TITLE

WIFI 6E FLEX CABLED 2X2 MIMO ANTENNA

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WIFI 6E FLEX CABLED 2X2 MIMO 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 DESCRIPTION

2.1 PRODUCT NAME AND SERIES NUMBER (S)

Product name: WiFi 6E Flex Cabled 2x2 MIMO Antenna

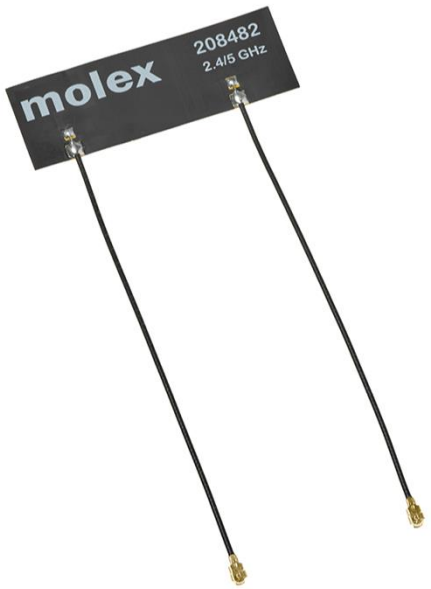
Series Number: 208482

2.2 DESCRIPTION

Series 208482 is one monopole(Port 1) and one dipole(Port 2) type, and low profile flexible antenna for 2.4/5/6Hz band applications, including WiFi 6E, Bluetooth and Zigbee.It's made from Poly-flexible material, has a size form 55.20mm x 19.20mm x 0.16mm and has double-sided TESA adhesive for "peel and stick" easy mounting.

2.3 PRODUCT STRUCTURE INFORMATION

Please refer to PS-2084820100 for full information.



PRODUCT PHOTOGRAPH

3.0 APPLICABLE DOCUMENTS

DOCUMENT	NUMBER	DESCRIPTION
Sale Drawing (SD)	SD-2084820100	Mechanical Dimension of the product
Product Specification (PS)	PS-2084820100	Product Specification
Packing Drawing (PK)	PK-2084820100	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. 2084820100 with a cable length of 100mm.

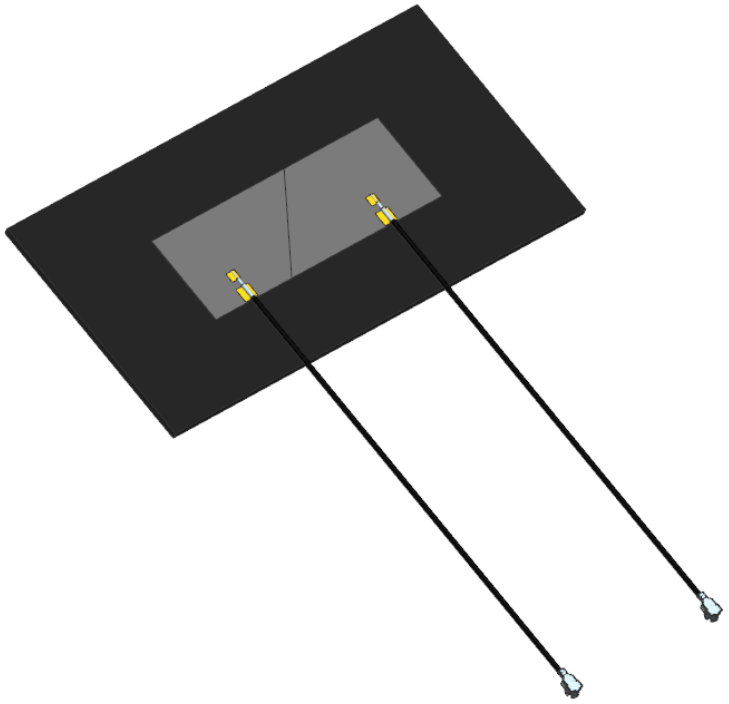


FIGURE4.1.1 ANTENNA LOADED WITH PC/ABS BLOCK OF 1.5MM THICKNESS

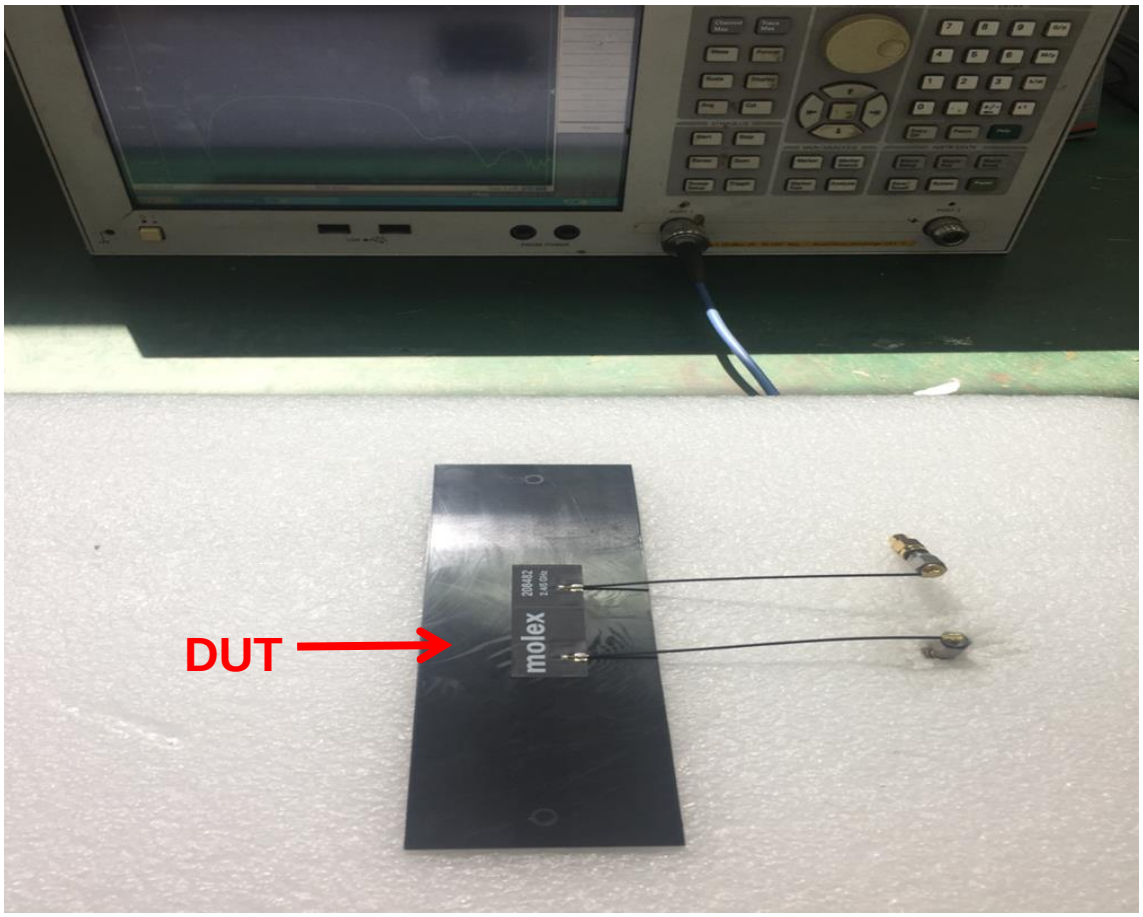


FIGURE4.1.2 ANTENNA LOADED WITH PC/ABS BLOCK OF 1.5MM THICKNESS TESTED WITH VNA E5071C

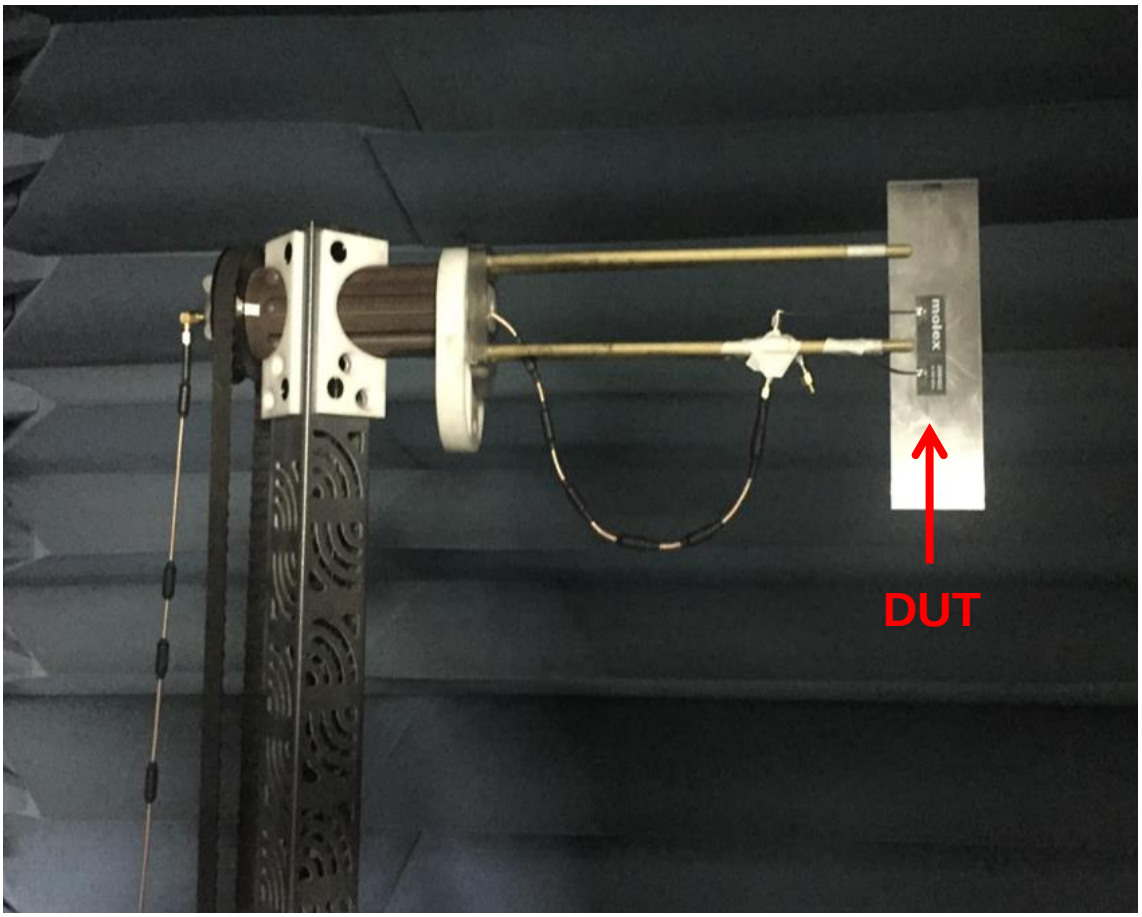


FIGURE4.1.3 ANTENNA LOADED WITH PC/ABS BLOCK OF 1.5MM THICKNESS TESTED IN OTA CHAMBER

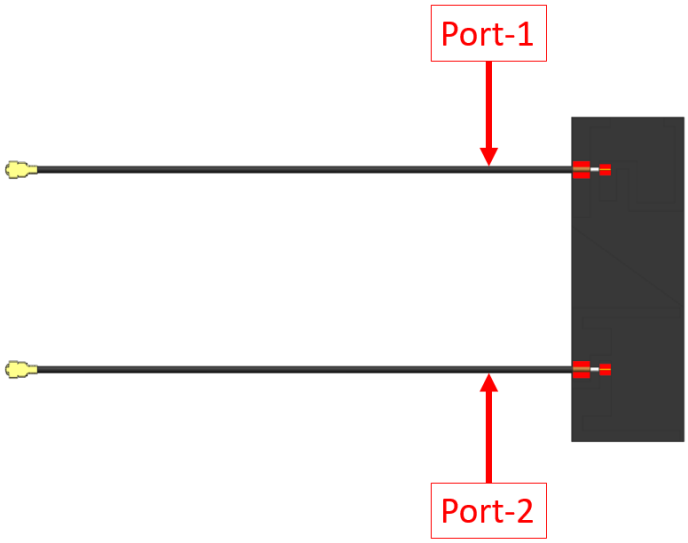


FIGURE4.1.4 ANTENNA TESTED EQUIPMENT

4.2 ANTENNA PERFORMANCE

Description	Equipment	Requirement Port 1		
Frequency Range	VNA E5071C	2.4-2.5GHz	5.15-5.85GHz	5.925-7.125GHz
Return Loss	VNA E5071C	<-8dB	<-13dB	<-8dB
Peak Gain (Max)	OTA Chamber	2.9 dBi	5.0 dBi	4.4 dBi
Average Total Efficiency	OTA Chamber	>65%	>75%	>65%
Polarization	OTA Chamber	Linear		
Input Impedance	VNA E5071C	50 ohms		

Description	Equipment	Requirement Port 2		
Frequency Range	VNA E5071C	2.4-2.5GHz	5.15-5.85GHz	5.925-7.125GHz
Return Loss	VNA E5071C	<-9dB	<-13dB	<-10dB
Peak Gain (Max)	OTA Chamber	3.4 dBi	5.9 dBi	5.1 dBi
Average Total Efficiency	OTA Chamber	>75%	>70%	>65%
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.

4.3 RETURN LOSS PLOT

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

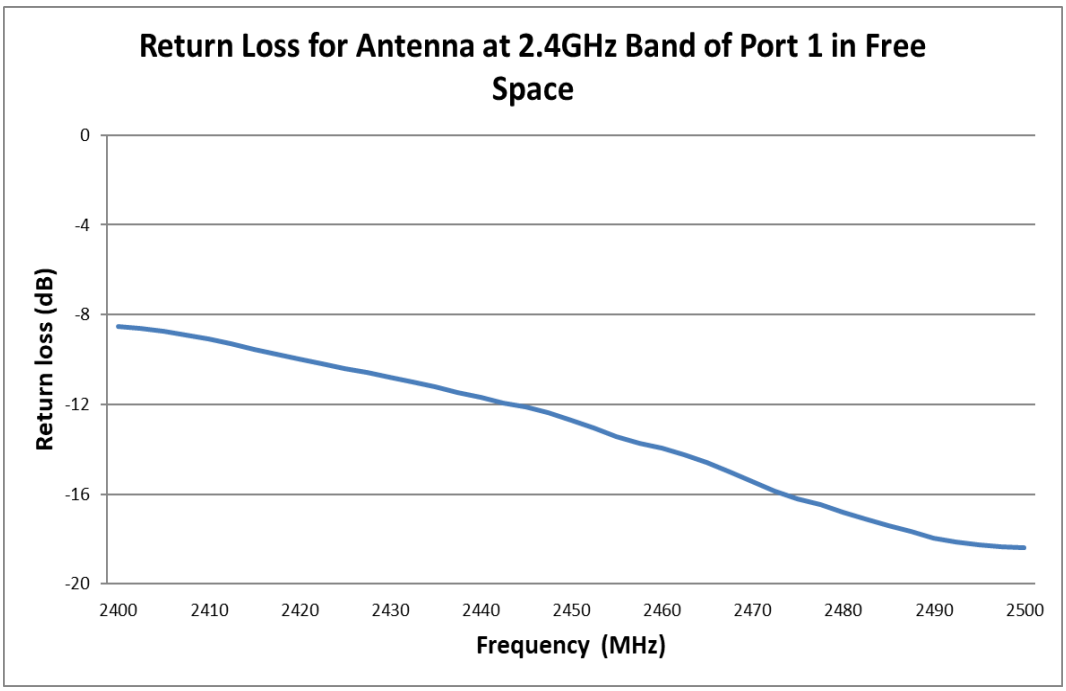


FIGURE 4.3.1 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND OF PORT1 IN FREE SPACE

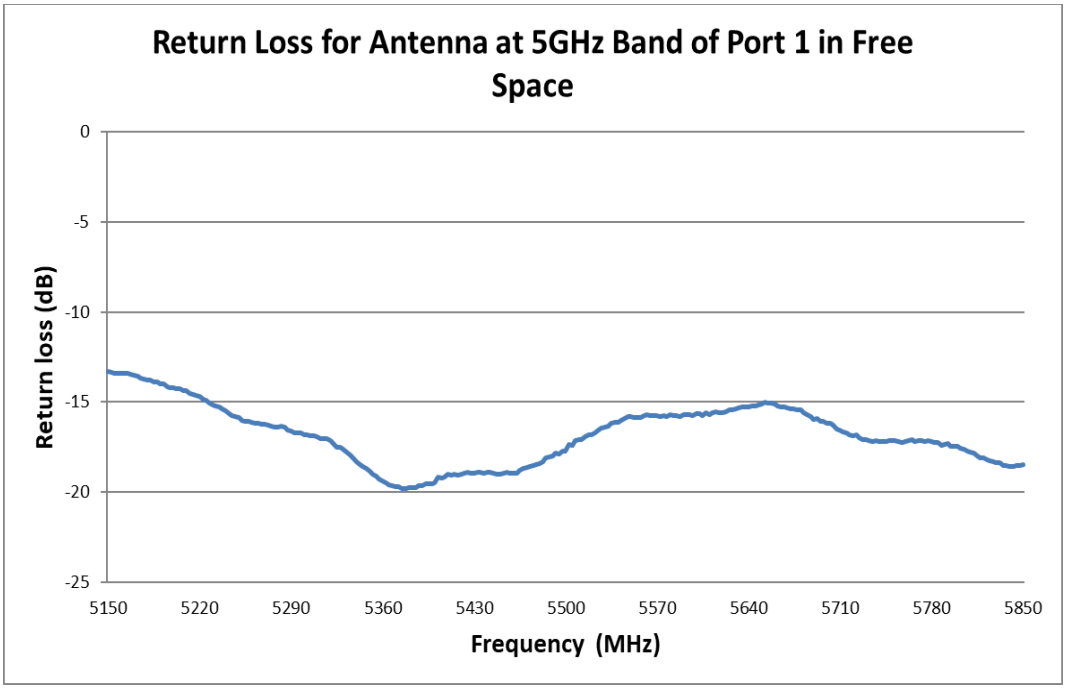


FIGURE 4.3.2 RETURN LOSS OF ANTENNA AT 5GHZ BAND OF PORT1 IN FREE SPACE

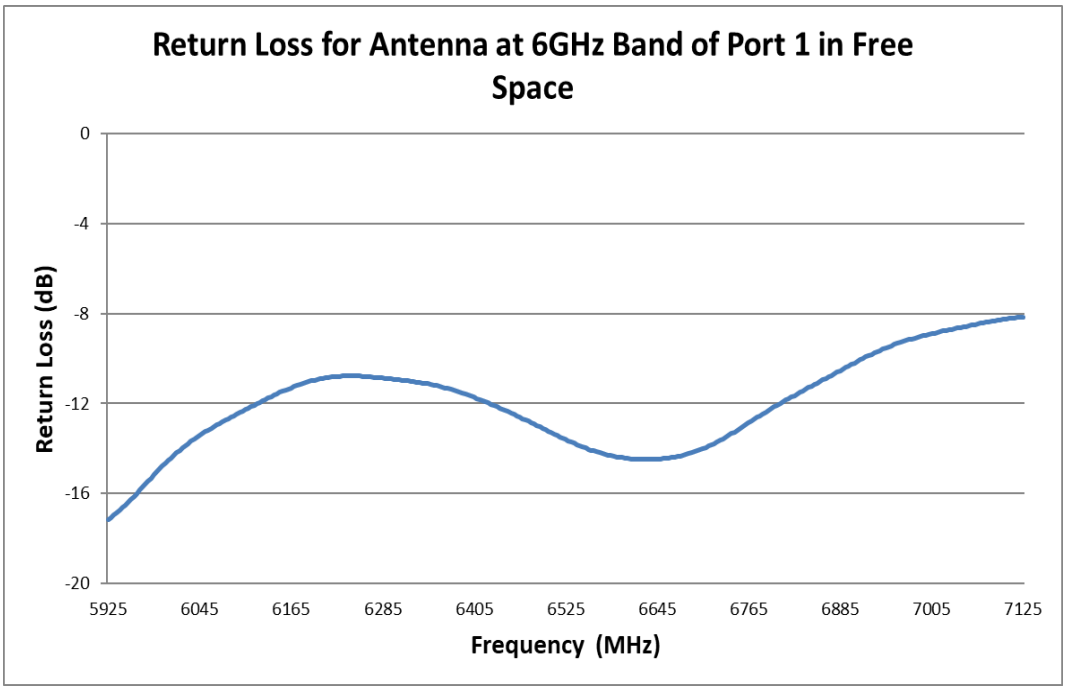


FIGURE 4.3.3 RETURN LOSS OF ANTENNA AT 6GHZ BAND OF PORT1 IN FREE SPACE

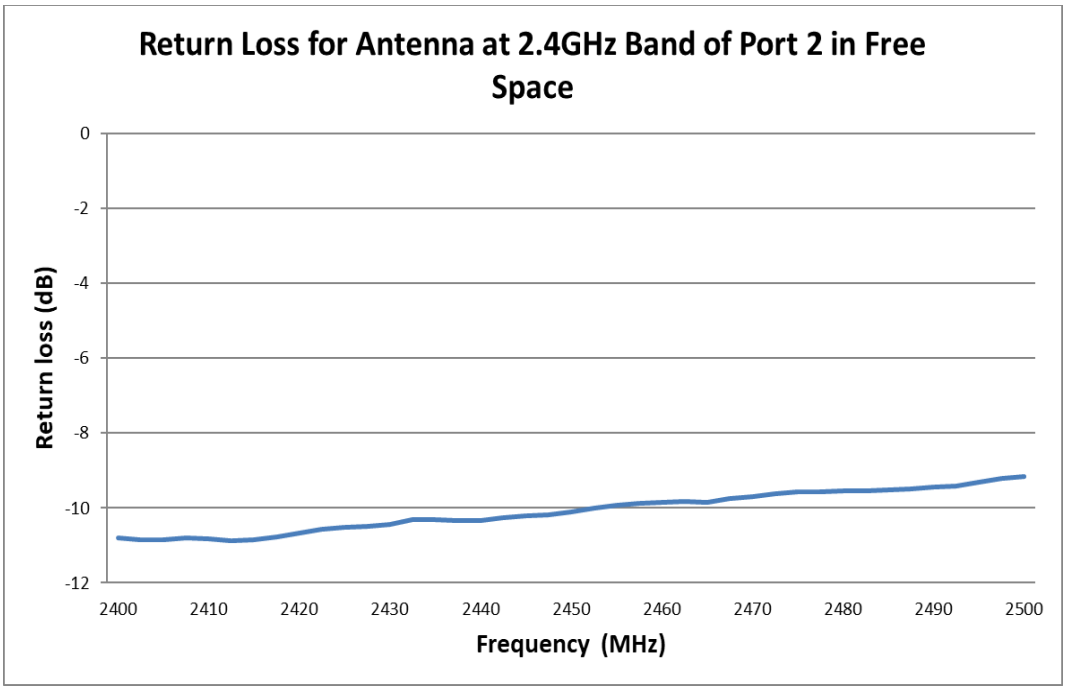


FIGURE 4.3.4 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND OF PORT 2 IN FREE SPACE

