



# APPLICATION SPECIFICATION

## TITLE

## 2.4/5GHZ CERAMIC ANTENNA

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REVISION:	ECR/ECN INFORMATION:	TITLE:	SHEET No.
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<b>AS-2065140001</b>	Liu Hai	Cheng Kang	Benson Hung

## 2.4/5GHZ CERAMIC ANTENNA

### 1.0 SCOPE

This specification describes the antenna application and surrounding. The information in this document is for reference and benchmark purposes only.

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

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

Product name: 2.4/5GHz Ceramic Antenna

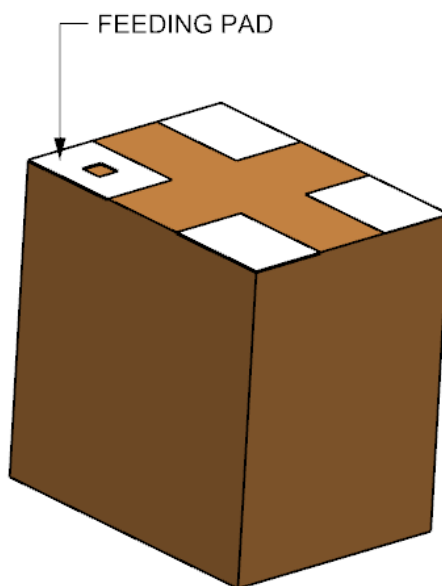
Series Number: 2065140001

#### 2.2 DESCRIPTION

206514 is a SMT high performance antenna implemented using ceramic with recommendation to meet the customer needs. It is designed to cover the frequency bands from 2.4-2.5GHz and 5.15-5.85GHz.

#### 2.3 PRODUCT STRUCTURE INFORMATION

Please refer to PS-2065140001 for full information.



ANTENNA 3D VIEW

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## 3.0 APPLICABLE DOCUMENTS

DOCUMENT	NUMBER	DESCRIPTION
Sale Drawing (SD)	SD-2065140001	Mechanical Dimension of the product
Product Specification (PS)	PS-2065140001	Product Specification
Packing Drawing (PK)	PK-2065140001	Product packaging specifications

## 4.0 ANTENNA PERFORMANCE

### 4.1 RF TEST CONDITIONS

All measurements are done of the antenna mounted on a reference PCB (100\*40\*0.8mm) with VNA Agilent E5071C and Over-The-Air (OTA) chamber.

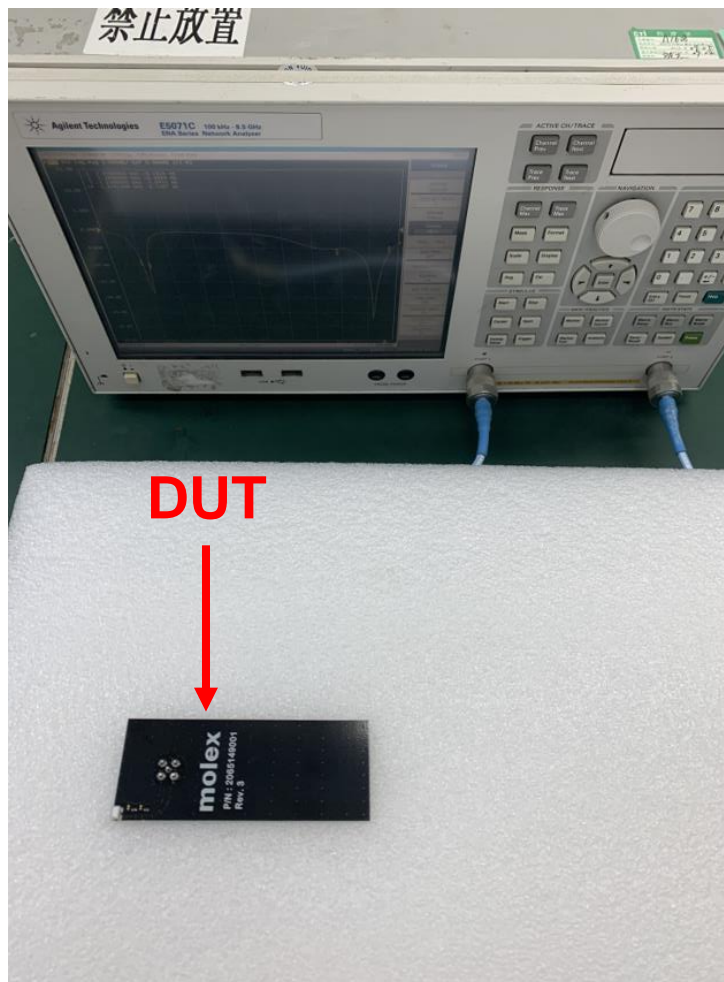
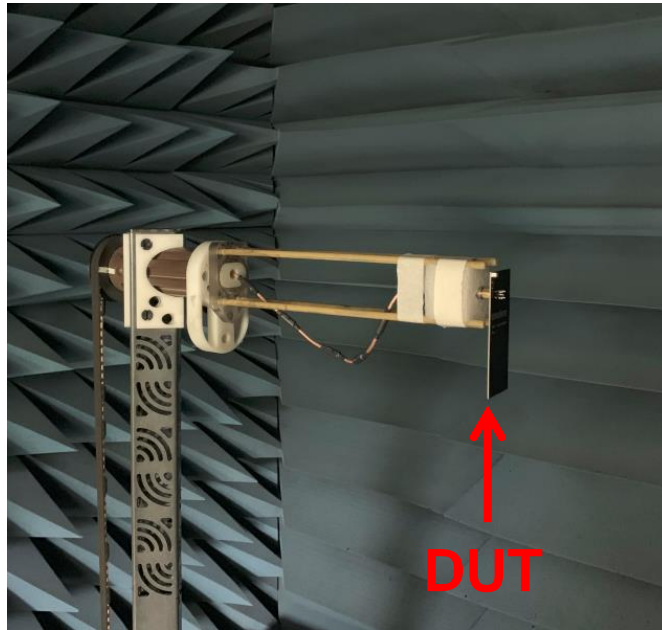


FIGURE4.1.1 ANTENNA LOADED WITH REFERENCE PCB TESTED WITH VNA E5071C

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**FIGURE4.1.2 ANTENNA LOADED WITH REFERENCE PCB TESTED IN OTA CHAMBER**

## 4.2 ANTENNA PERFORMANCE

DESCRIPTION	EQUIPMENT	REQUIREMENT	
Frequency Range	VNA E5071C	2.4-2.5GHz	5.15-5.85GHz
Return Loss	VNA E5071C	< -8 dB	< -5 dB
Peak Gain (Max)	OTA Chamber	3.5dBi	6.2dBi
Average Total Efficiency	OTA Chamber	>75%	>75%
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 reference PCB 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.

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## 4.3 RETURN LOSS PLOT

All measurements in this document are done on a reference PCB.

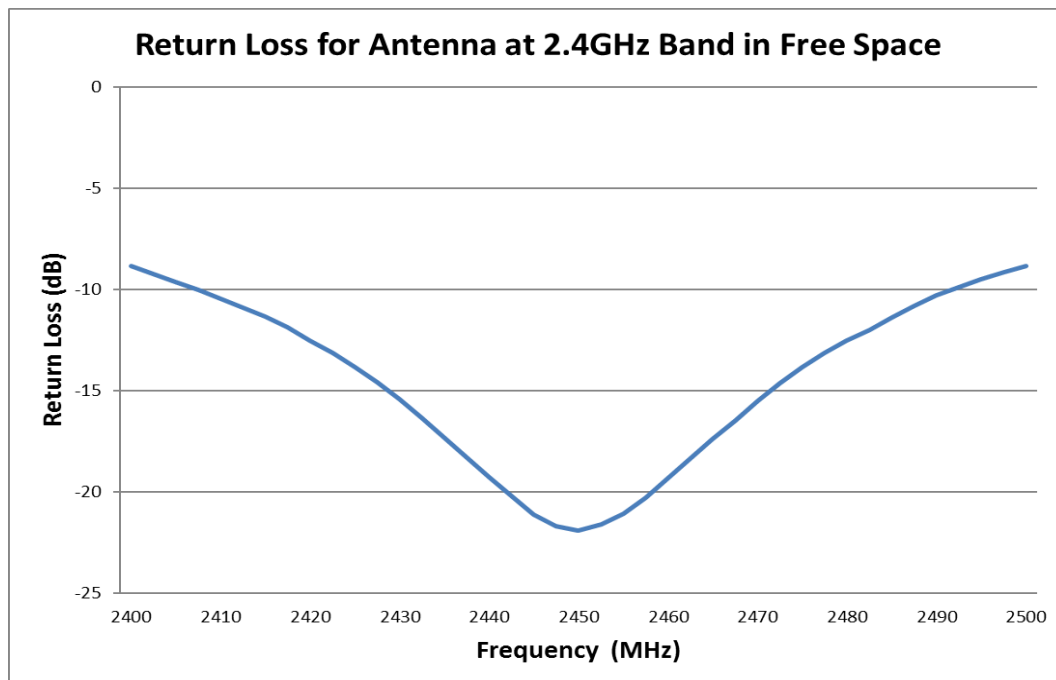


FIGURE 4.3.1 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND IN FREE SPACE

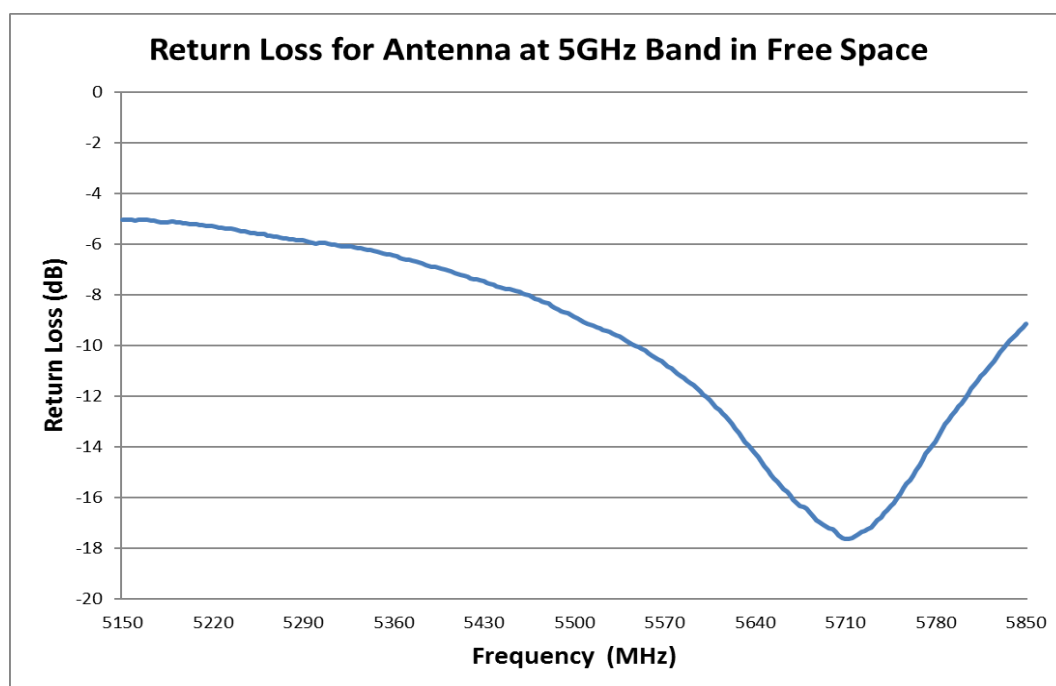


FIGURE 4.3.2 RETURN LOSS OF ANTENNA AT 5GHZ BAND IN FREE SPACE

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## 4.3 EFFICIENCY PLOT

All measurements in this document are done on a reference PCB.

