



APPLICATION SPECIFICATION

TITLE

HELIX SMD GPS ANTENNA

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REVISION:	ECR/ECN INFORMATION:	TITLE:	SHEET No.
C	EC No: 632887 DATE: 2020/02/27	Helix SMD GPS Antenna Application Specification	1 of 26
DOCUMENT NUMBER:	CREATED / REVISED BY:	CHECKED BY:	APPROVED BY:
AS-1462350001	Liu Hai 2019/01/25	Cheng Kang 2019/01/25	Andy Zhang 2019/01/25

HELIX SMD GPS 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.

All measurements are done of the antenna mounted on the recommended PCB with VNA Agilent 5071C and OTA chamber.

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: Helix SMD GPS Antenna

Series Number: 1462350001

2.2 DESCRIPTION

Series 146235 is a broadband GPS SMD antenna. Its frequency covers BEIDOU, GPS and GLONASS. It is small size and suitable for limited space environment.

2.3 PRODUCT STRUCTURE INFORMATION

Please refer to PS-1462350001 for full information.



ANTENNA PICTURE

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3.0 APPLICABLE DOCUMENTS

DOCUMENT	NUMBER	DESCRIPTION
Sale Drawing (SD)	SD-1462350001	Mechanical Dimension of the product
Product Specification (PS)	PS-1462350001	Product Specification
Packing Drawing (PK)	PK-1462350001	Product packaging specifications

4.0 ANTENNA PERFORMANCE

4.1 RF TEST CONDITIONS

All measurements are done of the antenna mounted on the reference PCB with VNA Agilent 5071C and Over-The-Air (OTA) chamber. All measurements in this document are done with the part no.1462350001 with reference PCB.



FIGURE4.1.1 ANTENNA LOADED WITH REFERENCE PCB WITH VNA

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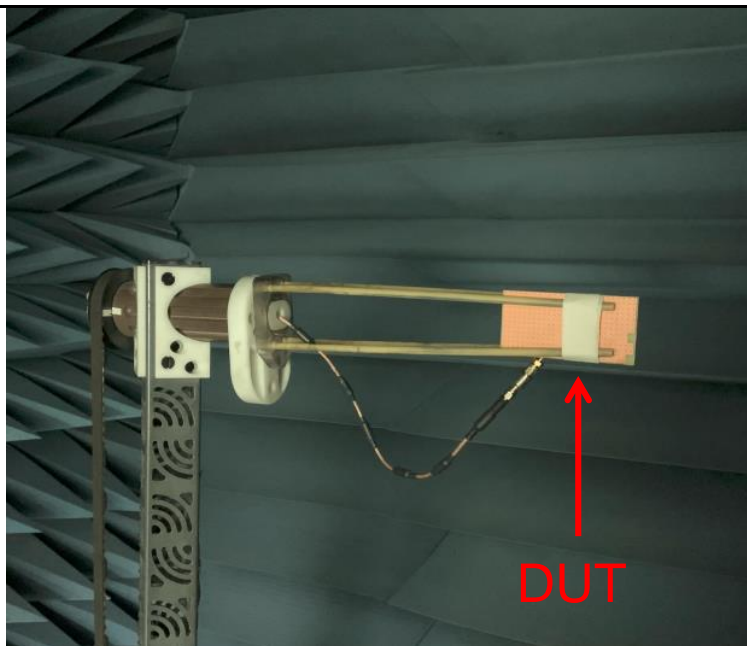


FIGURE4.1.2 ANTENNA LOADED WITH REFERENCE PCB WITH OTA CHAMBER

4.2 ANTENNA PERFORMANCE

DESCRIPTION	EQUIPMENT	Requirements		
Frequency Range	VNA E5071C	1561MHz (+/-3MHz)	1575MHz (+/-3MHz)	1602MHz (+/-3MHz)
Return Loss	VNA E5071C	<-5dB		
Peak Gain (Max)	OTA Chamber	0.7dBi	1.1dBi	1.1dBi
Average Total Efficiency	OTA Chamber	>50%	>55%	>50%
Polarization	OTA Chamber	Linear		
Input Impedance	VNA E5071C	50 ohms		

Note that the above antenna performance is measured with just the antenna mounted on a reference PCB to similar a free-space condition. When implement into the system, the frequency resonant might be off-tune due to the loading of surrounding components especially metal plane. This off-tune can be compensated through matching. Although module manufacturers specify a peak gain limit, it is based on free-space conditions. The peak gain will be degraded by 1 to 2dBi in the actual implementation as the radiation pattern will change due to the surround components. As such, during selection of antenna, you can select one with high peak gain to compensate for the loss. Molex can offer assistant to choose the best location and best tuning in-order to meet this peak gain requirement.

