# 斯贝克电子 （嘉善）有限公司
# SPEAKER ELECTRONIC (JIASHAN)CO.,LTD
# 样品承认书
# SPECIFICATION FOR APPROVAL

| | | |
|---|---|---|
| 配件型号(斯贝克电子) | 蓝牙天线；2.4G SMD ANTENNA ON GROUND 50 OHMS；品牌：Molex | |
| 配件编码(斯贝克电子) | PA036000A079 | |
| 供应商 | 16062 昂氏 | |
| 供应商型号 | 2.4G SMD ANTENNA ON GROUND 50 OHMS;47948-0001 | |
| **USER** | **CHECKED** | **APPROVED** |
| 陆一炜<br>2020.11.17 | 邓溯源<br>2020.11.17 | 徐军普<br>2020.11.17 |
| ISSUED DATE （出版日期）： 2019-02-12 | | REV(版本)：A0 |

检验目标

1，来料型号与包装上型号一致，为47948-0001；品牌为Molex；盘装

2：焊盘上锡正常，无氧化生锈

3: 外观完整无破损

# APPLICATION SPECIFICATION

## 2.4 GHz MID SMT ANTENNA

### 1.0 SCOPE

This specification describes the antenna application and recommended PCB layout for the Molex 2.4 GHz MID SMT Antenna. The information in this document is for reference and benchmark purposes only. The user is responsible for validating antenna RF performance based on users own PCB and matching circuits.

All measurements are done of the antenna mounted on the recommended PCB with VNA Agilent 5071C and OTA chamber.

Antenna illustrations in this document are generic representations. They are not intended to be an image of any antenna listed in the scope.

### 2.0 PRODUCT DESCRIPTION

#### A. DEFINITIONS OF TERMS

##### I. ANTENNA DESCRIPTION

The antenna design is based on carrier size 3mm × 3mm × 4mm (Length*Width* Height). There is one feeding pad, three fixing pads and antenna radiator. See figure 1.

1. **FEEDING PAD**
   SMD mounted to feeding pad on PCB. The signal from the transmission line must feed into the feeding pad on the PCB.
2. **FIXING PAD**
   SMD mounted to dummy pads on PCB. Anchoring the antenna to the PCB
3. **ANTENNA RADIATOR**
   To act as a transducer that converts unguided electromagnetic wave to guided electromagnetic wave and vice versa.
4. **PICK AND PLACE FEATURE**
   To enable the antenna to be picked up by SMT machine pick up nozzle.

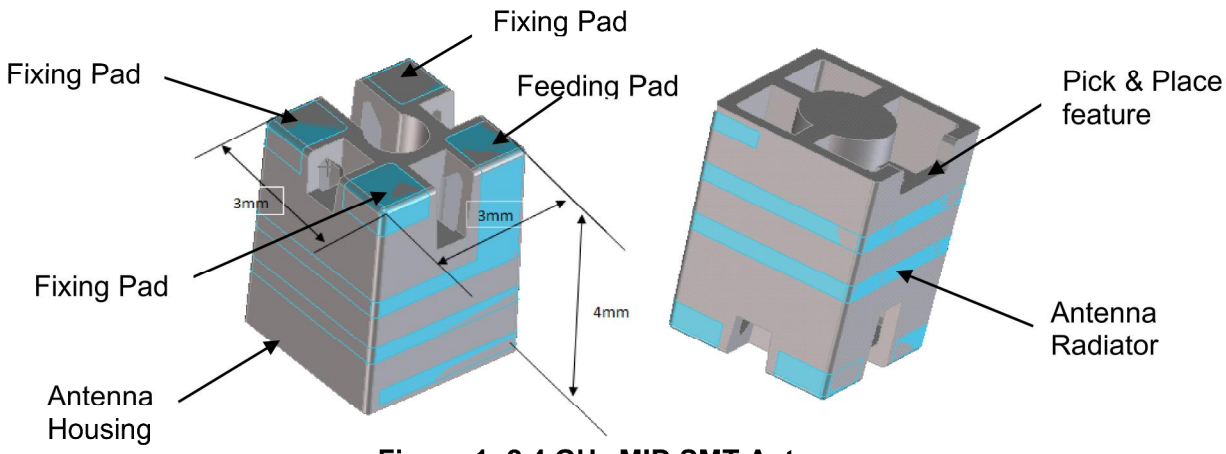


**Figure 1: 2.4 GHz MID SMT Antenna**

| REVISION: | ECR/ECN INFORMATION: | TITLE: | SHEET No. |
|---|---|---|---|
| E | EC No: 121588<br>DATE: 2017 / 09 / 08 | 2.4 GHz MID SMT ANTENNA | 1 of 16 |

| DOCUMENT NUMBER: | CREATED / REVISED BY: | CHECKED BY: | APPROVED BY: |
|---|---|---|---|
| AS-47948-001 | Benson Liu 2017/09/08 | Colin Xu 2017/09/08 | Chirs Zhong 2017/09/08 |

## B. REFERENCE IMPLEMENTATION

### I. REFERENCE PCB DESCRIPTION

The size of reference PCB design is 100mm* 40mm *1mm, which is used for this antenna performance verification. There is one feeding pad and three fixing pads. Furthermore, there is one "L" type matching network reserved close to feeding pad. See figure 2 and 2.1

1. **FEEDING PAD**
   The signal from transmission line must feed into the feeding pad.
2. **MATCHING CIRCUIT**
   It is necessary to reserve PCB space for one "L" type matching circuit in this design. In order to adjust the return loss due to loading by the device housing and surroundings, the matching circuits need to be changed accordingly.

