TITLE

WIFI 6E FLEX CABLED 4X4 MIMO ANTENNA

TABLE OF CONTENTS

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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: WiFi 6E Flex Cabled 4x4 MIMO Antenna

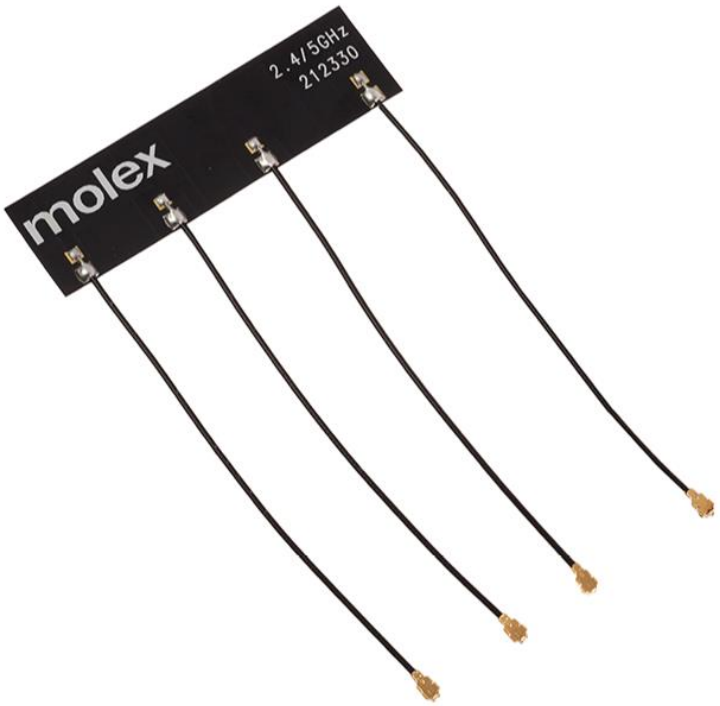
Series Number: 212330

2.2 DESCRIPTION

Series 212330 is a 4*4 MIMO flexible dipole type antenna for high speed WiFi 6E network. It's made from Poly-flexible material, size form 70mm x 20mm with double sided 3M adhesive for "peel and stick" easy mounting. Potential application is High speed HD video streaming, high capacity communication network, like router, gateway, set-top box…

2.3 PRODUCT STRUCTURE INFORMATION

Please refer to PS-2123300100 for full information.



PRODUCT PHOTOGRAPH

3.0 APPLICABLE DOCUMENTS

DOCUMENT	NUMBER	DESCRIPTION
Sale Drawing (SD)	SD-2123300100	Mechanical Dimension of the product
Product Specification (PS)	PS-2123300100	Product Specification
Packing Drawing (PK)	PK-2123300100	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 1.5mm thickness with VNA Agilent E5071C and Over-The-Air (OTA) chamber. All measurements in this document are done with the part No. 2123300100 with a cable length of 100mm.

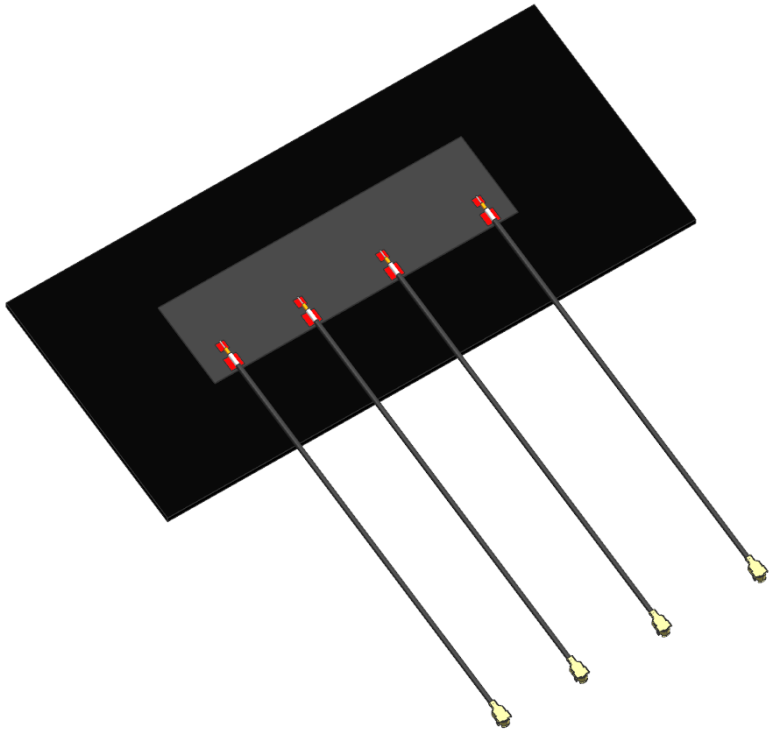


FIGURE 4.1.1 ANTENNA LOADED WITH PC/ABS BLOCK OF 1.5MM THICKNESS

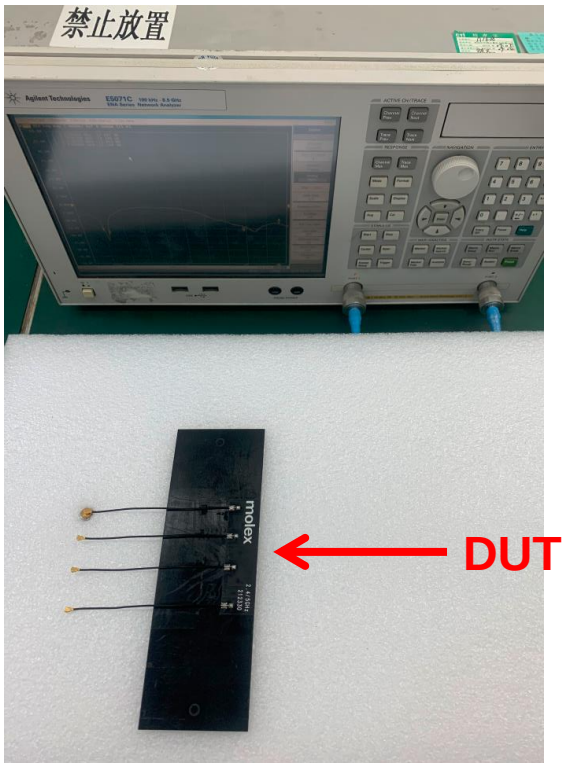


FIGURE 4.1.2 ANTENNA LOADED WITH PC/ABS BLOCK OF 1.5MM THICKNESS TESTED WITH VNA E5071C

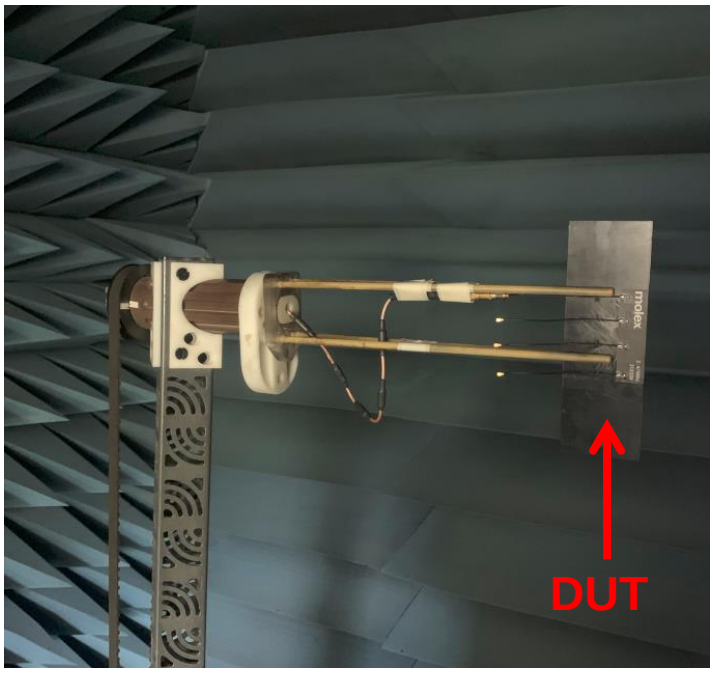


FIGURE 4.1.3 ANTENNA LOADED WITH PC/ABS BLOCK OF 1.5MM THICKNESS TESTED IN OTA CHAMBER

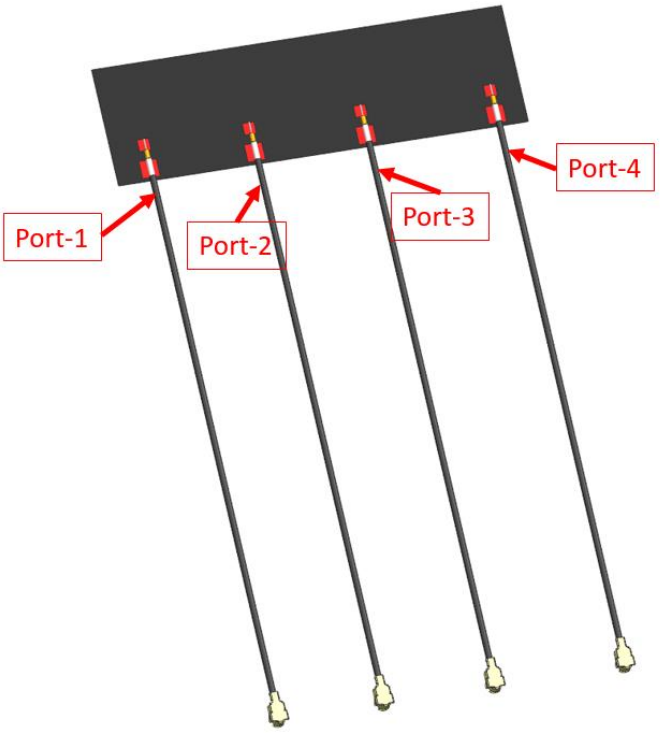


Figure 4.1.4 ANTENNA TESTED EQUIPMENT

4.2 ANTENNA PERFORMANCE

Description	Equipment	Port 1			Port 2		
Frequency Range	VNA E5071C	2.4-2.5GHz	5.15-5.85GHz	5.925-7.125GHz	2.4-2.5GHz	5.15-5.85GHz	5.925-7.125GHz
Return Loss	VNA E5071C	<-10dB	<-10dB	<-10dB	<-10dB	<-9dB	<-5dB
Peak Gain (Max)	OTA Chamber	2.4 dBi	3.3 dBi	5.2 dBi	2.6 dBi	2.3 dBi	2.9 dBi
Average Total Efficiency	OTA Chamber	>55%	>70%	>65%	>55%	>65%	>60%
Polarization	OTA Chamber	Linear					
Input Impedance	VNA E5071C	50 ohms					

Description	Equipment	Port 3			Port 4		
Frequency Range	VNA E5071C	2.4-2.5GHz	5.15-5.85GHz	5.925-7.125GHz	2.4-2.5GHz	5.15-5.85GHz	5.925-7.125GHz
Return Loss	VNA E5071C	<-10dB	<-10dB	<-10dB	<-10dB	<-10dB	<-5dB
Peak Gain (Max)	OTA Chamber	3.0 dBi	3.4 dBi	6.1 dBi	3.5 dBi	3.9 dBi	6.3 dBi
Average Total Efficiency	OTA Chamber	>50%	>70%	>60%	>55%	65%	>60%
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 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.

