



# APPLICATION SPECIFICATION

## 2.4/5GHZ FLEXIBLE ANTENNA

### TABLE OF CONTENTS

1.0 SCOPE

2.0 PRODUCT DESCRIPTION

3.0 APPLICABLE DOCUMENTS

4.0 ANTENNA PERFORMANCE

5.0 ASSEMBLY GUIDELINE

6.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION



REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>1 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30

## 2.4/5GHZ FLEXIBLE ANTENNA

### 1.0 SCOPE

This specification describes the antenna application and surrounding. The information in this document is for reference and benchmark purposes only. The user is responsible for validating antenna RF performance based on the user's actual implementation.

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 DESCRIPTIO

#### 2.1 PRODUCT NAME AND SERIES NUMBER (S)

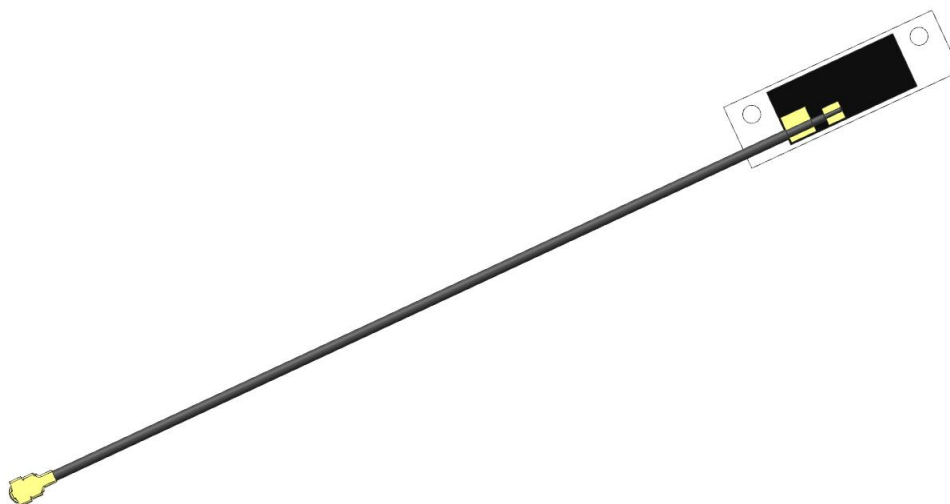
Product name: 2.4/5GHz Flexible Antenna  
Series Number: 206994

#### 2.2 DESCRIPTION

Series 206994 is a small monopole flexible antenna for 2.4/5GHz dual band. This antenna is made from poly-flexible material with small size 15.4\*6.4\*0.15mm, and has double-sided adhesive tape for easy "peel and stick" mounting.

#### 2.3 PRODUCT STRUCTURE INFORMATION

Please refer to PS-2069940100 for full information.



Molex 2069940100 2.4/5GHz Flexible Antenna 3D View

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>2 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30

### 3.0 APPLICABLE DOCUMENTS

Document	Number	Description
Sale Drawing(SD)	SD-2069940100	Mechanical Dimension of the product
Product Specification (PS)	PS-2069940100	Product Specification
Packing Drawing(PK)	PK-2069940100	Product packaging specifications

### 4.0 ANTENNA PERFORMANCE

#### 4.1 RF TEST CONDITIONS

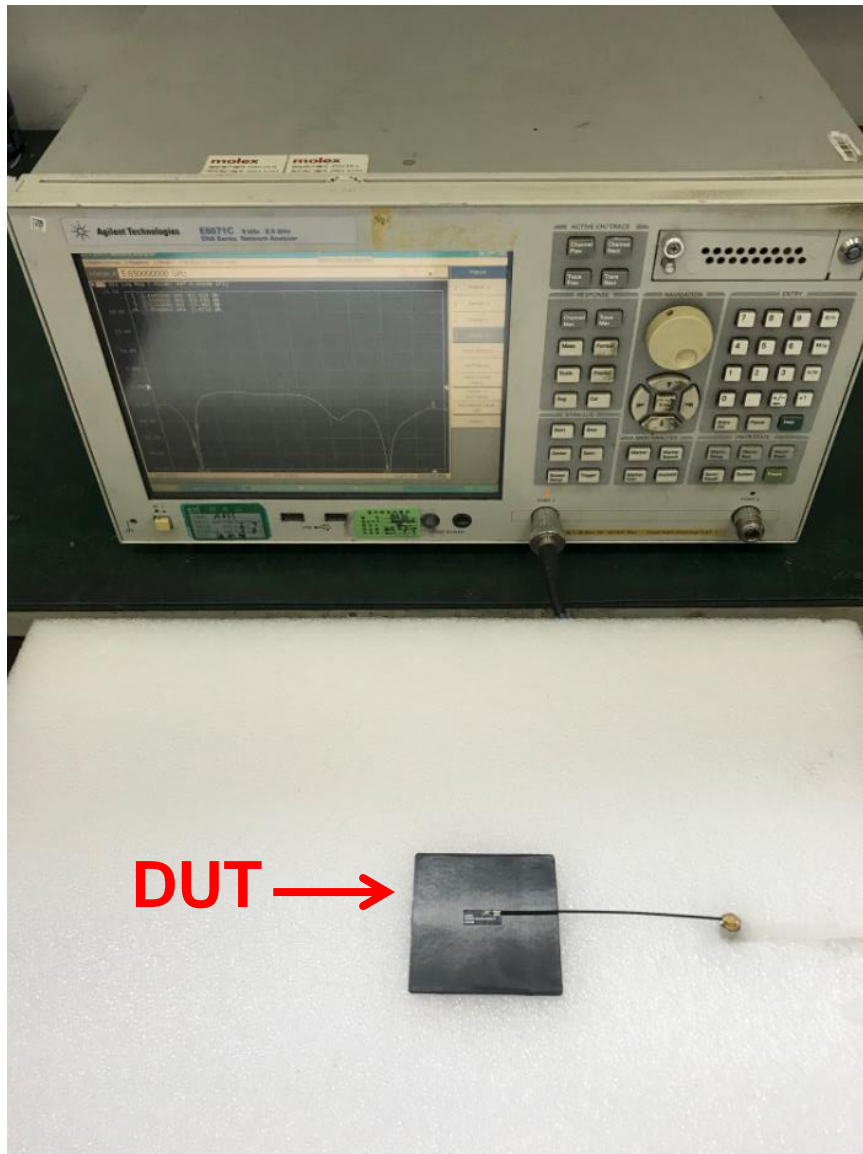
All measurements are done of the antenna mounted on a PC/ABS material block of 2mm thickness with VNA Agilent 5071C and Over-The-Air (OTA) chamber. All measurements in this document are done with the part no.2069940100 with a cable length of 100mm.



**FIGURE4.1.1 ANTENNA LOADED WITH PC/ABS BLOCK OF 2MM THICKNESS**



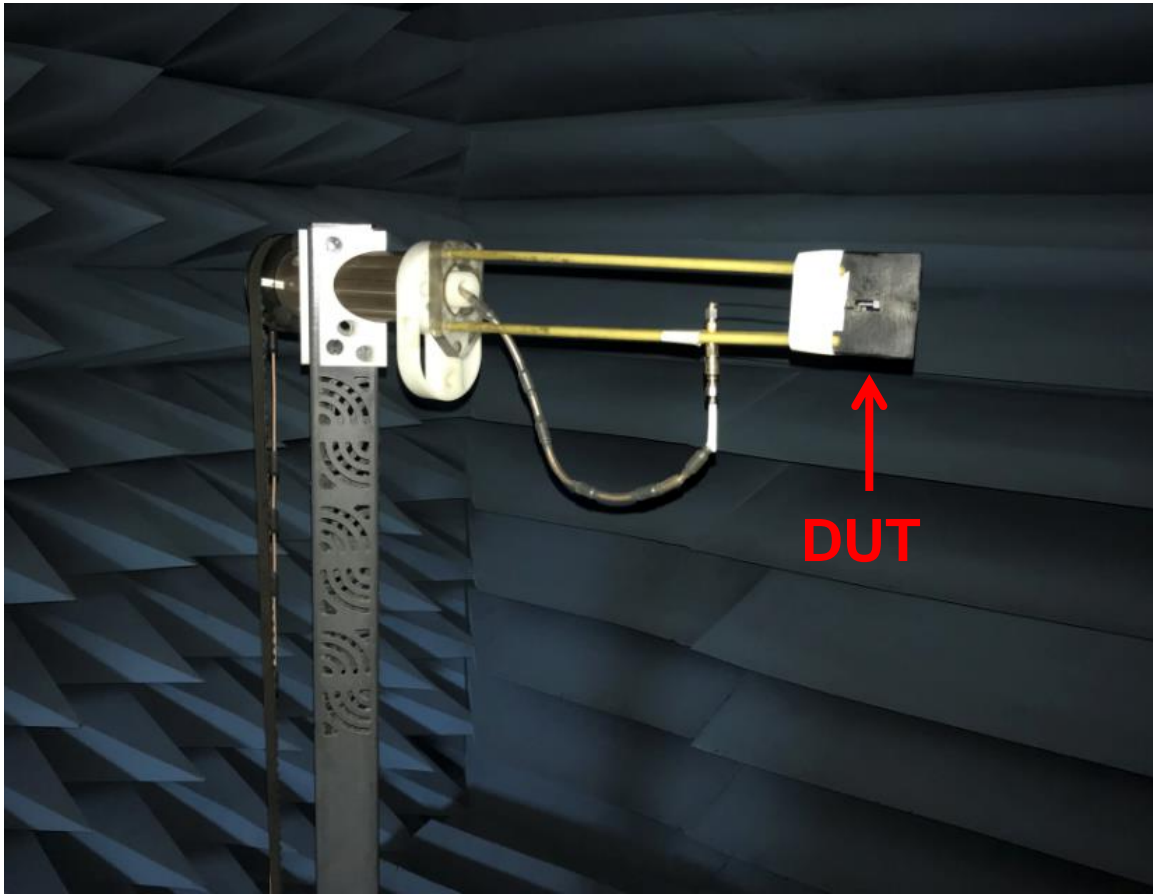
REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>3 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30



**FIGURE 4.1.2 ANTENNA LOADED WITH PC/ABS BLOCK OF 2MM THICKNESS TESTED WITH VNA E5071C**

PRE-RELEASE  
REFERENCE  
USE ONLY

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>4 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30



