# Small Size 2.4GHz PCB Antenna-AN043

## 1 DATASHEET KEYWORDS

The PCB antenna Description

- Antenna Name : AN043
- Model Number : AN043
- Maximum Gain :3.0dBi
- Antenna Type : PCB Antenna
- Operation Frequency : 2400~2500MHz

The Manufacturer Information

- Manufacturer Name : Espressif Systems
- Manufacturer Address:

  #101, Block 2, 690 Bibo Road, Zhang Jiang HiJiangShanghai, China

## 2 TEST INTRODUCTION

The PCB antenna described in this application note is now used on ESP8266 module reference design. However,it can also be used in all 2.4 GHz designs, especially small space is required for the antenna.

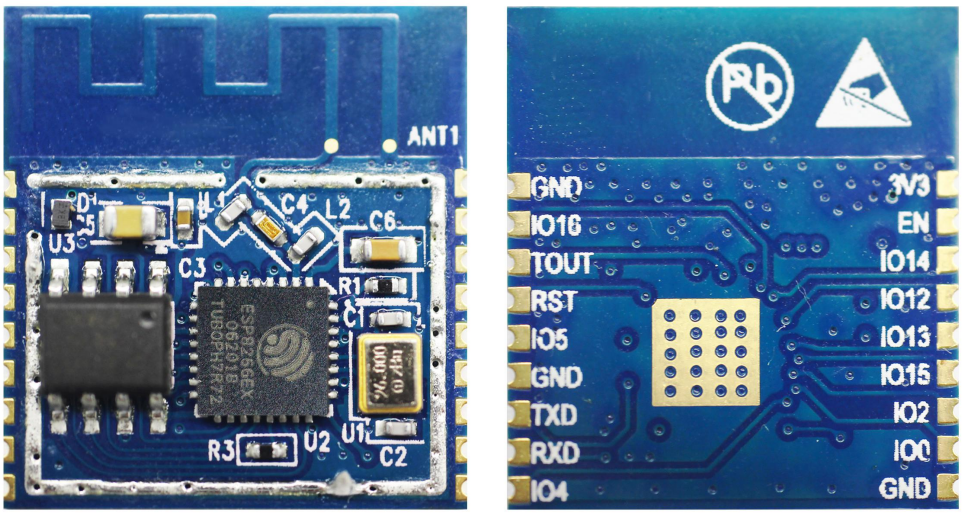


**Figure 1: ESP8266 Module**

### 2.1 Layout and Implementation

Small changes of the antenna dimensions may have large impact on the performance. Therefore it is strongly recommended to make an exact copy of the reference design to achieve optimum performance. It is also recommended to use the same thickness and type of PCB material as used in the reference design.