4.3 RETURN LOSS PLOT

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

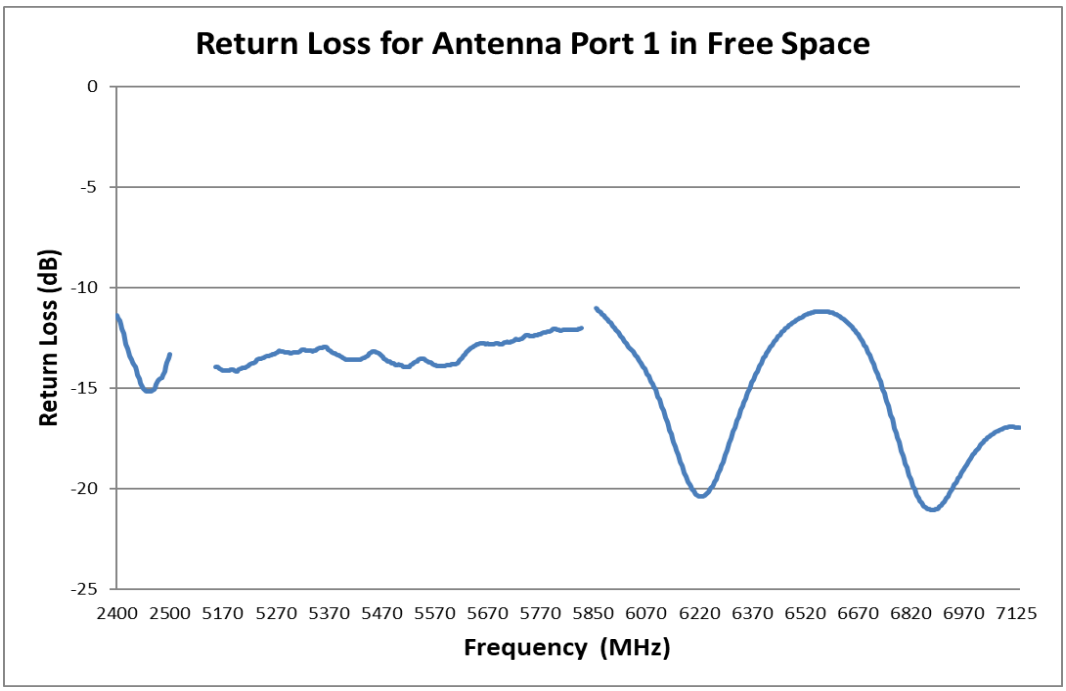


FIGURE 4.3.1 RETURN LOSS OF ANTENNA PORT 1 IN FREE SPACE

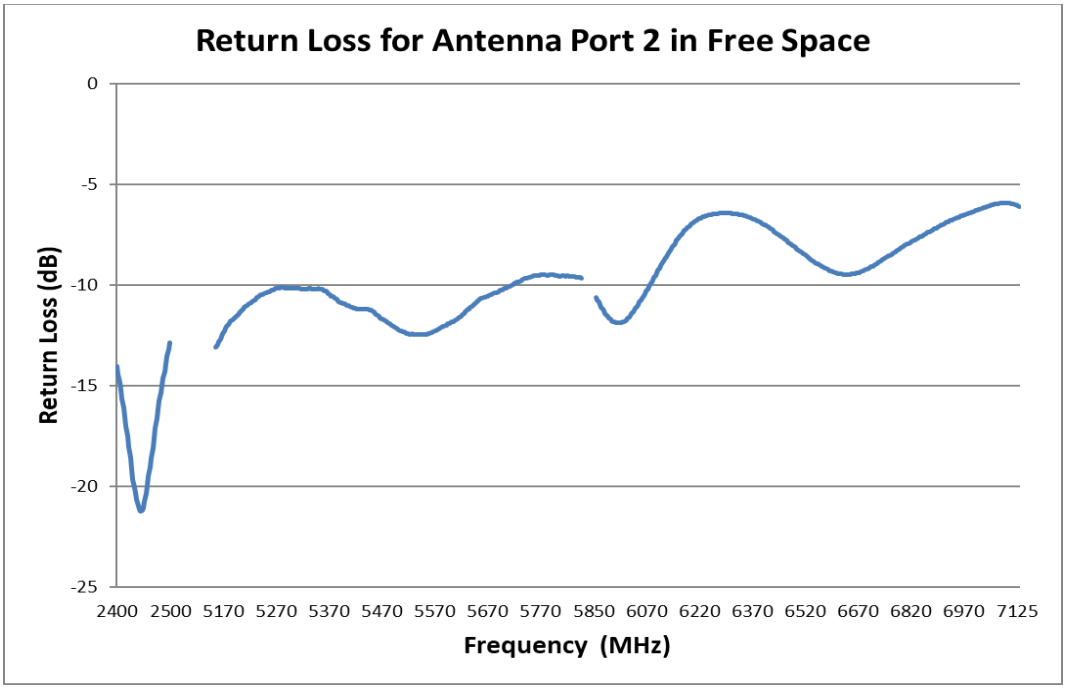


FIGURE 4.3.2 RETURN LOSS OF ANTENNA PORT 2 IN FREE SPACE

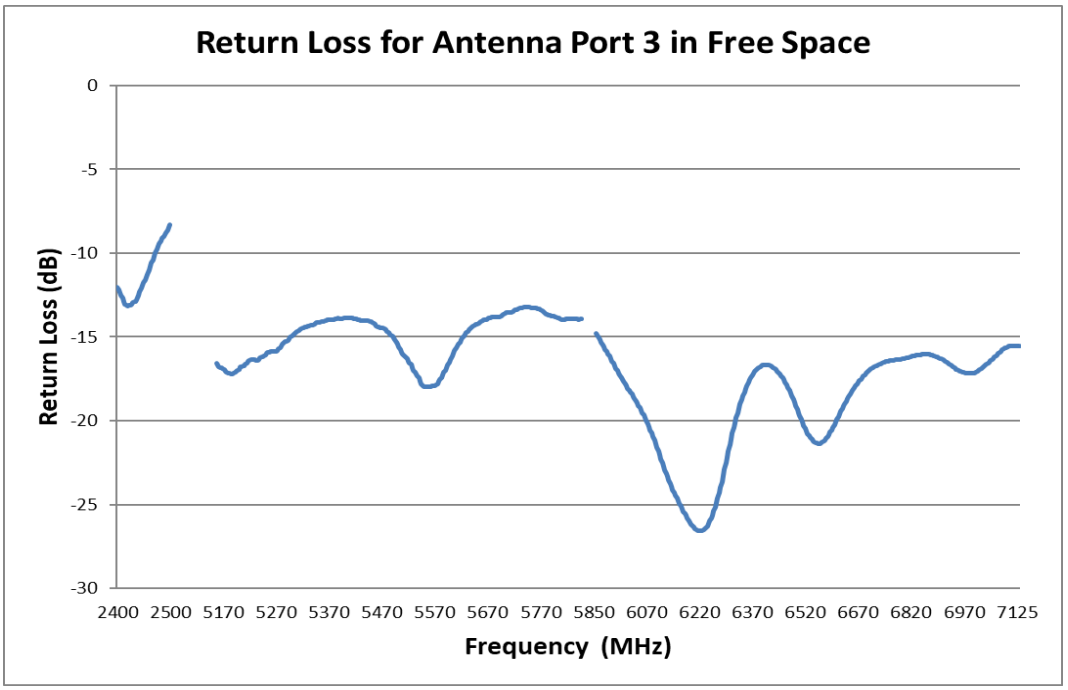


FIGURE 4.3.3 RETURN LOSS OF ANTENNA PORT 3 IN FREE SPACE

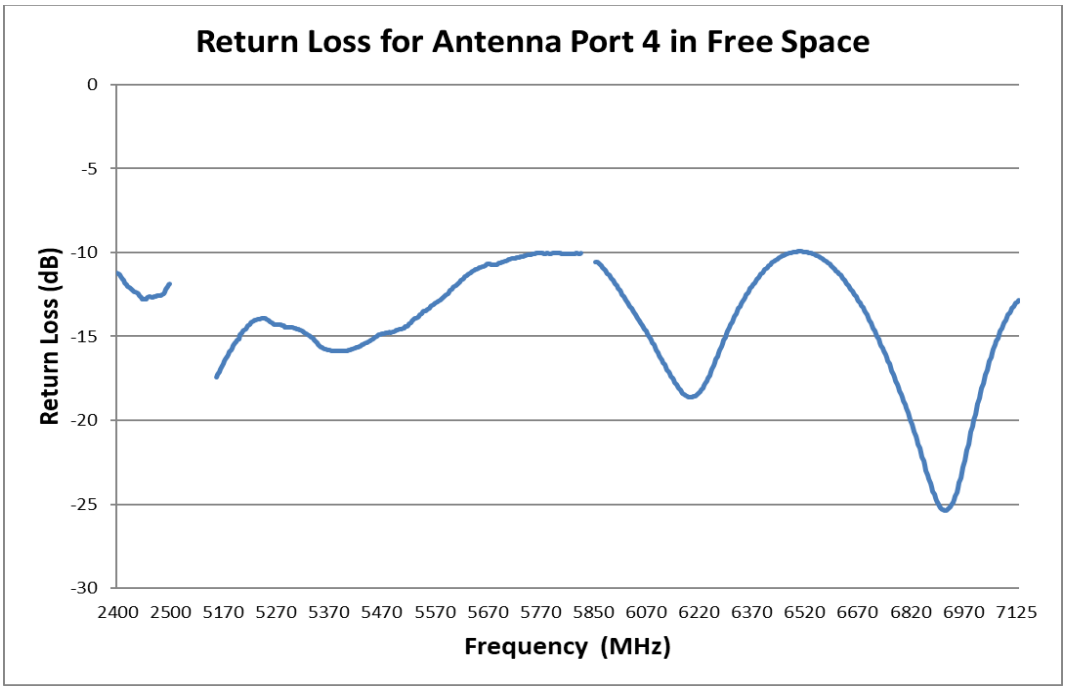


FIGURE 4.3.4 RETURN LOSS OF ANTENNA PORT 4 IN FREE SPACE

4.4 EFFICIENCY PLOT

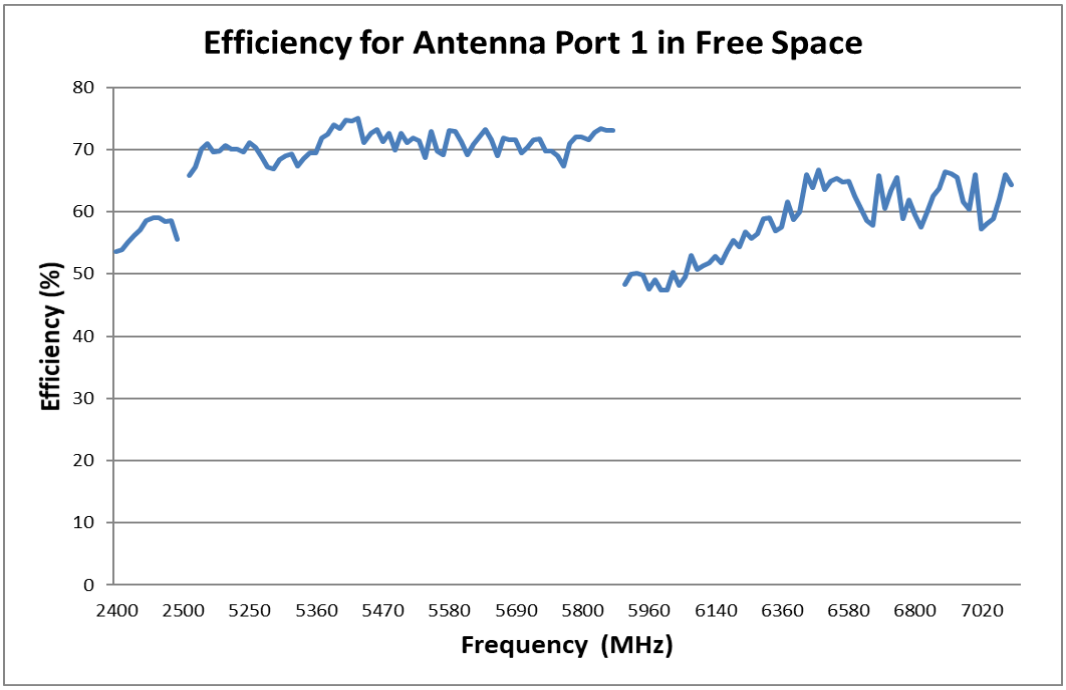


FIGURE 4.4.1 EFFICIENCY OF ANTENNA PORT 1 IN FREE SPACE

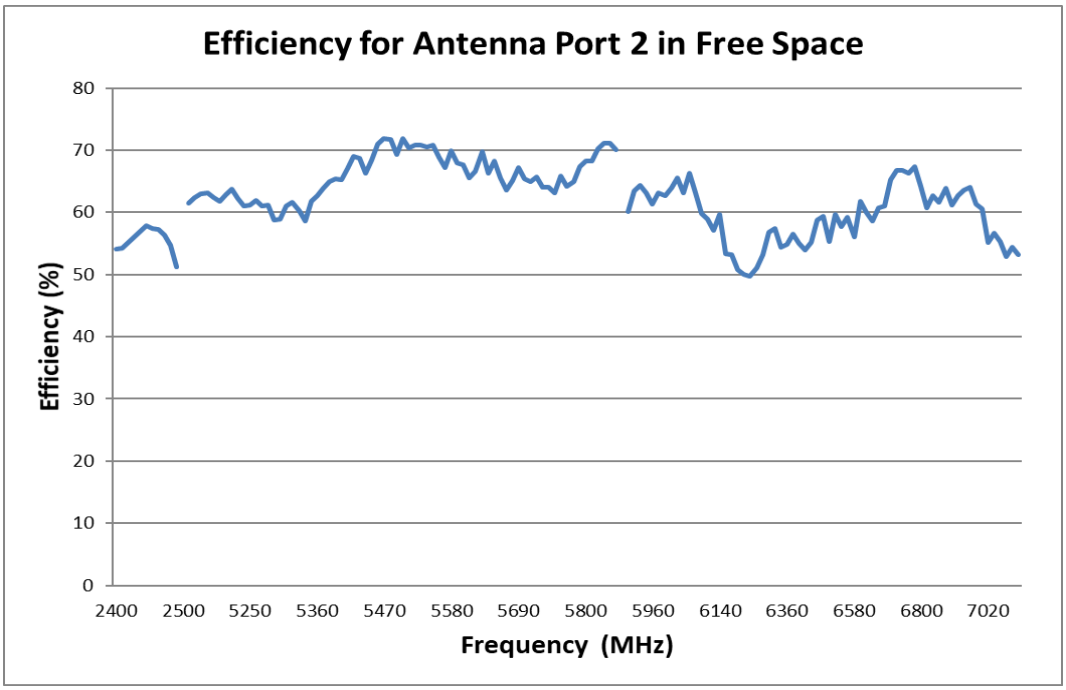


FIGURE 4.4.2 EFFICIENCY OF ANTENNA PORT 2 IN FREE SPACE

