



# APPLICATION SPECIFICATION

## WIFI TRIPLE BAND (900MHZ/2.4GHZ/5GHZ) SMT ANTENNA

### 1.0 SCOPE

This specification describes the antenna application and recommended PCB layout for the Molex WIFI Triple Band (900MHz/2.4GHz/5GHz) 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

The antenna part design is based on carrier size 20mm x 5mm x 4mm (Length\*Width\* Height). There are one feeding pad, one grounding pad, three fixing pads and one antenna radiator. See figure 1.

**1. FEEDING PAD**

SMT mounted to feeding pad on PCB. The signal from the transmission line must feed into the feeding pad on the PCB.

**2. GROUNDING PAD**

SMT mounted to grounding pad on PCB.

**3. FIXING PAD**

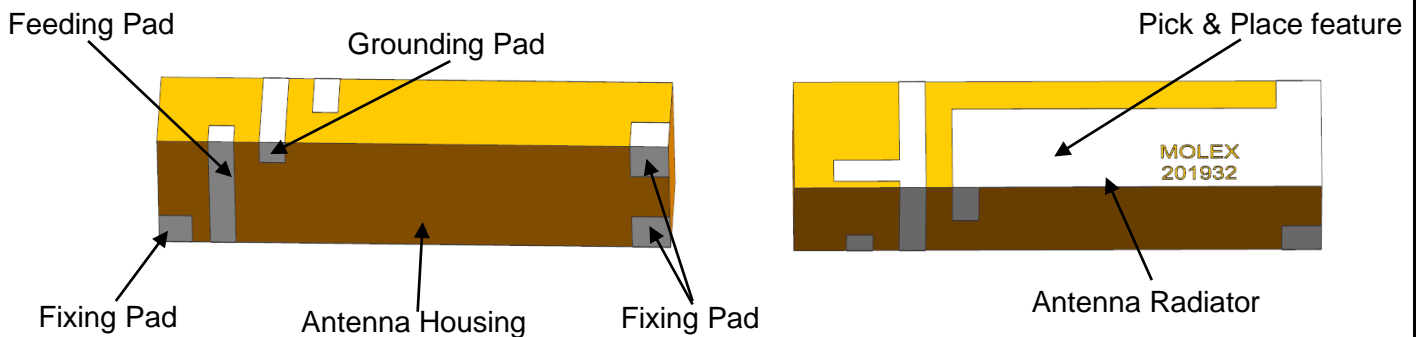
SMT mounted to dummy pads on PCB. Anchoring the antenna to the PCB.

**4. ANTENNA RADIATOR**

To act as a transducer that converts unguided electromagnetic wave to guided electromagnetic wave and vice versa.

**5. PICK AND PLACE FEATURE**

To enable the antenna to be picked up by SMT machine pick up nozzle.



**FIGURE 1. WIFI TRIPLE BAND (900MHZ/2.4GHZ/5GHZ) SMT ANTENNA**

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DOCUMENT NUMBER: <b>AS-2019320001</b>	CREATED / REVISED BY: <b>Benson Liu 2017/06/08</b>	CHECKED BY: <b>Chris Zhong 2017/06/08</b>	APPROVED BY: <b>Welson Tan 2017/06/08</b>

## B. REFERENCE IMPLEMENTATION

### I. REFERENCE PCB DESCRIPTION

There are two different PCB sizes in this design. The big size PCB part design is based on a recommended double sided PCB size of 150\*100\*0.8mm. The small size PCB part design is based on a recommended double sided PCB size of 35mm\* 20mm \*0.8mm. There are one feeding pad, one ground pad and three fixing pads. Furthermore there is a “pi” type matching network reserved close to feeding pad. See figure 2.

#### 1. FEEDING PAD

The signal from transmission line must be fed into the feeding pad.

#### 2. GROUNDING PAD

The antenna must be SMT mounted to grounding pad on PCB.

#### 3. MATCHING CIRCUIT

It is necessary to reserve PCB space for a “pi” type matching circuit in this design. In order to adjust the return loss due to loading by the device housing and surrounding component, the matching circuits need to be changed according.