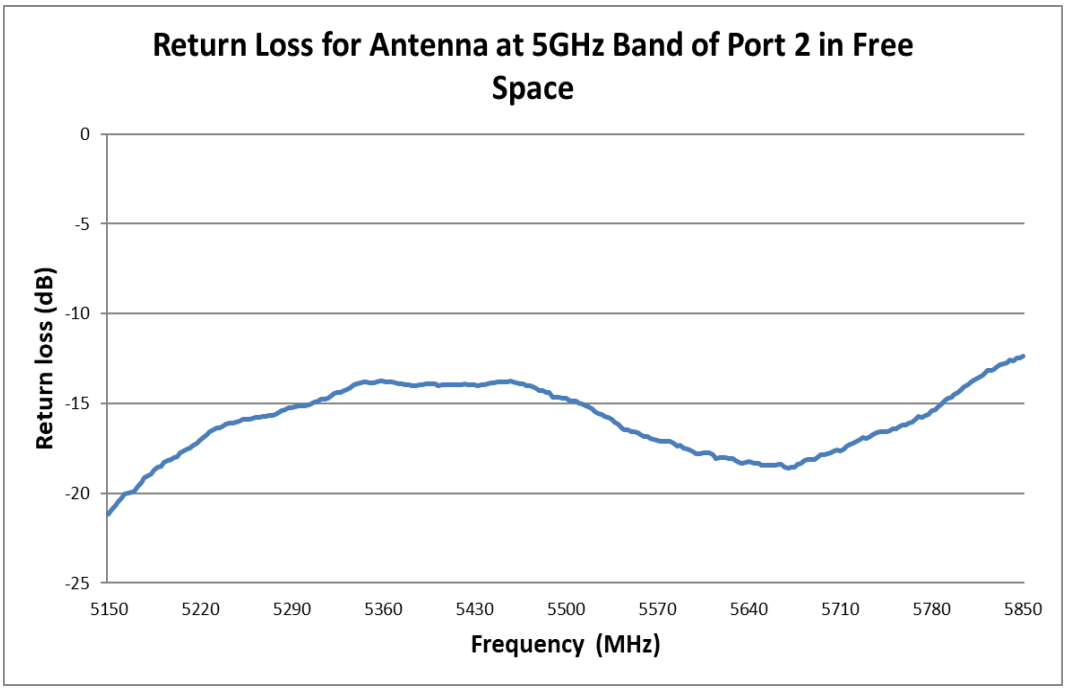


FIGURE 4.3.5 RETURN LOSS OF ANTENNA AT 5GHZ BAND OF PORT 2 IN FREE SPACE

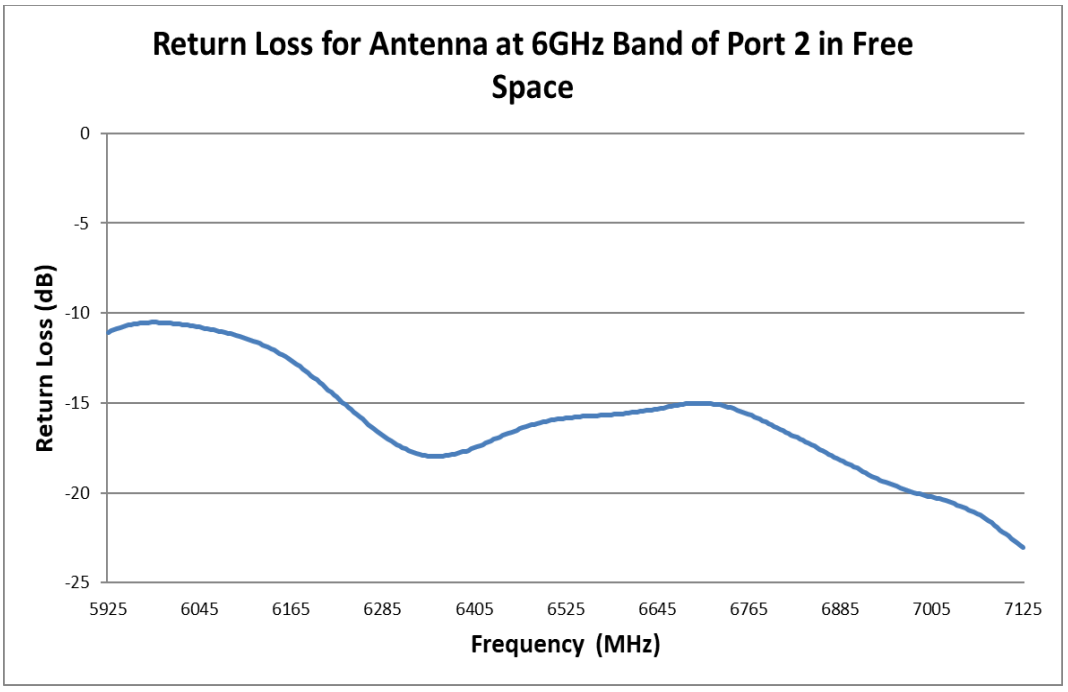


FIGURE 4.3.6 RETURN LOSS OF ANTENNA AT 6GHZ BAND OF PORT 2 IN FREE SPACE

4.4 EFFICIENCY PLOT

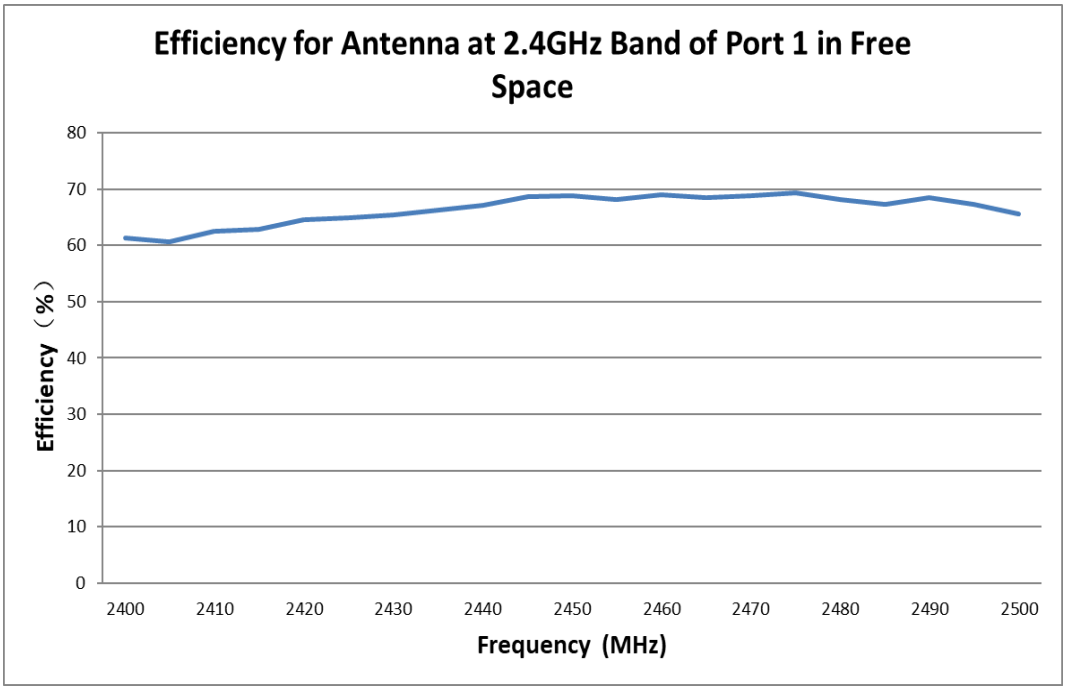


FIGURE 4.4.1 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND OF PORT 1 IN FREE SPACE

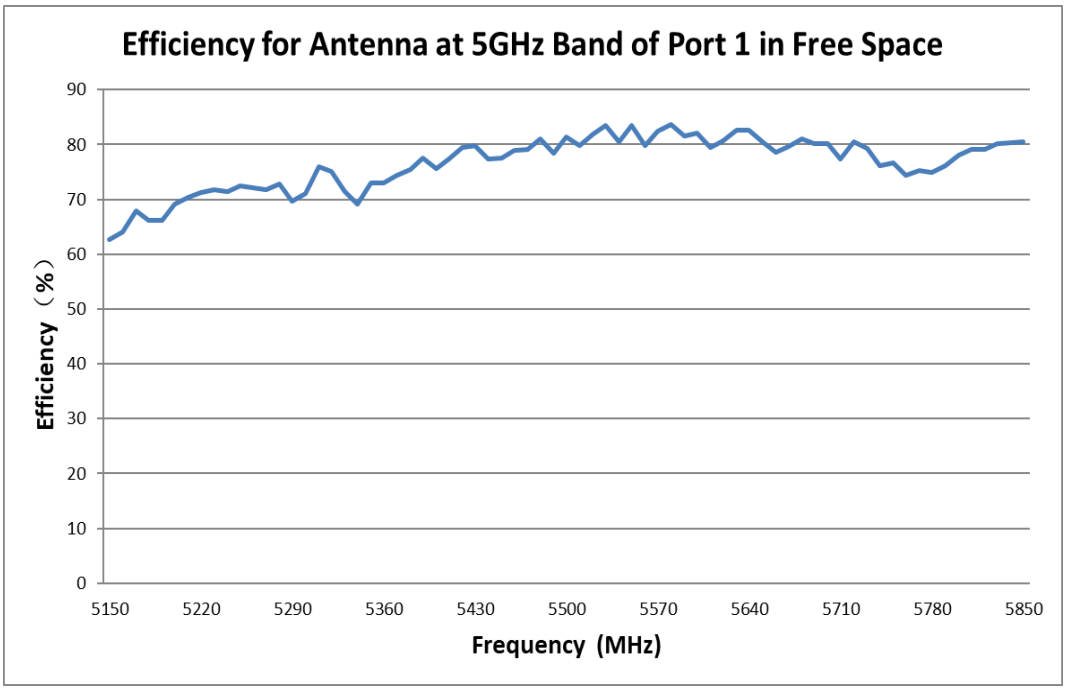


FIGURE 4.4.2 EFFICIENCY OF ANTENNA AT 5GHZ BAND OF PORT 1 IN FREE SPACE

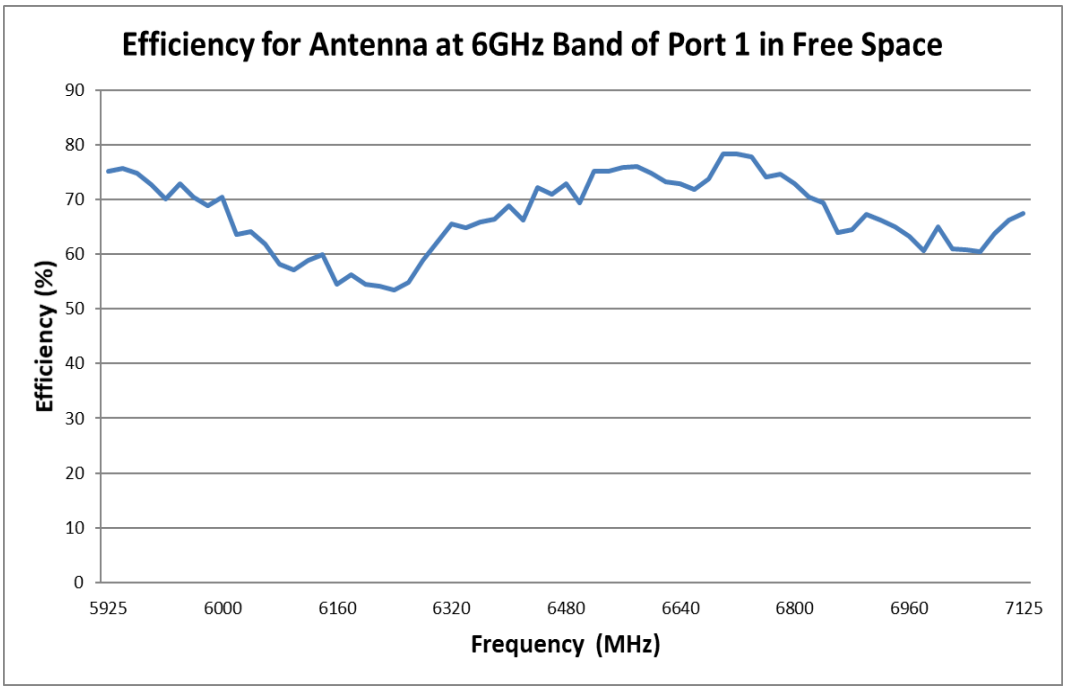


FIGURE 4.4.3 EFFICIENCY OF ANTENNA AT 6GHZ BAND OF PORT 1 IN FREE SPACE

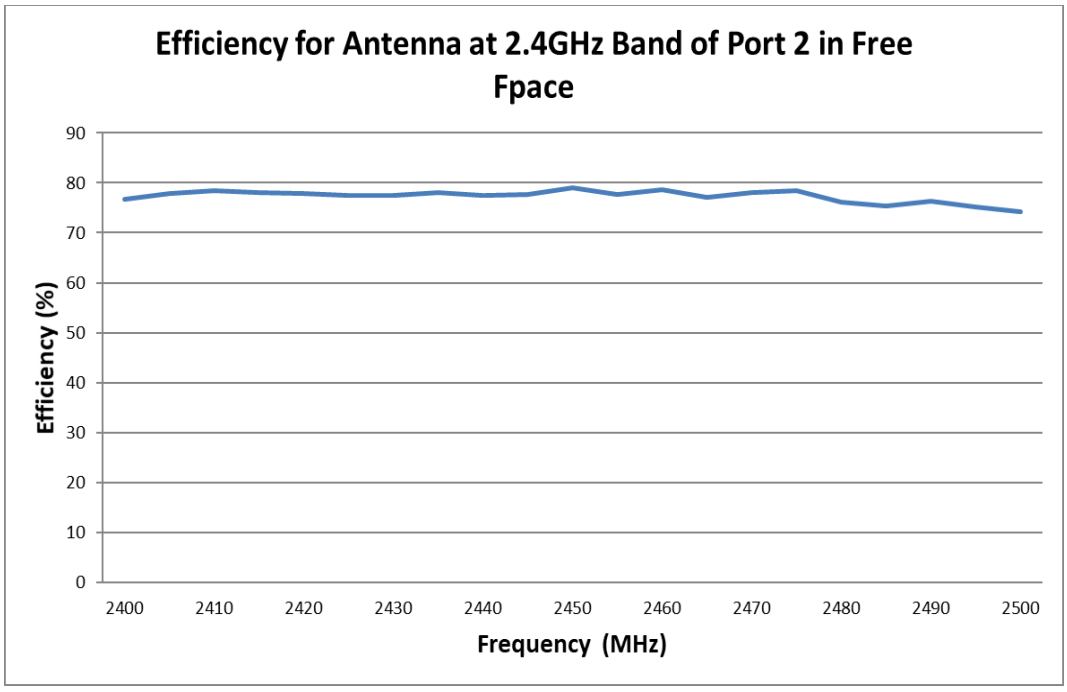


FIGURE 4.4.4 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND OF PORT 2 IN FREE SPACE