### II. REFERENCE PCB LAYOUT

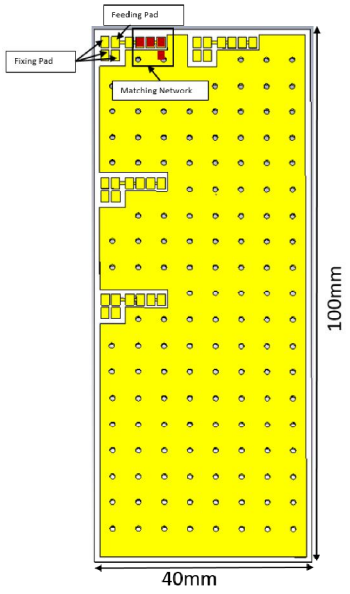


**Figure 2: REFERENCE PCB Layout**

**(Note: PCB Ground Size of 100 mm x 40 mm x 1mm)**

### III. ANTENNA PERFORMANCE AT RECOMMENDED LOCATION

The recommended antenna location is at corner of the PCB as shown in Figure 2.1

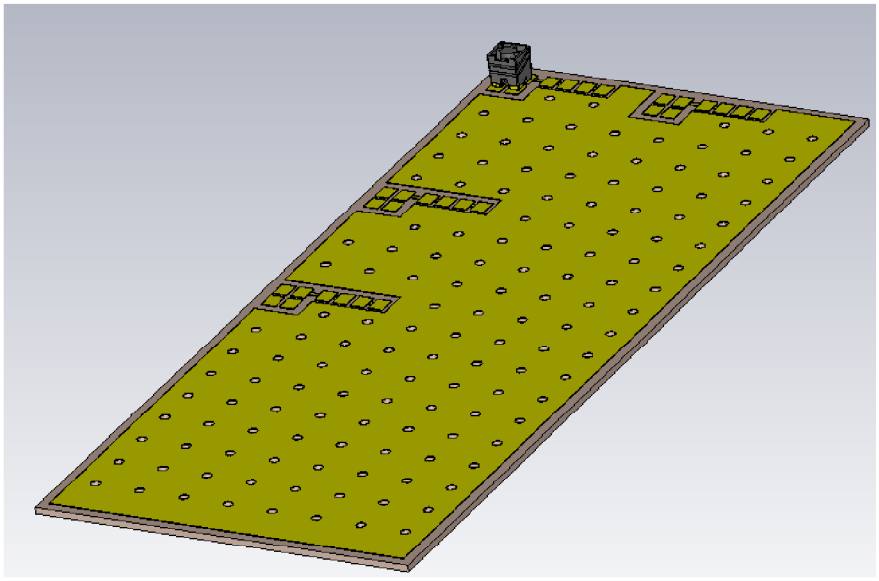

**FIGURE 2.1 RECOMMENDED ANTENNA LOCATION**

| DESCRIPTION | TEST CONDITION | REQUIREMENT |
|---|---|---|
| Frequency Range | Measure antenna on recommended PCB through VNA E5071C | 2400MHz-2500MHz |
| Return Loss | Measure antenna on recommended PCB through VNA E5071C | < -7 dB |
| Peak Gain (Max) | Measure antenna on recommended PCB through OTA chamber | 3.3dBi |
| Avg. Total Efficiency | Measure antenna on recommended PCB through OTA chamber | -1.8dB |
| Polarization | Measure antenna on recommended PCB through OTA chamber | Linear |
| Input Impedance | Measure antenna on recommended PCB through VNA E5071C | 50Ohms |