### II. REFERENCE PCB DESCRIPTION

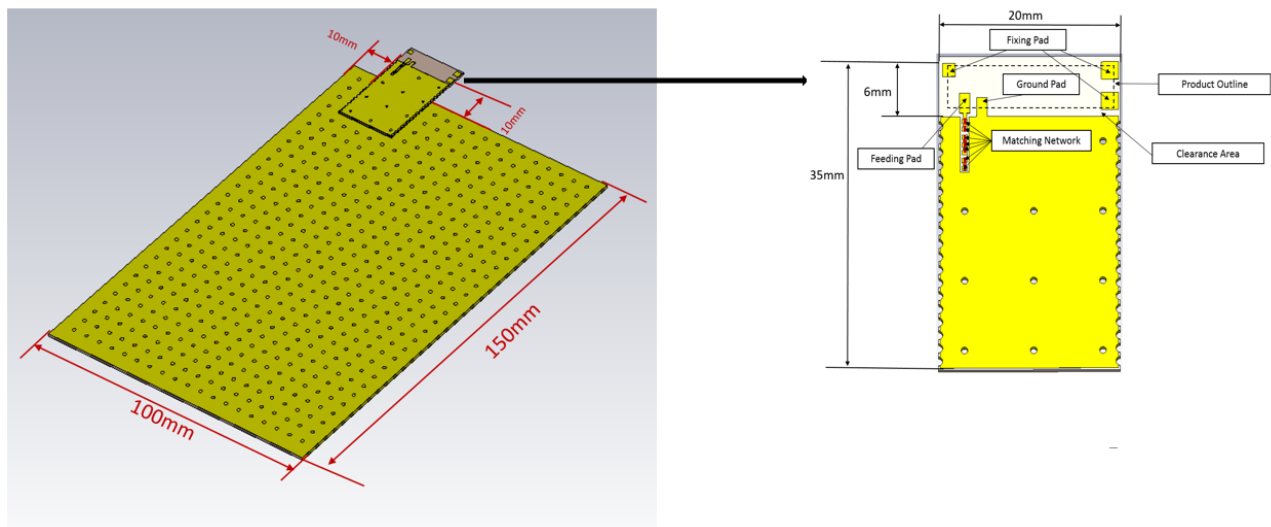


FIGURE 2 RECOMMENDED PCB LAYOUT

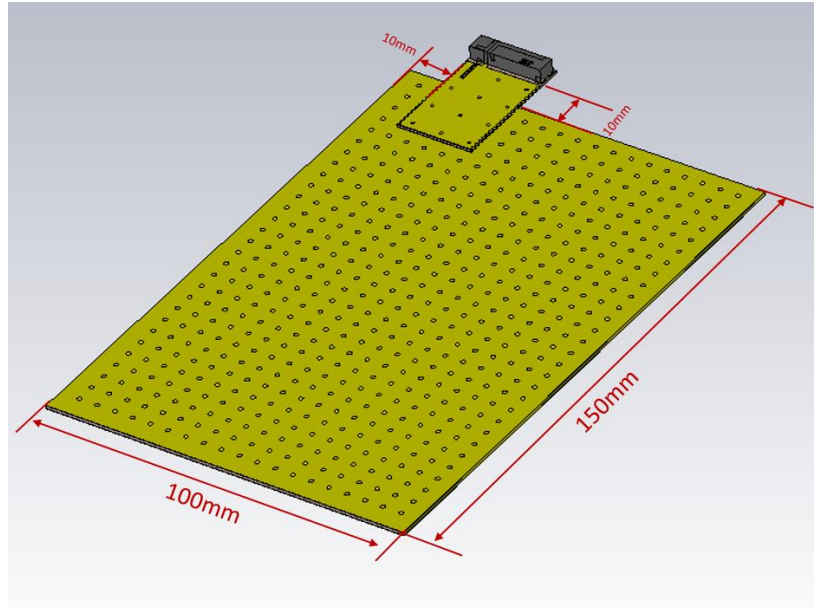
REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 117699 DATE: 2017/06/08	TITLE: <b>WIFI Triple Band (900MHz/2.4GHz/5GHz) SMT Antenna Application Specification</b>	SHEET No. <b>2 of 17</b>
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## III. ANTENNA PERFORMANCE AT RECOMMENDED LOCATION

The recommended antenna location is just as shown in Figure 2.1



(Note: PCB Ground Size of 100x150x0.8mm)

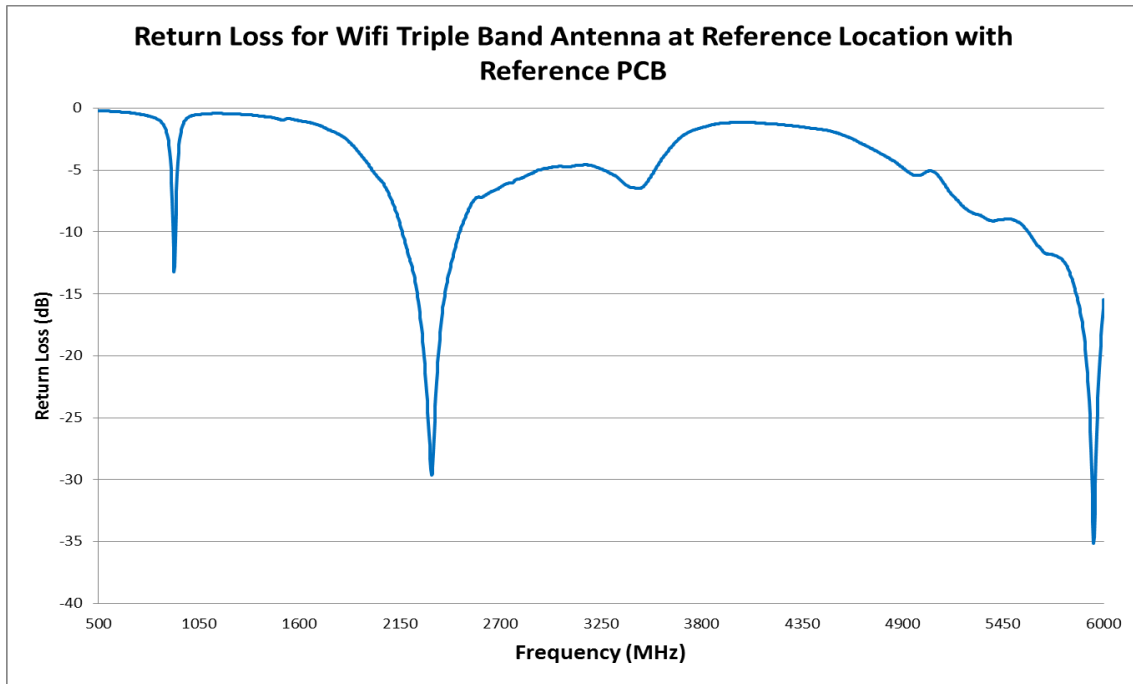
Figure 2.1 REFERENCE ANTENNA LOCATION

DESCRIPTION	Test Condition	Requirements		
		900-924MHz	2.4-2.5GHz	5.15-5.85GHz
Frequency Range	Measure antenna on recommended PCB through VNA E5071C	900-924MHz	2.4-2.5GHz	5.15-5.85GHz
Return Loss	Measure antenna on recommended PCB through VNA E5071C	<-5dB	<-6dB	<-5dB
Peak Gain(Max)	Measure antenna on recommended PCB through OTA chamber	0.7dBi	4.2dBi	4.5dBi
Avg. Total Efficiency	Measure antenna on recommended PCB through OTA chamber	>40%	>65%	>55%
Polarization	Measure antenna on recommended PCB through OTA chamber	Linear	Linear	Linear
Input Impedance	Measure antenna on recommended PCB through VNA E5071C	50 Ohms	50 Ohms	50 Ohms

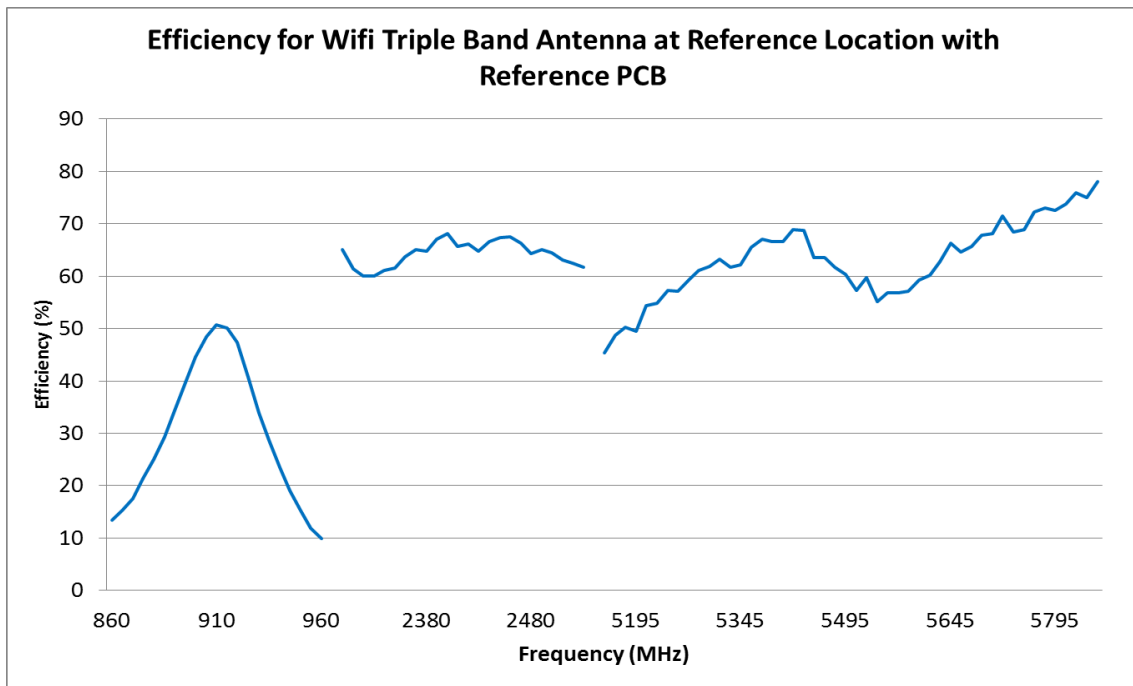
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**FIGURE 2.2 RETURN LOSS FOR ANTENNA AT REFERENCE LOCATION WITH REFERENCE PCB**