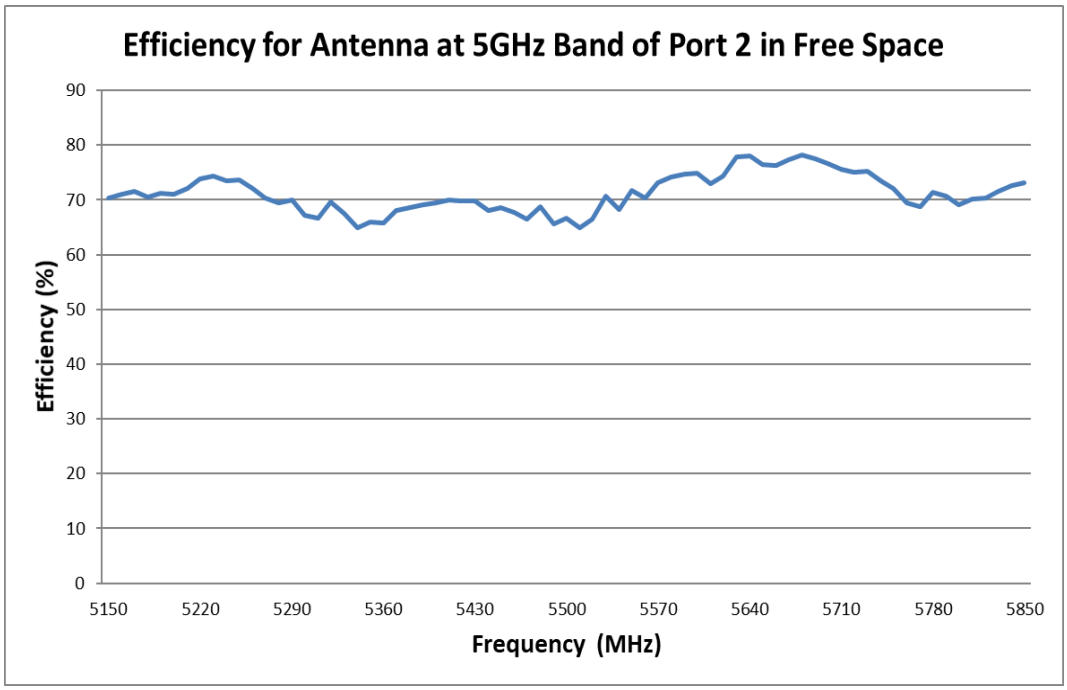


FIGURE 4.4.5 EFFICIENCY OF ANTENNA AT 5GHZ BAND OF PORT 2 IN FREE SPACE

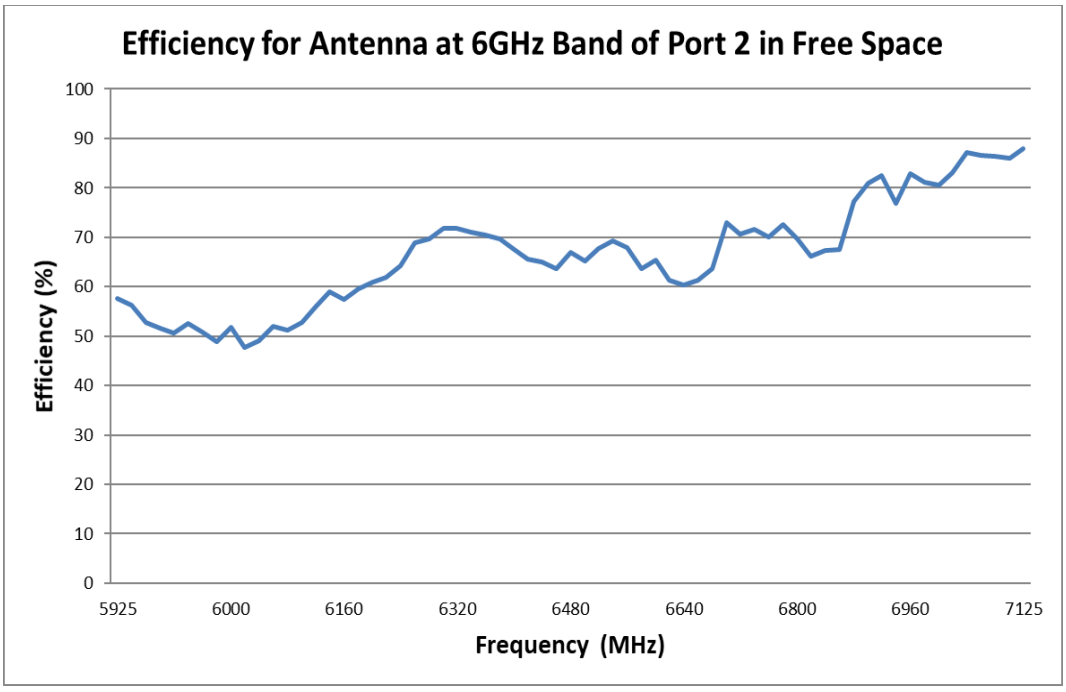


FIGURE 4.4.6 EFFICIENCY OF ANTENNA AT 6GHZ BAND OF PORT 2 IN FREE SPACE

4.5 2D RADIATION PATTERN

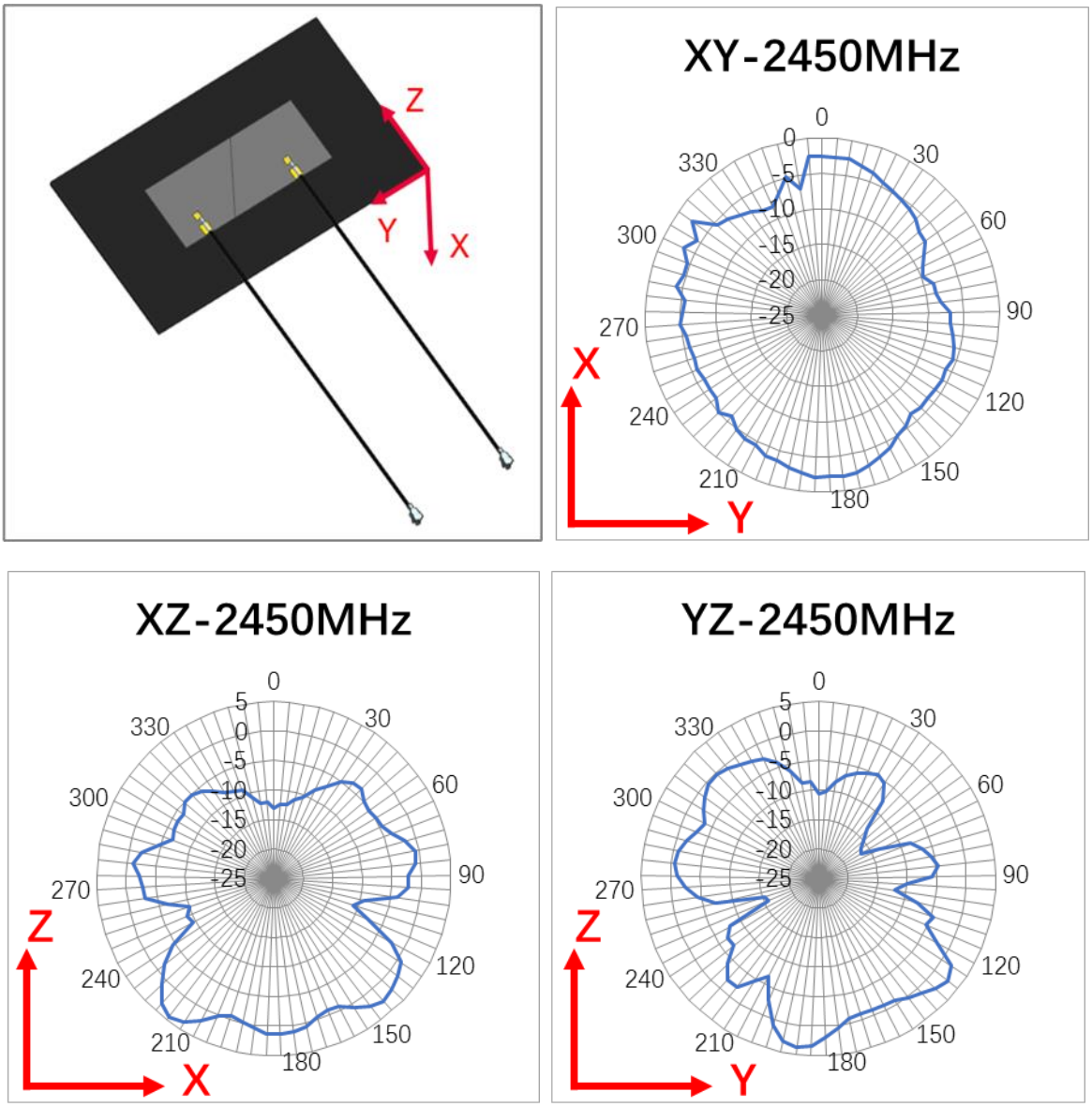


FIGURE 4.5.1 2D RADIATION PATTERN OF ANTENNA AT 2450MHZ BANDOF PORT 1 IN FREE SPACE

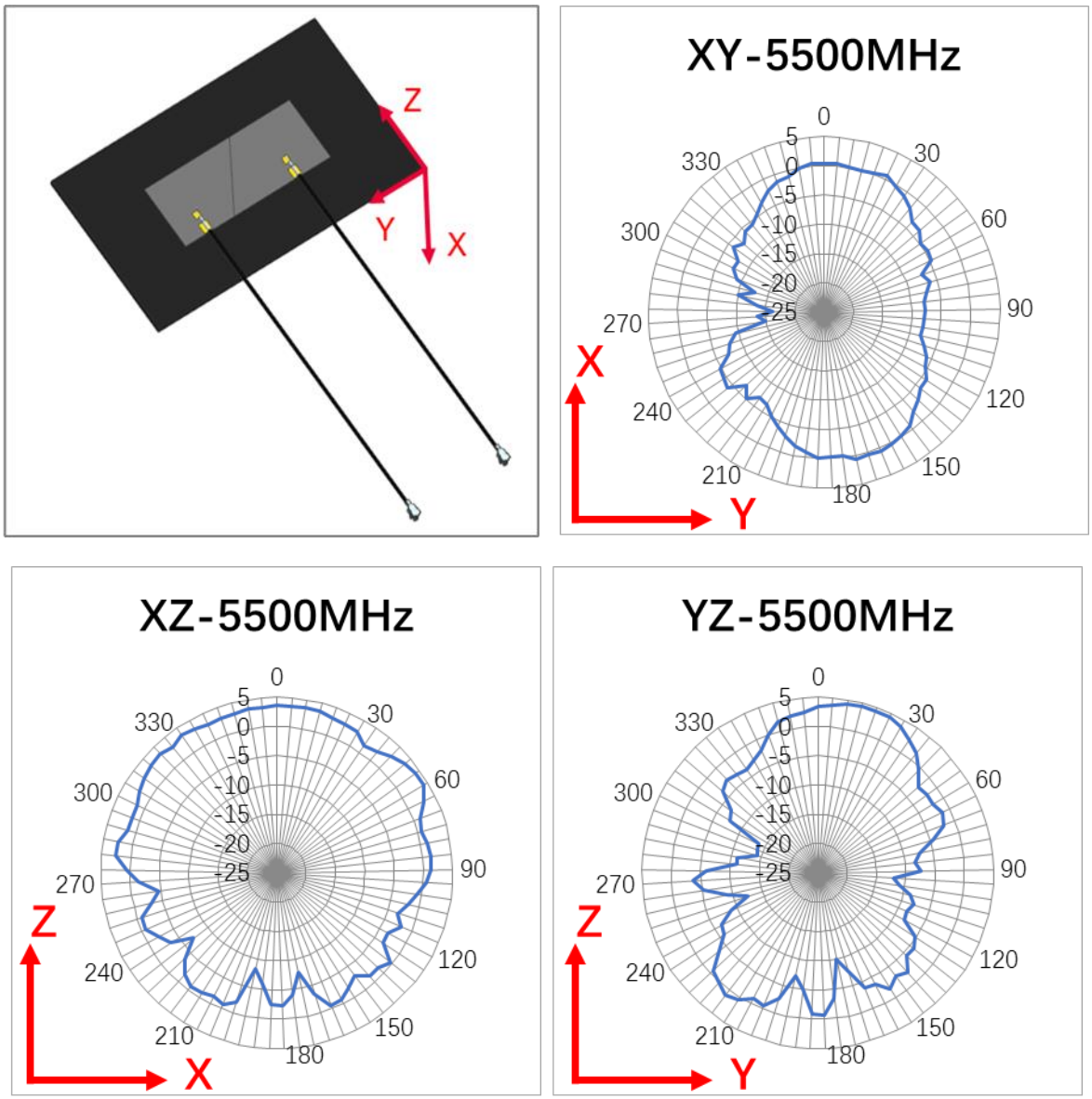


FIGURE 4.5.2 2D RADIATION PATTERN OF ANTENNA AT 5500MHZ BAND OF PORT 1 IN FREE SPACE

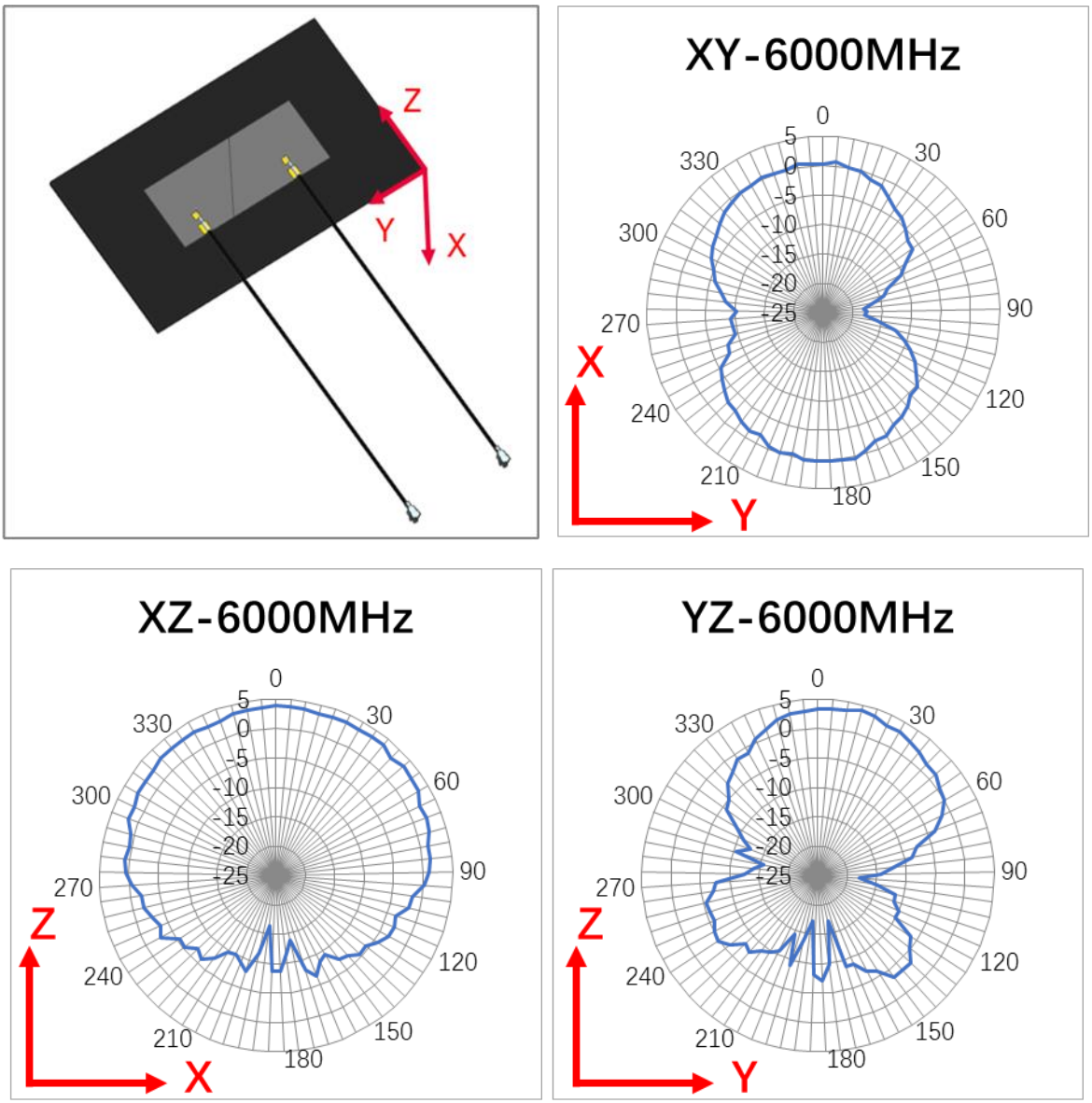


FIGURE 4.5.3 2D RADIATION PATTERN OF ANTENNA AT 6000MHZ BAND OF PORT 1 IN FREE SPACE

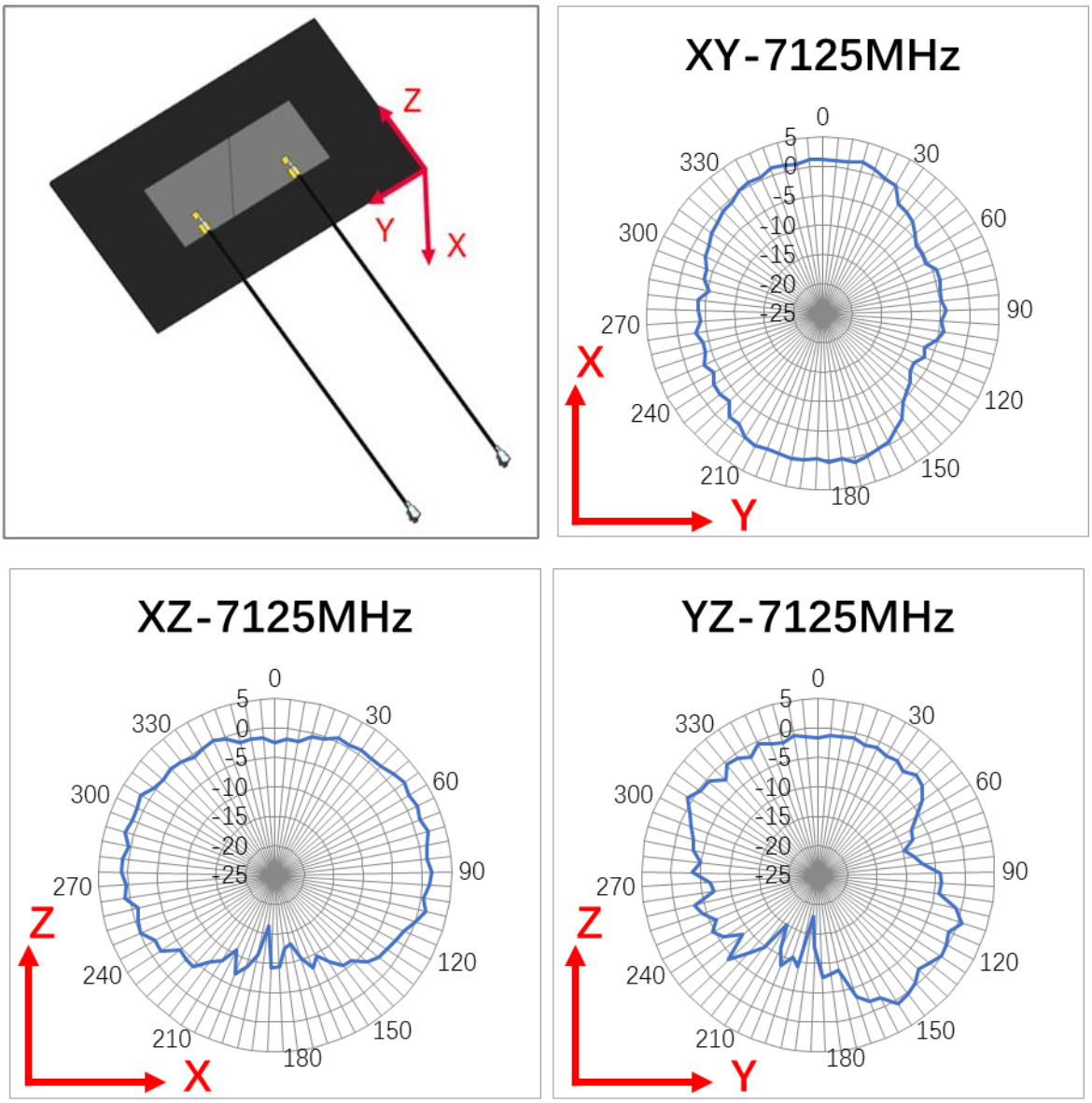


FIGURE 4.5.4 2D RADIATION PATTERN OF ANTENNA AT 7125MHZ BAND OF PORT 1 IN FREE SPACE

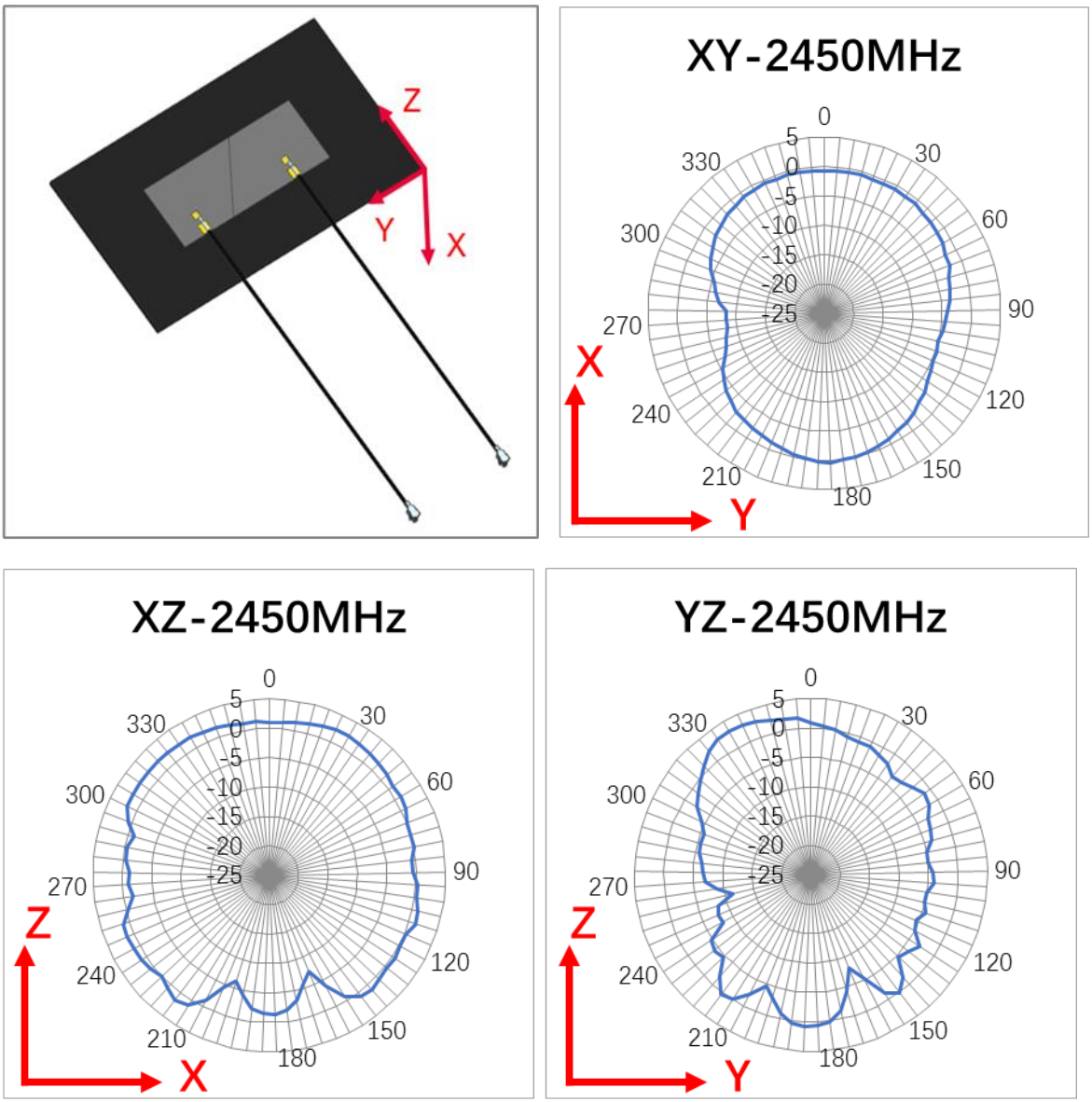


FIGURE 4.5.5 2D RADIATION PATTERN OF ANTENNA AT 2450MHZ BAND OF PORT 2 IN FREE SPACE

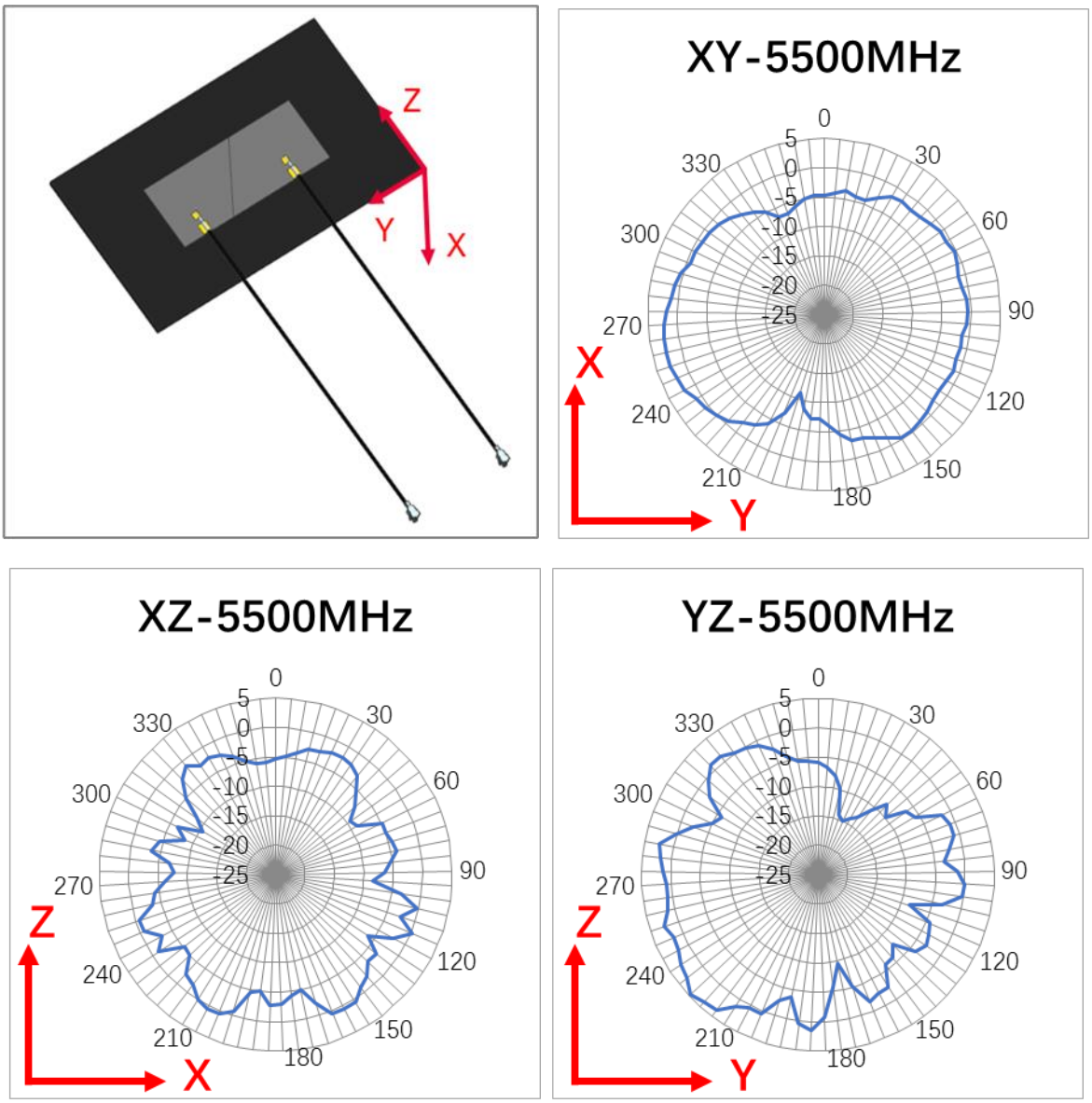


