

Maximum Permissible Exposure

RF Exposure Limit

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the Environmental 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 / Contral 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	6
300 - 1500	...	...	F/300	6
1500 - 100000	...	...	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 - 1500	...	...	F/1500	30
1500 - 100000	...	...	1	30

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

Fries formula

Fries transmission formula : $P_d = (P_{out} * G) / (4 * \pi * r^2)$

$$r = \sqrt{((P_{out} * G) / 4 * \pi * P_d)}$$

Where

P_d = Power density in mW/cm²

P_{out} = Output power to antenna in mW

G = Gain of antenna in linear scale

π = 3.1416

r = Distance between observation point center of the radiator in cm

If we know the Maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the Maximum distance r where the MPE limit is reached and Power density at prediction frequency.

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Test Result :

RFID

Maximum EIRP:	-50.90	(dBm)
Maximum EIRP:	0.000008128305	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	13.56	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.9789	(mW/cm ²)
Power density at prediction frequency:	<u>0.000000001617075</u>	<u>(mW/cm²)</u>
Test result:	PASS	

WIFI/BT (Certified module)

Maximum EIRP:	22.50	(dBm)
Maximum EIRP:	177.82794	(mW)
Prediction distance:	20	(cm)
Prediction frequency:	2412	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	1	(mW/cm ²)
Power density at prediction frequency:	<u>0.03538</u>	<u>(mW/cm²)</u>
Test result:	PASS	

Sum of the ratios of the exposure from RFID and WIFI/BT.

Power density in RFID mode:	0.000000001617075	(mW/cm ²)
Ratio of the Power density in RFID mode:	0.000000001651931	
Power density in WIFI/BT mode:	0.03538	(mW/cm ²)
Ratio of the Power density in WIFI/BT mode:	0.03538	
Sum of the ratios of the exposure from each mode:	<u>0.03538</u>	
Limit (Unity):	1.000	
Test result:	PASS	