**FIGURE 4.1.3 ANTENNA LOADED WITH PC/ABS BLOCK OF 2MM THICKNESS TESTED IN OTA CHAMBER**

PRE-RELEASE  
REFERENCE  
USE ONLY

<b>REVISION:</b>  <b>A</b>	<b>ECR/ECN INFORMATION:</b> EC No: 173500 DATE: 2018/03/30	<b>TITLE:</b>  <b>2.4/5GHz Flexible Antenna</b>		<b>SHEET No.</b>  <b>5 of 21</b>
<b>DOCUMENT NUMBER:</b> <b>AS-2069940100</b>		<b>CREATED / REVISED BY:</b> Hai Liu 2018/03/30	<b>CHECKED BY:</b> Kang Cheng 2018/03/30	<b>APPROVED BY:</b> Chris Zhong 2018/03/30



# APPLICATION SPECIFICATION

## 4.2 ANTENNA PERFORMANCE

Description	Equipment	Requirement	
		Frequency Range	VNA E5071C
Return Loss	VNA E5071C	< -10 dB	<-5dB
Peak Gain (Max)	OTA Chamber	3.6dBi	3.6dBi
Average Total Efficiency	OTA Chamber	>55%	>70%
Polarization	OTA Chamber	Linear	
Input Impedance	VNA E5071C	50 ohms	

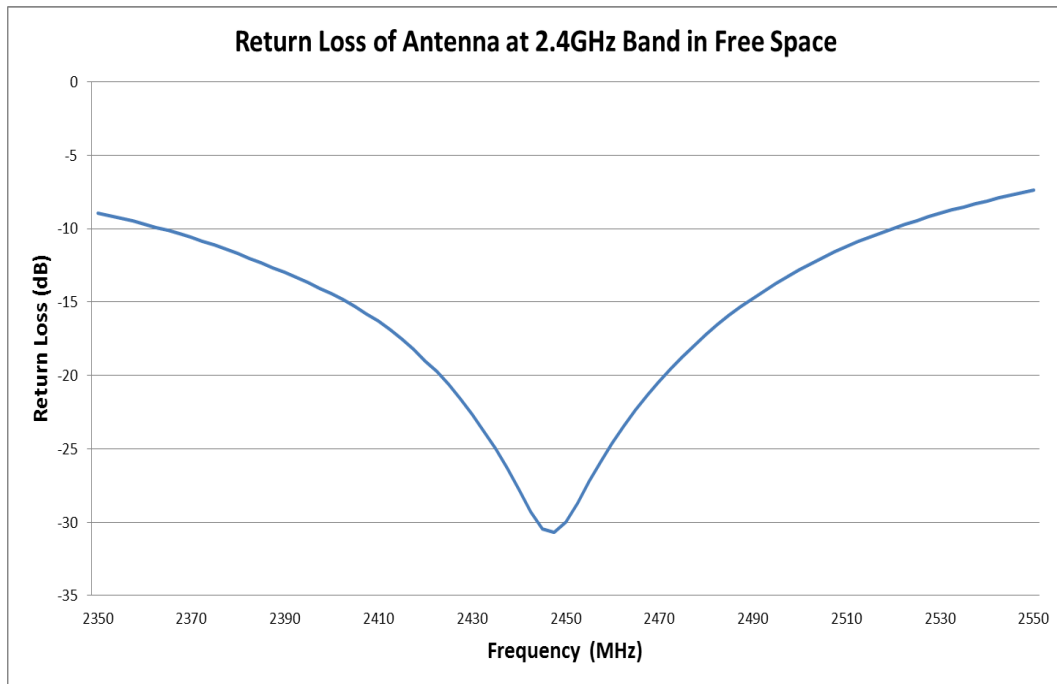
Note that the above antenna performance is measured with just the antenna mounted on a PC/ABS block to similar a free-space condition. When implement into the system, the frequency resonant might be off-tune due to the loading of surrounding components especially metal plane. This off-tune can be compensated through matching. Although module manufacturers specify a peak gain limit, it is based on free-space conditions. The peak gain will be degraded by 1 to 2dBi in the actual implementation as the radiation pattern will change due to the surround components. As such, during selection of antenna, you can select one with high peak gain to compensate for the loss. Molex can offer assistant to choose the best location and best tuning in-order to meet this peak gain requirement.



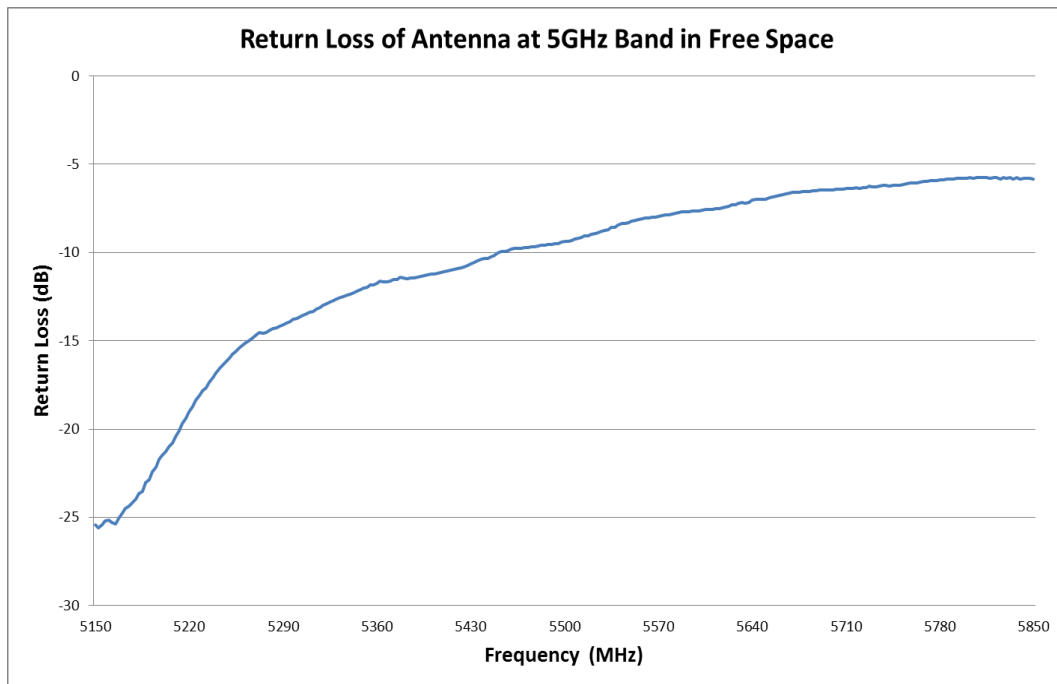
<u>REVISION:</u> <b>A</b>	<u>ECR/ECN INFORMATION:</u> EC No: <b>173500</b> DATE: <b>2018/03/30</b>	<u>TITLE:</u> <b>2.4/5GHz Flexible Antenna</b>	<u>SHEET No.</u> <b>6 of 21</b>
<u>DOCUMENT NUMBER:</u> <b>AS-2069940100</b>	<u>CREATED / REVISED BY:</u> <b>Hai Liu 2018/03/30</b>	<u>CHECKED BY:</u> <b>Kang Cheng 2018/03/30</b>	<u>APPROVED BY:</u> <b>Chris Zhong 2018/03/30</b>

## 4.3 RETURN LOSS PLOT

All measurements in this document are done with a cable length of 100mm.



