



# APPLICATION SPECIFICATION

## TITLE

### MOLEX 5G COMPATIBLE ANTENNA HINGED

## TABLE OF CONTENTS

1.0 SCOPE

2.0 PRODUCT DESCRIPTION

3.0 APPLICABLE DOCUMENTS

4.0 ANTENNA PERFORMANCE

5.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>1 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



# APPLICATION SPECIFICATION

## MOLEX 5G COMPATIBLE ANTENNA HINGED

### 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 DESCRIPTION

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

Product name: Molex 5G compatible antenna hinged

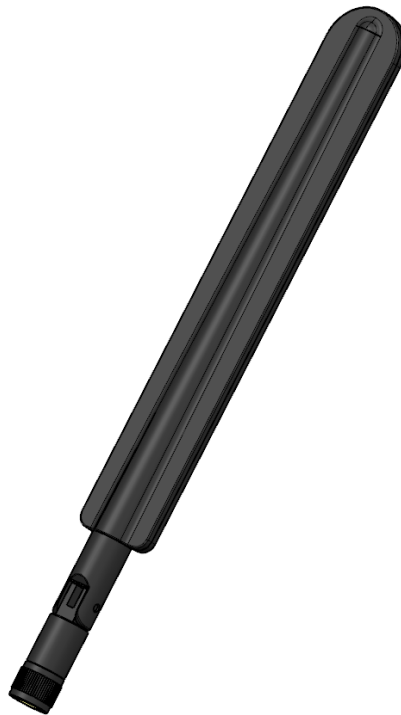
Series Number: 214429

#### 2.2 DESCRIPTION

213523 is external antenna being designed to cover all Cellular working frequencies in the 698-5000MHz spectrum. The joint hinge of the antenna allows 90°rotating on vertical plane, and the SMA-J connector allows 180°rotating on horizontal plane.

#### 2.3 PRODUCT STRUCTURE INFORMATION

Please refer to PS-2144290001 for full information.



Molex 2135230001 698~5000MHz EXTERNAL ANTENNA 3D VIEW

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>2 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19

### 3.0 APPLICABLE DOCUMENTS

DOCUMENT	NUMBER	DESCRIPTION
Sale Drawing (SD)	SD-2144290001	Mechanical Dimension of the product
Product Specification (PS)	PS-2144290001	Product Specification
Packing Drawing (PK)	PK-2135230001	Product packaging specifications

### 4.0 ANTENNA PERFORMANCE

#### 4.1 RF TEST CONDITIONS

All measurements are done of the antenna mounted on a 100\*100mm ground with VNA Agilent E5071C and Over-The-Air (OTA) chamber for the part No.214429 series.

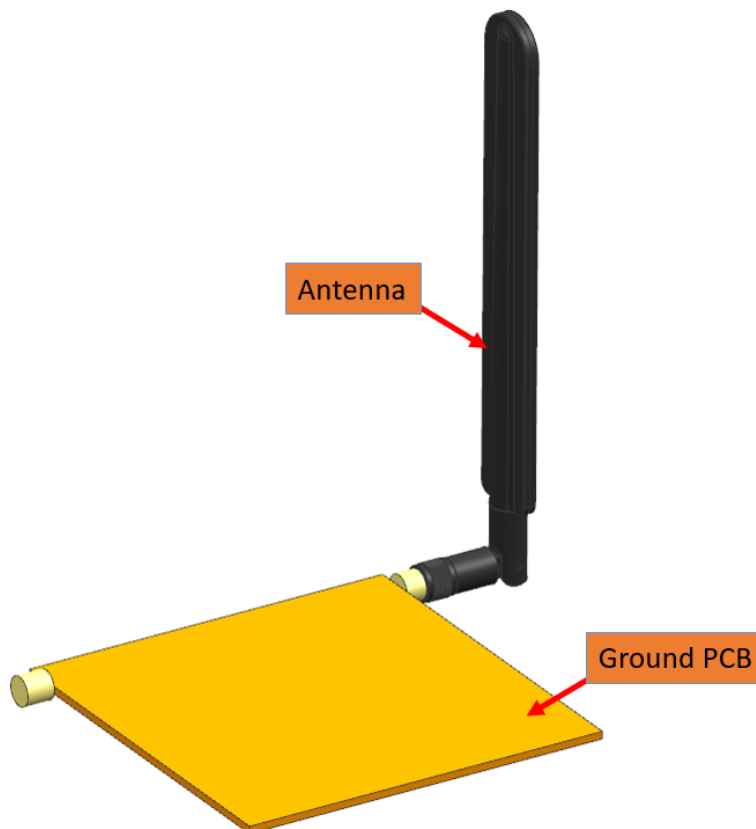
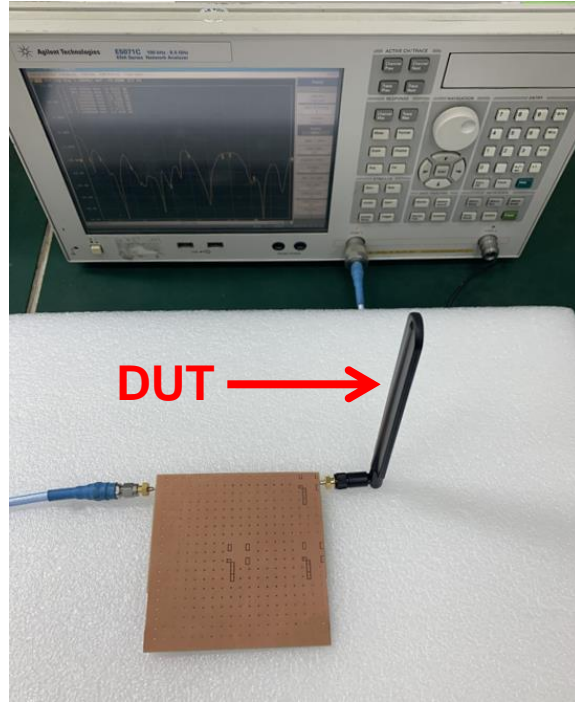
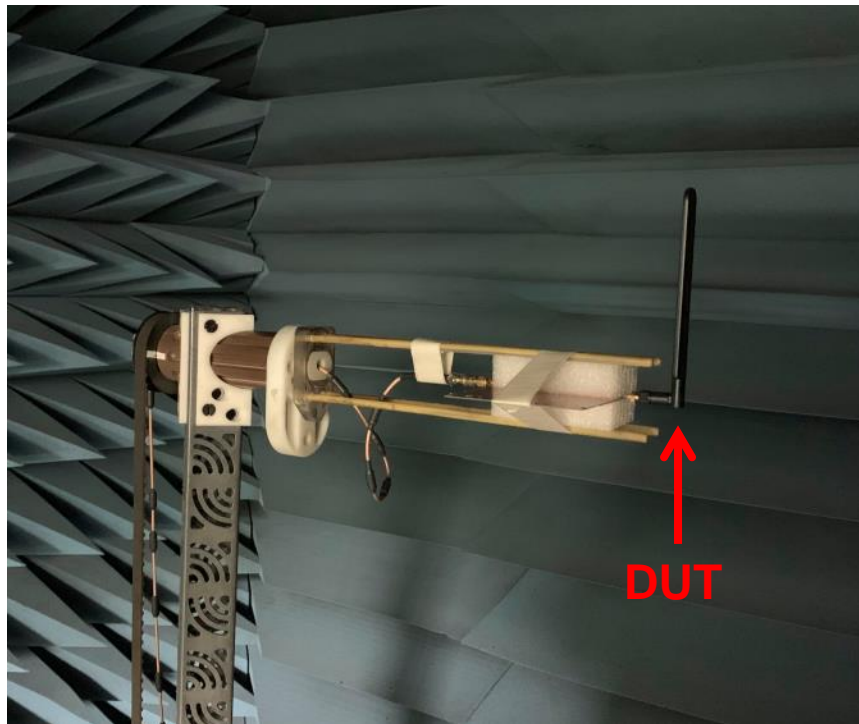


FIGURE4.1.1 ANTENNA MOUNTED ON A 100\*100MM GROUND

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>3 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



**FIGURE4.1.2 ANTENNA MOUNTED ON 100\*100MM GROUND TESTED WITH VNA E5071C**



**FIGURE4.1.3 ANTENNA MOUNTED ON 100\*100MM GROUND TESTED IN OTA CHAMBER**

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DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



# APPLICATION SPECIFICATION

## 4.2 ANTENNA PERFORMANCE

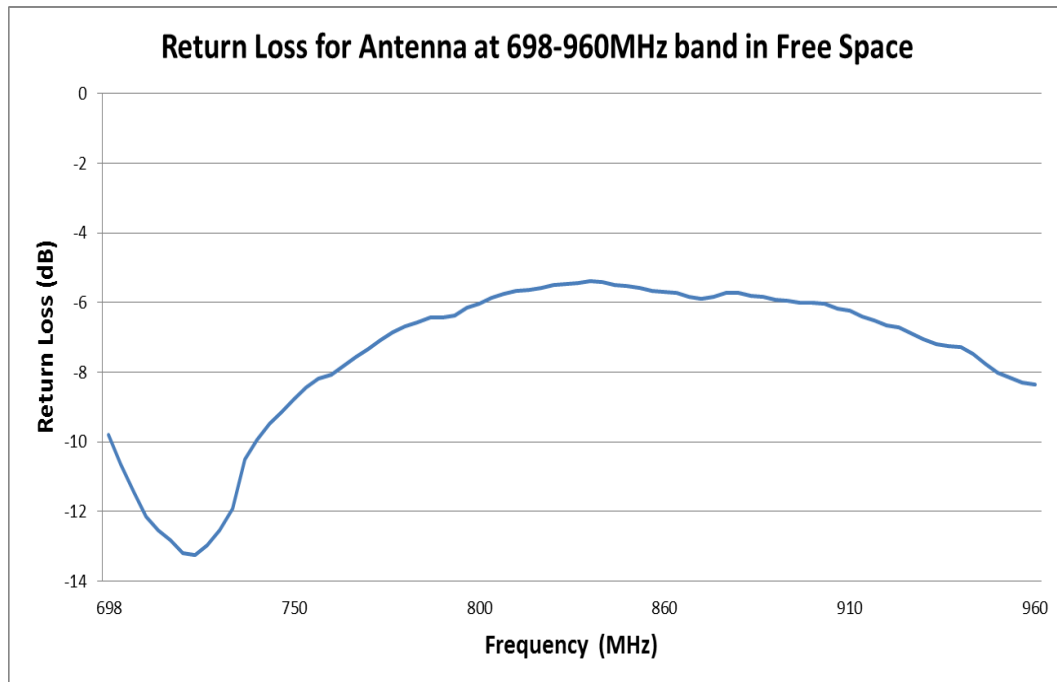
Description	Equipment	Requirement			
		698-960MHz	1.71-2.69GHz	3.3-4.2GHz	4.4-5GHz
Frequency Range	VNA E5071C	698-960MHz	1.71-2.69GHz	3.3-4.2GHz	4.4-5GHz
Return Loss	VNA E5071C	<-5 dB	<-10 dB	<-5 dB	<-5 dB
Peak Gain (Max)	OTA Chamber	1.6dBi	5.5dBi	3.6dBi	3.5dBi
Average Total Efficiency	OTA Chamber	>55%	>70%	>60%	>55%
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 PCB to simulate 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.

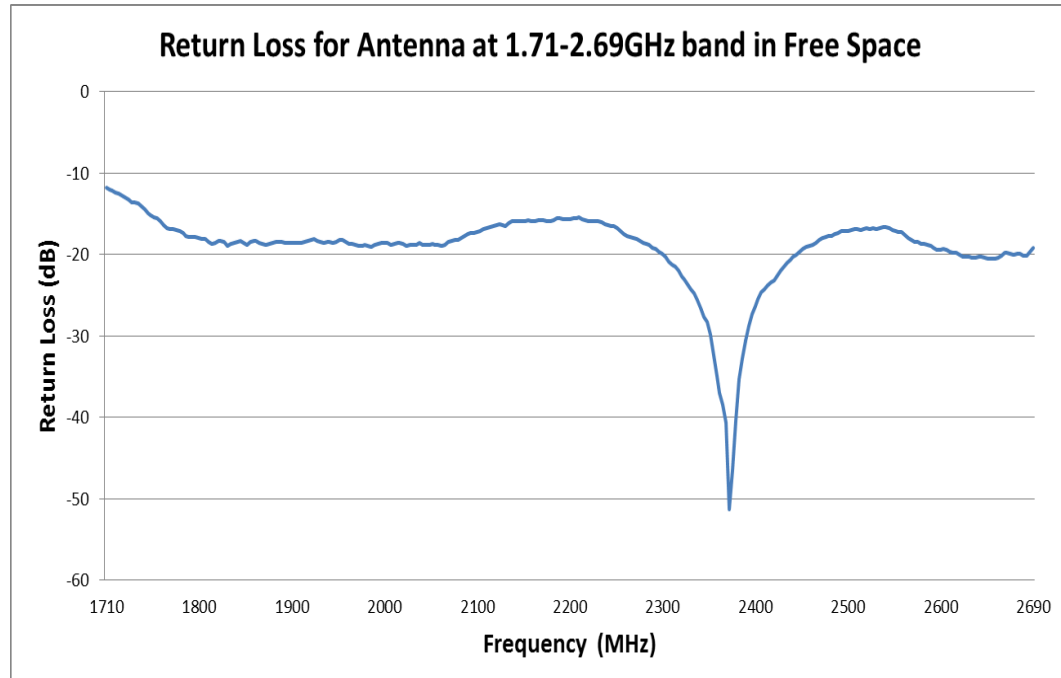
<b>REVISION:</b> <b>A</b>	<b>ECR/ECN INFORMATION:</b> EC No: 626276 DATE: 2019/10/18	<b>TITLE:</b> <b>698~5000MHz External Antenna Application Specification</b>	<b>SHEET No.</b> <b>5 of 37</b>
<b>DOCUMENT NUMBER:</b> <b>AS-2144290001</b>	<b>CREATED / REVISED BY:</b> Liu Hai 2019/09/19	<b>CHECKED BY:</b> Cheng Kang 2019/09/19	<b>APPROVED BY:</b> Andy Zhang 2019/09/19

## 4.3 RETURN LOSS PLOT

All measurements in this document are done by installing the antenna on 100\*100mm PCB.