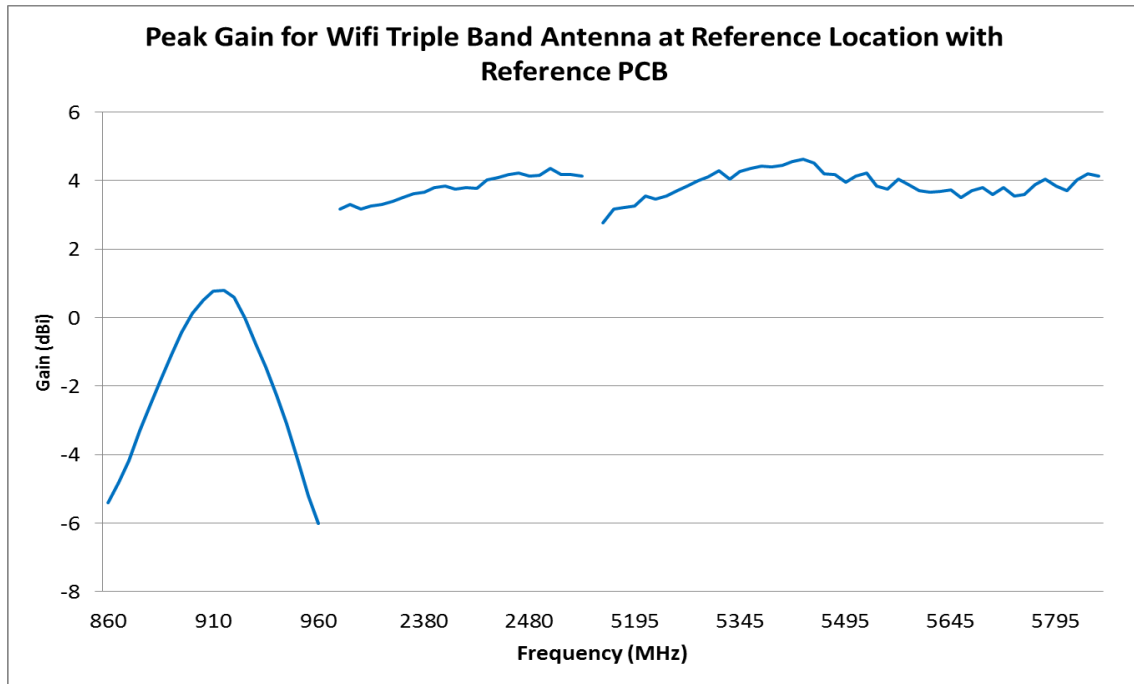


**FIGURE 2.3 EFFICIENCY FOR ANTENNA AT REFERENCE LOCATION WITH REFERENCE PCB**

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**FIGURE 2.4 PEAK GAIN FOR ANTENNA AT REFERENCE LOCATION WITH REFERENCE PCB**

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## 3.0 REFERENCE DOCUMENTS

- Sales Drawing: SD-2019320001
- Product Specification: PS-2019320001
- Packaging Information – Refer to the Molex related packaging drawings.

## 4.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

### 4.1 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT LOCATIONS ON THE REFERENCE PCB

Four different distances between the antenna and the big PCB have been evaluated RF performance and these locations are shown in figure 4.1. The figures 4.1.1-4.1.3 are shown the return loss, efficiency and peak gain at four locations.

From the study, we recommend that the distance should be at least 5mm. When the distance is less than 5mm, the performance will be significantly decreased.

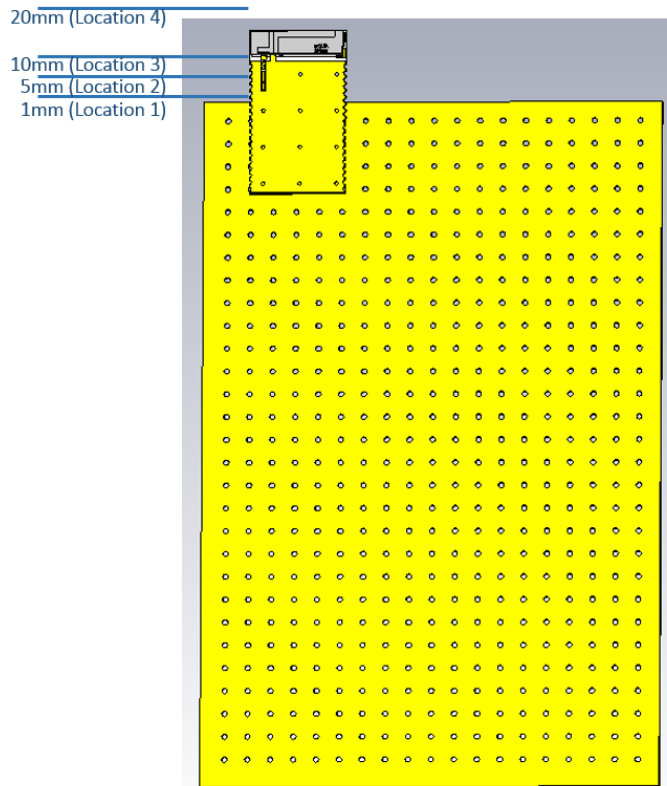
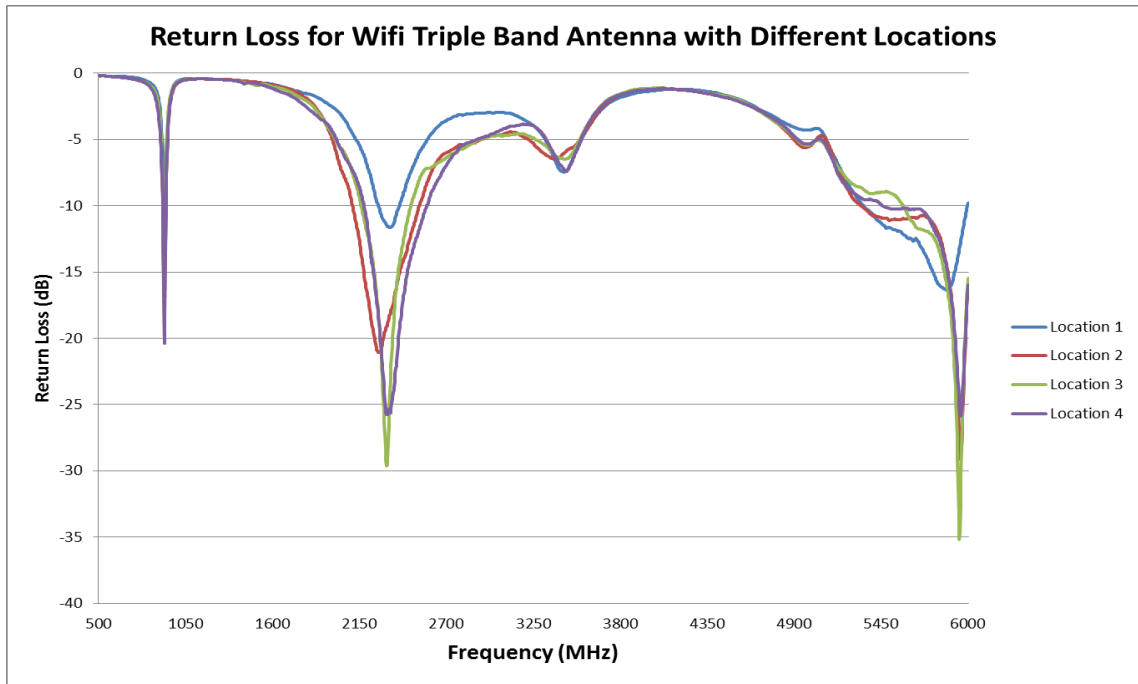