**FIGURE 4.3.1 RETURN LOSS OF ANTENNA AT WIFI 2.4GHZ BAND IN FREE SPACE**

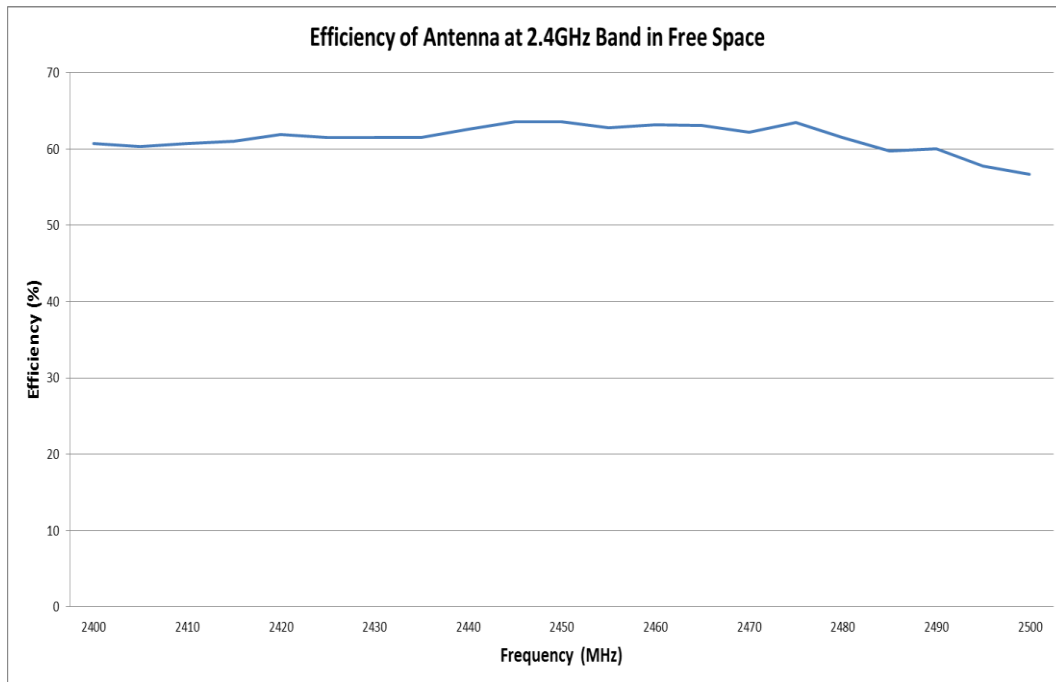


**FIGURE 4.3.2 RETURN LOSS OF ANTENNA AT WIFI 5GHZ BAND IN FREE SPACE**

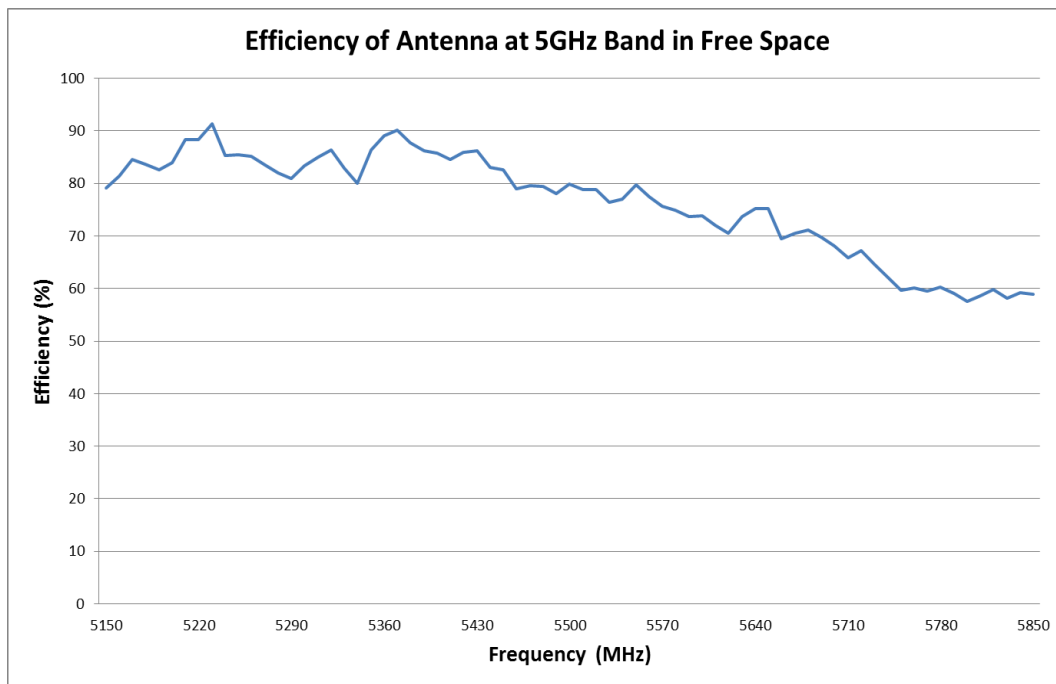
REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>7 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30

## 4.4 EFFICIENCY PLOT

All measurements in this document are done with a cable length of 100mm.



**FIGURE 4.4.1 EFFICIENCY OF ANTENNA AT WIFI 2.4GHZ BAND IN FREE SPACE**



**FIGURE 4.4.2 EFFICIENCY OF ANTENNA AT WIFI 5GHZ BAND IN FREE SPACE**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>8 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30



## 4.5 RADIATION PATTERN

All measurements in this document are done with a cable length of 100mm.

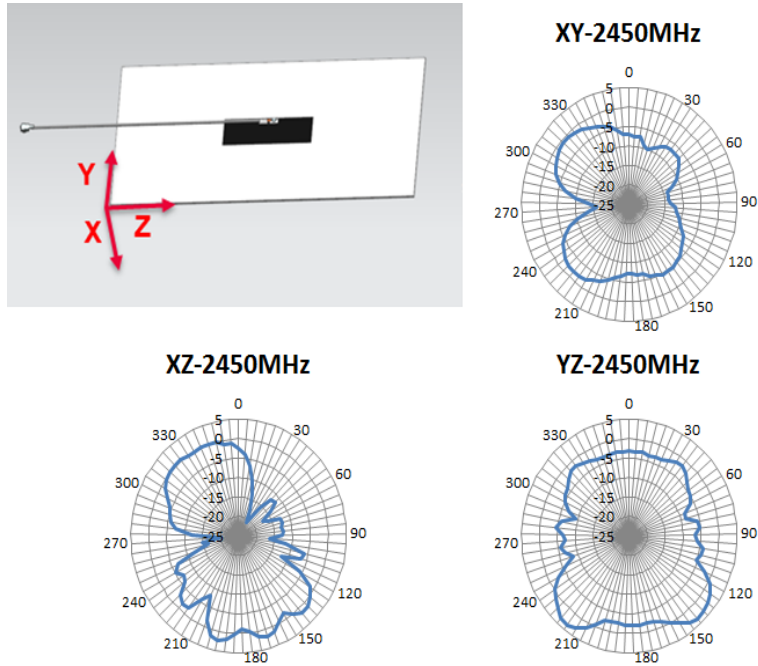


FIGURE 4.5.1 2D RADIATION PATTERN OF ANTENNA AT 2.45GHZ IN FREE SPACE

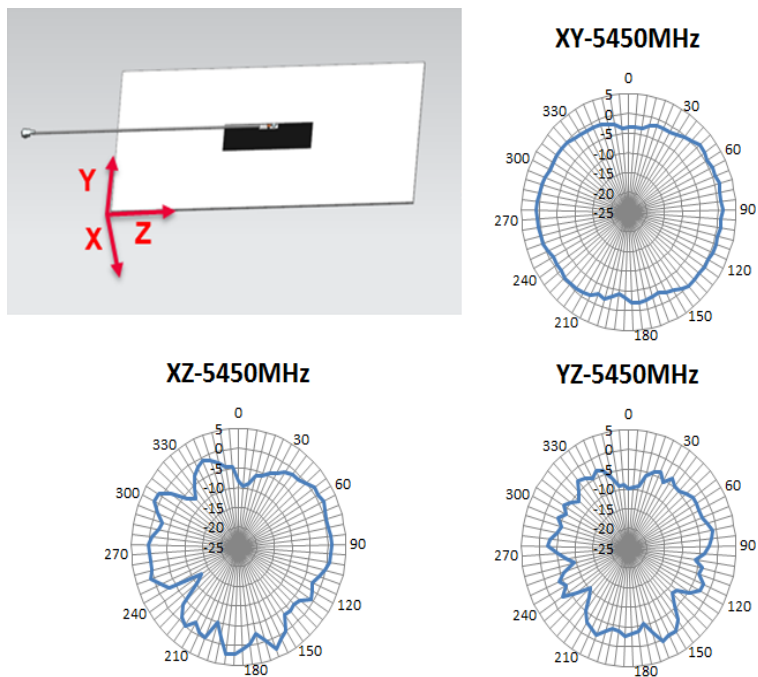
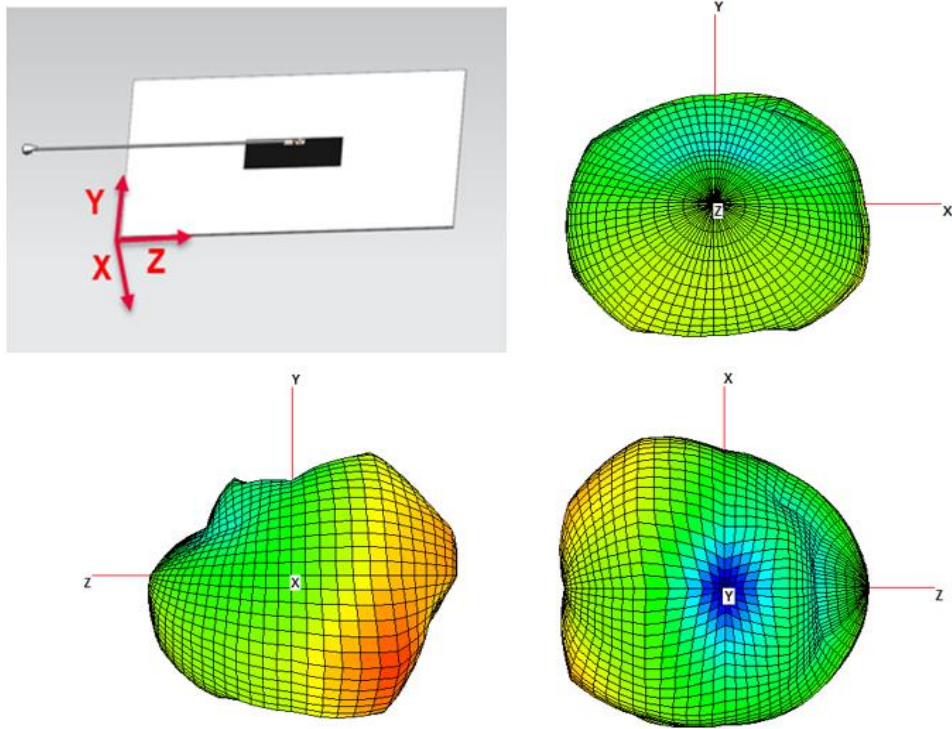
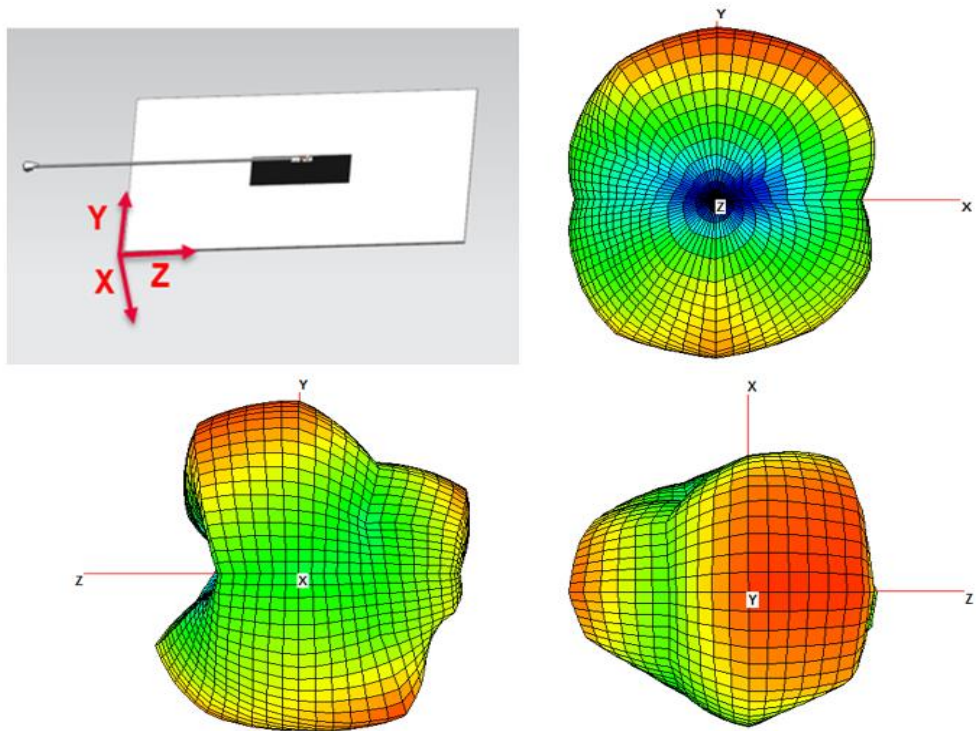


FIGURE 4.5.2 2D RADIATION PATTERN OF ANTENNA AT 5.45GHZ IN FREE SPACE

REVISION:	ECR/ECN INFORMATION:	TITLE:	SHEET No.
<b>A</b>	EC No: 173500 DATE: 2018/03/30	<b>2.4/5GHz Flexible Antenna</b>	<b>9 of 21</b>
DOCUMENT NUMBER:	CREATED / REVISED BY:	CHECKED BY:	APPROVED BY:
<b>AS-2069940100</b>	Hai Liu 2018/03/30	Kang Cheng 2018/03/30	Chris Zhong 2018/03/30



**FIGURE 4.5.3 3D RADIATION PATTERN OF ANTENNA AT 2.45GHZ IN FREE SPACE**



**FIGURE 4.5.4 3D RADIATION PATTERN OF ANTENNA AT 5.45GHZ IN FREE SPACE**

REVISION:	ECR/ECN INFORMATION:	TITLE:	SHEET No.
<b>A</b>	EC No: 173500 DATE: 2018/03/30	<b>2.4/5GHz Flexible Antenna</b>	<b>10 of 21</b>
DOCUMENT NUMBER:	CREATED / REVISED BY:	CHECKED BY:	APPROVED BY:
<b>AS-2069940100</b>	Hai Liu 2018/03/30	Kang Cheng 2018/03/30	Chris Zhong 2018/03/30

## 5.0 ASSEMBLY GUIDELINE

The flex antenna comes with an adhesive TESA 68537 for assemble onto the plastic wall of the system. The surface should be smooth with  $Ra < 1.6\mu m$ , and need to clean the surface before sticking this product. The antenna cannot be placed on a metallic surface.