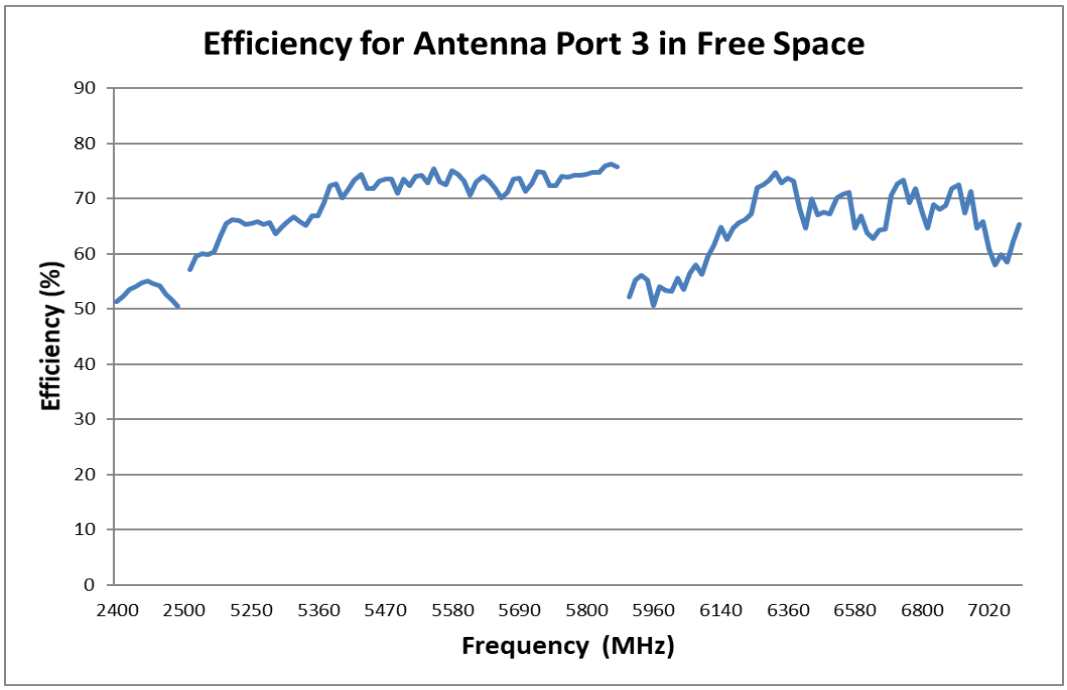


FIGURE 4.4.3 EFFICIENCY OF ANTENNA PORT 3 IN FREE SPACE

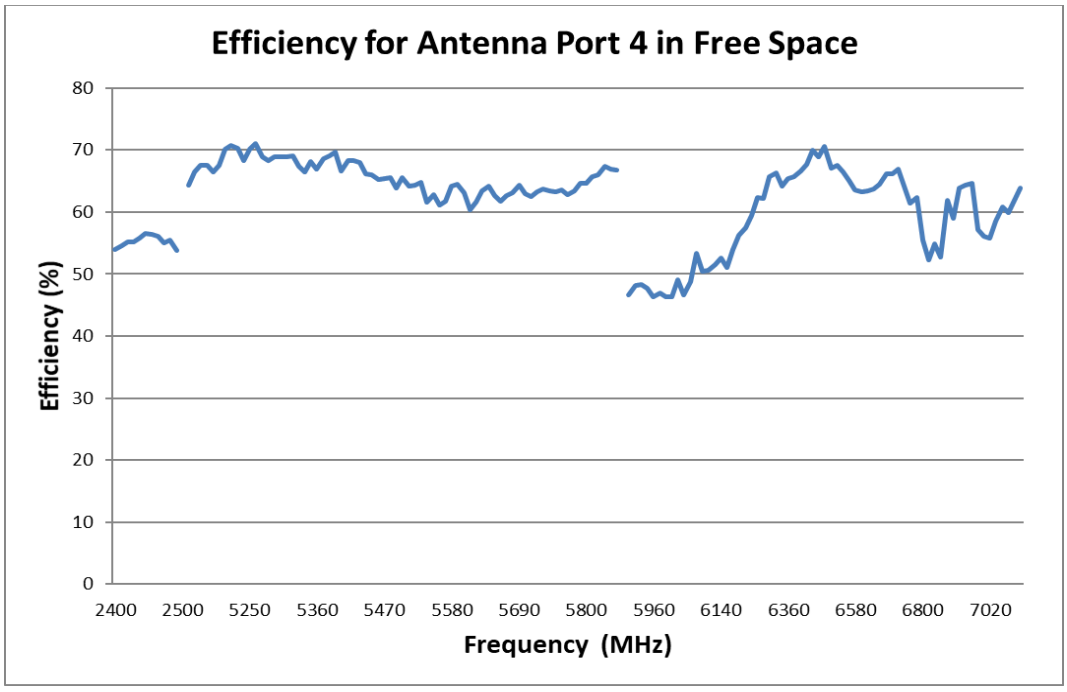


FIGURE 4.4.4 EFFICIENCY OF ANTENNA PORT 4 IN FREE SPACE

4.5 2D RADIATION PATTERN

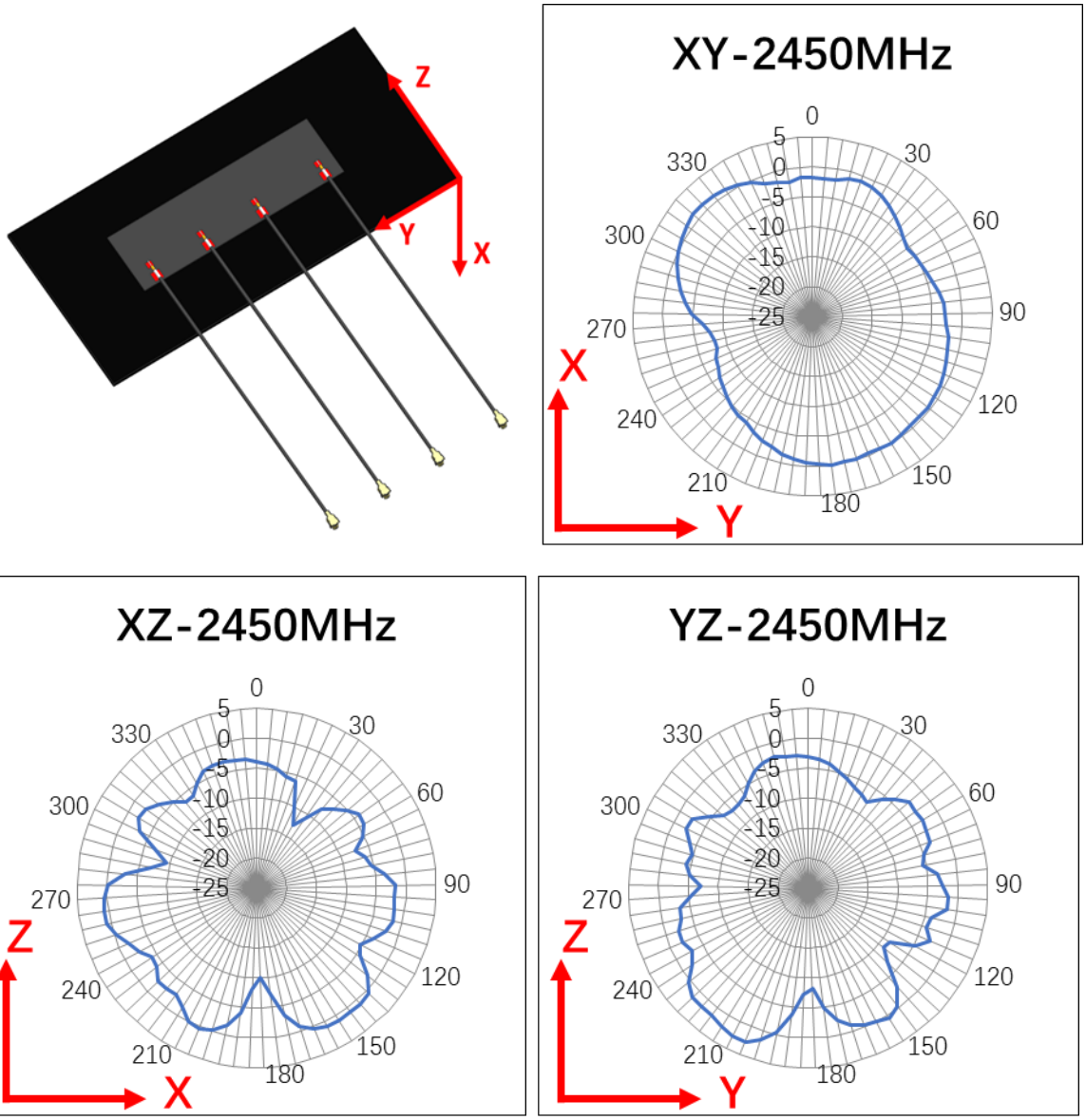


FIGURE 4.5.1 2D RADIATION PATTERN OF ANTENNA PORT 1 AT 2450MHZ IN FREE SPACE

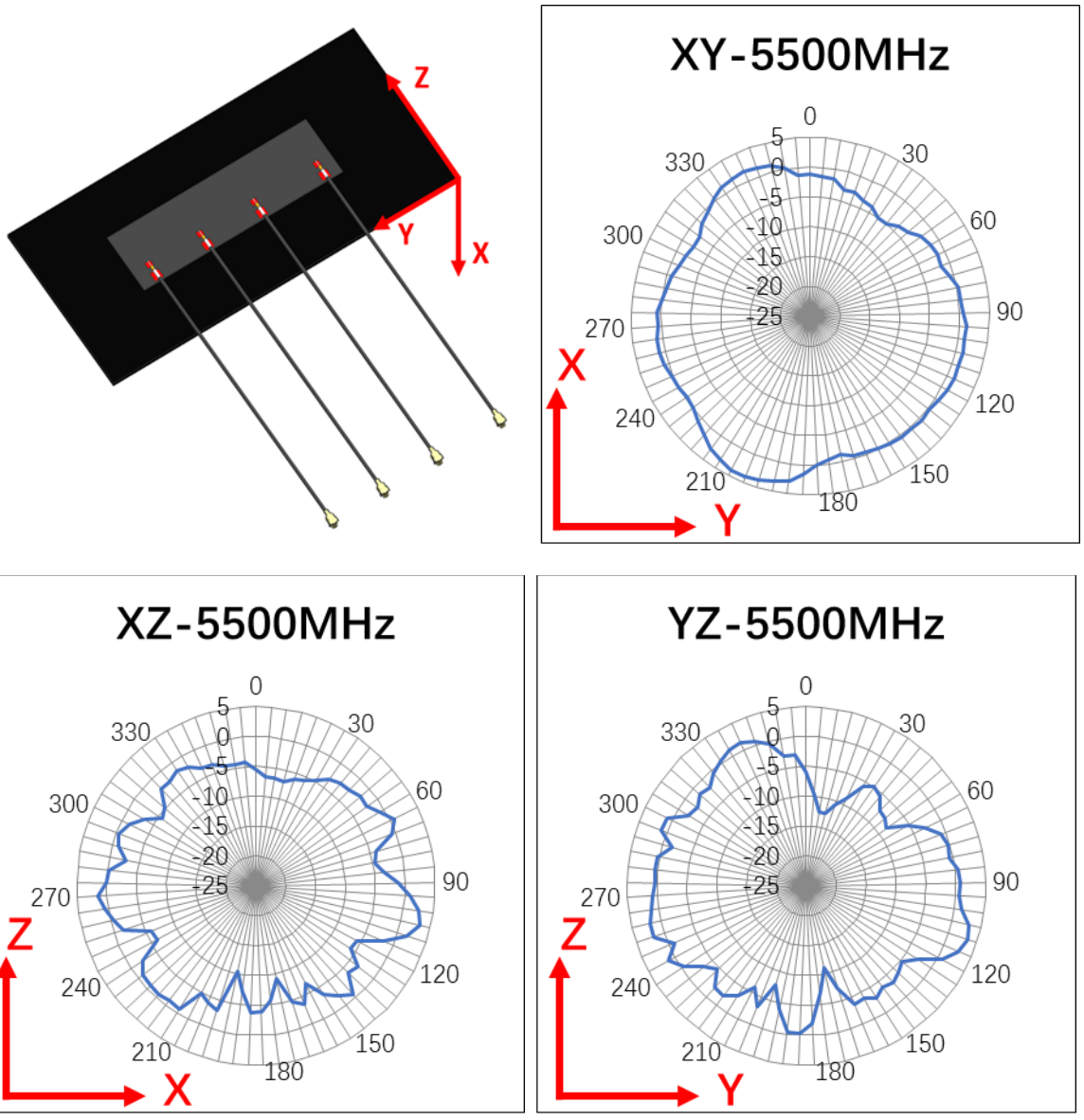


FIGURE 4.5.2 2D RADIATION PATTERN OF ANTENNA PORT 1 AT 5500MHZ BAND IN FREE SPACE

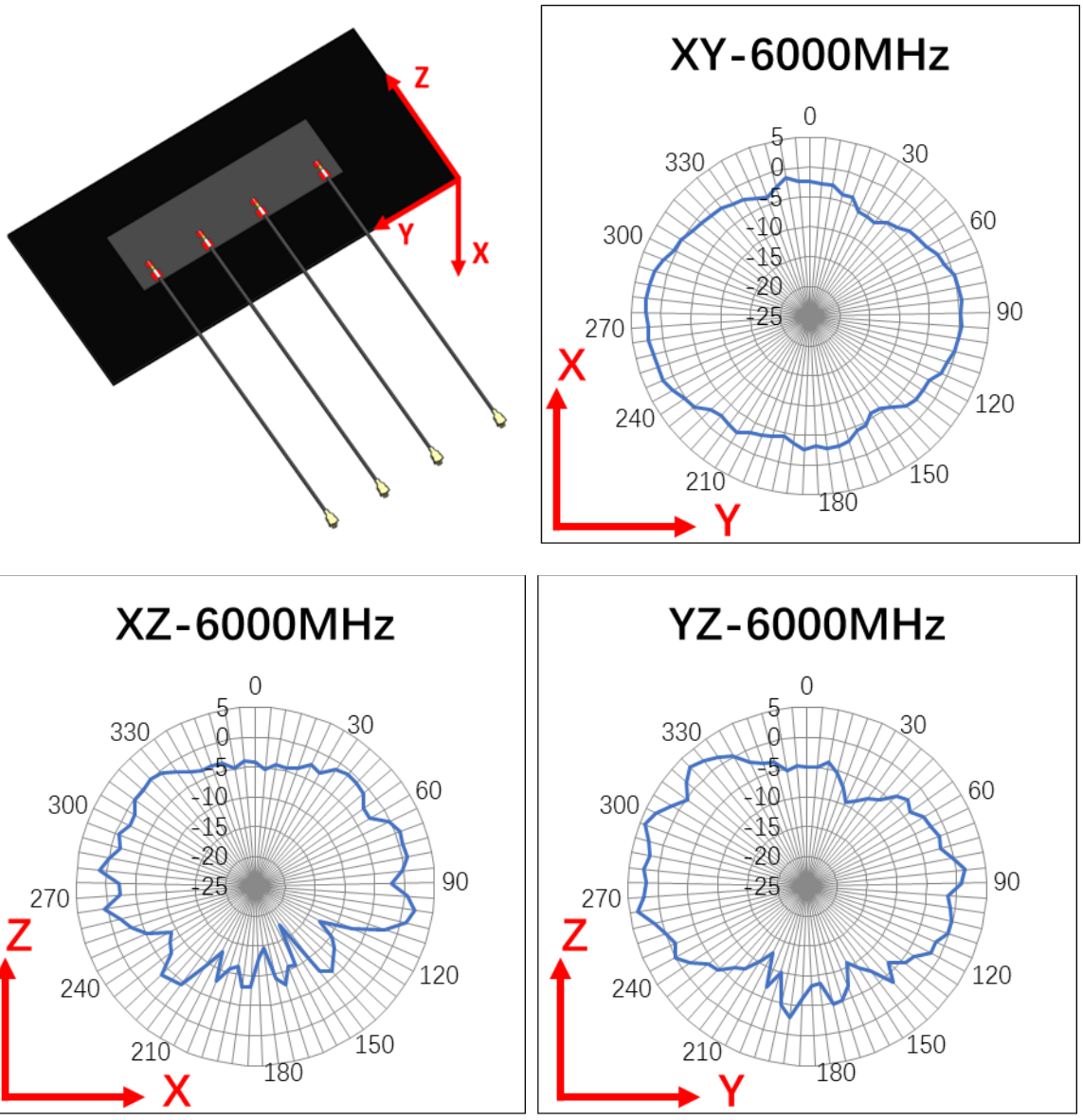


FIGURE 4.5.3 2D RADIATION PATTERN OF ANTENNA PORT 1 AT 6000MHZ IN FREE SPACE

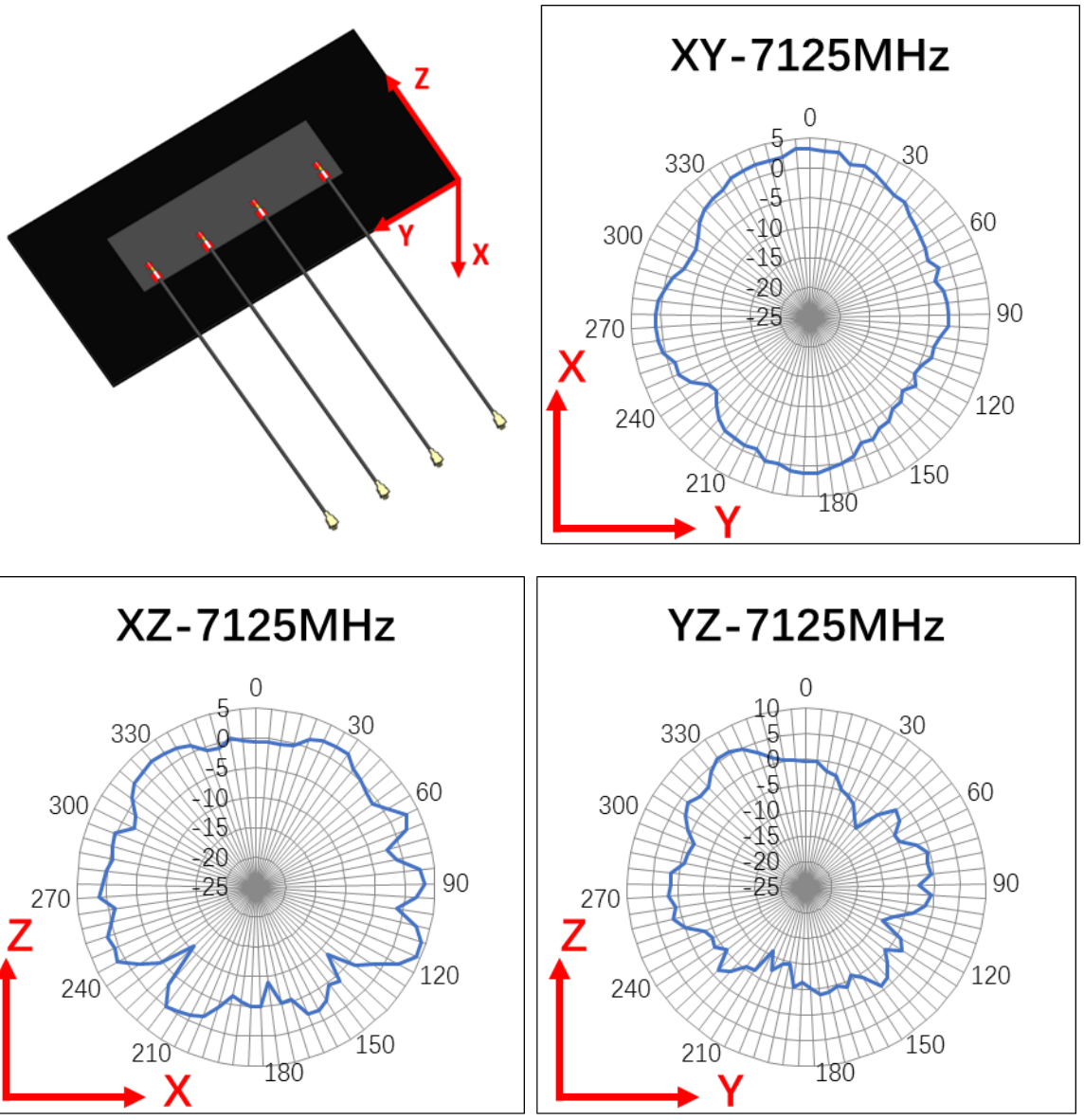