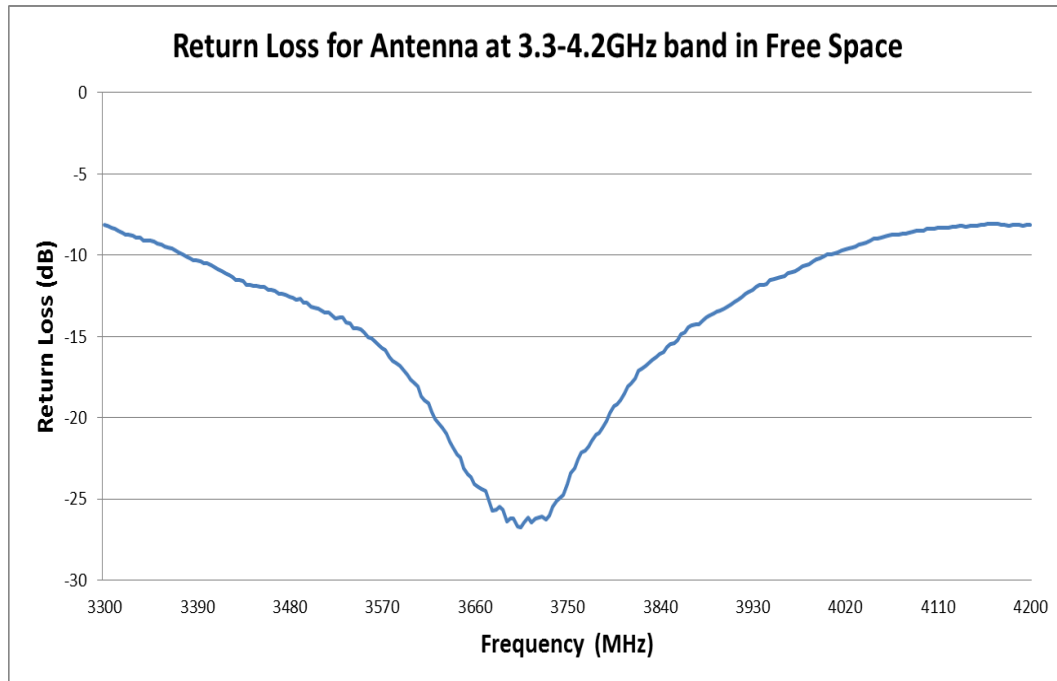


**FIGURE 4.3.1 RETURN LOSS OF ANTENNA AT 698-960MHZ IN FREE SPACE**

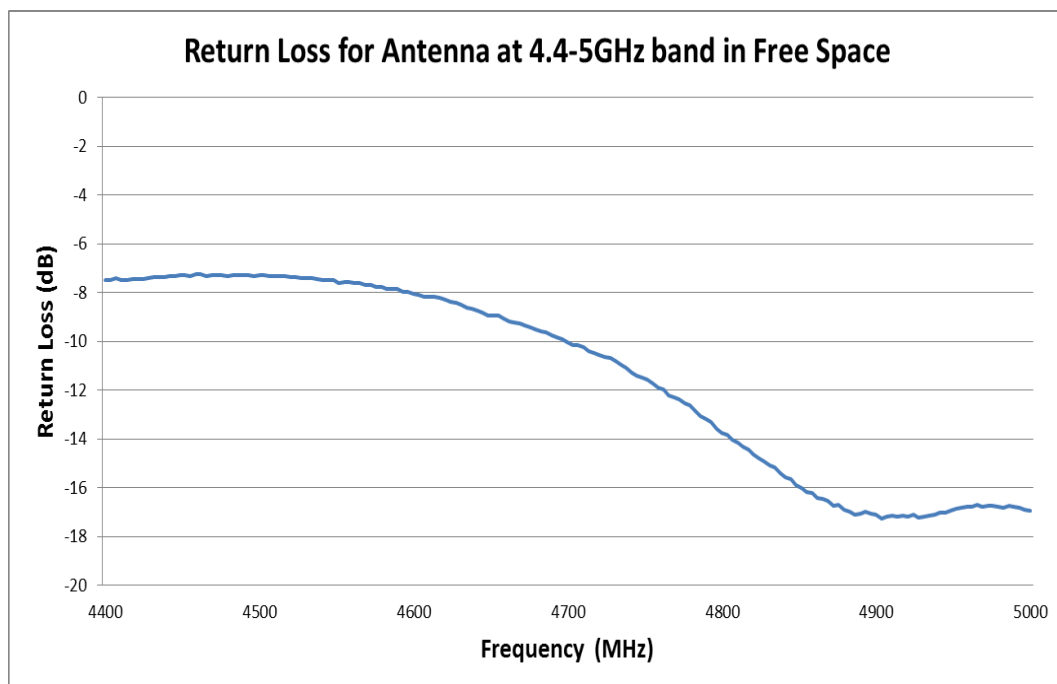


**FIGURE 4.3.2 RETURN LOSS OF ANTENNA AT 1.71-2.69GHZ IN FREE SPACE**

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DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



**FIGURE 4.3.3 RETURN LOSS OF ANTENNA AT 3.3-4.2GHZ IN FREE SPACE**

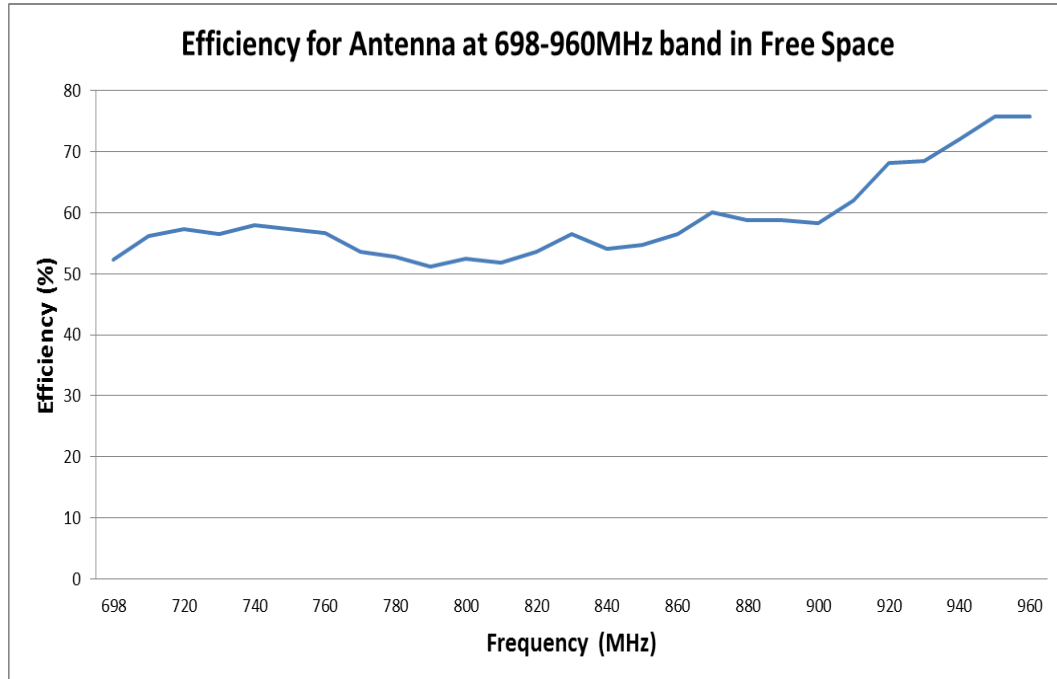


**FIGURE 4.3.4 RETURN LOSS OF ANTENNA AT 4.4-5GHZ IN FREE SPACE**

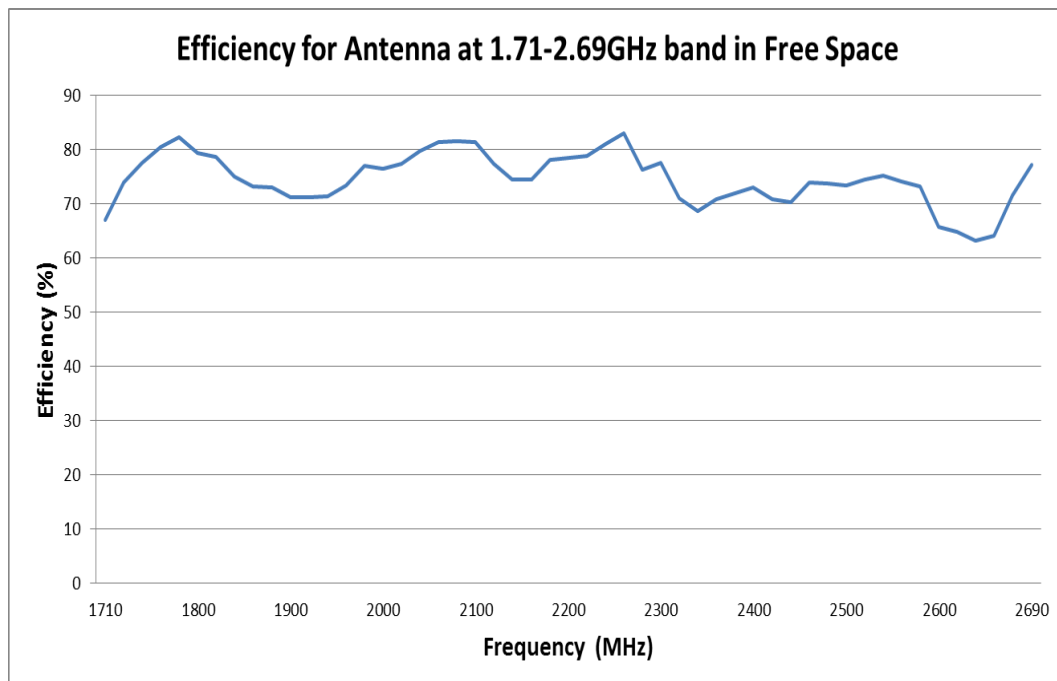
REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>7 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19

## 4.4 EFFICIENCY PLOT

All measurements in this document are done by installing the antenna on 100\*100mm PCB.



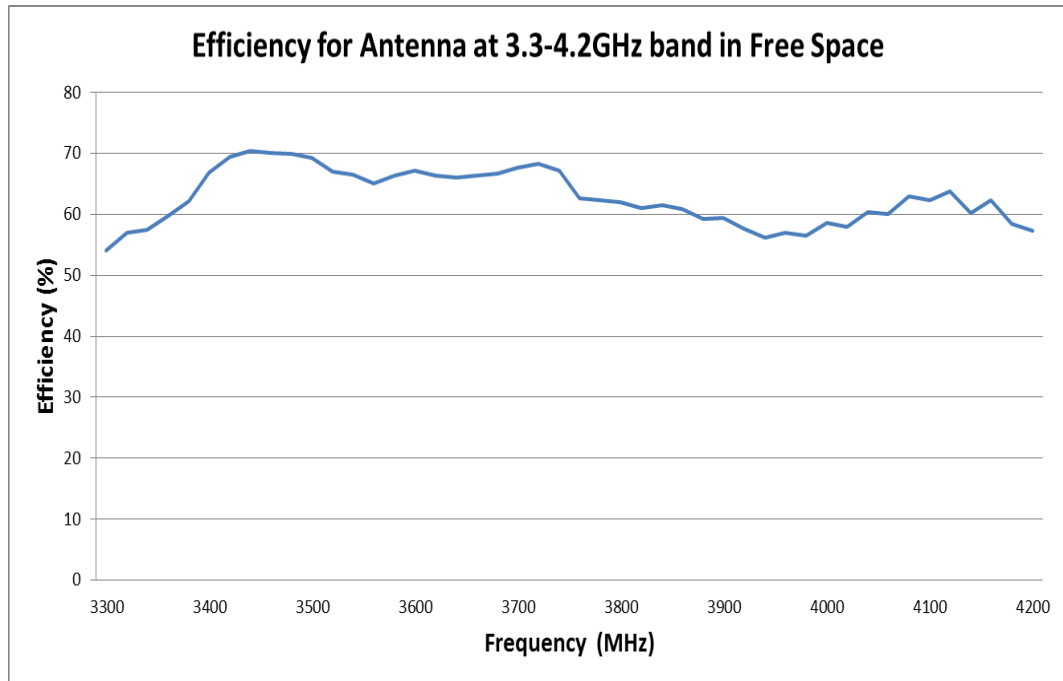
**FIGURE 4.4.1 EFFICIENCY OF ANTENNA AT 698-960MHZ IN FREE SPACE**



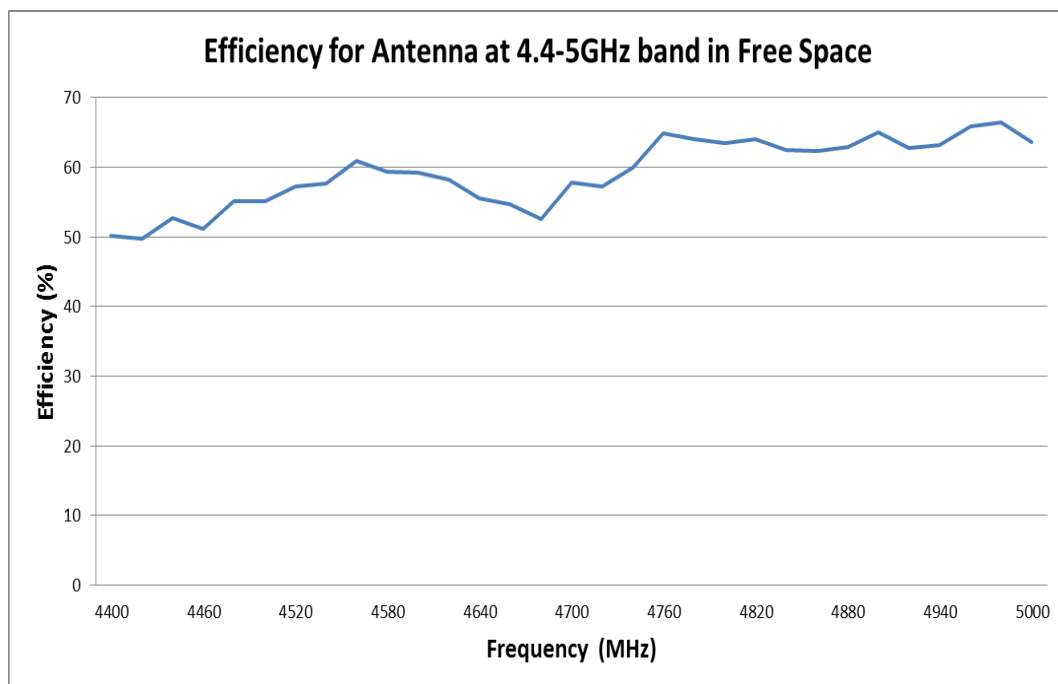
**FIGURE 4.4.2 EFFICIENCY OF ANTENNA AT 1.71-2.69GHZ IN FREE SPACE**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>8 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19





**FIGURE 4.4.3 EFFICIENCY OF ANTENNA AT 3.3-4.2GHZ IN FREE SPACE**

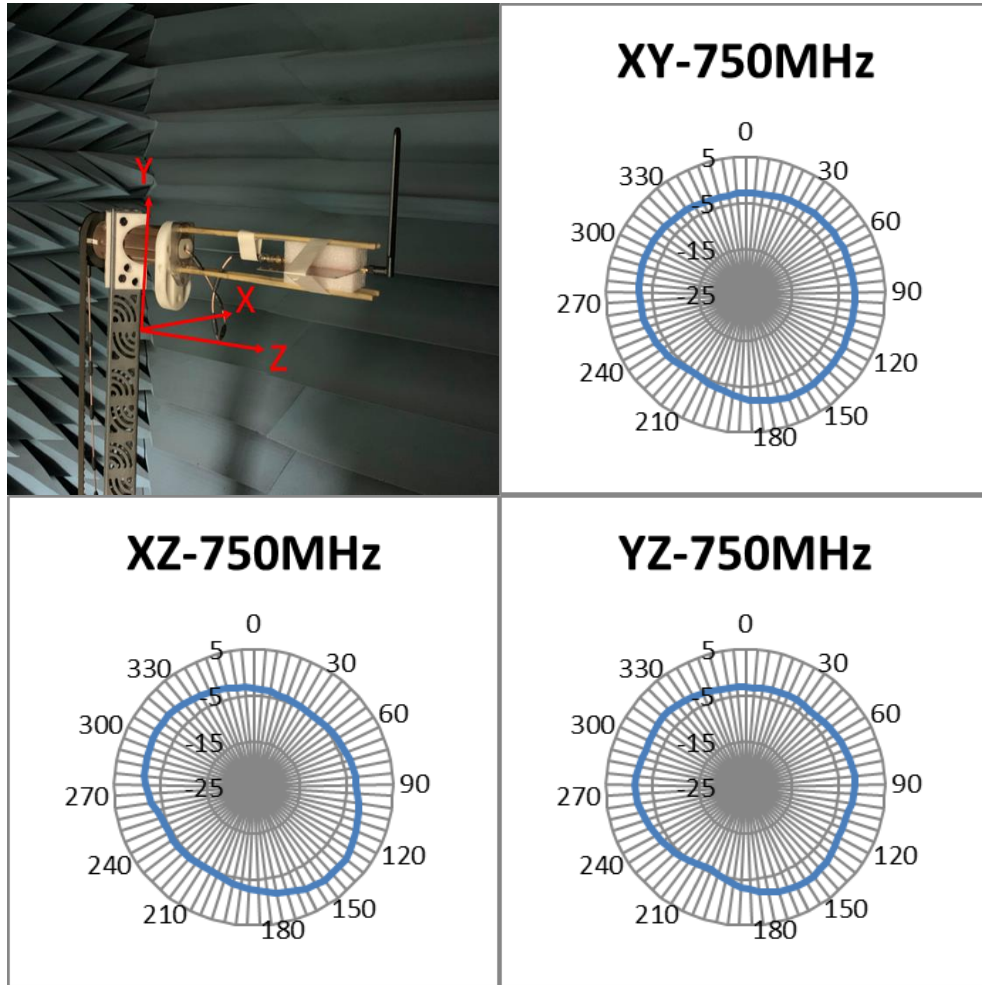


**FIGURE 4.4.4 EFFICIENCY OF ANTENNA AT 4.4-5GHZ IN FREE SPACE**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>9 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19

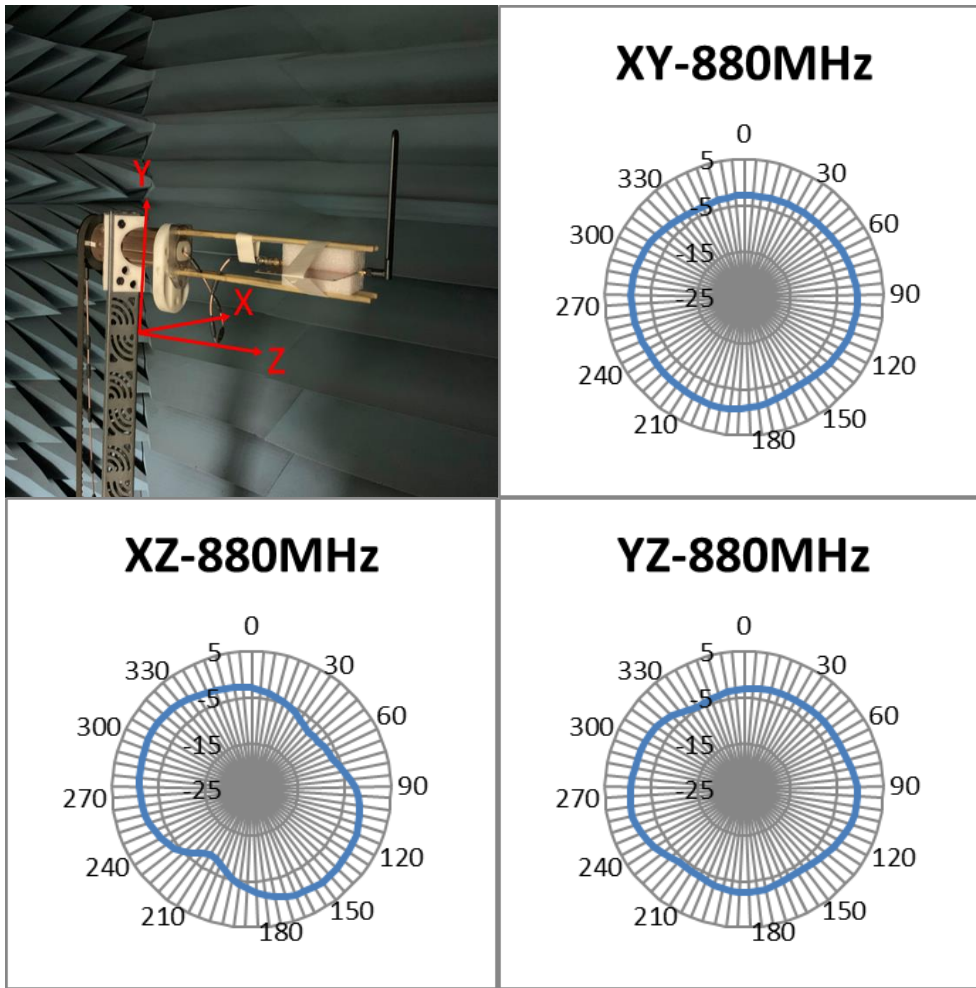
## 4.5 2D RADIATION PATTERN

All measurements in this document are done by installing the antenna on 100\*100mm PCB.