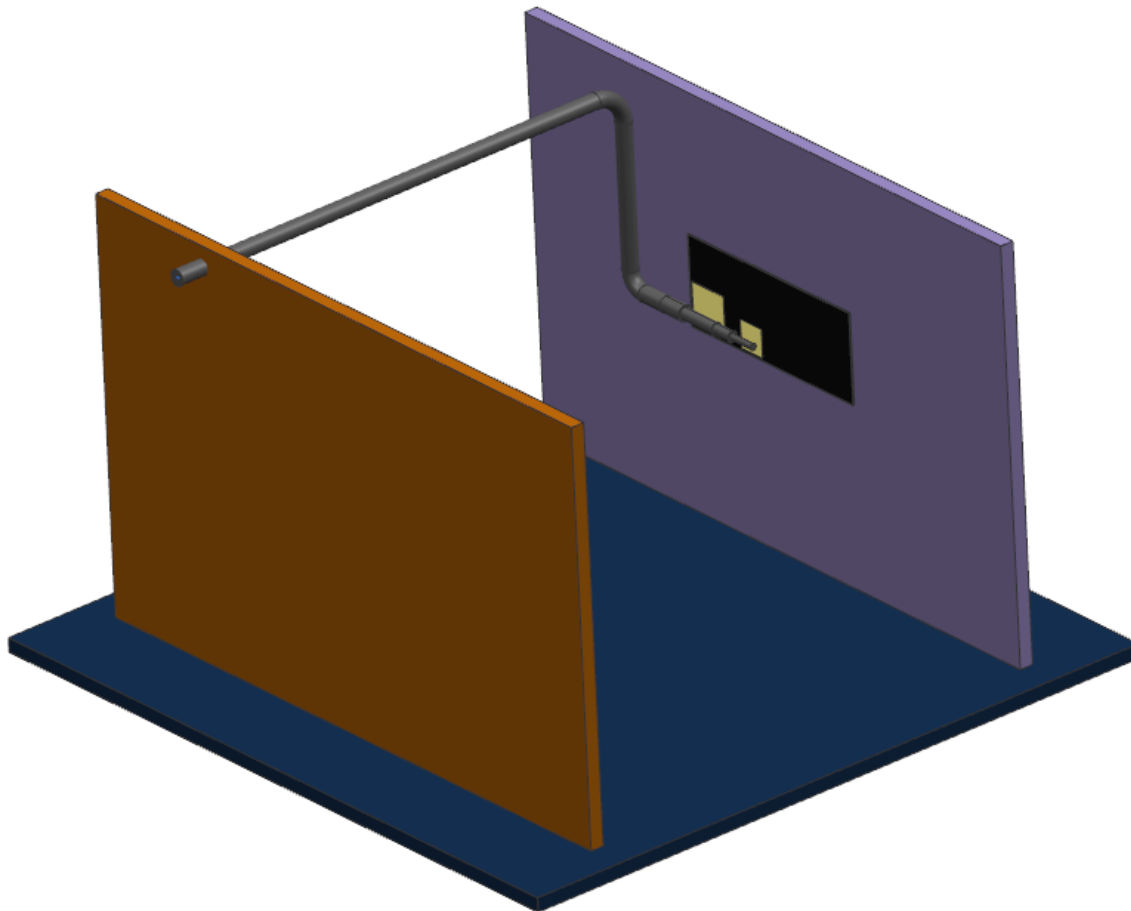


FIGURE 5.1 ASSEMBLY GUIDELINE



REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>11 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30

During the assembly of the antenna in a device, the cable needs to be positioned away from the antenna flex to achieve best performance. The cable must be away from the pattern at least 5mm as shown in figure 5.2. If the cable crosses into the antenna flex, the antenna performance will be degraded.

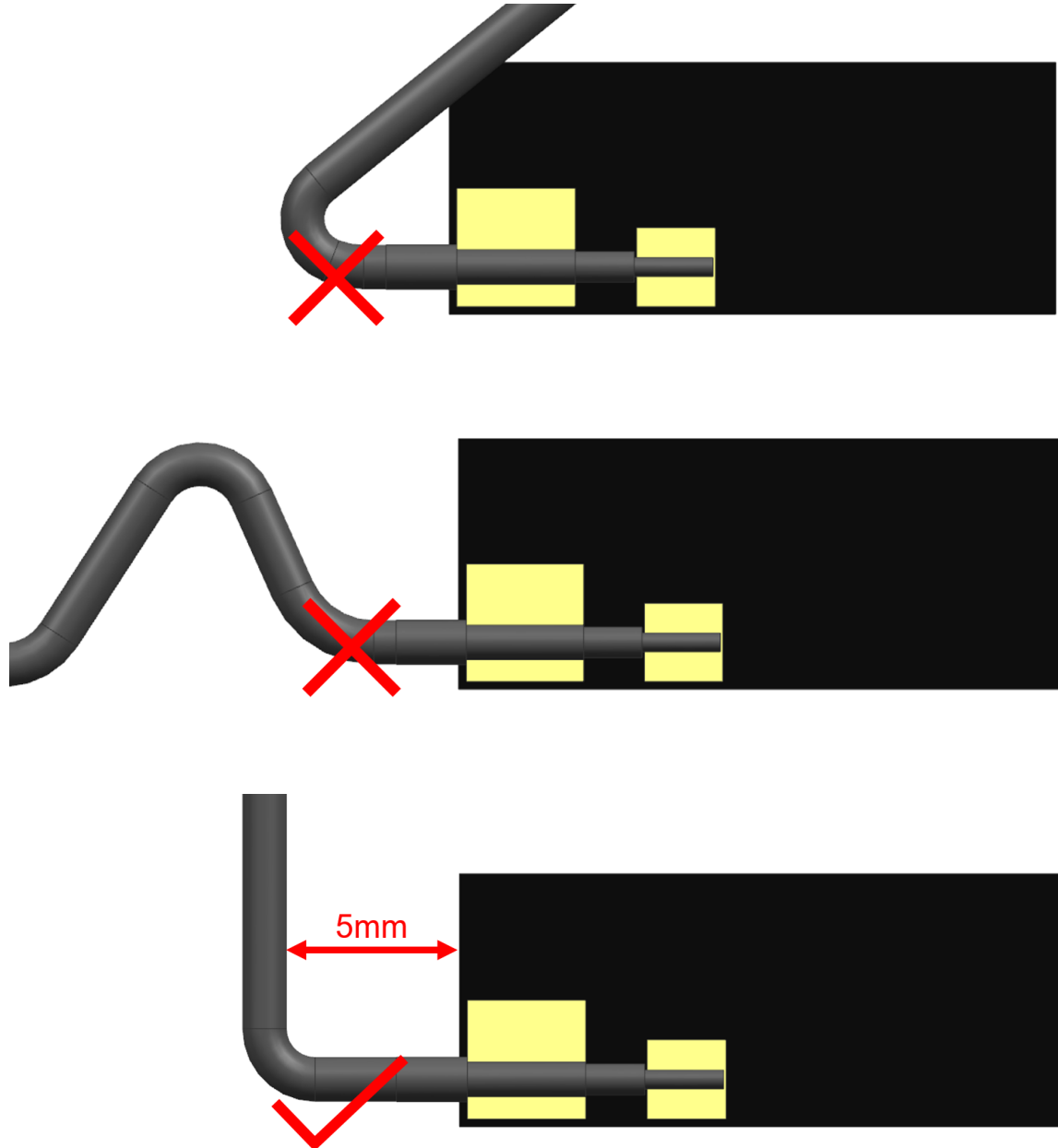


FIGURE 5.2 CABLE BENDING

PRE-REFER-  
USE ONLY

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>12 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30

## 6.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

### 6.1 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT LOCATIONS WITH PARALLEL PLANE GROUND

Antenna performance will be degraded if the antenna is placed too close to a ground plane. Four locations from 5mm, 10mm, 15mm and 20mm with a parallel plane ground have been evaluated. The locations are shown in figure 6.1.1. The plane ground size is 90mm\*90mm. The antenna performance is better with larger distance between antenna and parallel plane ground. The minimum distance between antenna and plane ground is recommended to be at least 10mm to achieve acceptable RF performance.

