TITLE

WIFI GNSS CHIP COMBO ANTENNA

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WIFI GNSS CHIP COMBO 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: WIFI GNSS chip combo antenna

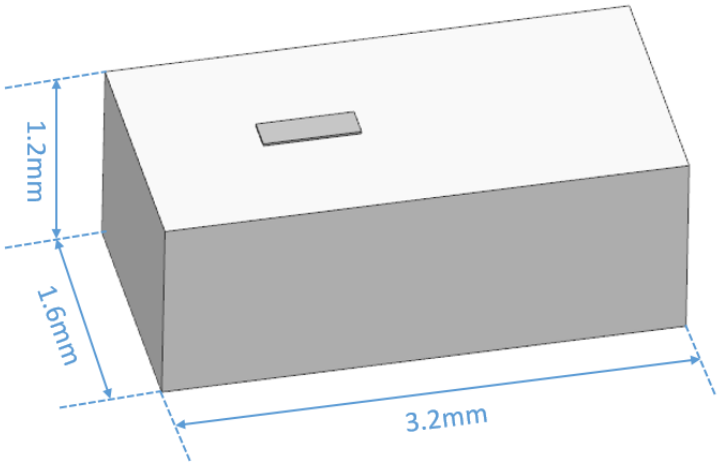
Series Number: 2169420001

2.2 DESCRIPTION

216942 is a ceramic SMT/chip antenna simultaneously working at frequency bands of GNSS (1.561/1.575/1.601GHz) and WiFi (2.4/5.8GHz). It eliminates the need of putting two standalone antennas to support the two standards. It is compact size (3.2x1.6x1.2mm) and only needs a small keep-out space (8x6mm). Hence, 216942 is a perfect choice for those space constrained and cost sensitive applications, for example, wearable/portable devices, car black box, tracker, navigation devices, etc.

2.3 PRODUCT STRUCTURE INFORMATION

Please refer to PS-2169420001 for full information.



Molex 2169420001 3D VIEW

3.0 APPLICABLE DOCUMENTS

DOCUMENT	NUMBER	DESCRIPTION
Sale Drawing (SD)	SD-2169420001	Mechanical Dimension of the product
Product Specification (PS)	PS-2169420001	Product Specification
Packing Drawing (PK)	PK-2169420001	Product packaging specifications

4.0 ANTENNA PERFORMANCE

4.1 RF TEST CONDITIONS

All measurements are done of the antenna mounted on a reference PCB (80*40*0.8mm) with VNA Agilent E5071C and Over-The-Air (OTA) chamber.

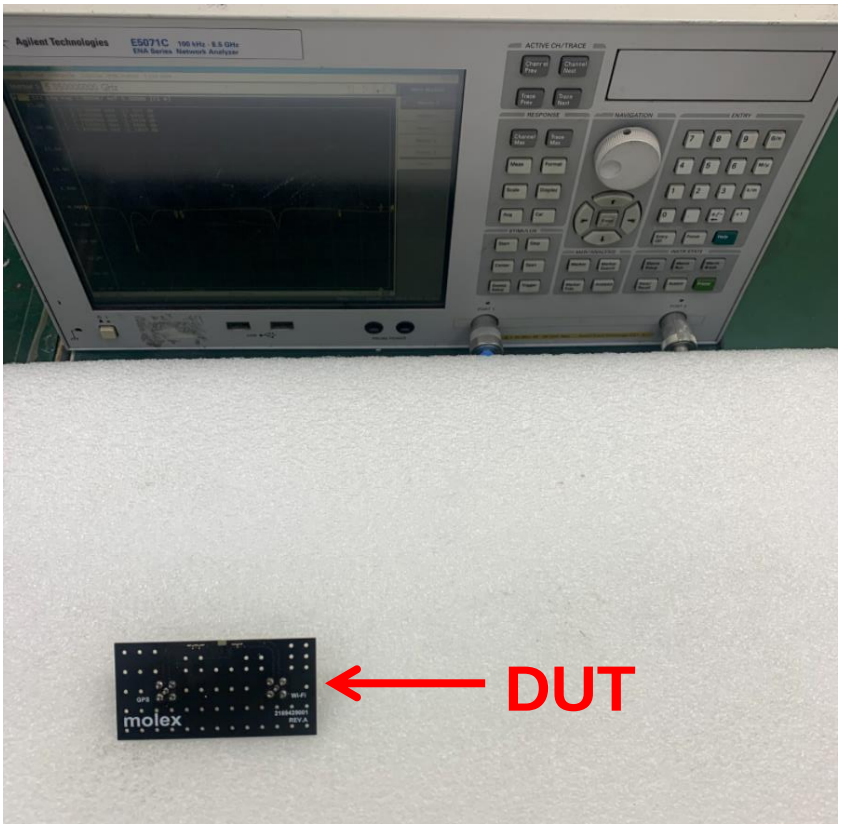


FIGURE4.1.1 ANTENNA LOADED WITH REFERENCE PCB TESTED WITH VNA E5071C

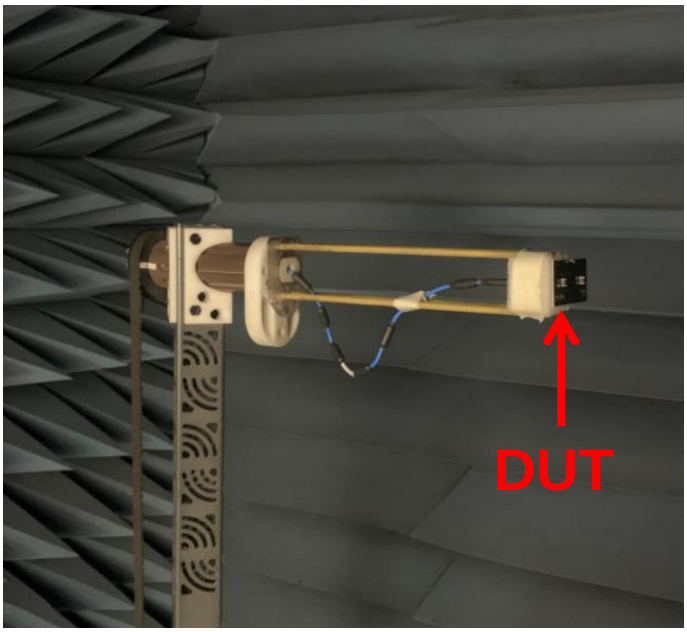
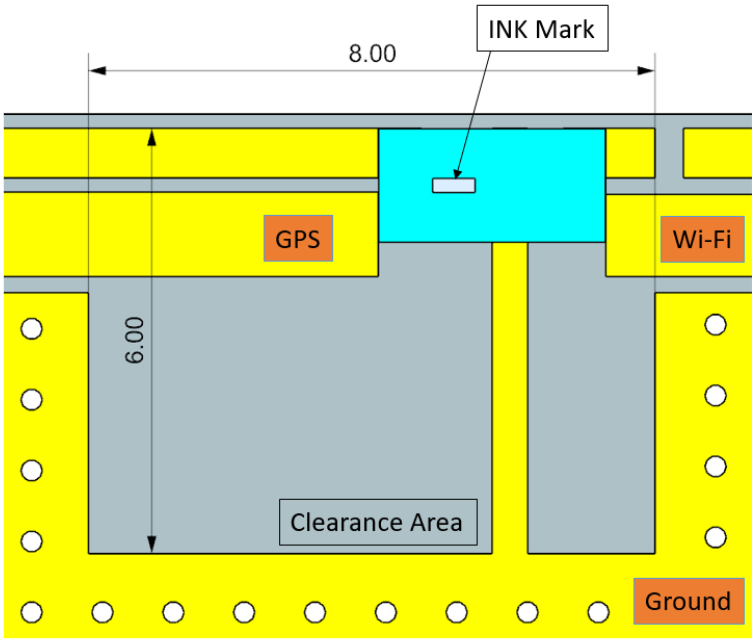


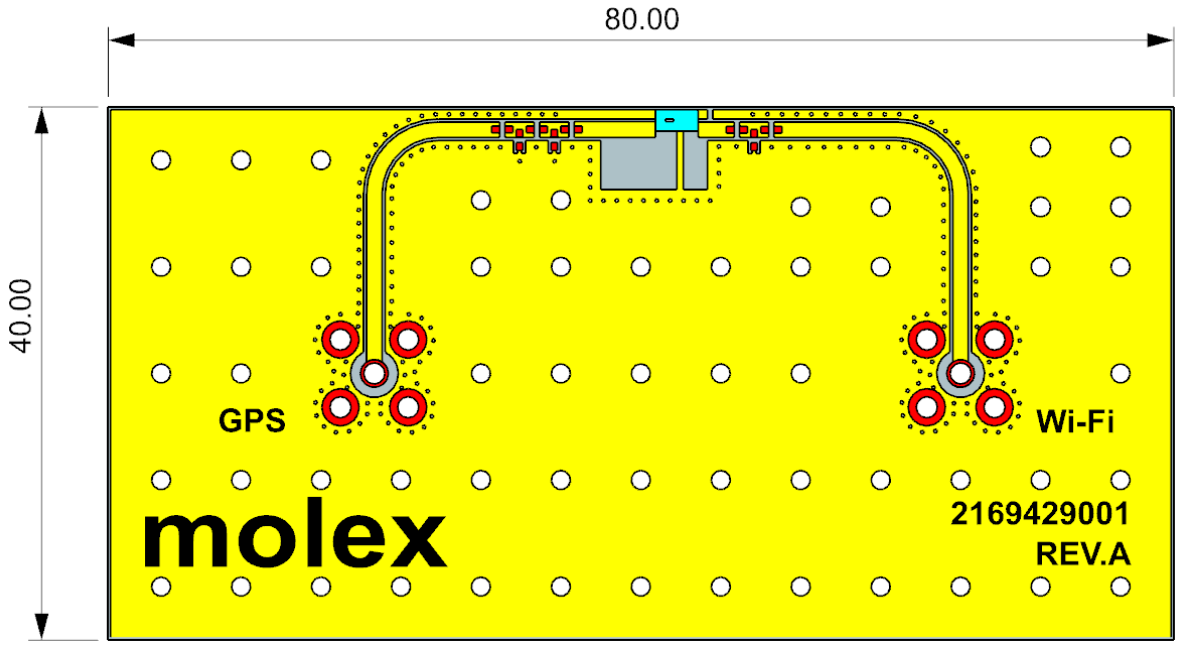
FIGURE4.1.2 ANTENNA LOADED WITH REFERENCE PCB TESTED IN OTA CHAMBER

4.2 ANTENNA PERFORMANCE

DESCRIPTION	EQUIPMENT	Requirements (For GPS)			Requirements (For WIFI)	
Frequency Range	VNA E5071C	1561.098± 2.046 MHz	1575.42± 1.023 MHz	1602.56± 4MHz	2.4-2.5GHz	5.15-5.85GHz
Return Loss	VNA E5071C	< -6 dB	< -10 dB	< -6 dB	< -7 dB	< -5 dB
Peak Gain (Max)	OTA Chamber	0.4dBi	0.8dBi	0.8dBi	1.3dBi	3.0dBi
Average Total Efficiency	OTA Chamber	>40%	>45%	>45%	>50%	>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 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.