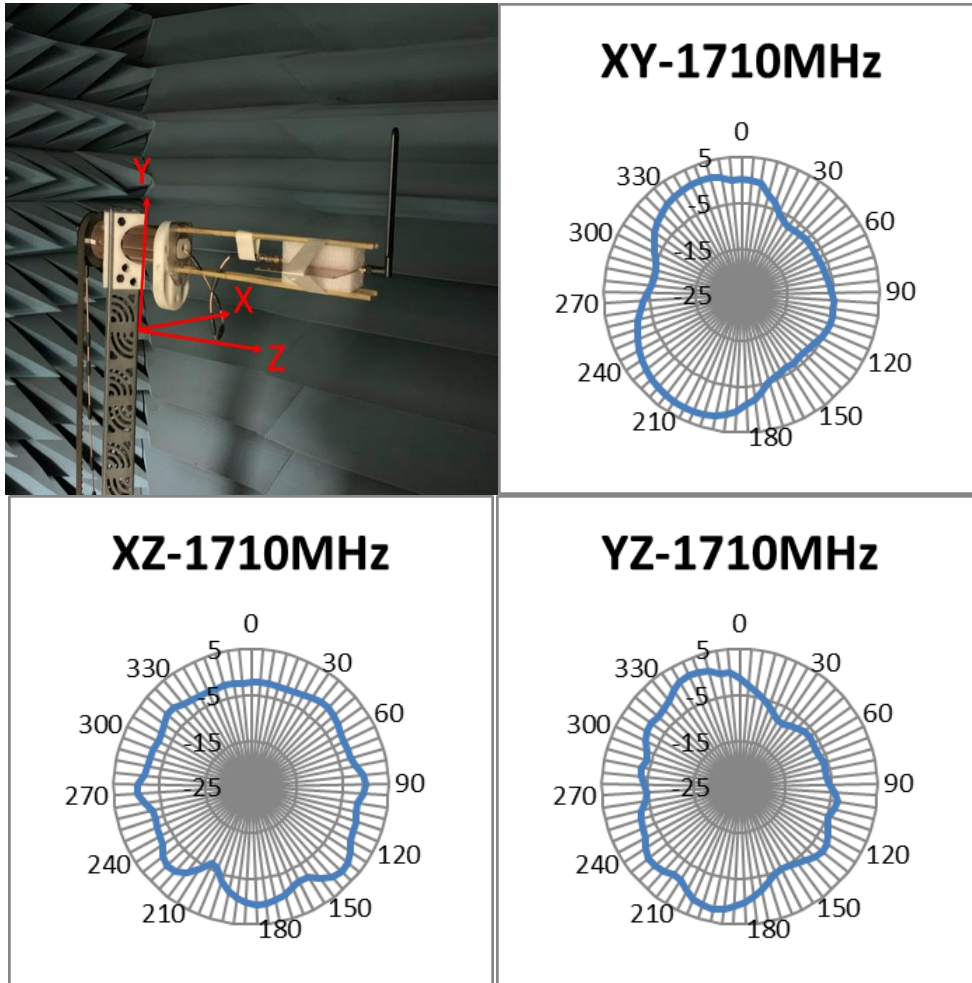
**FIGURE 4.5.1 2D RADIATION PATTERN OF ANTENNA AT 750MHZ IN FREE SPACE**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>10 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



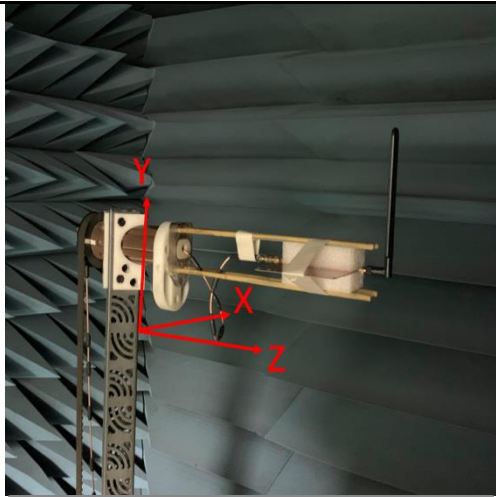
**FIGURE 4.5.2 2D RADIATION PATTERN OF ANTENNA AT 880MHZ IN FREE SPACE**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>11 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19

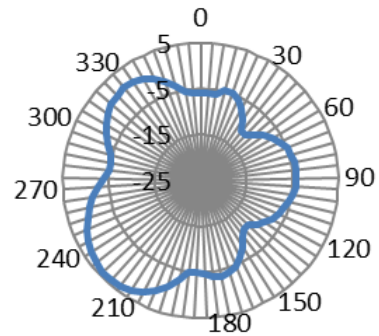


**FIGURE 4.5.3 2D RADIATION PATTERN OF ANTENNA AT 1710MHZ IN FREE SPACE**

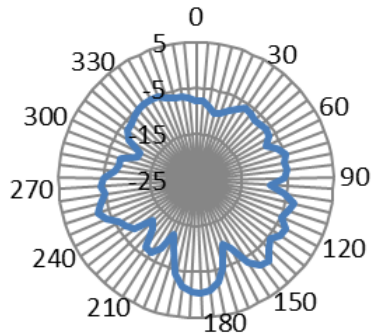
REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>12 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



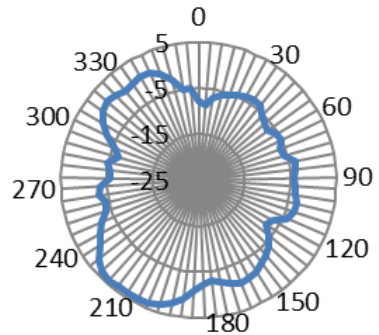
### XY-2170MHz



### XZ-2170MHz

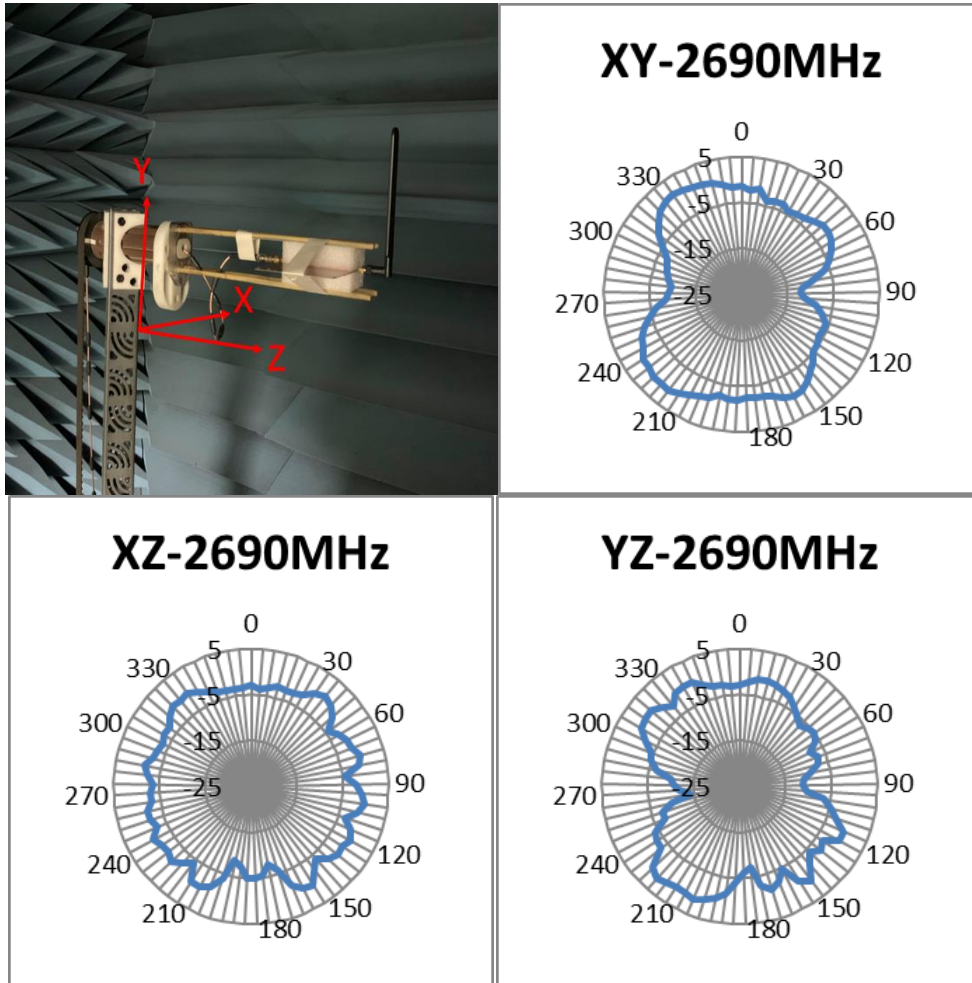


### YZ-2170MHz



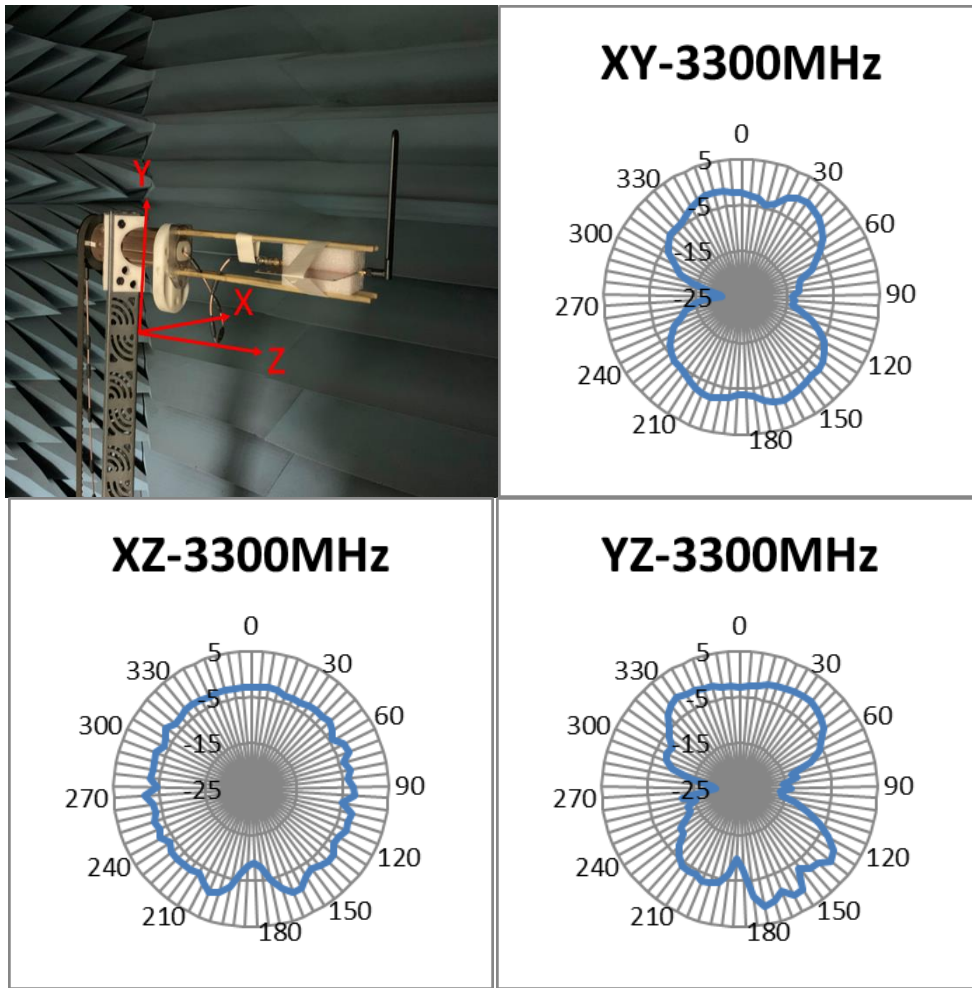
**FIGURE 4.5.4 2D RADIATION PATTERN OF ANTENNA AT 2170MHZ IN FREE SPACE**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>13 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



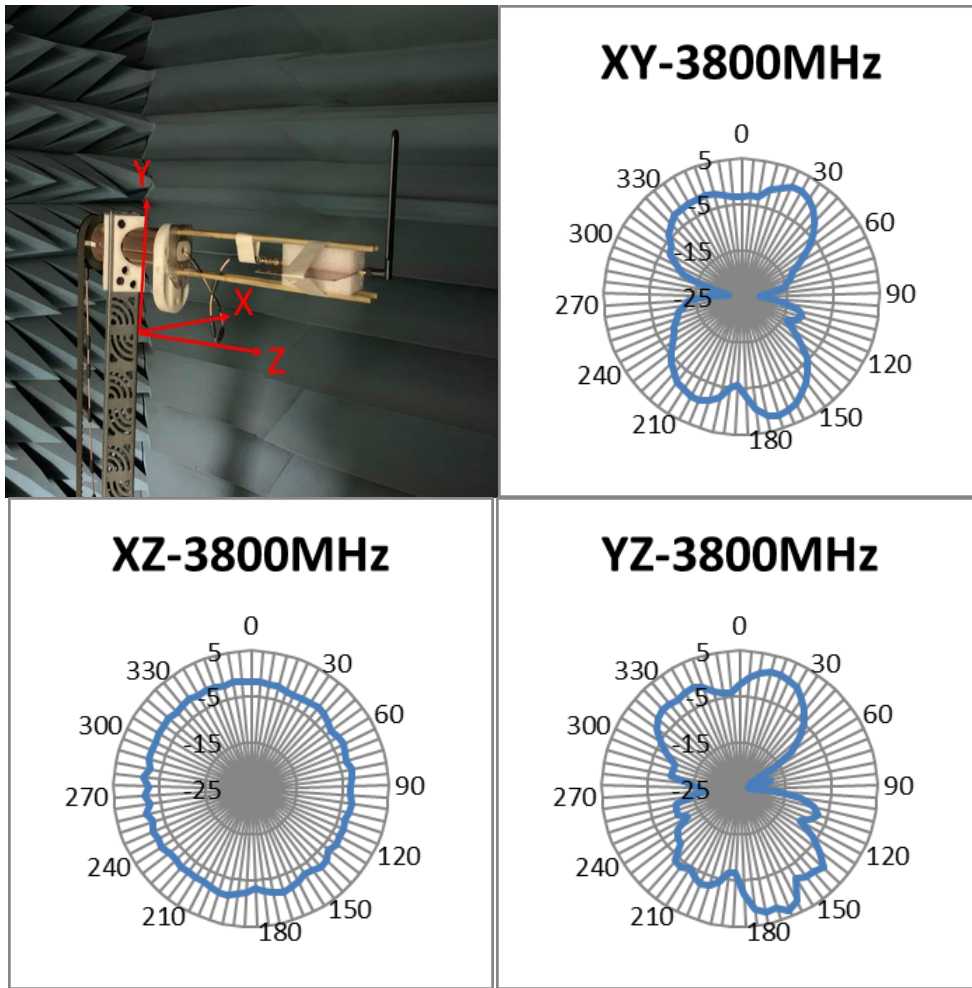
**FIGURE 4.5.5 2D RADIATION PATTERN OF ANTENNA AT 2690MHZ IN FREE SPACE**

REVISION:  <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE:  <b>698~5000MHz External Antenna Application Specification</b>		SHEET No.  <b>14 of 37</b>
DOCUMENT NUMBER:  <b>AS-2144290001</b>		CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