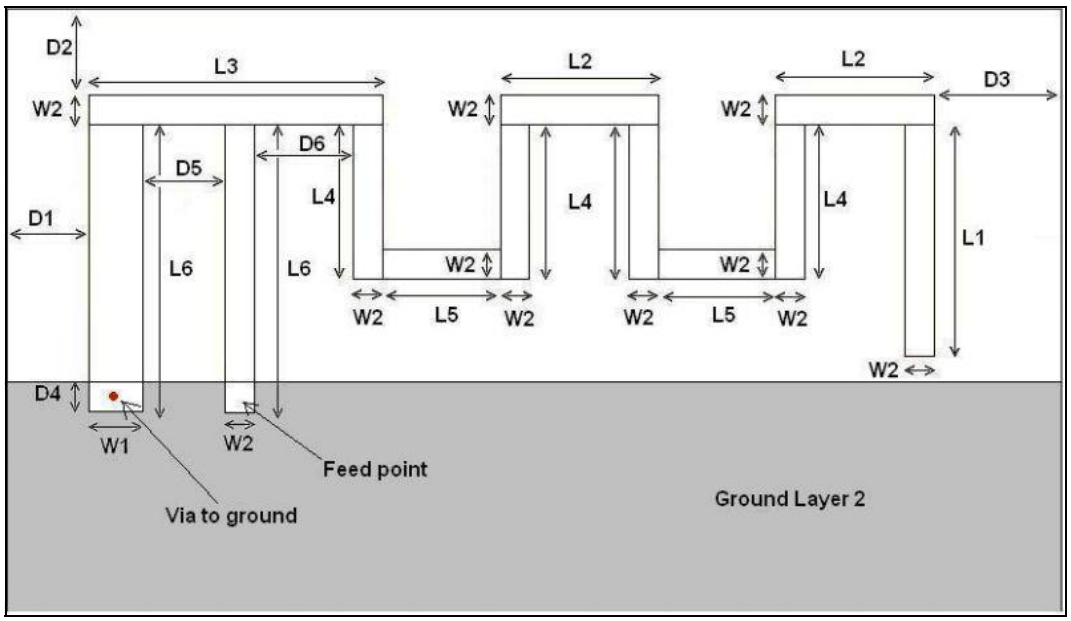


**Figure 2: Antenna Dimensions**

| | |
|---|---|
| L1 | 3.94 |
| L2 | 2.70 |
| L3 | 5.00 |
| L4 | 2.64 |
| L5 | 2.00 |
| L6 | 4.90 |
| W1 | 0.90 |
| W2 | 0.50 |
| D1 | 0.50 |
| D2 | 0.30 |
| D3 | 0.30 |
| D4 | 0.50 |
| D5 | 1 .40 |
| D6 | 1 .70 |

**Table 1: Antenna Dimensions (Unit: mm)**

## 4 TEST RESULTS

Reflection, radiation pattern were measured to verify the performance of the PCB antenna.

### 4.1 Reflection

All the reflection measurements were performed with a network analyzer connected to a semi-rigid coax cable, which was soldered to the feed point of the antenna. Because of the small size antenna and the small ground plane this kind of measurements is heavily affected by the presence and placement of the coax cable. This influence can result in a small uncertainty in resonance

frequency and measured reflection. Typically different placement of the semi-rigid coax cable could change the resonance frequency with 5 -10 MHz and the reflection with 3 - 4 dB.