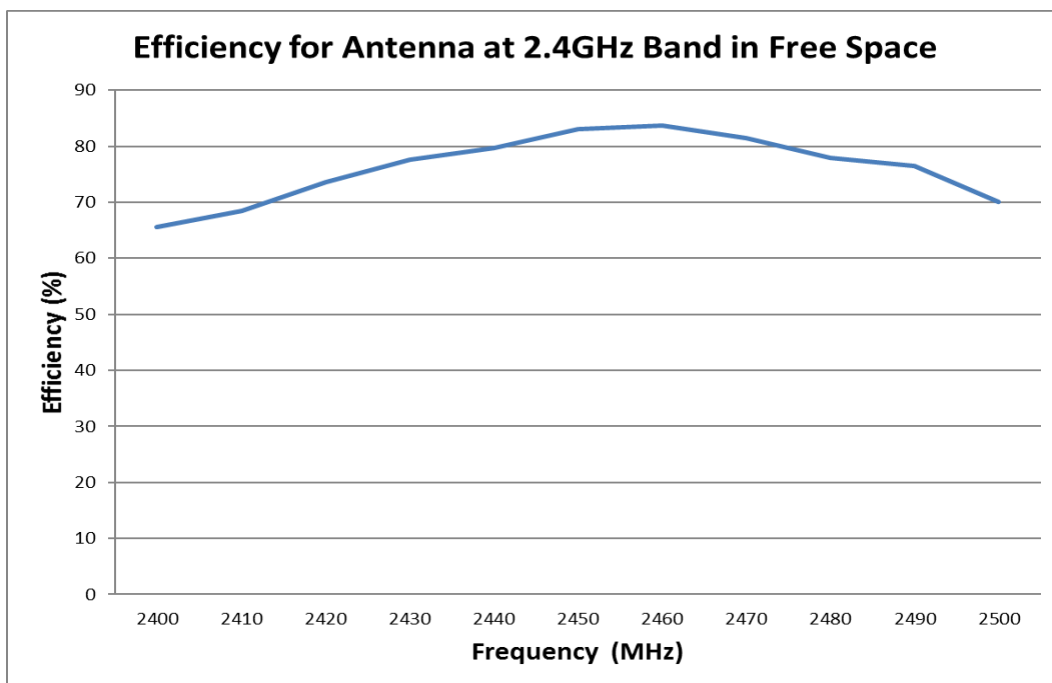


FIGURE 4.4.1 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND IN FREE SPACE

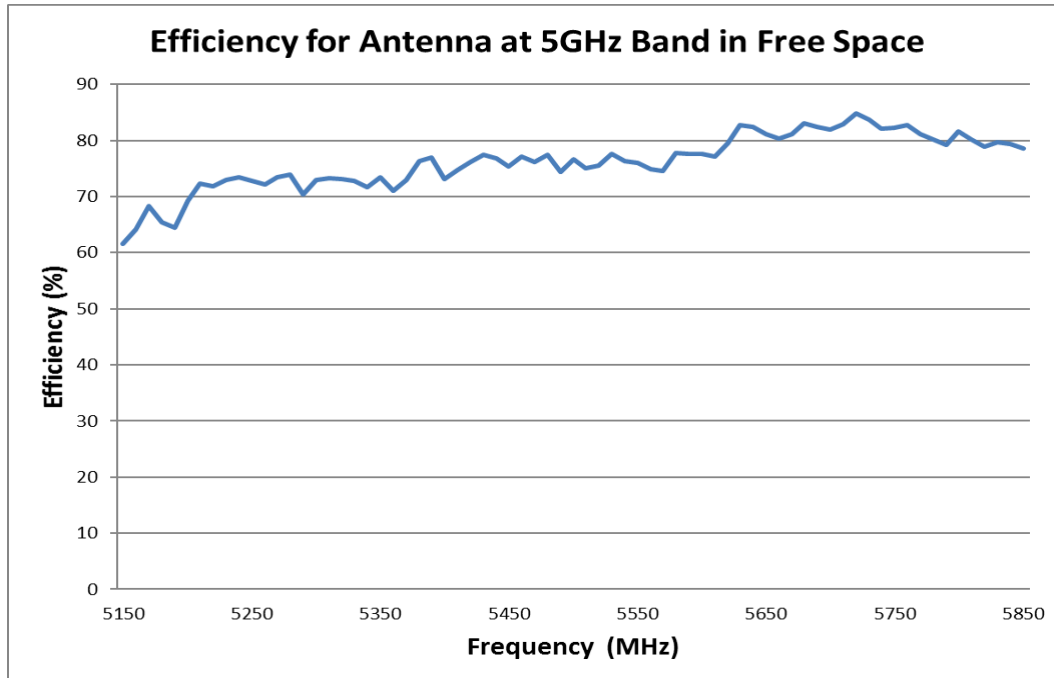
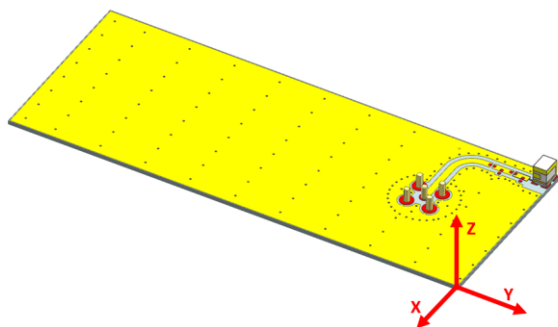


FIGURE 4.4.2 EFFICIENCY OF ANTENNA AT 5GHZ BAND IN FREE SPACE

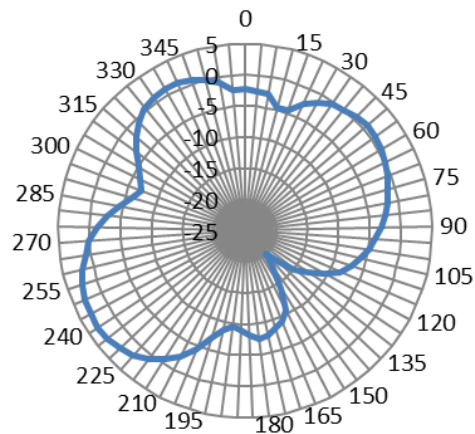
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## 4.5 2D RADIATION PATTERN

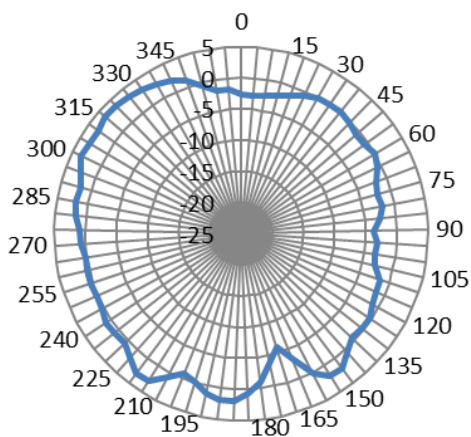
All measurements in this document are done on a reference PCB.



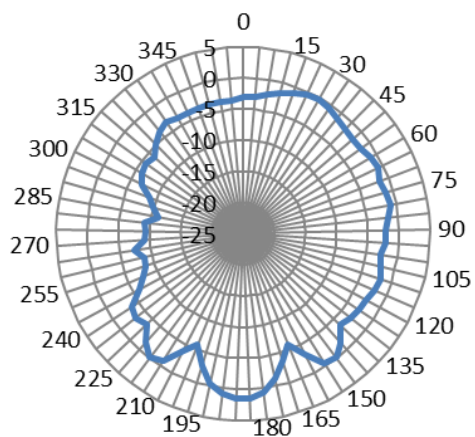
**XY-2450MHz**



**XZ-2450MHz**

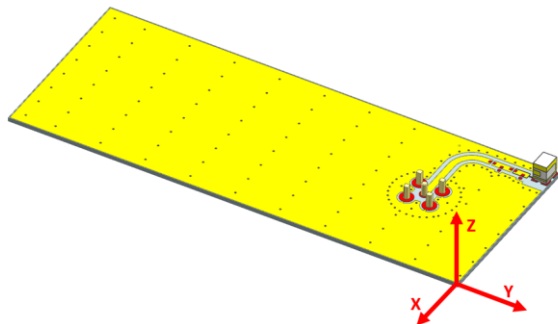


**YZ-2450MHz**

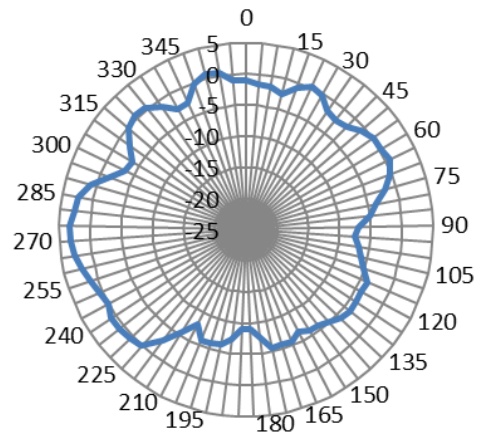


**FIGURE 4.5.1 2D RADIATION PATTERN OF ANTENNA AT 2450MHZ  
IN FREE SPACE ON A REFERENCE PCB**

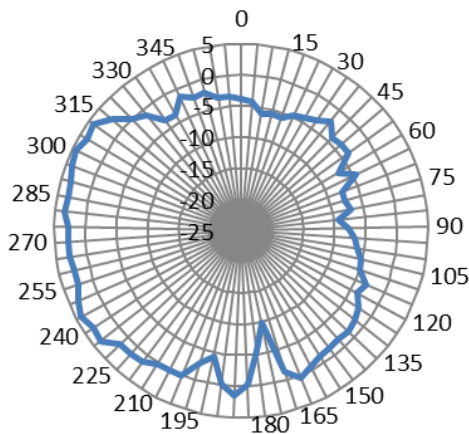
REVISION:	ECR/ECN INFORMATION:	TITLE:	SHEET No.
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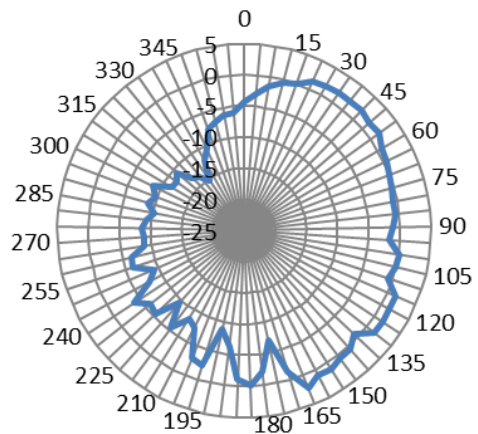
**XY-5500MHz**