FIGURE 4.1 FOUR LOCATIONS ON REFERENCE PCB

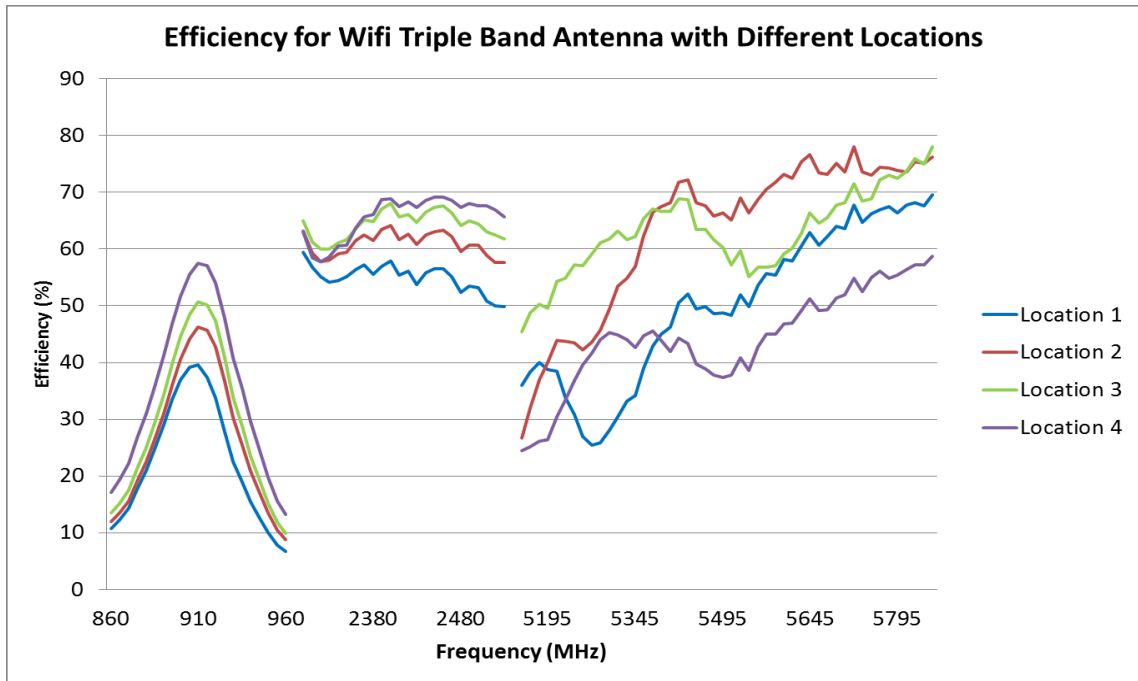
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**Figure 4.1.1 RETURN LOSS FOR ANTENNA WITH DIFFERENT LOCATIONS**

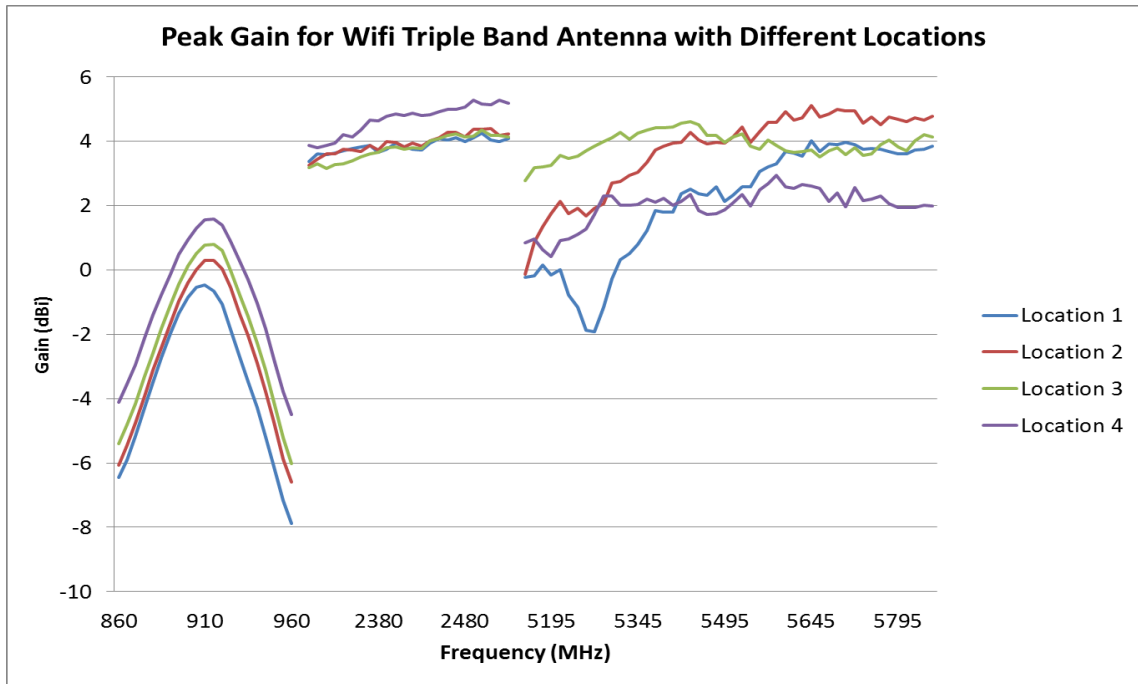


**Figure 4.1.2 EFFICIENCY FOR ANTENNA WITH DIFFERENT LOCATIONS**

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**Figure 4.1.3 PEAK GAIN FOR ANTENNA WITH DIFFERENT LOCATIONS**

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## 4.2 RF PERFORMANCE AS AN EFFECT OF PCB GROUND SIZES

4 kinds of big PCB ground plane sizes have been evaluated and these configurations are shown in figure 4.2. The figures 4.2.1-4.2.3 show the return loss, efficiency and peak gain of this antenna with 4 kinds of big PCB ground size.

The recommended minimum big PCB ground size for this antenna is 50mm\*100mm. When the big PCB ground size is less than 50mm\*100mm, the performance will be significantly decreased.