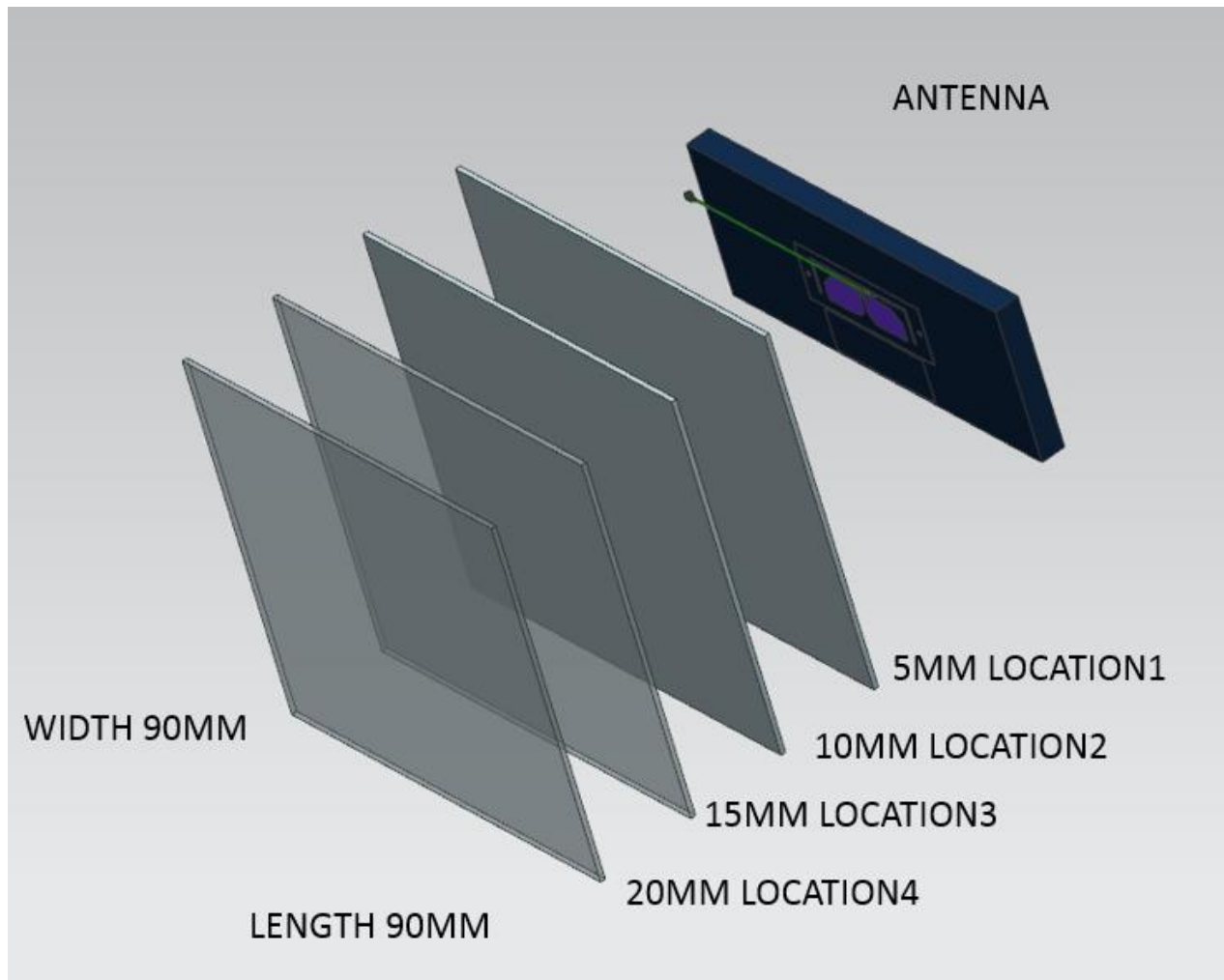
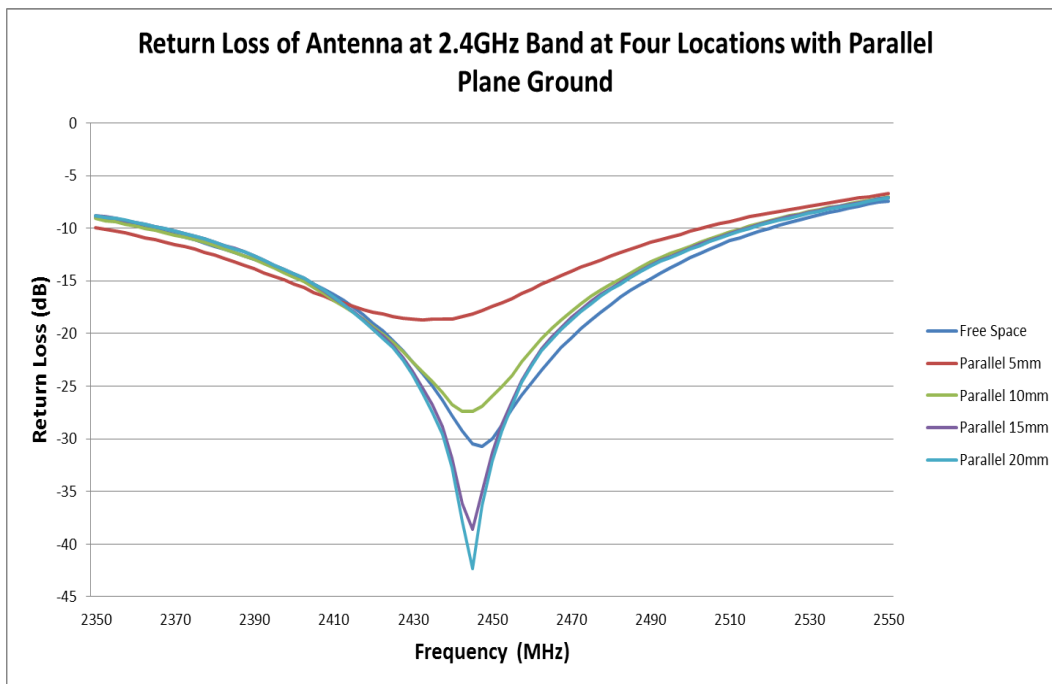


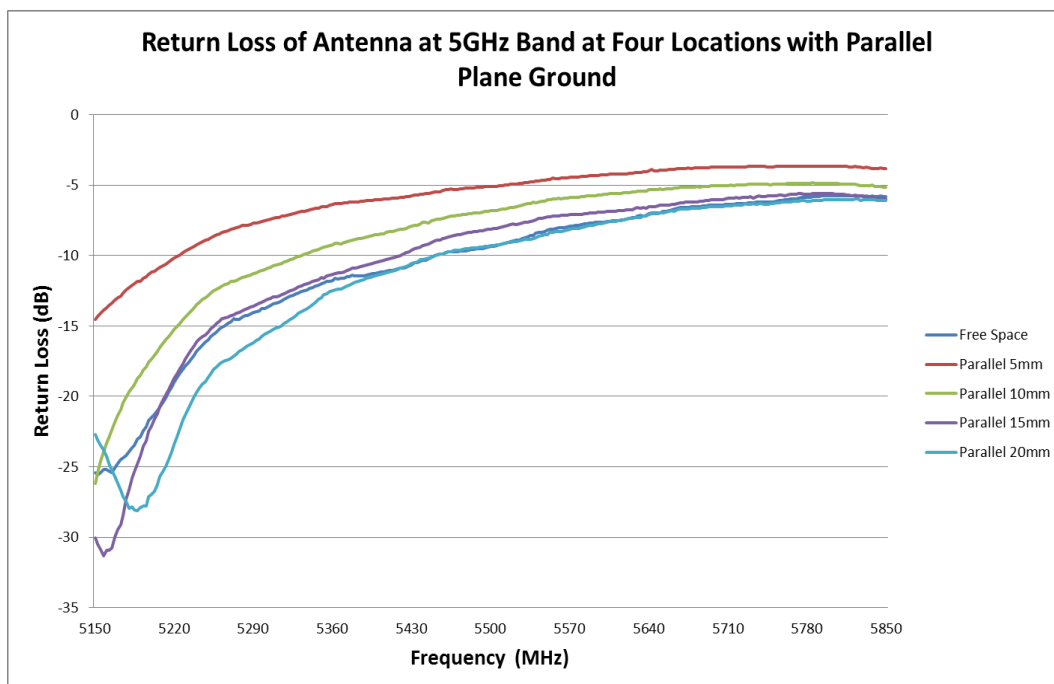
FIGURE 6.1.1 FOUR LOCATIONS WITH PARALLEL PLANE GROUND

PRE-RELEASE  
REFERENCE  
USE ONLY

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>13 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30