**FIGURE 4.5.6 2D RADIATION PATTERN OF ANTENNA AT 3300MHZ IN FREE SPACE**

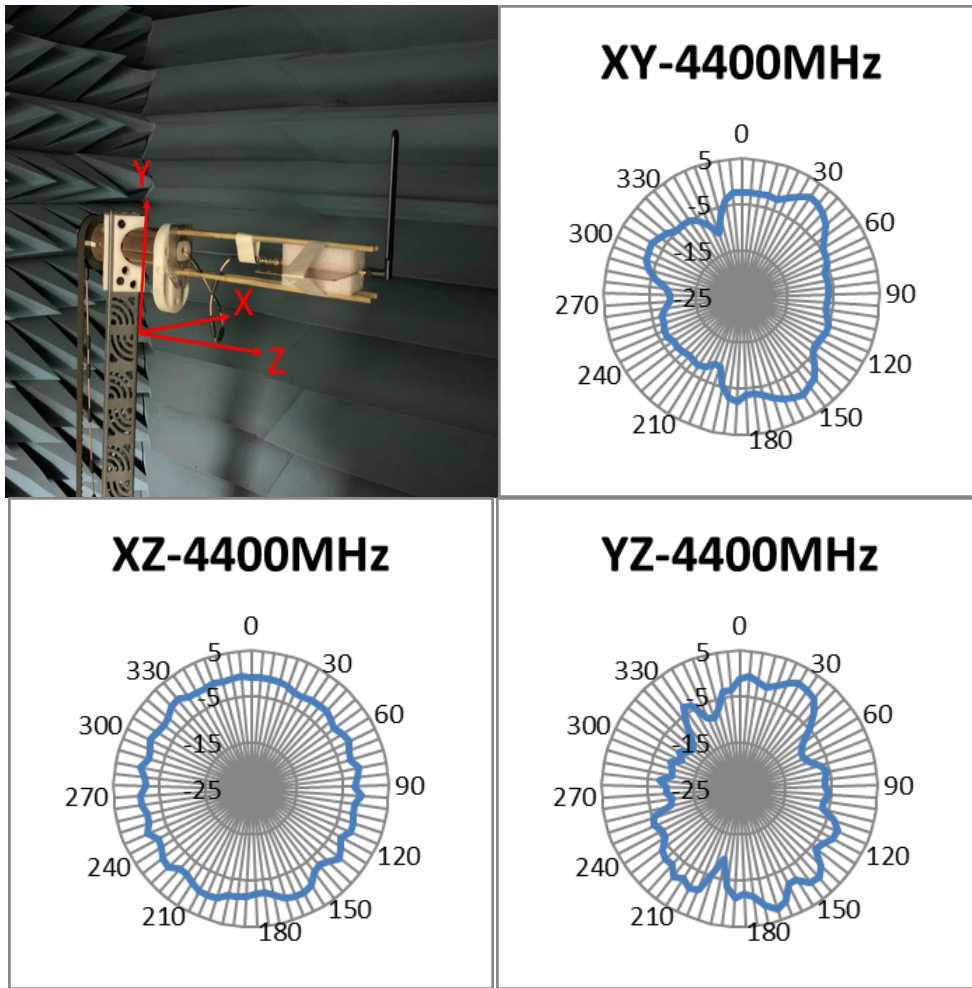
REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>15 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



**FIGURE 4.5.7 2D RADIATION PATTERN OF ANTENNA AT 3800MHZ IN FREE SPACE**

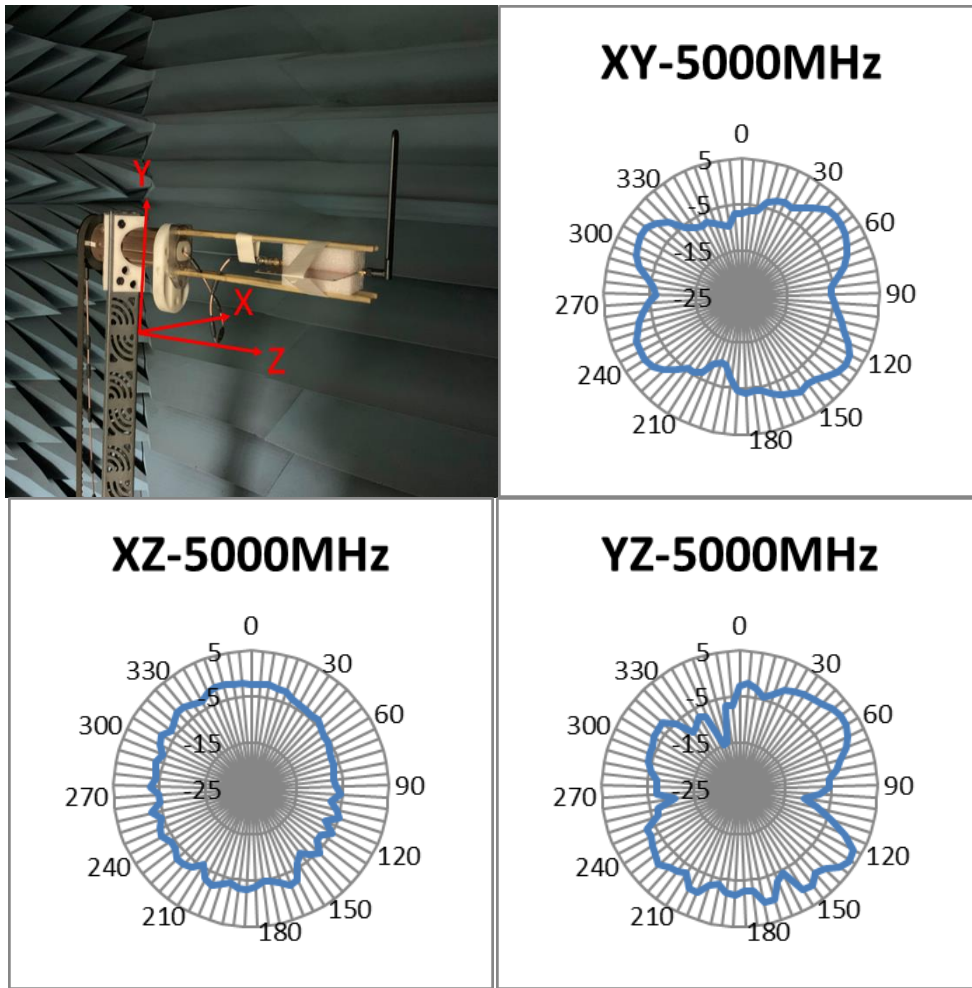
REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>16 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19





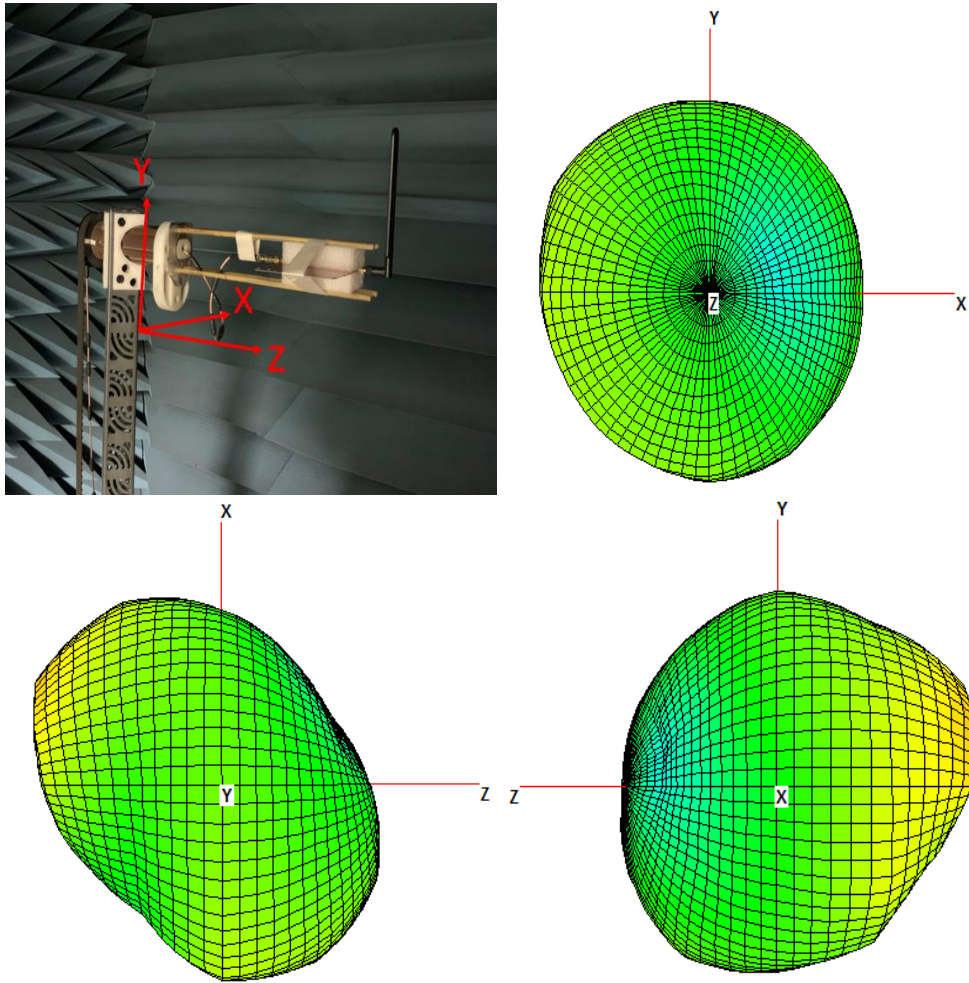
**FIGURE 4.5.8 2D RADIATION PATTERN OF ANTENNA AT 440MHZ IN FREE SPACE**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>17 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



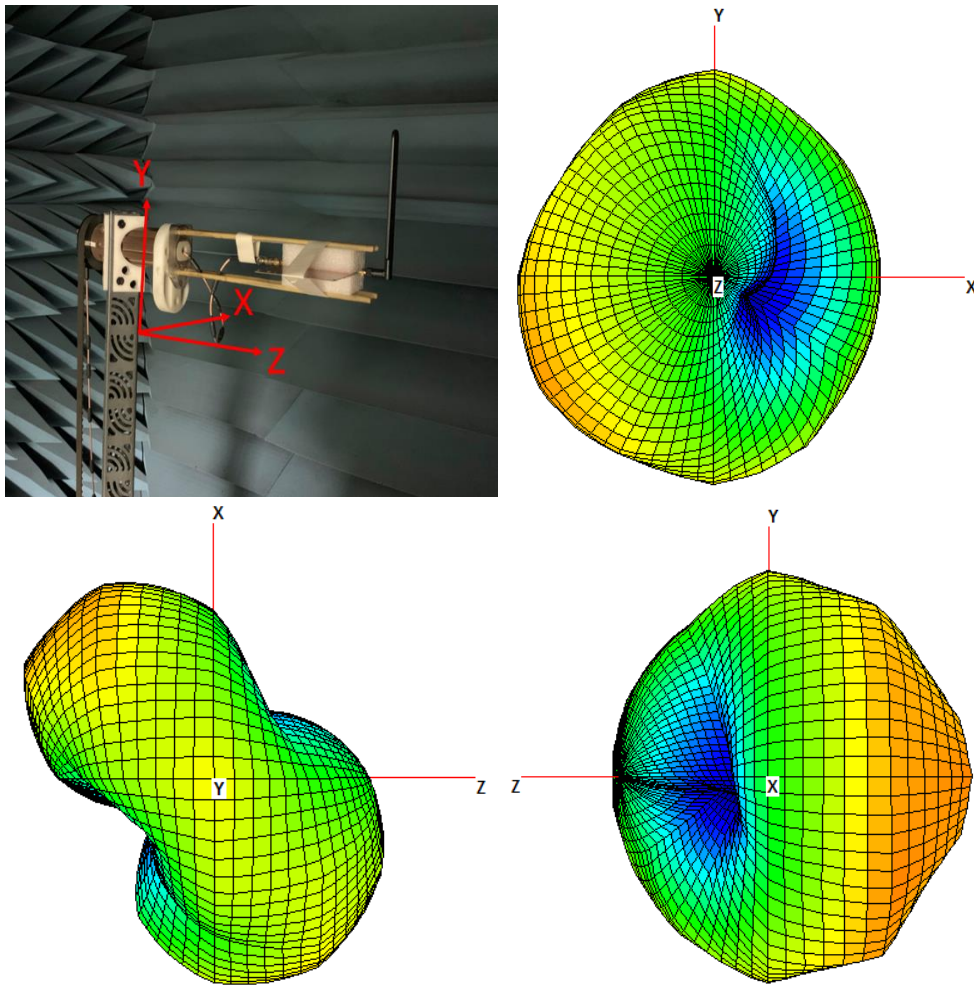
**FIGURE 4.5.9 2D RADIATION PATTERN OF ANTENNA AT 5000MHZ IN FREE SPACE**

REVISION:  <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE:  <b>698~5000MHz External Antenna Application Specification</b>	SHEET No.  <b>18 of 37</b>
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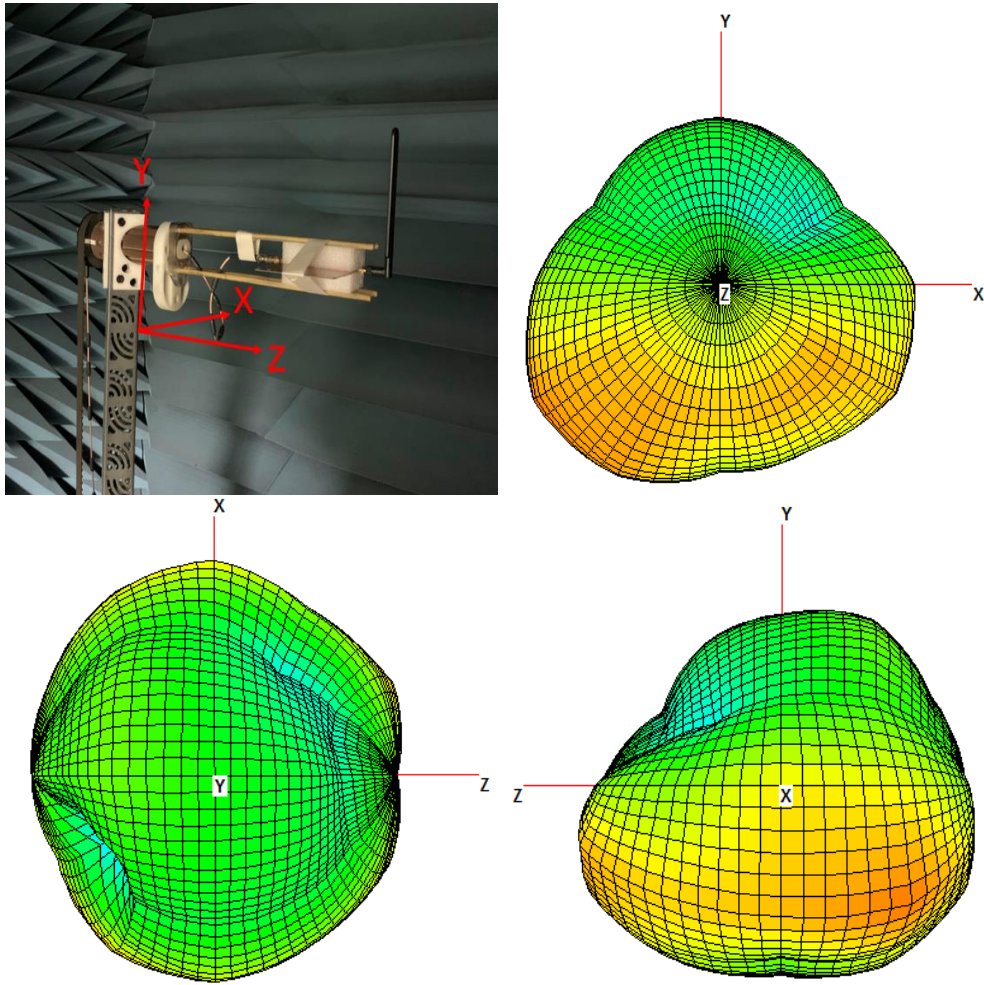
**FIGURE 4.5.10 3D RADIATION PATTERN OF ANTENNA AT 750MHZ IN FREE SPACE**