FIGURE 4.5.4 2D RADIATION PATTERN OF ANTENNA PORT 1 AT 7125MHZ IN FREE SPACE

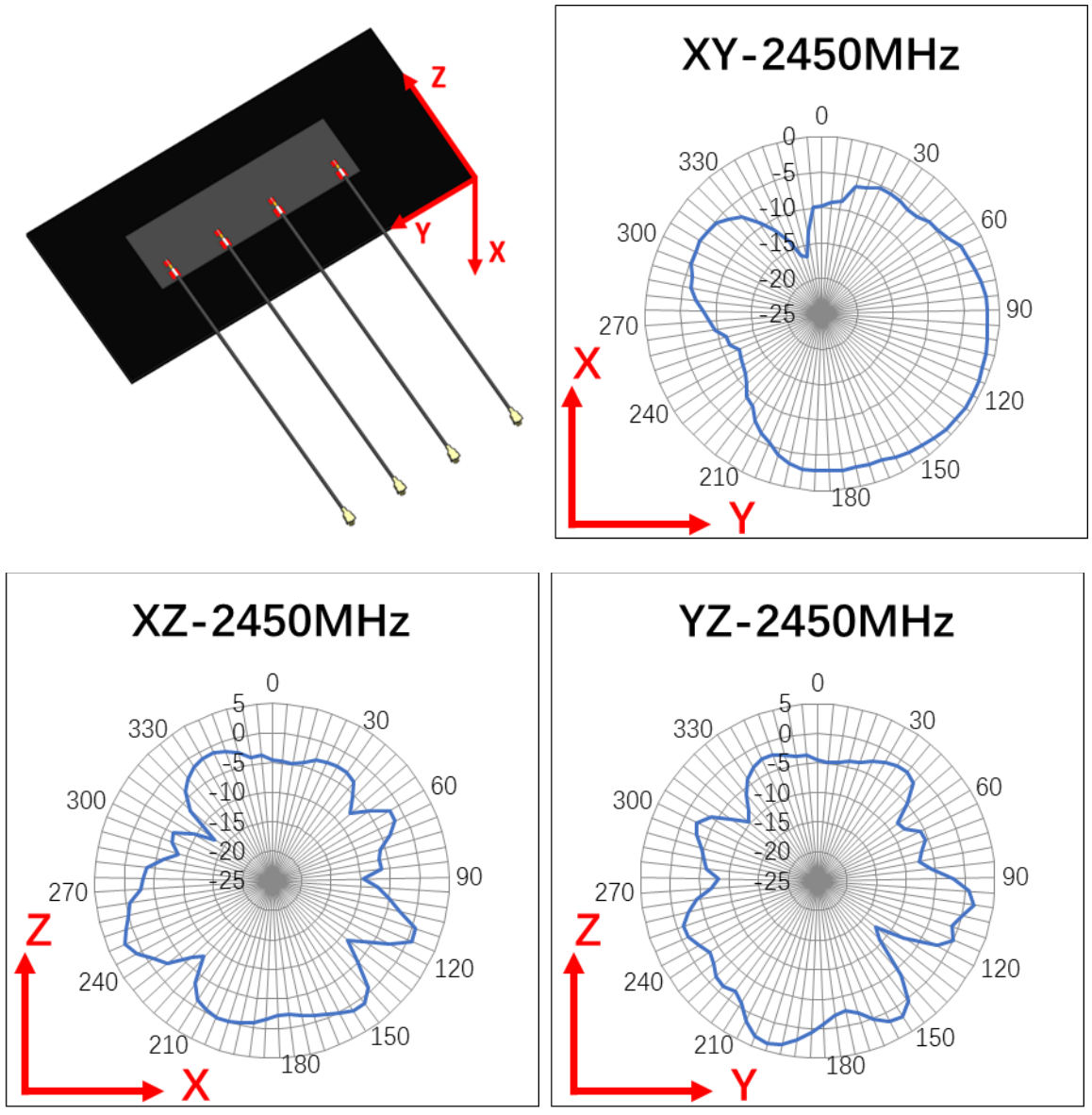


FIGURE 4.5.5 2D RADIATION PATTERN OF ANTENNA PORT 2 AT 2450MHZ IN FREE SPACE

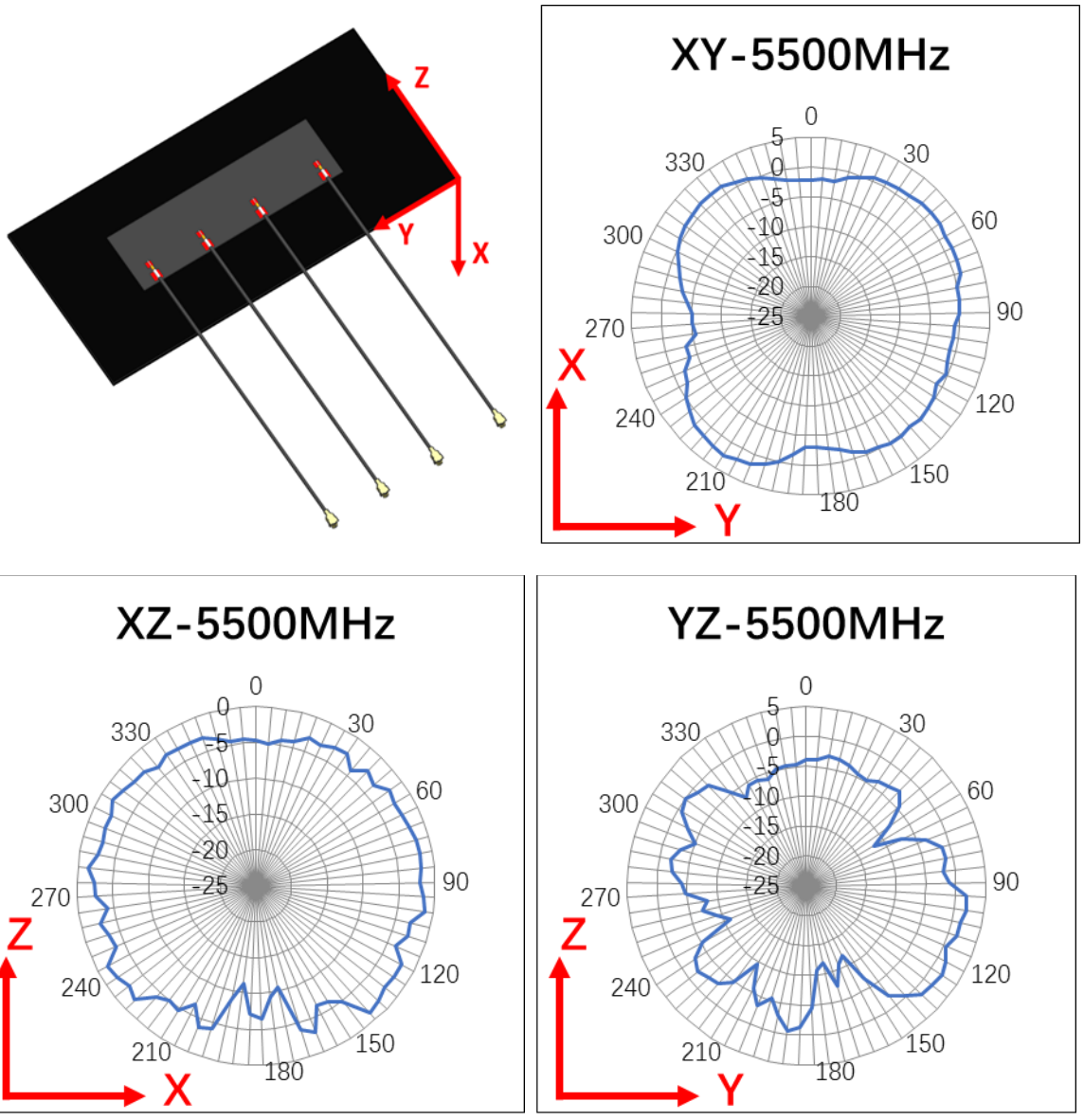


FIGURE 4.5.6 2D RADIATION PATTERN OF ANTENNA PORT 2 AT 5500MHZ IN FREE SPACE

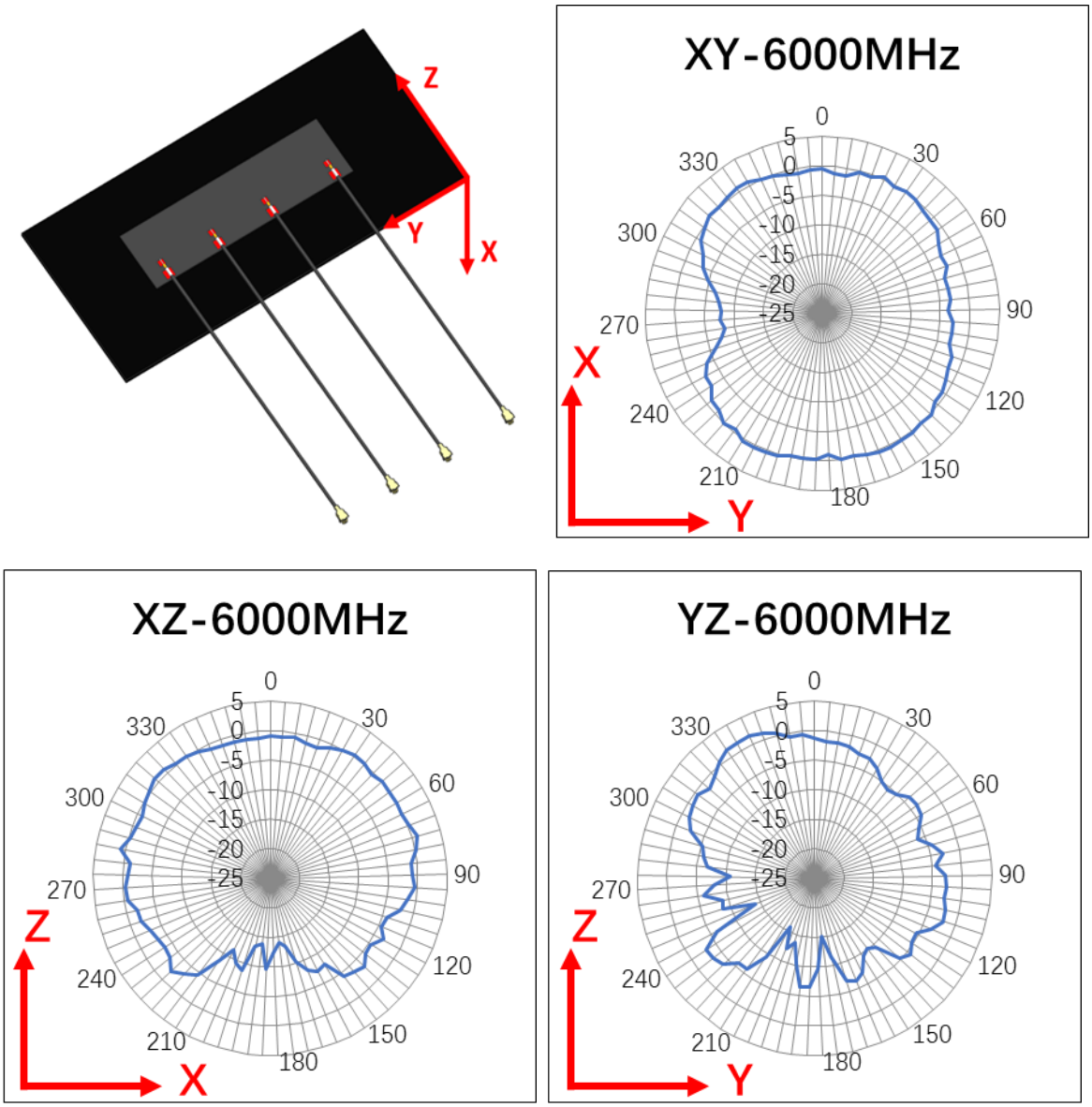


FIGURE 4.5.7 2D RADIATION PATTERN OF ANTENNA PORT 2 AT 6000MHZ IN FREE SPACE

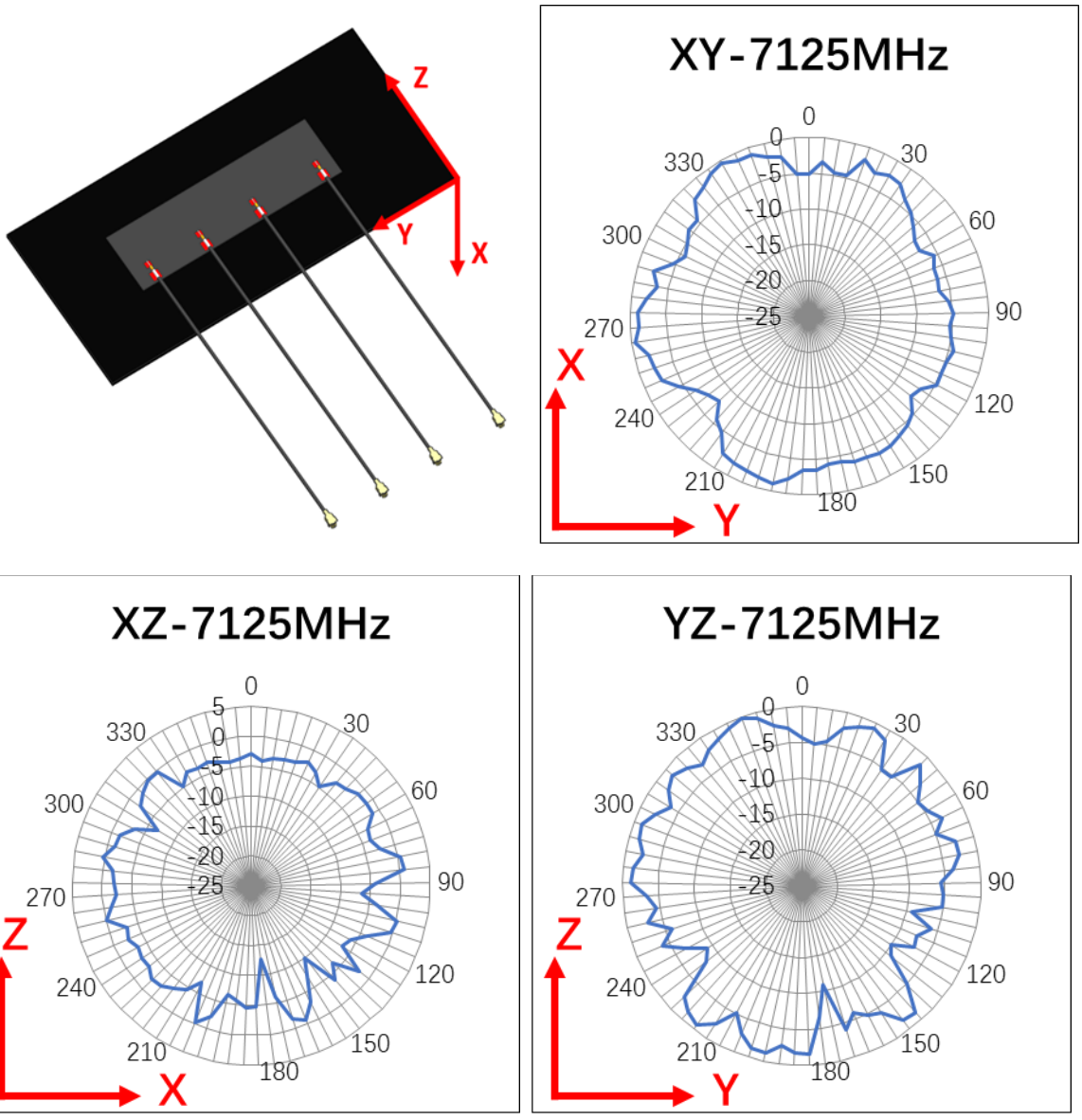


FIGURE 4.5.8 2D RADIATION PATTERN OF ANTENNA PORT 2 AT 7125MHZ IN FREE SPACE

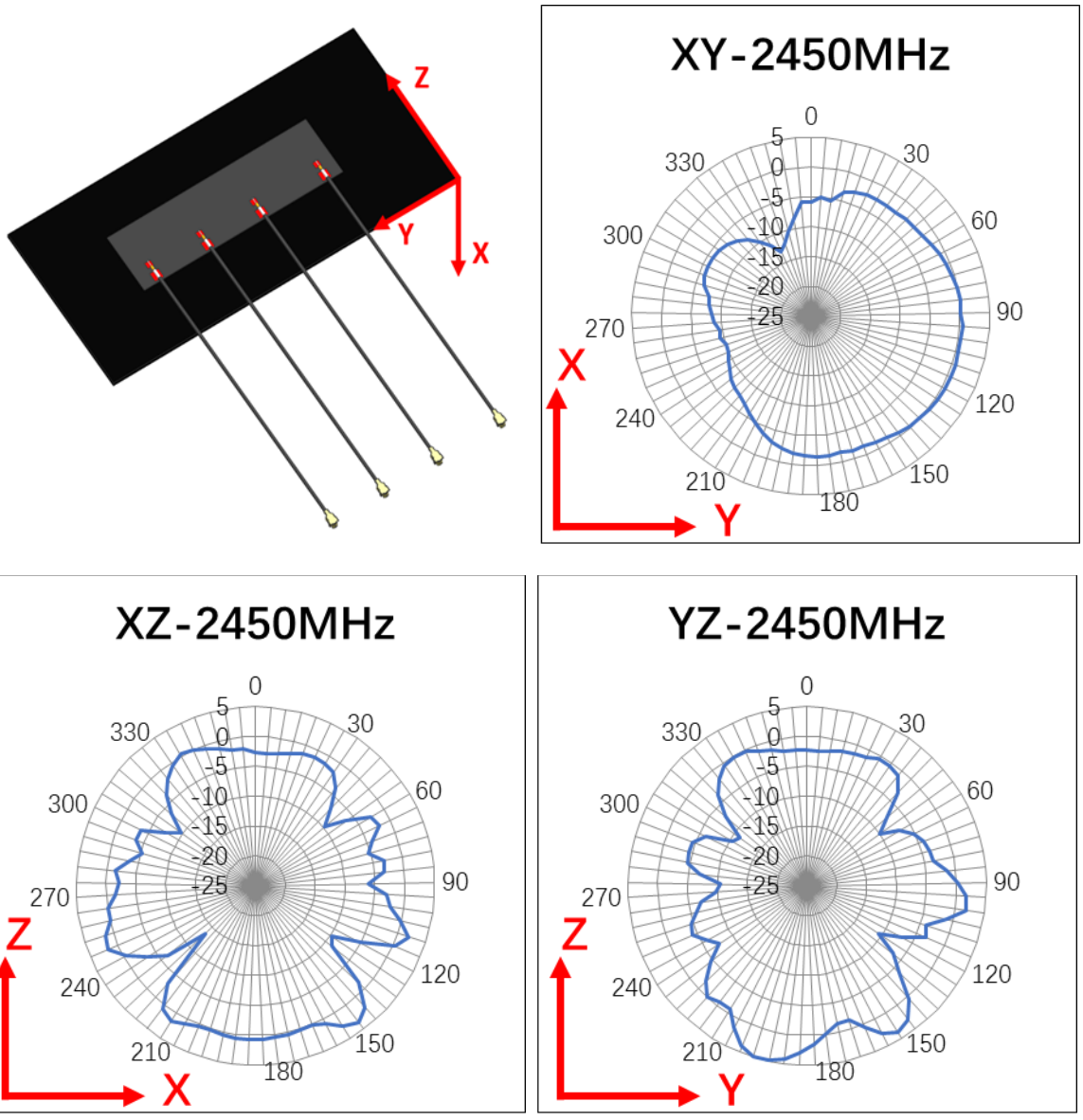
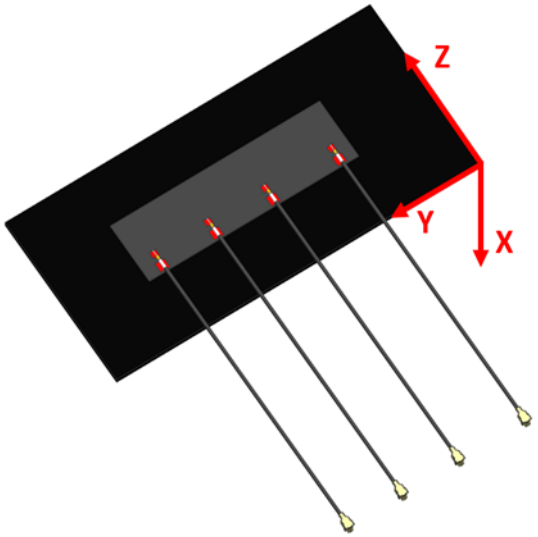
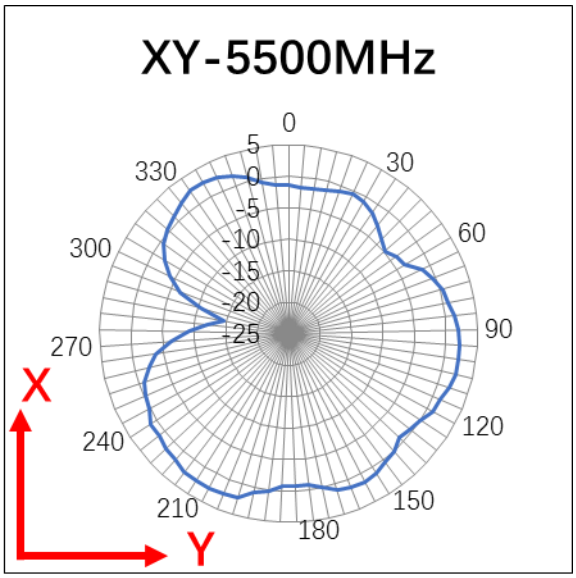
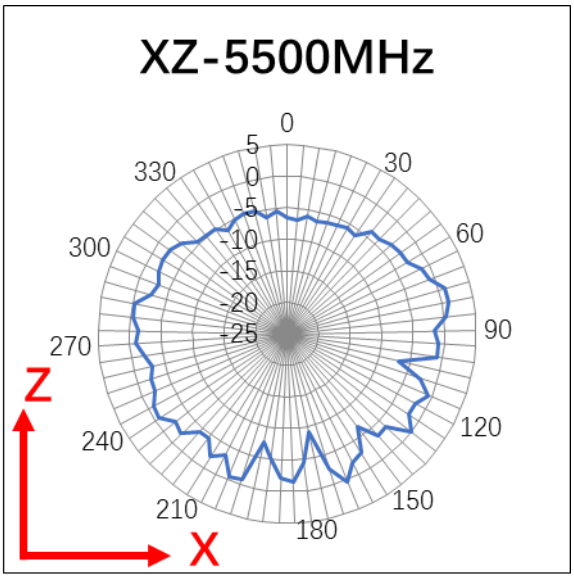