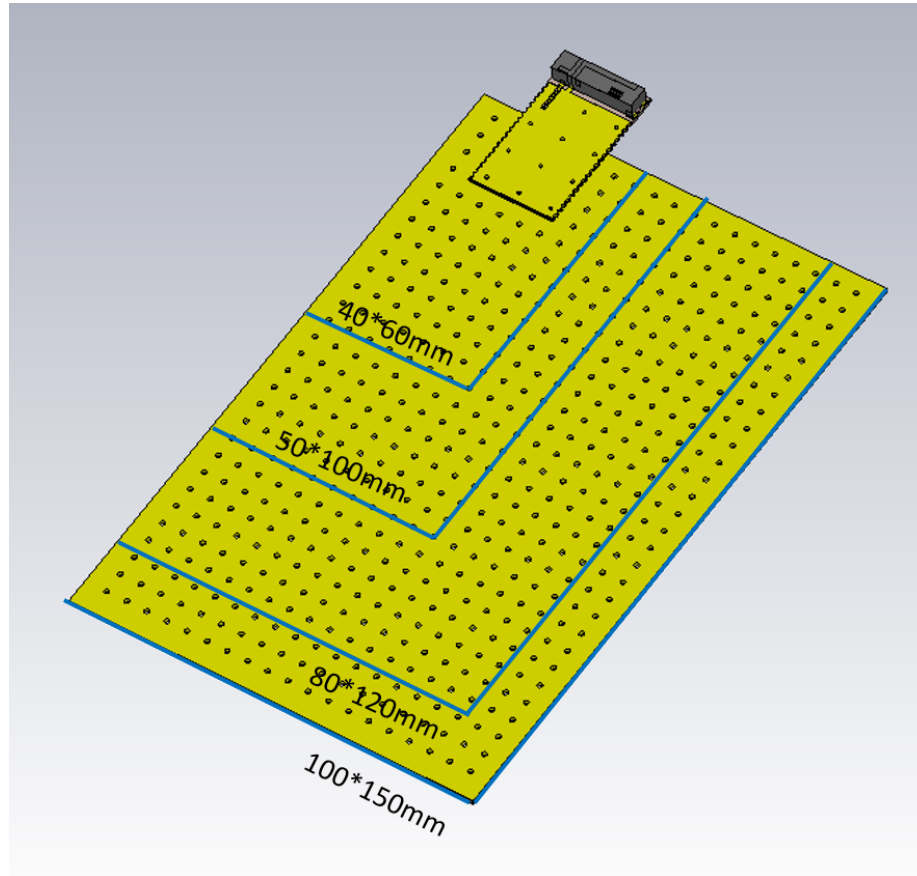
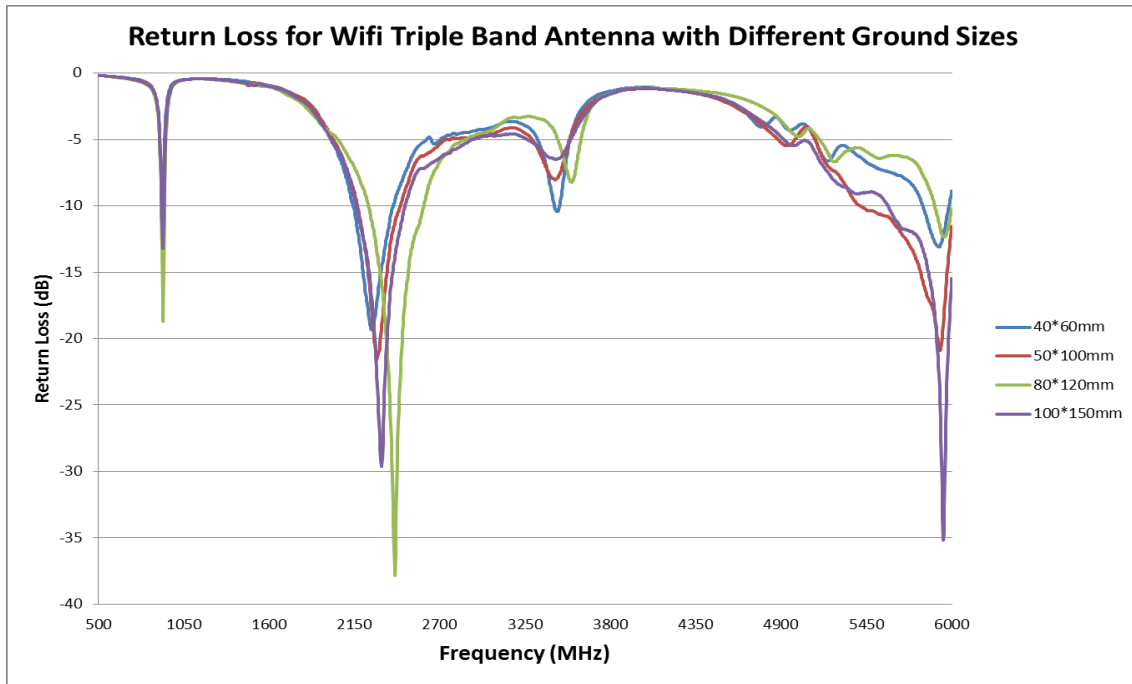


Figure 4.2 FOUR KINDS OF BIG PCB GROUND PLANE SIZES

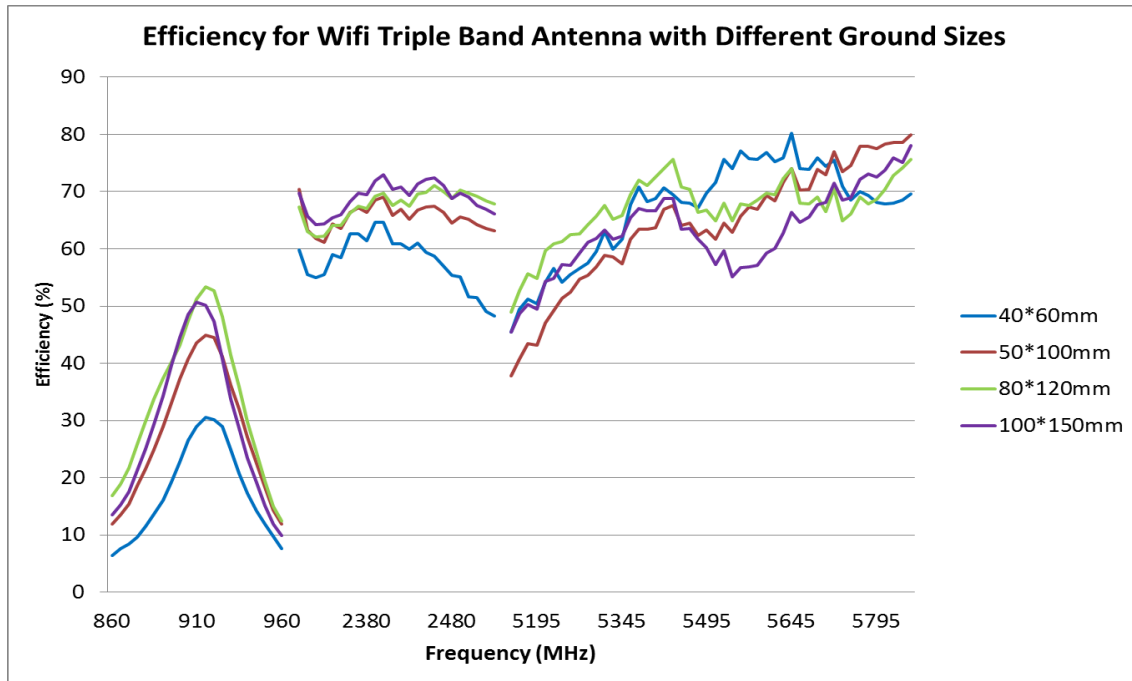
REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 117699 DATE: 2017/06/08	TITLE: <b>WIFI Triple Band (900MHz/2.4GHz/5GHz) SMT Antenna Application Specification</b>		SHEET No. <b>9 of 17</b>
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**FIGURE 4.2.1 RETURN LOSS FOR ANTENNA WITH DIFFERENT GROUND SIZES**