REVISION:	ECR/ECN INFORMATION:	TITLE:	SHEET No.
A	EC No: 660310 DATE: 2021/04/10	WIFI GNSS Chip Combo Antenna Application Specification	5 of 28

DOCUMENT NUMBER:	CREATED / REVISED BY:	CHECKED BY:	APPROVED BY:
AS-2169420001	Liu Hai 2021/04/08	Stern Zhao 2021/04/08	Chris Zhong 2021/04/08

4.3 RETURN LOSS PLOT

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

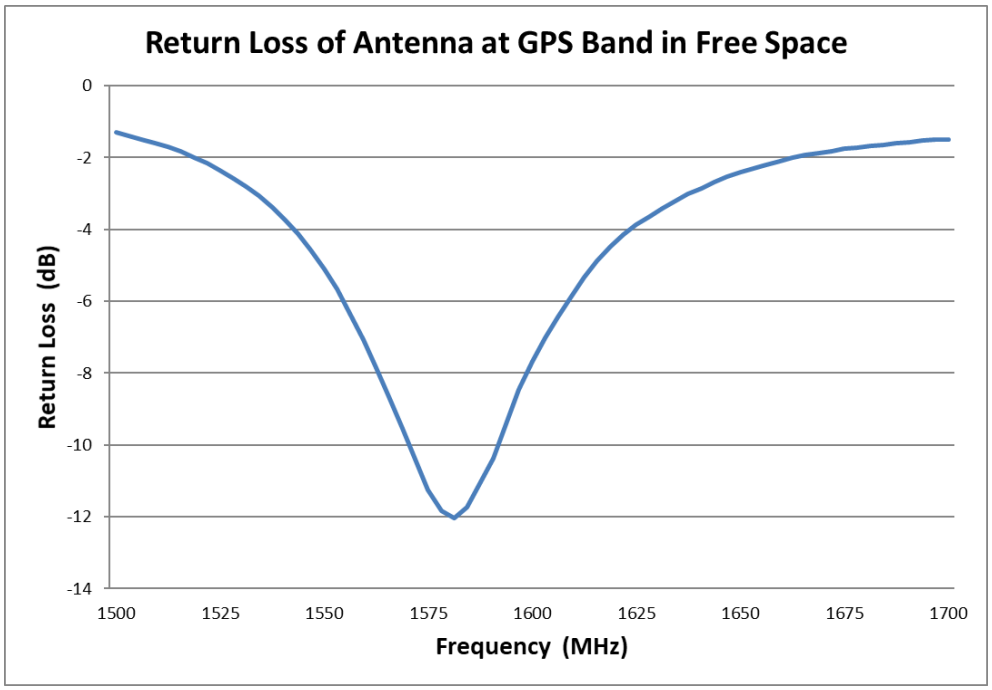


FIGURE 4.3.1 RETURN LOSS OF ANTENNA AT GPS BAND IN FREE SPACE

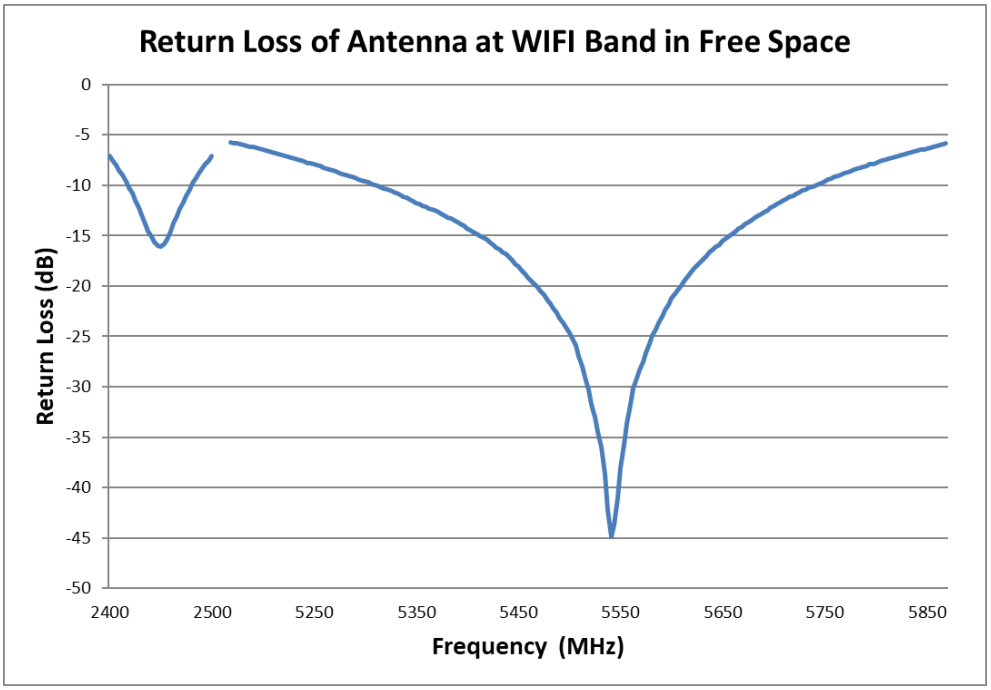


FIGURE 4.3.2 RETURN LOSS OF ANTENNA AT WIFI BAND IN FREE SPACE

4.4 EFFICIENCY PLOT

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