REVISION:  <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE:  <b>698~5000MHz External Antenna Application Specification</b>		SHEET No.  <b>19 of 37</b>
DOCUMENT NUMBER:  <b>AS-2144290001</b>		CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



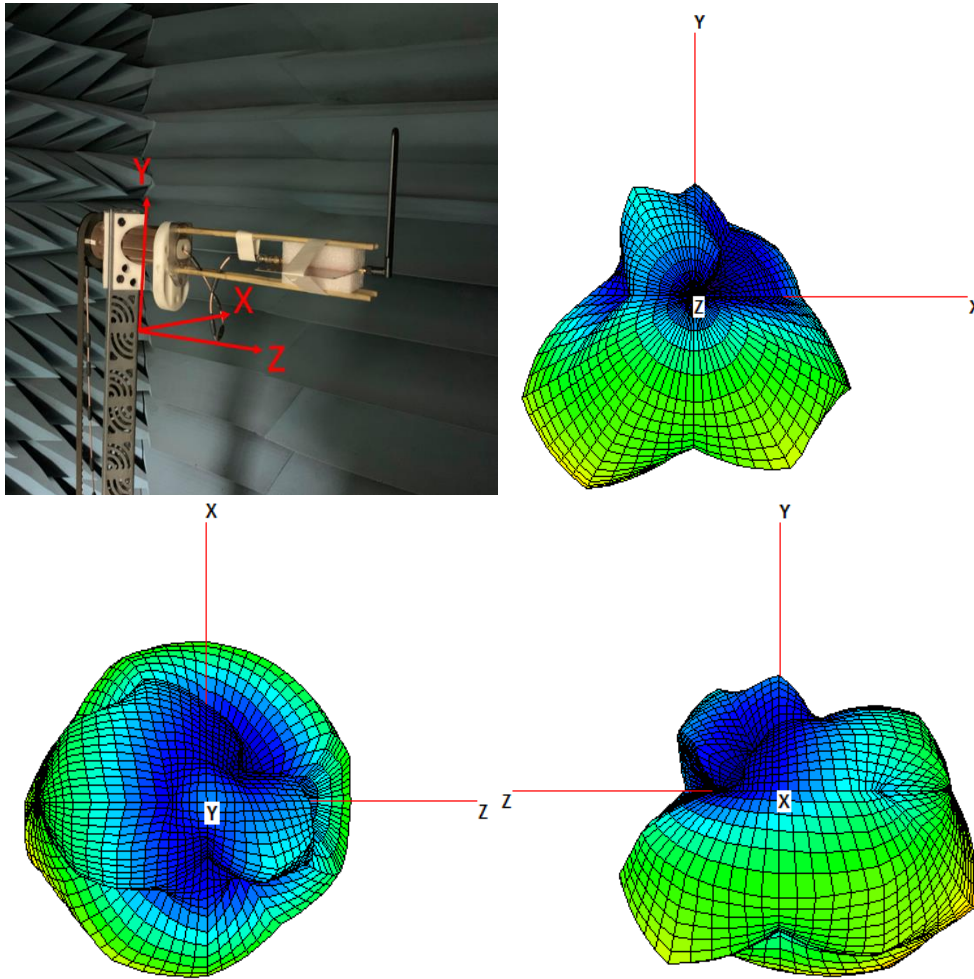
**FIGURE 4.5.11 3D RADIATION PATTERN OF ANTENNA AT 880MHZ IN FREE SPACE**

REVISION:  <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE:  <b>698~5000MHz External Antenna Application Specification</b>		SHEET No.  <b>20 of 37</b>
DOCUMENT NUMBER:  <b>AS-2144290001</b>		CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



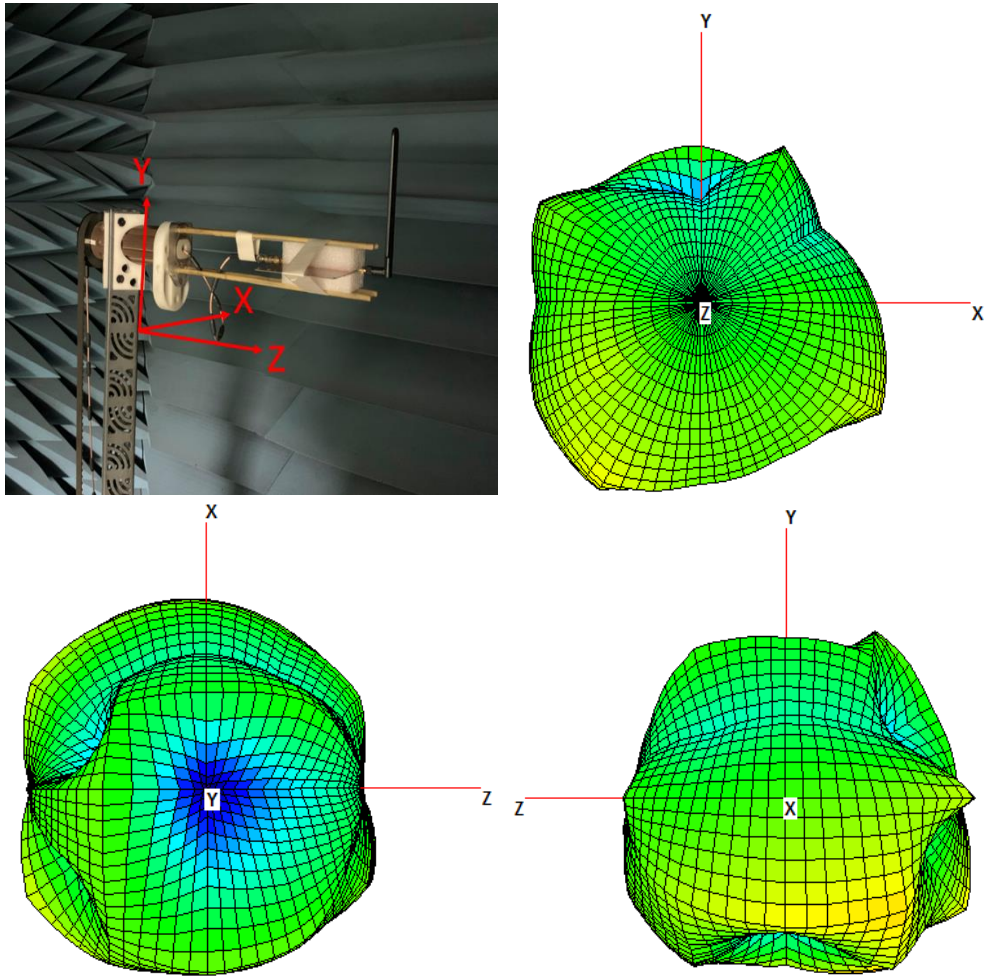
**FIGURE 4.5.12 3D RADIATION PATTERN OF ANTENNA AT 1710MHZ IN FREE SPACE**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>21 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



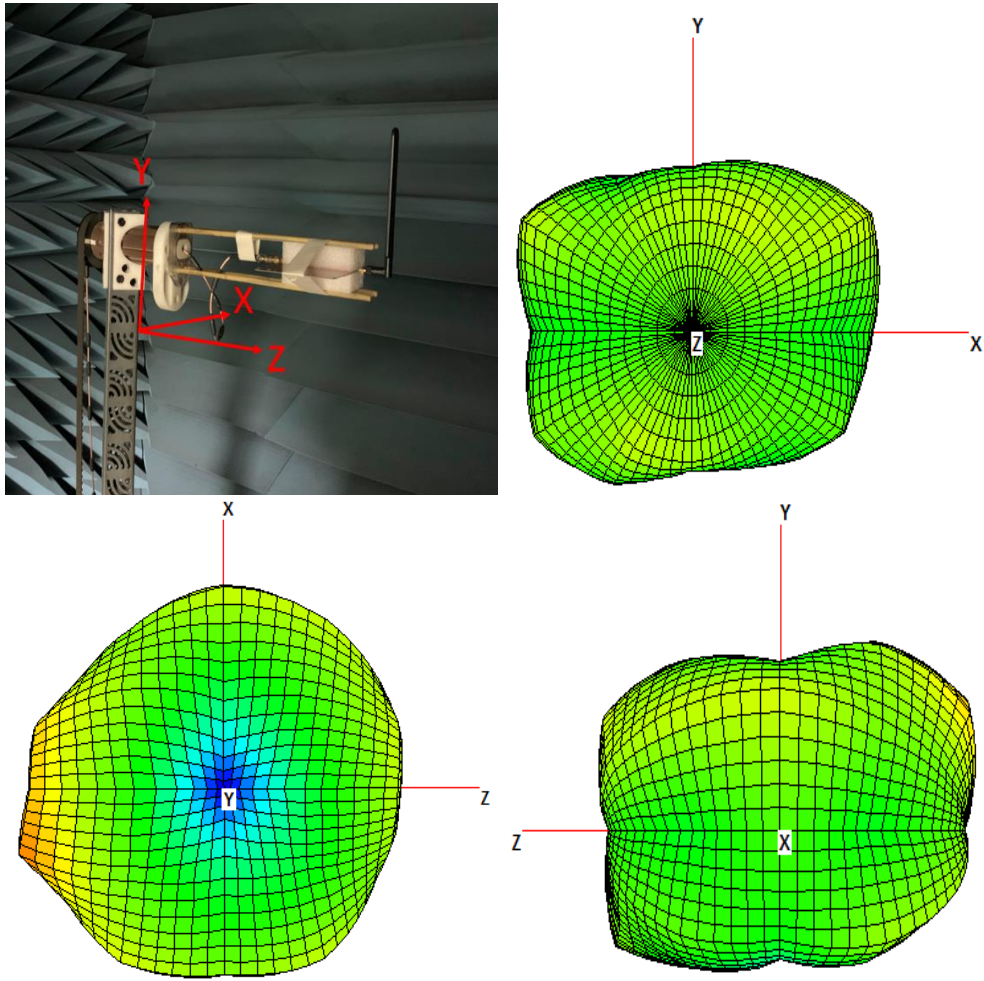
**FIGURE 4.5.13 3D RADIATION PATTERN OF ANTENNA AT 2170MHZ IN FREE SPACE**

REVISION:  <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE:  <b>698~5000MHz External Antenna Application Specification</b>		SHEET No.  <b>22 of 37</b>
DOCUMENT NUMBER:  <b>AS-2144290001</b>		CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



**FIGURE 4.5.14 3D RADIATION PATTERN OF ANTENNA AT 2690MHZ IN FREE SPACE**

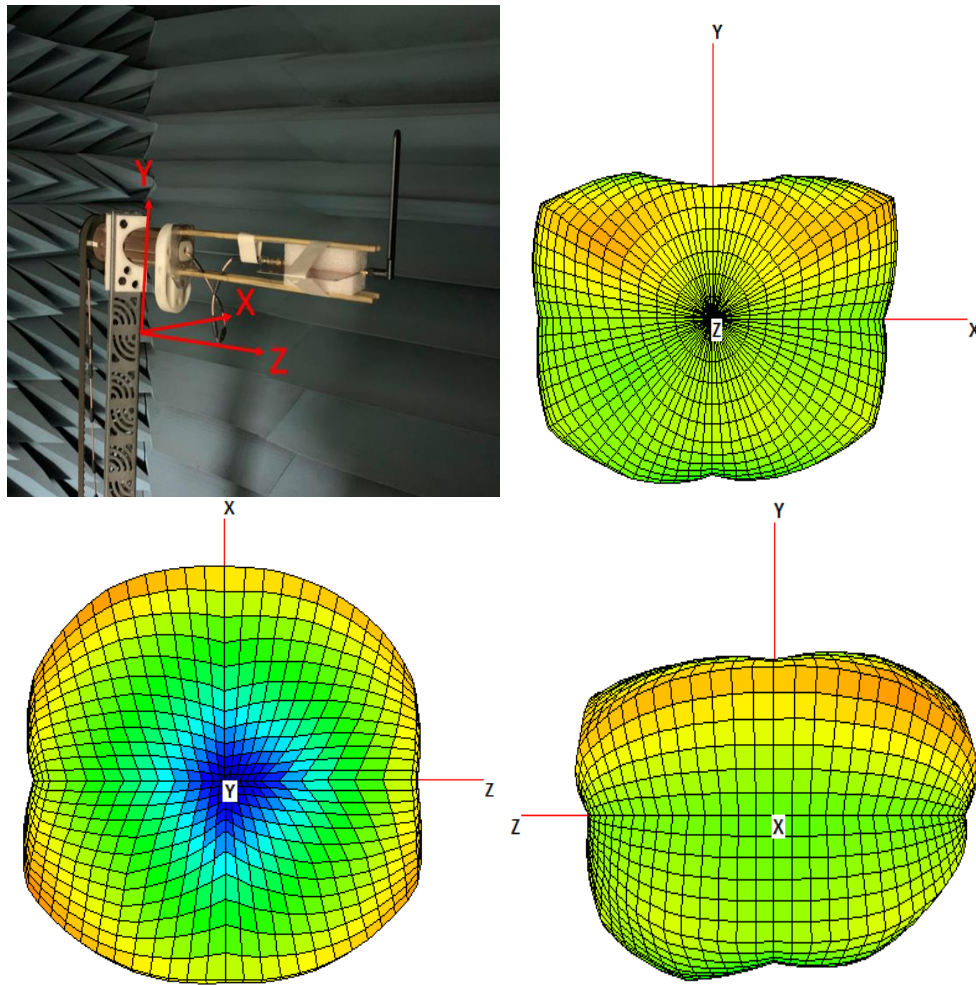
REVISION:  <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE:  <b>698~5000MHz External Antenna Application Specification</b>		SHEET No.  <b>23 of 37</b>
DOCUMENT NUMBER:  <b>AS-2144290001</b>		CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



**FIGURE 4.5.15 3D RADIATION PATTERN OF ANTENNA AT 3300MHZ IN FREE SPACE**

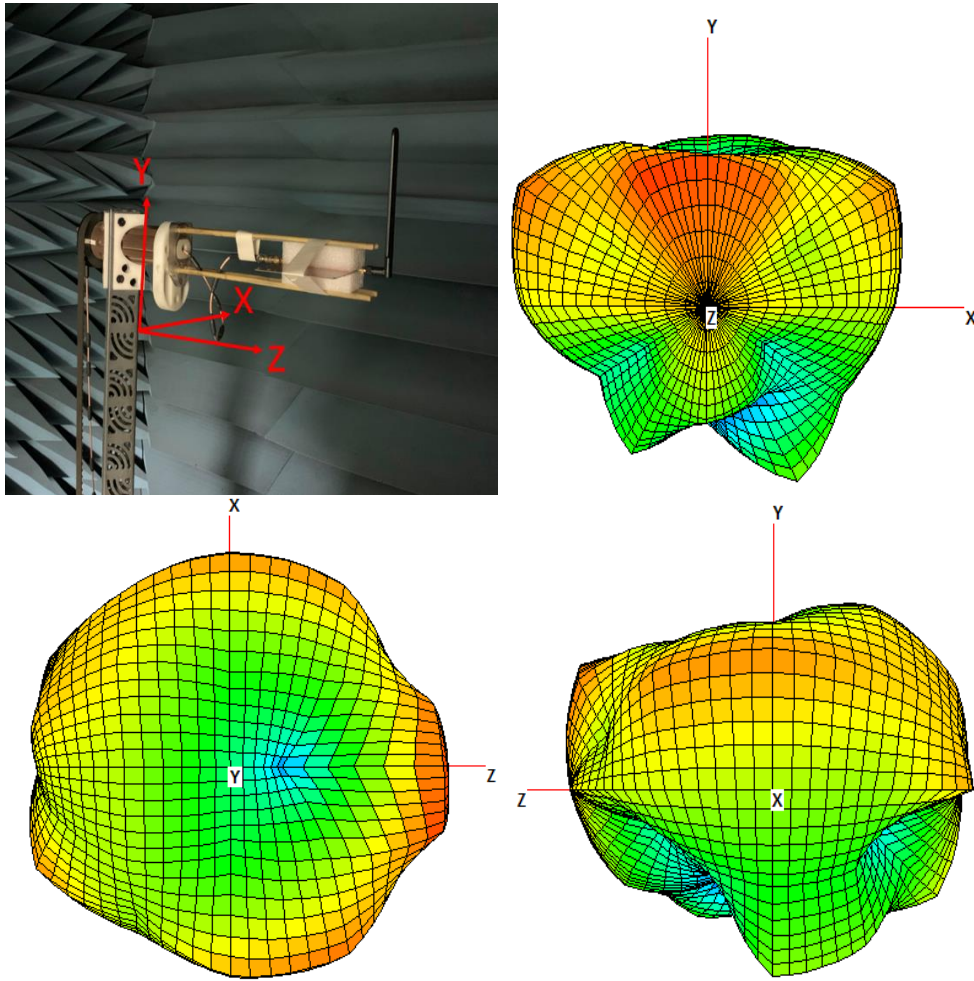
REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>24 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19