**XZ-5500MHz**



**YZ-5500MHz**



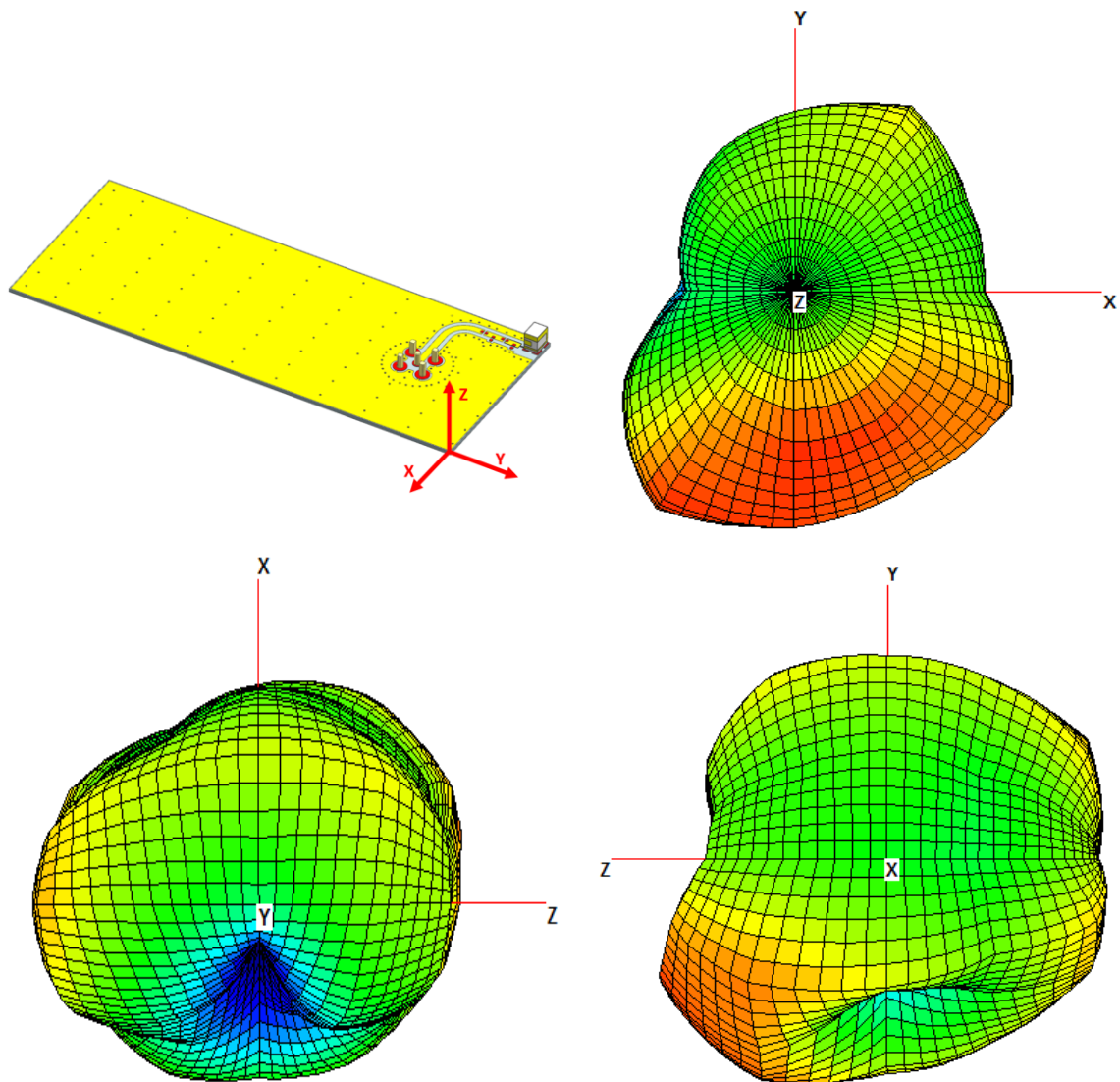
**FIGURE 4.5.2 2D RADIATION PATTERN OF ANTENNA AT 5500MHZ  
IN FREE SPACE ON A REFERENCE PCB**

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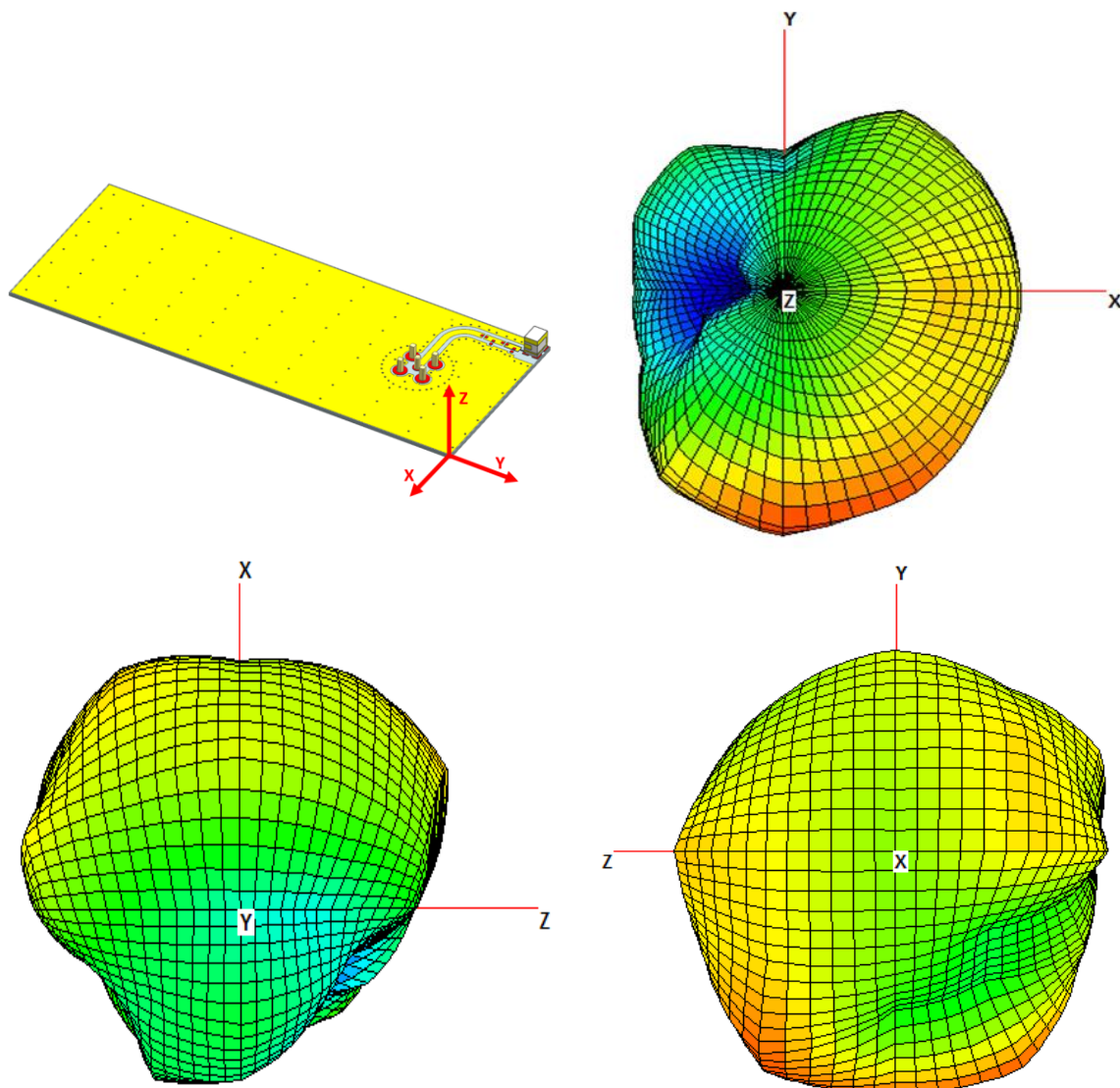
## 4.6 3D RADIATION PATTERN

All measurements in this document are done on a reference PCB.



**FIGURE 4.6.1 3D RADIATION PATTERN OF ANTENNA AT 2450MHZ  
IN FREE SPACE ON A REFERENCE PCB**

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**FIGURE 4.6.2 3D RADIATION PATTERN OF ANTENNA AT 5500MHZ  
IN FREE SPACE ON A REFERENCE PCB**

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## 5.0 MATCHING NETWORK DESRICPTION

The recommended matching network shown in Figure 5.1-5.2.