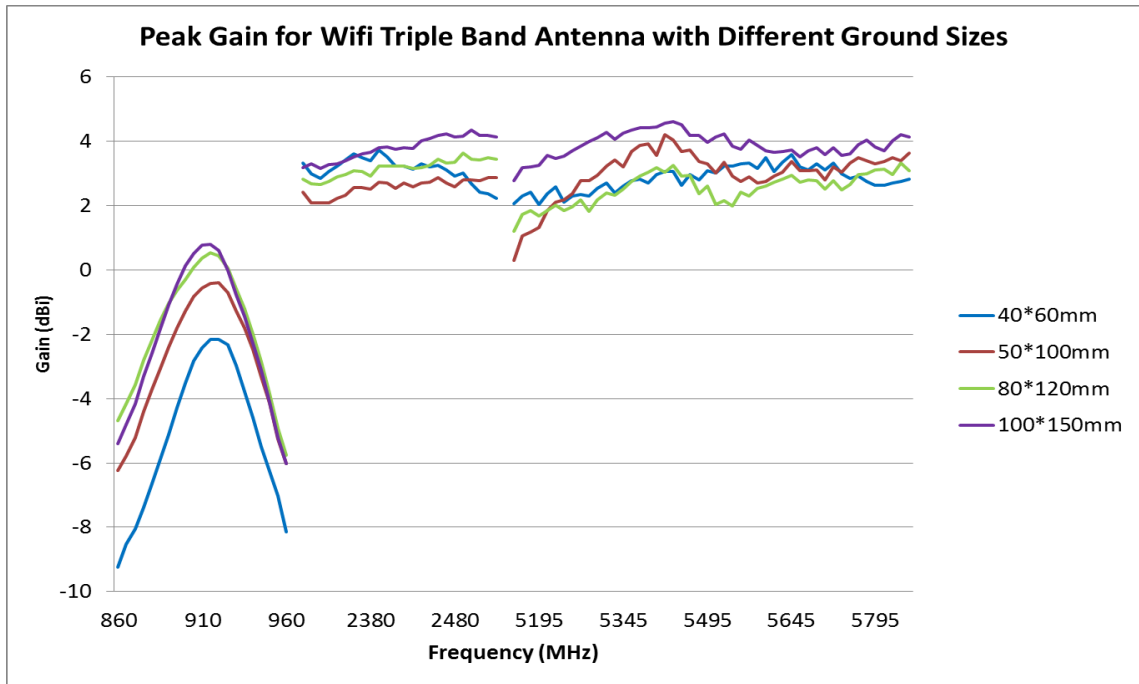


**FIGURE 4.2.2 EFFICIENCY FOR ANTENNA WITH DIFFERENT GROUND SIZES**

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**FIGURE 4.2.3 PEAK GAIN FOR ANTENNA WITH DIFFERENT GROUND SIZES**

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## 5.0 MATCHING NETWORK DESCRIPTION

A matching circuit is needed if the resonance frequency needs adjustment due to loading by the device housing and surrounding components effect.

Two matching configurations as shown in Figure 5.1 and Figure 5.2 are recommended for signal 900MHz band and 5GHz band matching, respectively. The combination of these two configurations can be applied for both of the two bands matching at the same time, which can be seen in Figure 5.3.

Take configuration 1 for example, the matching network is a series capacitor followed with a parallel inductor. The sequence of series capacitor and parallel inductor depends on the resistance of antenna in smith chart. Furthermore, in some case, only one series capacitor or a parallel inductor can achieve matching purpose. These tips can also be used for configure 2 and the combination topology are shown in Figure 5.3.