FIGURE 4.5.6 2D RADIATION PATTERN OF ANTENNA AT 5500MHZ BAND OF PORT 2 IN FREE SPACE

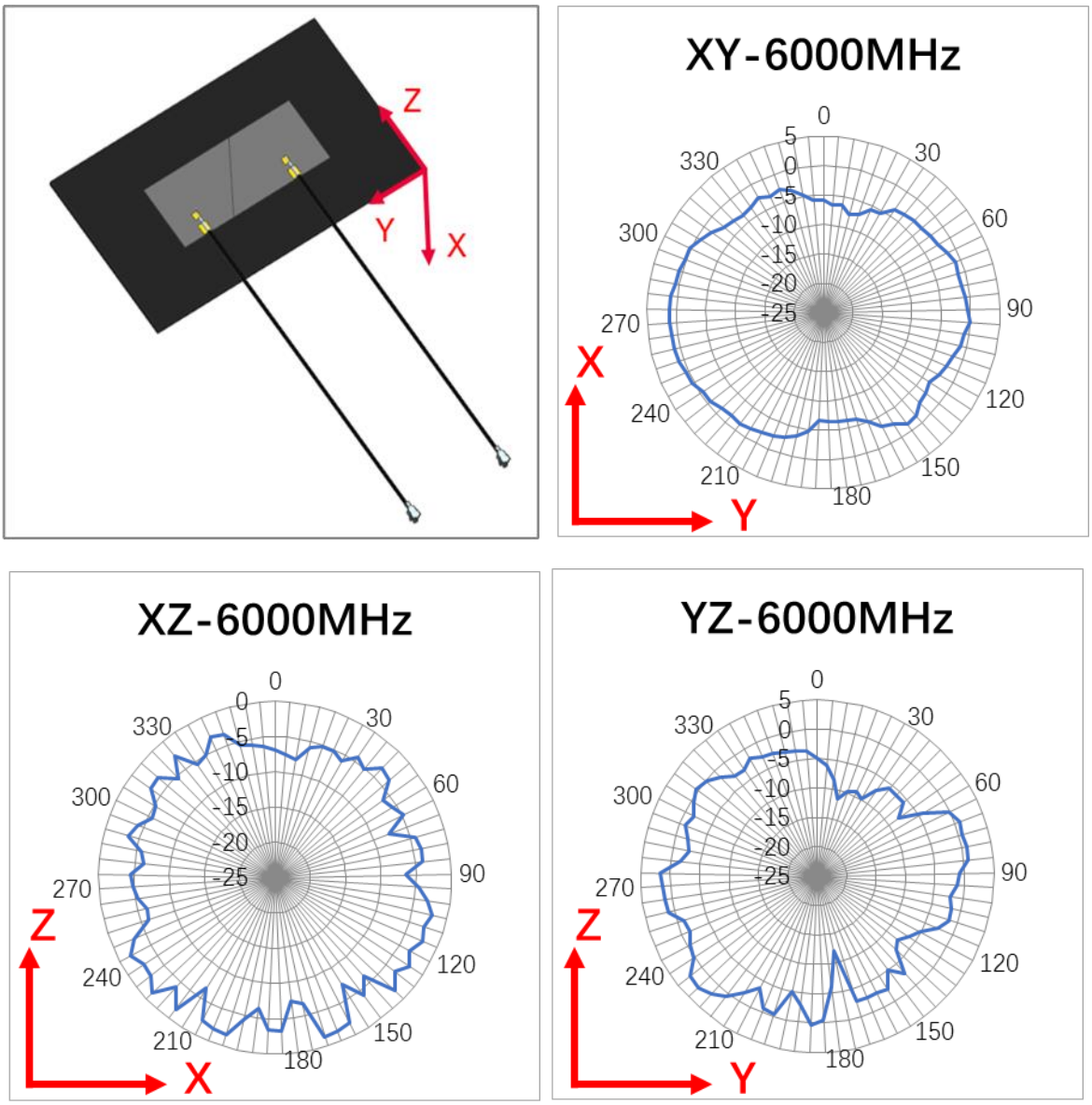


FIGURE 4.5.7 2D RADIATION PATTERN OF ANTENNA AT 6000MHZ BAND OF PORT 2 IN FREE SPACE

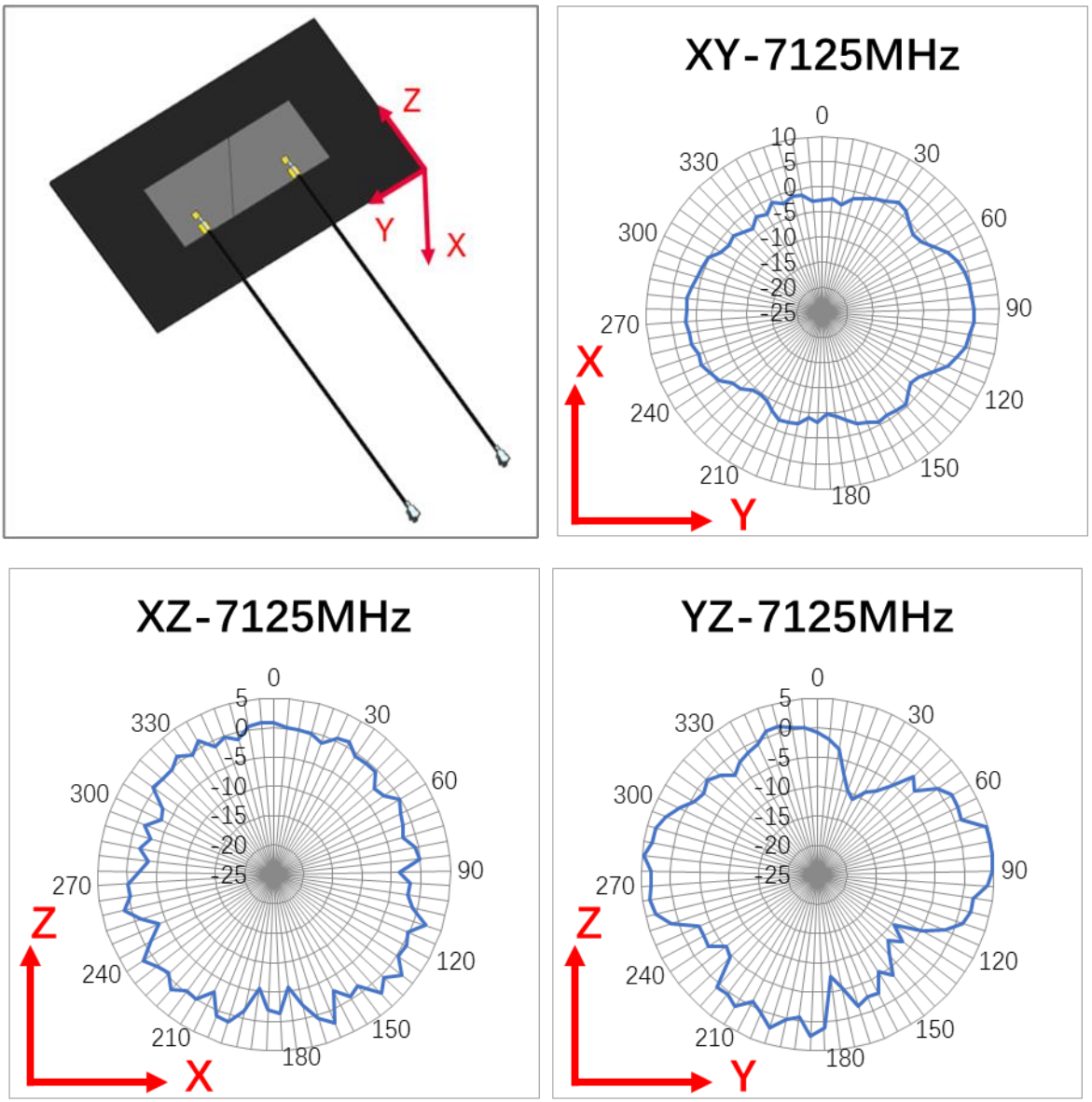


FIGURE 4.5.8 2D RADIATION PATTERN OF ANTENNA AT 7125MHZ BAND OF PORT 2 IN FREE SPACE

4.6 3D RADIATION PATTERN

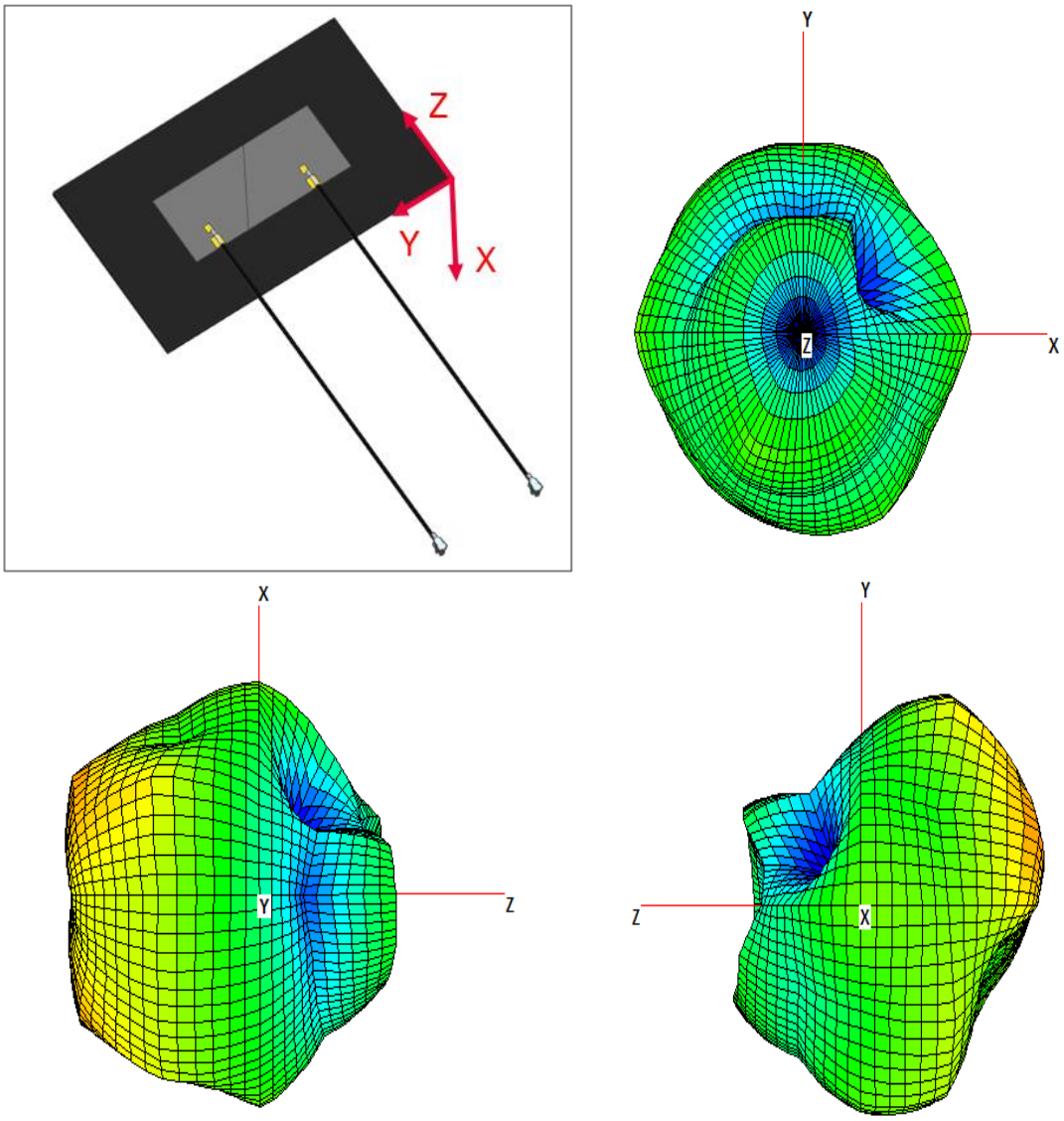


FIGURE 4.6.1 3D RADIATION PATTERN OF ANTENNA AT 2450MHZ BAND OF PORT 1 IN FREE SPACE

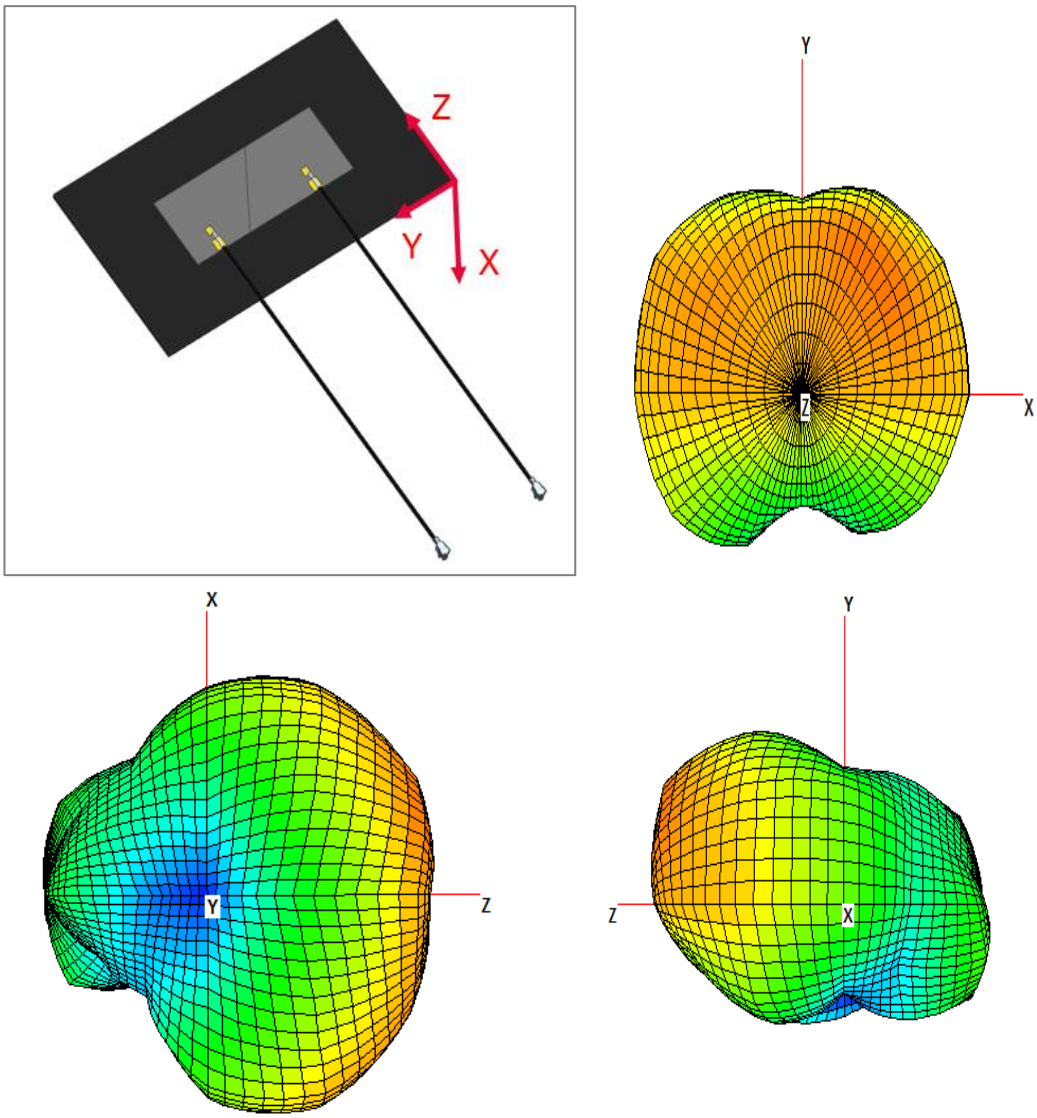


FIGURE 4.6.2 3D RADIATION PATTERN OF ANTENNA AT 5500MHZ BAND OF PORT 1 IN FREE SPACE

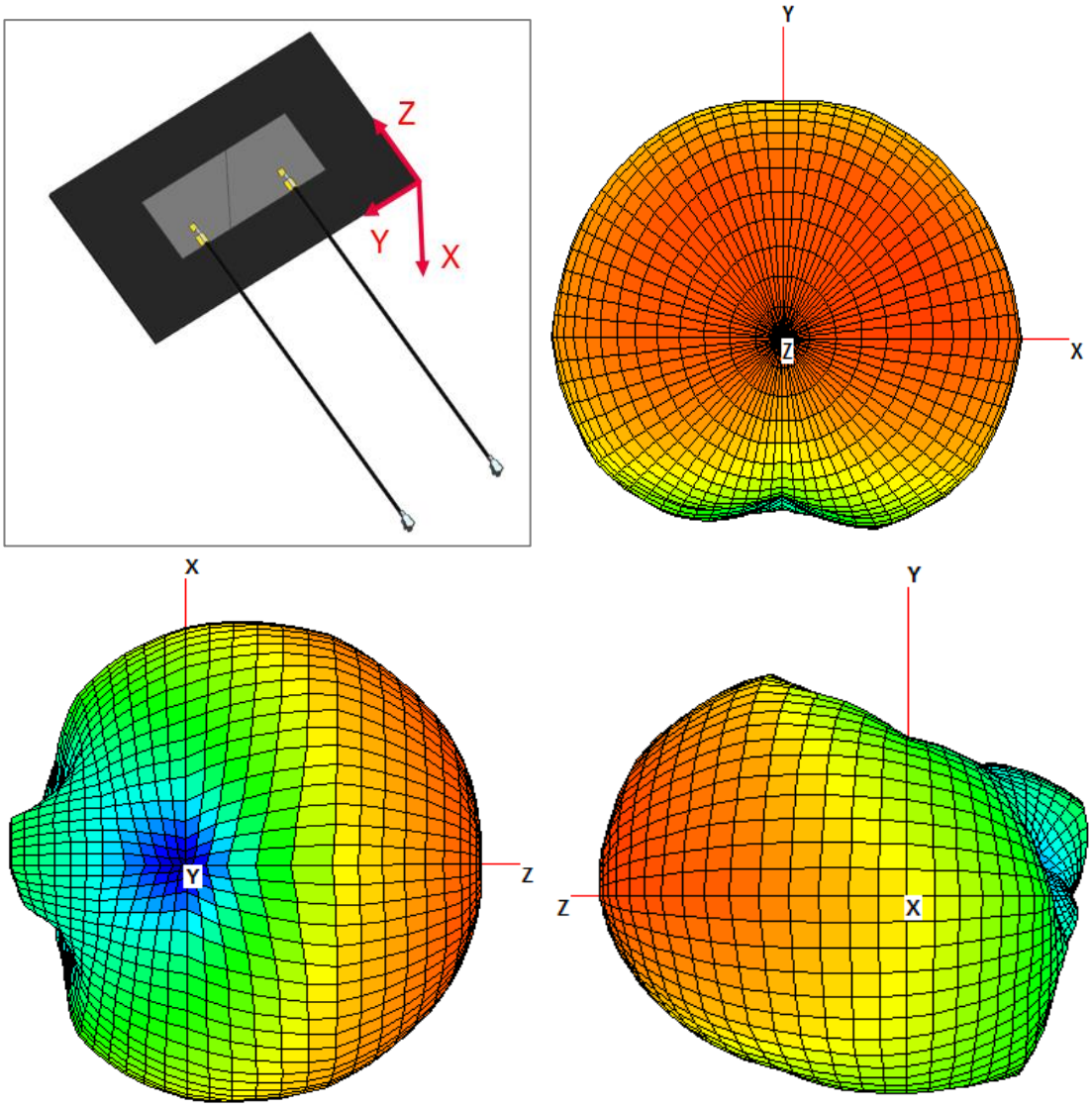


FIGURE 4.6.3 3D RADIATION PATTERN OF ANTENNA AT 6000MHZ BAND OF PORT 1 IN FREE SPACE

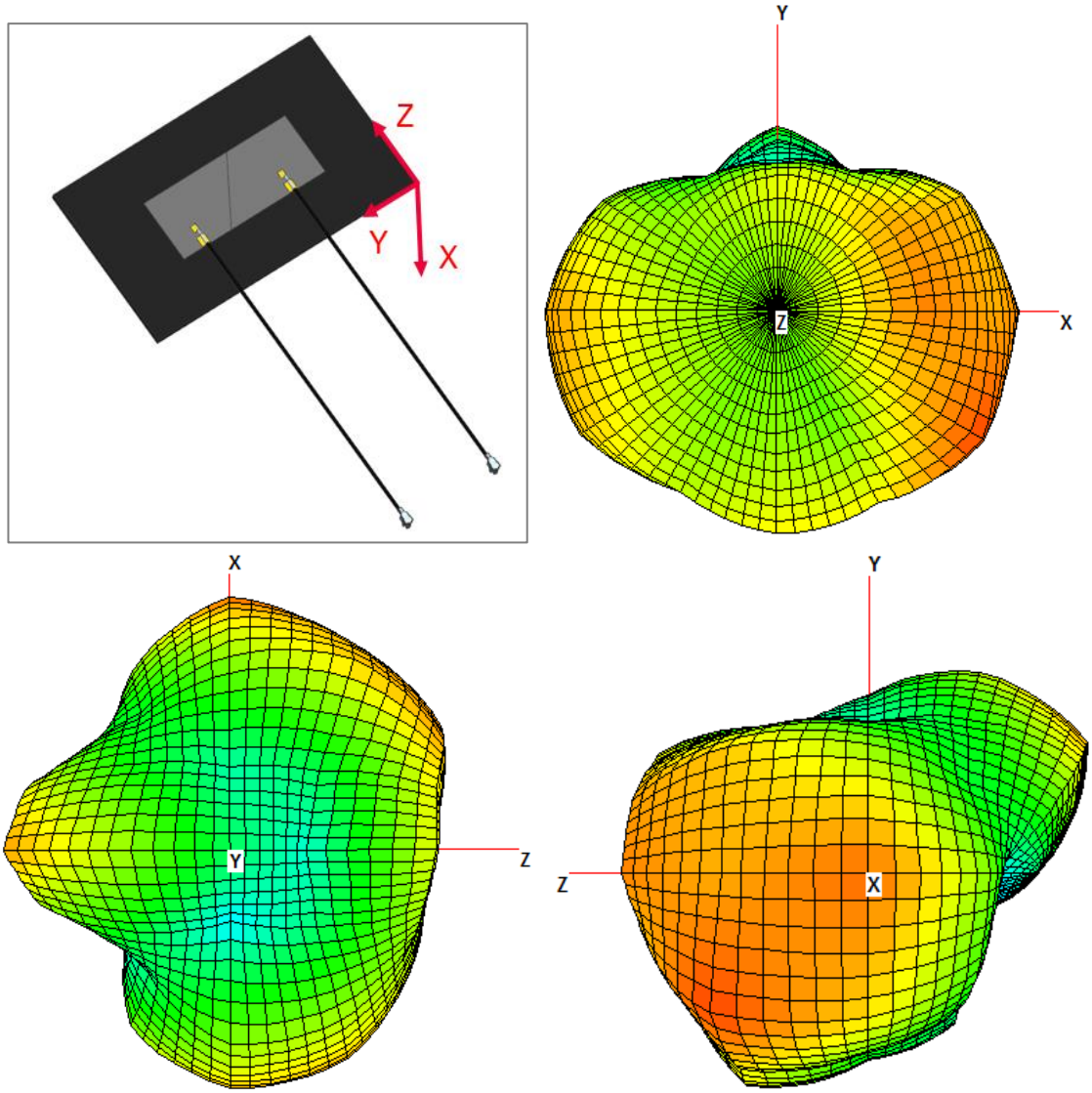


FIGURE 4.6.4 3D RADIATION PATTERN OF ANTENNA AT 7125MHZ BAND OF PORT 1 IN FREE SPACE

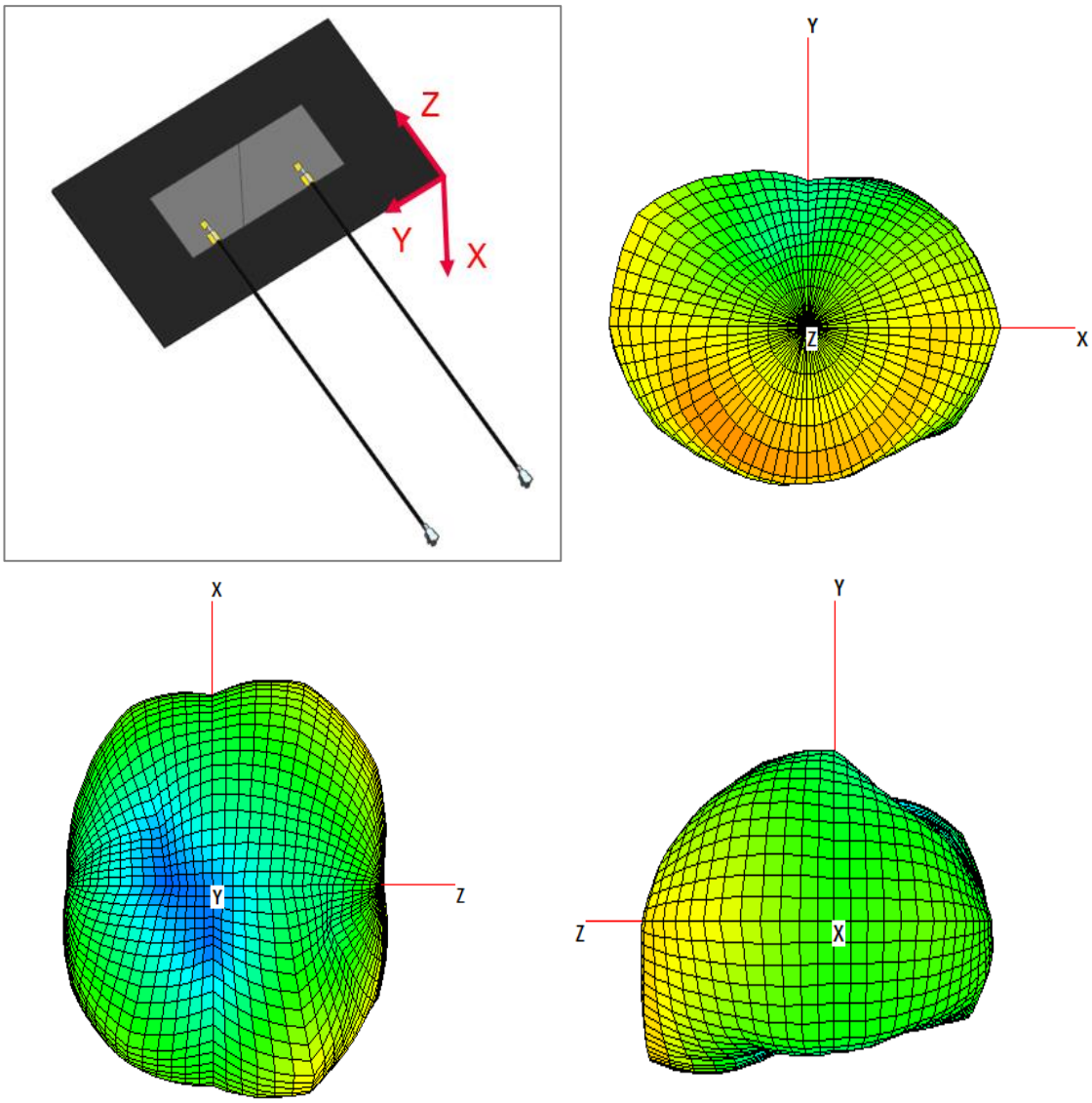