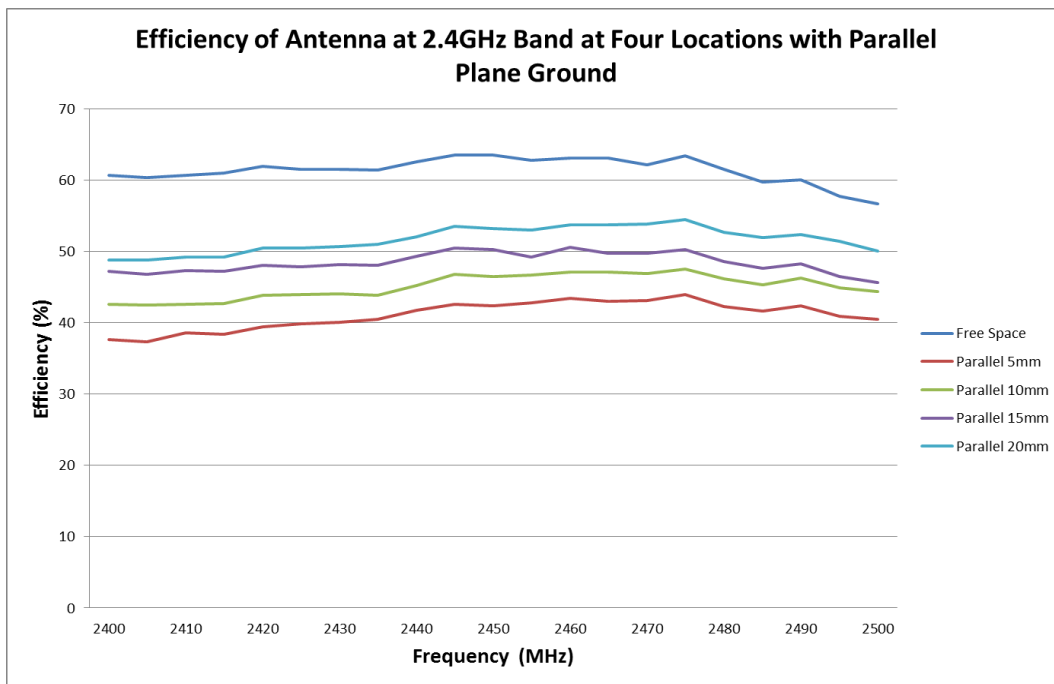


**FIGURE 6.1.2 RETURN LOSS OF ANTENNA AT WIFI 2.4GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

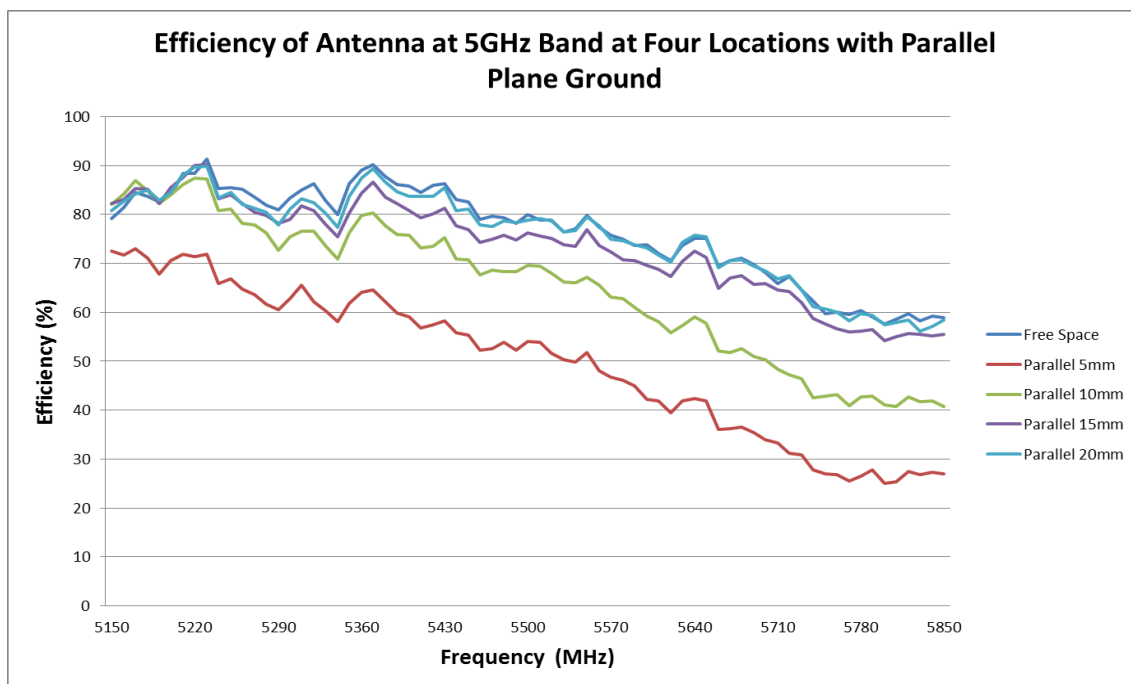


**FIGURE 6.1.3 RETURN LOSS OF ANTENNA AT WIFI 5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>14 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30



**FIGURE 6.1.4 EFFICIENCY OF ANTENNA AT WIFI 2.4GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**



**FIGURE 6.1.5 EFFICIENCY OF ANTENNA AT WIFI 5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>15 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30

## 6.2 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT LOCATIONS WITH VERTICAL PLANE GROUND

Antenna performance will be degraded if the antenna is placed too close to a ground plane. Four locations of 5mm, 10mm, 15mm and 20mm away from the vertical plane ground have been evaluated. These locations are shown in figure 6.2.1. The plane ground size is 90mm\*90mm. The antenna performance is better with larger distance between antenna and vertical plane ground. The minimum distance between antenna and plane ground is recommended to be at least 5mm to achieve acceptable RF performance.

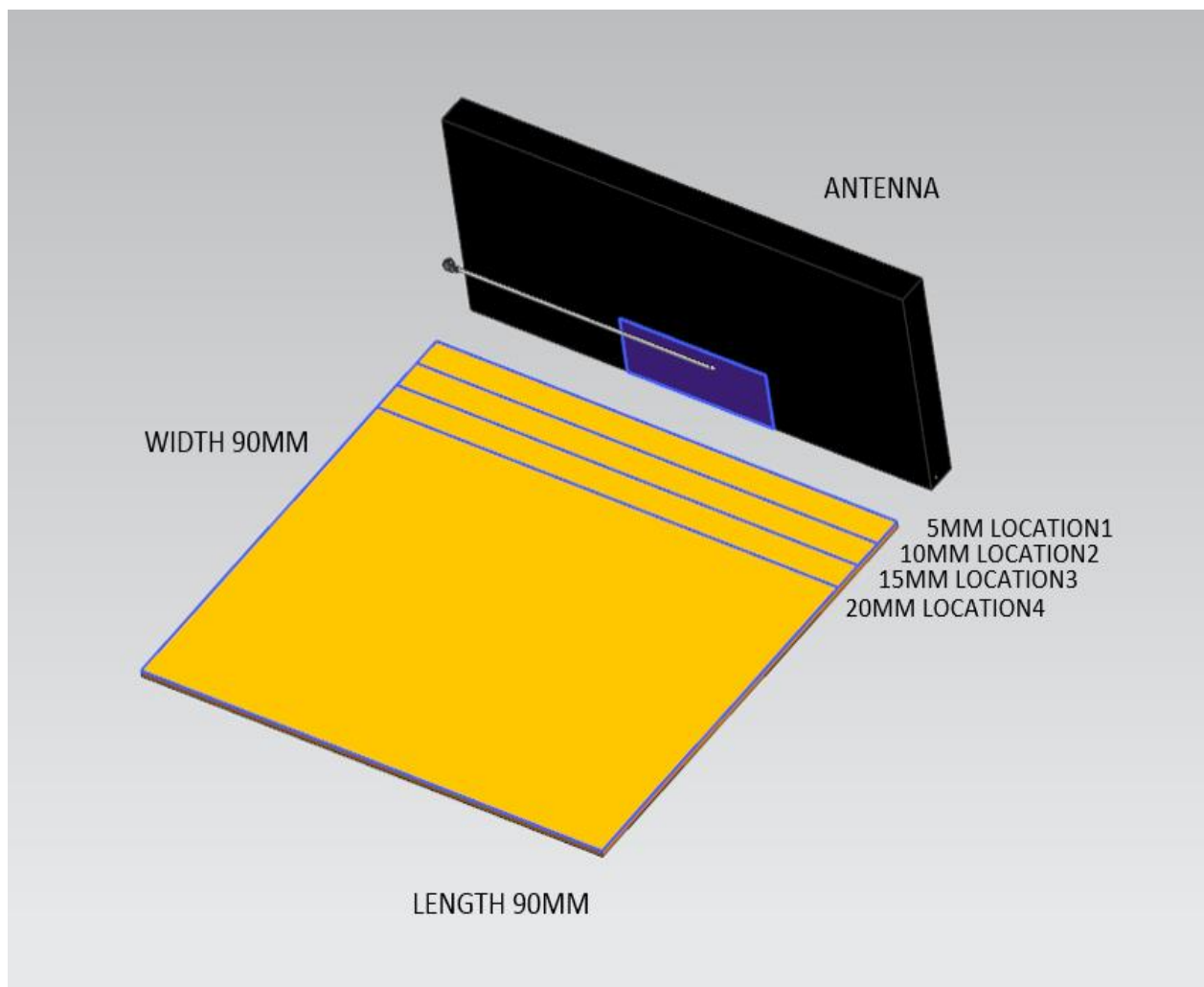
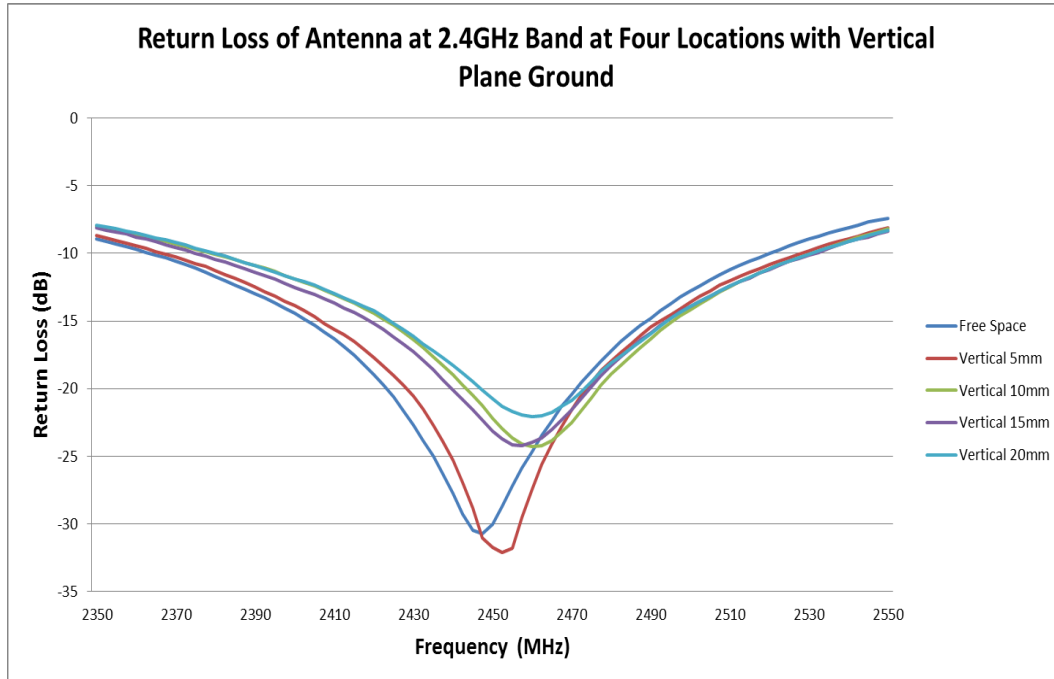


FIGURE 6.2.1 FOUR LOCATIONS WITH VERTICAL PLANE GROUND

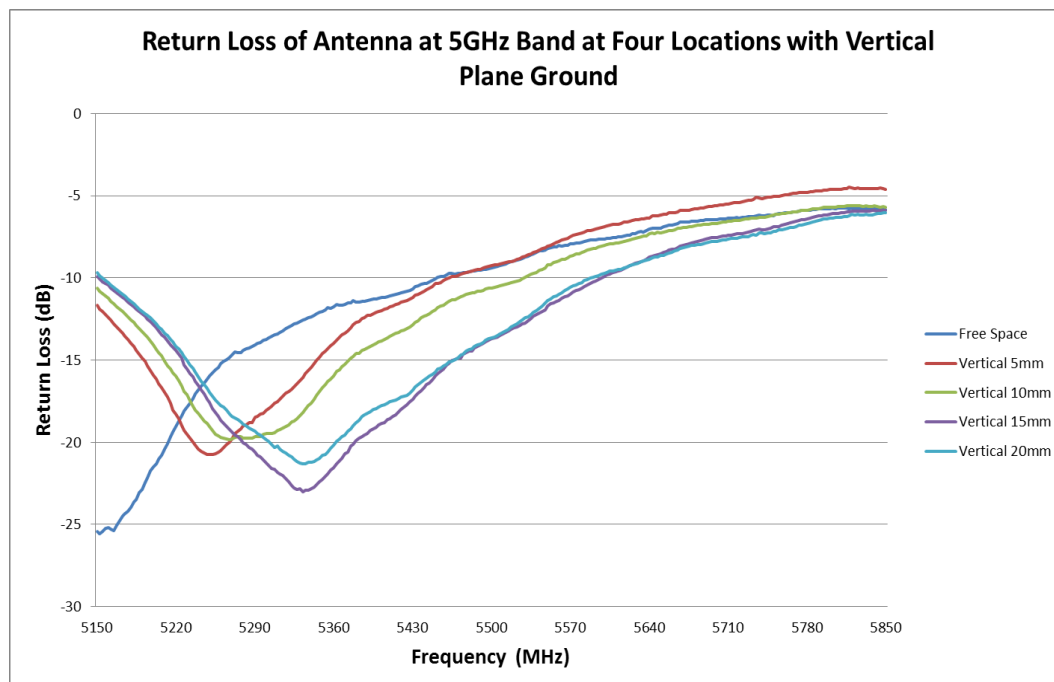
PRE-  
REFERENCE  
USE ONLY

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>16 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30