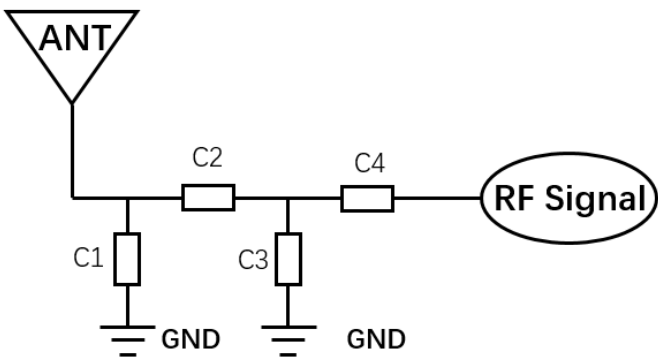
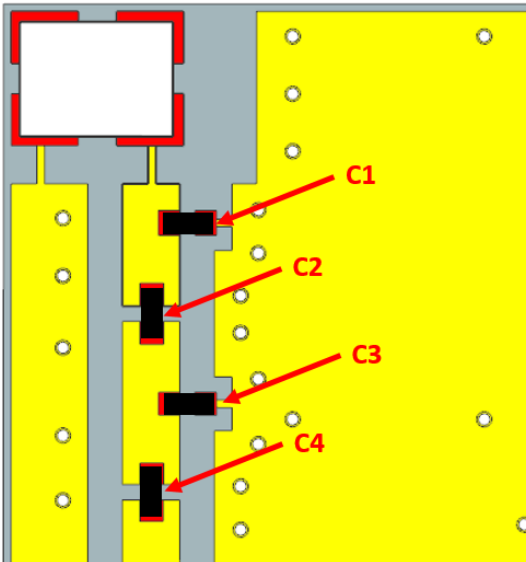


FIGURE 5.1 RECOMMENDED MATCHING CIRCUIT SCHEMATIC



Component	206514 2.4/5GHz Ceramic Antenna
C1	NA
C2	0Ω
C3	NA
C4	0Ω

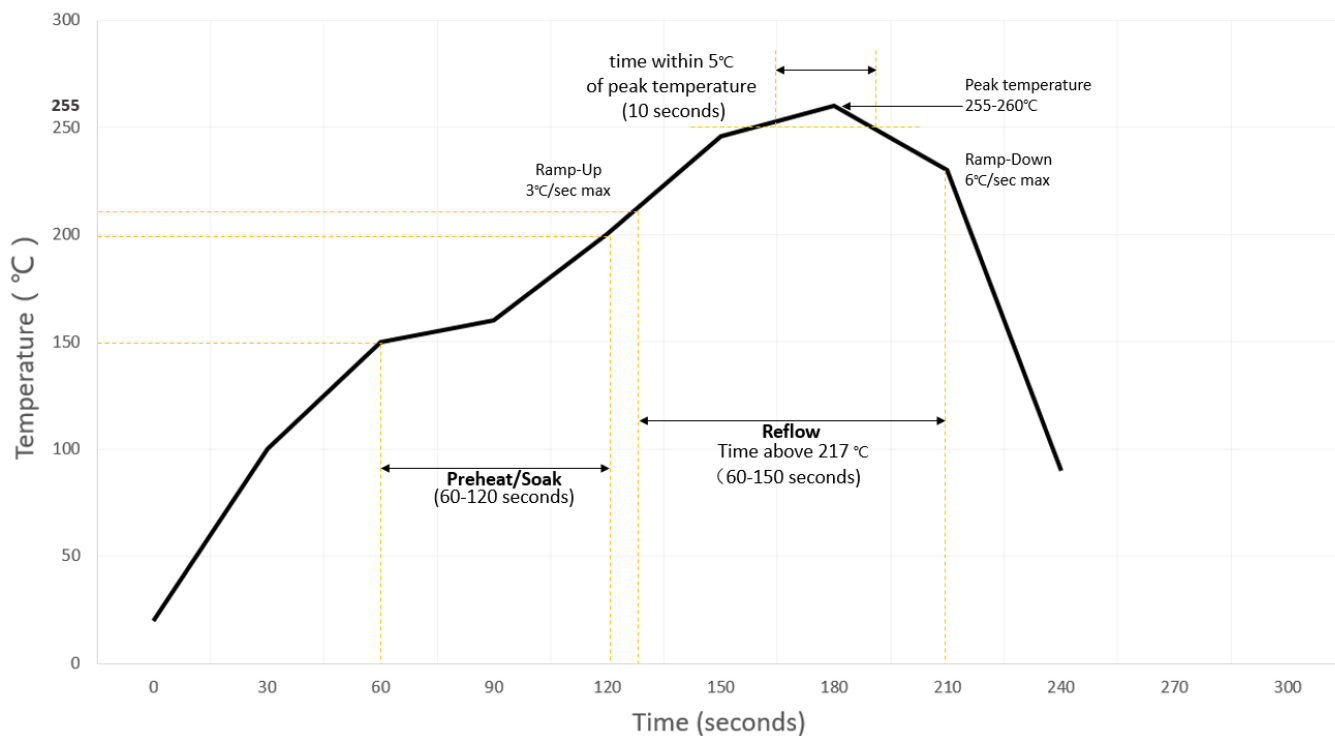
FIGURE 5.2 RECOMMENDED MATCHING CIRCUIT

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## 6.0 RECOMMENDED REFLOW CONDITION



Recommended IR reflow times: 1 time.

Recommended solder paste: ALPHA CAP-390 SAC305(Ag%≥3%)

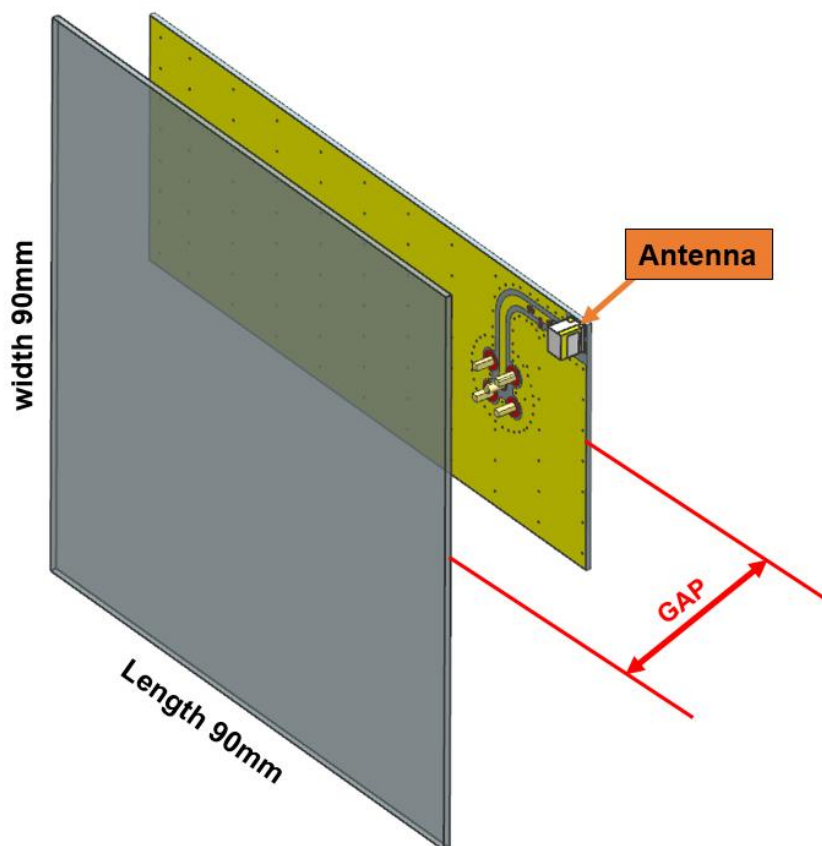
For mechanically challenging applications Molex recommends using surface mount glue (e.g. Loctite 3611) before reflow soldering process, to ensure increased mechanical retention on the PCB.

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## 7.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

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

Four locations with parallel plane ground have been evaluated and these locations are shown in figure 7.1. The plane ground size is 90mm\*90mm and we move the plane ground to four locations for each test. Parallel plane ground has great influence on low frequency. The minimum distance between antenna and plane ground is recommended to be 5mm to achieve acceptable RF performance.



**FIGURE 7.1 FIVE LOCATIONS WITH PARALLEL PLANE GROUND**

Ground Size: 90mm\*90mm;

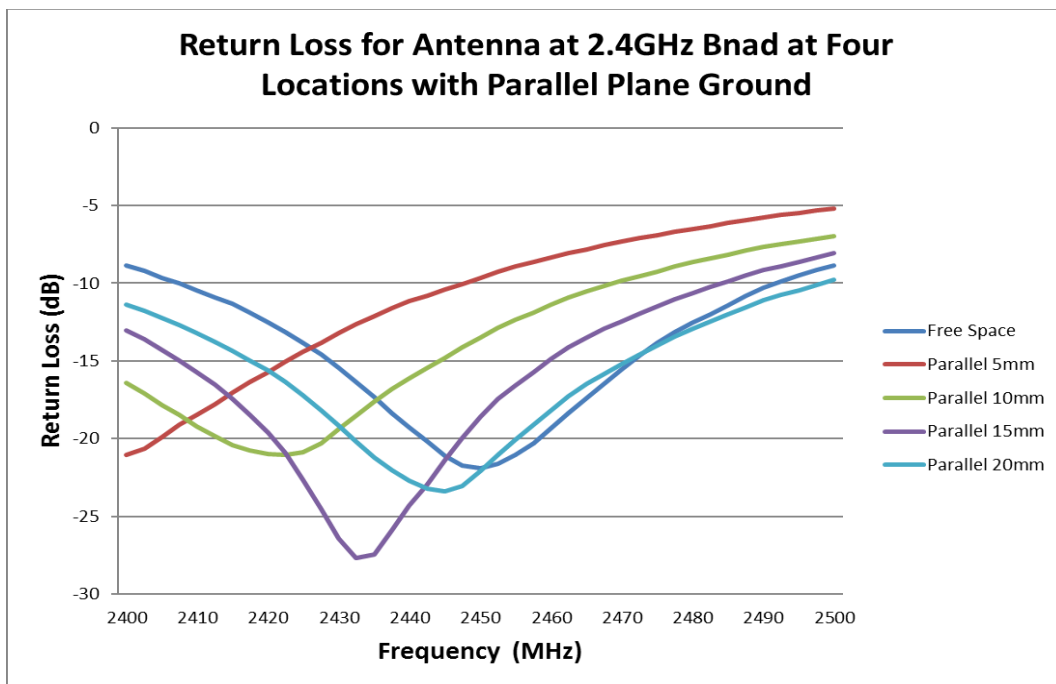
Location 1: Distance between antenna and plane ground (GAP) is about 5mm;

Location 2: Distance between antenna and plane ground (GAP) is about 10mm;

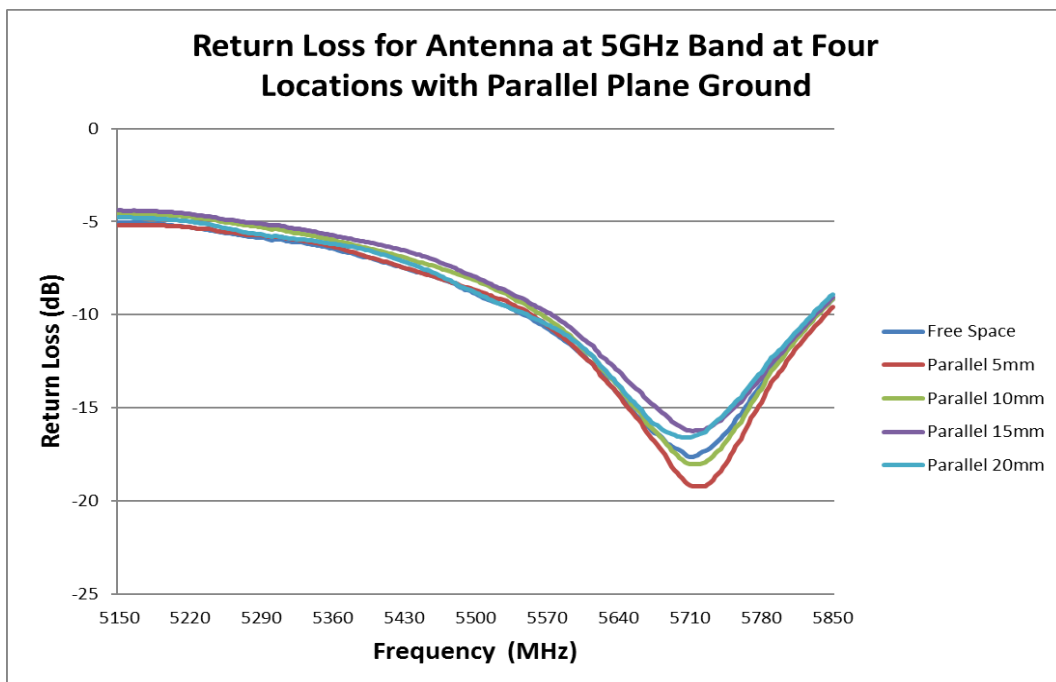
Location 3: Distance between antenna and plane ground (GAP) is about 15mm;