FIGURE 4.6.5 3D RADIATION PATTERN OF ANTENNA AT 2450MHZ BAND OF PORT 2 IN FREE SPACE

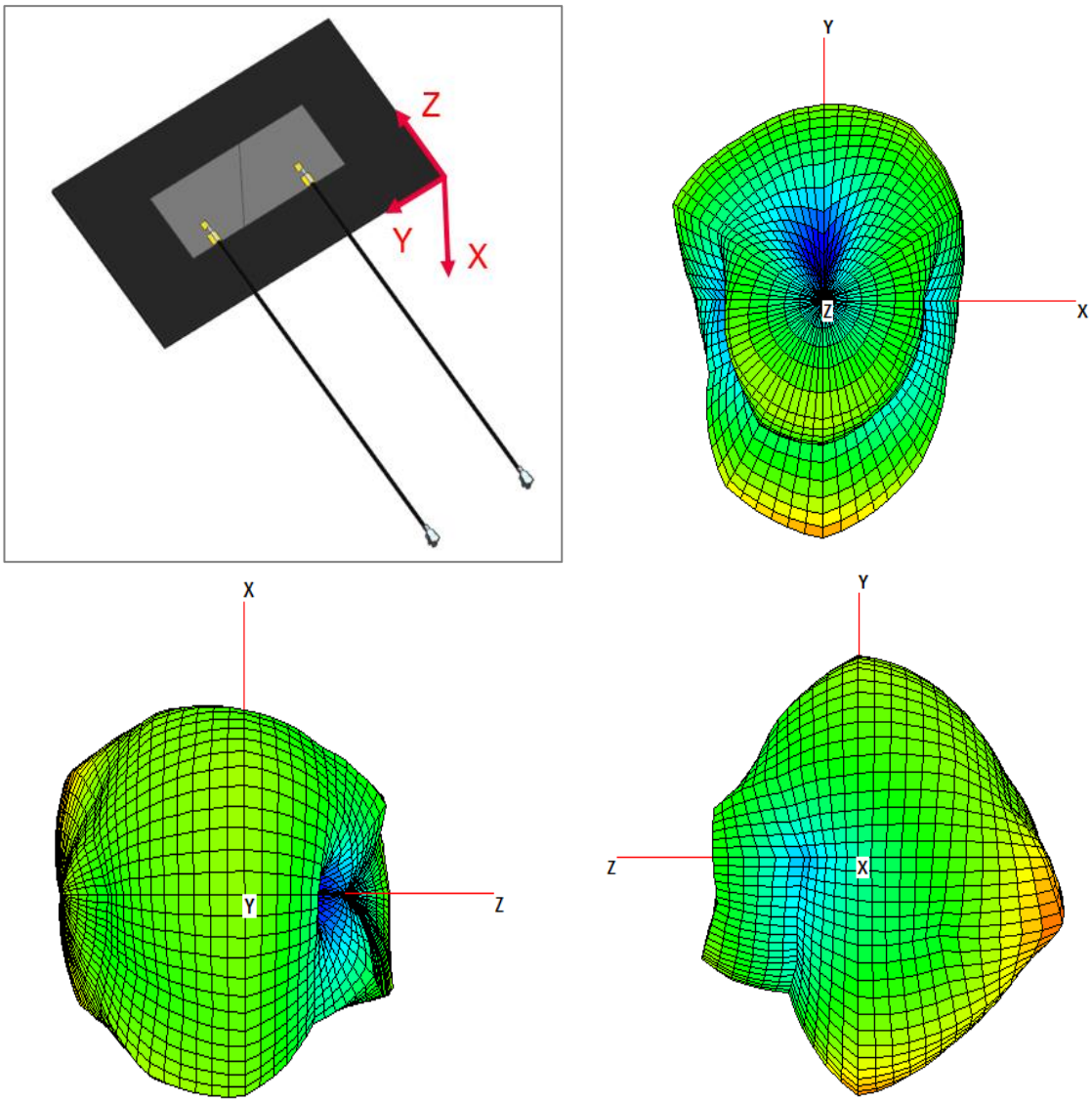


FIGURE 4.6.6 3D RADIATION PATTERN OF ANTENNA AT 5500MHZ BAND OF PORT 2 IN FREE SPACE

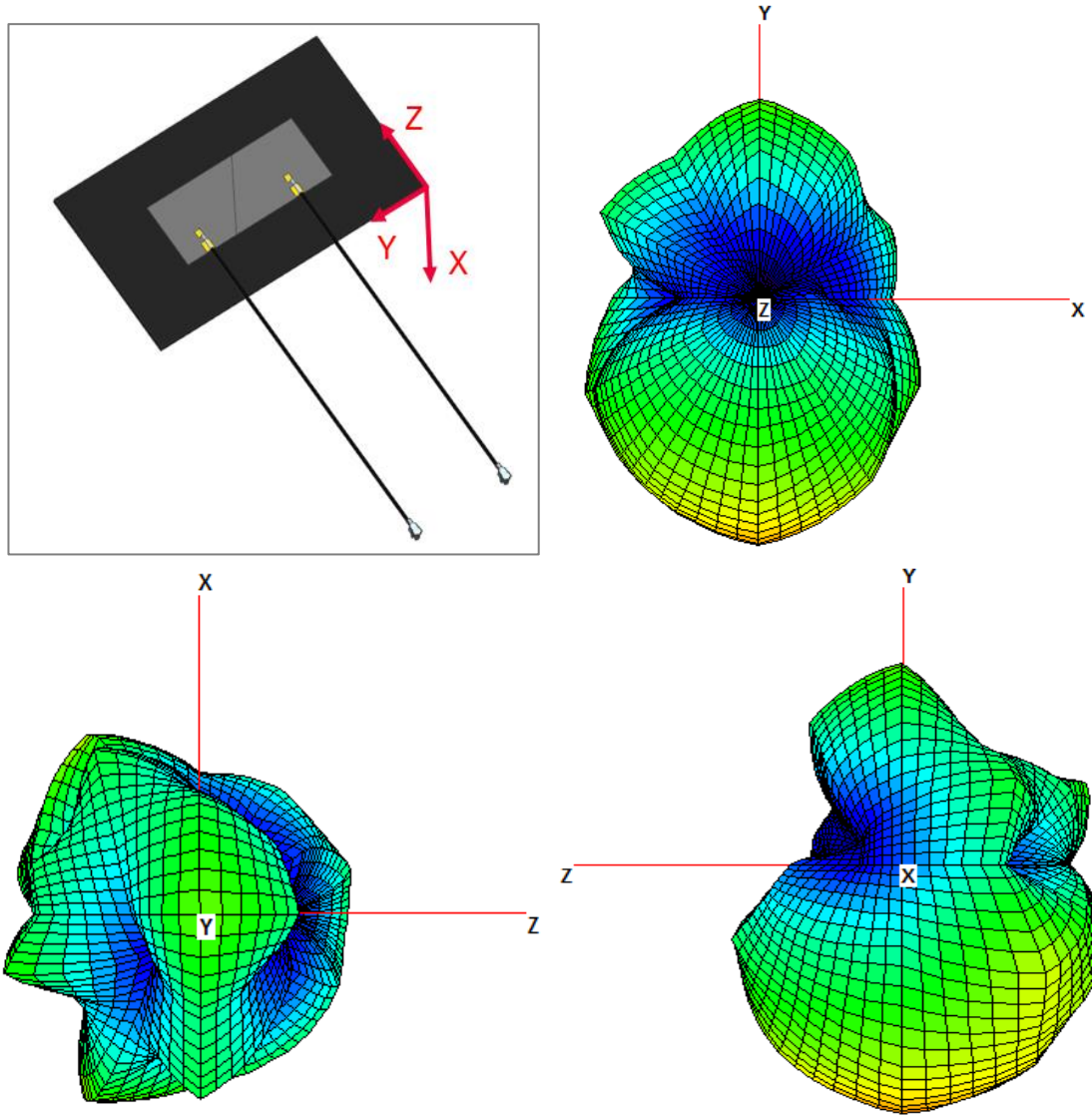


FIGURE 4.6.7 3D RADIATION PATTERN OF ANTENNA AT 6000MHZ BAND OF PORT 2 IN FREE SPACE

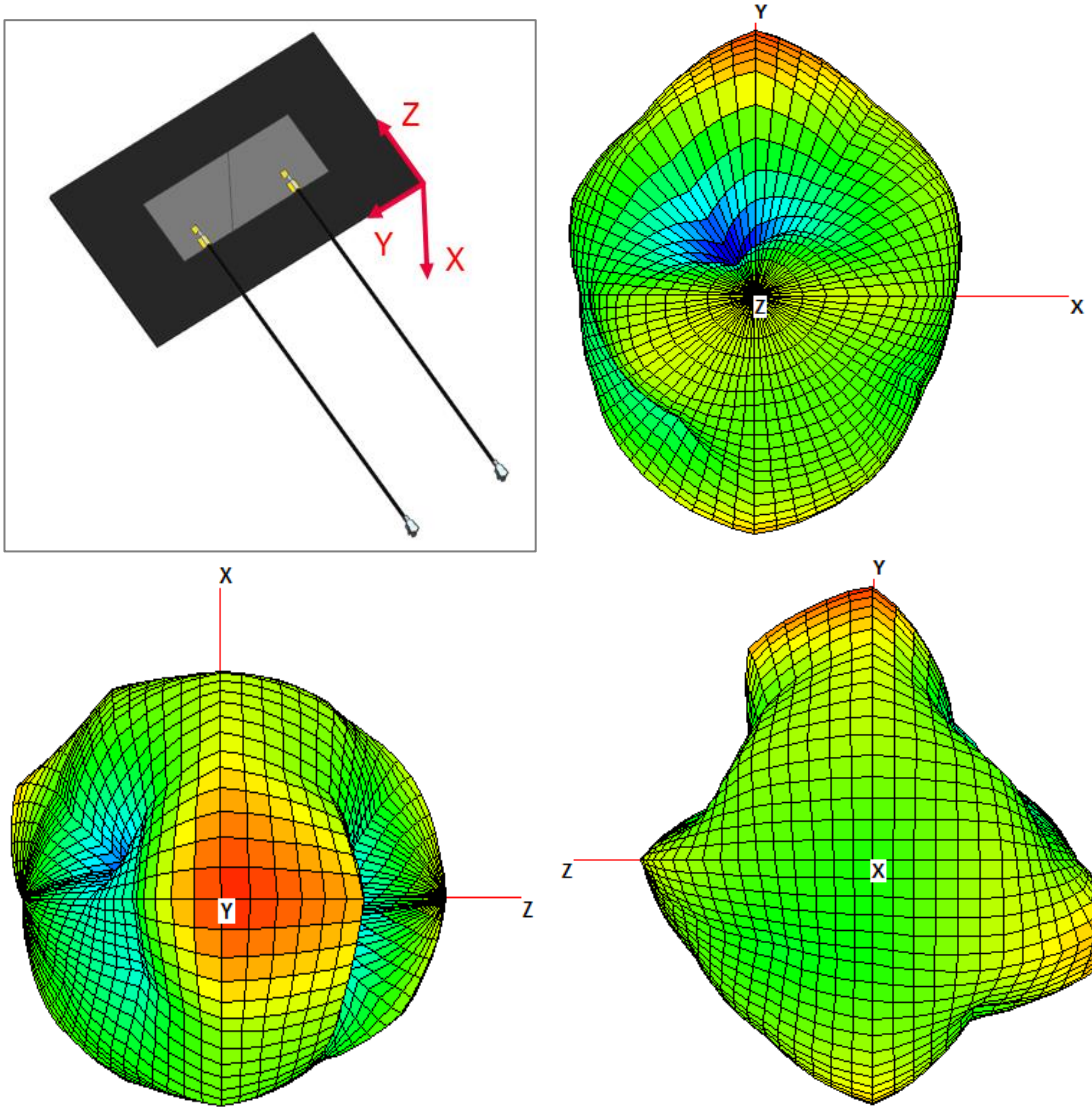


FIGURE 4.6.8 3D RADIATION PATTERN OF ANTENNA AT 7125MHZ BAND OF PORT 2 IN FREE SPACE

5.0 ASSEMBLY GUIDELINE

The flex antenna comes with an adhesive TESA 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.

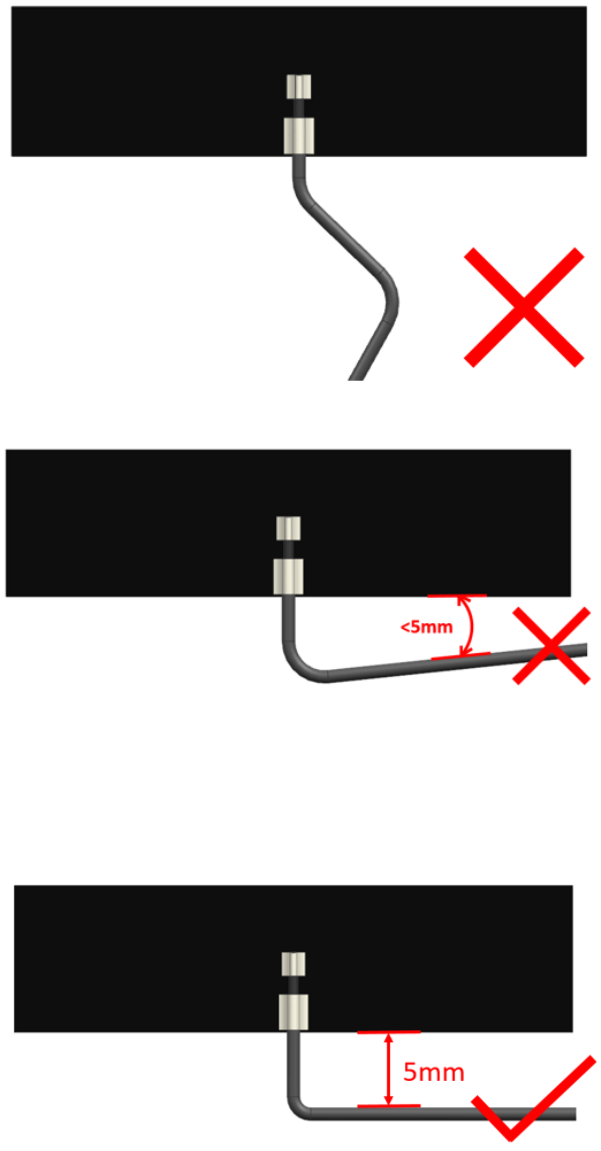


FIGURE 5.2.1 CABLE BENDING

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 15mm to achieve acceptable RF performance.

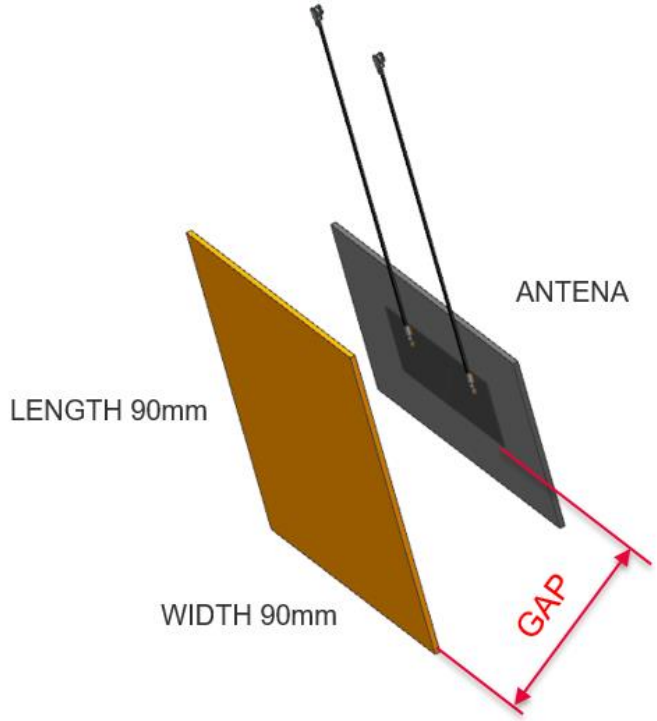


FIGURE 6.1.0 FOUR LOCATIONS WITH PARALLEL PLANE GROUND

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.

