00	21.0	125.89	20	0.050	1
LTE Band 4	1710-1755	3.0	2.00	22.0	158.49	20	0.063	1
LTE Band 5	824-849	0.5	1.12	23.0	199.53	20	0.045	0.549
LTE Band 12	699-716	0.5	1.12	23.5	223.87	20	0.050	0.466
LTE Band 38	2570-2620	3.0	2.00	20.0	100.00	20	0.040	1
LTE Band 41	2496-2690	3.0	2.00	19.0	79.43	20	0.032	1

Note : The tune-up power and antenna gain was declared by the applicant.

Note*: It was the time average power according to the below duty cycle.

For SAR, the time based average power is relevant, the difference in between depends on the duty cycle of the TDMA signal.

Number of Time slot	1	2	3	4
Duty Cycle	1:8	1:4	1:2.66	1:2
Time based Ave. power compared to slotted Ave. power	-9 dB	-6 dB	-4.25 dB	-3 dB
Crest Factor	8	4	2.66	2

Simultaneous transmitting consideration (worst case):

The ratio=MPE_{BT}/limit $_{BT}$ + MPE $_{Wi-Fi}$/limit $_{Wi-Fi}$ + MPE_{GSM850}/limit $_{GSM850}$
= 0.00005/1+0.004/1+0.071/0.549=0.133＜1.0

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.