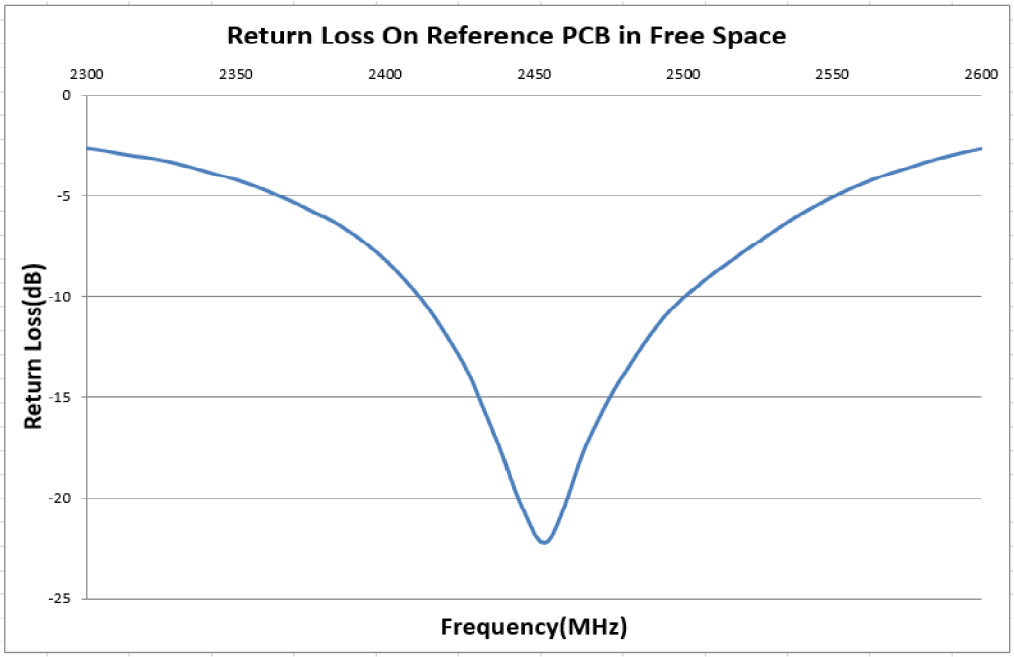


**FIGURE 2.2 RETURN LOSS OF ANTENNA ON REFERENCE PCB AT REFERENCE LOCATION IN FREE SPACE**

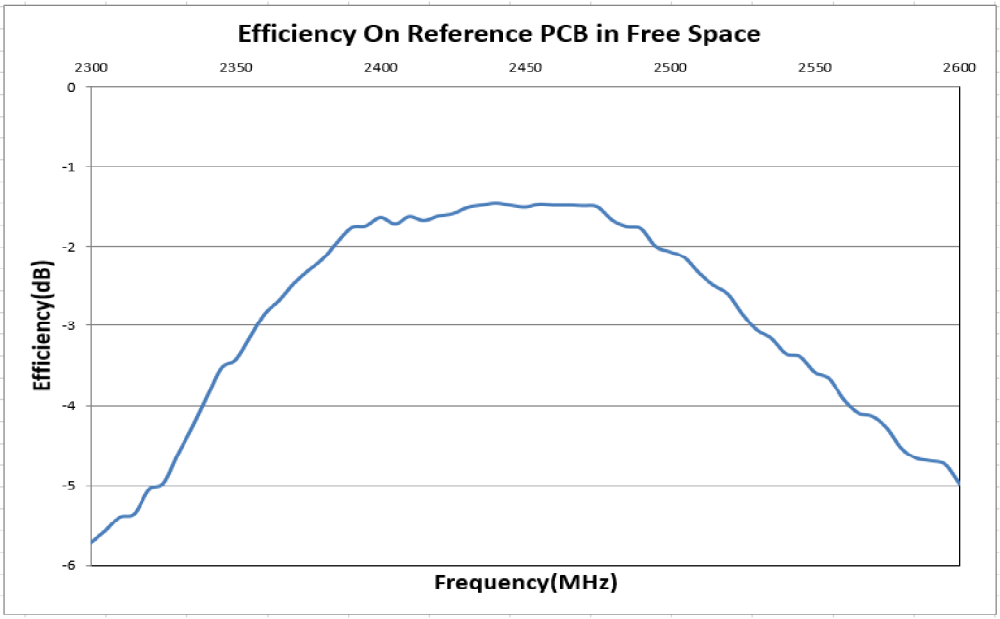


**FIGURE 2.3 EFFICIENCY OF ANTENNA ON REFERENCE PCB AT REFERENCE LOCATION IN FREE SPACE**

## 3.0 REFERENCE DOCUMENTS

- Sales Drawing: SD-47948-001
- Product Specification: PS-47948-001
- Packaging Information – Refer to the Molex related packaging drawings.

## 4.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

### 4.0.1 ANTENNA RF PERFORMANCE AS A FUNCTION OF LOCATION ON REFERENCE PCB

Four locations have been evaluated RF performance and these locations are shown in figure 4.1. Figure 4.1.1 and figure 4.1.2 comparatively present the return loss and efficiency at four locations with matching circuits. The RF performance at Location 1 is the best and it is the recommended location for this antenna.