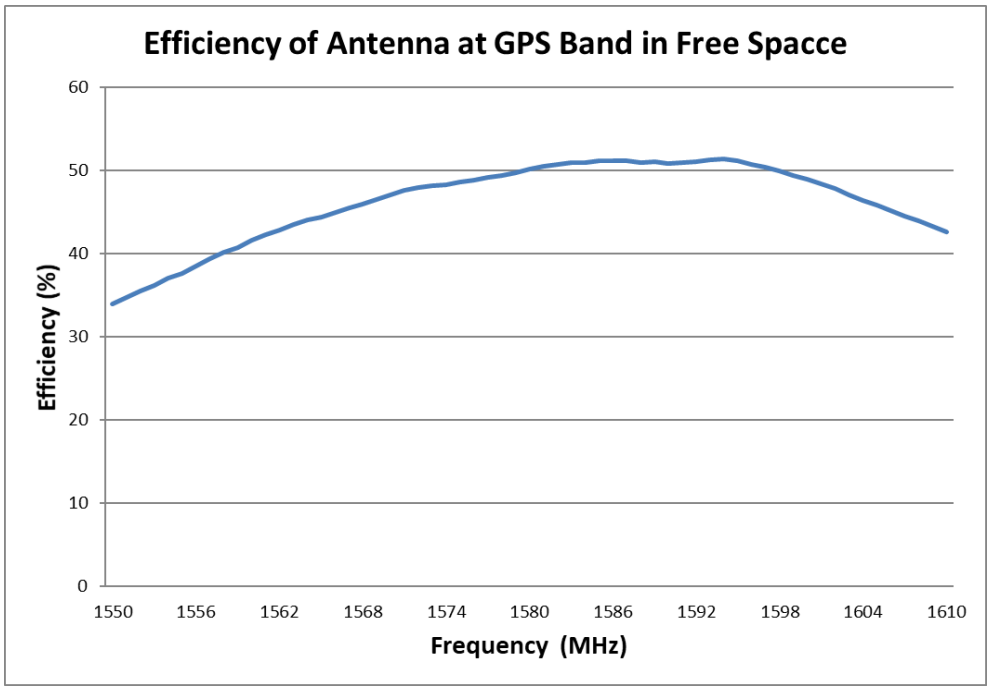


FIGURE 4.4.1 EFFICIENCY OF ANTENNA AT GPS BAND IN FREE SPACE

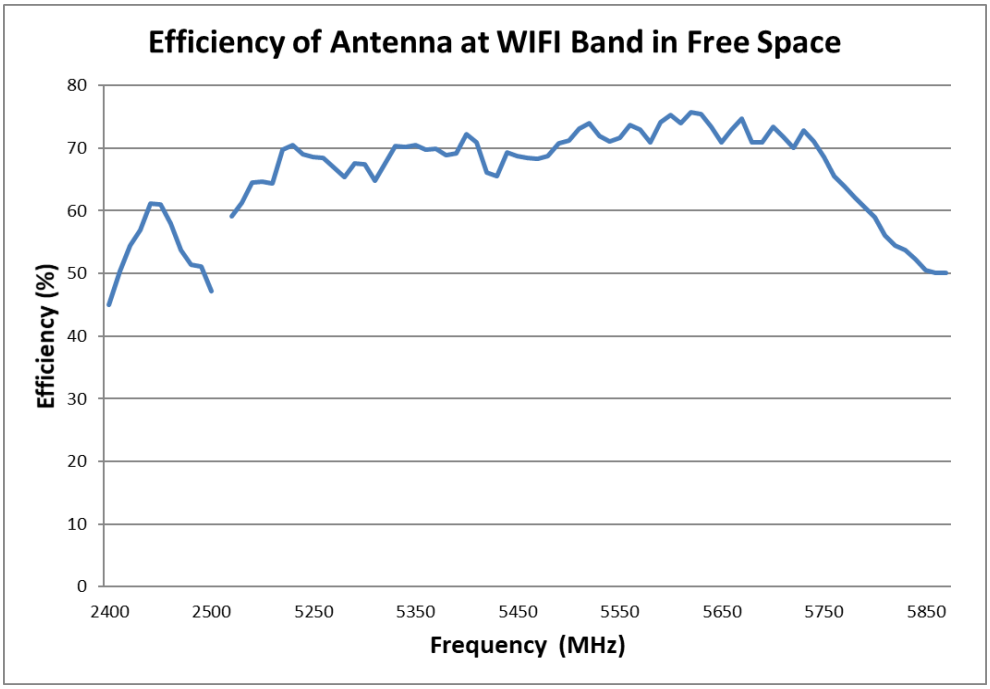


FIGURE 4.4.2 EFFICIENCY OF ANTENNA AT WIFI BAND IN FREE SPACE

4.5 2D RADIATION PATTERN

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

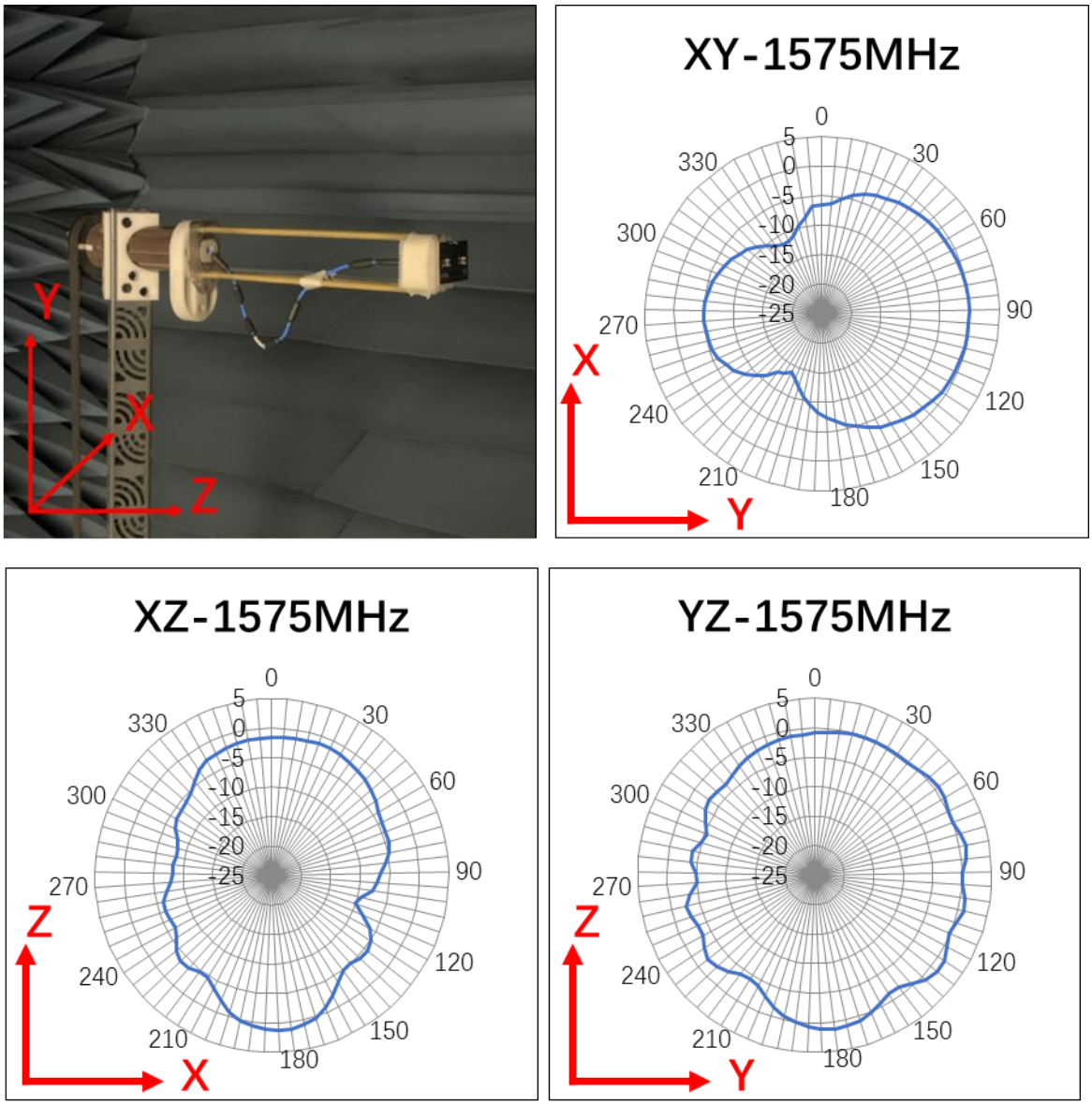


FIGURE 4.5.1 2D RADIATION PATTERN OF ANTENNA AT 1575MHZ IN FREE SPACE

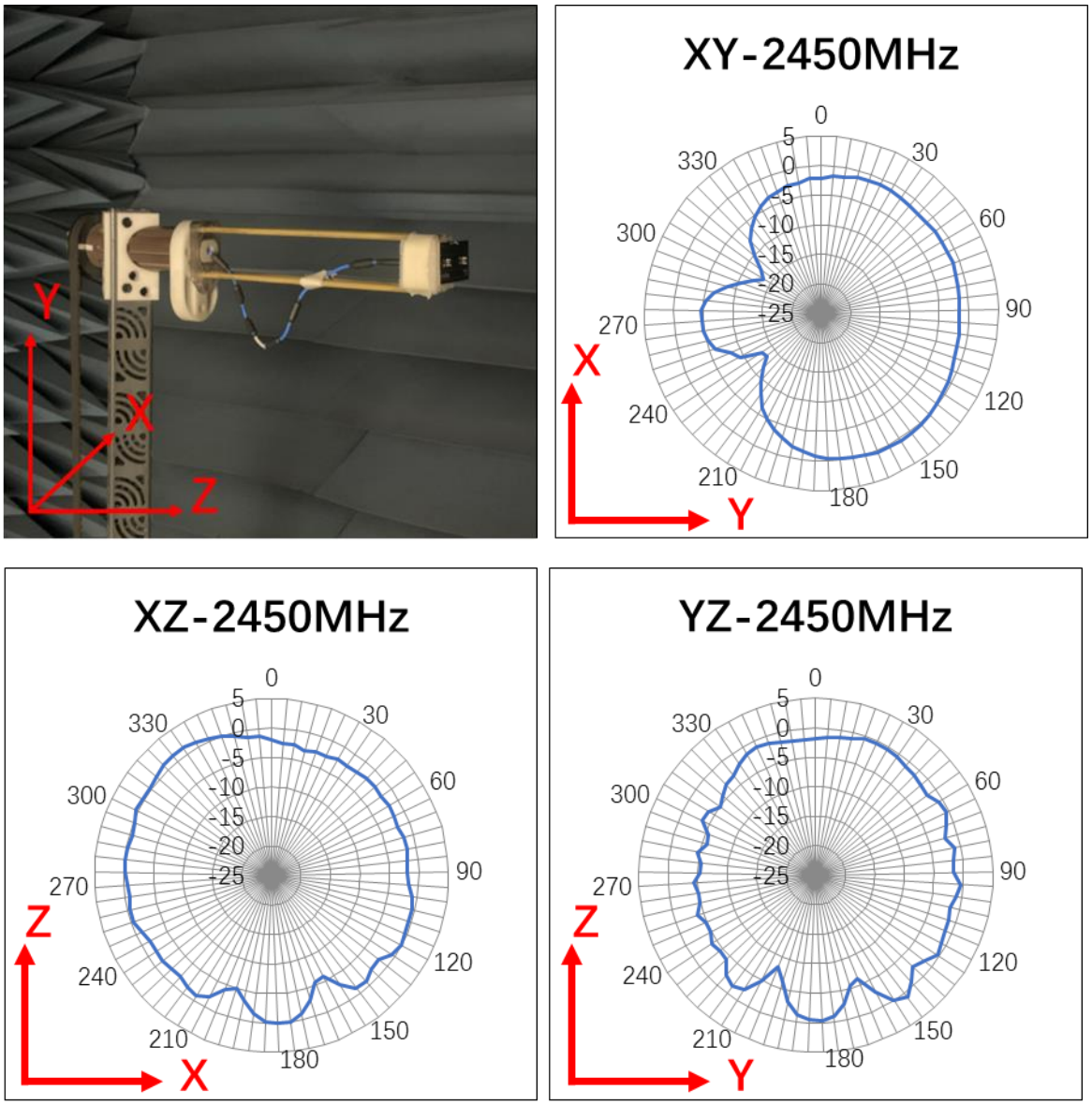


FIGURE 4.5.2 2D RADIATION PATTERN OF ANTENNA AT 2450MHZ IN FREE SPACE

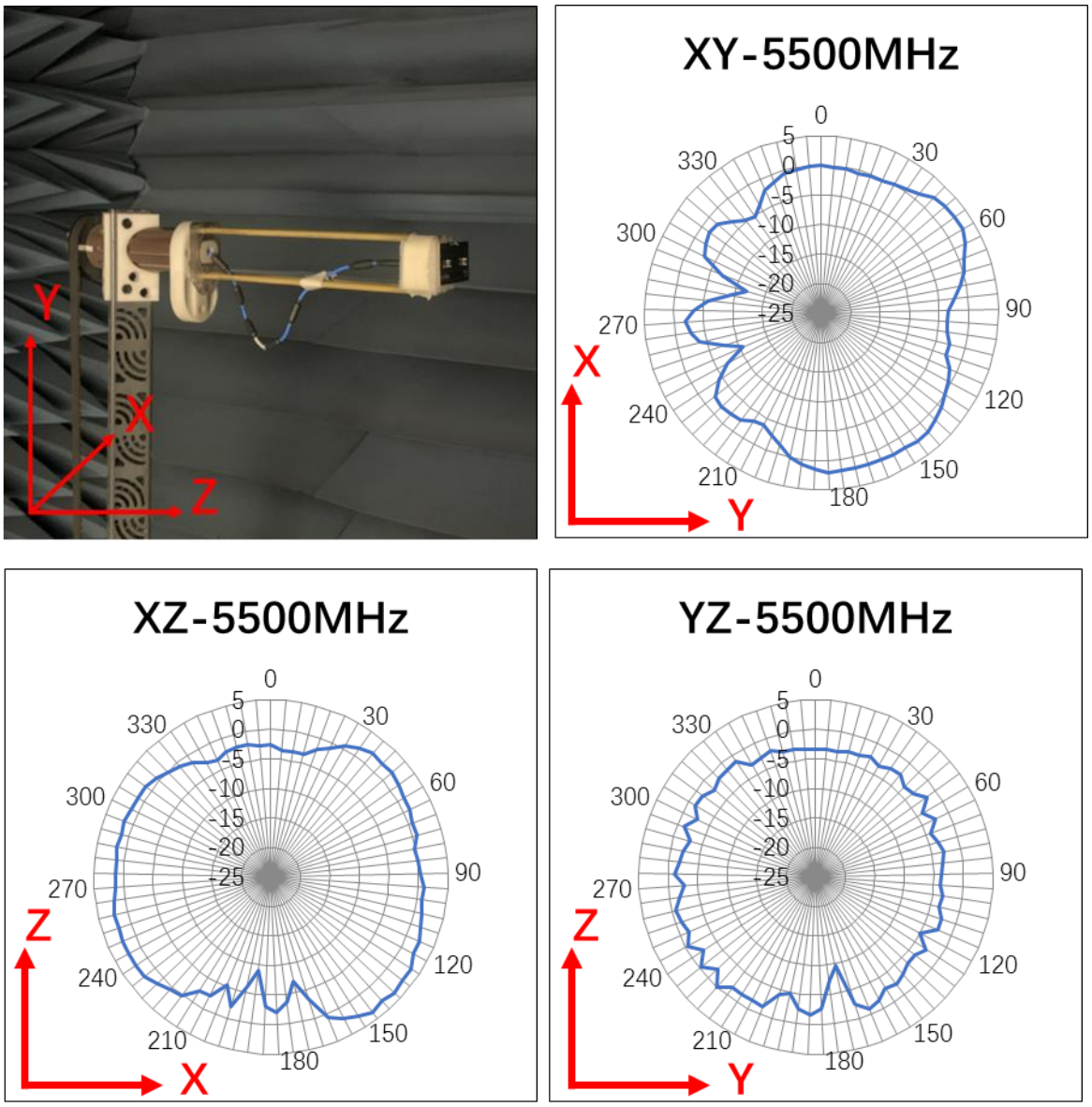


FIGURE 4.5.3 2D RADIATION PATTERN OF ANTENNA AT 5500MHZ IN FREE SPACE