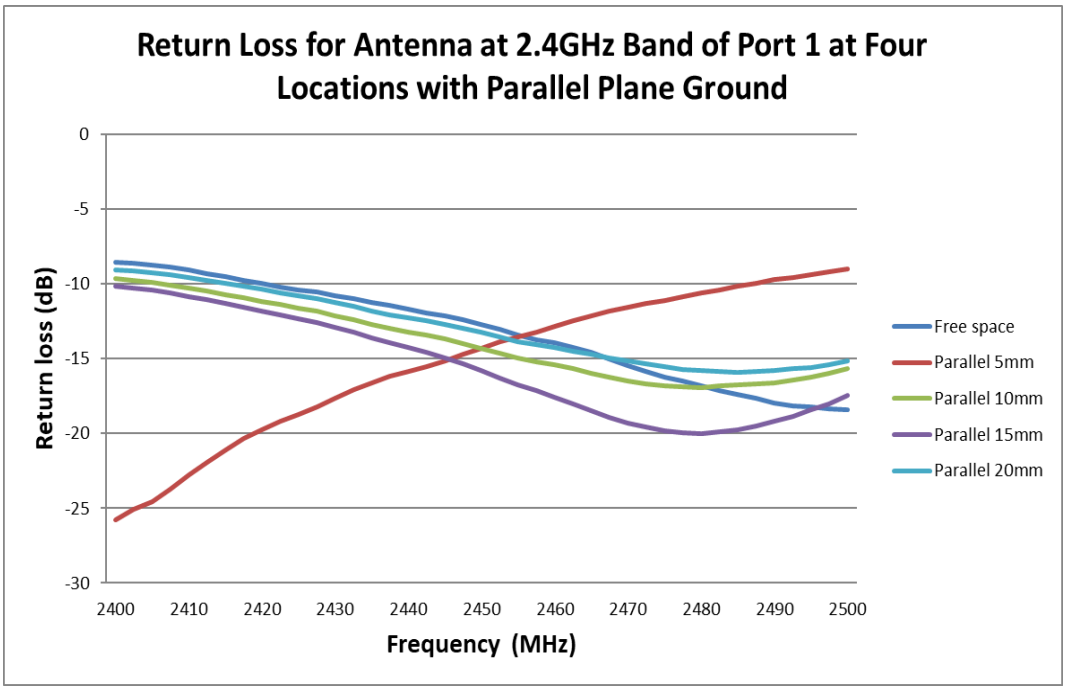


FIGURE 6.1.1 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND OF PORT1 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

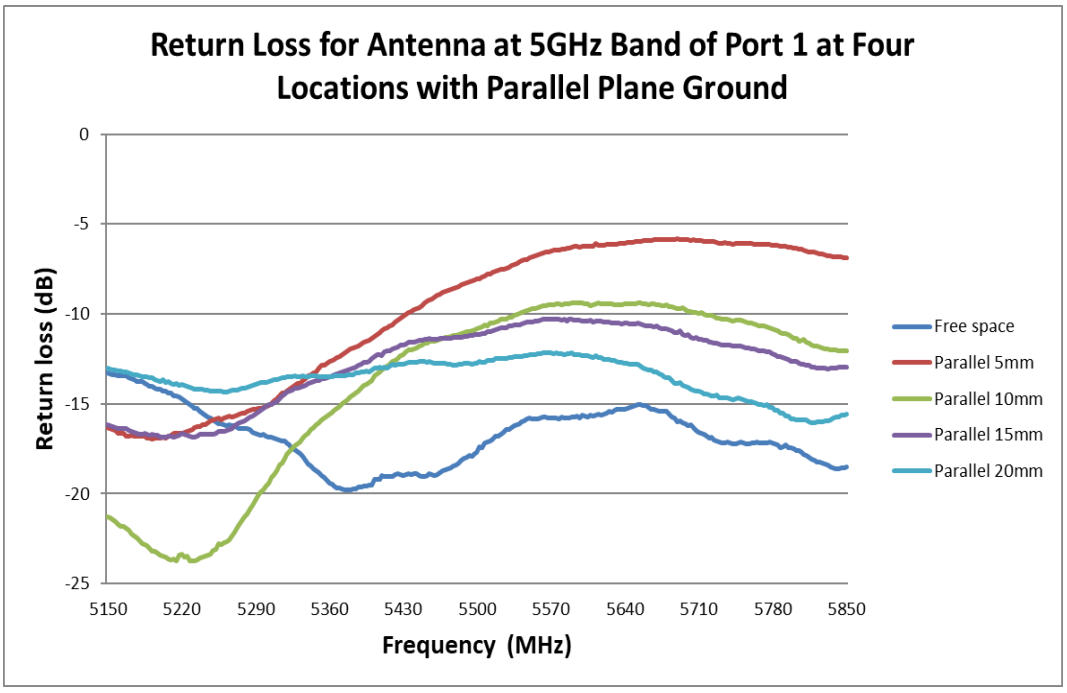


FIGURE 6.1.2 RETURN LOSS OF ANTENNA AT 5GHZ BAND OF PORT1 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

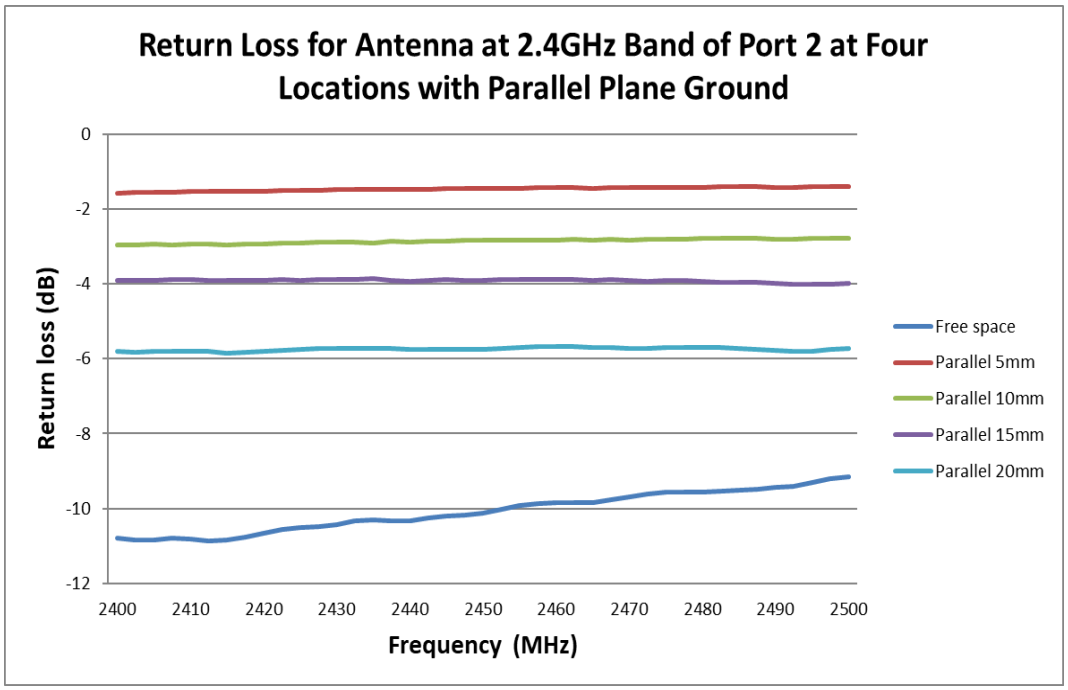


FIGURE 6.1.3 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND OF PORT2 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

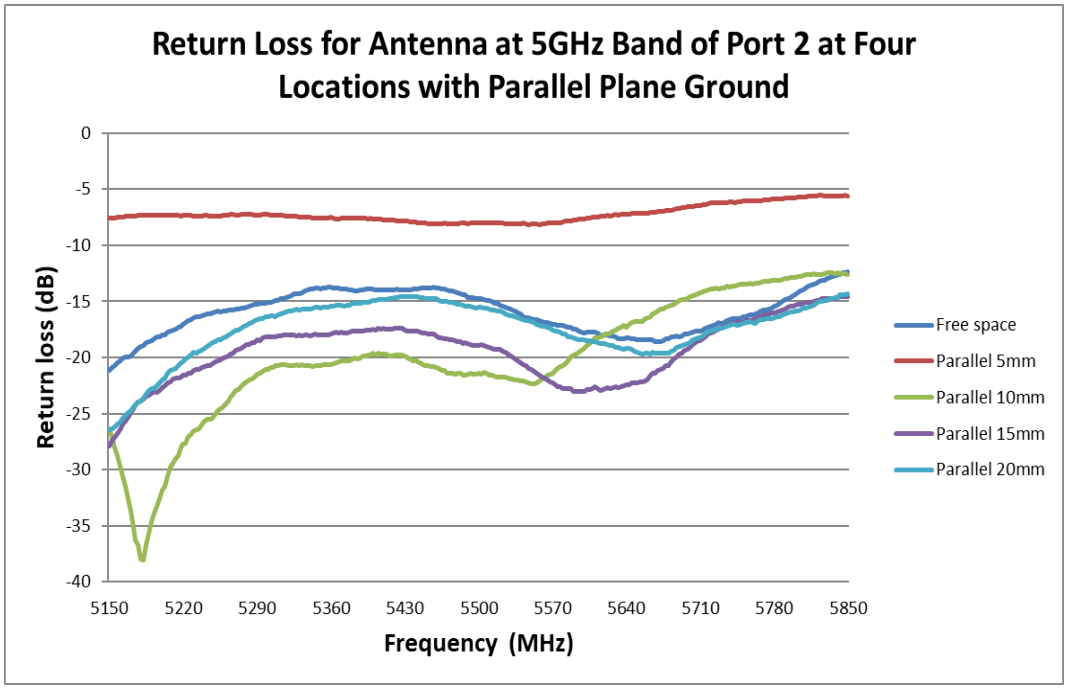


FIGURE 6.1.4 RETURN LOSS OF ANTENNA AT 5GHZ BAND OF PORT2 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

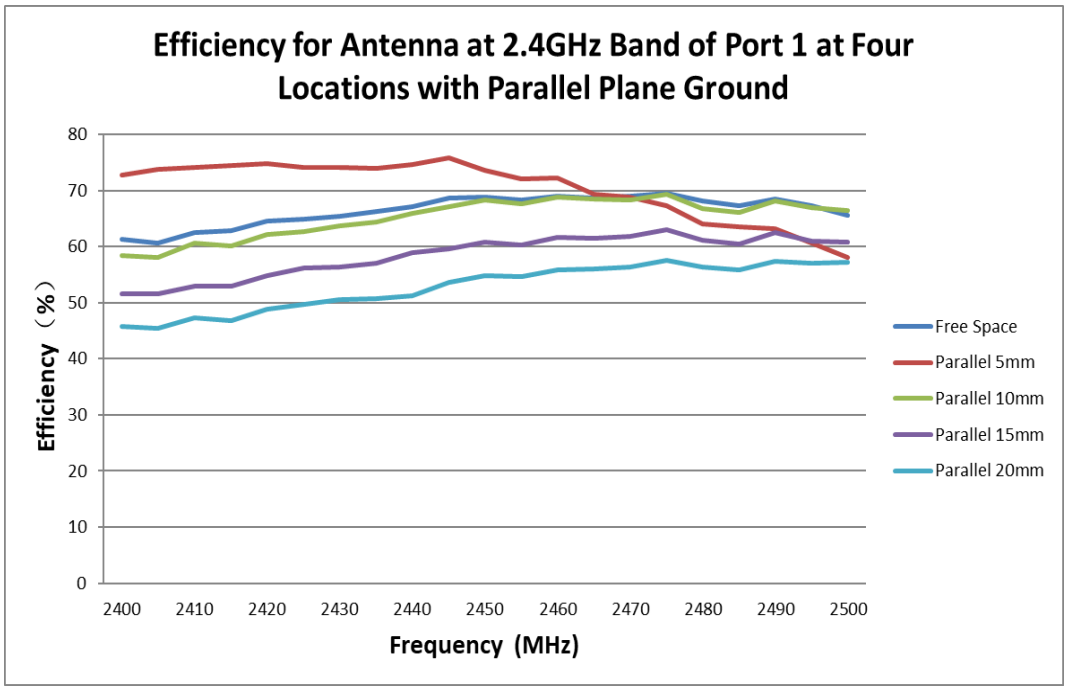


FIGURE 6.1.5 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND OF PORT1 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

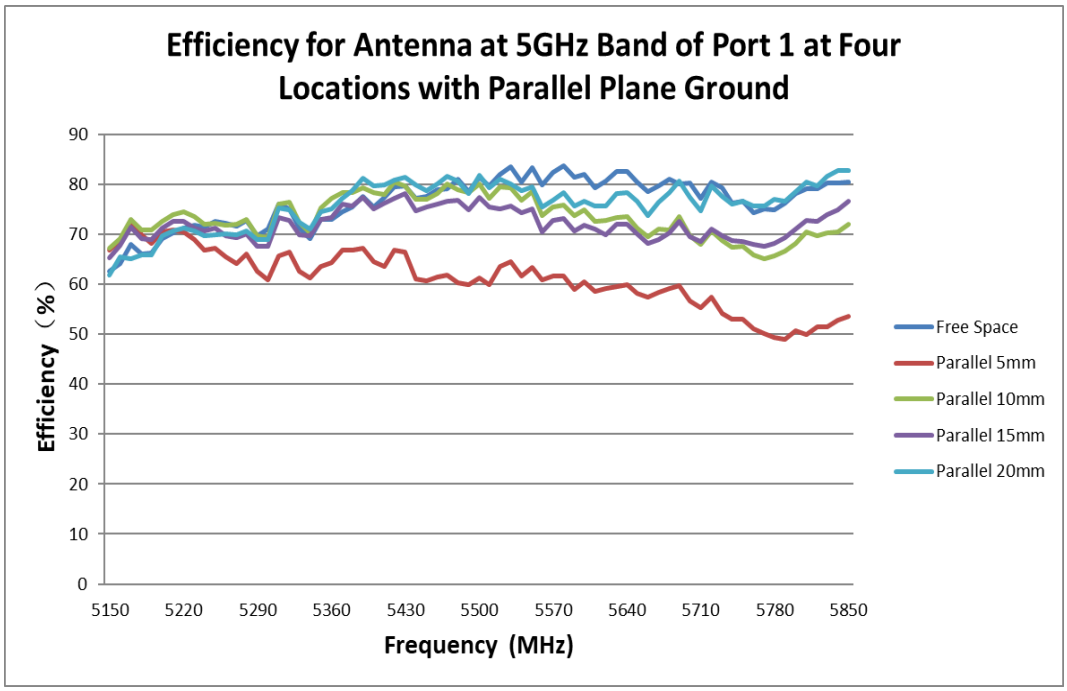


FIGURE 6.1.6 EFFICIENCY OF ANTENNA AT 5GHZ BAND OF PORT1 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

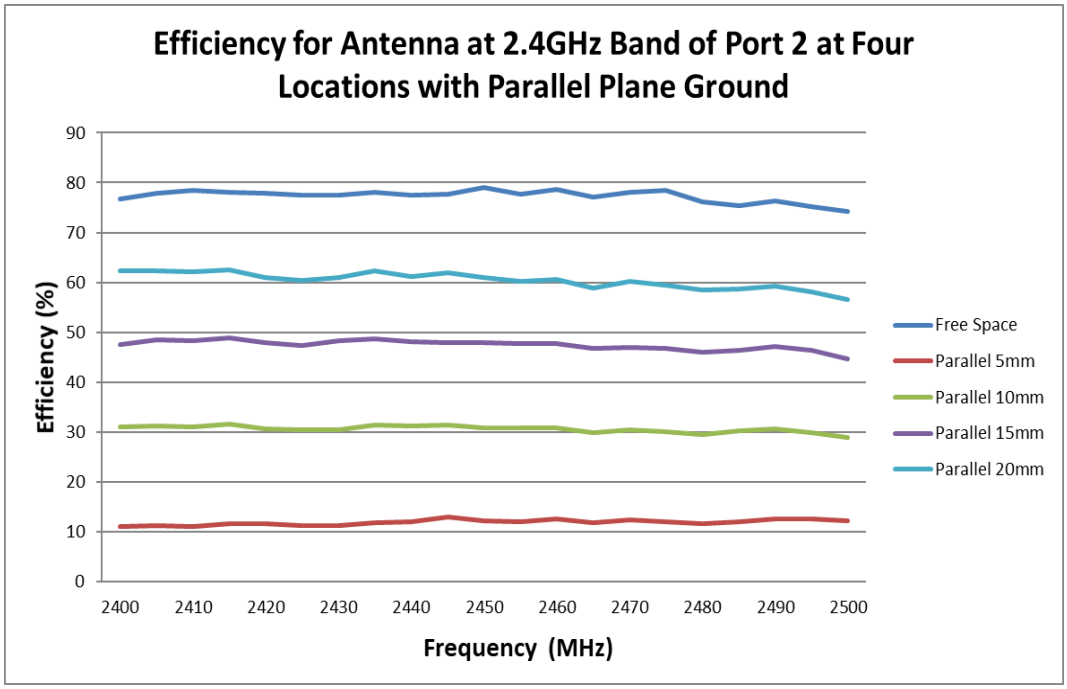


FIGURE 6.1.7 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND OF PORT2 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

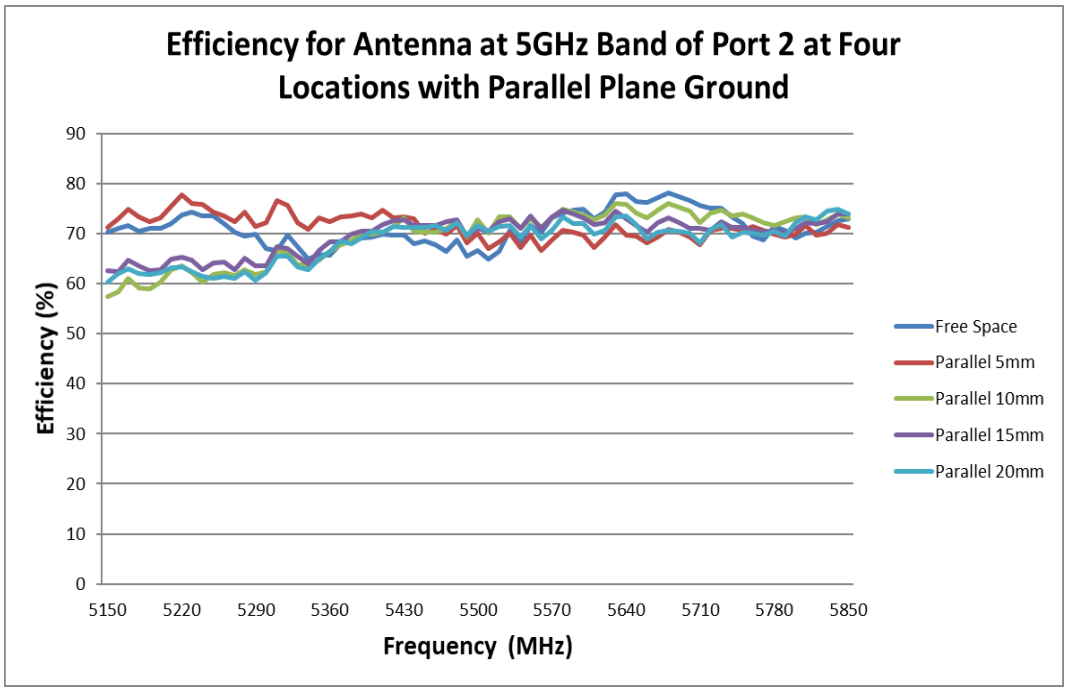


FIGURE 6.1.8 EFFICIENCY OF ANTENNA AT 5GHZ BAND OF PORT2 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

6.2 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 6.2.0. The plane ground size is 90mm*90mm and we move the plane ground to four locations for each test. The distance between antenna and vertical plane ground affect the antenna performance slightly. We still suggest the minimum distance between antenna and plane ground is recommended to be 5mm.

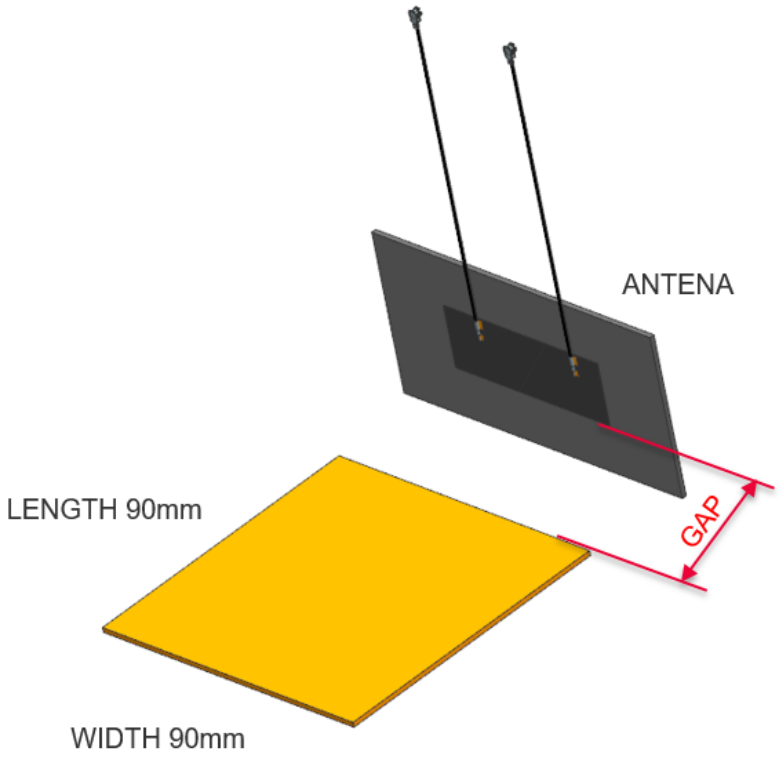


FIGURE 6.2.0 FOUR LOCATIONS WITH VERTICAL PLANE GROUND

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.