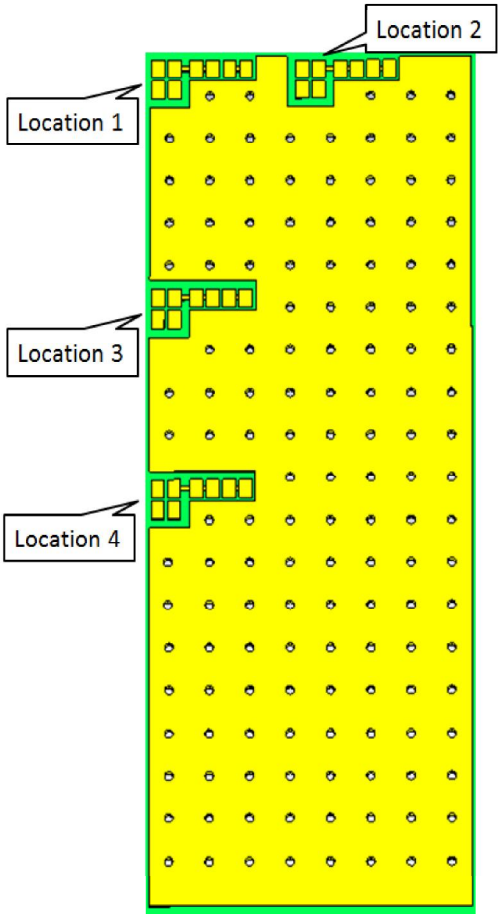


**FIGURE 4.1 FOUR LOCATIONS ON REFERENCE PCB**

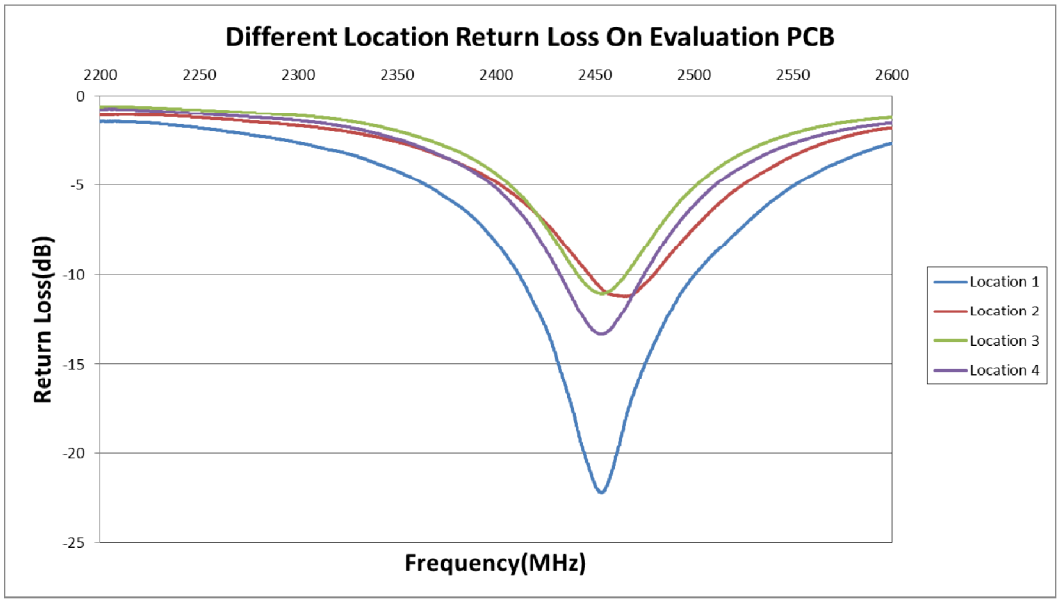


**Figure 4.1.1 RETURN LOSS OF ANTENNA AT 2.4GHZ AT FOUR LOCATIONS**

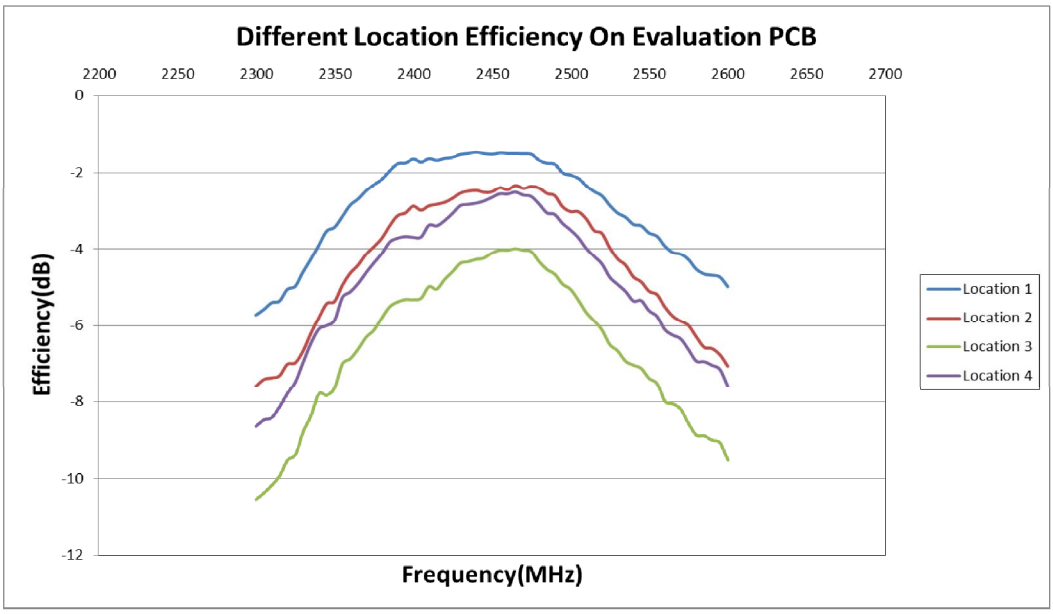


**Figure 4.1.2 EFFICIENCY OF ANTENNA AT 2.4GHZ AT FOUR LOCATIONS**

### 4.0.2 ANTENNA RF PERFORMANCE AS AN EFFECT OF NEARBY SHIELDING CAN

A shielding can with size of 30mm*30mm*2mm was used for this study.

The effect of shielding can be evaluated with 3 different distances from the antenna which is located at the recommended location. The 3 distances are as following: 1mm, 3mm and 5mm.

From the study, we recommend that a shielding can should be placed 5mm away from the antenna. When the distance is less than 5mm, the antenna performance will be significantly degraded. Refer to figure 4.2.1- 4.2.2.