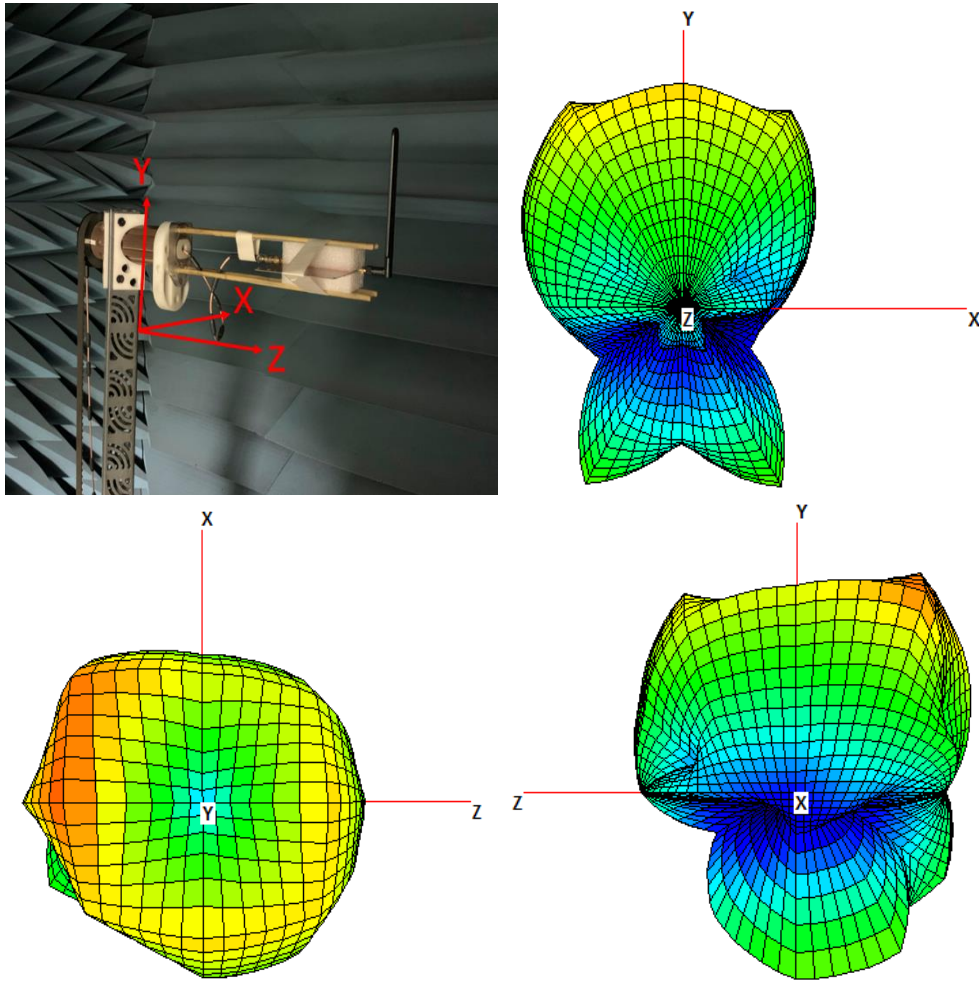
**FIGURE 4.5.16 3D RADIATION PATTERN OF ANTENNA AT 3800MHZ IN FREE SPACE**

REVISION:  <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE:  <b>698~5000MHz External Antenna Application Specification</b>		SHEET No.  <b>25 of 37</b>
DOCUMENT NUMBER:  <b>AS-2144290001</b>		CREATED / REVISED BY:  Liu Hai 2019/09/19	CHECKED BY:  Cheng Kang 2019/09/19	APPROVED BY:  Andy Zhang 2019/09/19



**FIGURE 4.5.17 3D RADIATION PATTERN OF ANTENNA AT 4400MHZ IN FREE SPACE**

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DOCUMENT NUMBER:  <b>AS-2144290001</b>		CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



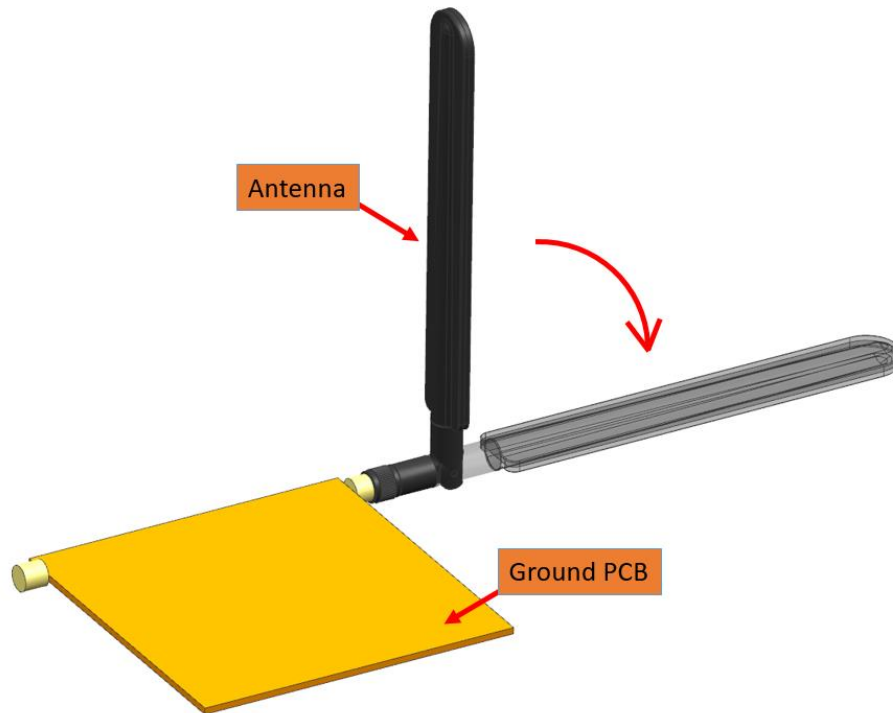
**FIGURE 4.5.18 3D RADIATION PATTERN OF ANTENNA AT 5000MHZ IN FREE SPACE**

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DOCUMENT NUMBER: <b>AS-2144290001</b>		CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19

## 5.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

### 5.1 ANTENNA RF PERFORMANCE AS A FUNCTION OF DIFFERENT STATES

Four states for antenna have been evaluated and these states are shown in figure 5.1.0. The ground size is 100mm\*100mm. After testing, the performance of antenna installed on PCB is better than that not installed on PCB, so we recommend using Reference state. The 4.4-5GHz performance in reference state is better than state2, so we still recommend using standard state.



**FIGURE 5.1.0 FOUR STATES FOR ANTENNA**

Ground Size: 100mm\*100mm;

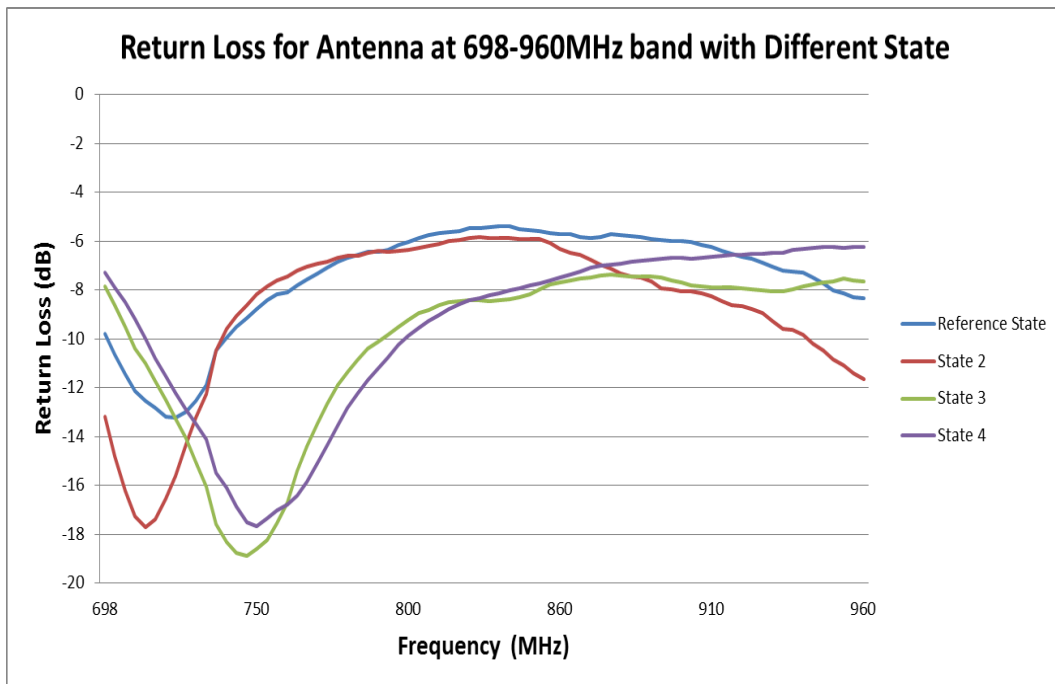
Reference state: Antenna mounted on Ground and bend 90 degree;

State 2: Antenna mounted on Ground and no bending;

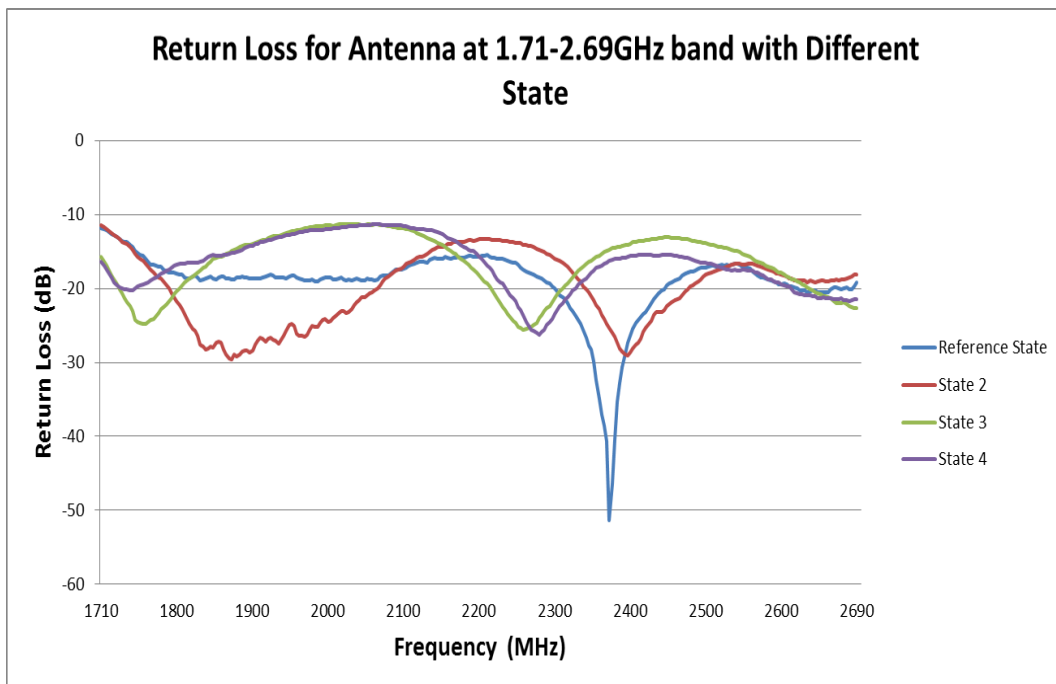
State 3: Signal antenna no bending (no mount on ground);

State 4: Signal antenna and bend 90 degree (no mount on ground).

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DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19

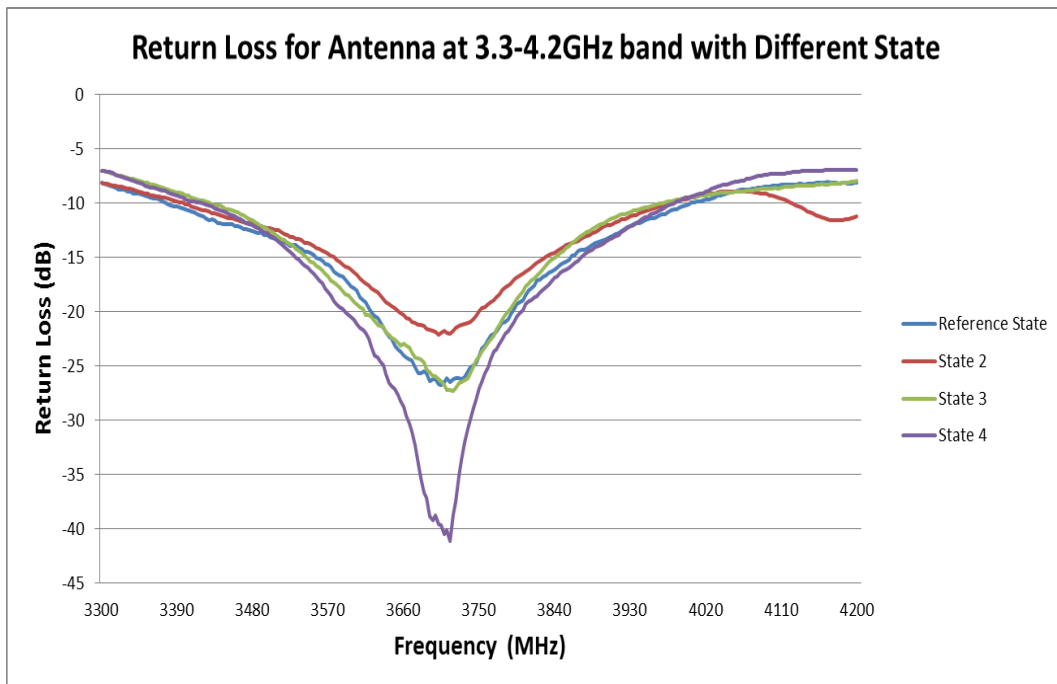


**FIGURE 5.1.1 RETURN LOSS OF ANTENNA AT 698-960MHZ WITH DIFFERENT STATES**

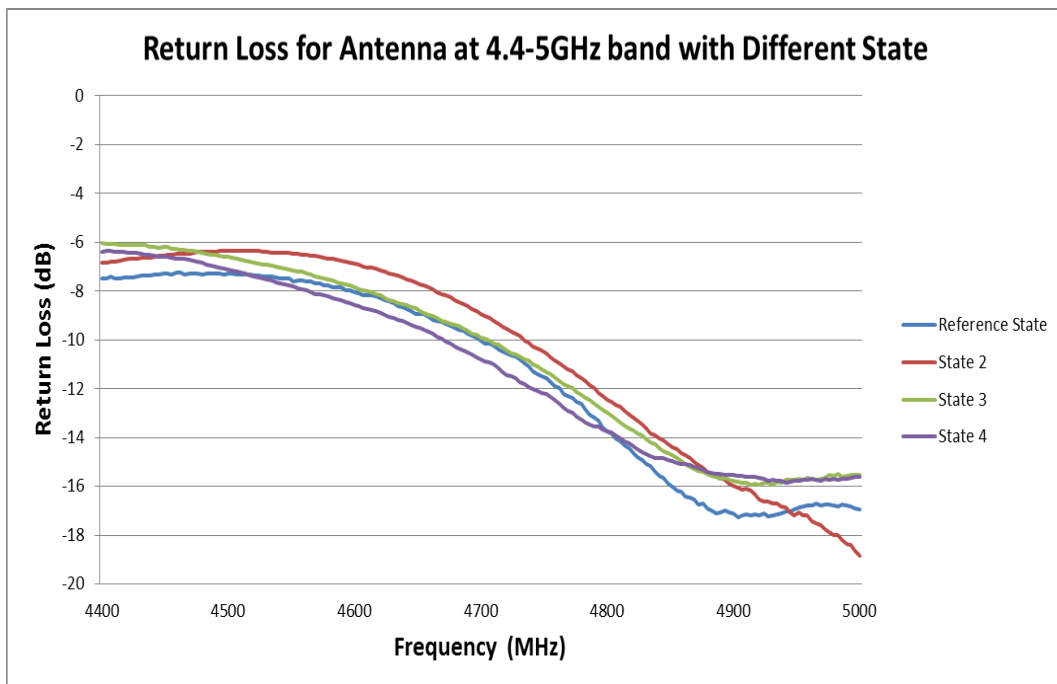


**FIGURE 5.1.2 RETURN LOSS OF ANTENNA AT 1.71-2.69GHZ WITH DIFFERENT STATES**

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DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19