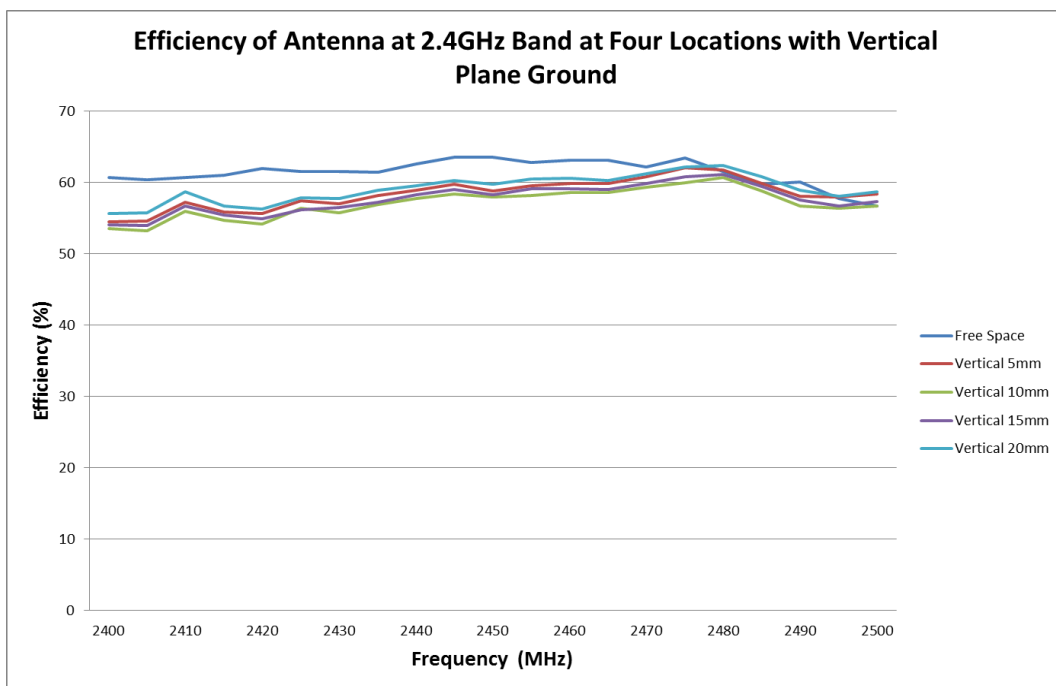


**FIGURE 6.2.2 RETURN LOSS OF ANTENNA AT WIFI 2.4GHZ BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

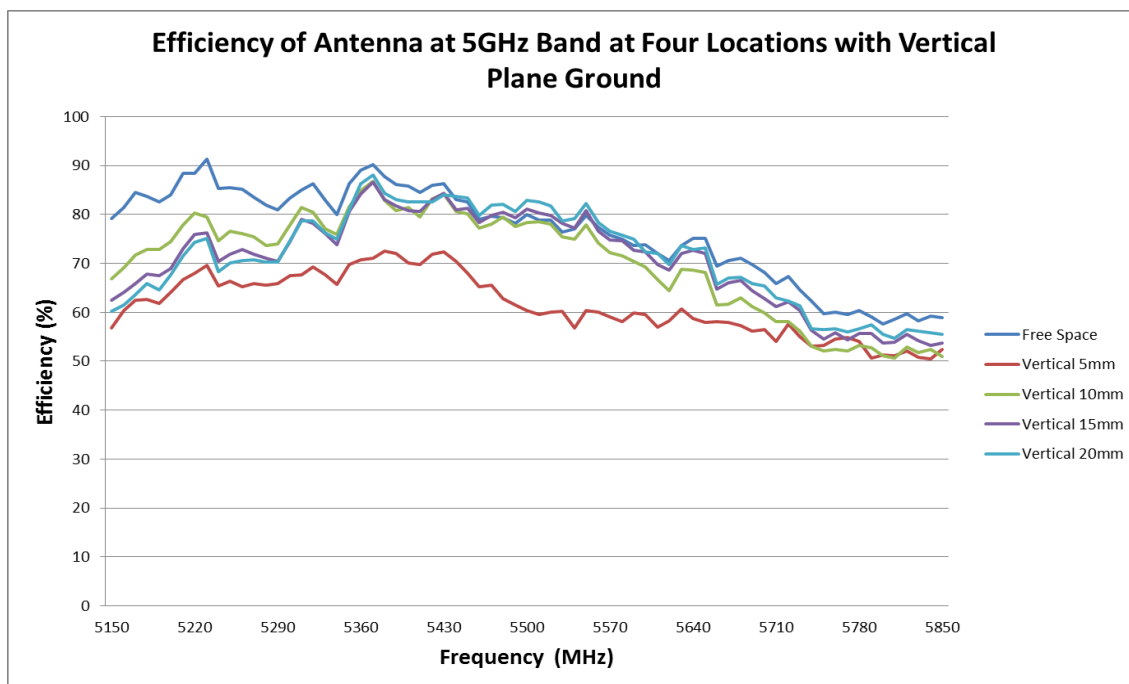


**FIGURE 6.2.3 RETURN LOSS OF ANTENNA AT WIFI 5GHZ BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>17 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30



**FIGURE 6.2.4 EFFICIENCY OF ANTENNA AT WIFI 2.4GHZ BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

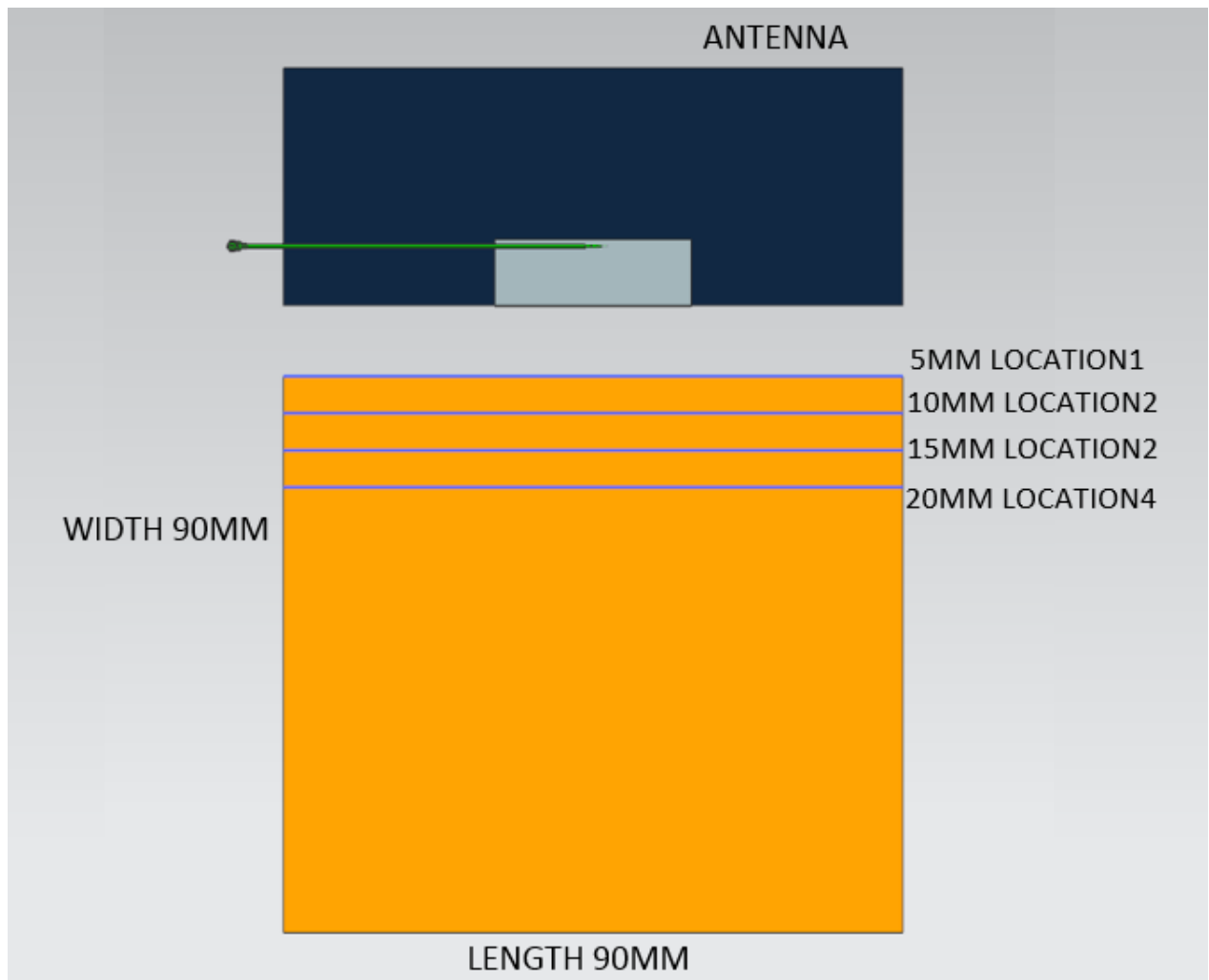


**FIGURE 6.2.5 EFFICIENCY OF ANTENNA AT WIFI 5GHZ BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>18 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30