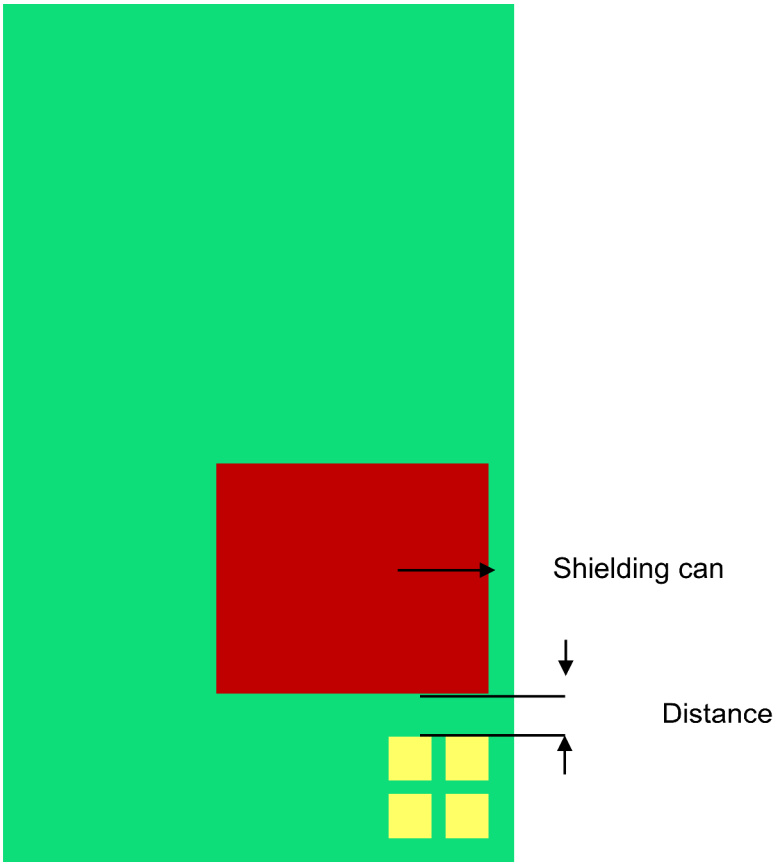


**Figure 4.2 SHIELDING CAN FIXED ON REFERENCE PCB**

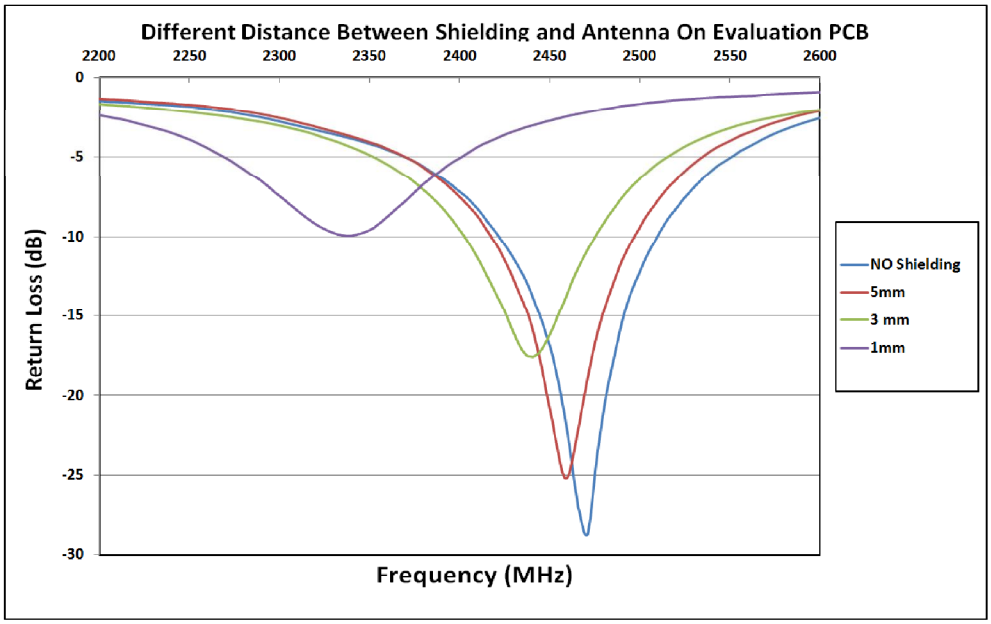


FIGURE 4.2.1 RETURN LOSS COMPARISON AT 2.4GHZ OF SHIELDING CAN DISTANCE FROM ANTENNA

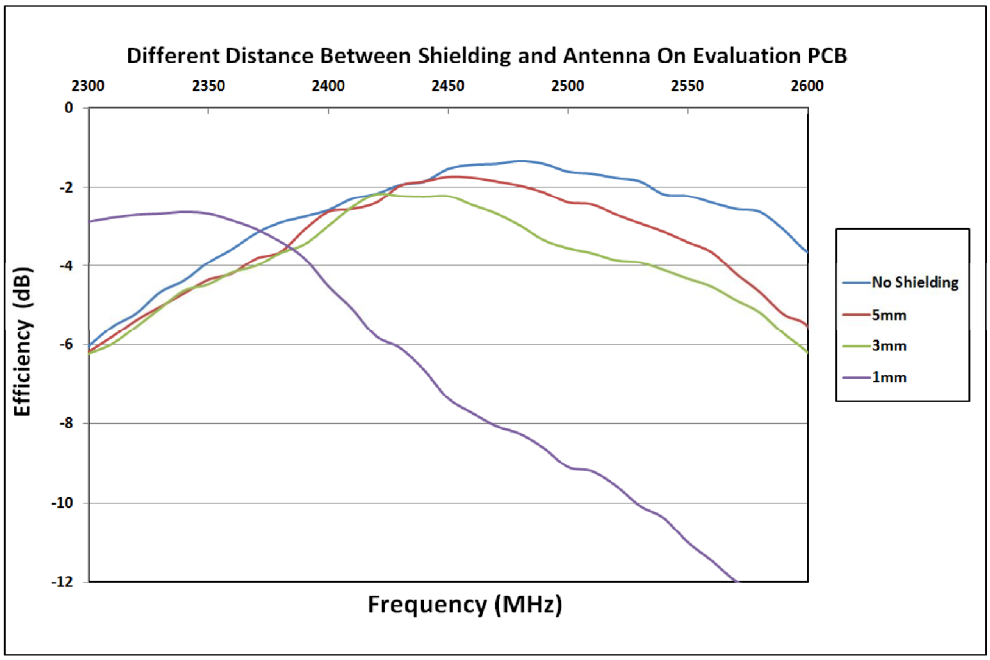


FIGURE 4.2.2 EFFICIENCY COMPARISON AT 2.4GHZ OF SHIELDING CAN DISTANCE FROM ANTENNA

**4.0.3 RF PERFORMANCE AS AN EFFECT OF NEARBY BATTERY**
A battery with size of 30mm*60mm*2mm was used for this study.

The effect of battery is evaluated with 3 different distances from the antenna which is located at the recommended location. The 3 distances are as follow: 1mm, 3mm and 5mm.

From the study, we recommend that a battery should be placed at least 5mm away from the antenna. When the distance is less than 5mm, the antenna performance will be significantly degraded. Refer to figure 4.3.1-4.3.2