4.6 3D RADIATION PATTERN

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

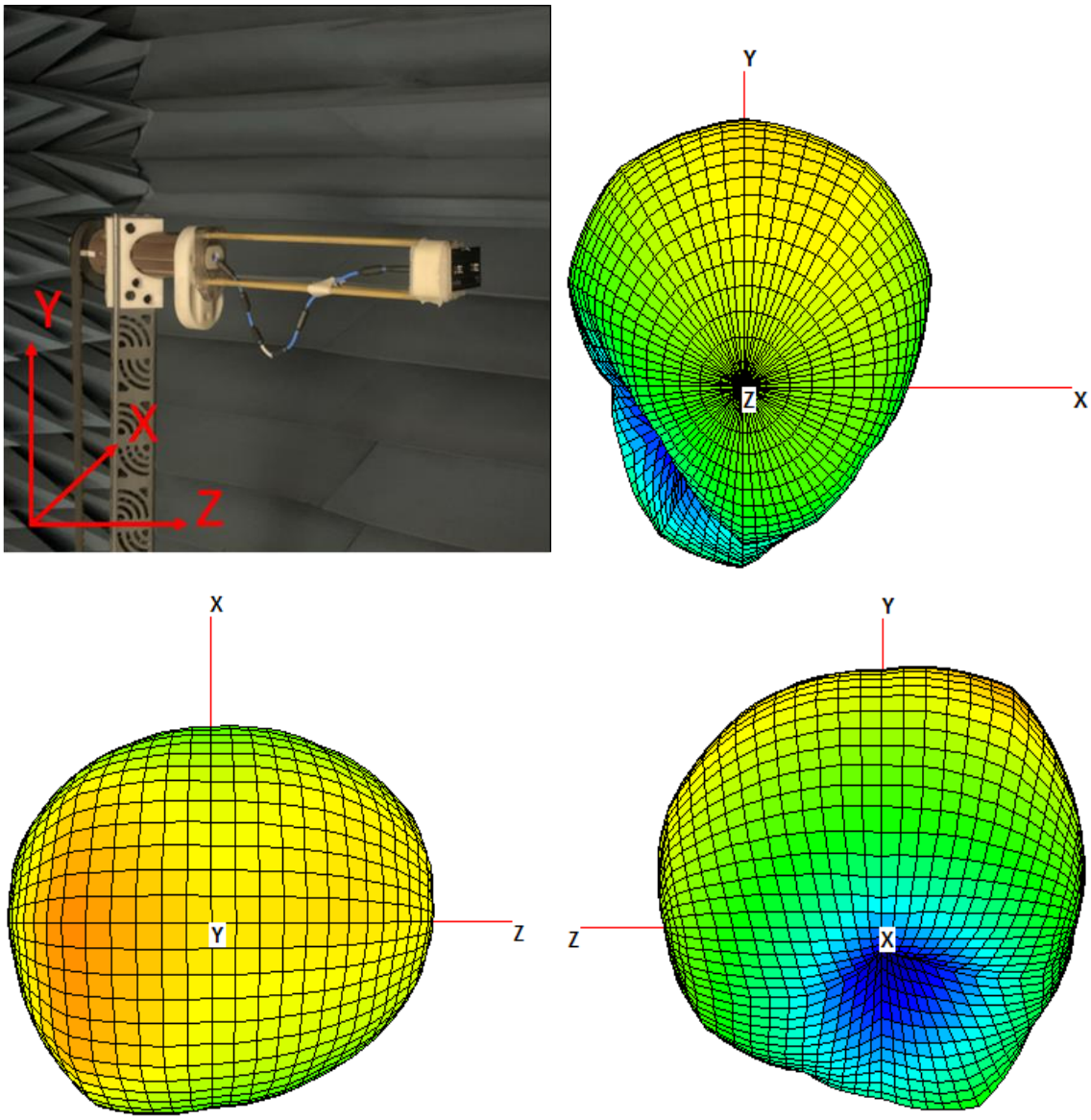


FIGURE 4.6.1 3D RADIATION PATTERN OF ANTENNA AT 1575MHZ IN FREE SPACE

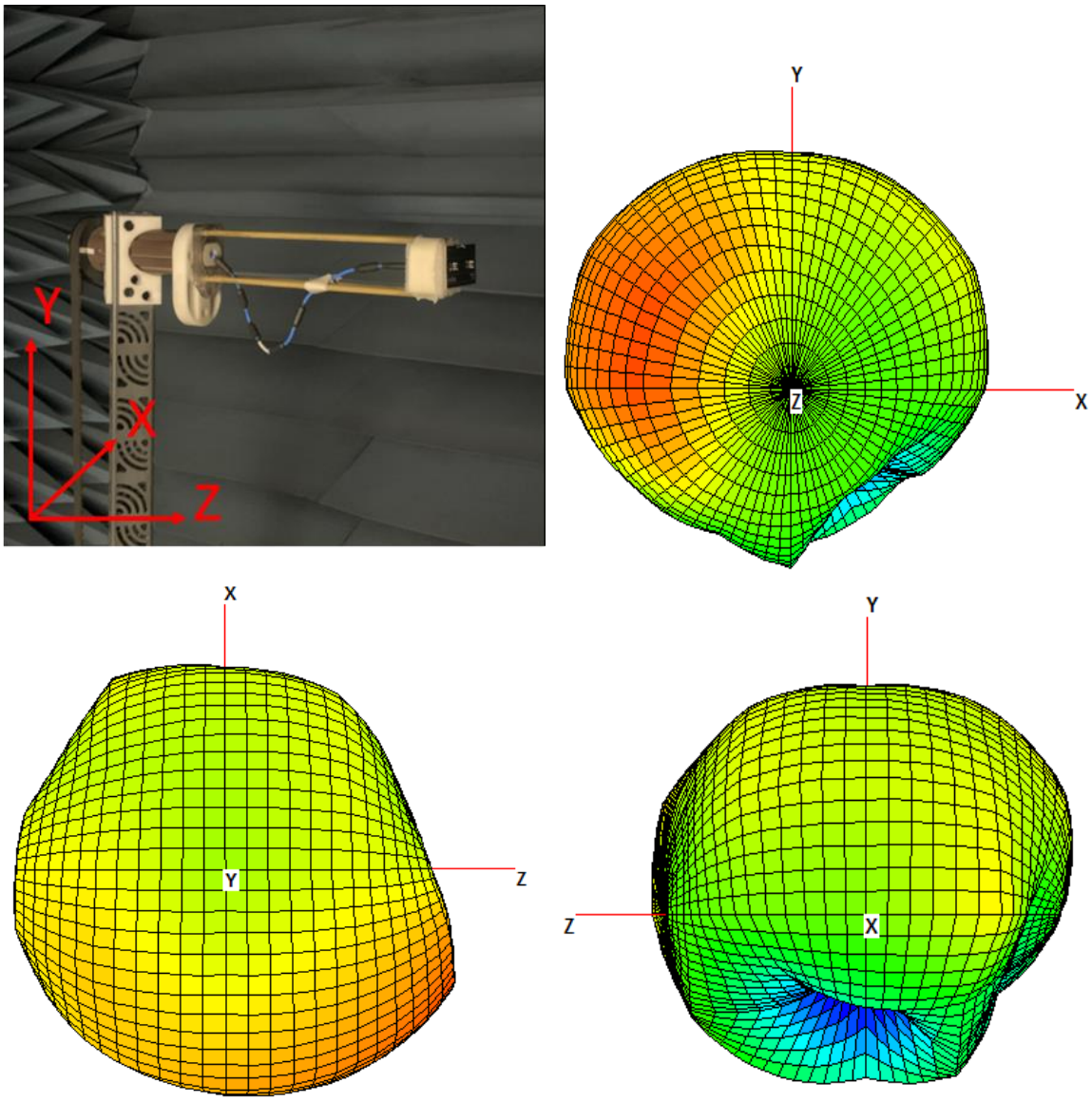


FIGURE 4.6.2 3D RADIATION PATTERN OF ANTENNA AT 2450MHZ IN FREE SPACE

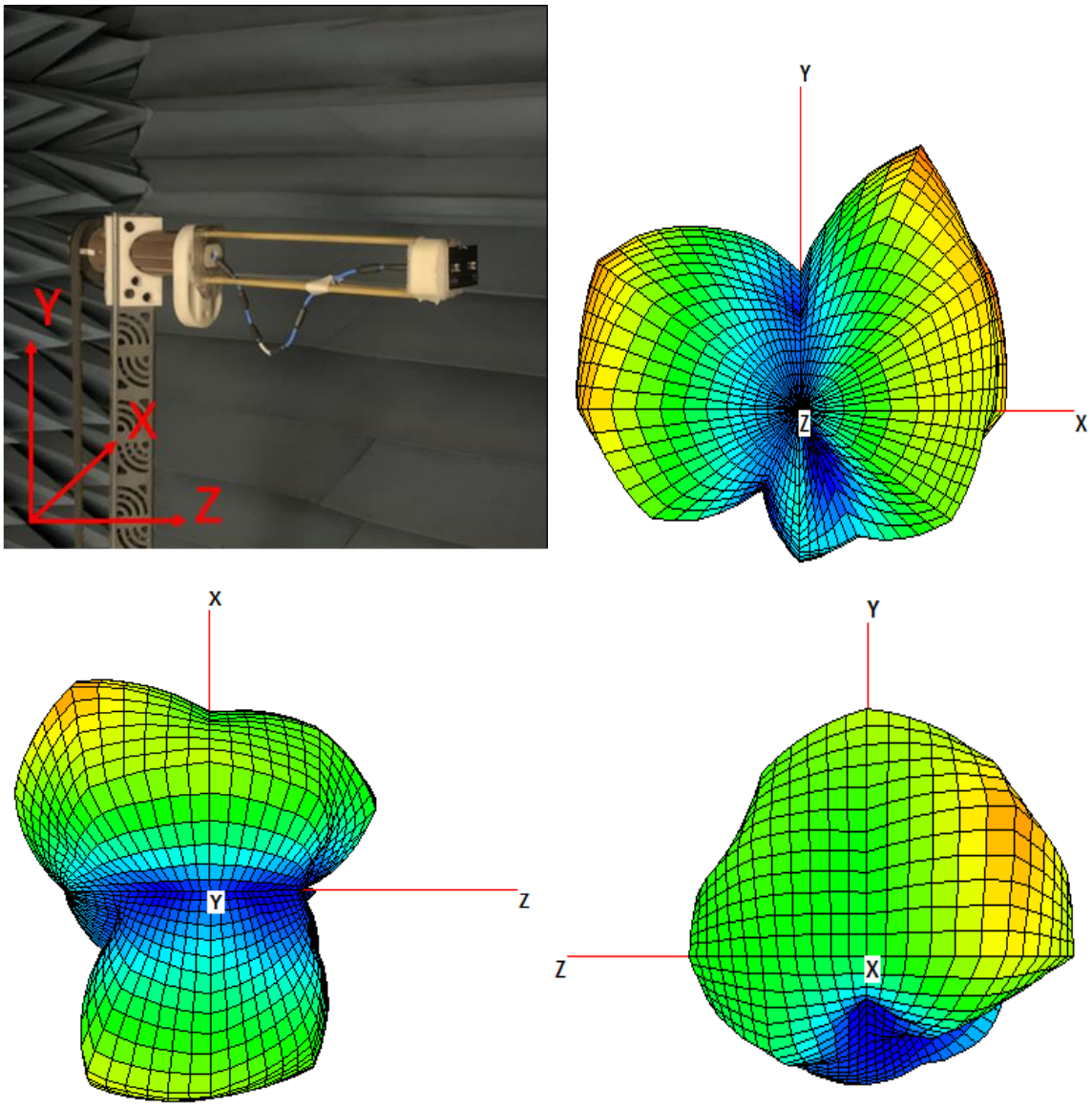


FIGURE 4.6.3 3D RADIATION PATTERN OF ANTENNA AT 5500MHZ IN FREE SPACE

5.0 MATCHING NETWORK DESRICPTION

The recommended matching network shown in Figure 5.1-5.2.

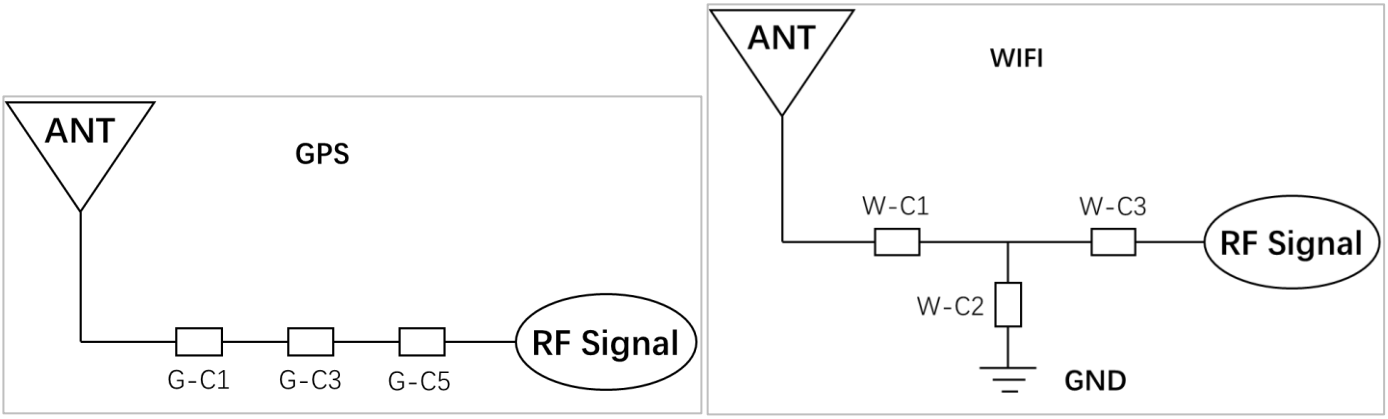
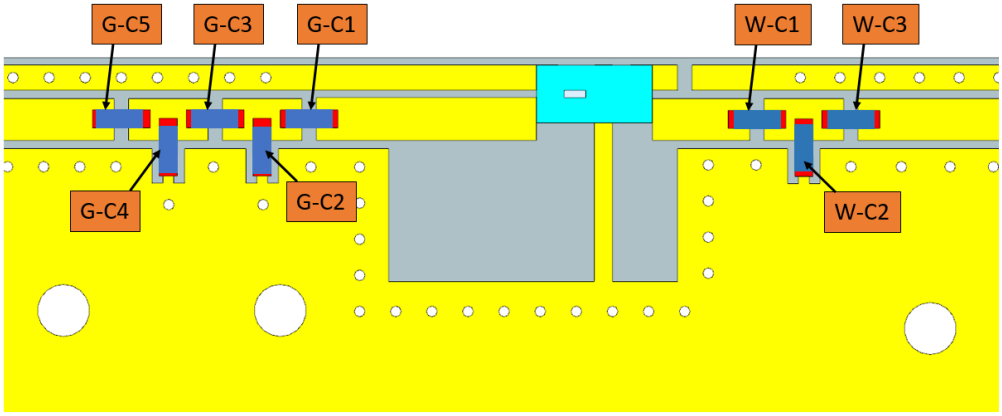


