FCC ID: 2BPG9-TFPL407

KDB447498 D01 General RF Exposure Guidance v06

Maximum Permissible Exposure (MPE)

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency(RF) Radiation as specified in §1.1307(b)

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	$*900/f^2$	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
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
300-1,500			f/1500	30
1,500-100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

MPE Calculation Method

E (V/m) $= \frac{\sqrt{30 * P * G}}{d}$ Power Density: *Pd* (W/m²) $= \frac{E^2}{377}$

E = Electric field (V/m)

P = Average RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$Pd = \frac{30 * P * G}{377 * D^2}$

From the EUT RF output power, the minimum mobile separation distance, as well as the gain of the used antenna, the RF power density can be obtained.

BLE:

Measurement Result

Operation Frequency: 2402MHz~2480MHz
Power density limited: 1mW/ cm^2
Antenna Type:PCB antenna
Antenna gain:2.91dBi;
R=5cm
mW=10^(dBm/10)
antenna gain Numeric=10^(dBi/10)= 10^(2.91/10)=1.95

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2402	GFSK(1M)	6.11	6±1	7	5.012	2.91	1.95	0.0312	1
2440		5.96	6±1	7	5.012	2.91	1.95	0.0312	1
2480		6.27	6±1	7	5.012	2.91	1.95	0.0312	1
2402	GFSK(2M)	6.14	6±1	7	5.012	2.91	1.95	0.0312	1
2440		5.99	6±1	7	5.012	2.91	1.95	0.0312	1
2480		6.3	6±1	7	5.012	2.91	1.95	0.0312	1

NFC:
Operation Frequency: 13.56MHz
Antenna Type:Induction coil
R=5cm

Transmit power
NFC

Frequency (MHz)	Max Output power (dBuV/m)	field strength (V/m)
13.56	61.14	0.013

Mode	Channel Freq. (MHz)	field strength (V/m)	field strength Limits (V/m)
NFC	13.56	0.013	60.77

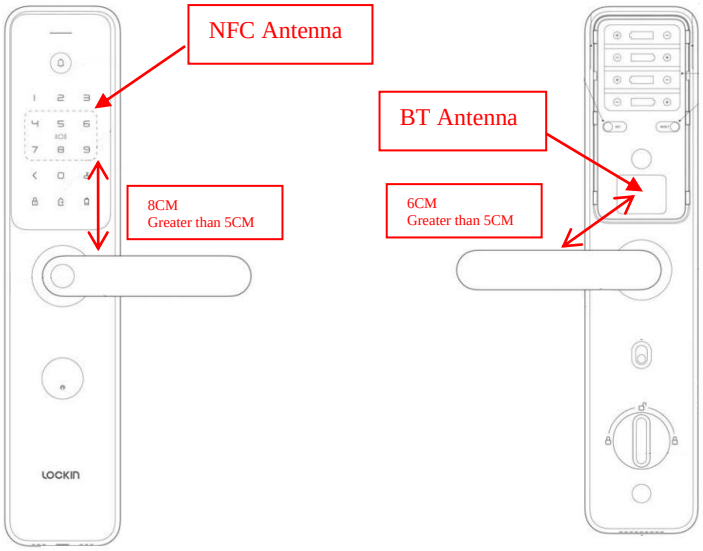
SIMULTANEOUS TRANSMISSIONS

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE. To comply with the MPE, the fraction of the MPE in terms of E^2, H^2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity. In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} \leq 1$$

BLE+NFC=(0.0312/1)+(0.013/60.77)=0.0314<1

Antenna position



Conclusion:
For the max result : 0.0314≤ 1.0 for Max Power Density, compliance RF exposure..

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