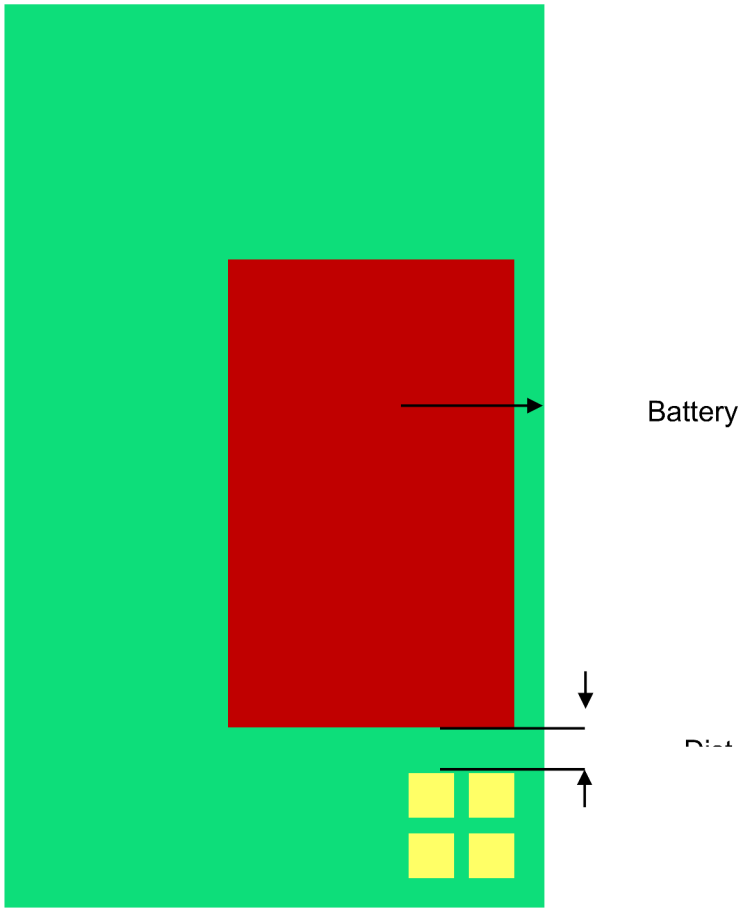


**FIGURE 4.3 BATTERY FIXED ON REFERENCE PCB**

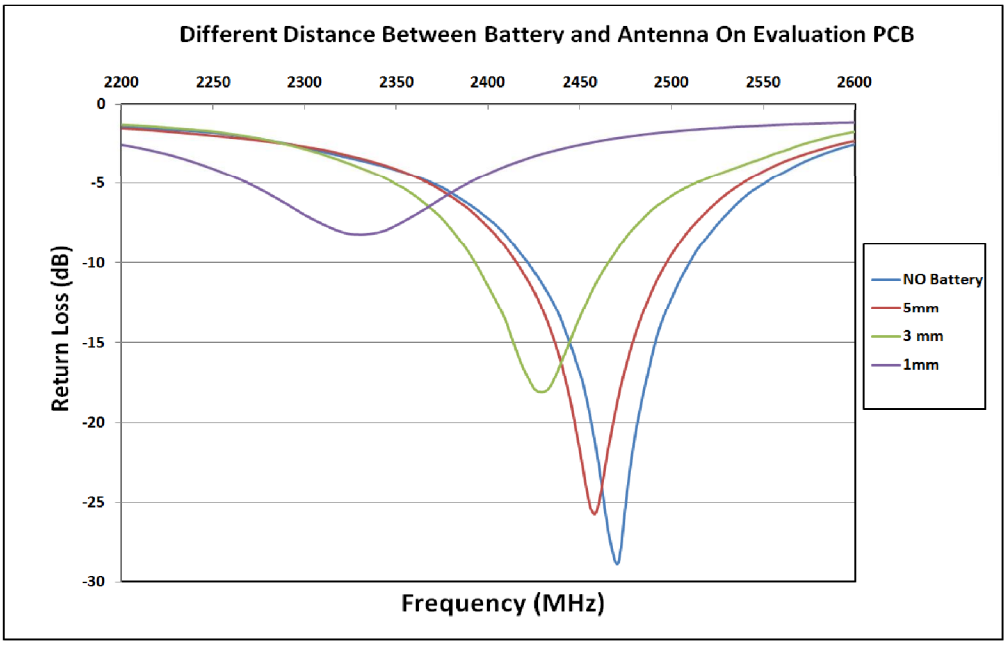


**FIGURE 4.3.1 RETURN LOSS COMPARISON AT 2.4GHZ OF BATTERY DISTANCE FROM ANTENNA**

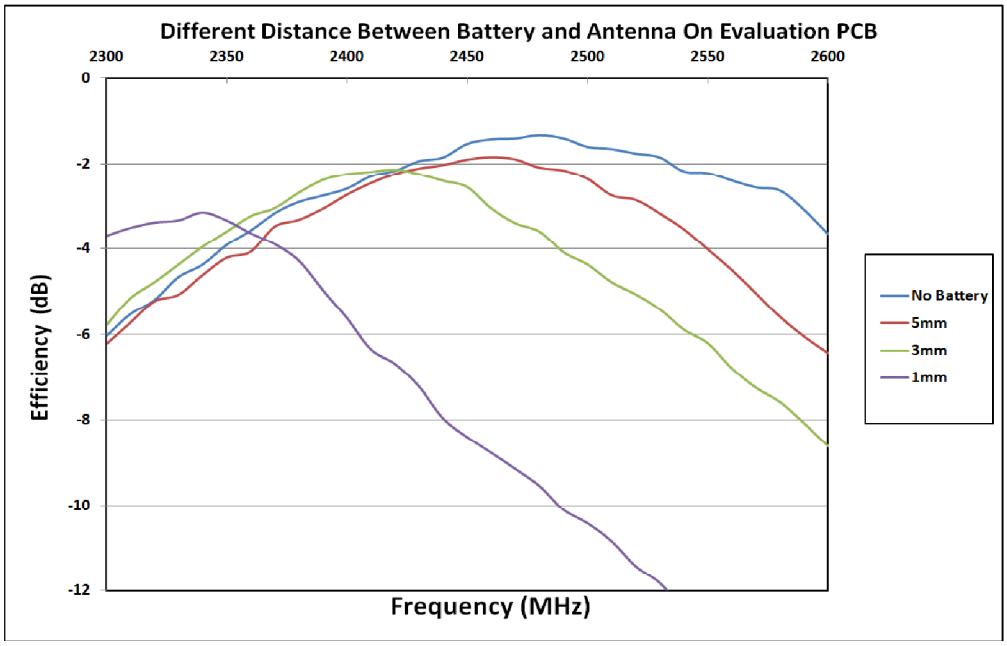


**FIGURE 4.3.2 EFFICIENCY COMPARISON AT 2.4GHZ OF BATTERY DISTANCE FROM ANTENNA**

## 5.0 MATCHING NETWORK DESRICPTION

The “L” type matching circuit is recommended to be applied for this antenna at the recommended position on reference PCB. The sequence of series element and parallel element depends on the impedance of antenna in smith chart shown in Figure 5.1. Figure 5.2 shows the matching network for this antenna at 2.4GHz at the recommended position on reference PCB. The matching network is a series 1.8nH inductor following with a parallel 1.3pF capacitor for 2.4GHz band.

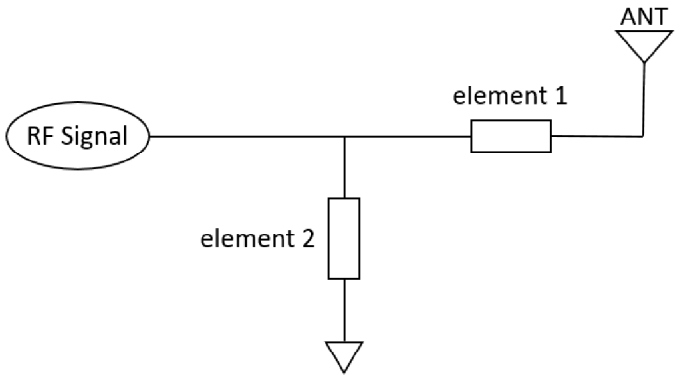


**FIGURE 5.1 CONFIGURE 1 FOR 2.4GHZ**

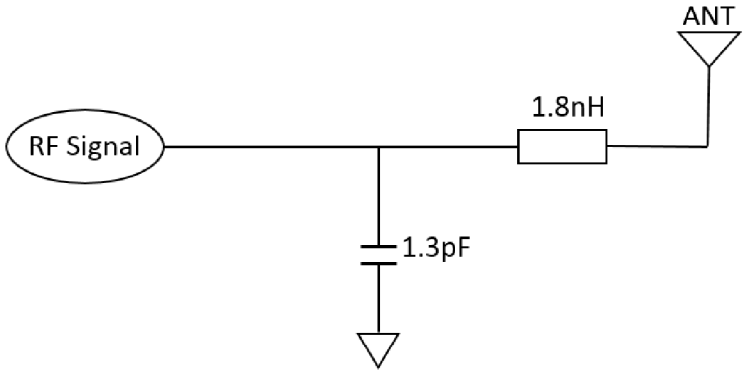


**FIGURE 5.2 RECOMMEND MATCHING NETWORK FOR ANTENNA AT 2.4GHZ BAND**

The following figure 5.3 and figure 5.4 are the return loss and smith chart comparison with and without the matching network for the antenna at 2.4GHz on reference PCB ground size and at reference location.