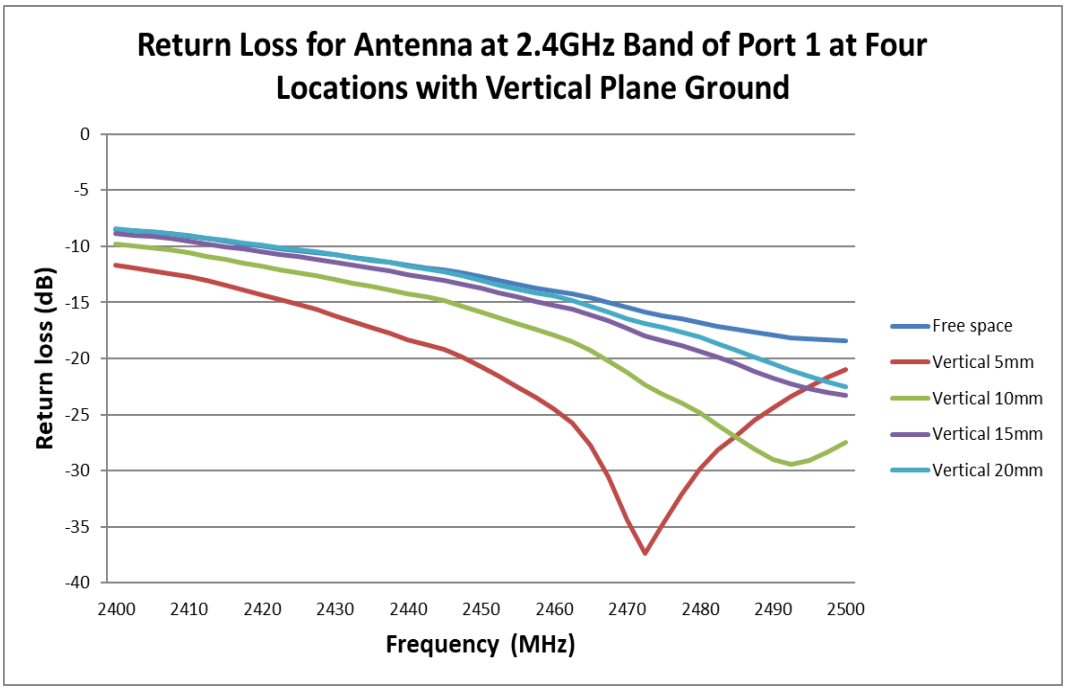


FIGURE 6.2.1 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND OF PORT1 AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND

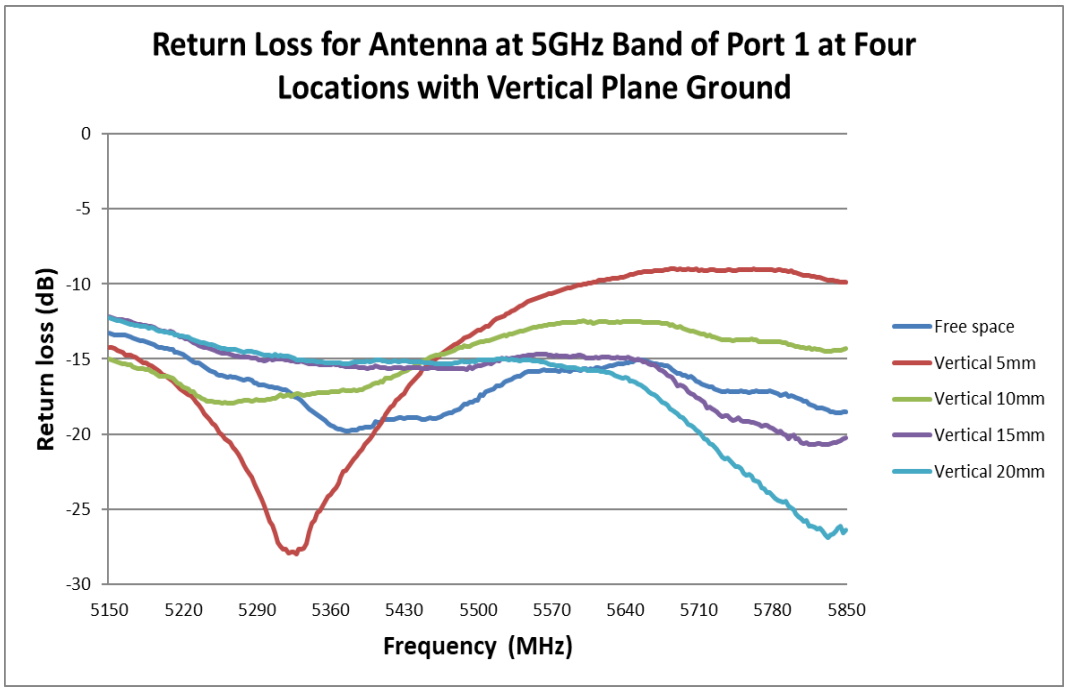


FIGURE 6.2.2 RETURN LOSS OF ANTENNA AT 5GHZ BAND OF PORT1 AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND

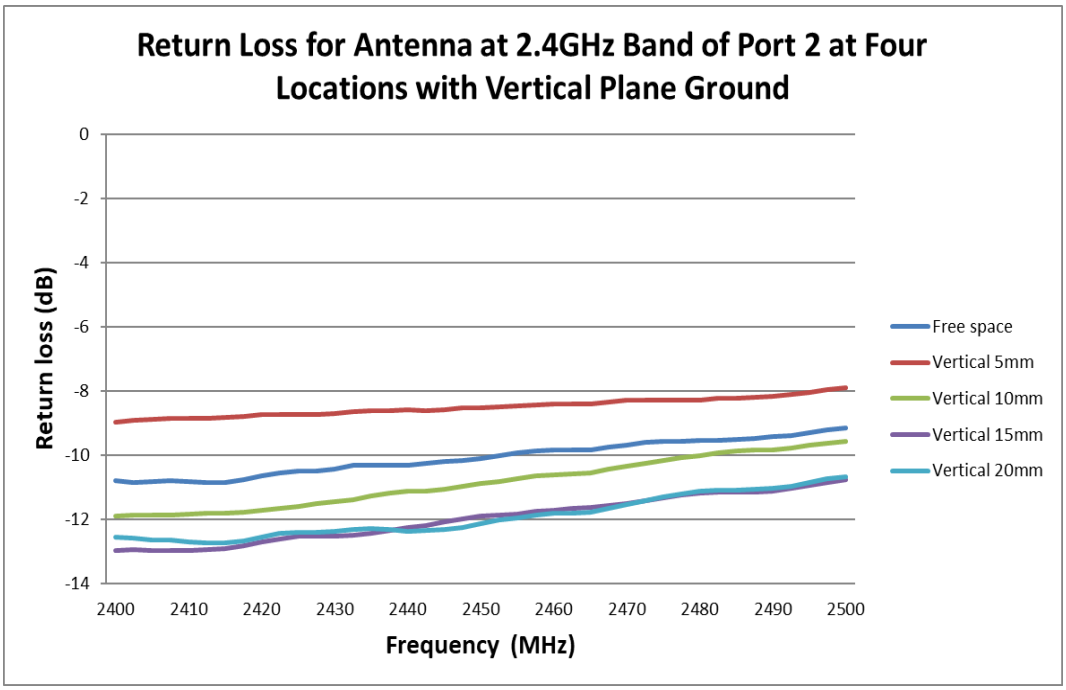


FIGURE 6.2.3 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND OF PORT2 AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND

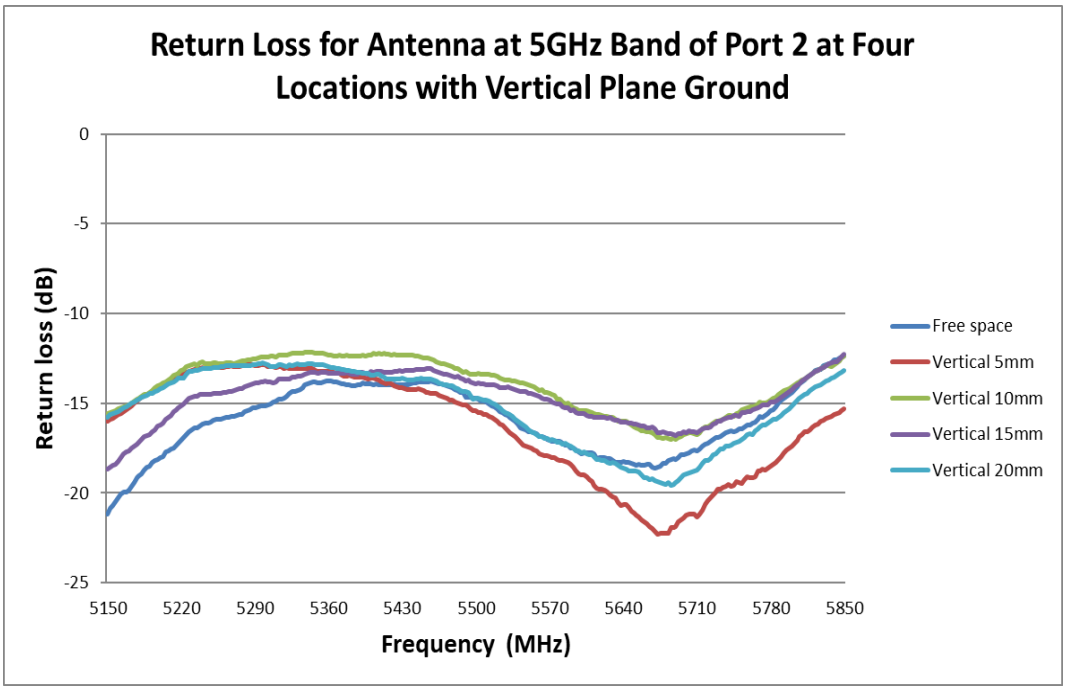


FIGURE 6.2.4 RETURN LOSS OF ANTENNA AT 5GHZ BAND OF PORT2 AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND

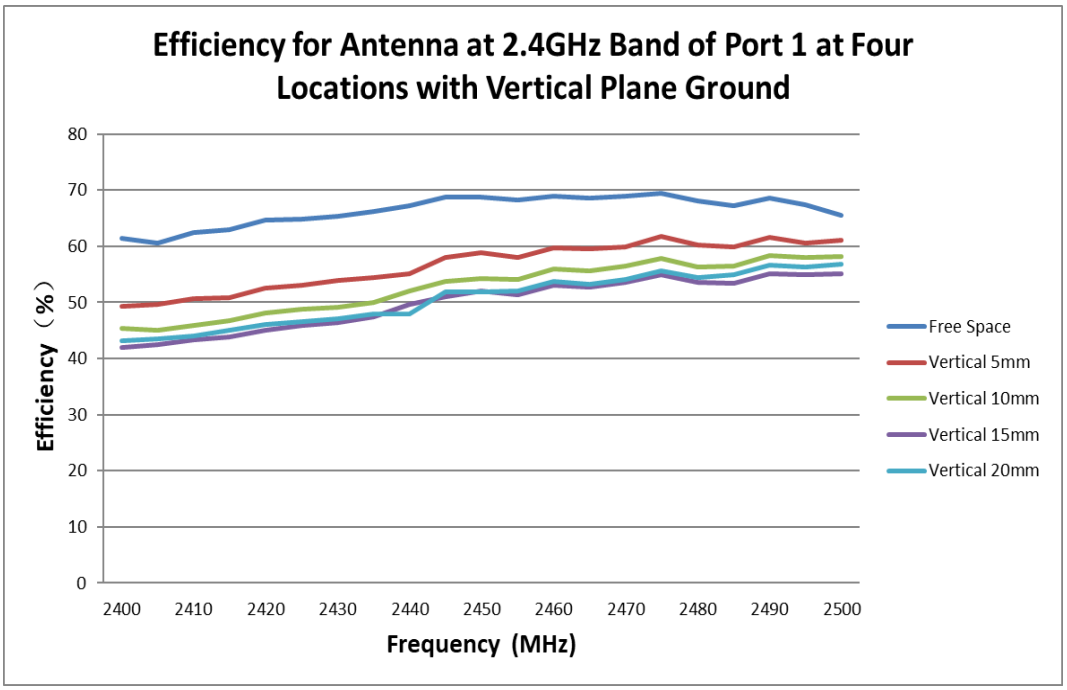


FIGURE 6.2.5 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND OF PORT1 AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND

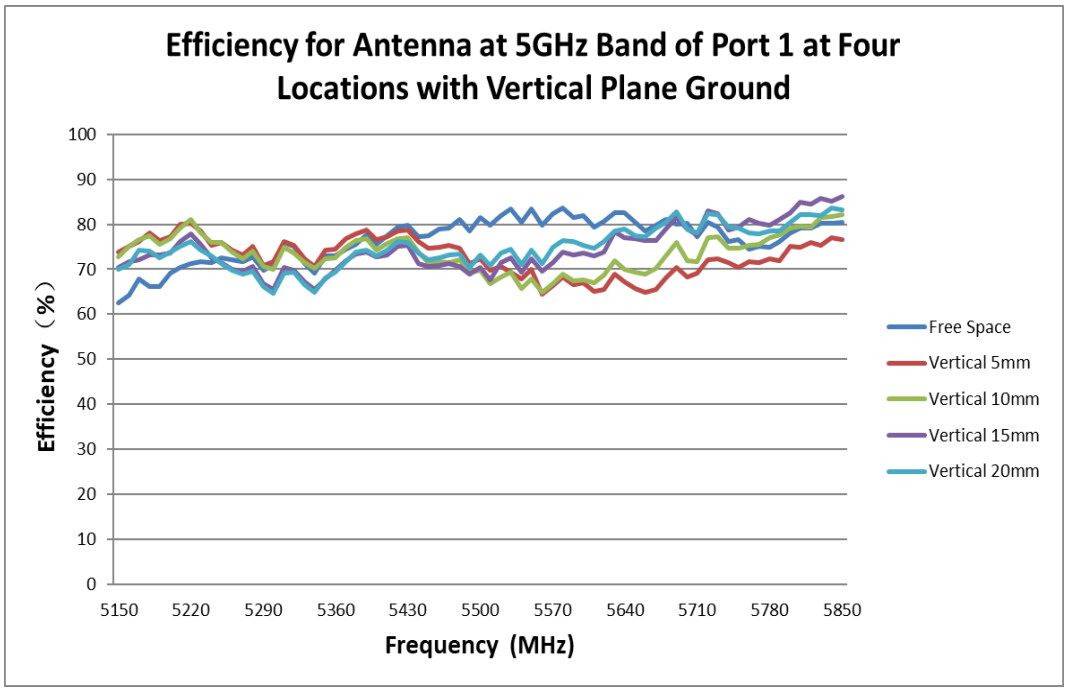


FIGURE 6.2.6 EFFICIENCY OF ANTENNA AT 5GHZ BAND OF PORT1 AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND

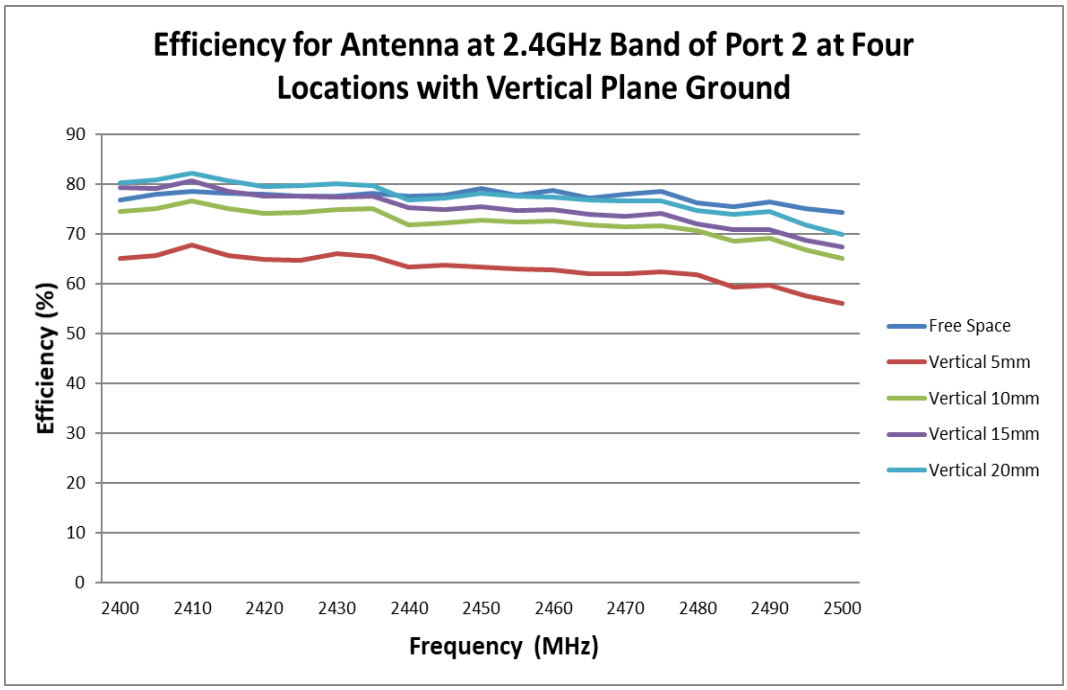


FIGURE 6.2.7 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND OF PORT2 AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND

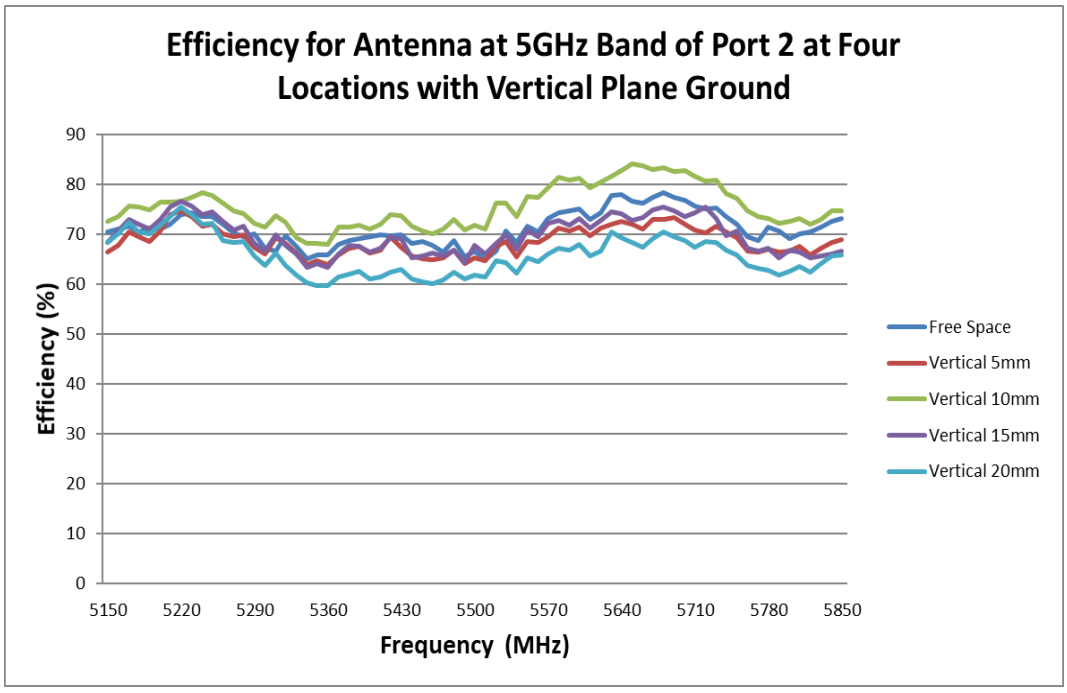


FIGURE 6.2.8 EFFICIENCY OF ANTENNA AT 5GHZ BAND OF PORT2 AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND

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

Four locations with the parallel plane ground have been evaluated and these locations are shown in figure 6.3.0. The plane ground size is 90mm*90mm and we move the plane ground to four locations for each test. The distance between the antenna and the parallel plane ground affect the antenna performance slightly. We still suggest the minimum distance between the antenna and the plane ground is recommended to be 5mm.

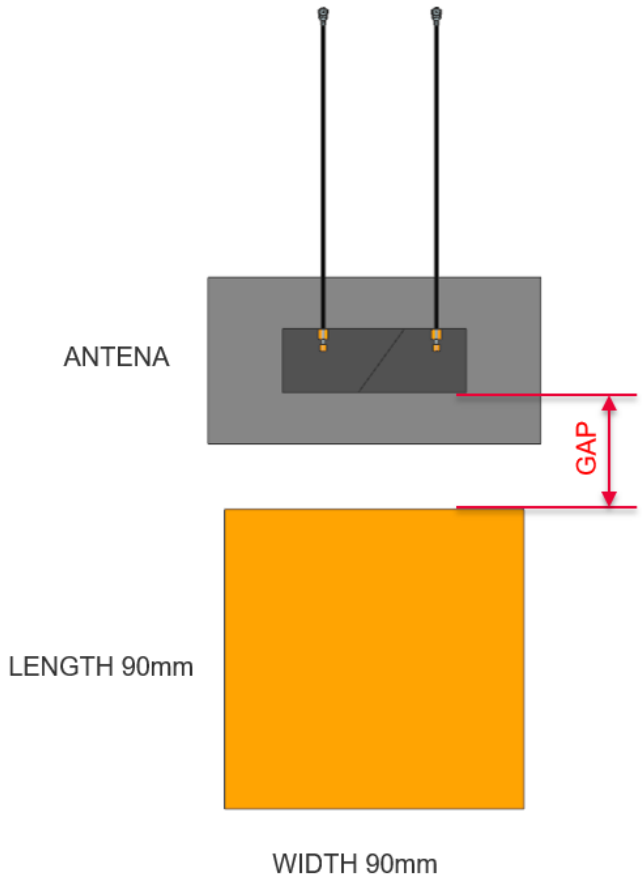


FIGURE 6.3.0 FOUR LOCATIONS WITH PARALLEL PLANE GROUND

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.