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4.3 RETURN LOSS PLOT

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

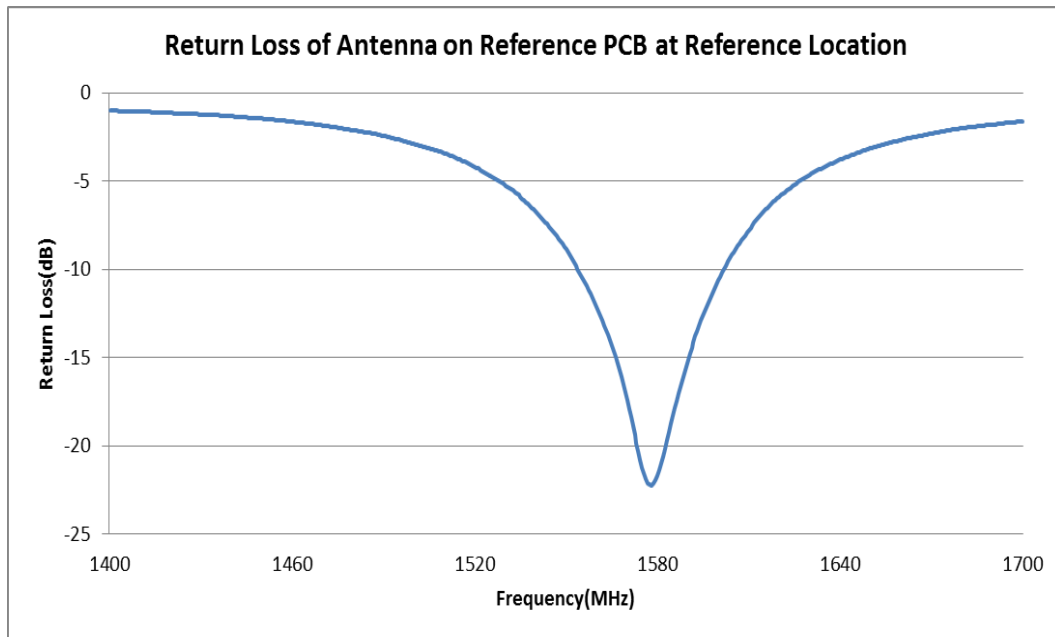


FIGURE 4.3 RETURN LOSS OF ANTENNA AT GPS BAND AT REFERENCE LOCATION

4.4 EFFICIENCY PLOT

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

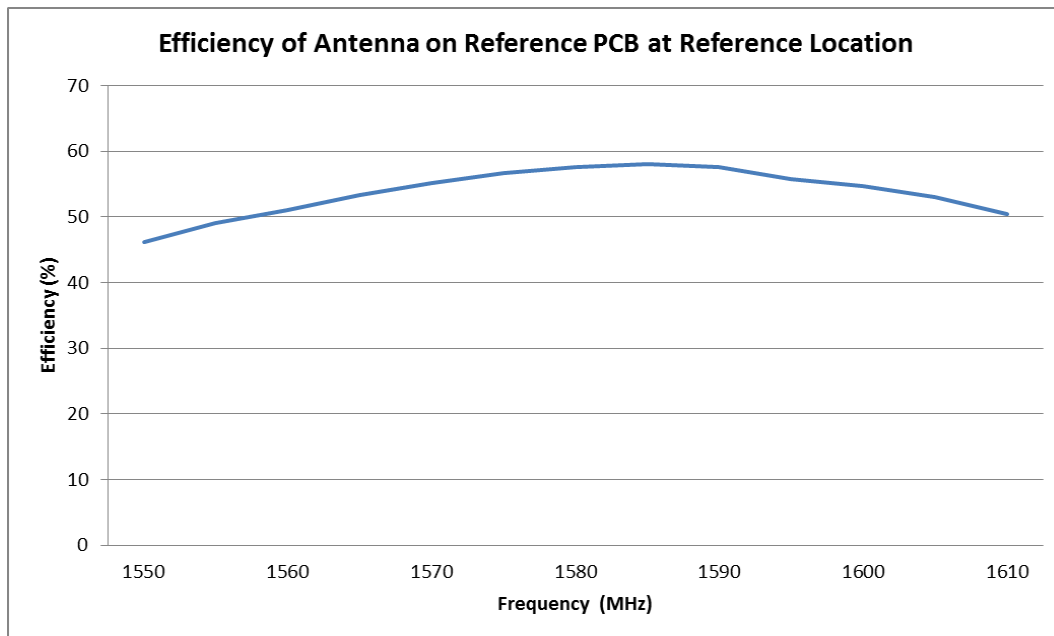


FIGURE 4.4 EFFICIENCY OF ANTENNA AT GPS BAND AT REFERENCE LOCATION