**FIGURE 5.3 RETURN LOSS OF ANTENNA WITH AND WITHOUT MATCHING ON REFERENCE PCB GROUND SIZE AT REFERENCE**

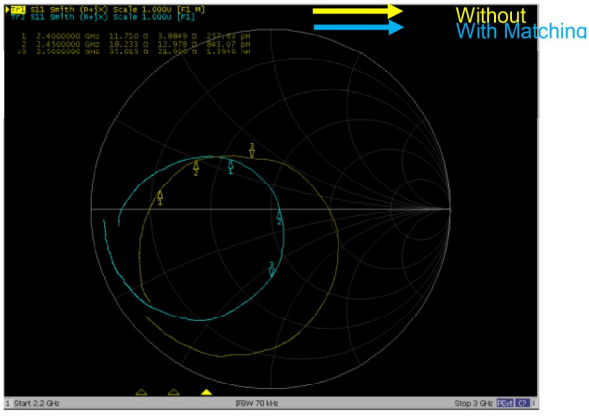


**FIGURE 5.4 SMITH CHART OF ANTENNA WITH AND WITHOUT MATCHING ON REFERENCE PCB GROUND SIZE AT REFERENCE LOCATION**

## 6.0 RADIATION PATTERN

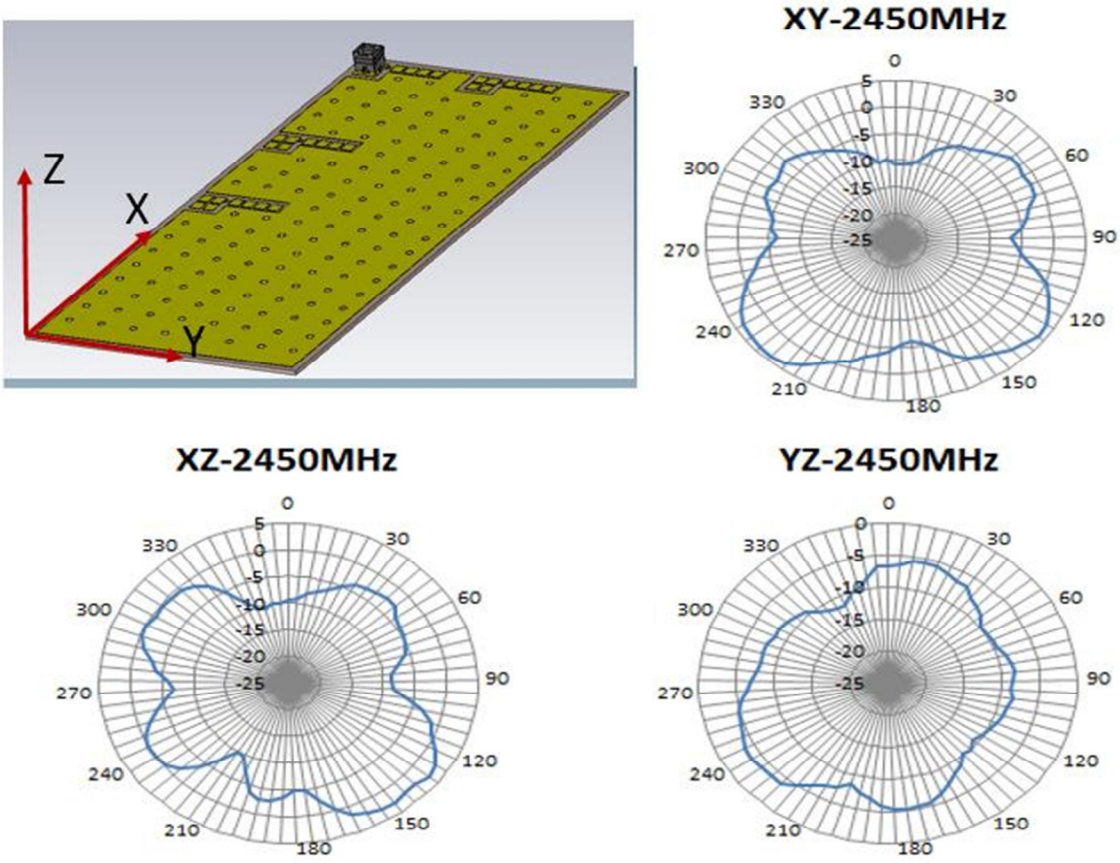


**FIGURE 6.1 RADIATION PATTERN OF ATNENNA AT 2.4GHZ AT RECOMMENDED LOCATION**

## 7.0 ASSEMBLY INSTRUCTIONS

### A. RECOMMENDED SMT REFLOW PROFILE

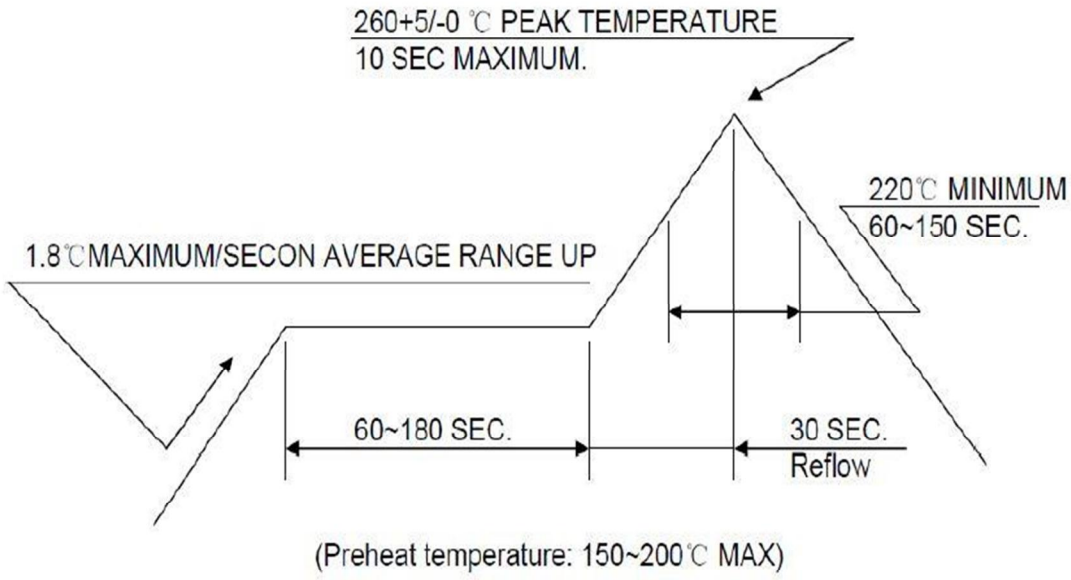