FIGURE 4.5.9 2D RADIATION PATTERN OF ANTENNA PORT 3 AT 2450MHZ IN FREE SPACE







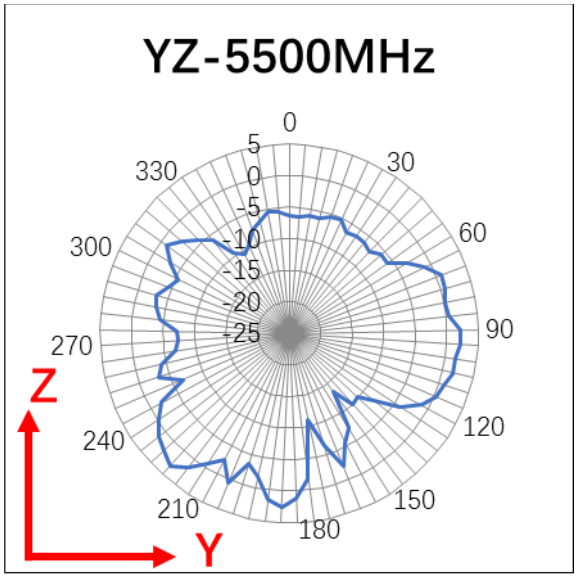


FIGURE 4.5.10 2D RADIATION PATTERN OF ANTENNA PORT 3 AT 5500MHZ BAND IN FREE SPACE

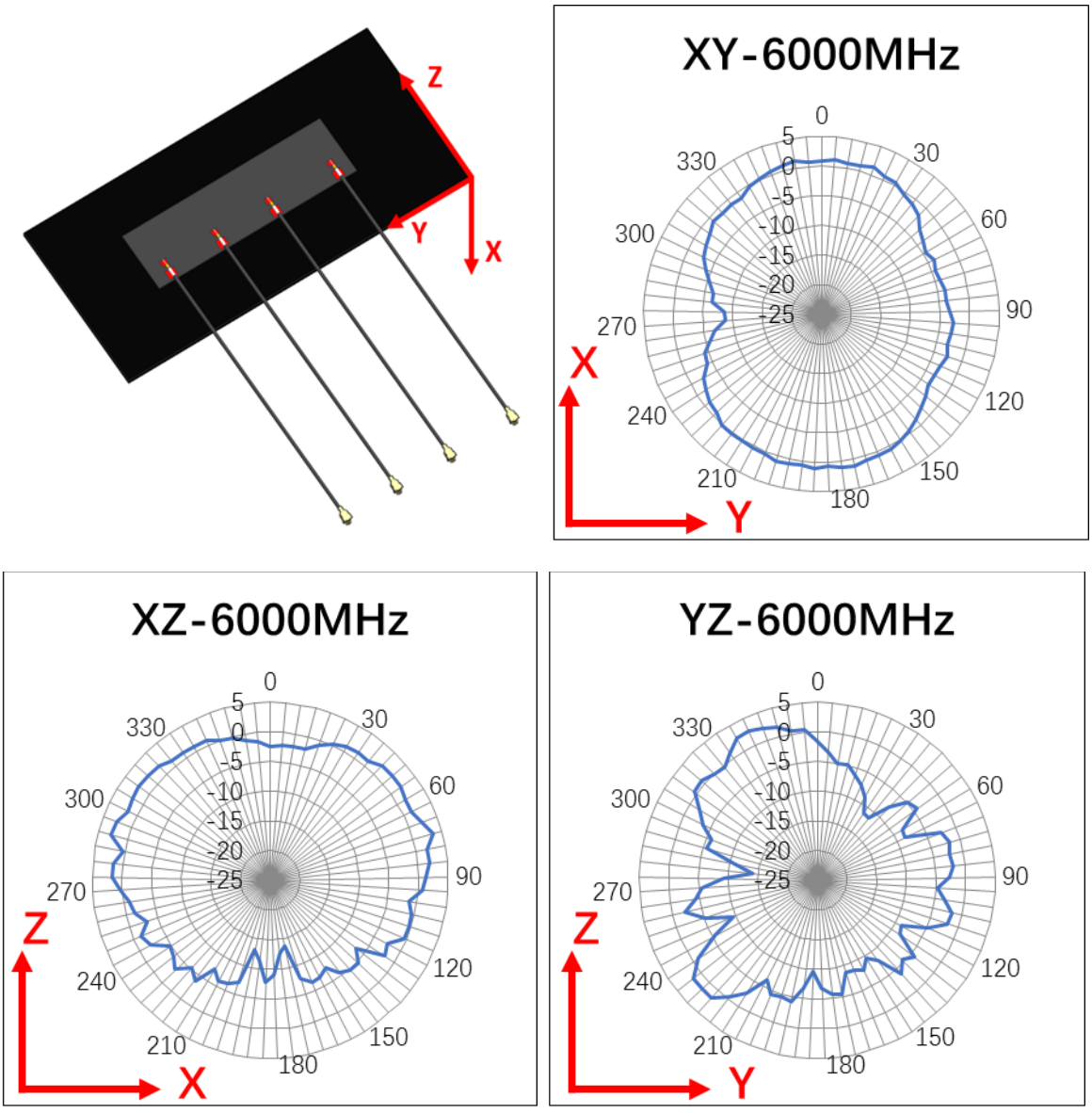


FIGURE 4.5.11 2D RADIATION PATTERN OF ANTENNA PORT 3 AT 6000MHZ IN FREE SPACE

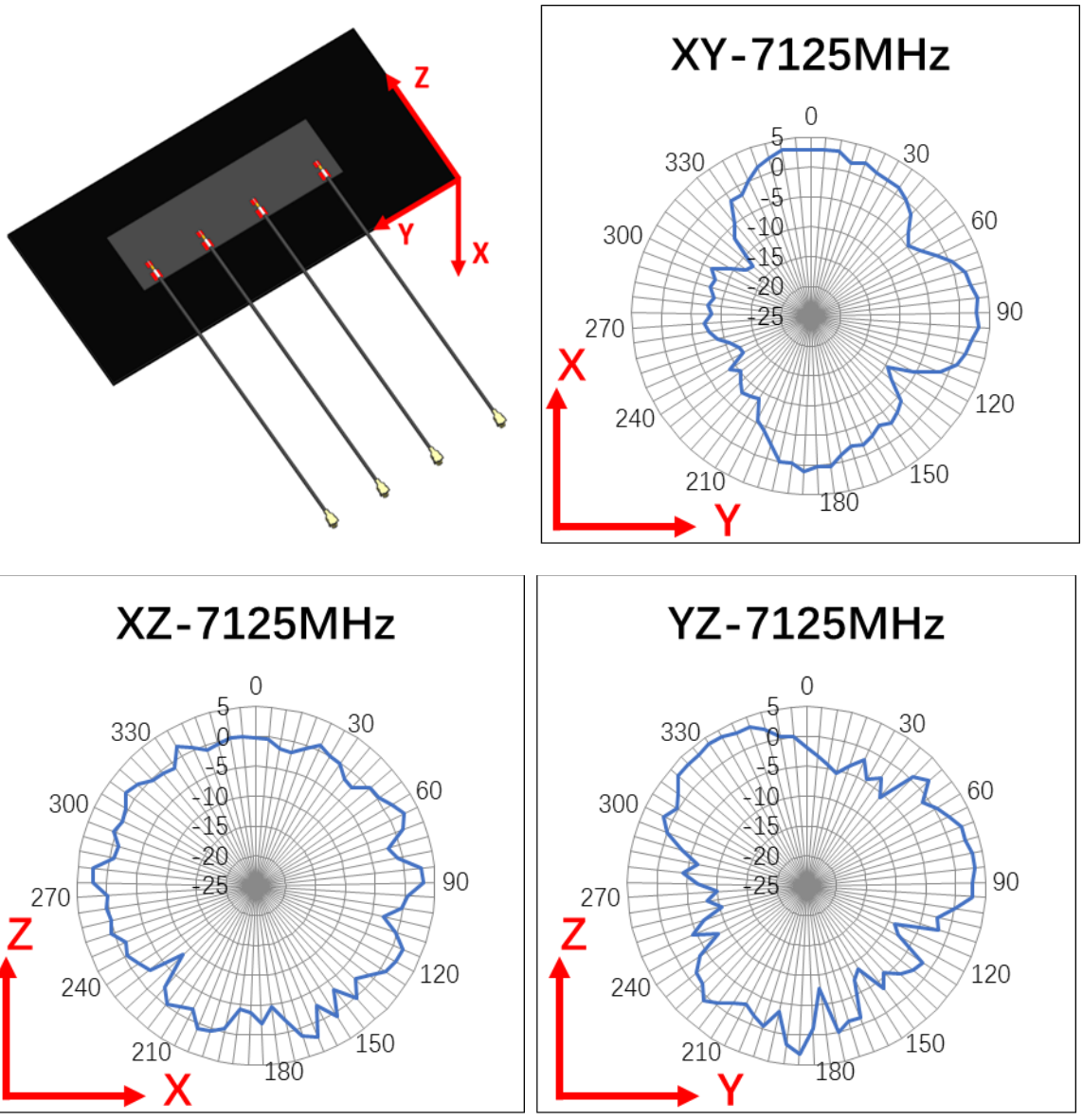


FIGURE 4.5.12 2D RADIATION PATTERN OF ANTENNA PORT 3 AT 7125MHZ IN FREE SPACE

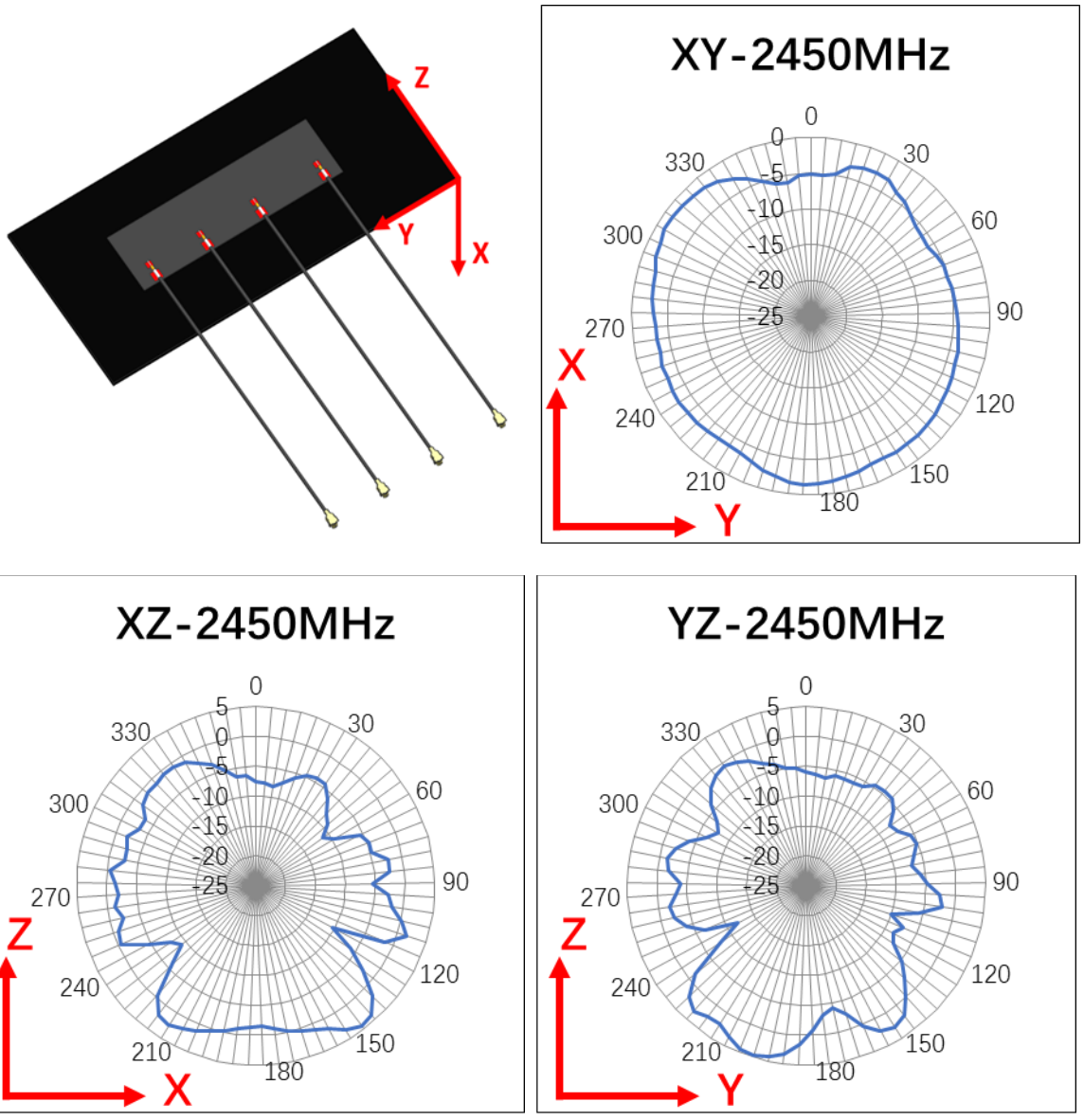


FIGURE 4.5.13 2D RADIATION PATTERN OF ANTENNA PORT 4 AT 2450MHZ IN FREE SPACE

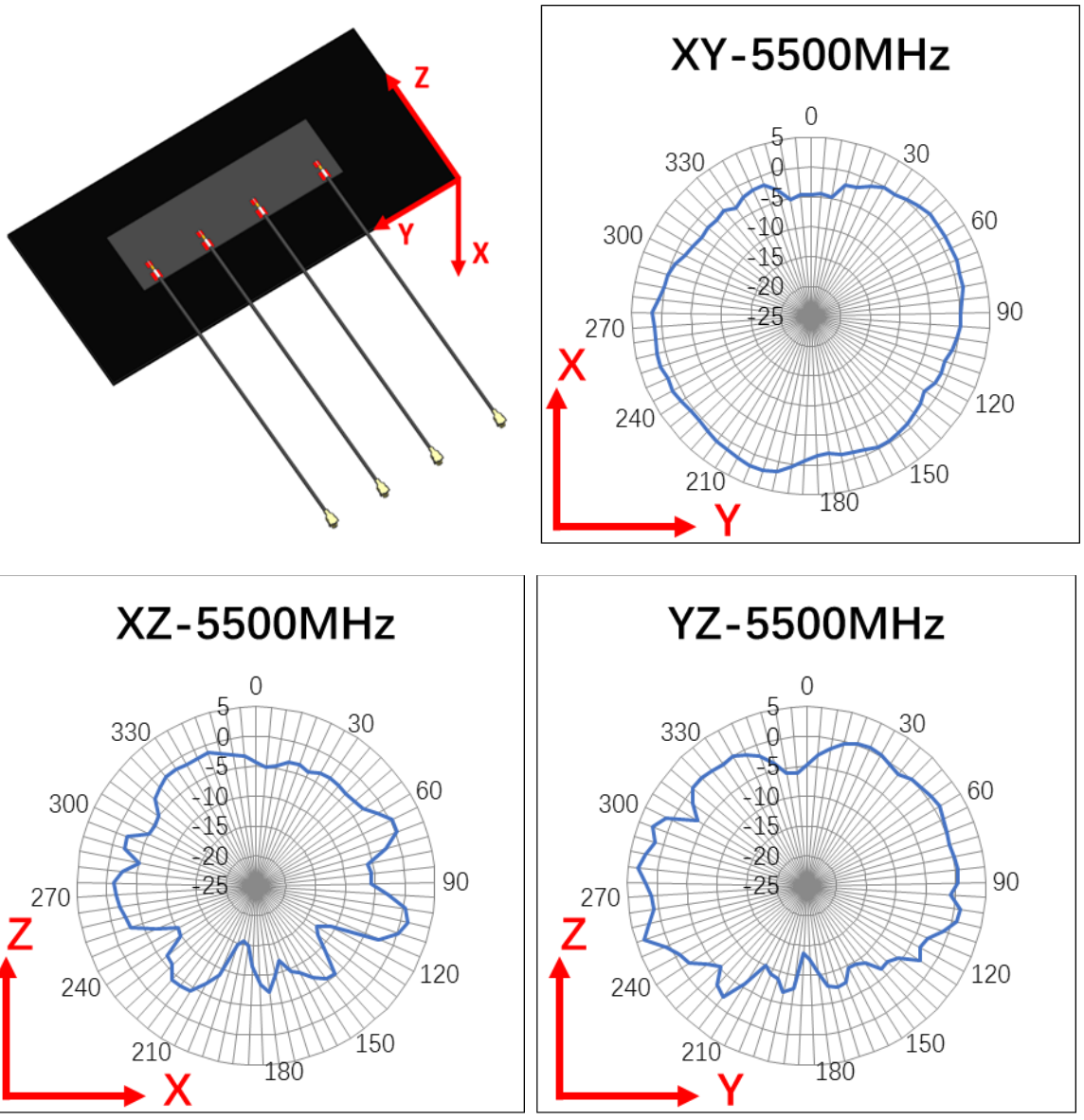


FIGURE 4.5.14 2D RADIATION PATTERN OF ANTENNA PORT 4 AT 5500MHZ IN FREE SPACE

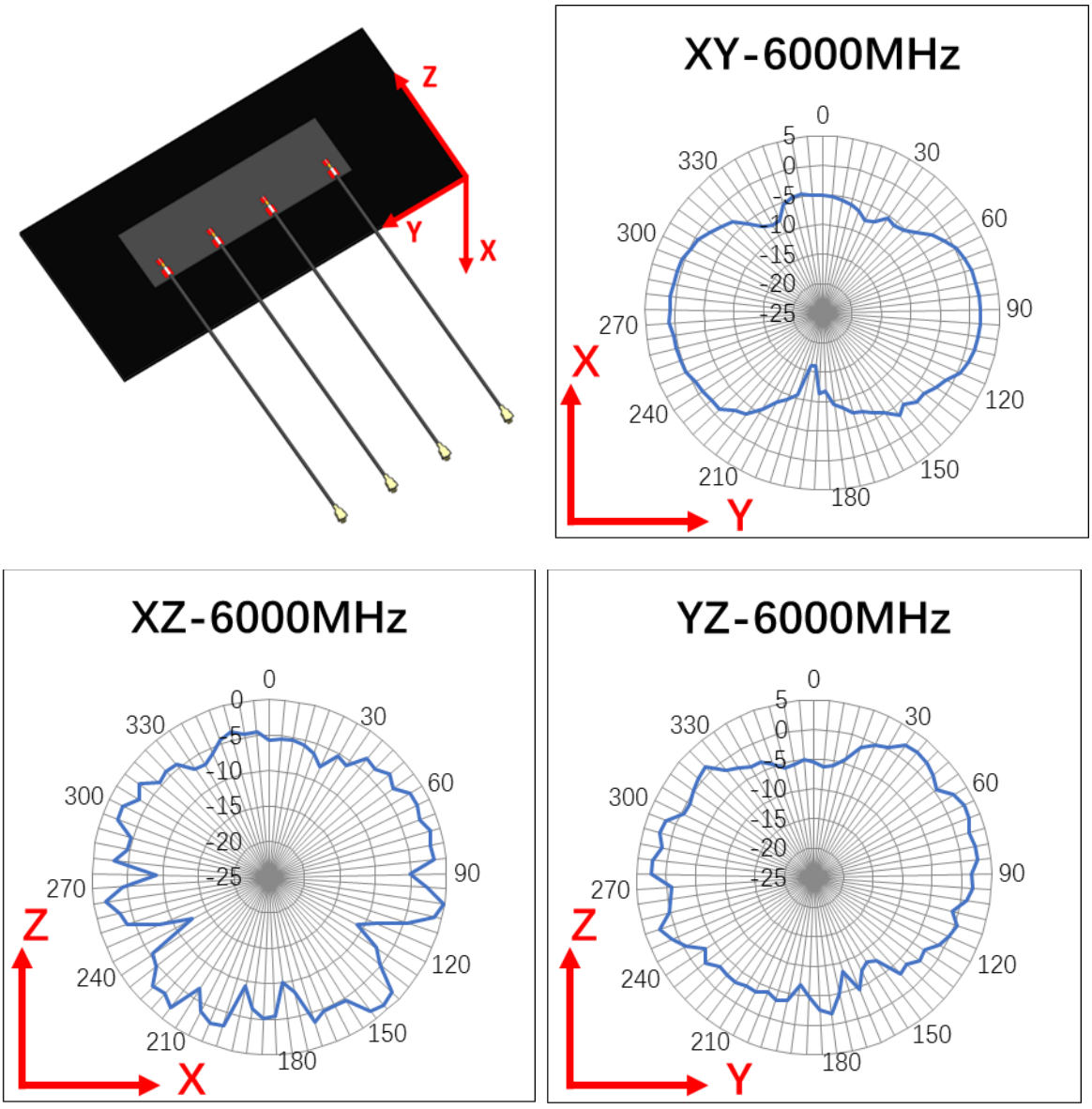


FIGURE 4.5.15 2D RADIATION PATTERN OF ANTENNA PORT 4 AT 6000MHZ IN FREE SPACE

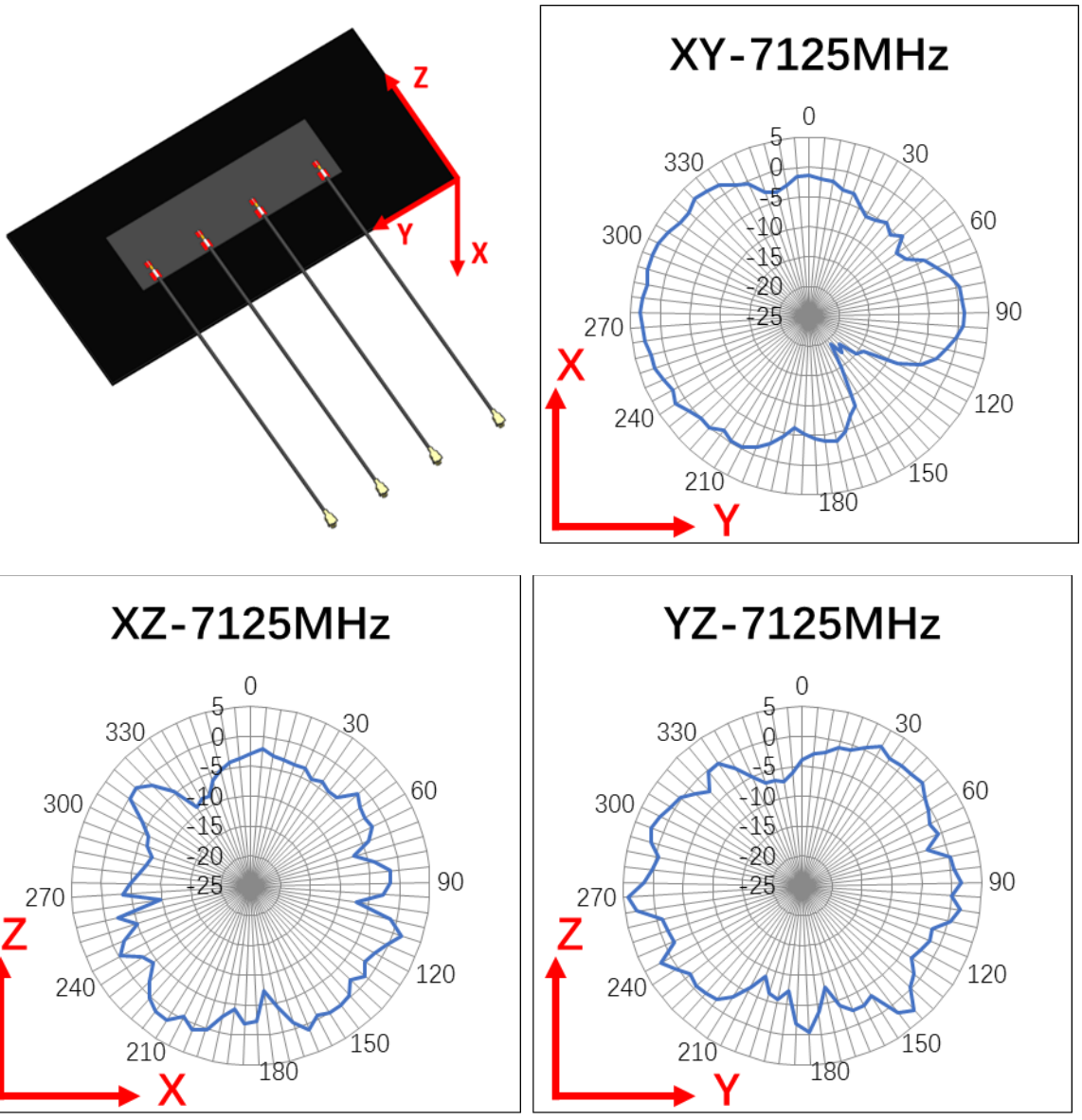


FIGURE 4.5.16 2D RADIATION PATTERN OF ANTENNA PORT 4 AT 7125MHZ IN FREE SPACE

4.6 3D RADIATION PATTERN

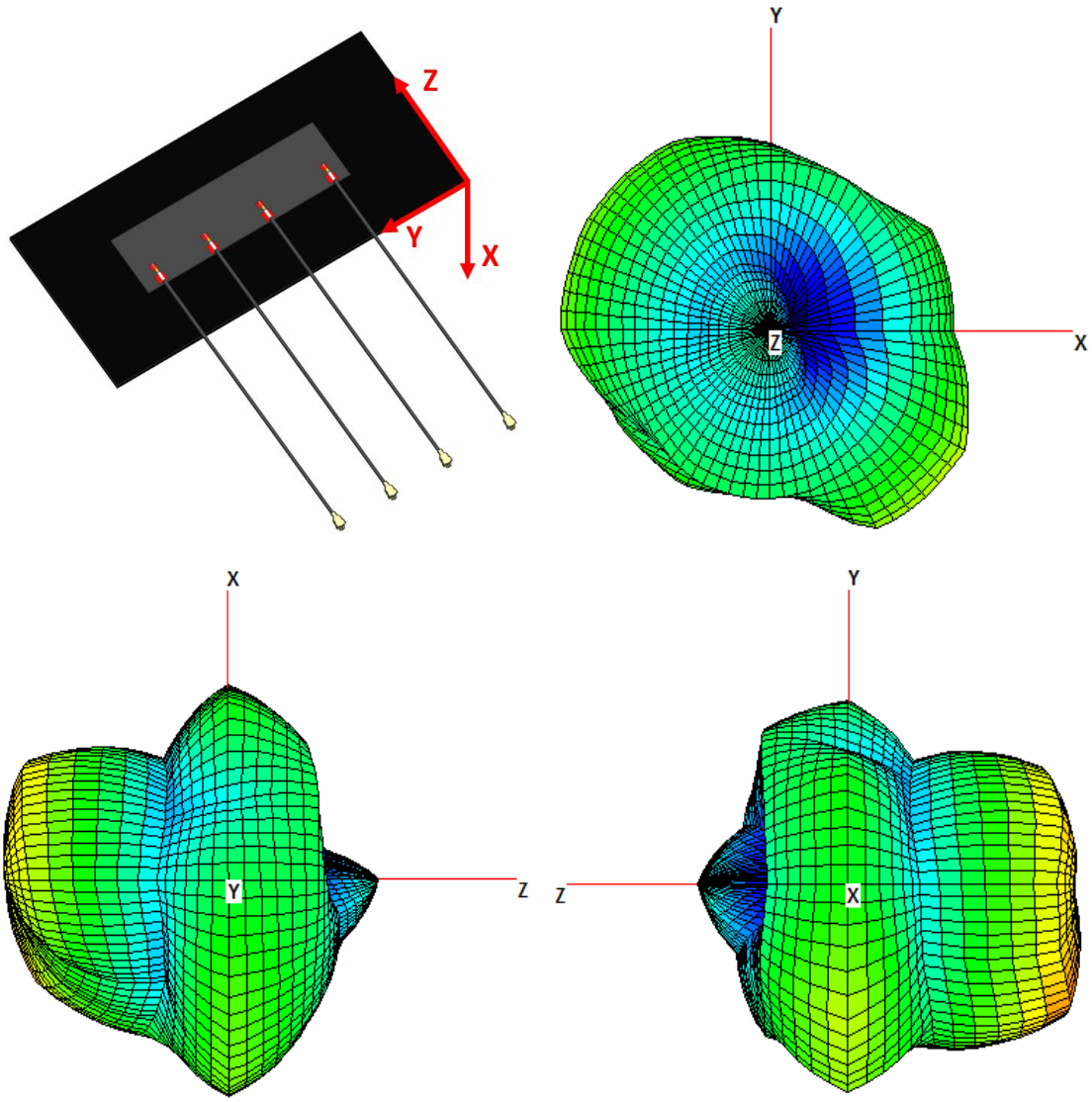


FIGURE 4.6.1 3D RADIATION PATTERN OF ANTENNA PORT 1 AT 2450MHZ IN FREE SPACE

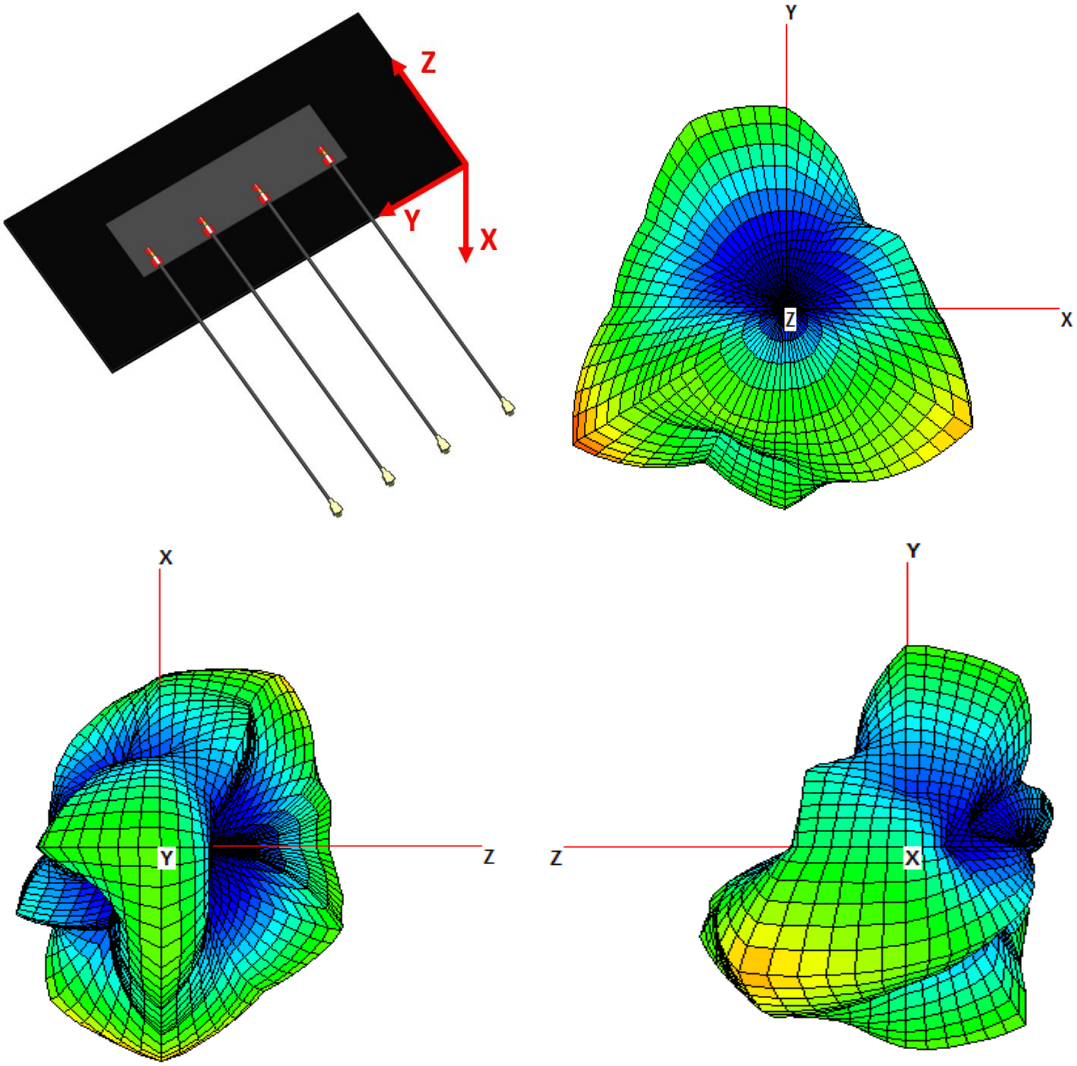