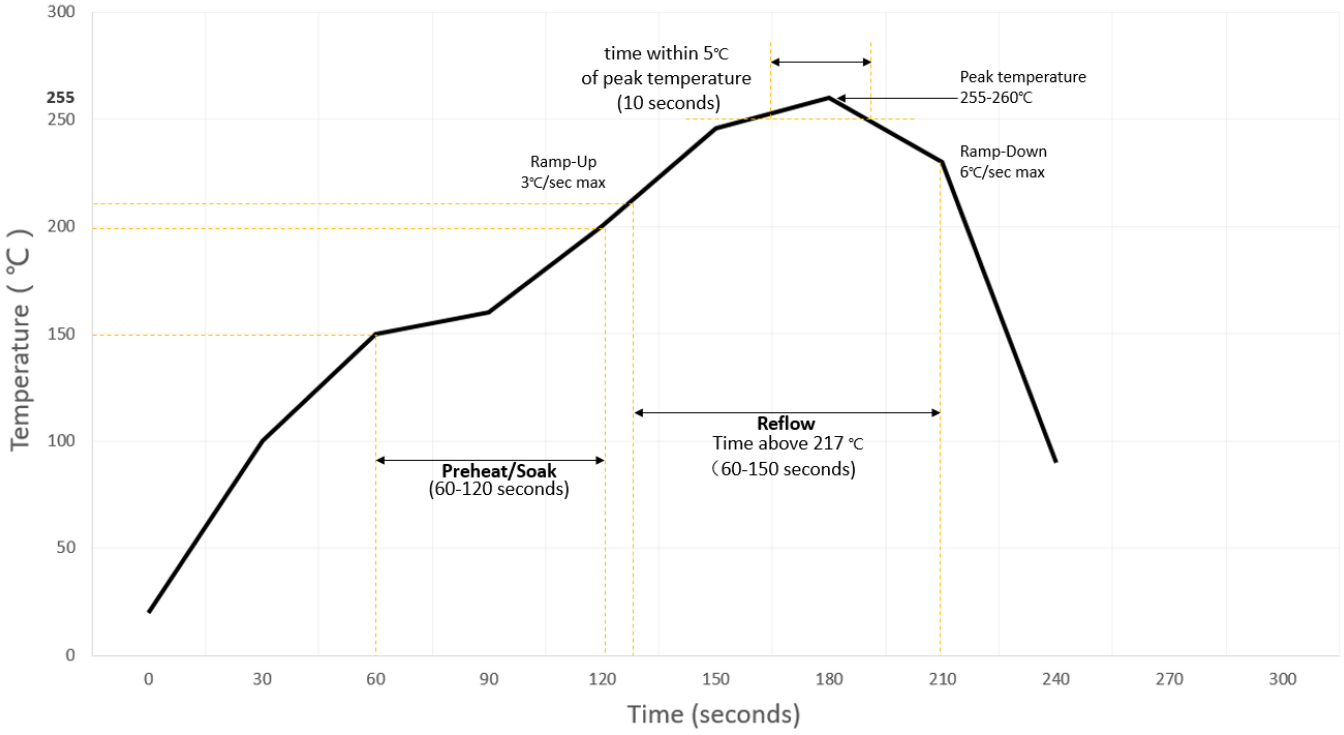
FIGURE 5.1 RECOMMENDED MATCHING CIRCUIT SCHEMATIC



Component	GPS	Component	WIFI
G-C1	1pF	W-C1	2.2pF
	Murata: GRM1555C1H1R0BA01D		Murata: GRM1555C1H2R2BA01D
G-C2	NA	W-C2	2.2nH
			Murata: LQP15MN2N2B02D
G-C3	10nH	W-C3	3.6nH
	Murata: LQW15AN10NG00D		Murata: LQP15MN3N6B02D
G-C4	NA		
G-C5	0.7pF		
	Murata: GRM1555C1HR70BA01D		

FIGURE 5.2 RECOMMENDED MATCHING CIRCUIT

6.0 RECOMMENDED REFLOW CONDITION



Recommended solder paste: ALPHA CAP-390 SAC305;

Recommended stencil thickness: 0.1MM≤ T ≤ 0.15MM;

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.

7.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

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

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 the location presentation is shown in figure 7.1. The plane ground size is 90mm*90mm and we move the plane ground to four locations for each test.

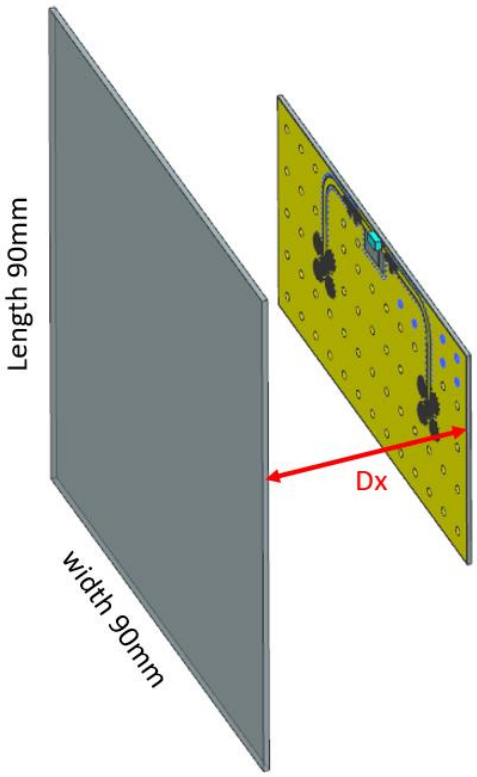


FIGURE 7.1 FOUR LOCATIONS WITH PARALLEL PLANE GROUND

Ground Size: 90mm*90mm;
Location D1: Distance between antenna and plane ground is about 10mm;
Location D2: Distance between antenna and plane ground is about 20mm;
Location D3: Distance between antenna and plane ground is about 30mm;
Location D4: Distance between antenna and plane ground is about 40mm
.

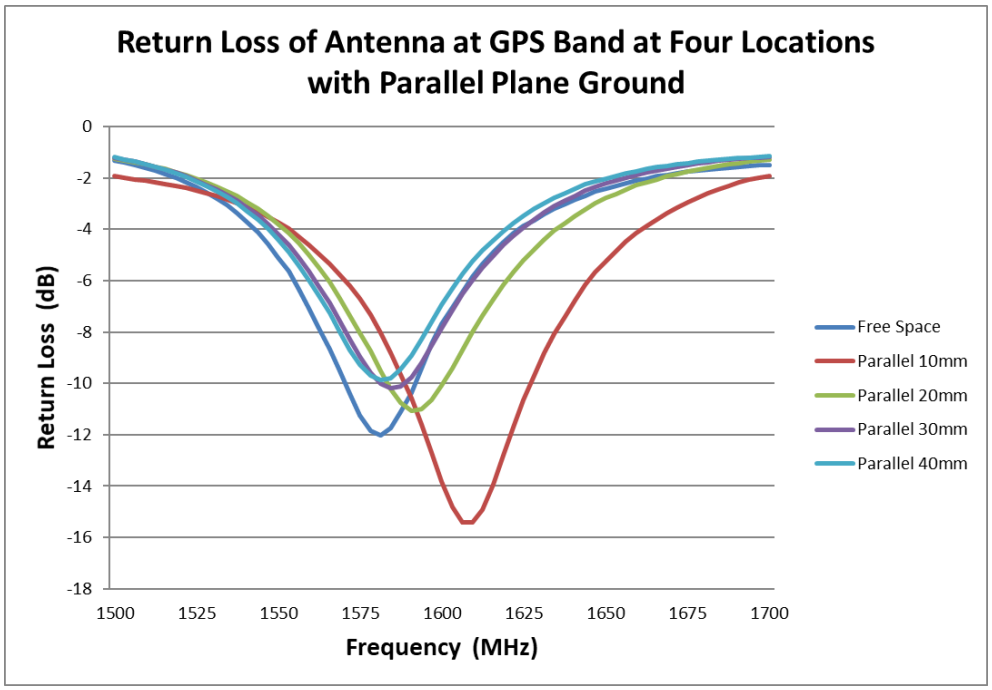


FIGURE 7.1.1 RETURN LOSS OF ANTENNA AT GPS BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND ON A REFERENCE PCB

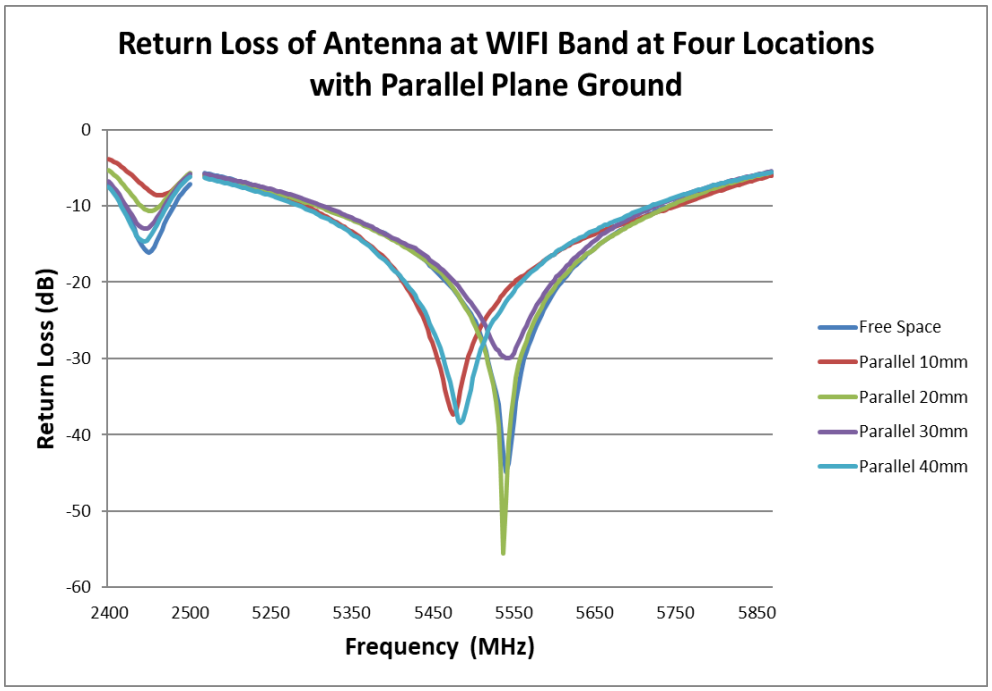


FIGURE 7.1.2 RETURN LOSS OF ANTENNA AT WIFI BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND ON A REFERENCE PCB

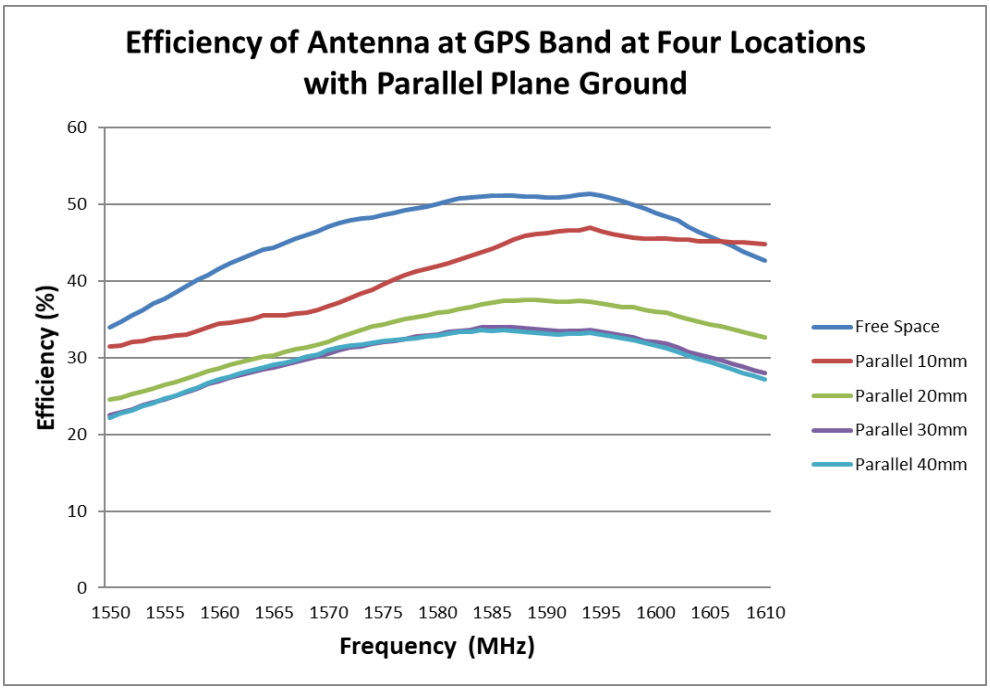


FIGURE 7.1.3 EFFICIENCY OF ANTENNA AT GPS BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND ON A REFERENCE PCB

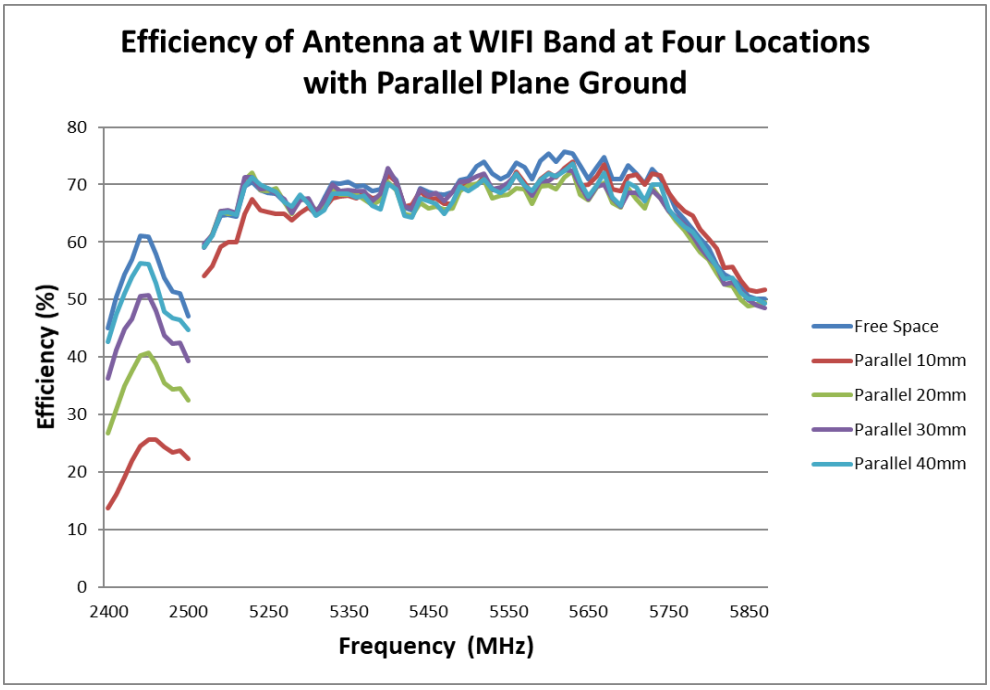


FIGURE 7.1.4 EFFICIENCY OF ANTENNA AT WIFI BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND ON A REFERENCE PCB

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 the location presentation is shown in figure 7.2. The plane ground size is 60*30mm and we move the plane ground to four locations for each test.