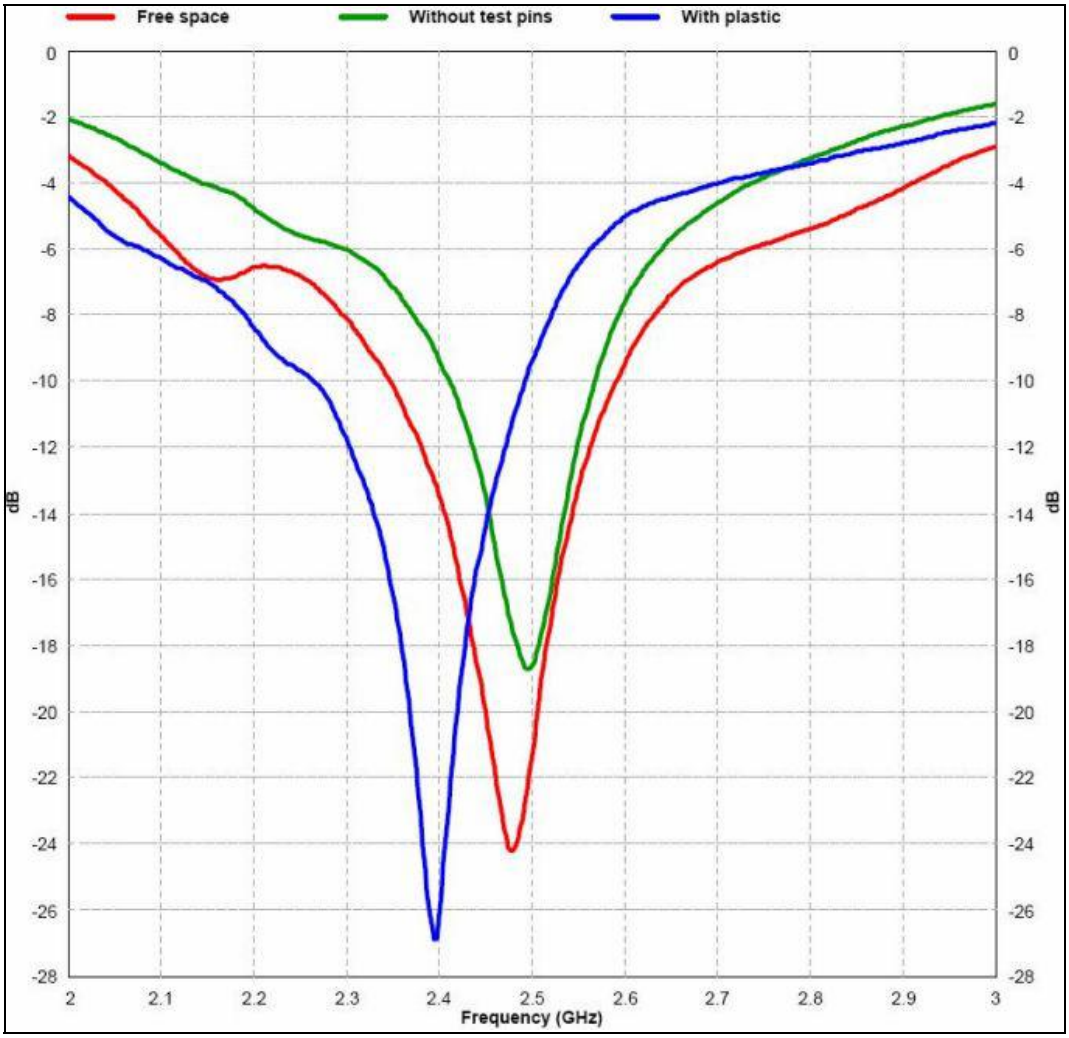


**Figure 3 : Influence of Plastic Encapsulation and Test Pins**

The size of the ground plane affects the performance of the PCB antenna.Soldering ESP8266 to a test board increases the size of the ground plane and thus the performance is affected. However, bandwidth still can be enough to cover the whole 2.4GHz ISM band.

### 4.2 Radiation Pattern

The radiation pattern for the antenna implemented on the ESP8266 reference design has been measured in an Lab chamber. Figure 4 through Figure 7 shows maximum value radiation patterns for three planes, XY, XZ and YZ, measured with vertical and horizontal polarization from 2400MHz~2500MHz frequency range. All measurements were performed with 0dBm output power.