FIGURE 4.6.2 3D RADIATION PATTERN OF ANTENNA PORT 1 AT 5500MHZ IN FREE SPACE

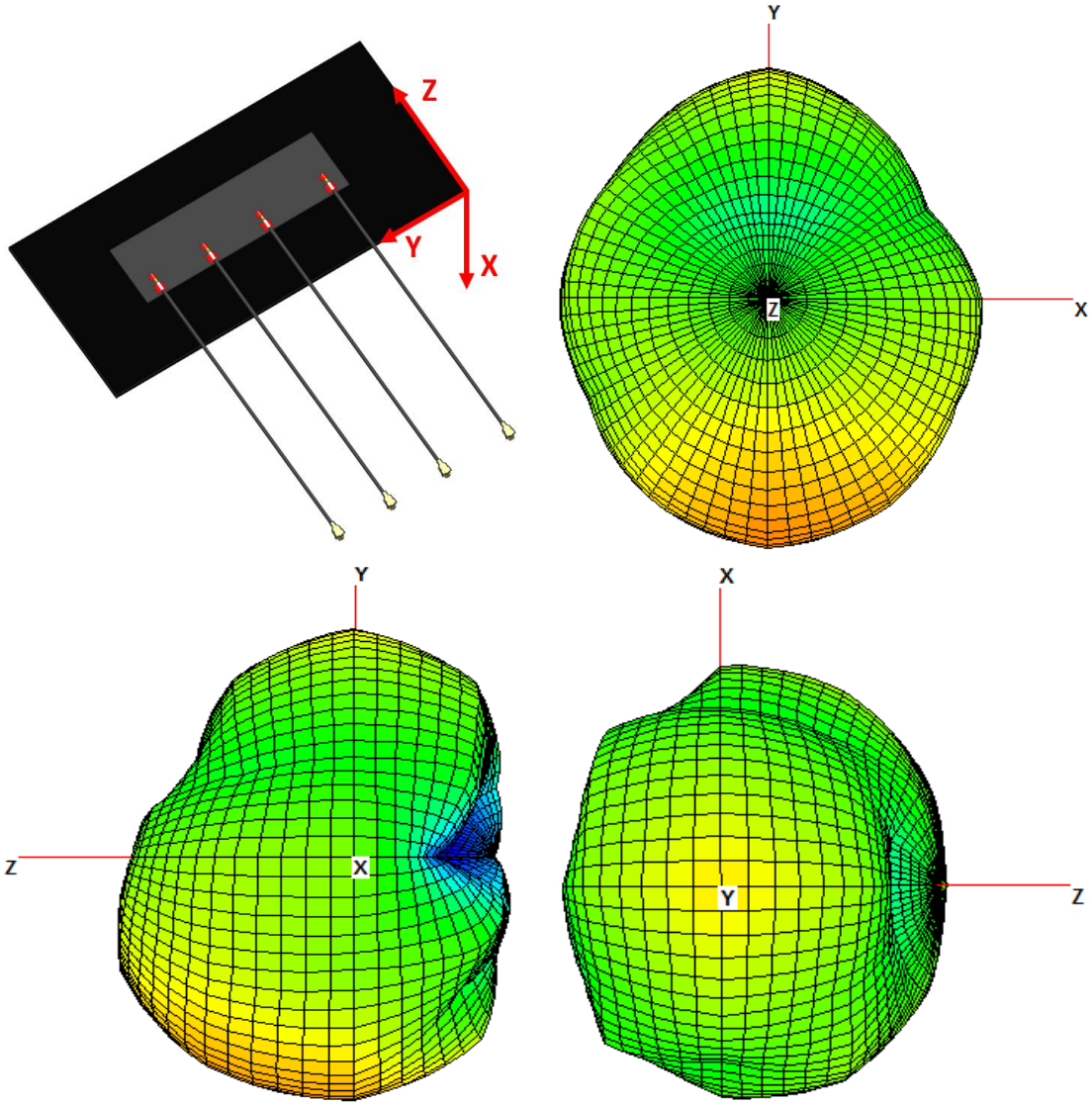


FIGURE 4.6.3 3D RADIATION PATTERN OF ANTENNA PORT 1 AT 6000MHZ IN FREE SPACE

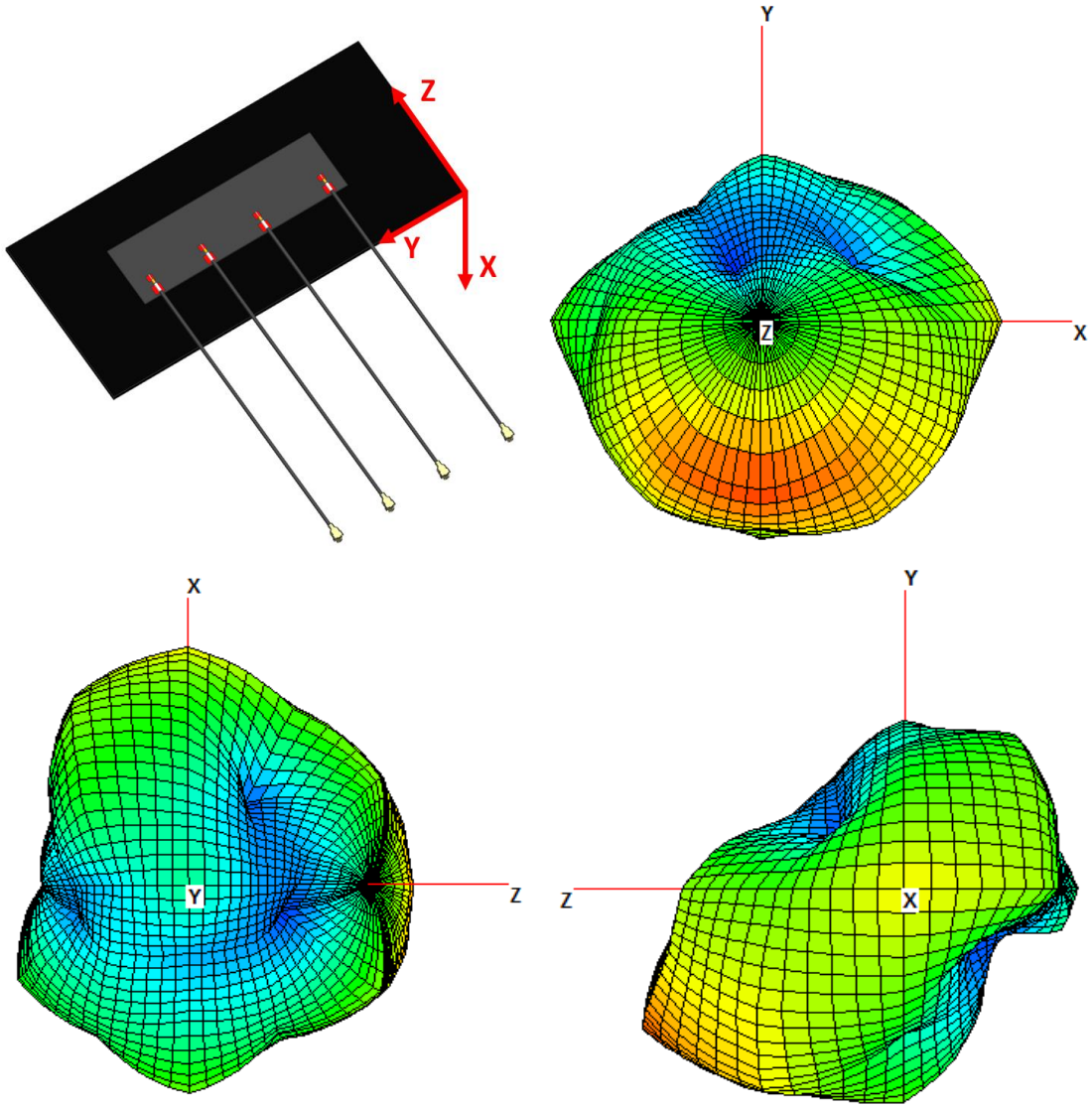


FIGURE 4.6.4 3D RADIATION PATTERN OF ANTENNA PORT 1 AT 7125MHZ IN FREE SPACE

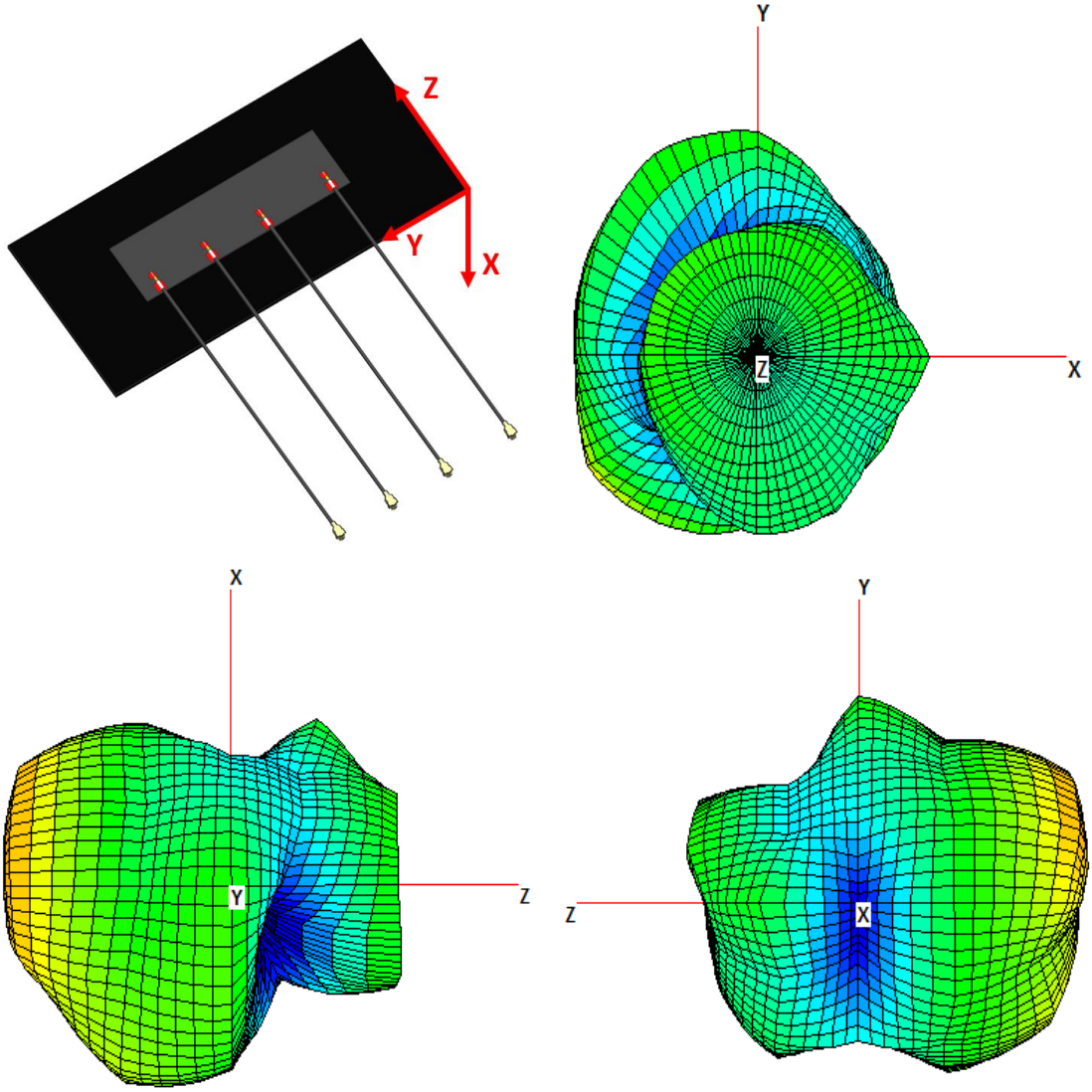


FIGURE 4.6.5 3D RADIATION PATTERN OF ANTENNA PORT 2 AT 2450MHZ IN FREE SPACE

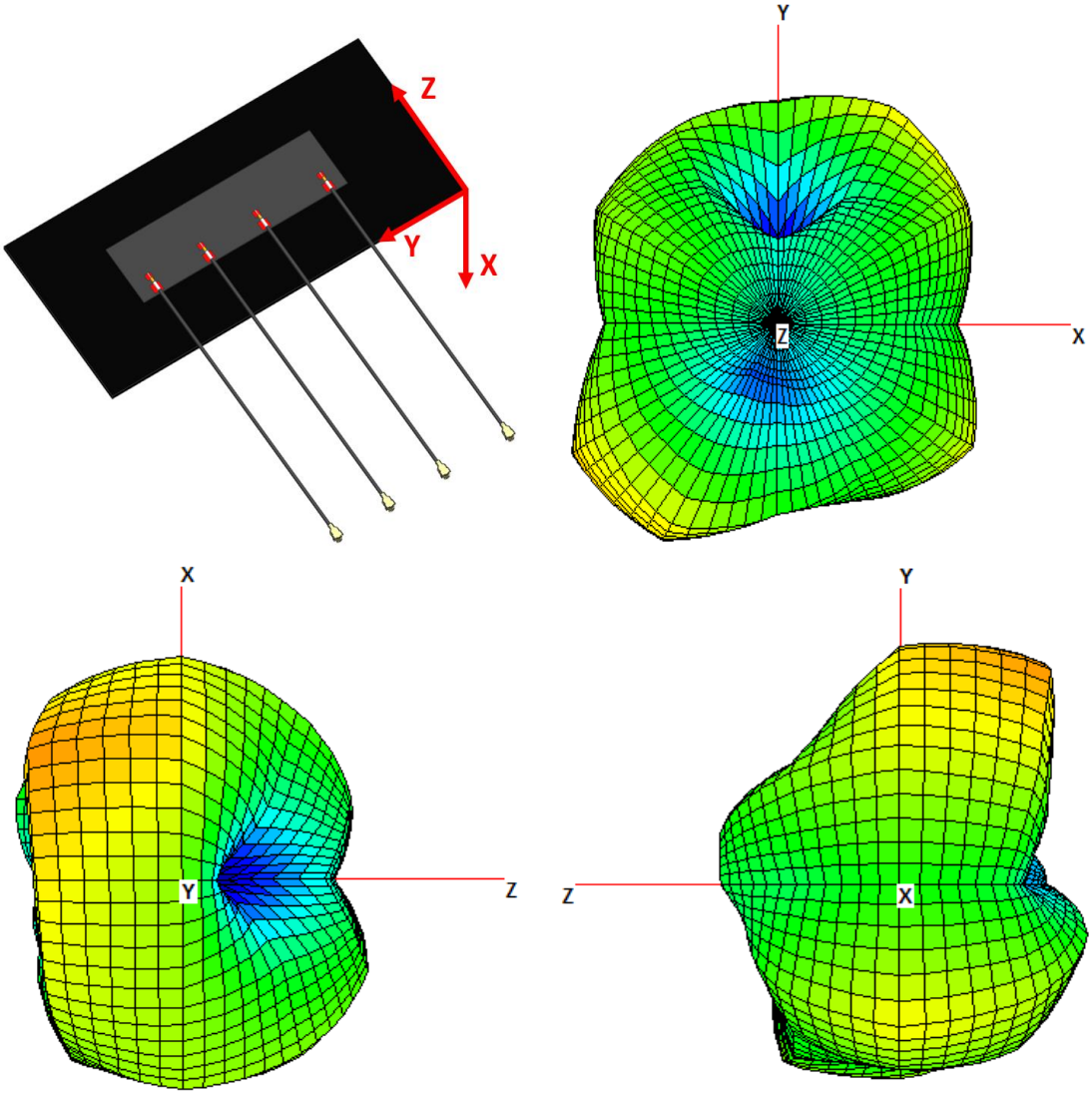


FIGURE 4.6.6 3D RADIATION PATTERN OF ANTENNA PORT 2 AT 5500MHZ IN FREE SPACE

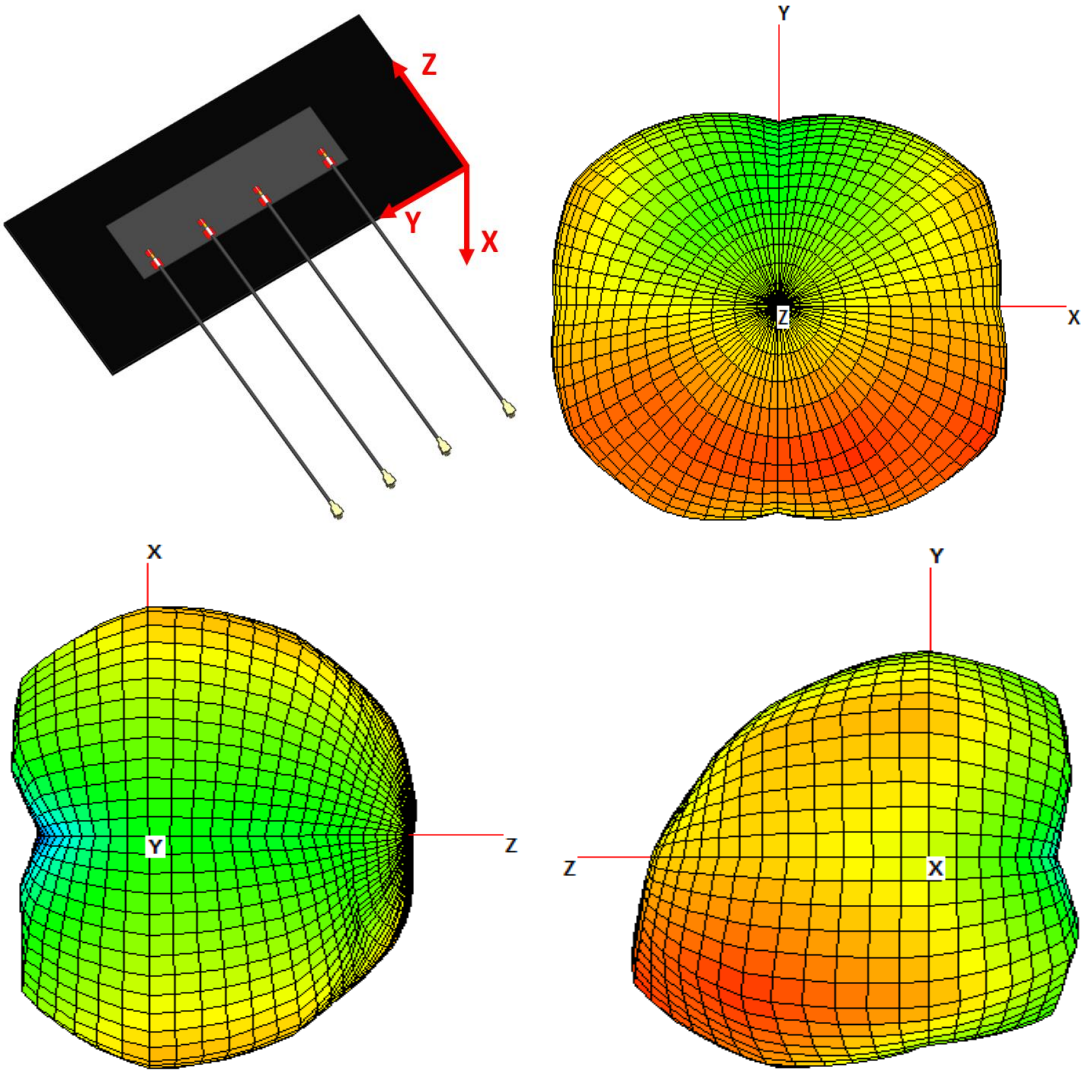


FIGURE 4.6.7 3D RADIATION PATTERN OF ANTENNA PORT 2 AT 6000MHZ IN FREE SPACE

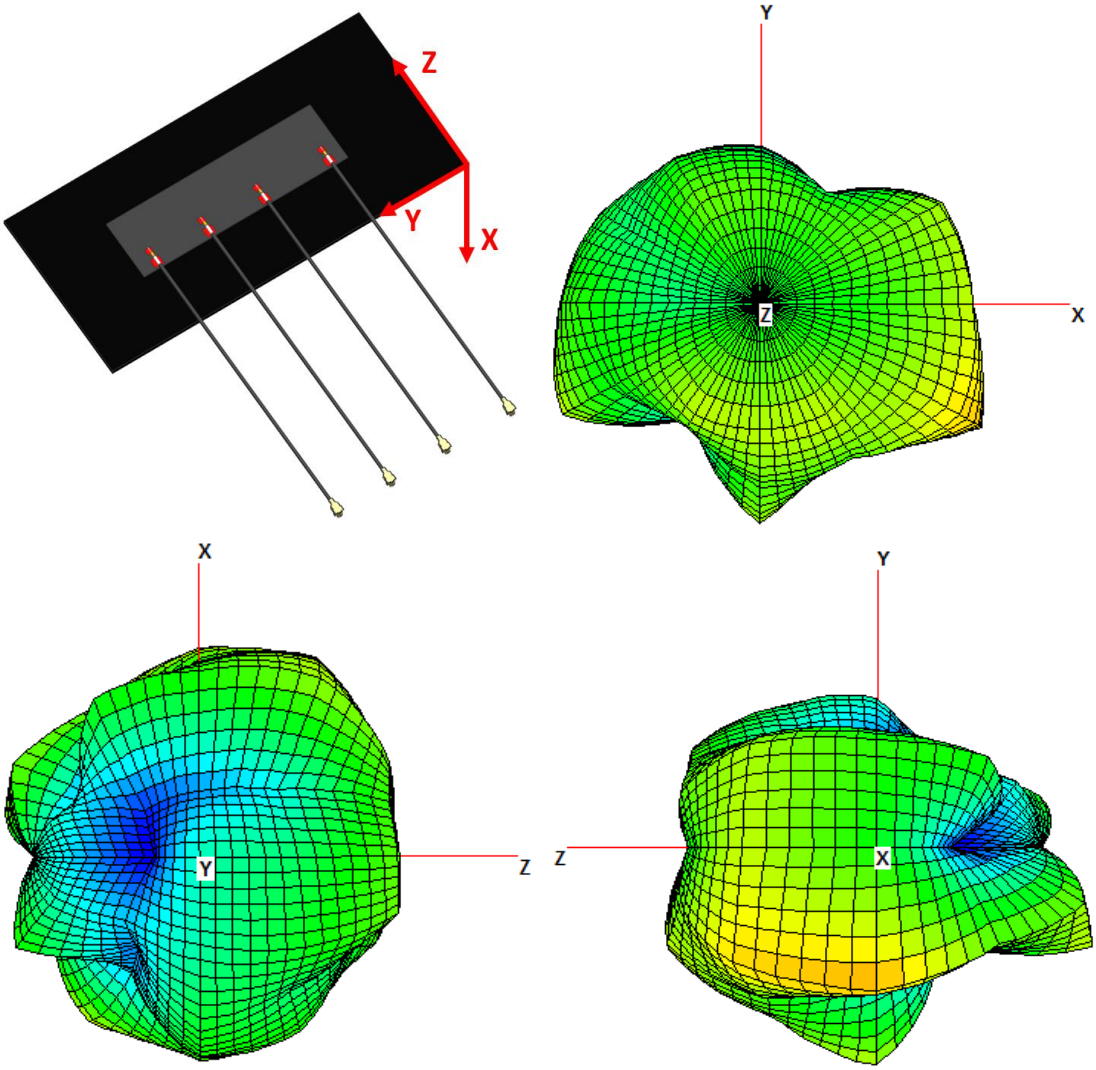


FIGURE 4.6.8 3D RADIATION PATTERN OF ANTENNA PORT 2 AT 7125MHZ IN FREE SPACE

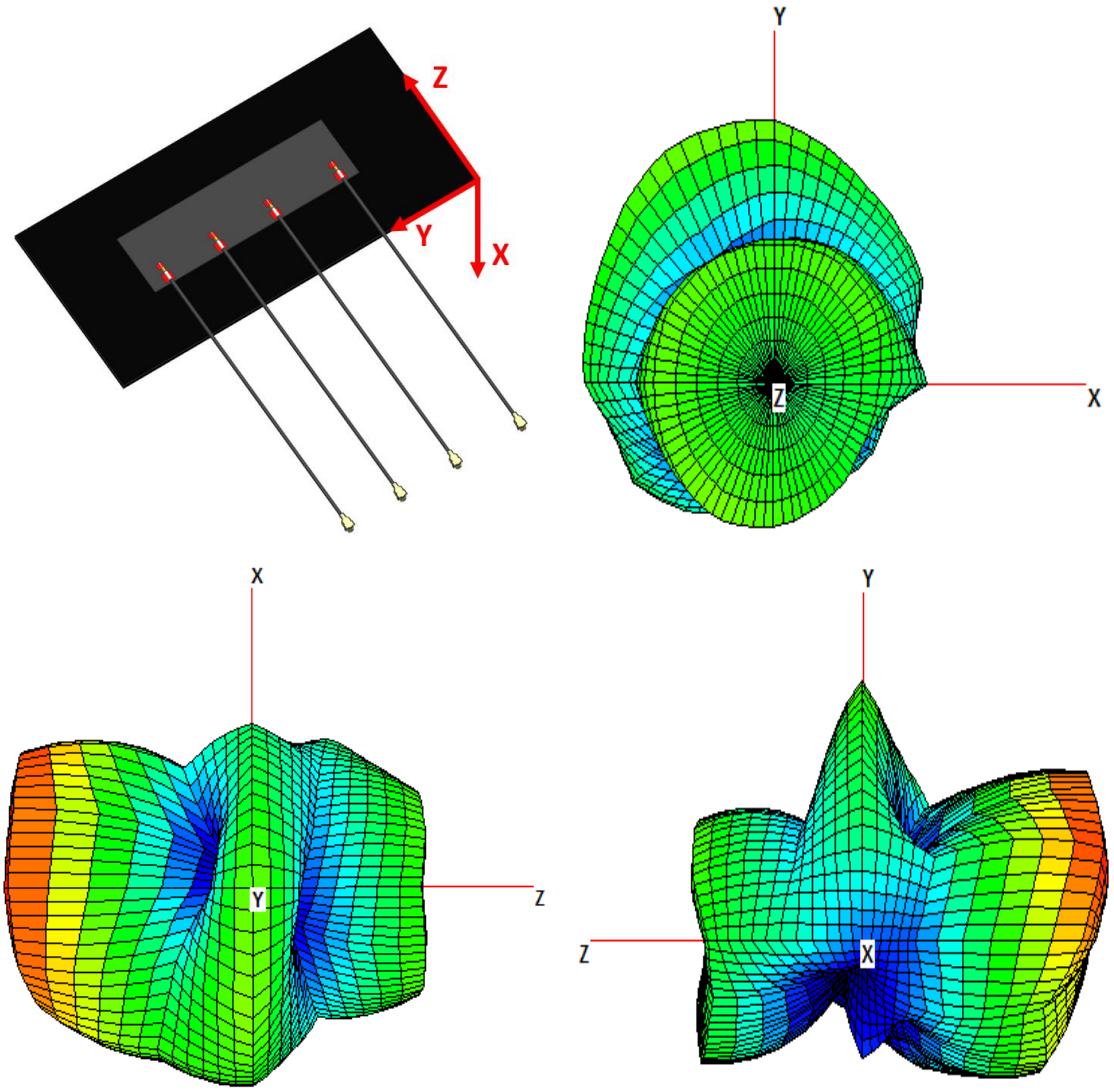


FIGURE 4.6.9 3D RADIATION PATTERN OF ANTENNA PORT 3 AT 2450MHZ IN FREE SPACE

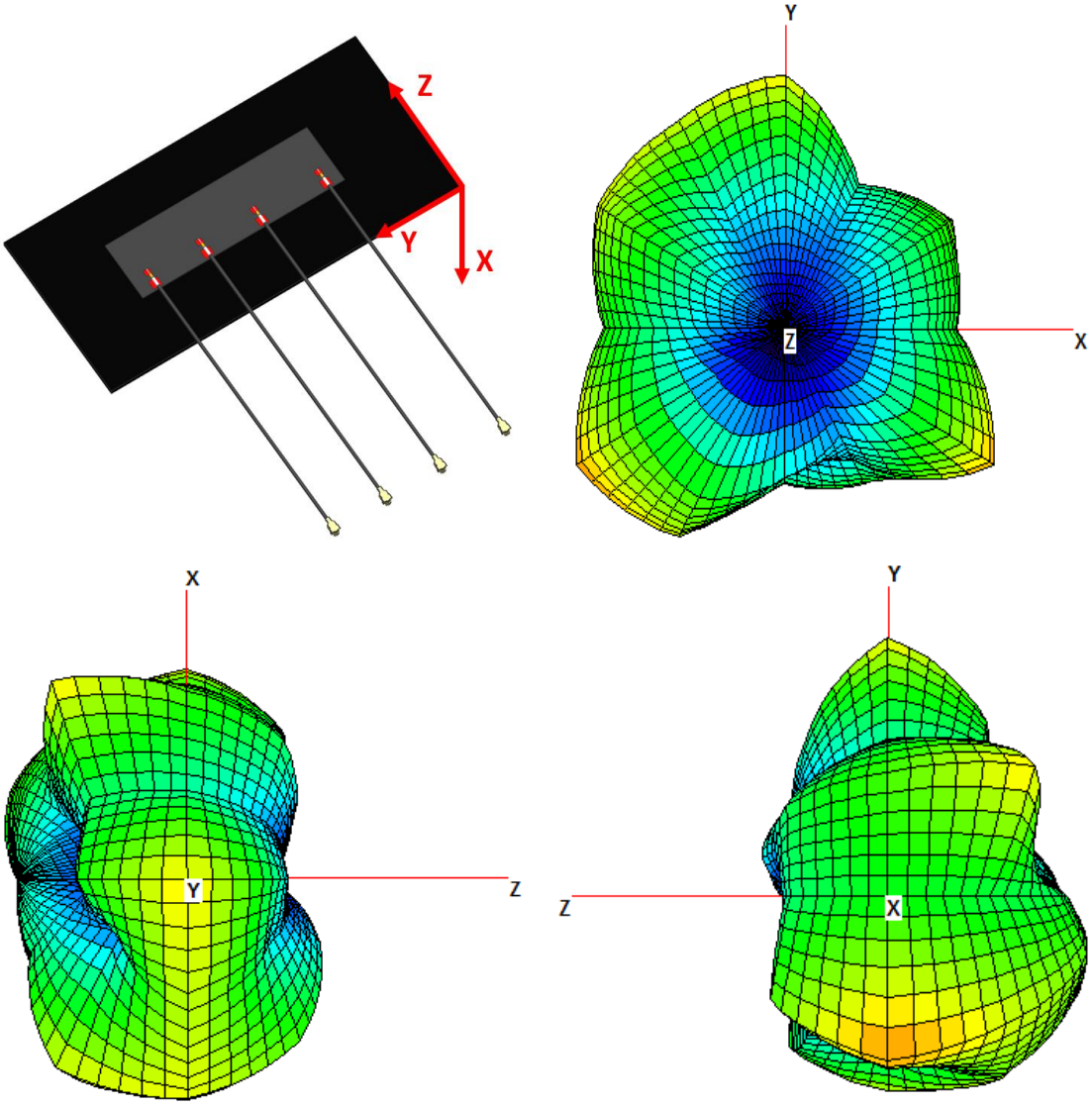


FIGURE 4.6.10 3D RADIATION PATTERN OF ANTENNA PORT 3 AT 5500MHZ IN FREE SPACE

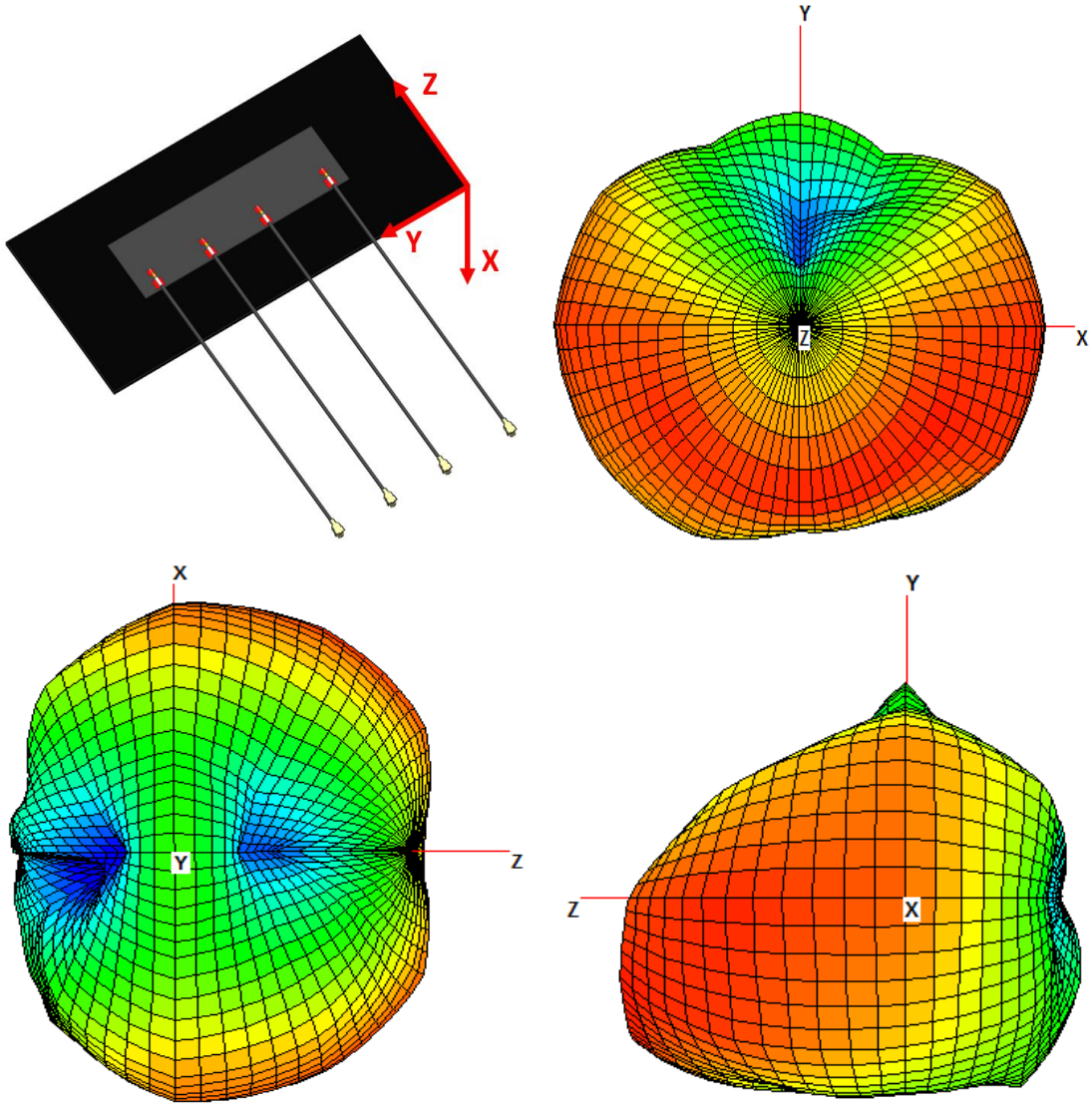