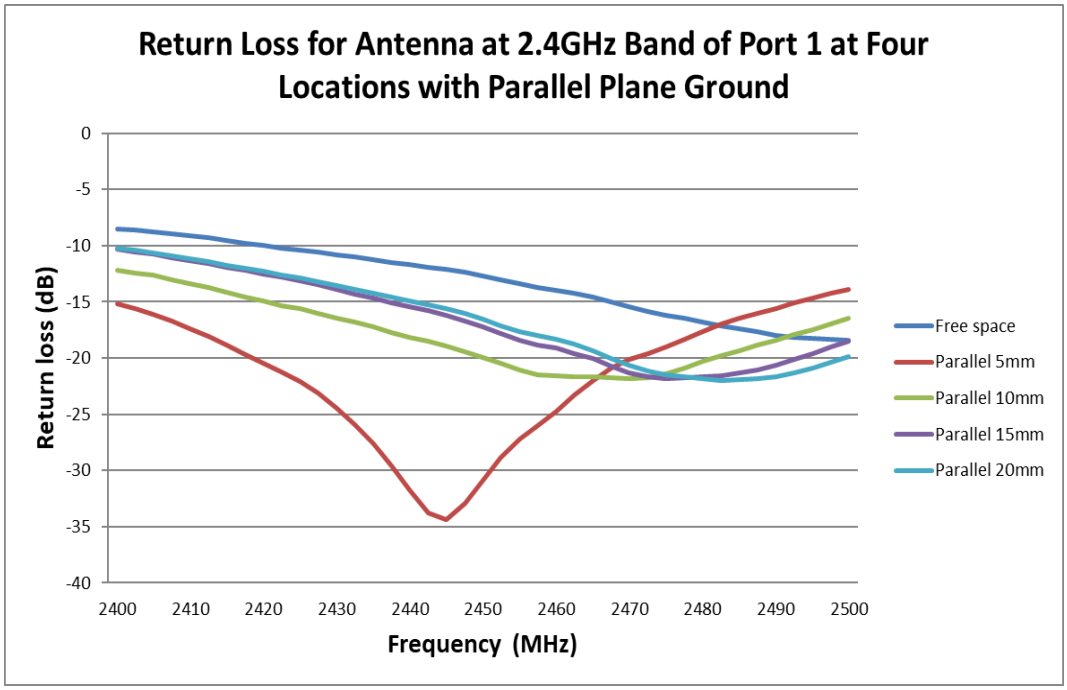


FIGURE 6.3.1 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND OF PORT1 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

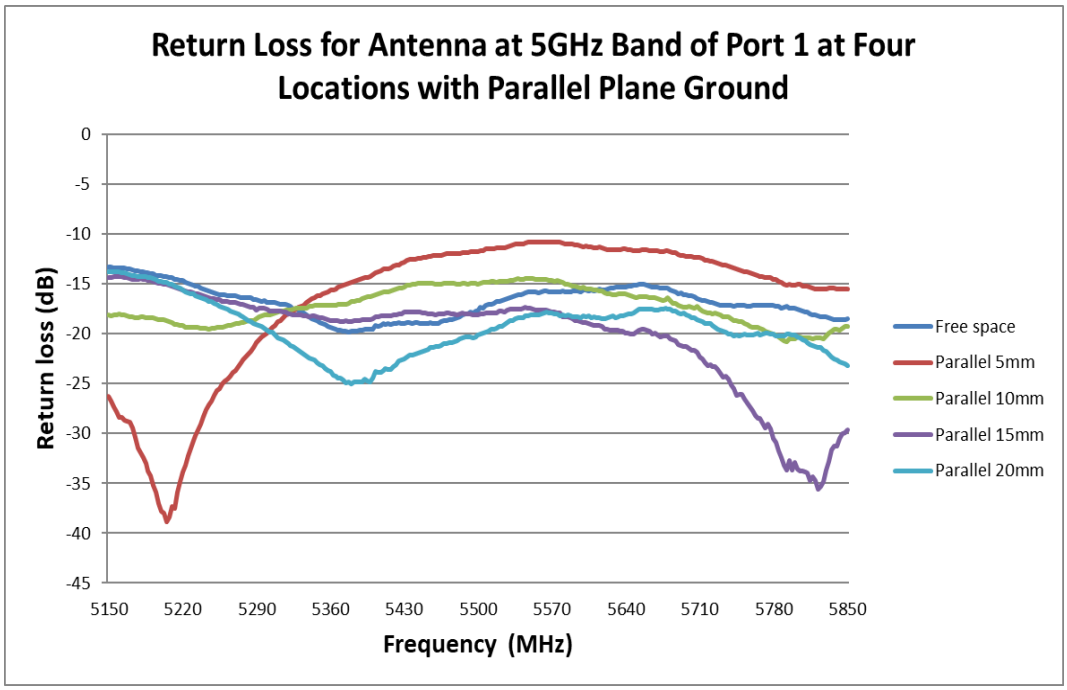


FIGURE 6.3.2 RETURN LOSS OF ANTENNA AT 5GHZ BAND OF PORT1 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

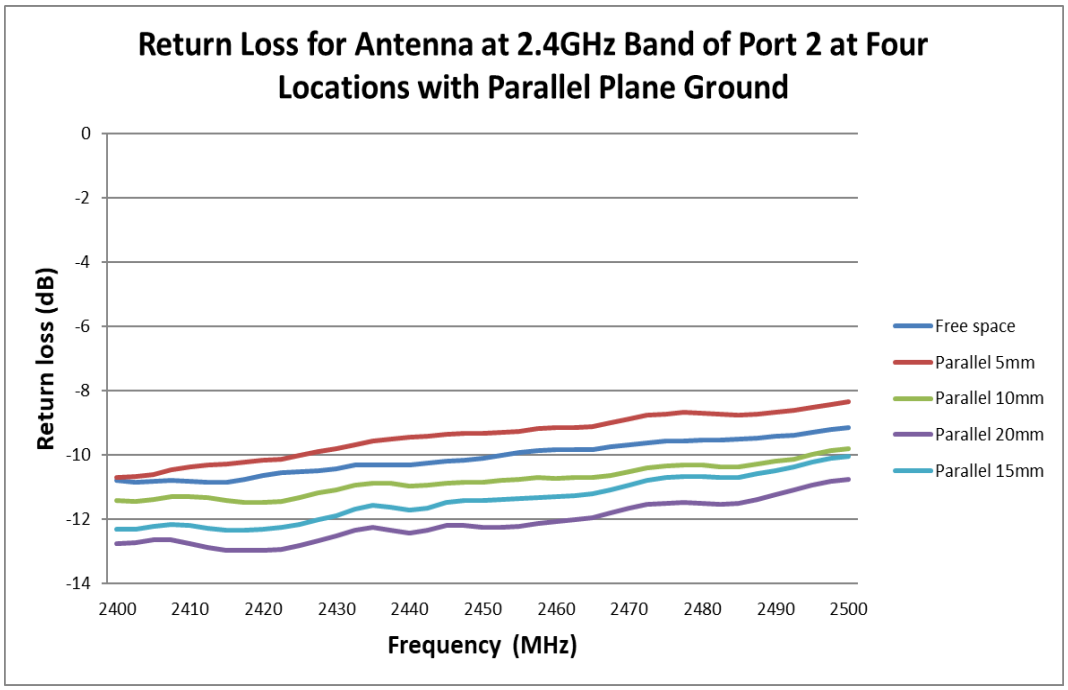


FIGURE 6.3.3 RETURN LOSS OF ANTENNA AT 2.4GHZ BAND OF PORT2 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

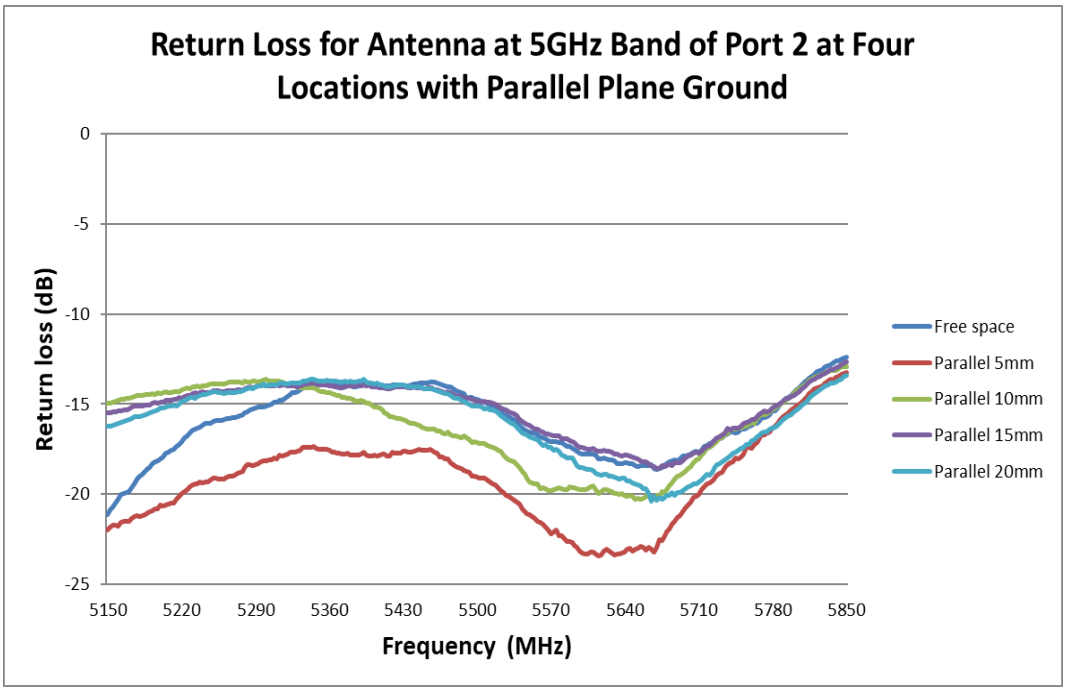


FIGURE 6.3.4 RETURN LOSS OF ANTENNA AT 5GHZ BAND OF PORT2 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

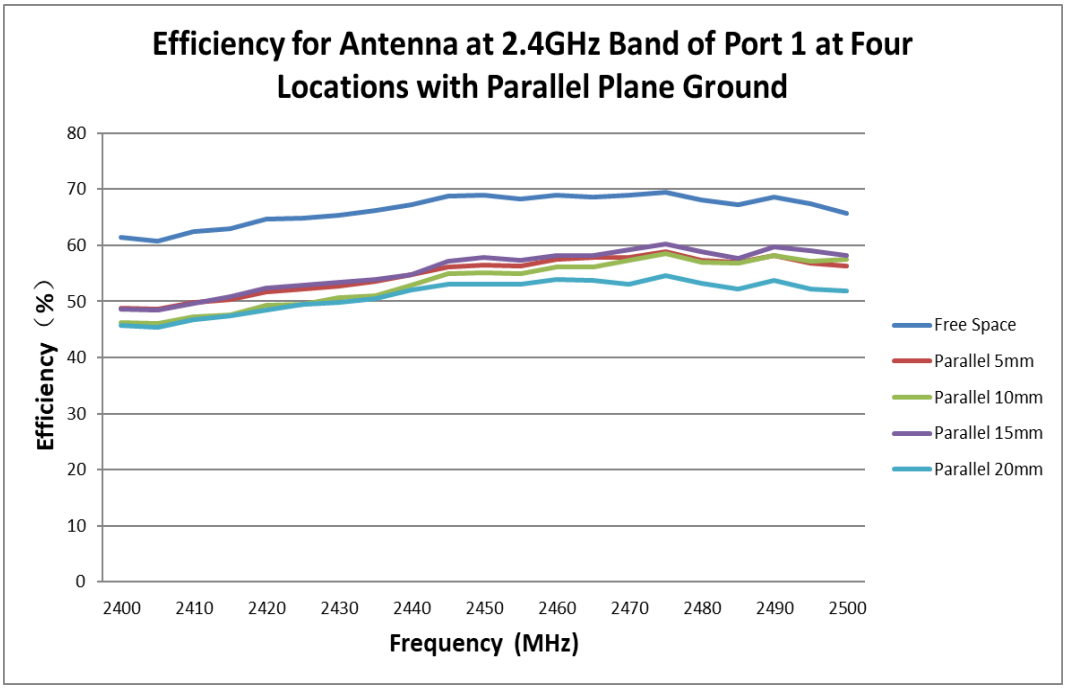


FIGURE 6.3.5 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND OF PORT1 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

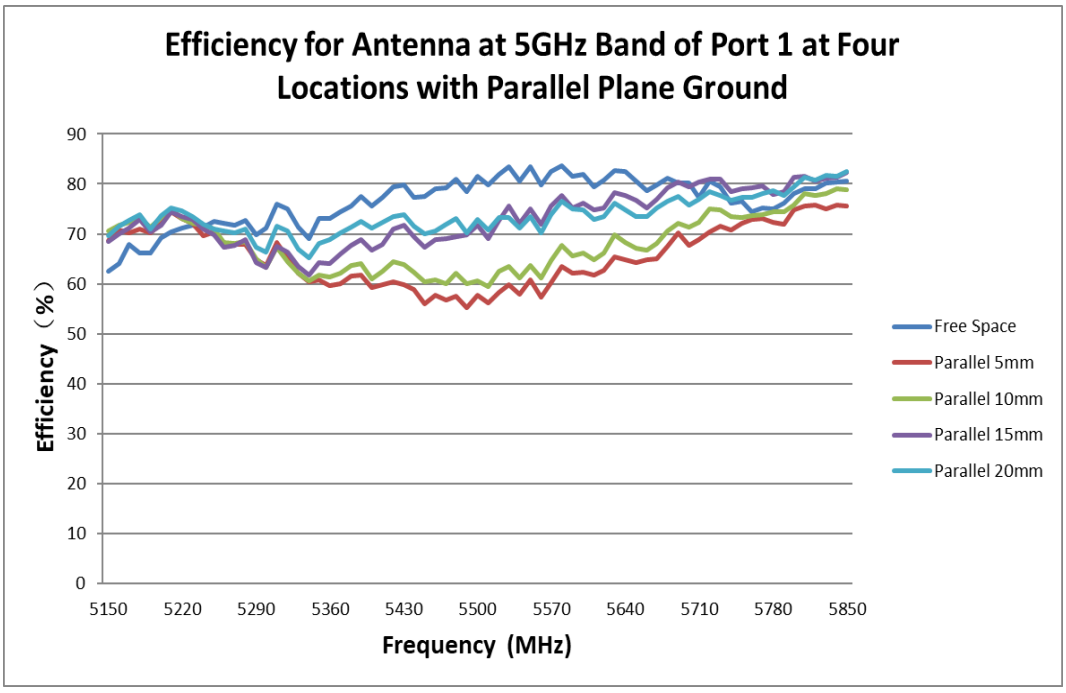


FIGURE 6.3.6 EFFICIENCY OF ANTENNA AT 5GHZ BAND OF PORT1 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

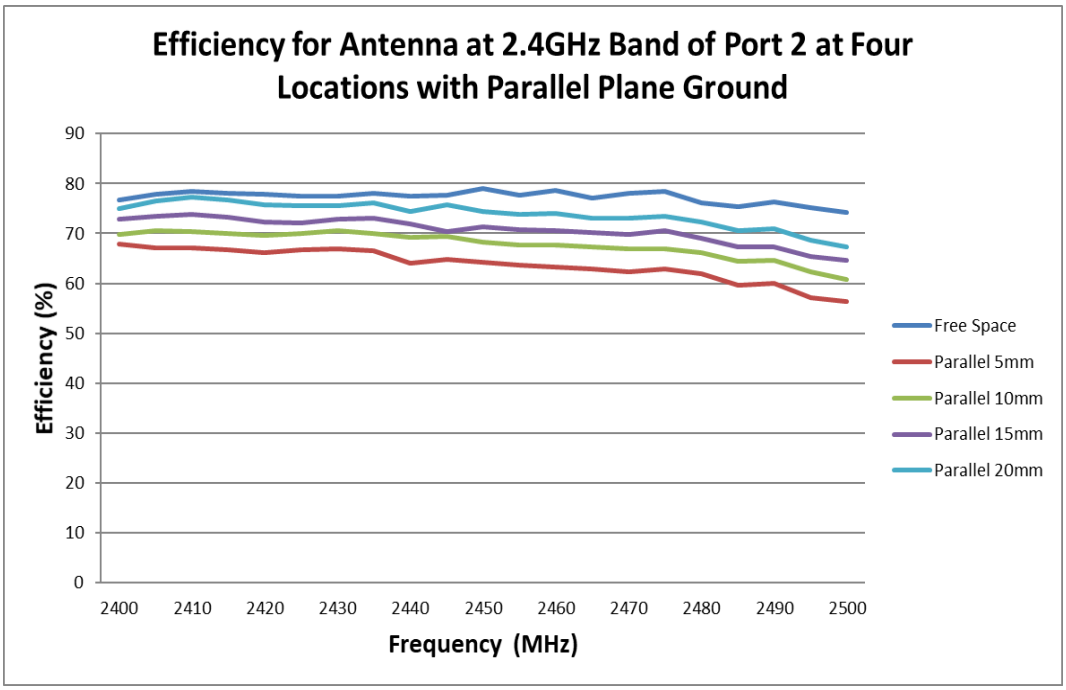


FIGURE 6.3.7 EFFICIENCY OF ANTENNA AT 2.4GHZ BAND OF PORT2 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

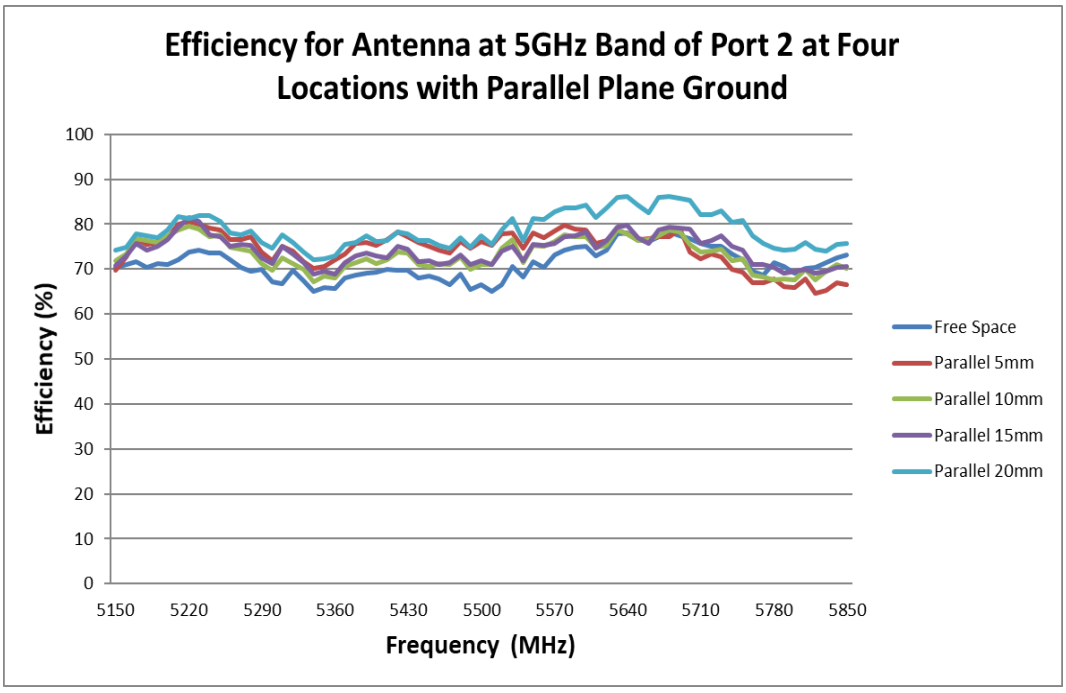


FIGURE 6.3.8 EFFICIENCY OF ANTENNA AT 5GHZ BAND OF PORT2 AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND

7.0 THE ANTENNA PERFORMANCE VARIATION WITH CABLE LENGTH

7.0.1 CABLE LOSS

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT		
7.0.1.1	Frequency Range	2.4GHz~7.125GHz	2.4GHz~2.5 GHz	5GHz~6GHz	6GHz-7.125GHz
7.0.1.2	Attenuation	1m cable measured by VNA5071C	⩽3dB/m	⩽5.5dB/m	⩽6.5dB/m

7.0.2 CABLE LENGTH AFFECT THE ANTENNA PERFORMANCE

Balance antenna resonance is insensitive by cable length, but the cable loss will affect the total efficiency. Refer to 7.0.1

7.0.3 FOR EXAMPLE

Base on the 100mm cable performance, we can mostly compute the 300mm cable's. This example is only for dipole antenna (Port 2).

Port 2	100mm cable			300mm cable	
Frequency (MHz)	Efficiency (dB)	Efficiency (%)	Cable Loss	Efficiency (dB)	Efficiency (%)
	X		X-LOSS=Y	Y	
2400	-1.17	76.43	0.2m*3dB/m	-1.77	66.57
2420	-1.09	77.87		-1.69	67.82
2440	-1.05	78.53		-1.65	68.39
2460	-1.08	78.06		-1.68	67.99
2480	-1.09	77.83		-1.69	67.78
2500	-1.11	77.37		-1.71	67.39
5150	-1.13	77.17	0.2m*5.5dB/m	-2.23	59.90
5200	-1.08	78.05		-2.18	60.59
5250	-1.11	77.53		-2.21	60.18
5300	-1.10	77.65		-2.20	60.28
5350	-1.01	79.20		-2.11	61.48
5400	-1.12	77.33		-2.22	60.02
5450	-1.04	78.68		-2.14	61.07
5500	-1.09	77.73		-2.19	60.33
5550	-1.09	77.83		-2.19	60.42
5600	-1.05	78.54		-2.15	60.97
5650	-1.19	76.10		-2.29	59.07
5700	-1.23	75.30		-2.33	58.46
5750	-1.18	76.29		-2.28	59.22
5800	-1.25	74.94		-2.35	58.17
5850	-1.30	74.07		-2.40	57.49

5925	-2.72	53.41		-3.82	41.46

Port 2	100mm cable			300mm cable	
Frequency (MHz)	Efficiency (dB)	Efficiency (%)	Cable Loss	Efficiency (dB)	Efficiency (%)
	X		X-LOSS=Y	Y	
6000	-2.49	56.38	0.2m*6.5dB/m	-3.79	41.79
6100	-2.55	55.62		-3.85	41.23
6200	-2.15	60.89		-3.45	45.13
6300	-1.45	71.62		-2.75	53.09
6400	-1.72	67.30		-3.02	49.89
6500	-1.87	65.05		-3.17	48.22
6600	-1.86	65.22		-3.16	48.35
6700	-1.39	72.55		-2.69	53.78
6800	-1.57	69.61		-2.87	51.60
6900	-0.95	80.39		-2.25	59.59
7000	-0.95	80.38		-2.25	59.59
7100	-0.87	81.90		-2.17	60.71
7125	-0.86	82.04		-2.16	60.81

The data is just for your reference, all accurate performance should be according to the test results in the OTA chamber

8.0 CHANGE HISTORY

REV	DATA	DESCRIPTION
A	2018/09/21	First Release
B	2020/07/06	Update file layout and add 6-7.125GHz band