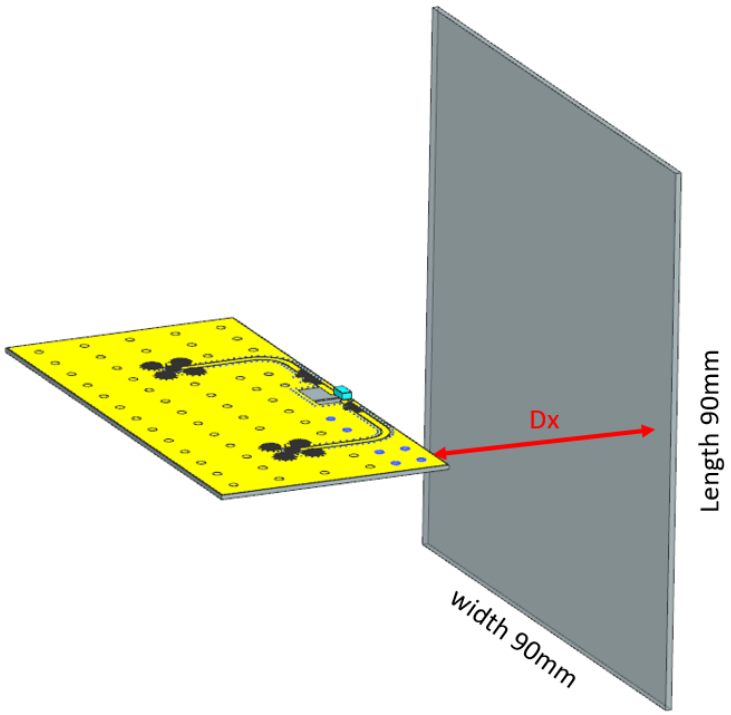


FIGURE 7.2 FOUR LOCATIONS WITH VERTICAL PLANE GROUND

Ground Size: 90mm*90mm;
Location D1: Distance between antenna and plane ground is about 10mm;
Location D2: Distance between antenna and plane ground is about 20mm;
Location D3: Distance between antenna and plane ground is about 30mm;
Location D4: Distance between antenna and plane ground is about 40mm.

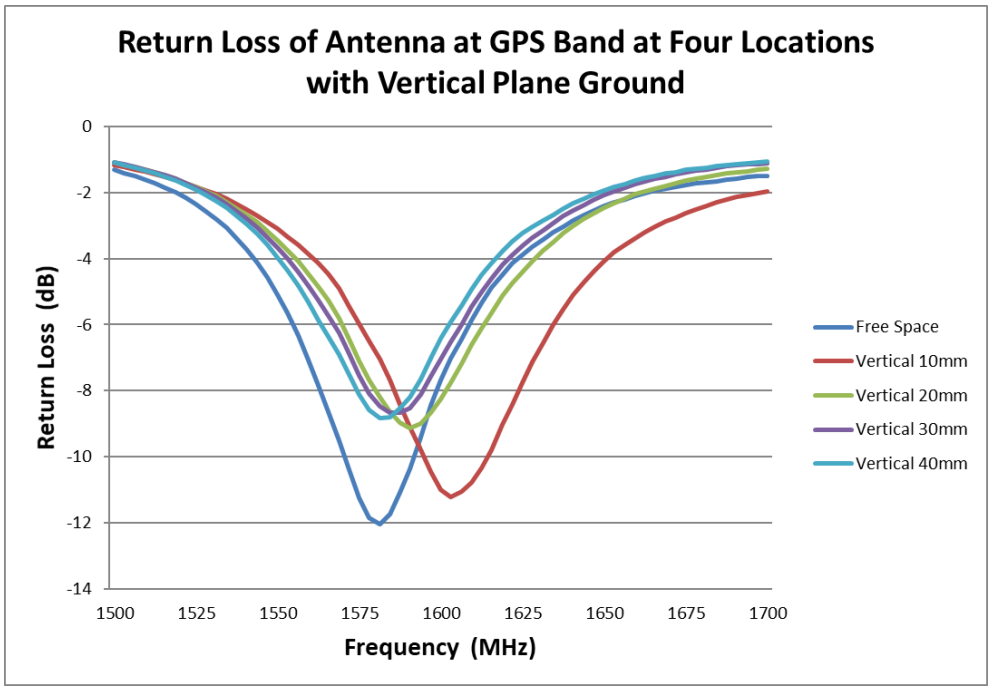


FIGURE 7.2.1 RETURN LOSS OF ANTENNA AT GPS BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND ON A REFERENCE PCB

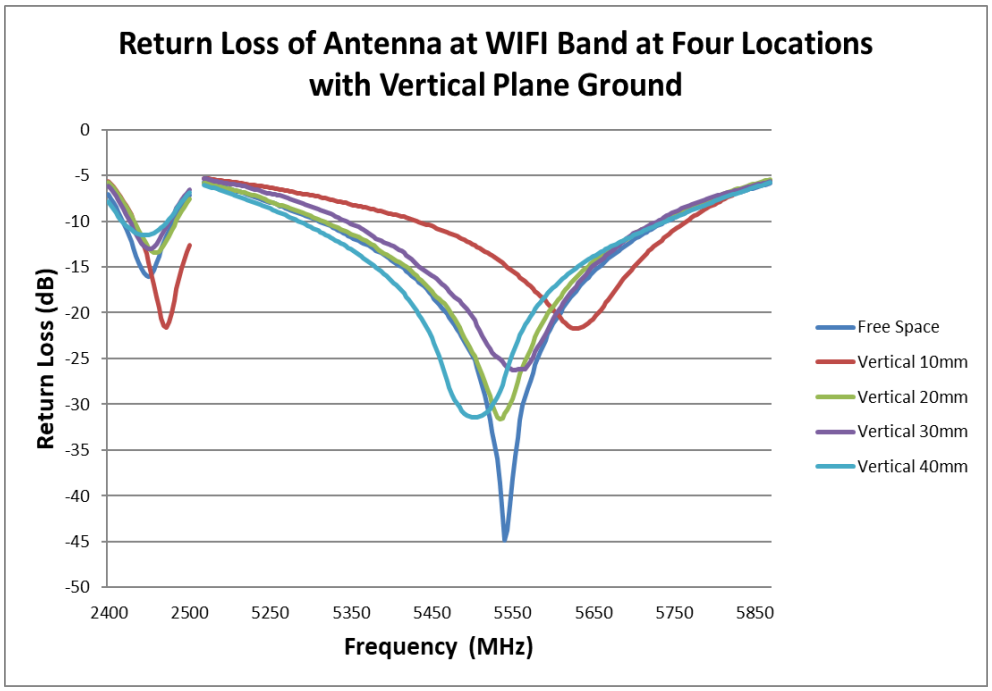


FIGURE 7.2.2 RETURN LOSS OF ANTENNA AT WIFI BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND ON A REFERENCE PCB

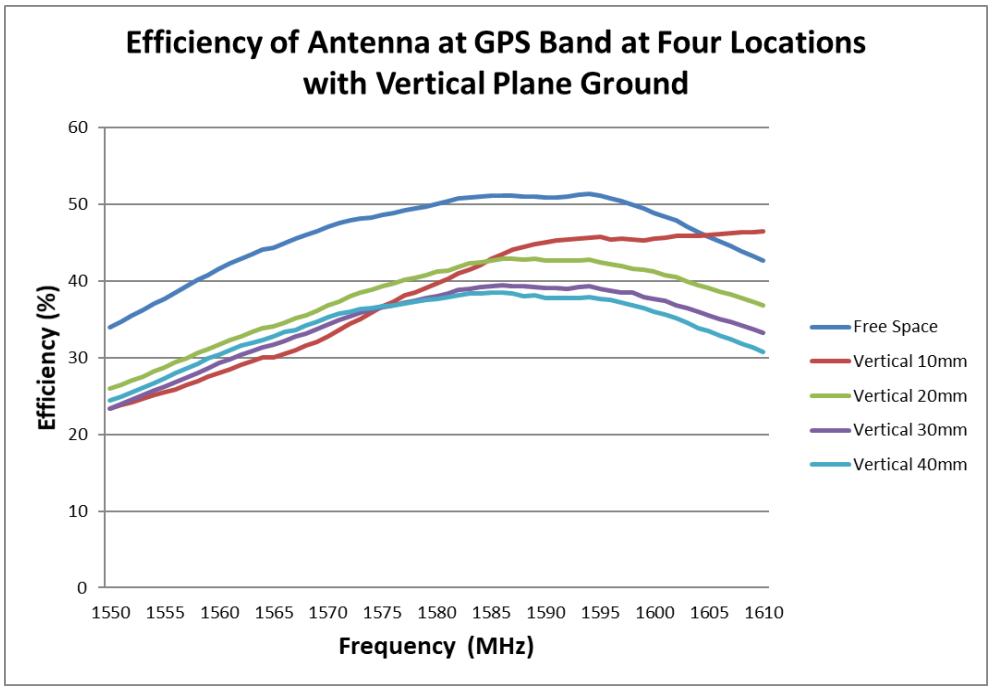


FIGURE 7.2.3 EFFICIENCY OF ANTENNA AT GPS BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND ON A REFERENCE PCB

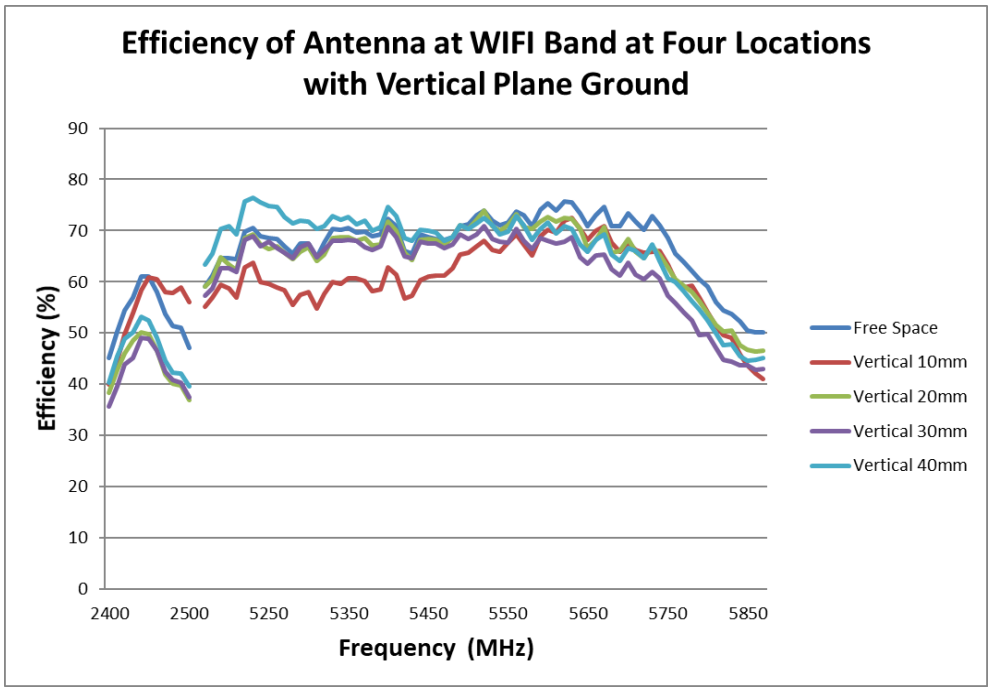


FIGURE 7.2.4 EFFICIENCY OF ANTENNA AT WIFI BAND AT FOUR LOCATIONS WITH VERTICAL PLANE GROUND ON A REFERENCE PCB

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 the location presentation is shown in figure 7.3. The plane ground size is 90*90mm and we move the plane ground to four locations for each test.