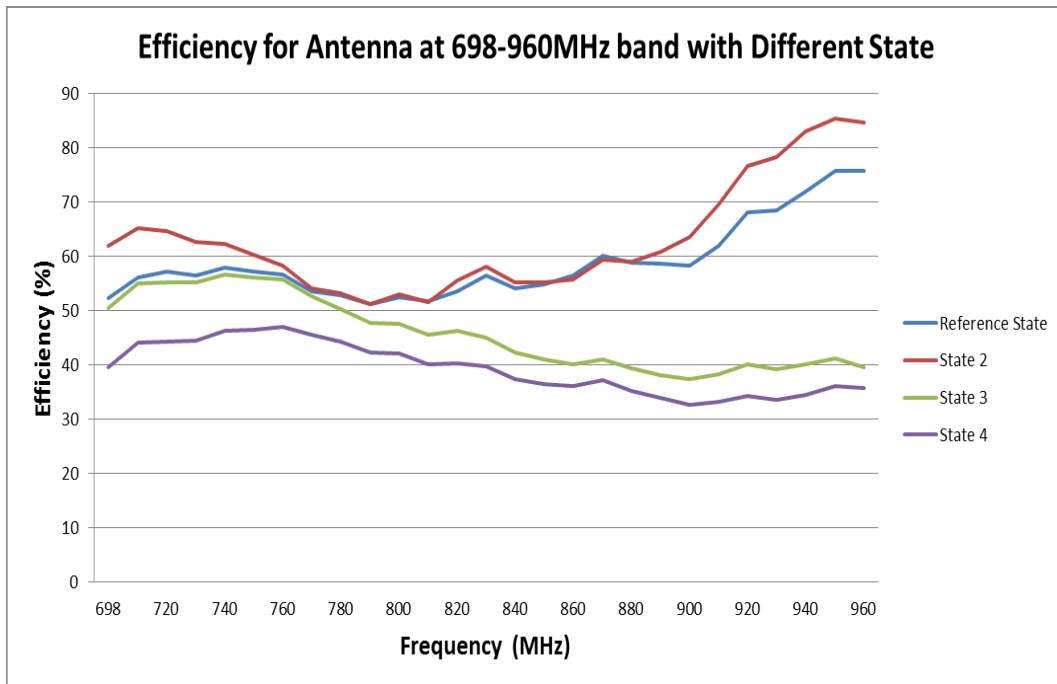


**FIGURE 5.1.3 RETURN LOSS OF ANTENNA AT 3.3-4.2GHZ WITH DIFFERENT STATES**

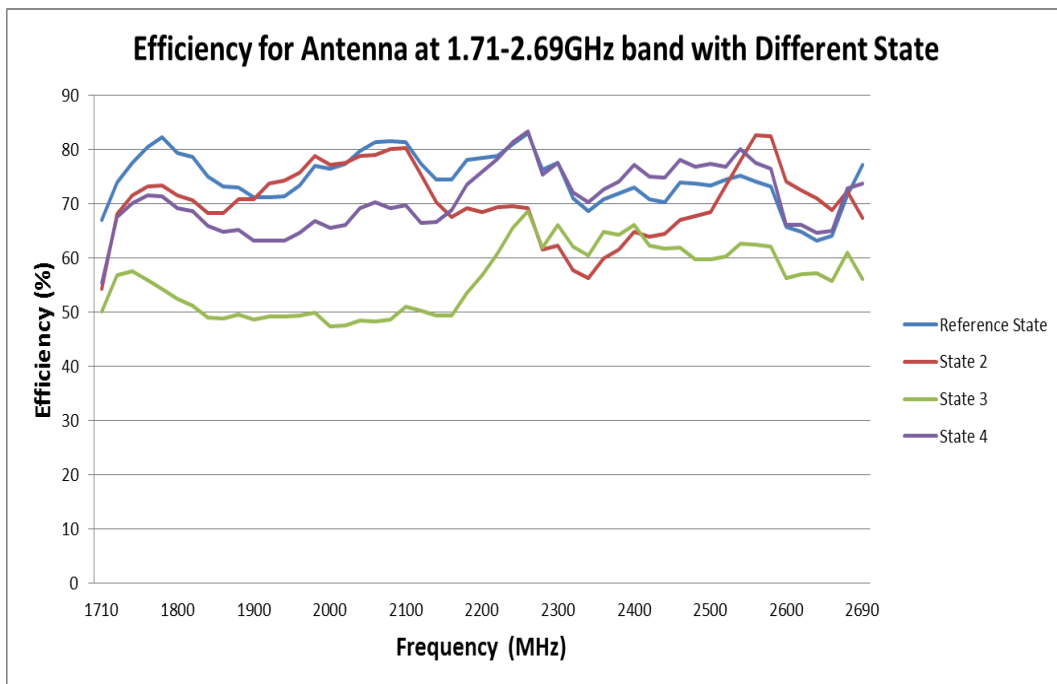


**FIGURE 5.1.4 RETURN LOSS OF ANTENNA AT 4.4-5GHZ WITH DIFFERENT STATES**

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DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



**FIGURE 5.1.5 EFFICIENCY OF ANTENNA AT 698-960MHZ WITH DIFFERENT STATES**



**FIGURE 5.1.6 EFFICIENCY OF ANTENNA 1.71-2.69GHZ WITH DIFFERENT STATES**

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DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



# APPLICATION SPECIFICATION

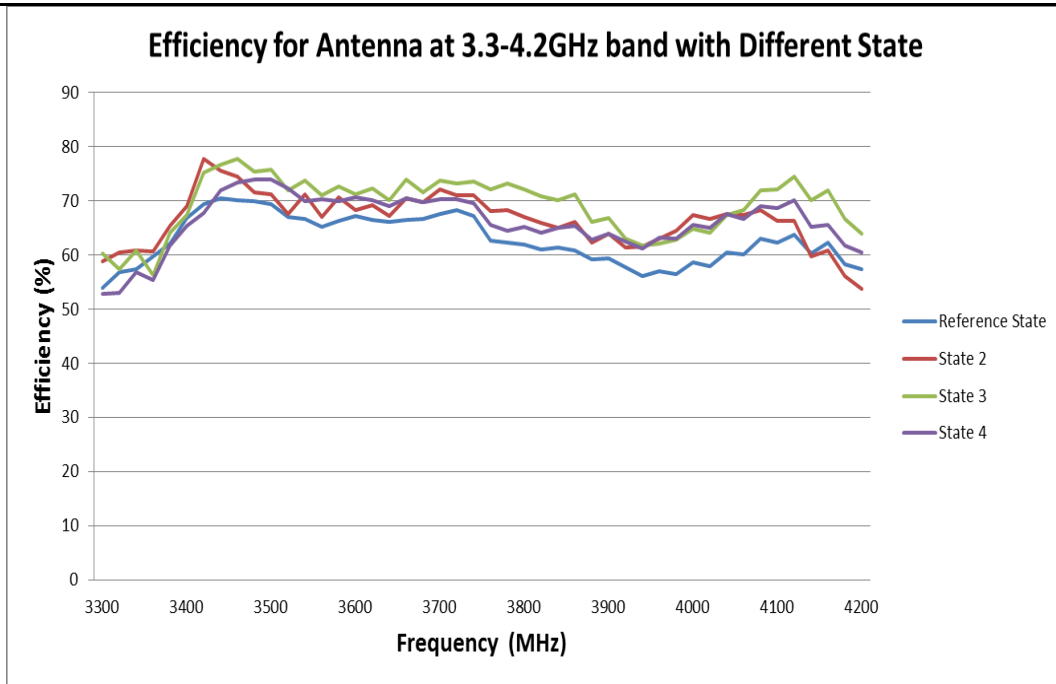


FIGURE 5.1.7 EFFICIENCY OF ANTENNA AT 3.3-4.2GHZ WITH DIFFERENT STATES

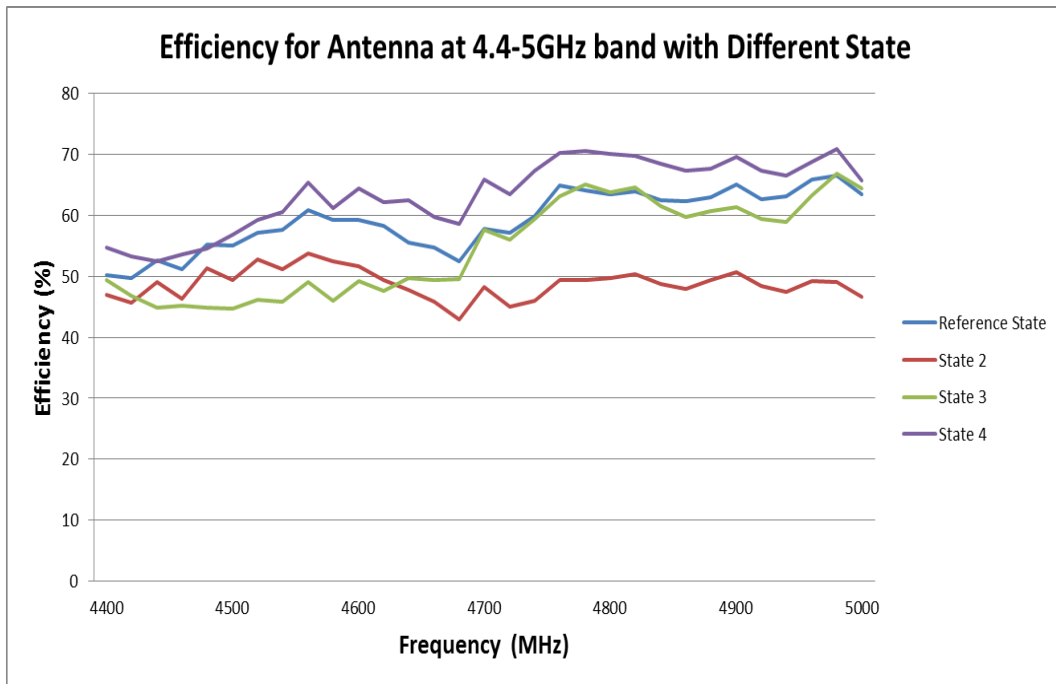


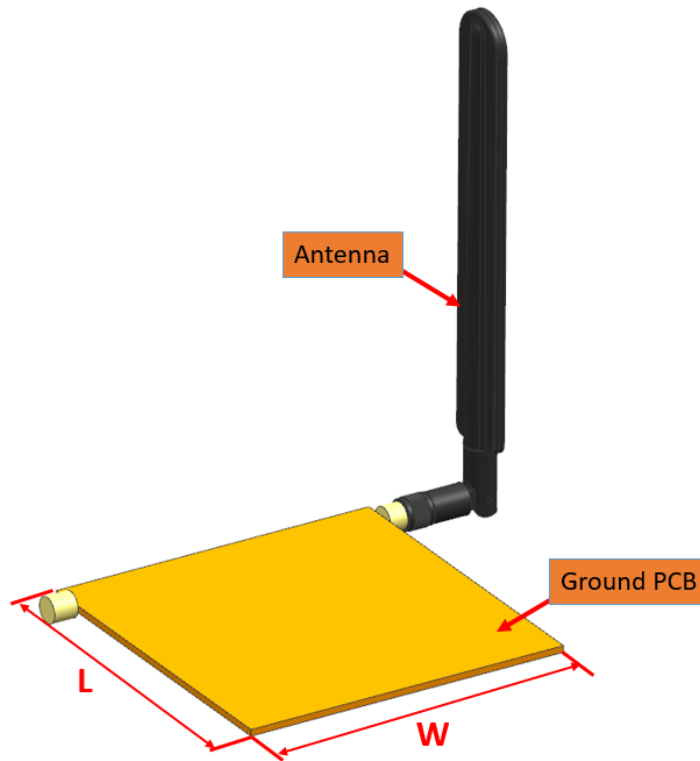
FIGURE 5.1.8 EFFICIENCY OF ANTENNA AT 4.4-5GHZ WITH DIFFERENT STATES

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DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



## 5.2 ANTENNA RF PERFORMANCE AS A FUNCTION WITH DIFFERENT GROUND SIZE

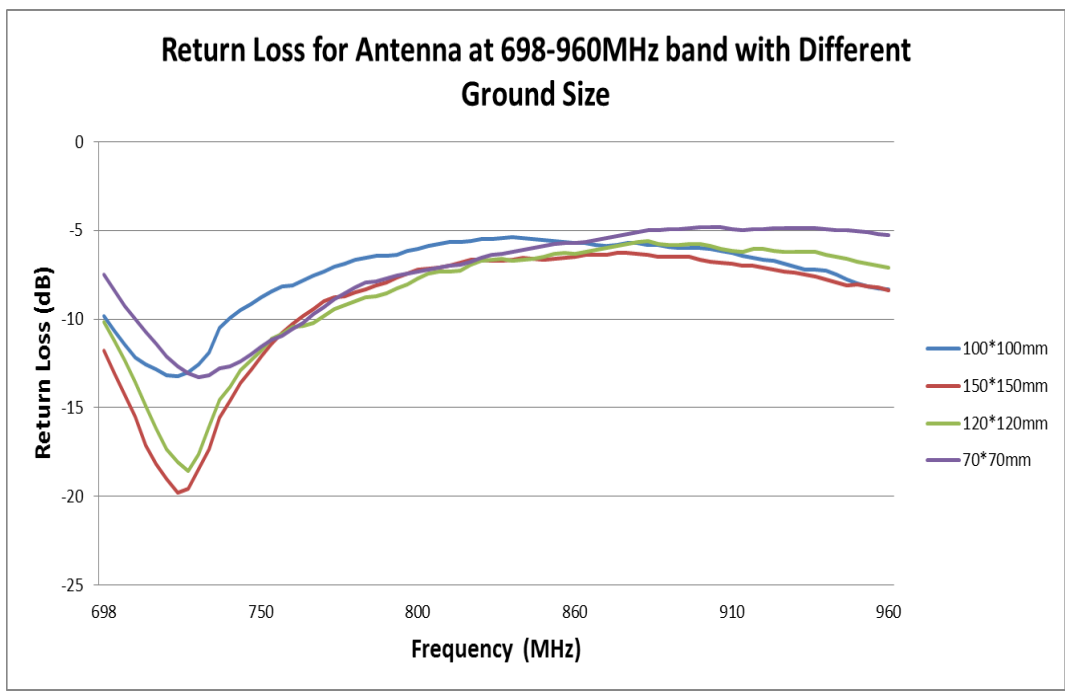
Four different ground size have been evaluated and the size are shown in figure 5.2.0. The increasing of ground size has little effect on the antenna performance, and the decreasing of ground size will lead to the deterioration of low frequency performance. The minimum ground size is suggested to be 100\*100mm.