Location 4: Distance between antenna and plane ground (GAP) is about 20mm

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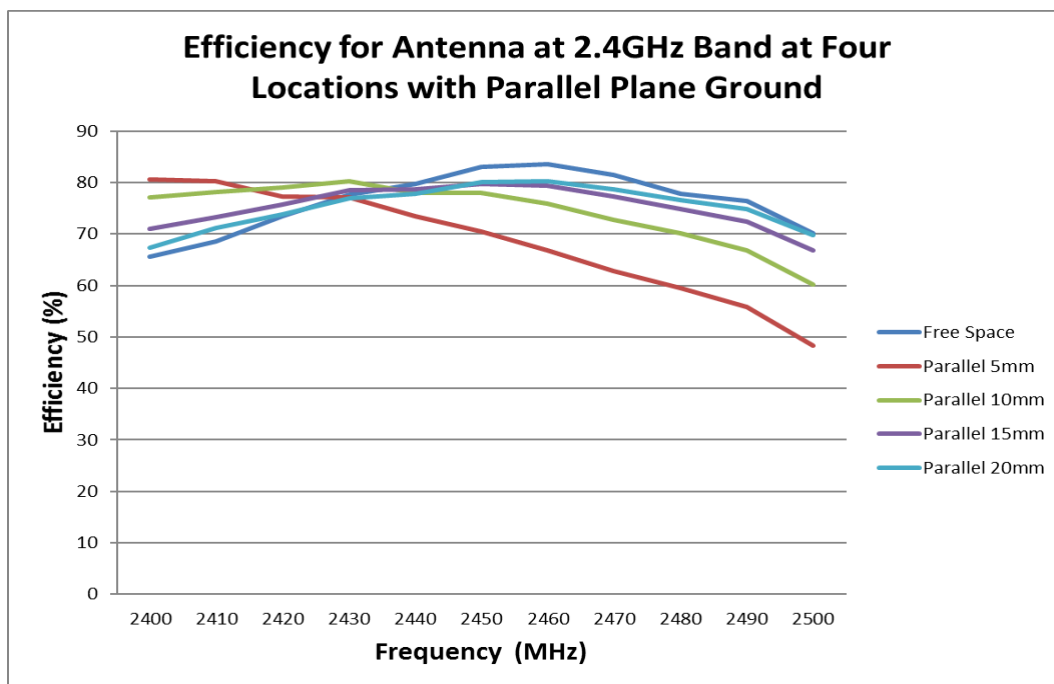


**FIGURE 7.1.1 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

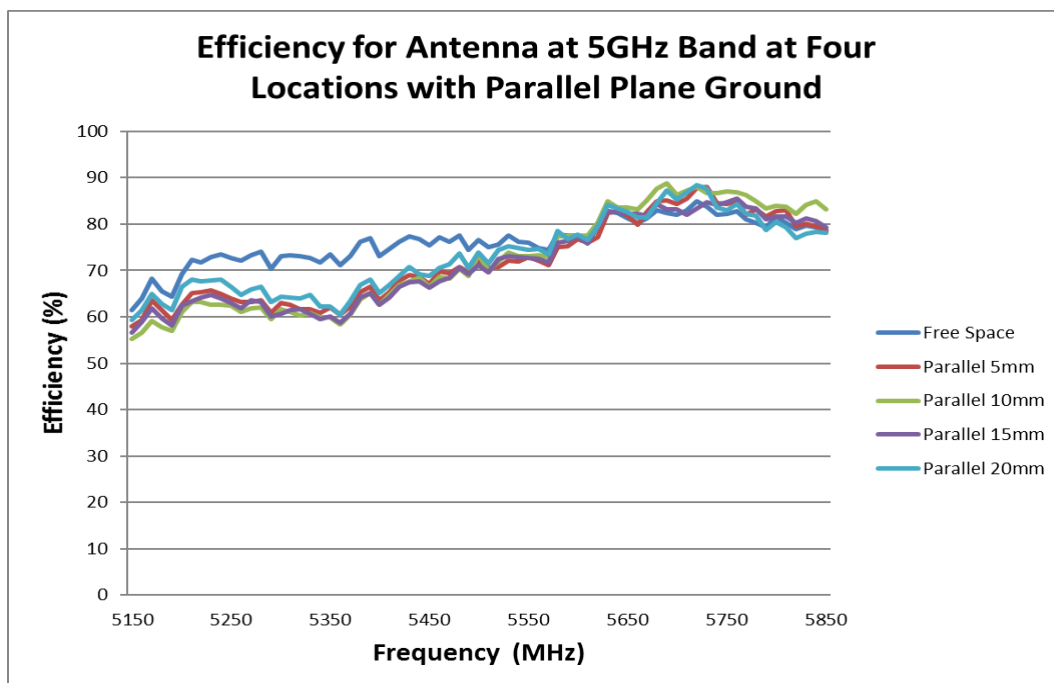


**FIGURE 7.1.2 RETURN LOSS OF ANTENNA AT 5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

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**FIGURE 7.1.3 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

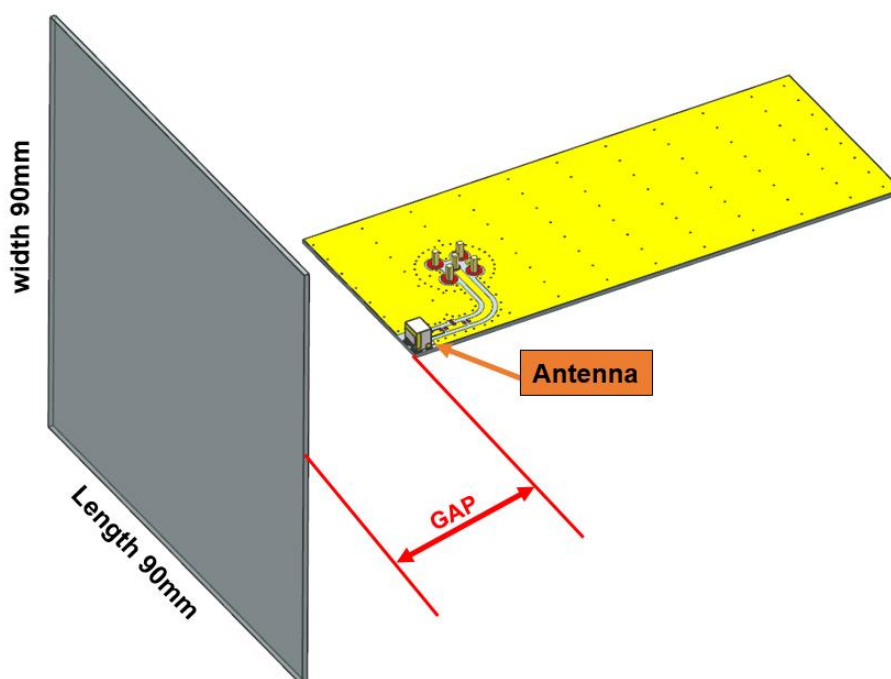


**FIGURE 7.1.4 EFFICIENCY OF ANTENNA AT 5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

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

Four locations with vertical plane ground have been evaluated and these locations are shown in figure 7.2. The plane ground size is 90mm\*90mm and we move the plane ground to four locations for each test. Vertical plane ground has great influence on low frequency. The minimum distance between antenna and plane ground is recommended to be 5mm to achieve acceptable RF performance.



**FIGURE 7.2 FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

Ground Size: 90mm\*90mm;

Location 1: Distance between antenna and plane ground (GAP) is about 5mm;

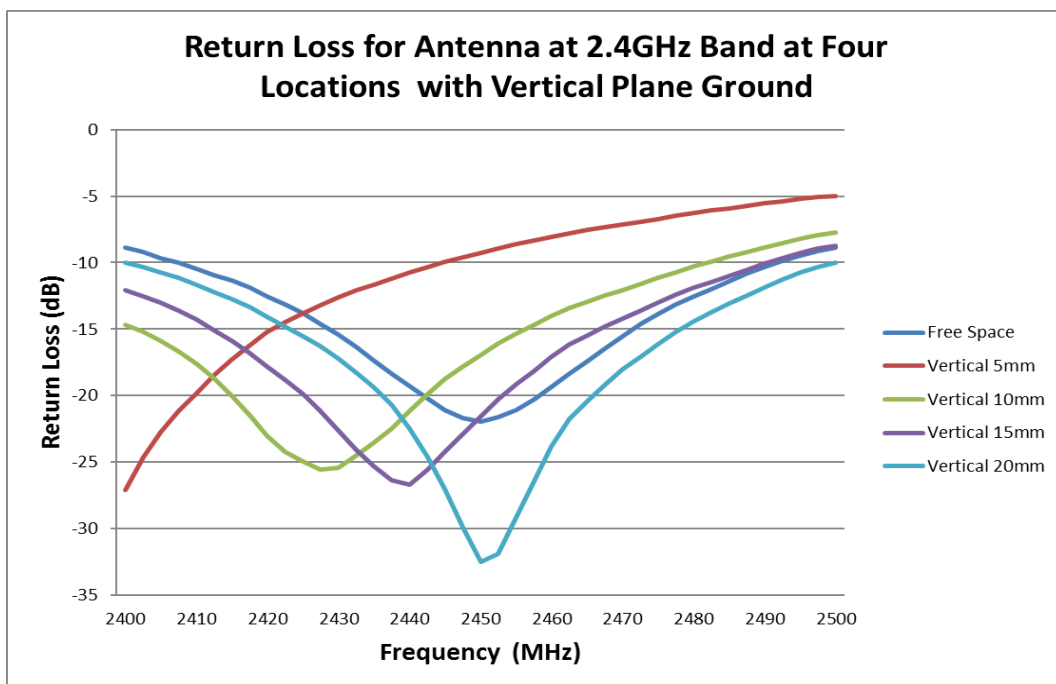
Location 2: Distance between antenna and plane ground (GAP) is about 10mm;