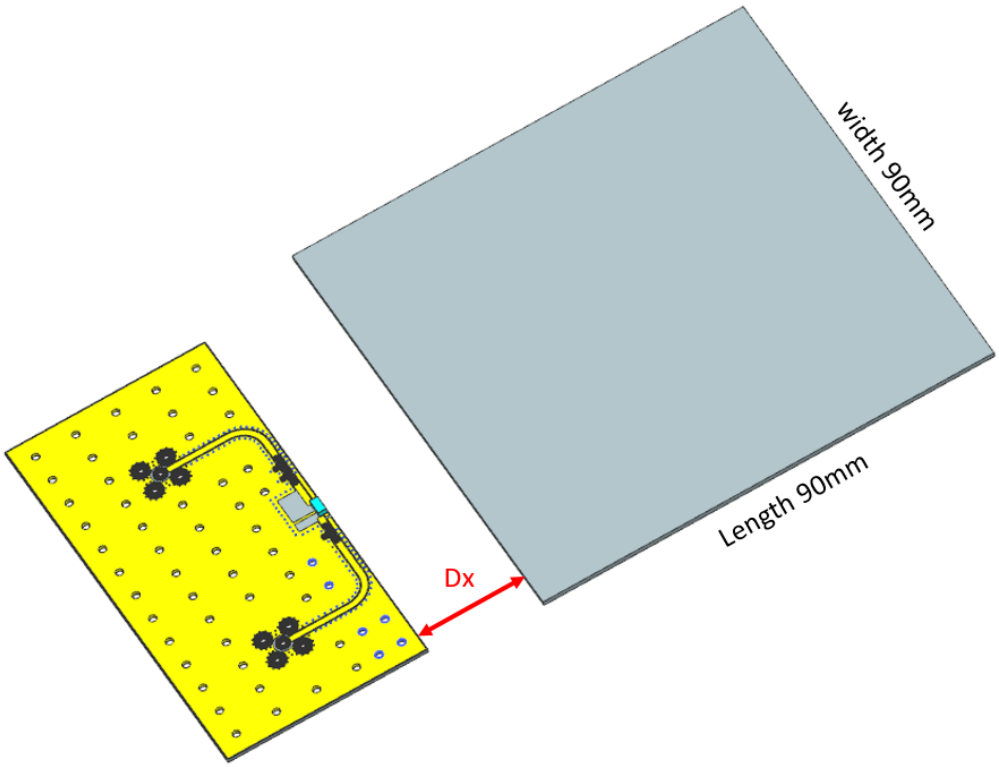


FIGURE 7.3 FOUR LOCATIONS WITH PARALLEL PLANE GROUND

Ground Size: 90mm*90mm;
Location D1: Distance between antenna and plane ground is about 10mm;
Location D2: Distance between antenna and plane ground is about 20mm;
Location D3: Distance between antenna and plane ground is about 30mm;
Location D4: Distance between antenna and plane ground is about 40mm.

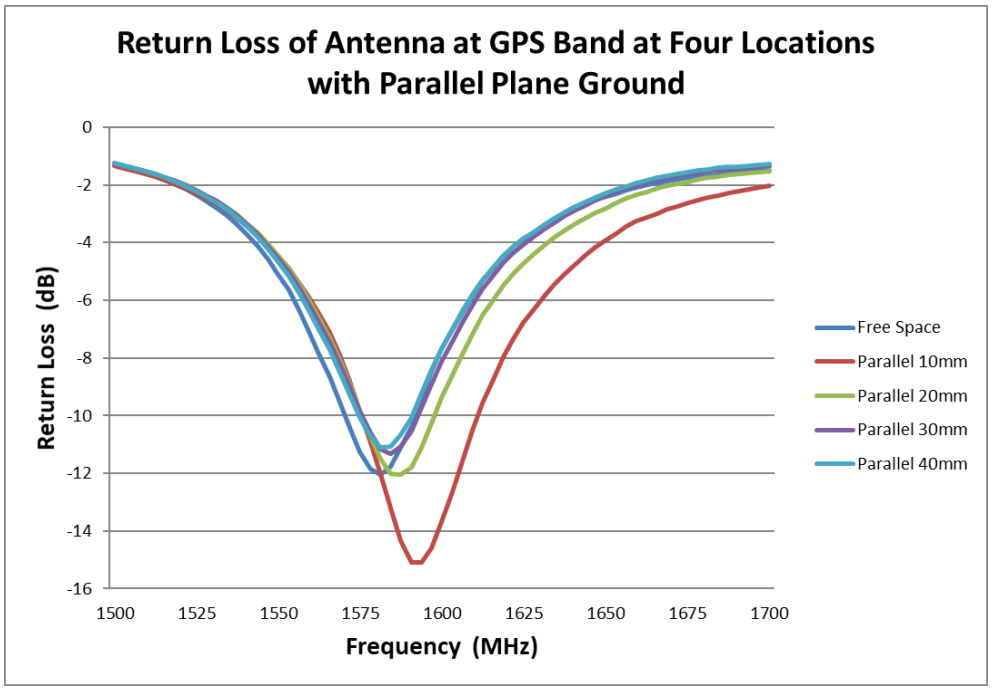


FIGURE 7.3.1 RETURN LOSS OF ANTENNA AT GPS BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND ON A REFERENCE PCB

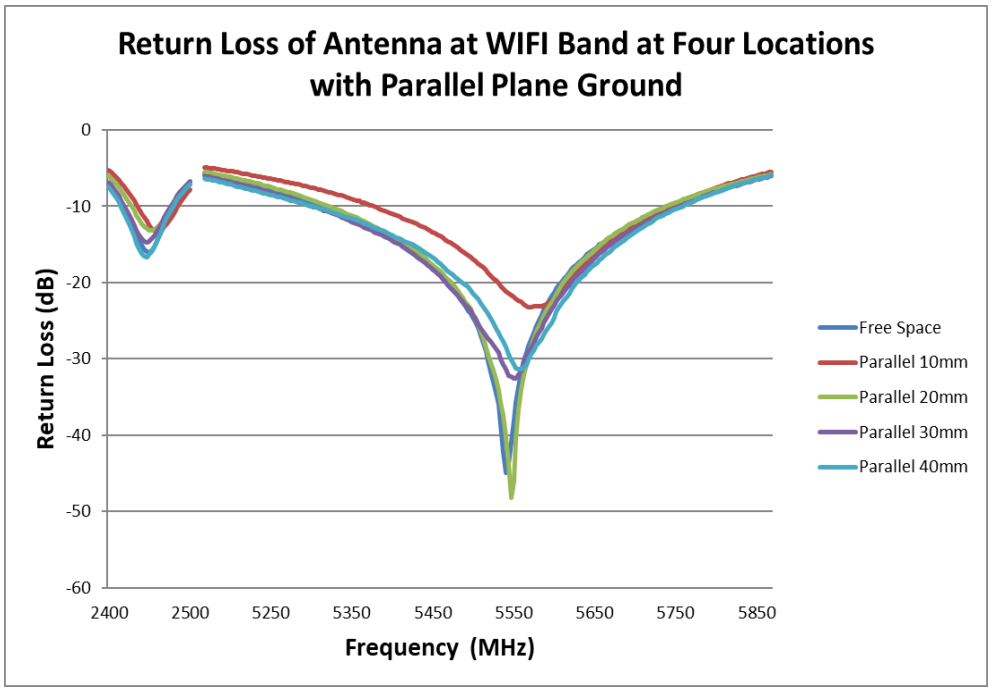


FIGURE 7.3.2 RETURN LOSS OF ANTENNA AT WIFI BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND ON A REFERENCE PCB

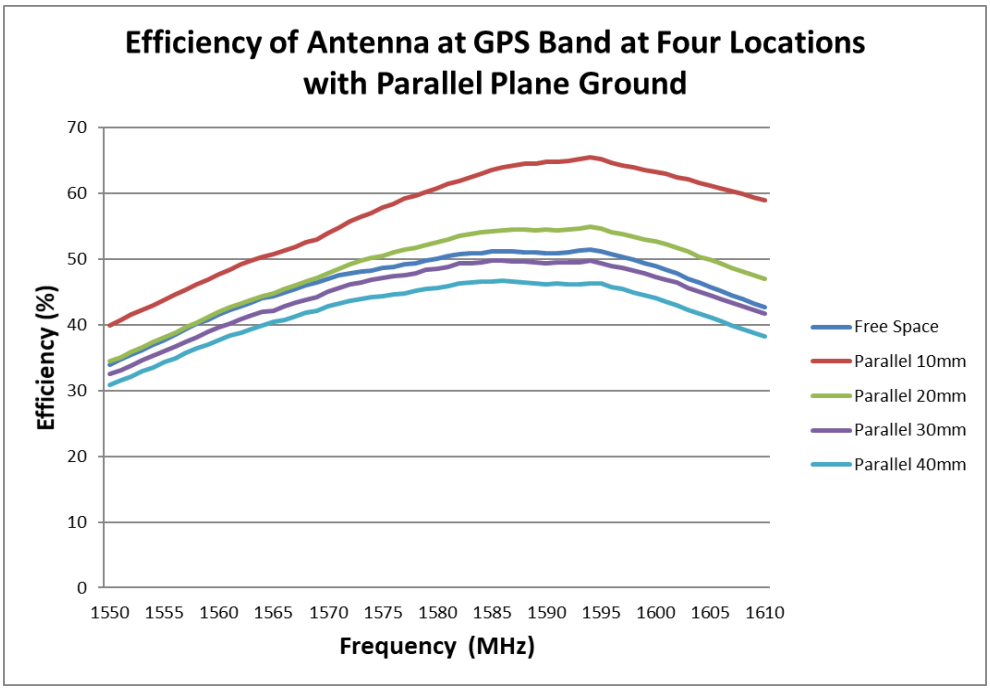


FIGURE 7.3.4 EFFICIENCY OF ANTENNA AT GPS BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND ON A REFERENCE PCB

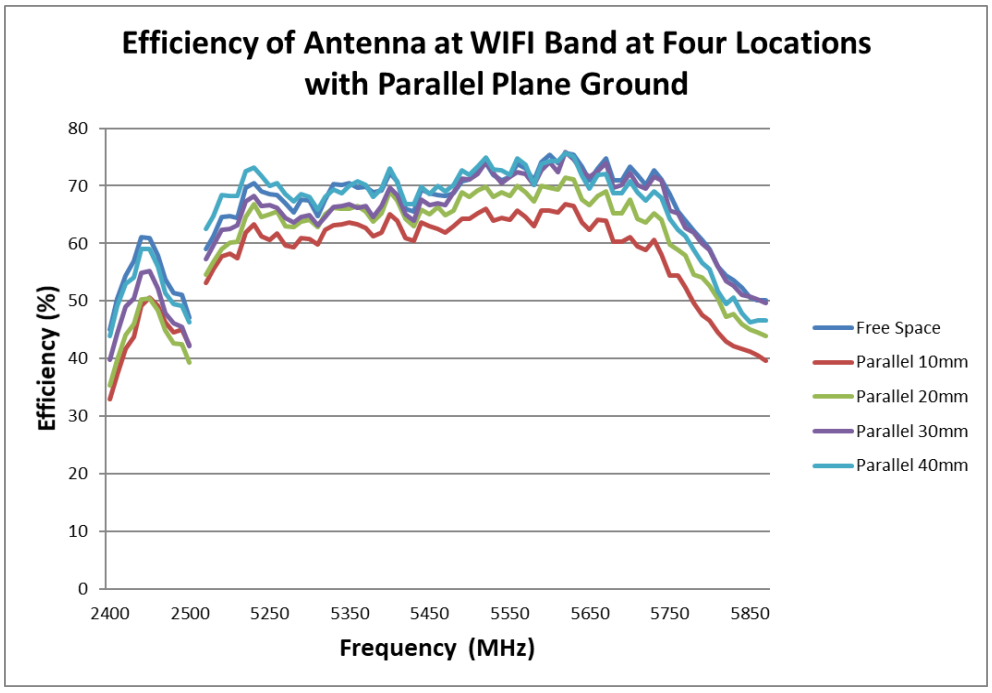


FIGURE 7.3.5 EFFICIENCY OF ANTENNA AT WIFI BAND AT FOUR LOCATIONS WITH PARALLEL PLANE GROUND ON A REFERENCE PCB

7.4 RF PERFORMANCE AS A FUNCTION ON DIFFERENT SIZE GROUD FOR CAONFIGURE 1 AND CONFIGURE 2

Three kinds of ground plane size were used for this study, which were 150*80mm, 120mm*60mm, 80mm*40mm (Reference PCB) and 60mm*30mm. (W*L)