FIGURE 4.6.11 3D RADIATION PATTERN OF ANTENNA PORT 3 AT 6000MHZ IN FREE SPACE

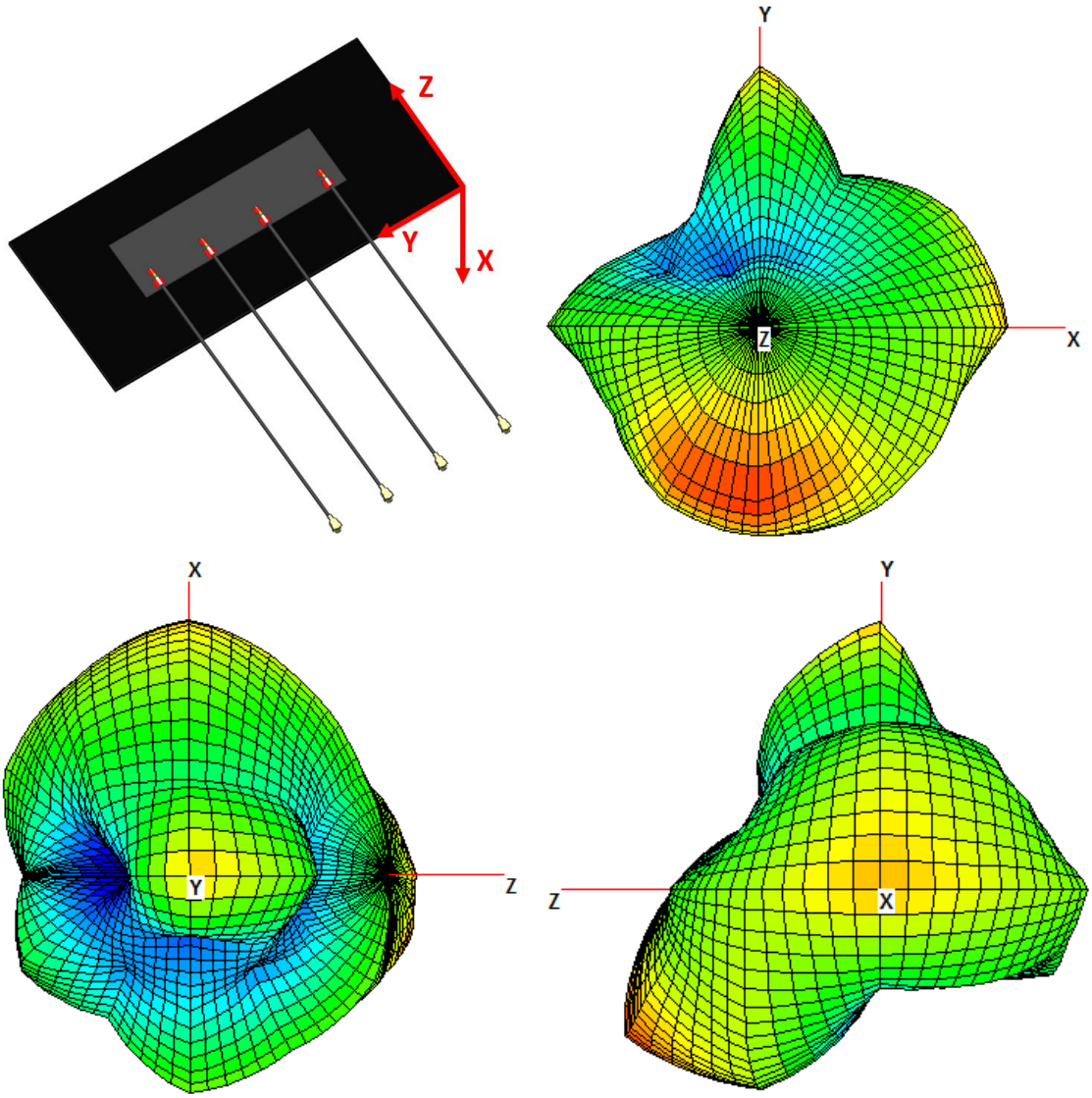


FIGURE 4.6.12 3D RADIATION PATTERN OF ANTENNA PORT 3 AT 7125MHZ IN FREE SPACE

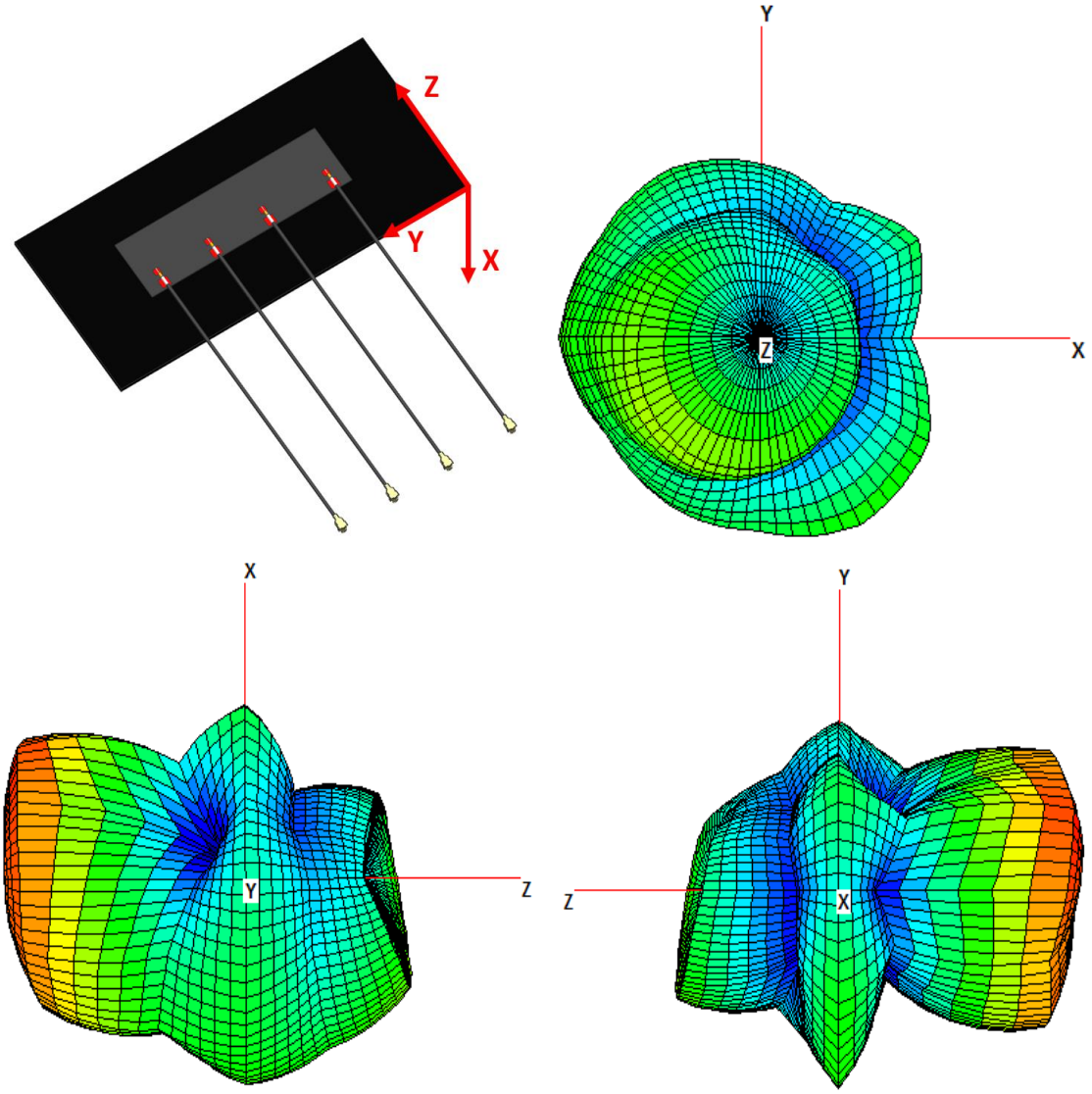


FIGURE 4.6.13 3D RADIATION PATTERN OF ANTENNA PORT 4 AT 2450MHZ IN FREE SPACE

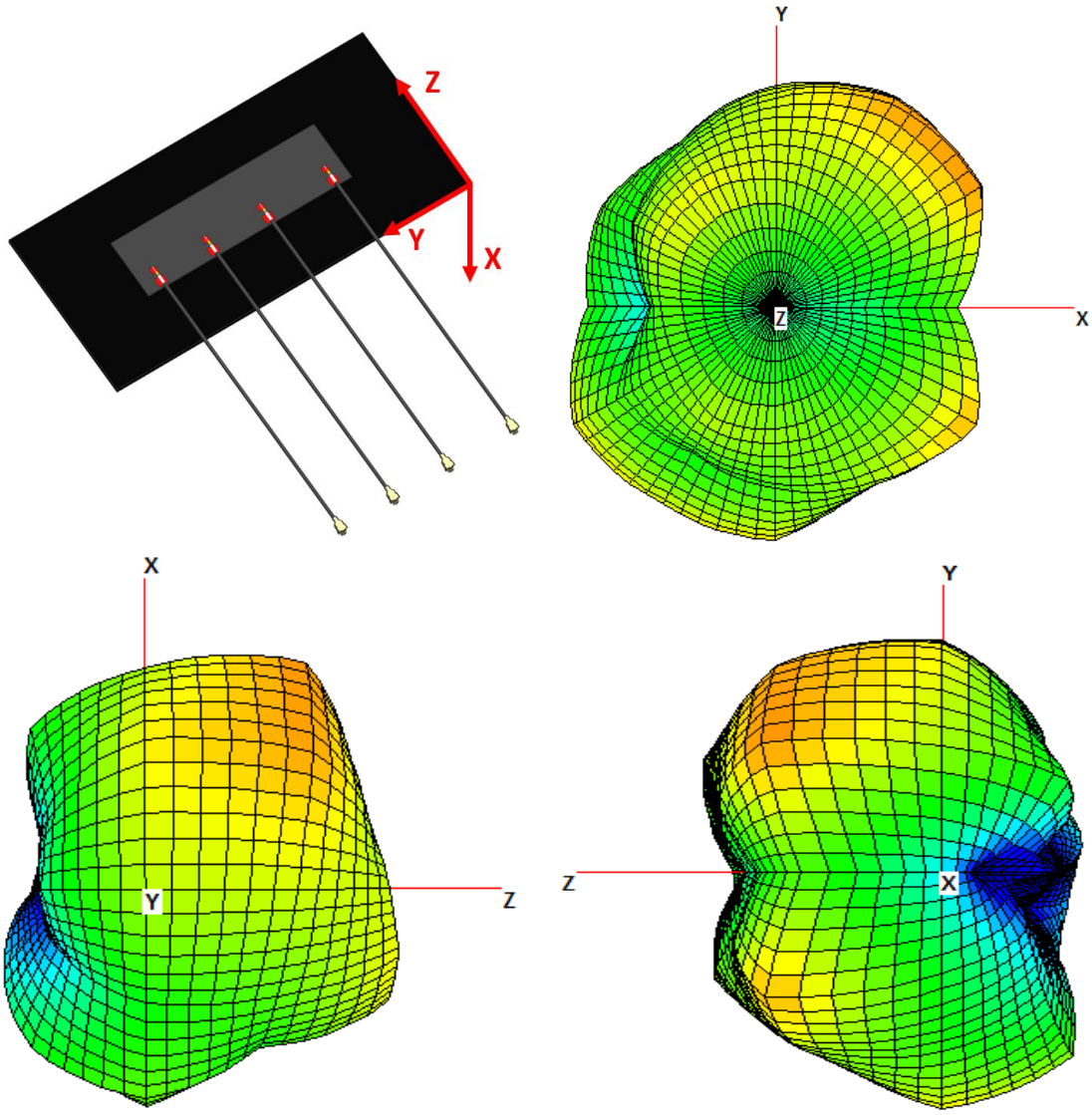


FIGURE 4.6.14 3D RADIATION PATTERN OF ANTENNA PORT 4 AT 5500MHZ IN FREE SPACE

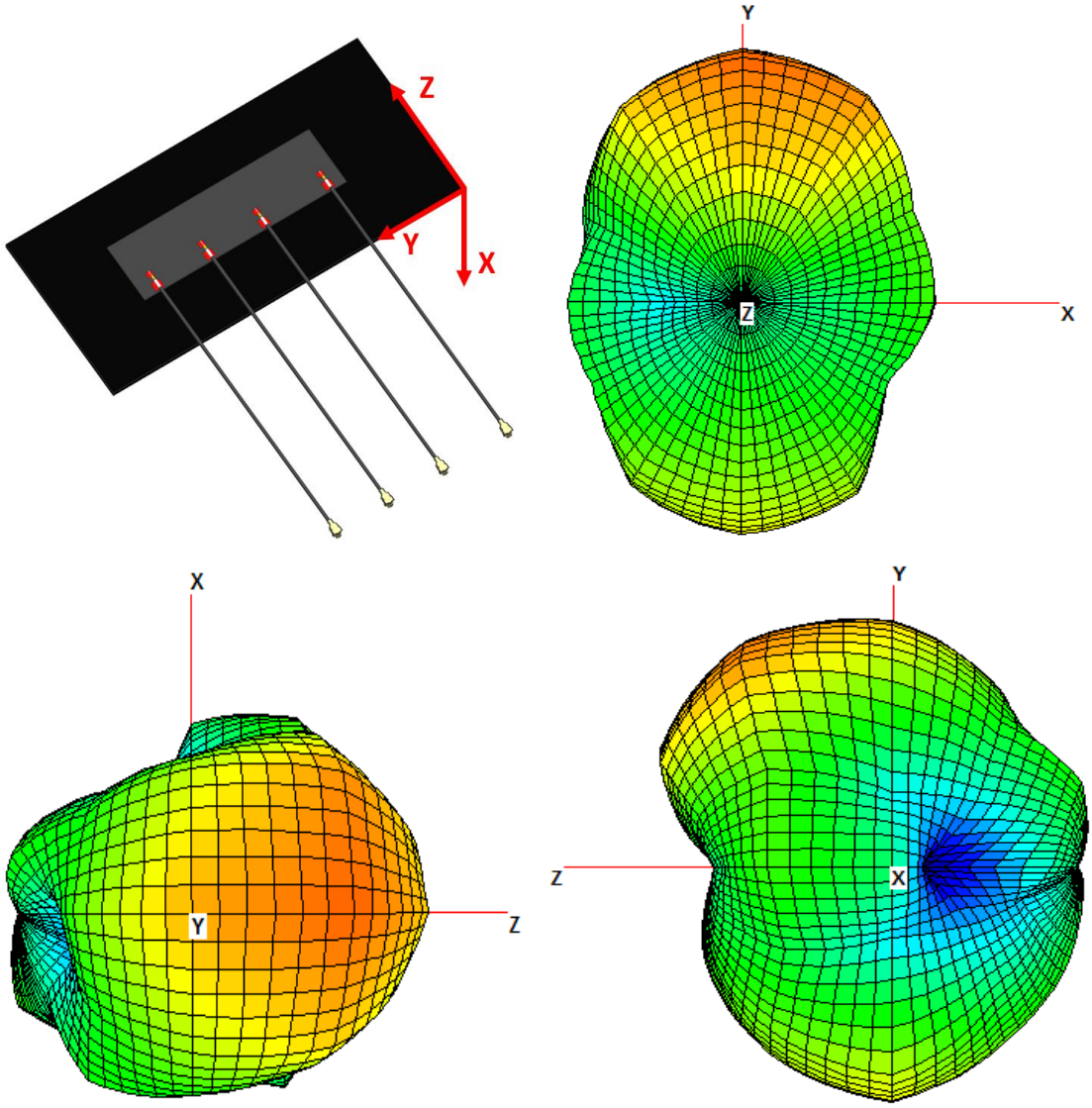


FIGURE 4.6.15 3D RADIATION PATTERN OF ANTENNA PORT 4 AT 6000MHZ IN FREE SPACE

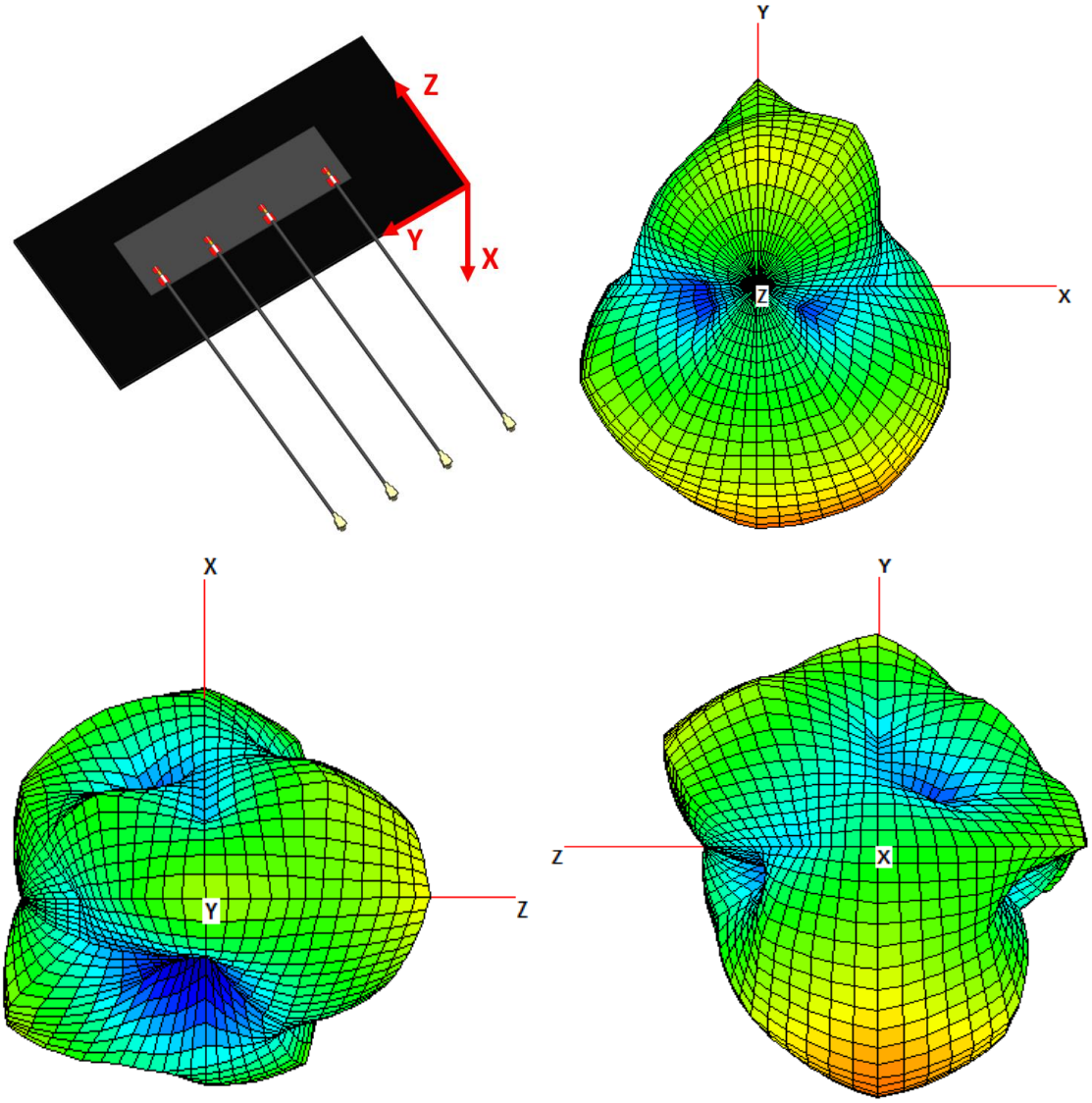
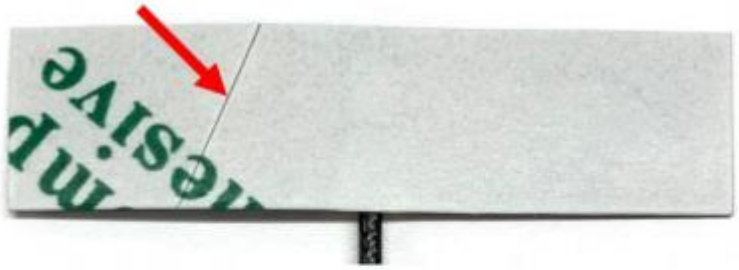


FIGURE 4.6.16 3D RADIATION PATTERN OF ANTENNA PORT 4 AT 7125MHZ IN FREE SPACE

5.0 ASSEMBLY GUIDELINE

The flex antenna comes with an adhesive 3m9077 for assemble onto the plastic wall of the system. The surface should be smooth with ra<1.6um and need to clean the surface before sticking this product. The antenna cannot be placed on a metallic surface.

5.1 HOW TO TEAR FLEX RELEASE PAPER



1. Find cut line on flex back side

2. Bend flex slight along cut line

3. Tear release paper