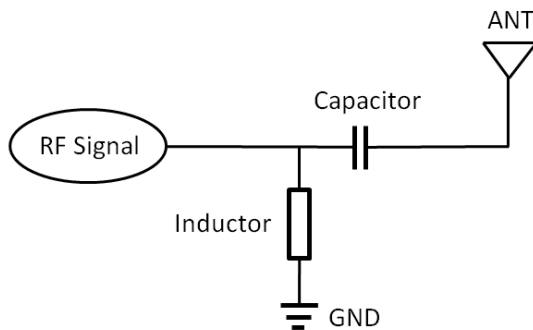


FIGURE 5.1 CONFIG 1 FOR 900MHZ BAND

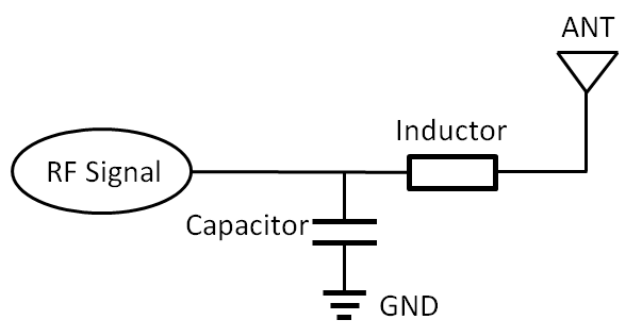


FIGURE 5.2 CONFIG 2 FOR 5GHZ BAND

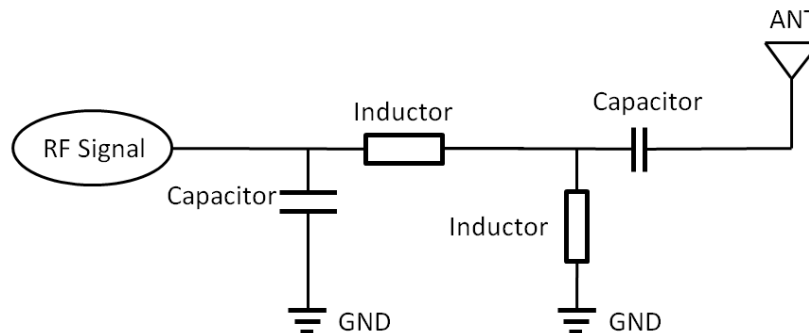


FIGURE 5.3 MATCHING TOPOLOGY FOR BOTH 900MHZ AND 5GHZ BAND

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## 6.0 RADIATION PATTERN

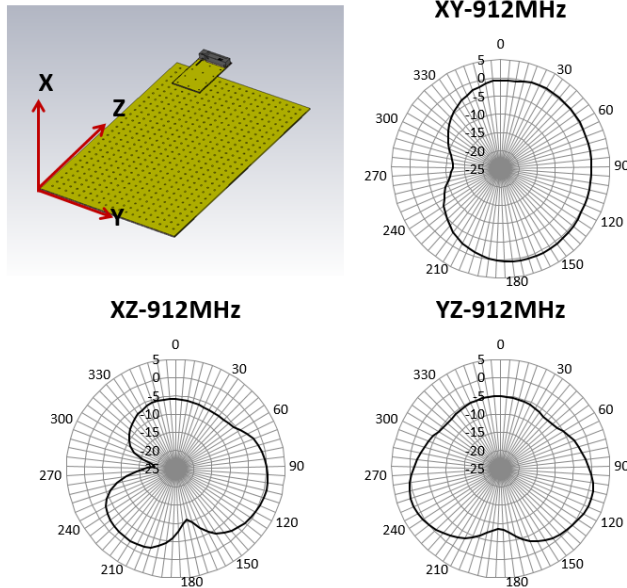


FIGURE 6.1 RADIATION PATTERN OF ATNENNA AT 912MHZ AT REFERENCE LOCATION

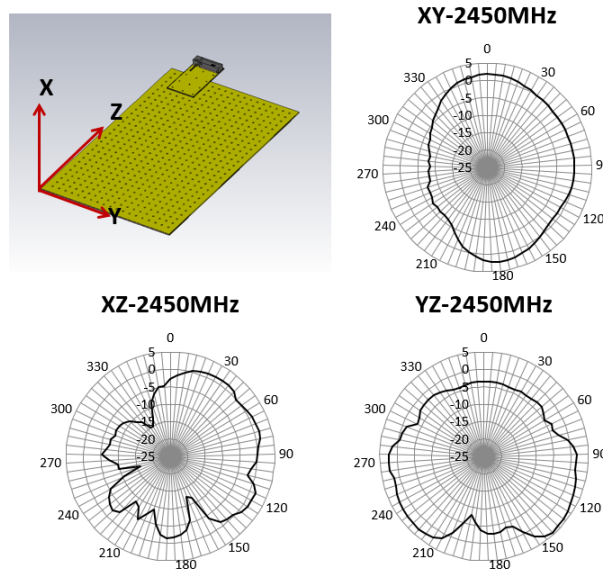


FIGURE 6.2 RADIATION PATTERN OF ATNENNA AT 2.45GHZ AT REFERENCE LOCATION

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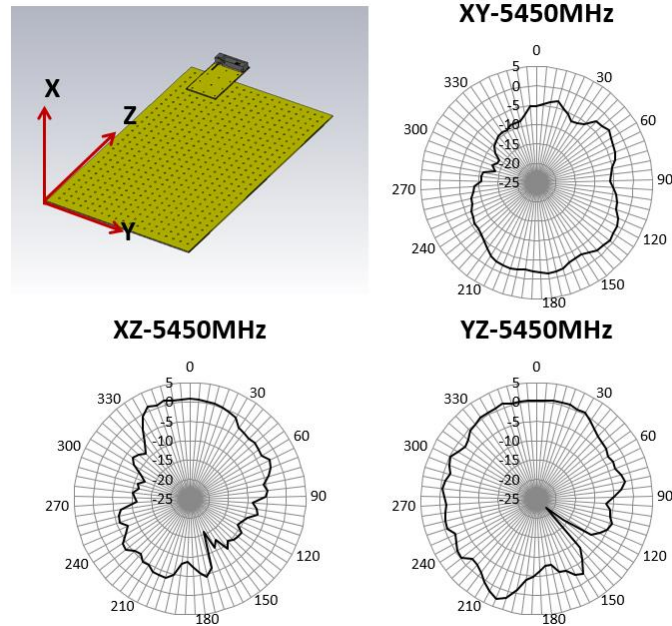