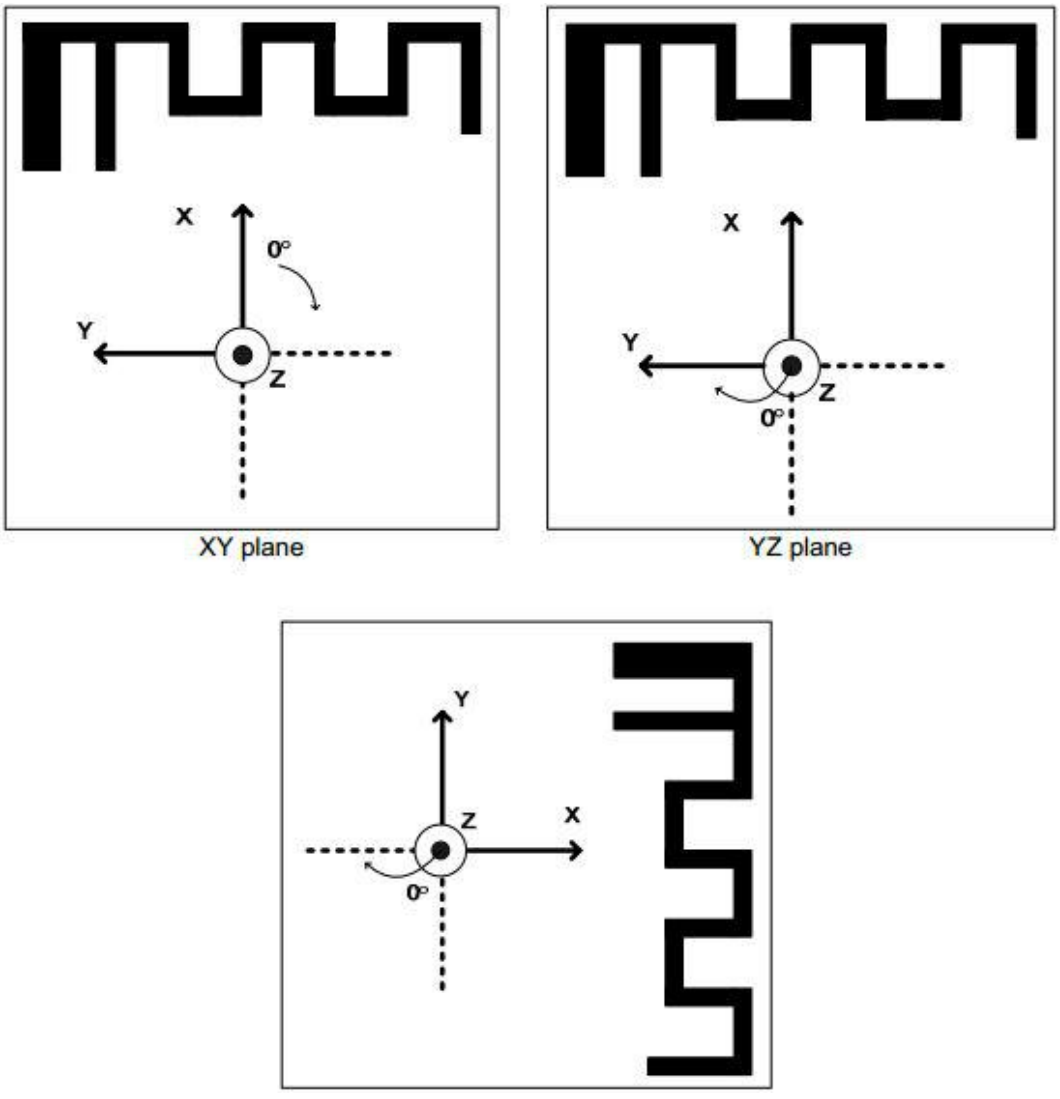


**Figure 4: How to Relate the Antenna to the Radiation Patterns**

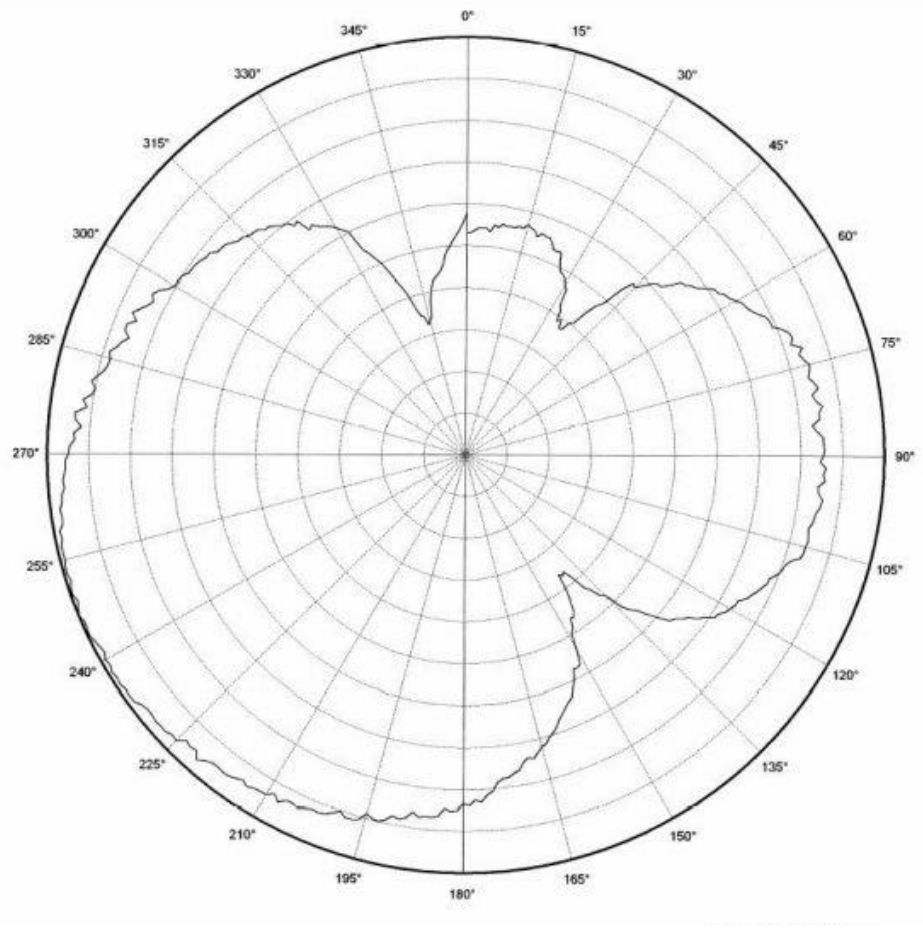


**Figure 5:AN043 XY Plane**