Location 3: Distance between antenna and plane ground (GAP) is about 15mm;

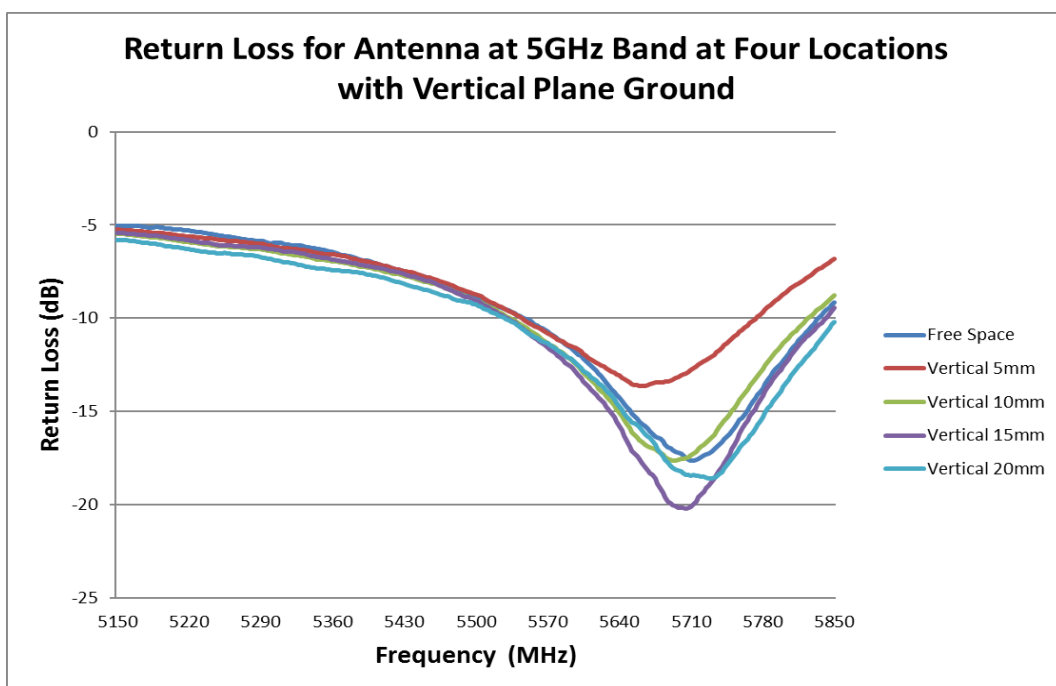
Location 4: Distance between antenna and plane ground (GAP) is about 20mm.

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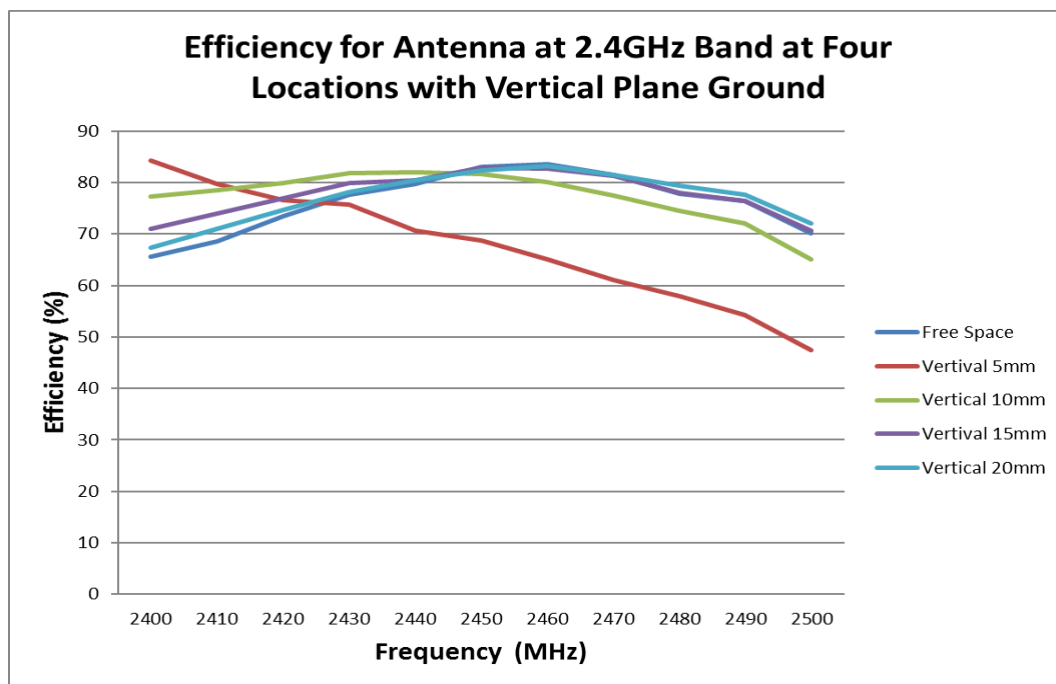


**FIGURE 7.2.1 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

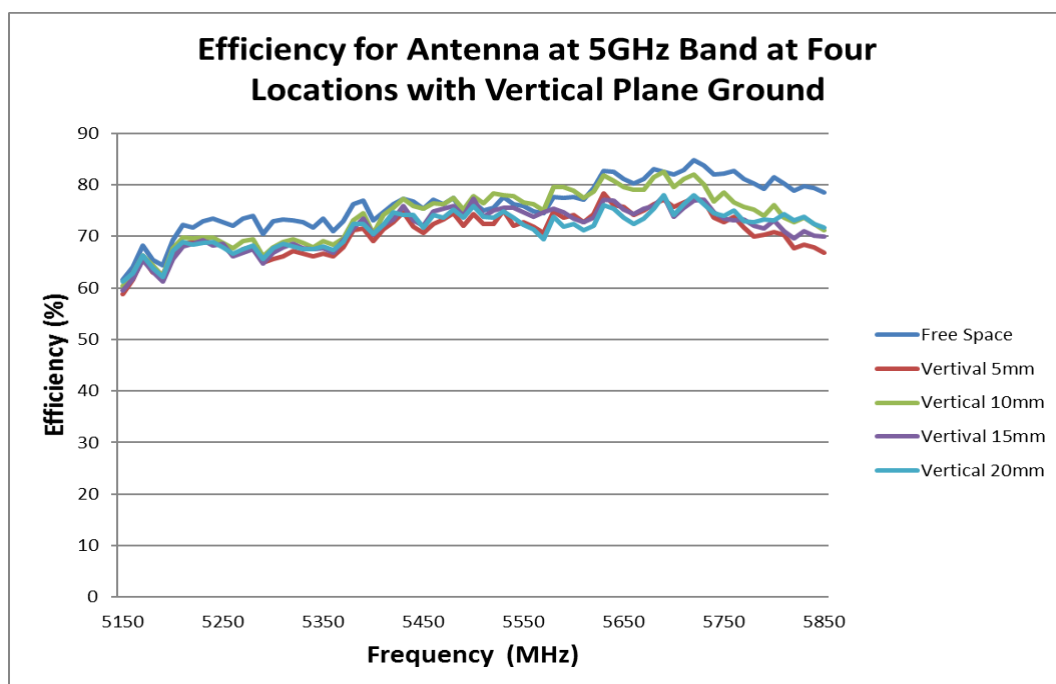


**FIGURE 7.2.2 RETURN LOSS OF ANTENNA AT 5GHZ BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

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**FIGURE 7.2.3 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

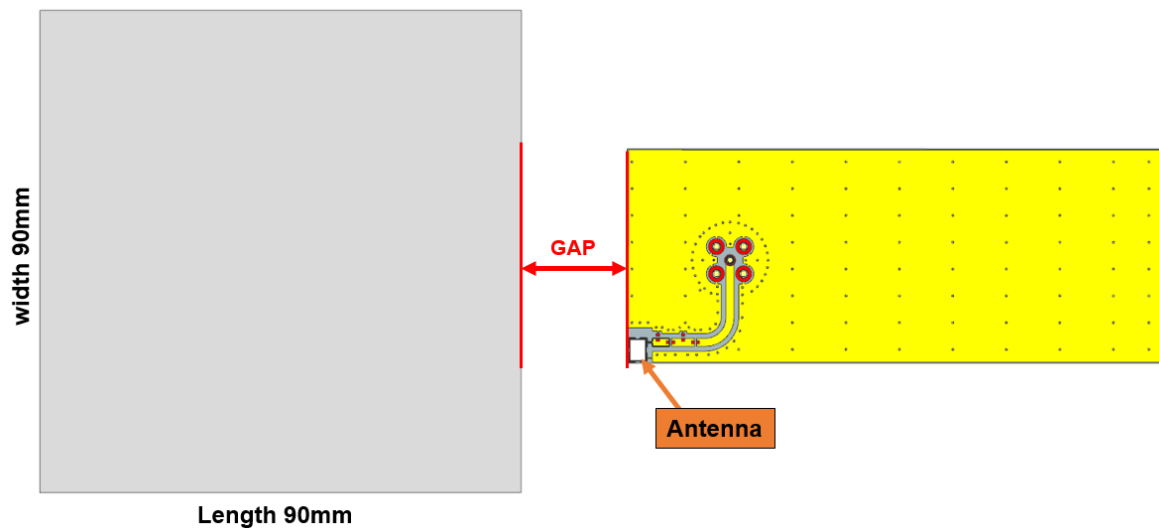


**FIGURE 7.2.4 EFFICIENCY OF ANTENNA AT 5GHZ BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

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

Four locations with parallel plane ground have been evaluated and these locations are shown in figure 7.3. The plane ground size is 90mm\*90mm and we move the plane ground to four locations for each test. The distance between antenna and parallel plane ground affect the antenna performance slightly. We still suggest the minimum distance between antenna and plane ground is recommended to be 5mm.