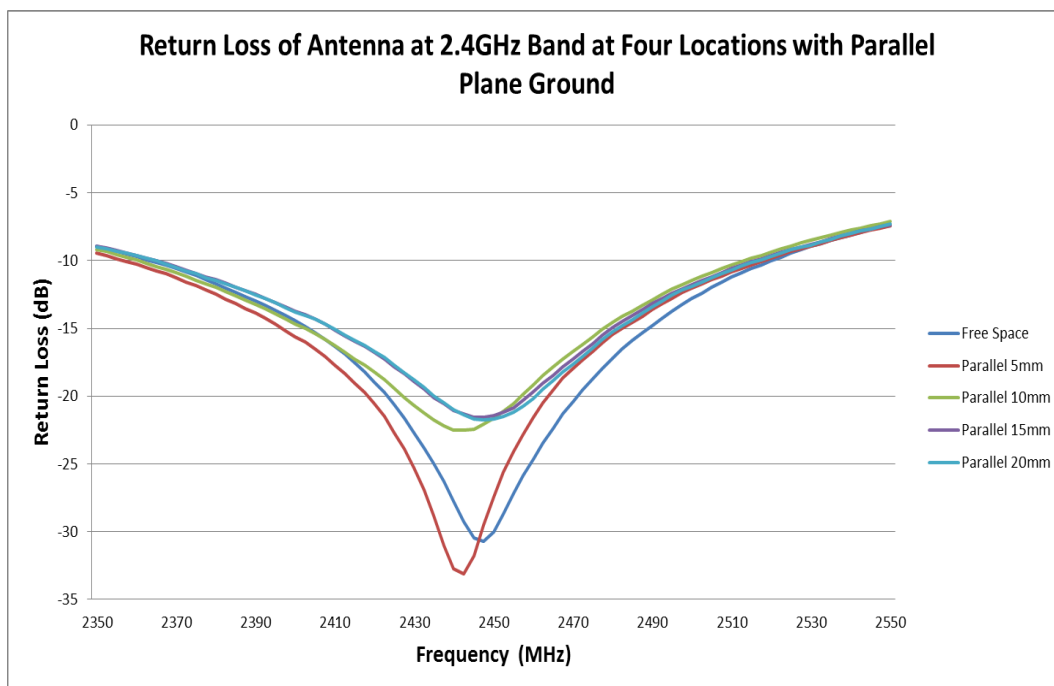
## 6.3 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT DISTANCES WITH PARALLEL PLANE GROUND

Antenna performance will be degraded if the antenna is placed too close to a ground plane. Four locations 5mm, 10mm, 15mm and 20mm from a parallel plane ground have been evaluated. These locations are shown in figure 6.3.1. The plane ground size is 90mm\*90mm. The antenna performance is better with larger distance between the antenna and the parallel plane ground. The minimum distance between the antenna and the plane ground is recommended to be at least 5mm to achieve acceptable RF performance.

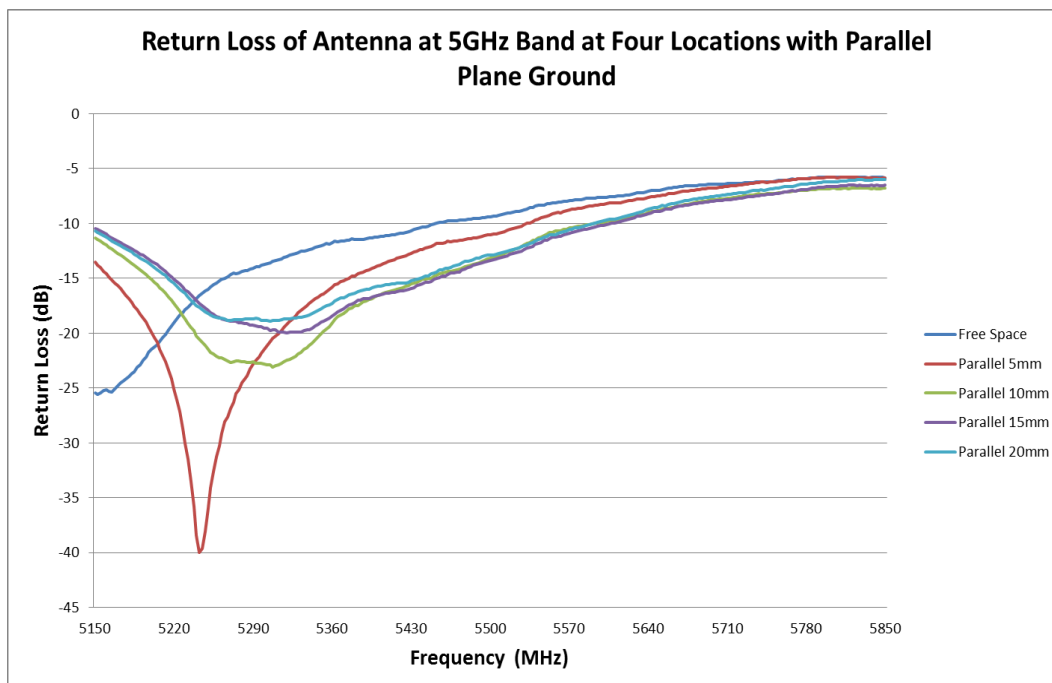


**FIGURE 6.3.1 FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>19 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30

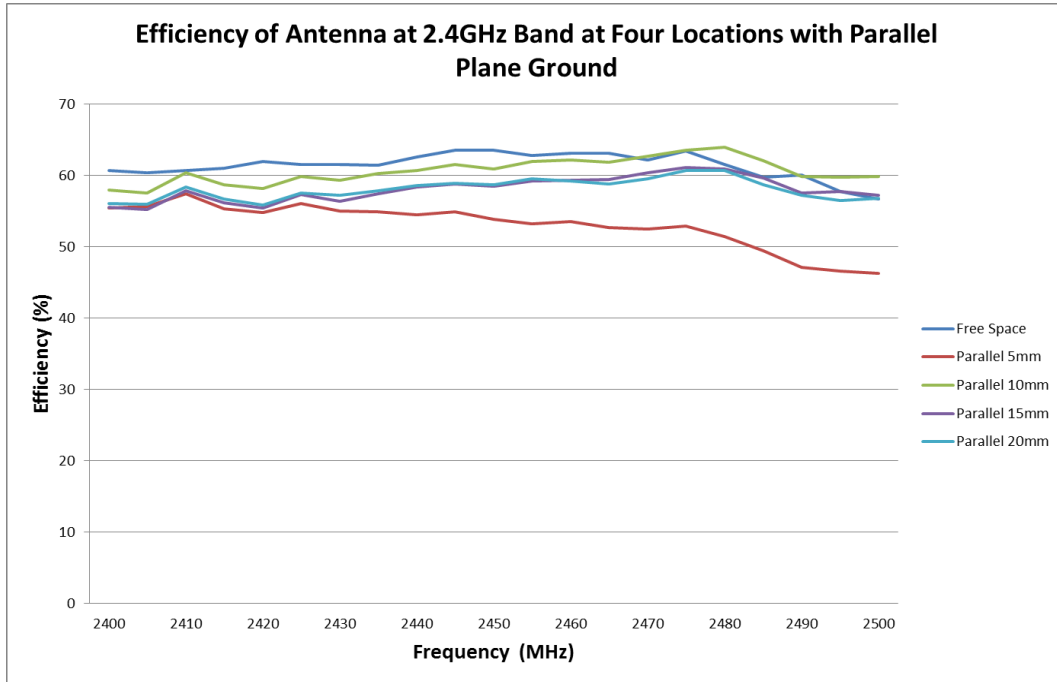


**FIGURE 6.3.2 RETURN LOSS OF ANTENNA AT WIFI 2.4GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

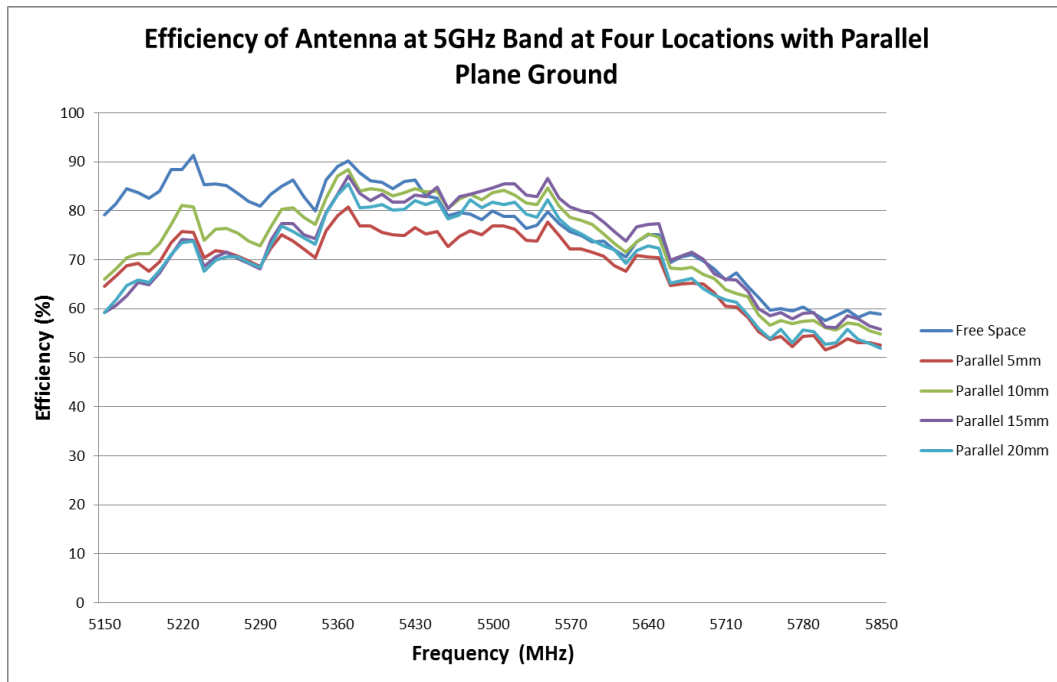


**FIGURE 6.3.3 RETURN LOSS OF ANTENNA AT WIFI 5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>20 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30



**FIGURE 6.3.4 EFFICIENCY OF ANTENNA AT WIFI 2.4GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**



**FIGURE 6.3.5 EFFICIENCY OF ANTENNA AT WIFI 5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 173500 DATE: 2018/03/30	TITLE: <b>2.4/5GHz Flexible Antenna</b>	SHEET No. <b>21 of 21</b>
DOCUMENT NUMBER: <b>AS-2069940100</b>	CREATED / REVISED BY: Hai Liu 2018/03/30	CHECKED BY: Kang Cheng 2018/03/30	APPROVED BY: Chris Zhong 2018/03/30