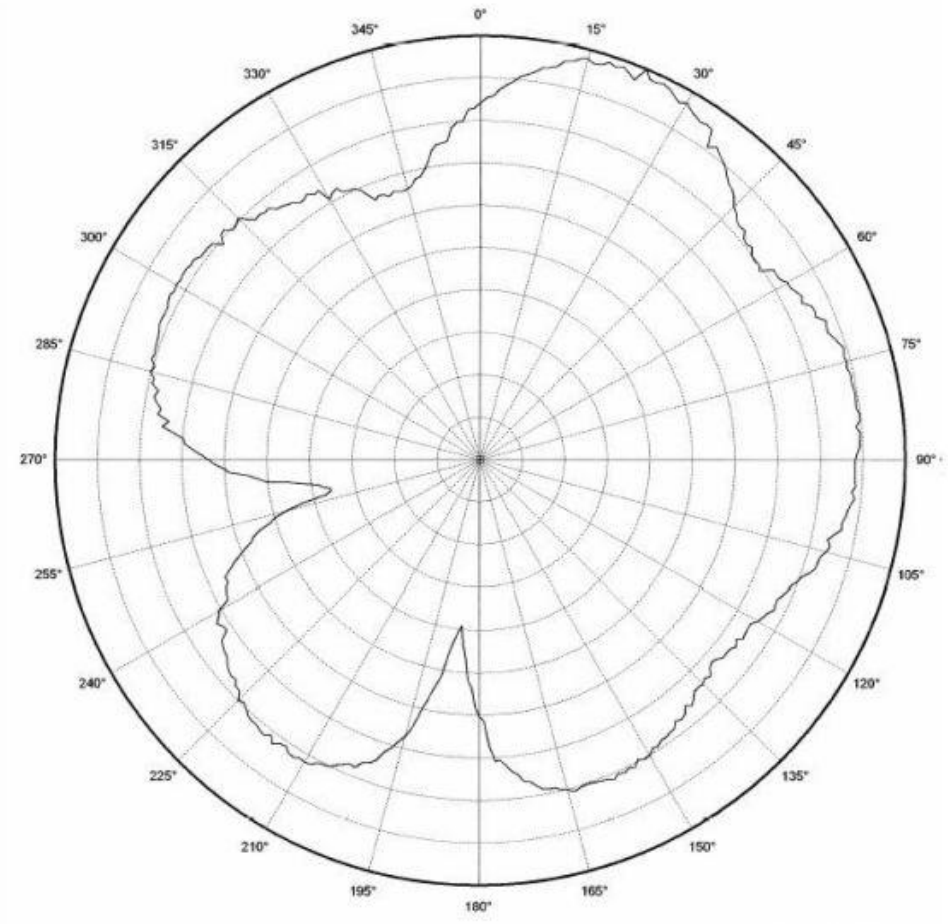


**Figure 6: AN043 XZ Plane**

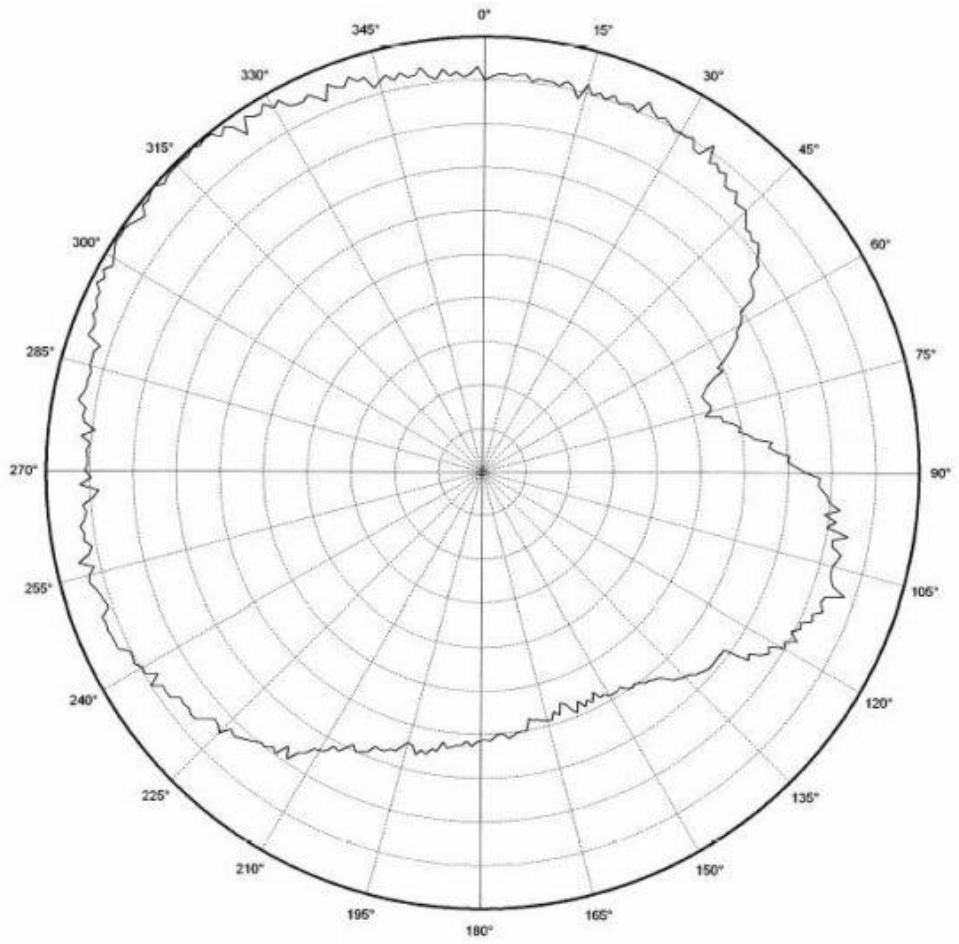


**Figure 7: AN043 YZ Plane**

### 4.3 Maximum Gain

The following table lists the Maximum Gain of the antenna. The free line of sight (LOS) range was measured with 250 kbps and 1% PER.

| | |
|---|---|
| Maximum Gain | 3.0 dBi |
| LOS range | 240 m |
| Antenna Size | 15.2 x 5.7 mm |