5.2 CABLE BENDING

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 5.2.1. If the cable crosses into the antenna flex, the antenna performance will be degraded.

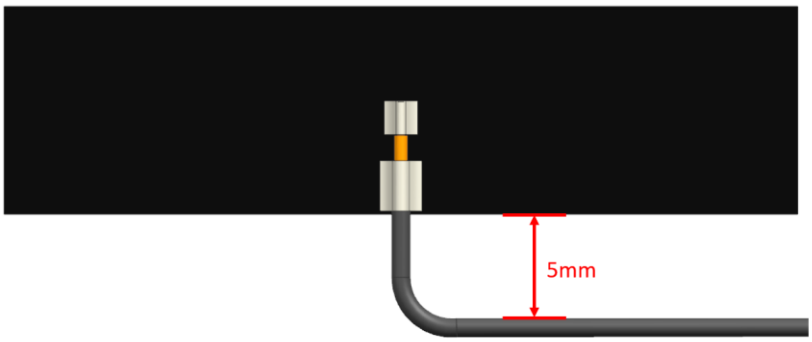


FIGURE 5.2.1 CABLE BENDING

6.0 PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

6.1 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 6.1.0. The plane ground size is 90mm*90mm and we move the plane ground to four locations for each test. The antenna performance is better with larger distance between antenna and parallel plane ground at high band. The minimum distance between antenna and plane ground is recommended to be 10mm to achieve acceptable RF performance.

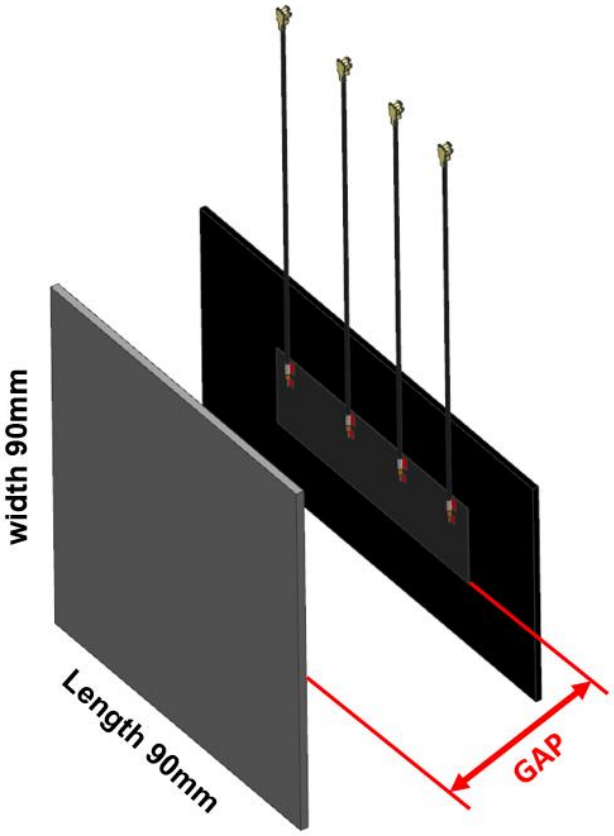


FIGURE 6.1.0 FOUR LOCATIONS WITH PARALLEL PLANE GROUND

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.

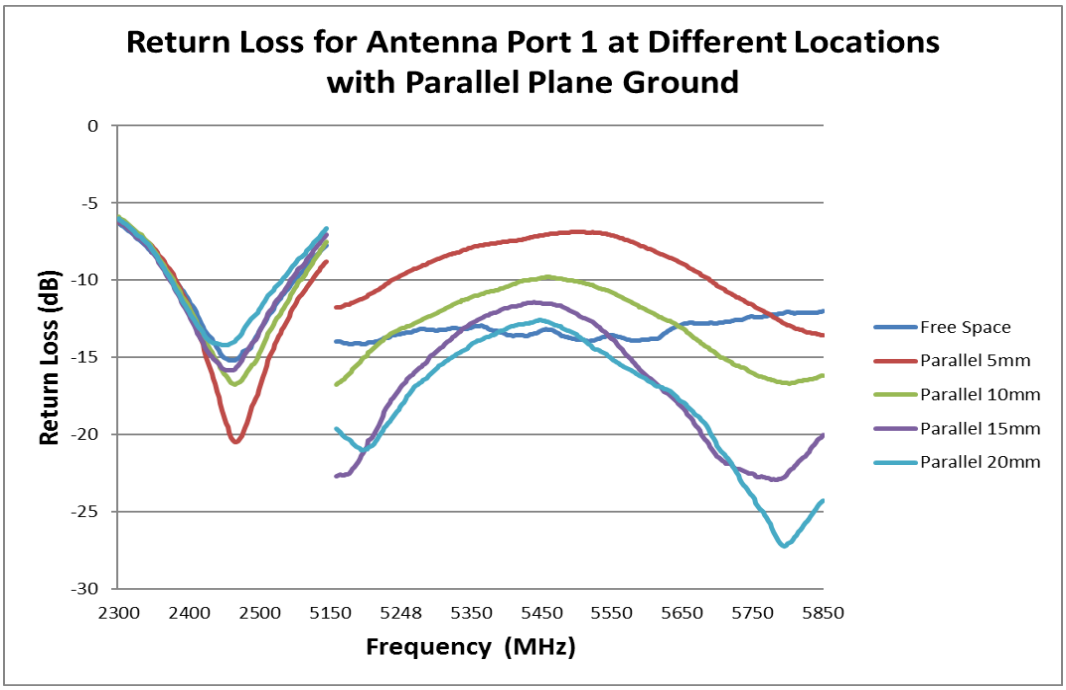


FIGURE 6.1.1 RETURN LOSS OF ANTENNA PORT 1 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

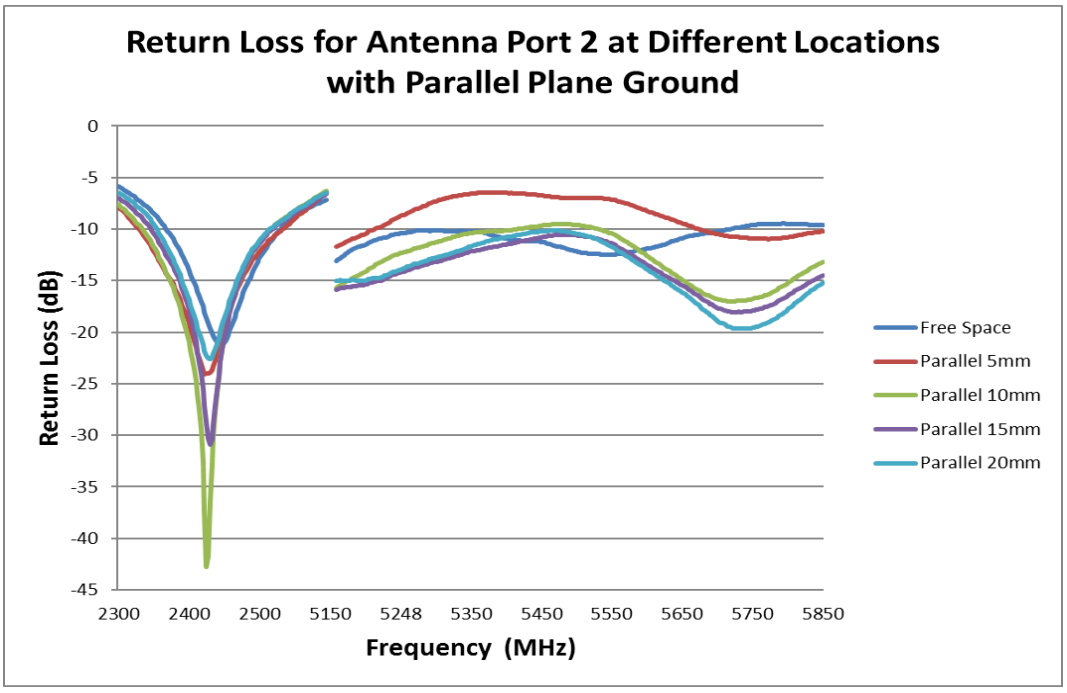


FIGURE 6.1.2 RETURN LOSS OF ANTENNA PORT 2 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND