

## **RF EXPOSURE EVALUATION**

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)

<b>Frequency Range(MHz)</b>	<b>Electric Field Strength(V/m)</b>	<b>Magnetic Field Strength(A/m)</b>	<b>Power Density(mW/cm<sup>2</sup>)</b>	<b>Average Time</b>
<b>(A) Limits for Occupational/Control Exposures</b>				
<b>300-1500</b>	--	--	<b>F/300</b>	<b>6</b>
<b>1500-100000</b>	--	--	<b>5</b>	<b>6</b>
<b>(B) Limits for General Population/Uncontrol Exposures</b>				
<b>300-1500</b>	--	--	<b>F/1500</b>	<b>6</b>
<b>1500-100000</b>	--	--	<b>1</b>	<b>30</b>

### **11.1 Friis transmission formula: $P_d = (P_{out} \cdot G) / (4 \cdot \pi \cdot R^2)$**

Where

$P_d$ = Power density in mW/cm<sup>2</sup>

$P_{out}$ =output power to antenna in mW

$G$ = Numeric gain of the antenna relative to isotropic antenna

$\pi$ =3.1416

$R$ = distance between observation point and center of the radiator in cm

At the limit of MPE,  $1\text{mW}/\text{cm}^2$ , If we know the maximum gain of the antenna and total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

RF Exposure Information: The radiated output power of this device meets the limits of FCC/IC radio frequency exposure limits. This device should be operated with a minimum separation distance of 20cm (8 inches) between the equipment and a person's body.

## 11.2 Measurement Result

WIFI

Antenna gain: 4.0 dBi

Modulation	Channel Freq. (MHz)	Measured power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Antenna Gain Numeric	Evaluation result ( $\text{mW}/\text{cm}^2$ )	Power density Limits ( $\text{mW}/\text{cm}^2$ )
802.11b	2412	15.04	$\pm 1$	16	2.51	0.019894	1
	2437	16.13	$\pm 1$	17	2.51	0.025045	1
	2462	16.49	$\pm 1$	17	2.51	0.025045	1
802.11g	2412	14.13	$\pm 1$	15	2.51	0.015803	1
	2437	13.72	$\pm 1$	15	2.51	0.015803	1
	2462	13.44	$\pm 1$	14	2.51	0.012552	1
802.11n (HT20)	2412	10.27	$\pm 1$	11	2.51	0.006291	1
	2437	9.38	$\pm 1$	10	2.51	0.004997	1
	2462	9.57	$\pm 1$	11	2.51	0.006291	1
802.11n (HT40)	2422	8.46	$\pm 1$	9	2.51	0.003969	1
	2437	7.32	$\pm 1$	8	2.51	0.003153	1
	2452	8.05	$\pm 1$	9	2.51	0.003969	1

Lora Mode:  
Antenna gain: 3 dBi

modulation	Channel Freq. (MHz)	E.I.R.P (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Evaluation result (mW/cm <sup>2</sup> )	Power density Limits (mW/cm <sup>2</sup> )
DTS	925.7	28.51	±1	29	0.1580	1
Hopping	902.3	24.57	±1	26	0.0792	1
Hybird	905.3	25.07	±1	26	0.0792	1

CONCLUSION of simultaneous transmitter

Both of the module 1 and module 2 can transmit simultaneously, the formula of calculated the MPE is:

$CPD1/LPD1 + CPD2/LPD2 + \dots \text{etc.} < 1$

CPD = Calculation power density

LPD = Limit of power density

Therefore the worst-case situation is  $0.0250 / 1.00 + 0.1580 / 1.00 = 0.183$ , which is less than "1",

This confirmed that the device comply with FCC 1.1310 MPE limit.

THE END