FIGURE 6.3 RADIATION PATTERN OF ANTENNA AT 5.45GHz AT REFERENCE LOCATION

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# APPLICATION SPECIFICATION

## 7.0 ASSEMBLY INSTRUCTIONS

### A. RECOMMENDED SMT REFLOW PROFILE

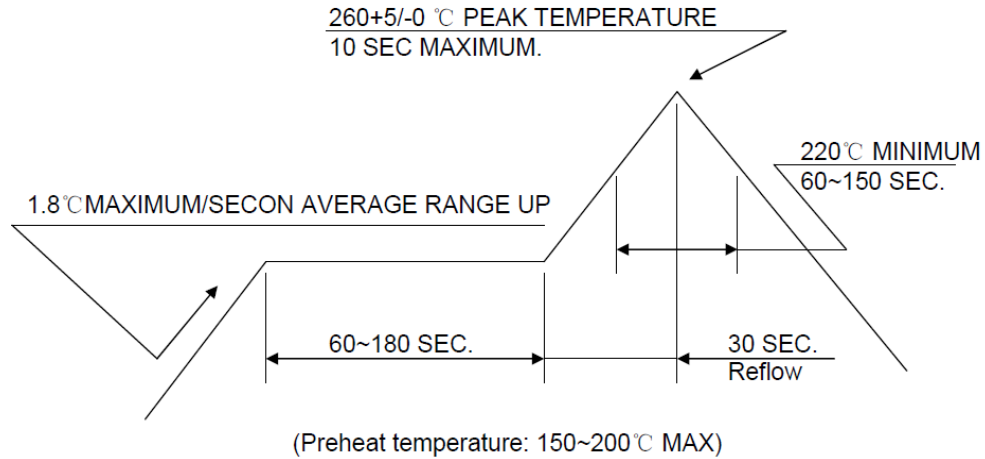


FIGURE 7.1 RECOMMENDED SMT REFLOW PROFILE

### B. MECHANICAL INTERFACE

#### I. GENERAL DESCRIPTION

The overall antenna size is 20mm x 5mm x 4mm

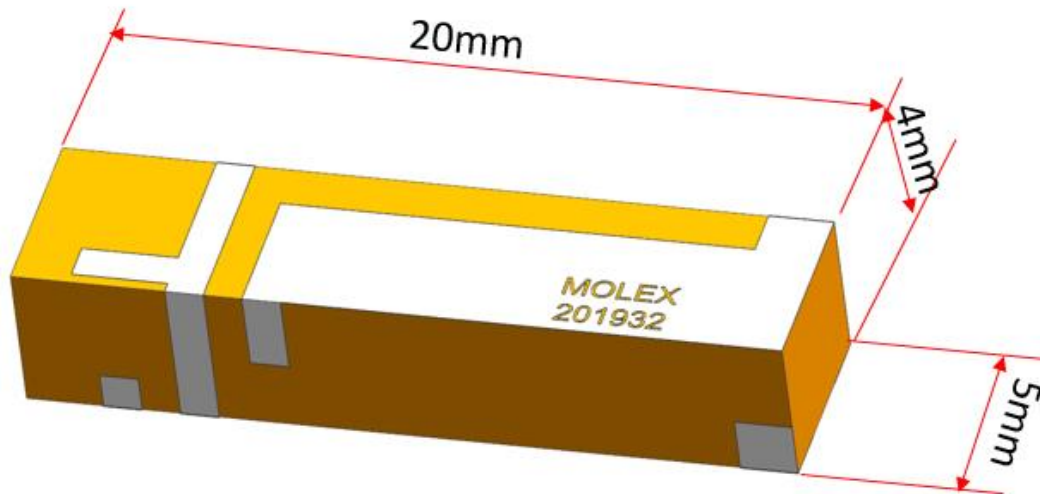
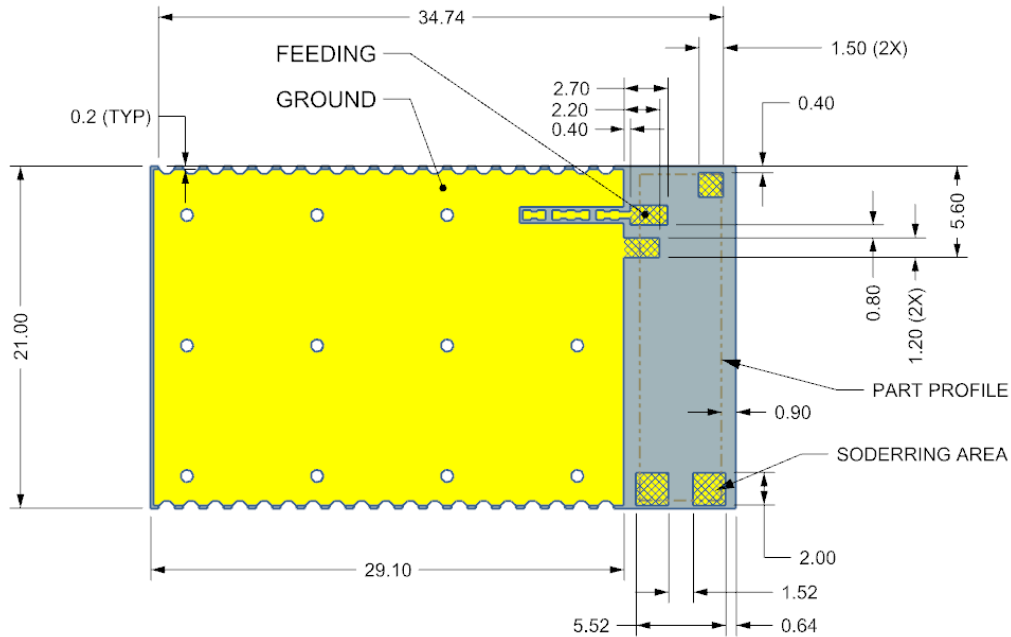


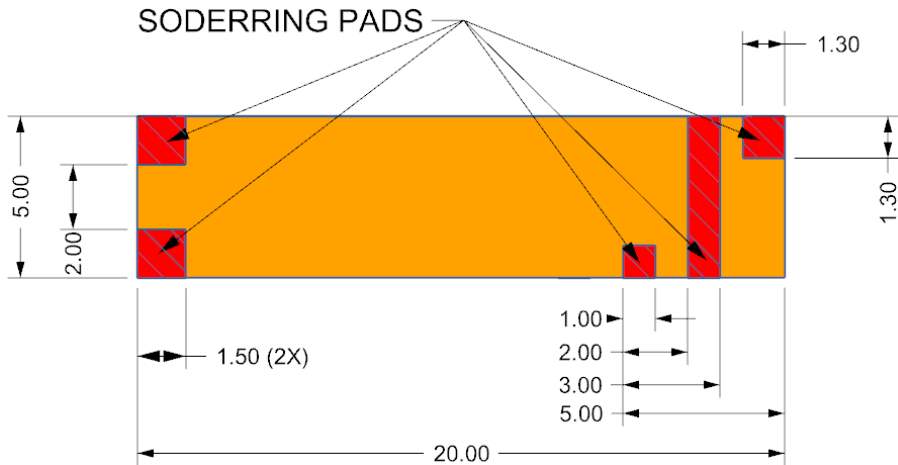
FIGURE 7.2 OVERALL ANTENNA SIZE

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## II. STRUCTURE FUNCTIONAL DESCRIPTION



**FIGURE 7.3 RECOMMENDED FOOTPRINT ON PCB FOR SOLDERING**



**FIGURE 7.4 PADS OF PRODUCT FOR SOLDERING**

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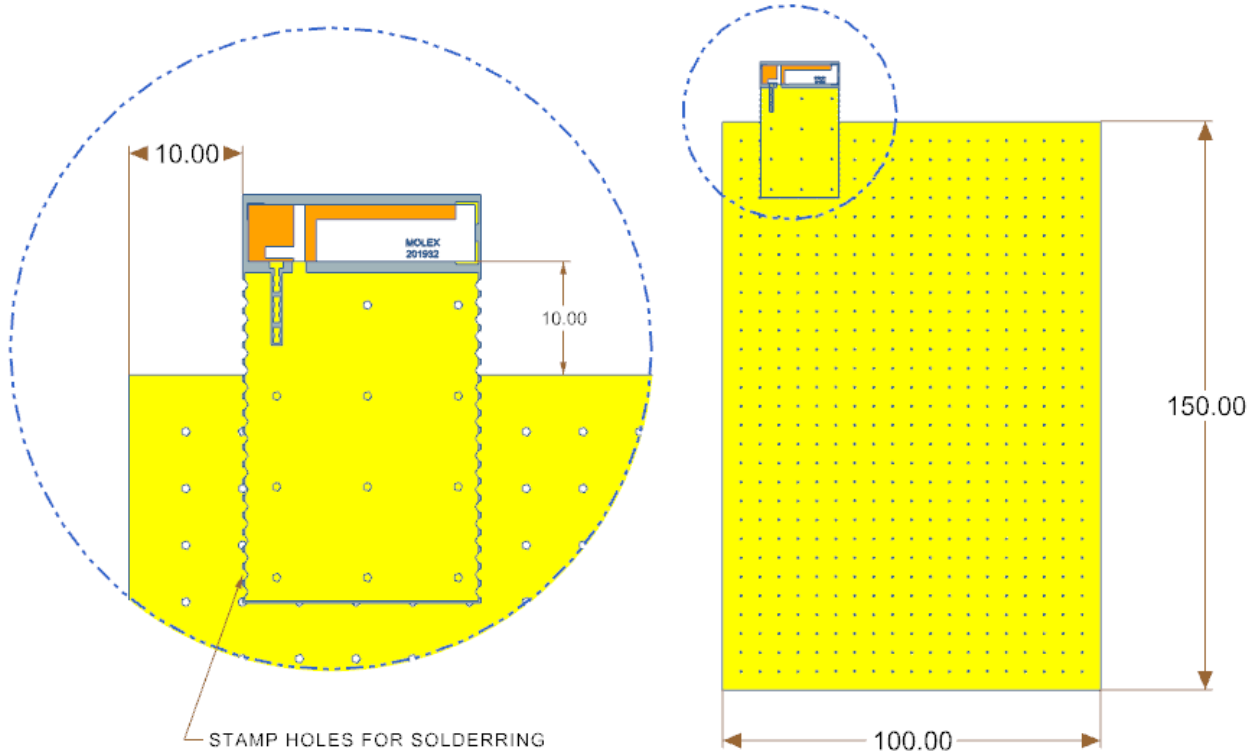


FIGURE 7.5 PCB ASSEMBLY LAYOUT

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