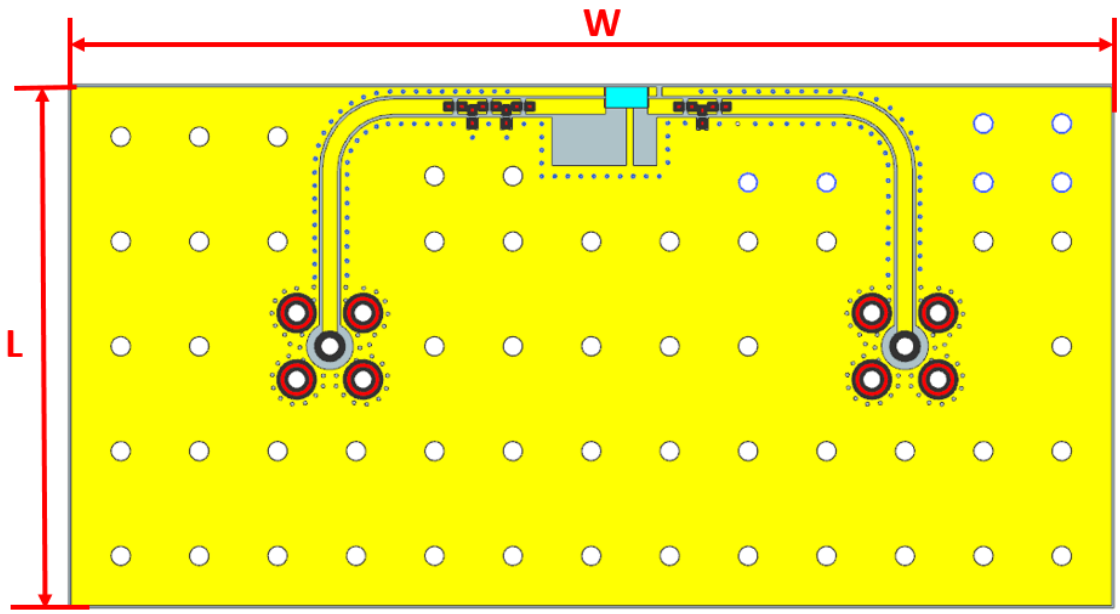


FIGURE 7.4 ANTENNA WITH DIFFERENT PLANE GROUNDS

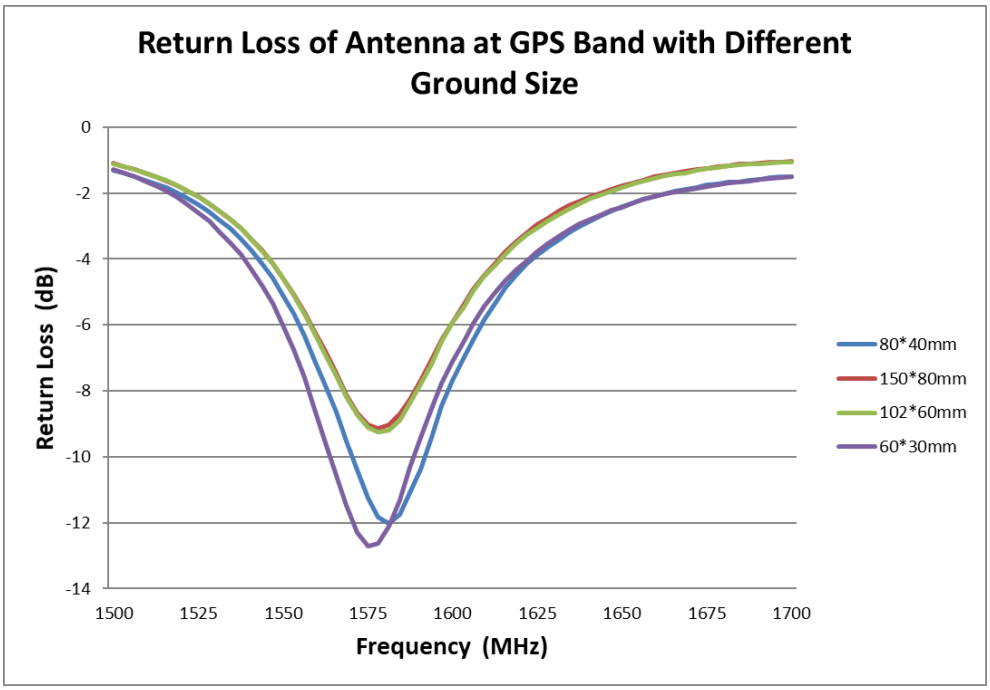


FIGURE 7.4.1 RETURN LOSS OF ANTENNA AT GPS BAND WITH DIFFERENT GROUND SIZES

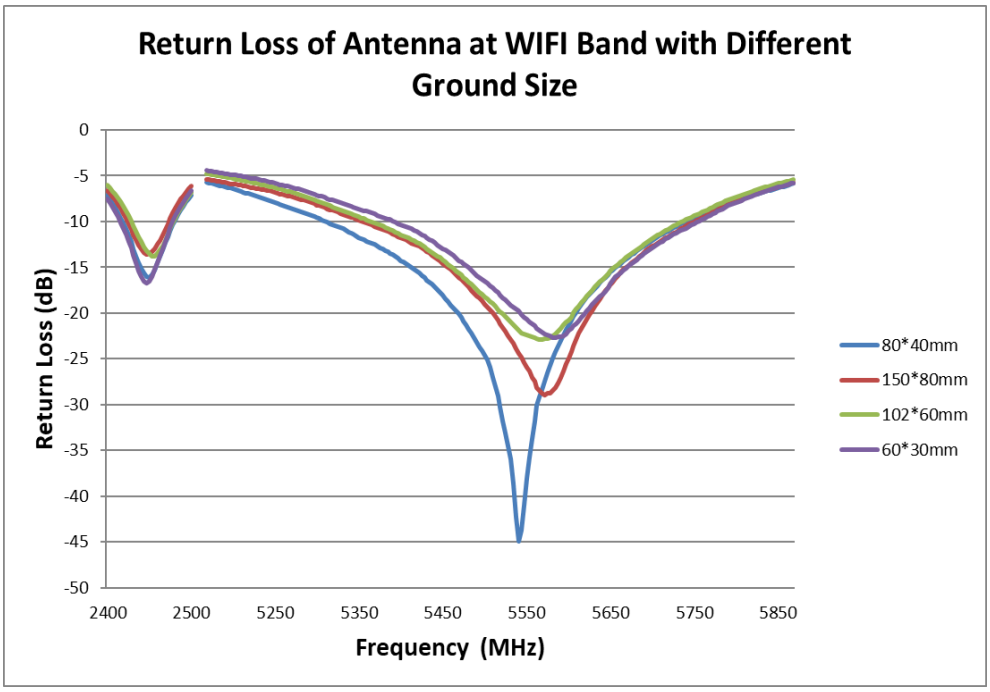


FIGURE 7.4.2 RETURN LOSS OF ANTENNA AT WIFI BAND WITH DIFFERENT GROUND SIZES

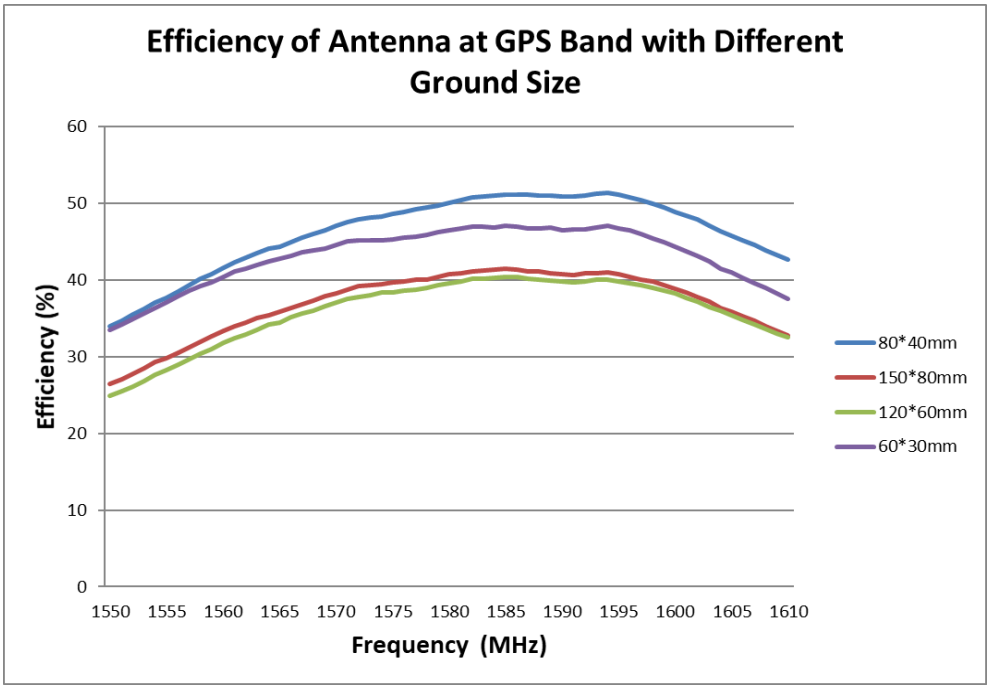


FIGURE 7.4.3 EFFICIENCY OF ANTENNA AT GPS BAND WITH DIFFERENT GROUND SIZES

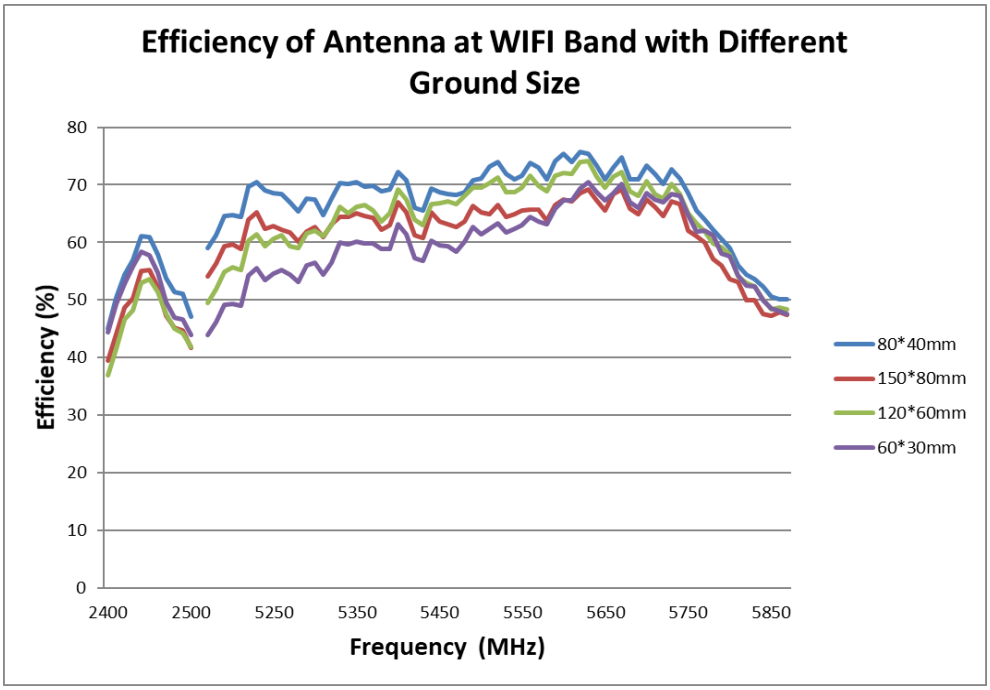


FIGURE 7.4.4 EFFICIENCY OF ANTENNA AT WIFI BAND WITH DIFFERENT GROUND SIZES

8.0 CHANGED HISTORY

REV	DATE	DECRIPTION
A	2021/04/10	First release