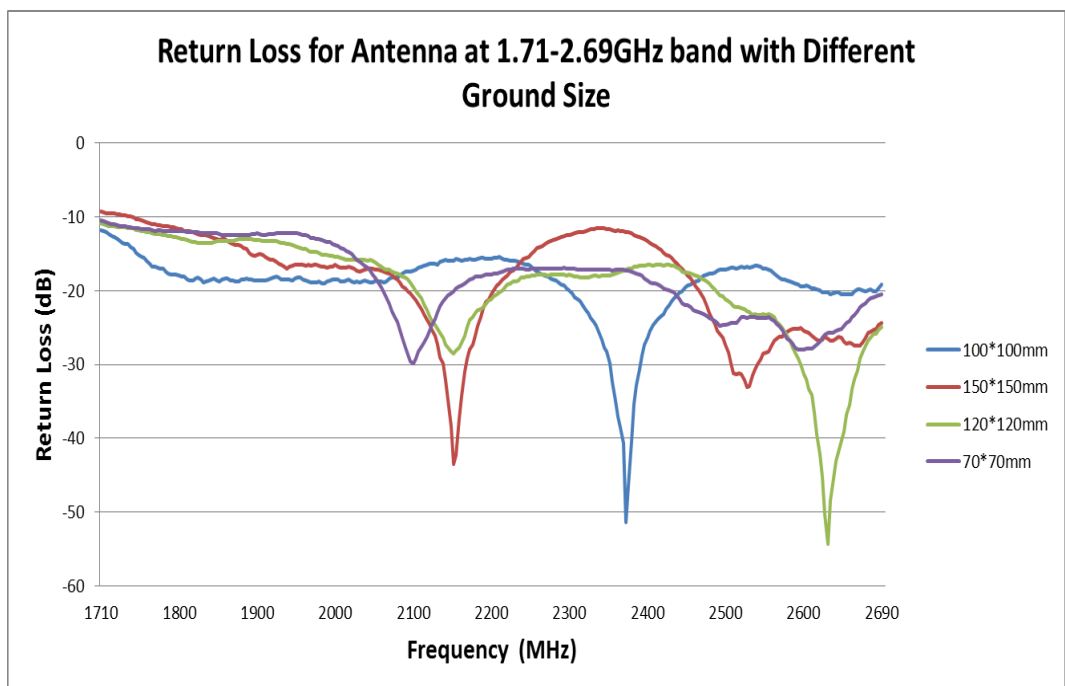
L\*W (70\*70、100\*100、120\*120、150\*150)

**FIGURE 5.2.0 FOUR DIFFERENT GROUND SIZE**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>33 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19

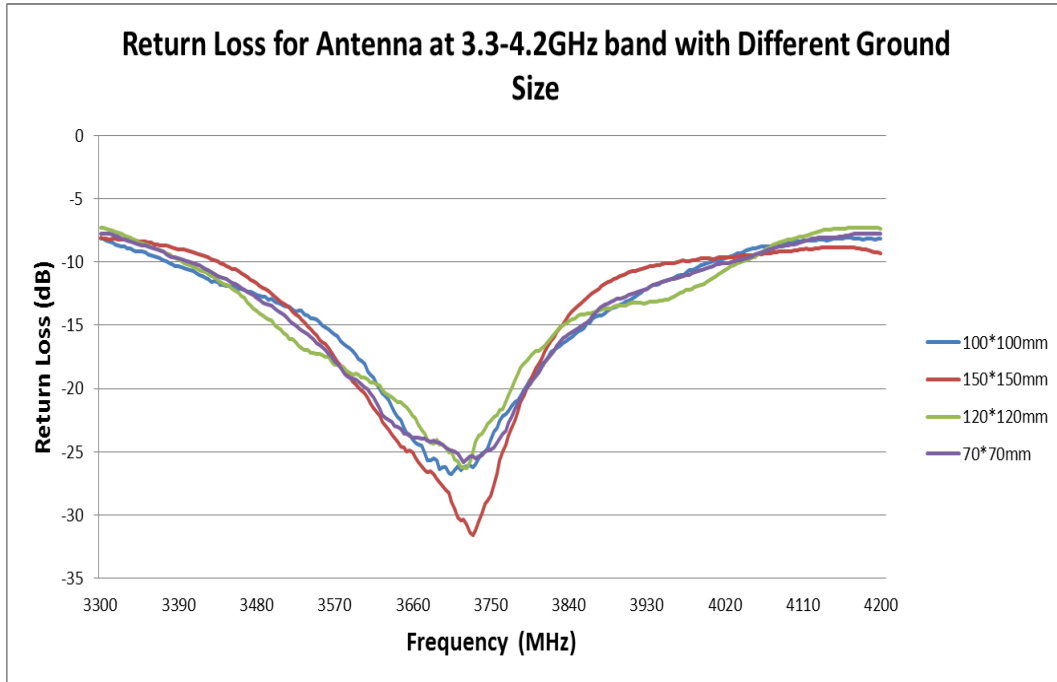


**FIGURE 5.2.1 RETURN LOSS OF ANTENNA AT 698-960MHZ WITH DIFFERENT GROUND SIZE**

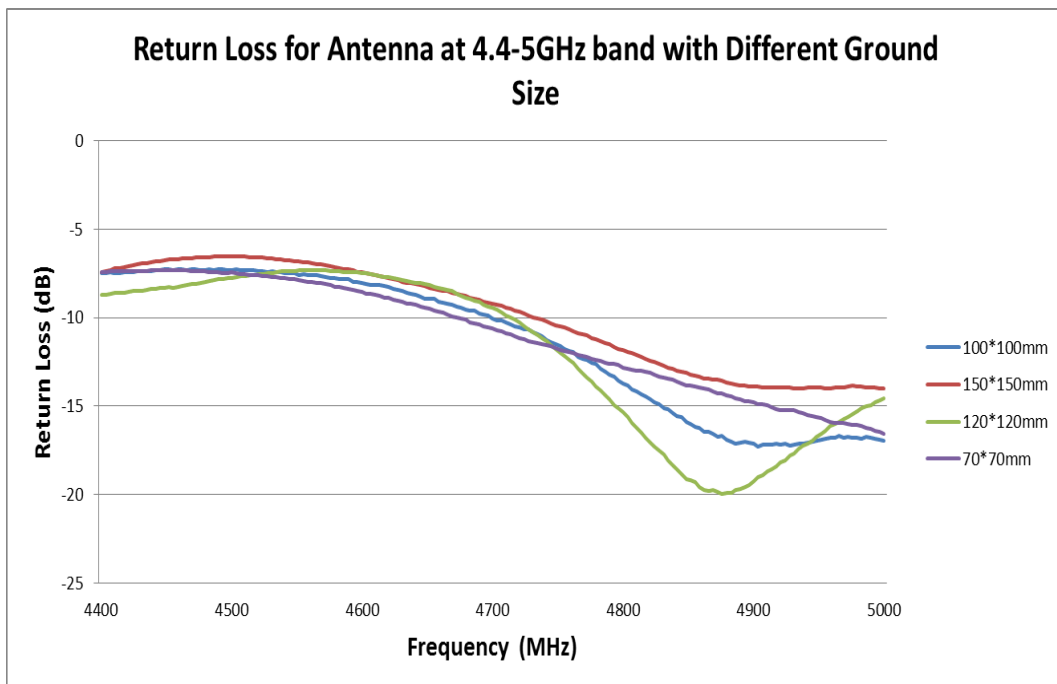


**FIGURE 5.2.2 RETURN LOSS OF ANTENNA AT 1.71-2.69HZ WITH DIFFERENT GROUND SIZE**

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DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



**FIGURE 5.2.3 RETURN LOSS OF ANTENNA AT 3.3-3.8GHZ WITH DIFFERENT GROUND SIZE**



**FIGURE 5.2.4 RETURN LOSS OF ANTENNA AT 4.4-5GHZ WITH DIFFERENT GROUND SIZE**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>35 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19

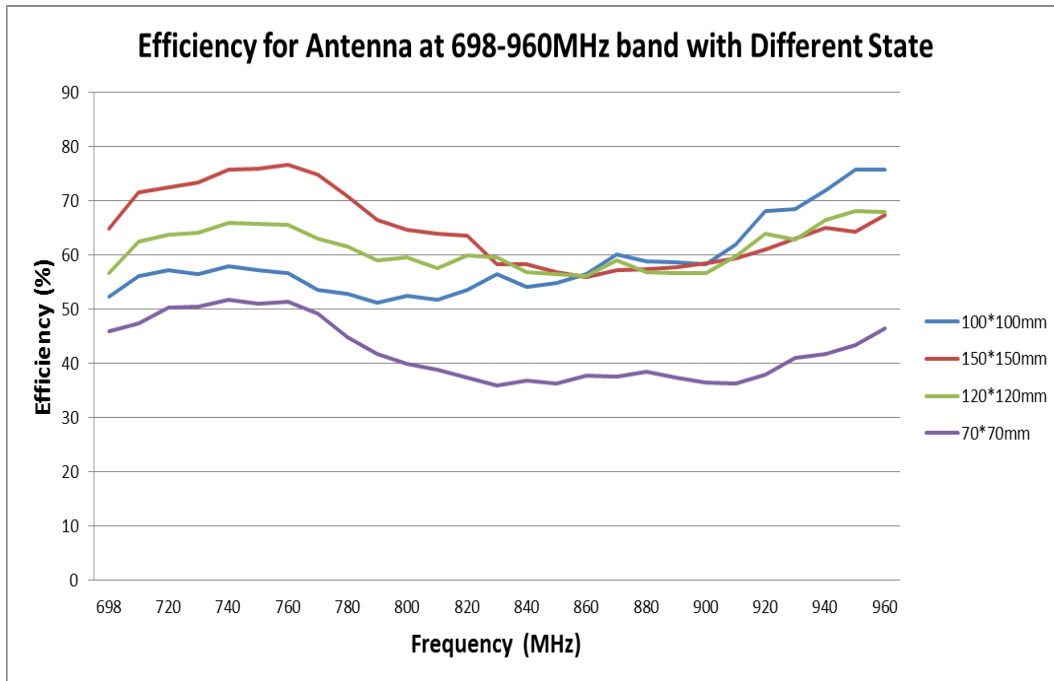


FIGURE 5.2.5 EFFICIENCY OF ANTENNA AT 698-960MHZ WITH DIFFERENT GROUND SIZE

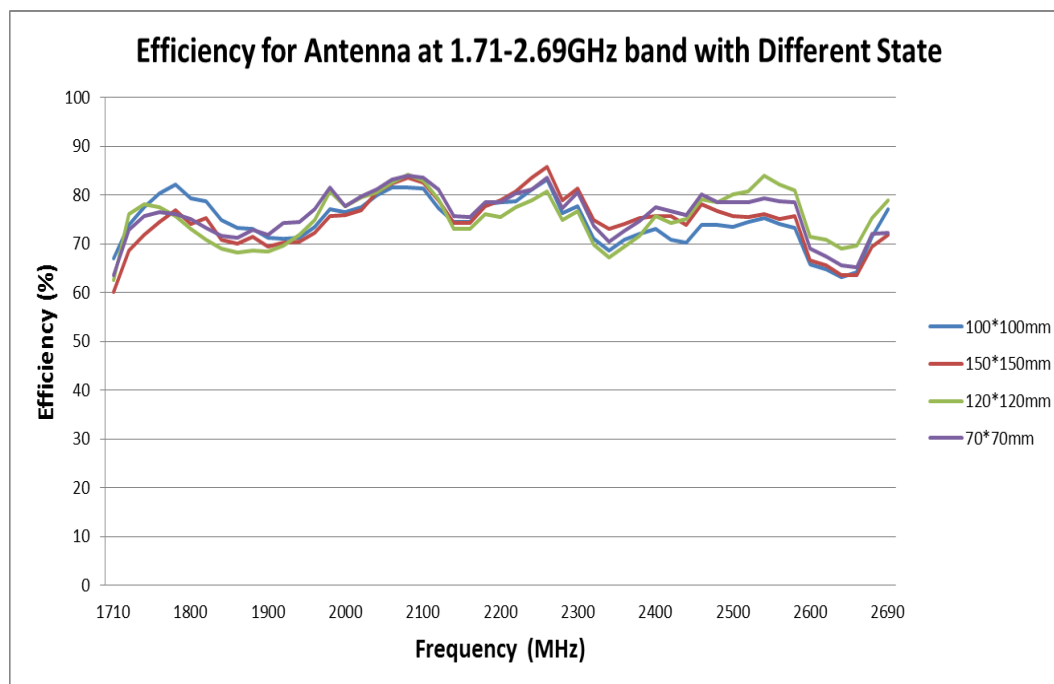
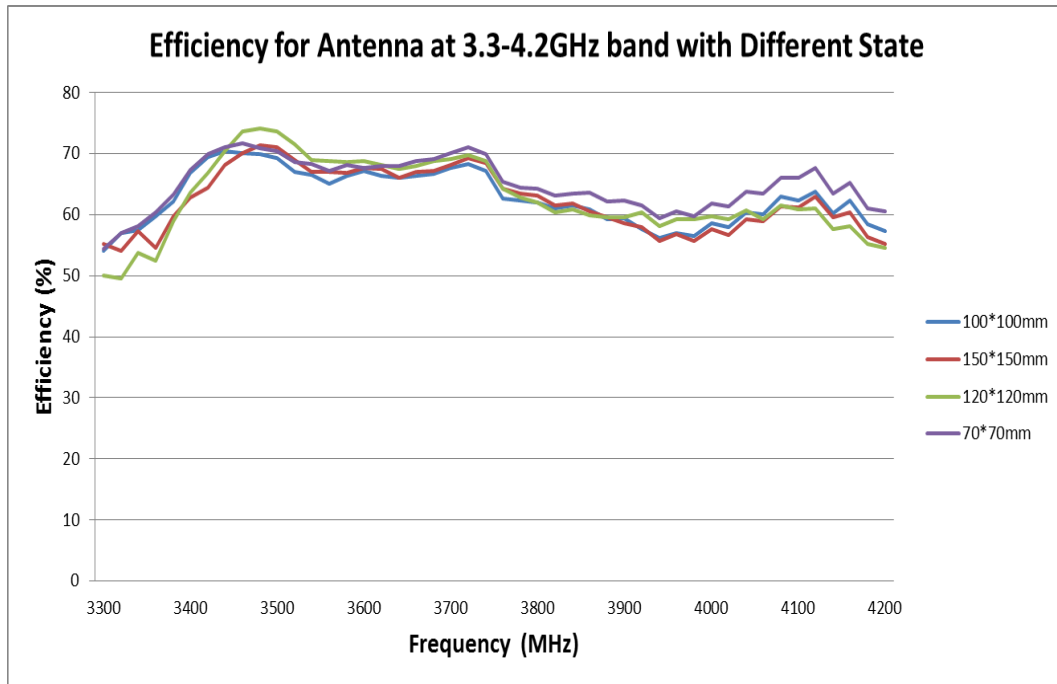
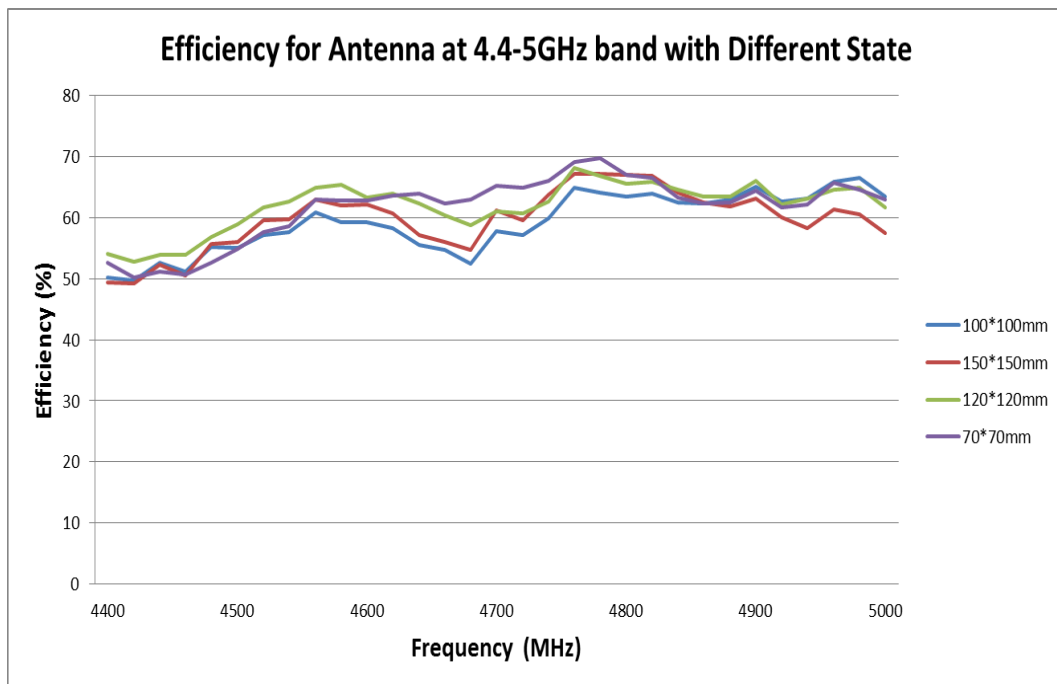


FIGURE 5.2.6 EFFICIENCY OF ANTENNA AT 1.71-2.69GHZ WITH DIFFERENT GROUND SIZE

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>36 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19



**FIGURE 5.2.7 EFFICIENCY OF ANTENNA AT 3.3-4.2GHZ WITH DIFFERENT GROUND SIZE**



**FIGURE 5.2.8 EFFICIENCY OF ANTENNA AT 4.4-5GHZ WITH DIFFERENT GROUND SIZE**

REVISION: <b>A</b>	ECR/ECN INFORMATION: EC No: 626276 DATE: 2019/10/18	TITLE: <b>698~5000MHz External Antenna Application Specification</b>	SHEET No. <b>37 of 37</b>
DOCUMENT NUMBER: <b>AS-2144290001</b>	CREATED / REVISED BY: Liu Hai 2019/09/19	CHECKED BY: Cheng Kang 2019/09/19	APPROVED BY: Andy Zhang 2019/09/19