

# FCC TEST REPORT

**REPORT NO.:** RF910307R02

**MODEL NO.:** AF411W  
AFN4110W

**ACCORDING:** FCC Guidelines for Human Exposure  
IEEE C95.1

**APPLICANT:** Zero One Technology Co. Ltd

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# RF Exposure Measurement

## 1. Introduction

2.4 GHz frequency band is regarded specially as a dangerous band for its heating harmfulness to the human body. That's why microwave oven is operating in this frequency band. The manufacturer whose product is working in this frequency band is obligatory to prove the harmfulness of his product.

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this product is measured in a Fully Anechoic Chamber (FAC) calibrated for antenna measurement in ADT, and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

## 2. RF Exposure Limit

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environmental 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 <sup>2</sup> ) | Average Time (minutes) |
|-----------------------------------------------------------------|-------------------------------|-------------------------------|-------------------------------------|------------------------|
| <b>(A)Limits For Occupational / Control Exposures</b>           |                               |                               |                                     |                        |
| 300-1500                                                        | ...                           | ...                           | F/300                               | 6                      |
| 1500-100,000                                                    | ...                           | ...                           | 5                                   | 6                      |
| <b>(B)Limits For General Population / Uncontrolled Exposure</b> |                               |                               |                                     |                        |
| 300-1500                                                        | ...                           | ...                           | F/1500                              | 6                      |
| 1500-100,000                                                    | ...                           | ...                           | 1.0                                 | 30                     |

F = Frequency in MHz

### 3. Friis Formula

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

where

$P_d$  = power density in  $mW/cm^2$

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

$G$  = gain of antenna in linear scale

$\pi$  = 3.1416

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

$P_d$  is the limit of MPE,  $1 mW/cm^2$ . If we know the maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance  $r$  where the MPE limit is reached.

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition,  
Page 640, Eq. (11-133).

### 4 EUT Operating condition

The software provided by Manufacturer enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

### 5 Climate Condition

The temperature and related humidity: 18 deg. C and 67 % RH

### 6. Classification

This device is not fixed inside the host equipment, it is connected with host through wire. So it is easy to be re-located in the place where at least 20 cm far away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance with the antenna should be included in users manual. So, this device is classified as **Mobile Device**.

## 7 Test Results

### 7.1 Antenna Gain

The maximum Gain measured in Fully Anechoic Chamber is 1dBi or 1.26 (numeric).

### 7.2 Output Power Into Antenna & RF Exposure Distance :

| CHANNEL | CHANNEL<br>FREQUENCY<br>(MHz) | OUTPUT POWER<br>TO ANTENNA (mW) | MINIMUM<br>ALLOWABLE<br>DISTANCE ( r )<br>FROM SKIN<br>(Centi-Meter) |
|---------|-------------------------------|---------------------------------|----------------------------------------------------------------------|
| 1       | 2412                          | 10.79                           | 1.04                                                                 |
| 6       | 2437                          | 11.27                           | 1.06                                                                 |
| 11      | 2462                          | 8.61                            | 0.93                                                                 |

The minimum allowable distance is very close to the enclosure of the antenna. So, the user has no need to worry about the harmfulness of radiation. But it is recommended to always keep, at least, 20 cm separation distance with the antenna.