**FIGURE 7.3 FOUR LOCATIONS WITH VERTICAL PLANE GROUND**

Ground Size: 90mm\*90mm;

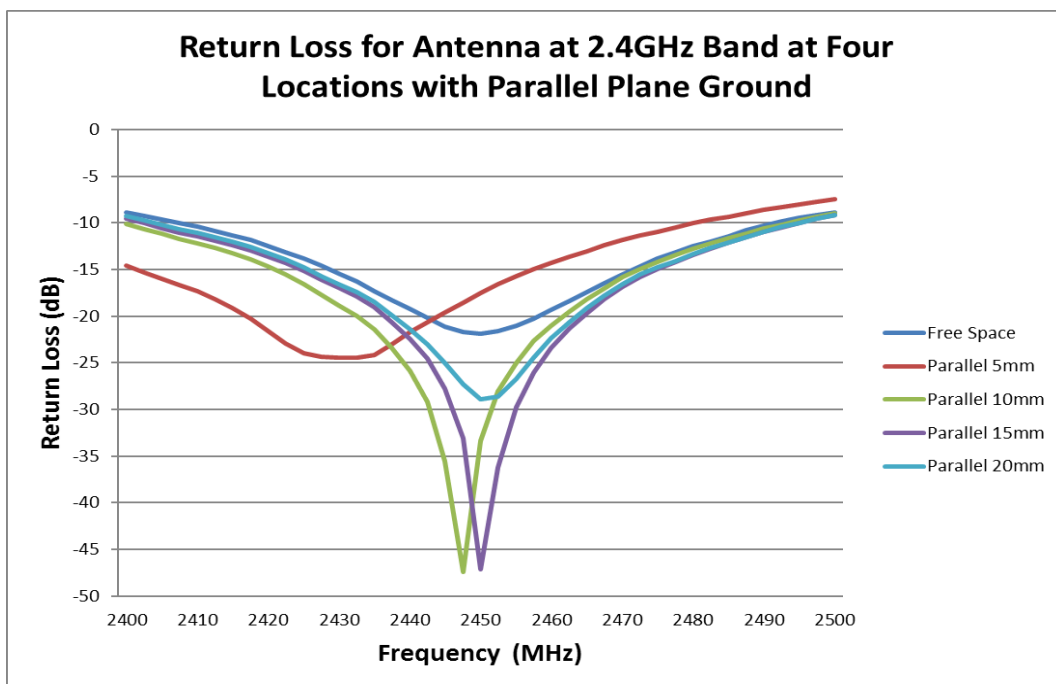
Location 1: Distance between antenna and plane (GAP) ground is about 5mm;

Location 2: Distance between antenna and plane (GAP) ground is about 10mm;

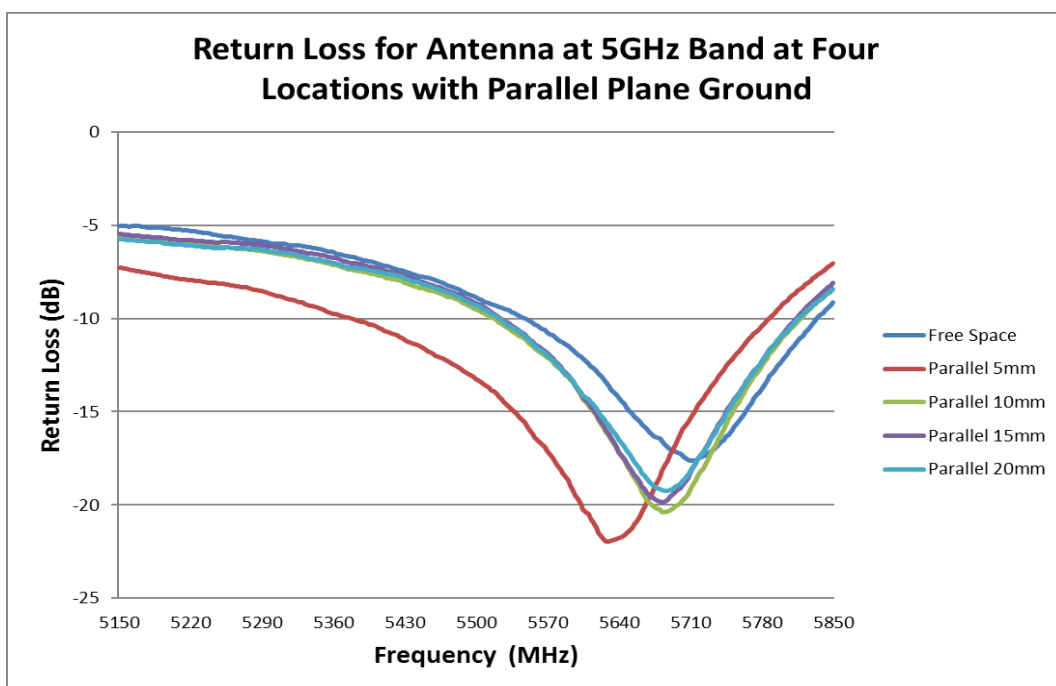
Location 3: Distance between antenna and plane (GAP) ground is about 15mm;

Location 4: Distance between antenna and plane (GAP) ground is about 20mm.

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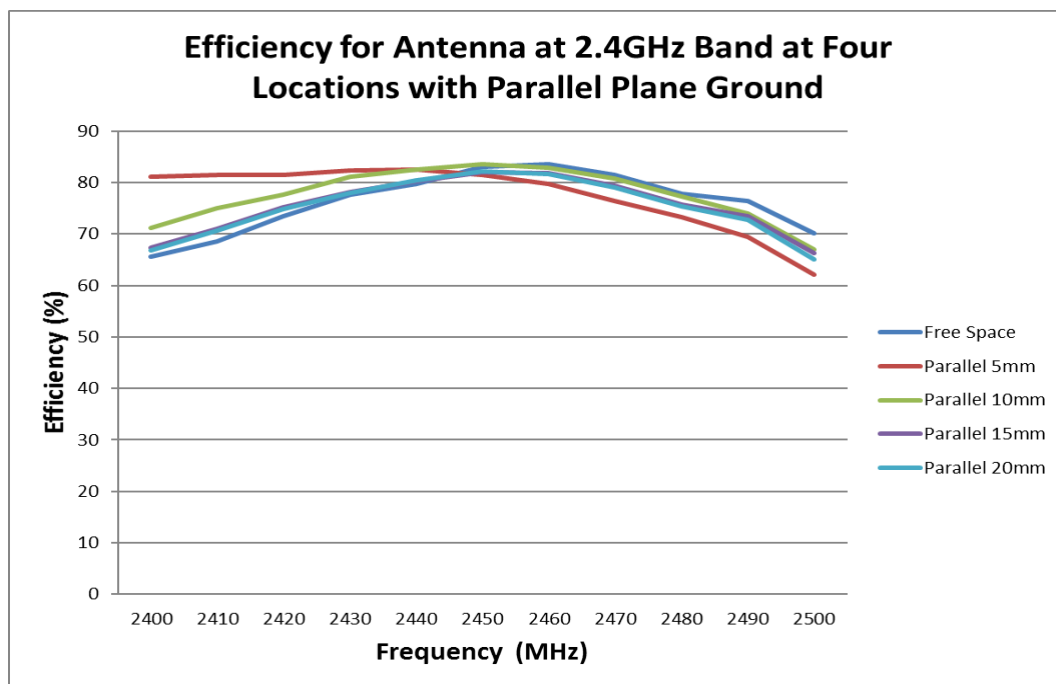


**FIGURE 7.3.1 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

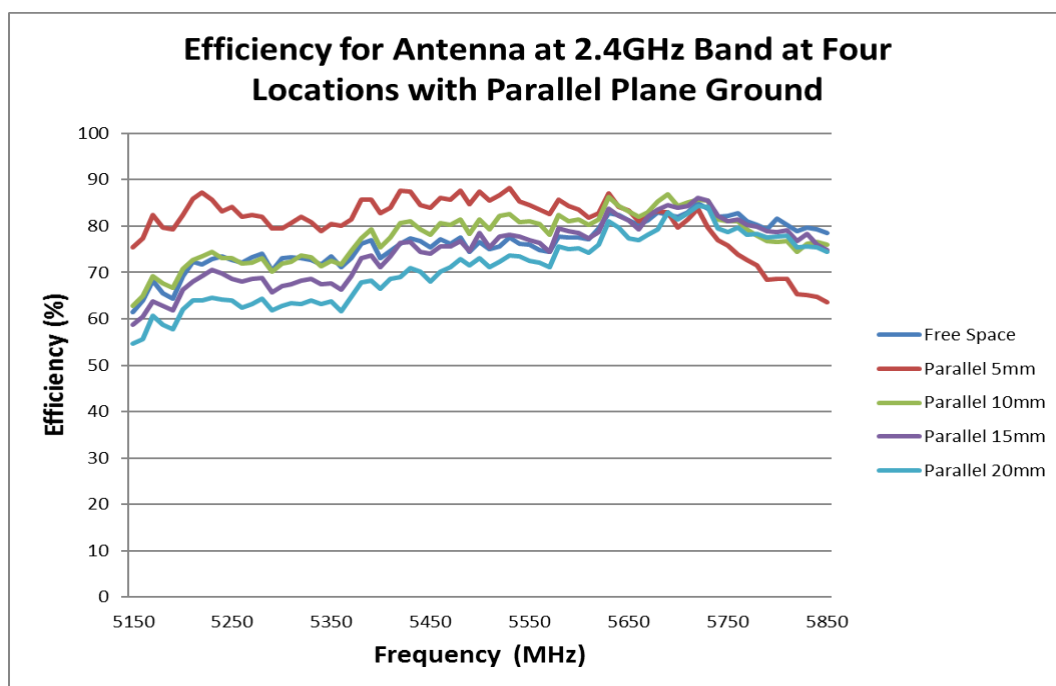


**FIGURE 7.3.2 RETURN LOSS OF ANTENNA AT 5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

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**FIGURE 7.3.3 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND ON A REFERENCE PCB**



**FIGURE 7.3.4 EFFICIENCY OF ANTENNA AT 5GHZ BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND**

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## 7.4 RF PERFORMANCE AS A FUNCTION ON DIFFERENT SIZE GROUD

Five kinds of ground plane size were used for this study, which were(L\*W) 150mm\*60mm, 120mm\*60mm, 100mm\*40mm (Reference PCB), 80mm\*40mm and 60mm\*30mm. From the test result we suggest the minimum ground size is 60\*30mm.

