# FCC ID: 2AITNWAVE

**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

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

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, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

# Measurement Result

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,
WIFI 802.11n HT40:2422-2452MHz
Power density limited: 1mW/ cm$^2$
Antenna Type: Antenna 1:Rod antenna
Antenna 2: PCB Antenna
WIFI antenna gain: Antenna 1: 2.5dBi
Antenna 2: 2.5dBi

R=20cm
mW=10^(dBm/10)

## WLAN2.4G MIMO MODE

| Antenna | Tune-up limit (dBm) | Gain (dBi) | EIRP (dBm) | EIRP (mW) | R(cm) | S (mW/cm$^2$) | MPE Limit (mW/cm$^2$) | Conclusion |
|---------|------|------|------|------|----|--------|----|------|
| Ant 1 | 13.33 | 2.5 | 15.83 | 38.282 | 20 | 0.0126 | 1 | Pass |
| Ant 2 | 12.14 | 2.5 | 14.64 | 29.11 | 20 | 0.0058 | 1 | |

## WLAN5.2G MIMO MODE

| Antenna | Tune-up limit (dBm) | Gain (dBi) | EIRP (dBm) | EIRP (mW) | R(cm) | S (mW/cm$^2$) | MPE Limit (mW/cm$^2$) | Conclusion |
|---------|------|------|------|------|----|--------|----|------|
| Ant 1 | 11.961 | 2.5 | 14.461 | 27.932 | 20 | 0.0092 | 1 | Pass |
| Ant 2 | 9.877 | 2.5 | 12.377 | 17.29 | 20 | 0.0034 | 1 | |

## WLAN5.2G MIMO MODE

| Antenna | Tune-up limit (dBm) | Gain (dBi) | EIRP (dBm) | EIRP (mW) | R(cm) | S (mW/cm2) | MPE Limit (mW/cm2) | Conclusion |
|---------|------|------|------|------|----|--------|----|------|
| Ant 1 | 8.968 | 2.5 | 11.468 | 14.022 | 20 | 0.0046 | 1 | Pass |
| Ant 2 | 9.951 | 2.5 | 12.451 | 17.58 | 20 | 0.0035 | 1 | |

## 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

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

### WLAN2.4G MIMO MODE

| Antenna | Tune-up limit (dBm) | Gain (dBi) | EIRP (dBm) | EIRP (mW) | R(cm) | S (mW/cm$^2$) | MPE Limit (mW/cm$^2$) | Calculation result | Conclusion |
|---|---|---|---|---|---|---|---|---|---|
| Ant 1 | 13.33 | 2.5 | 15.83 | 38.282 | 20 | 0.0126 | 1 | 0.0184 | Pass |
| Ant 2 | 12.14 | 2.5 | 14.64 | 29.11 | 20 | 0.0058 | 1 | | |

### WLAN5.2G MIMO MODE

| Antenna | Tune-up limit (dBm) | Gain (dBi) | EIRP (dBm) | EIRP (mW) | R(cm) | S (mW/cm$^2$) | MPE Limit (mW/cm$^2$) | Calculation result | Conclusion |
|---|---|---|---|---|---|---|---|---|---|
| Ant 1 | 11.961 | 2.5 | 14.461 | 27.932 | 20 | 0.0092 | 1 | 0.0126 | Pass |
| Ant 2 | 9.877 | 2.5 | 12.377 | 17.29 | 20 | 0.0034 | 1 | | |

### WLAN5.2G MIMO MODE

| Antenna | Tune-up limit (dBm) | Gain (dBi) | EIRP (dBm) | EIRP (mW) | R(cm) | S (mW/cm2) | MPE Limit (mW/cm2) | Calculation result | Conclusion |
|---|---|---|---|---|---|---|---|---|---|
| Ant 1 | 8.968 | 2.5 | 11.468 | 14.022 | 20 | 0.0046 | 1 | 0.0081 | Pass |
| Ant 2 | 9.951 | 2.5 | 12.451 | 17.58 | 20 | 0.0035 | 1 | | |

**Conclusion:**

For  the max result : 0.02510≤ 1.0 for Max Power Density, Compliance the RF Exposure requirement.
The 2.4Gwifi module 2 has the maximum Power Density value 0.0184 mW/cm2  in 2.4G MIMO transmitting mode;
The 5Gwifi module 2 has the maximum Power Density value 0.0126 mW/cm2  in 5G MIMO transmitting mode;

| Transmitting Mode | R(cm) | S (mW/cm2) | Total S (mW/cm2) | MPE Limit (mW/cm2) | Conclusion |
|---|---|---|---|---|---|
| Wifi 2.4G MIMO Mode | | 0.0184 | | | |
| Wifi 5G MIMO Mode | 20 | 0.0126 | 0.031 | 1.0 | Pass |

**Conclusion:**

For the max result: 0.0031≤ 1.0 for Max Power Density, compliance the RF Exposure.


Note:

1.  The Output power is the maximum eirp power of this EUT, and the data comes from the RF report for this EUT.

2.   The assess distance is 20cm.


**Signature:**

**Date:**  2021-02-03

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