**FIGURE 7.1 RECOMMENDED SMT REFLOW PROFILE**

## B. MECHANICAL INTERFACE

### I. GENERAL DESCRIPTION

The overall antenna size is 3mm × 3mm × 4mm

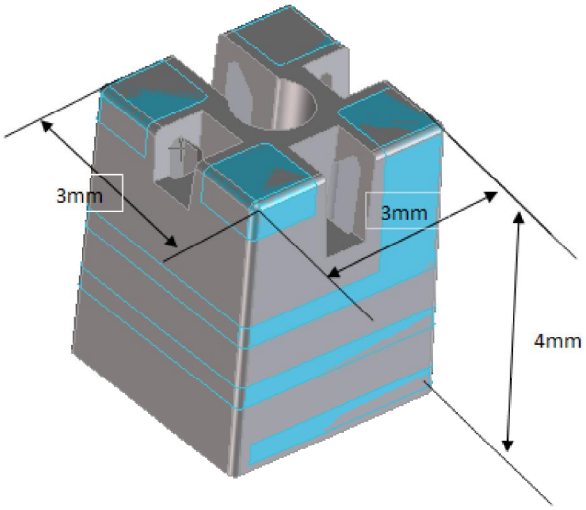


**FIGURE 7.2 OVERALL ANTENNA SIZE**

### II. STRUCTURE FUNCTIONAL DESCRIPTION

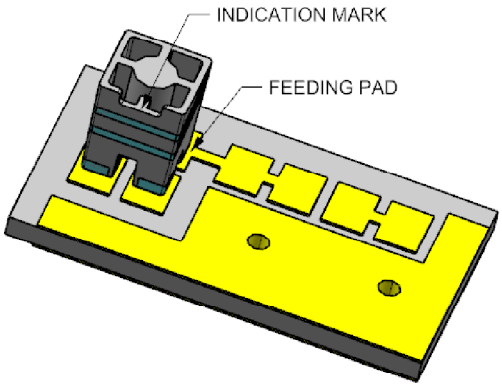


**FIGURE 7.3 ANTENNA ASSEMBLY**

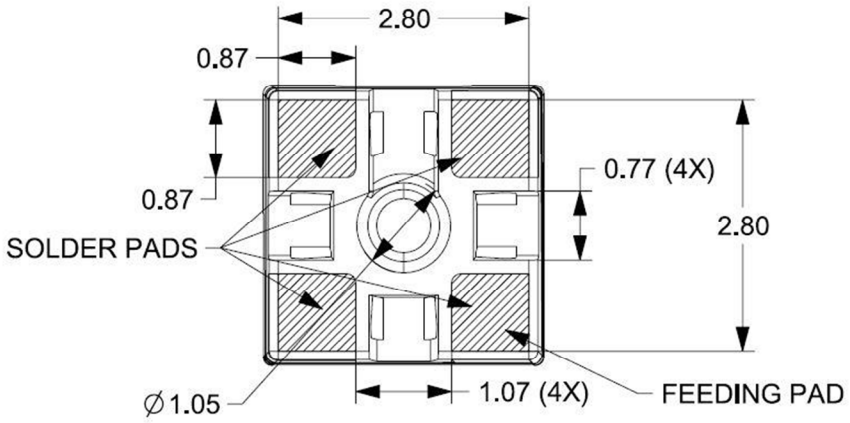


**FIGURE 7.4 PADS OF PRODUCT FOR SOLDERING**

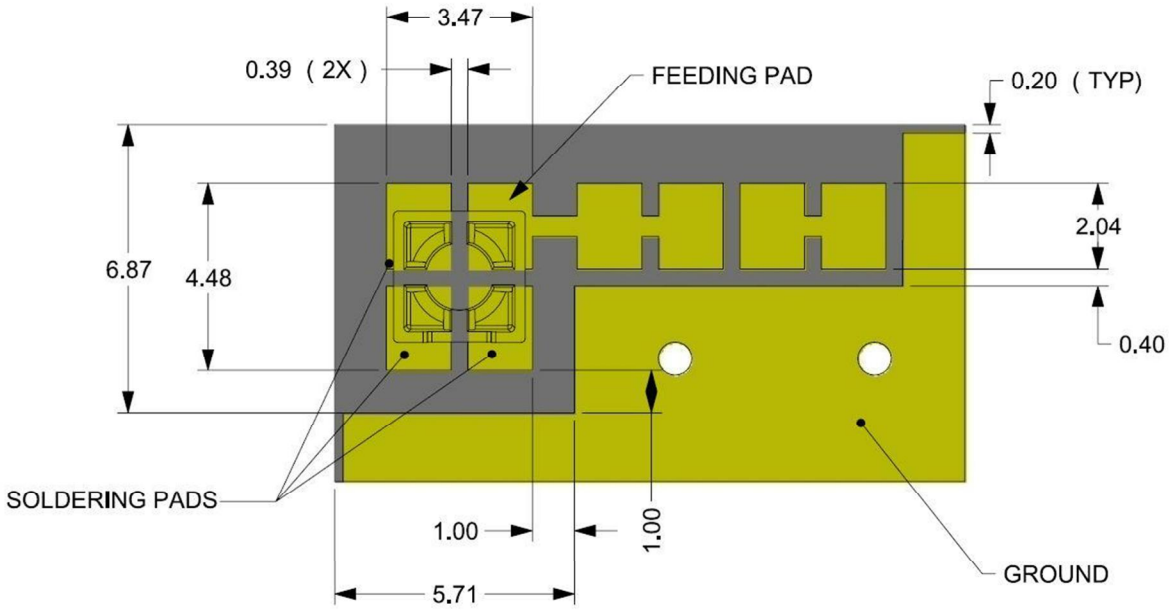


**FIGURE 7.5 RECOMMENDED FOOTPRINT ON PCB FOR SOLDERING**