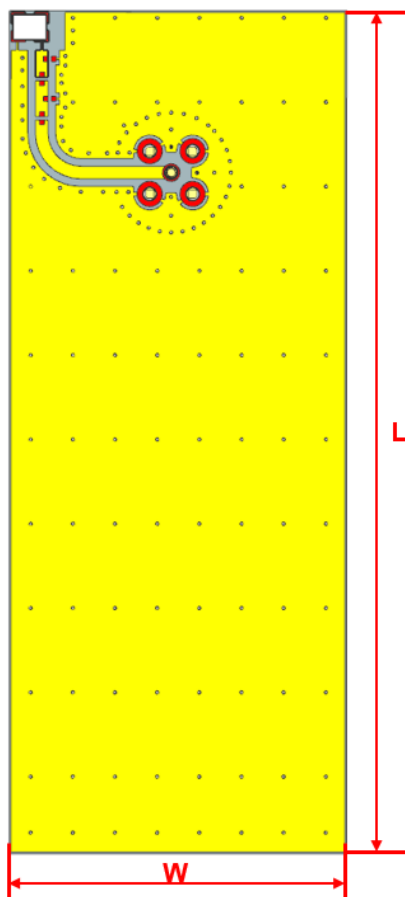


FIGURE 7.4 ANTENNA WITH DIFFERENT PLANE GROUNDS

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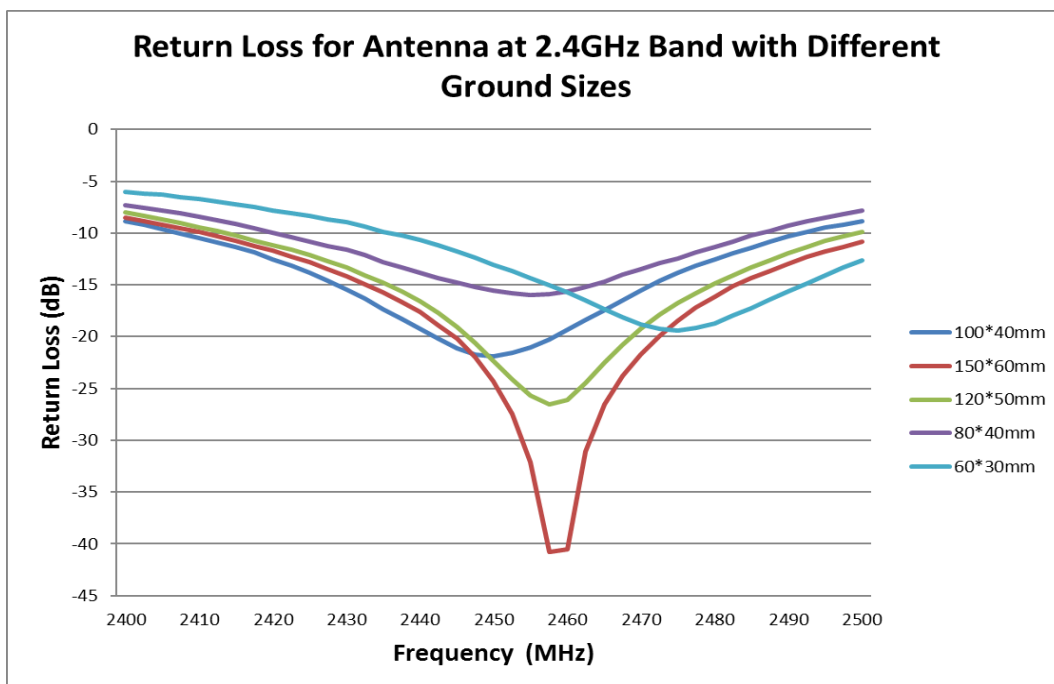


FIGURE 7.4.1 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND WITH DIFFERENT GROUND SIZES

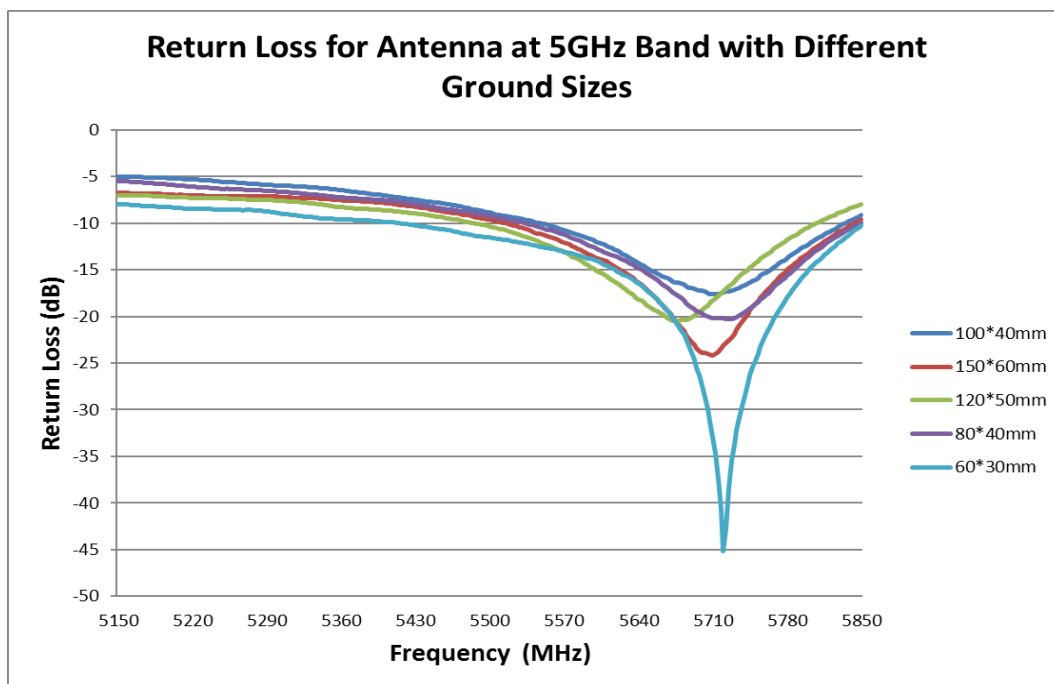


FIGURE 7.4.2 RETURN LOSS OF ANTENNA AT 5GHZ BAND WITH DIFFERENT GROUND SIZES

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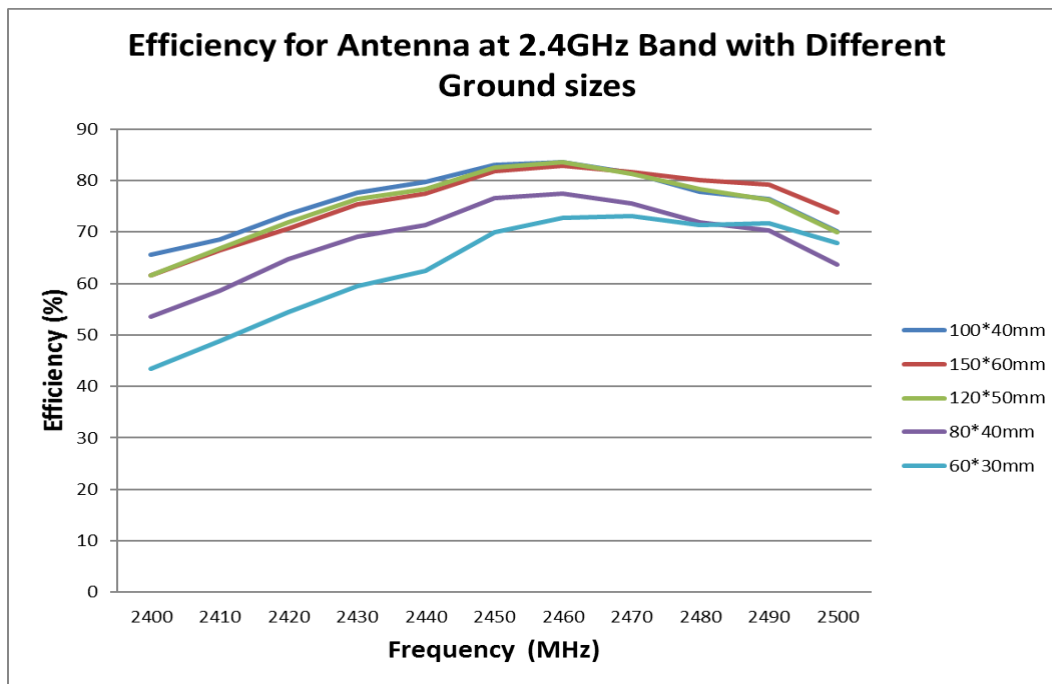


FIGURE 7.4.3 EFFICIENCY OF ANTENNA AT 2.4GHZ BADN WITH DIFFERENT GROUND SIZES

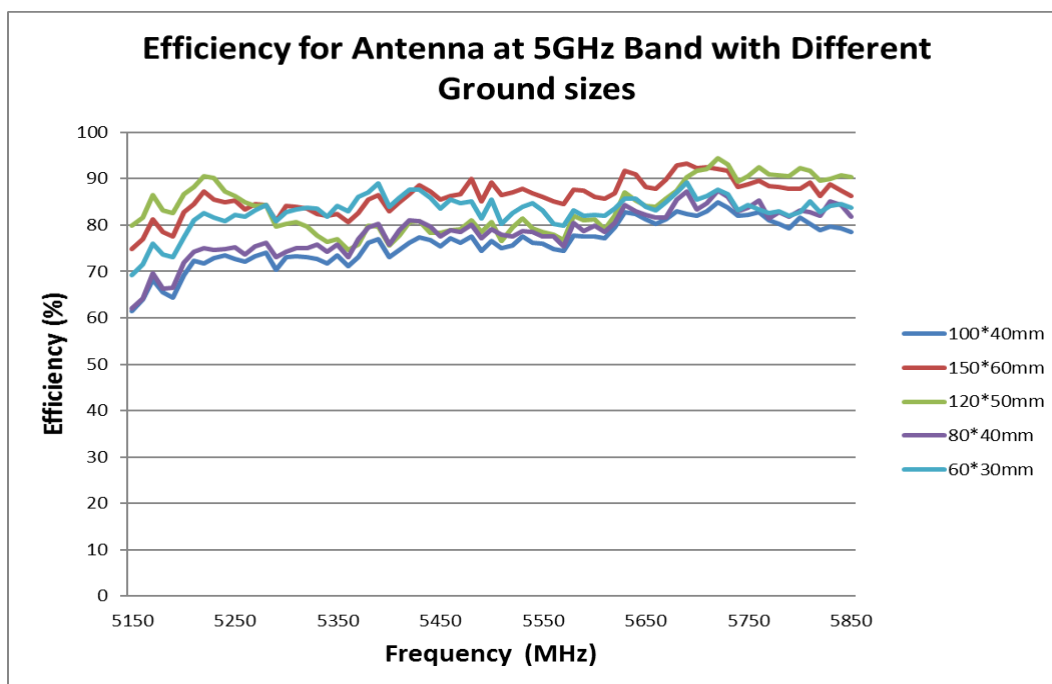


FIGURE 7.4.4 EFFICIENCY OF ANTENNA AT 5GHZ BAND WITH DIFFERENT GROUND SIZES

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# APPLICATION SPECIFICATION

## 8.0 OTHER MOLEX ANTENNA PRODUCTS

Please refer to the Antenna products in Molex home page to view all the Molex Antenna products.

<https://www.molex.com>

Molex, LLC

2222 Wellington Court

Lisle, IL 60532

USA

## 9.0 CHANGE HISTORY

REV	DATA	DESCRIPTION
A	2019/06/27	First Release
B	2022/12/13	Add Other molex antenna products

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