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4.5 PEAK GAIN PLOT

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

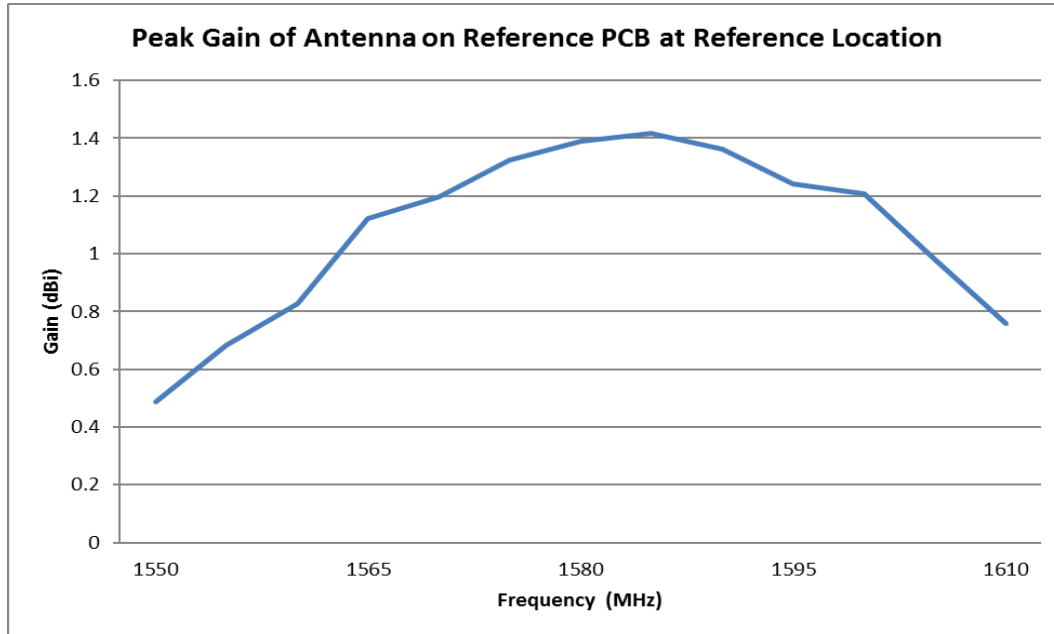


FIGURE 4.5 PEAK GAIN OF ANTENNA AT GPS BAND AT REFERENCE LOCATION

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4.6 RADIATION PATTERN

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

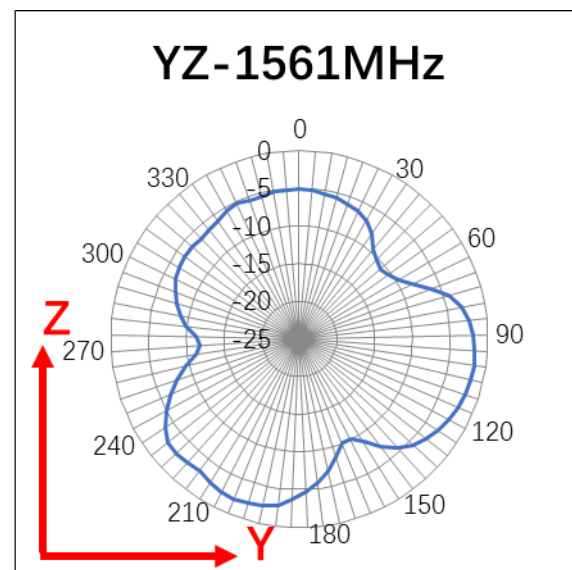
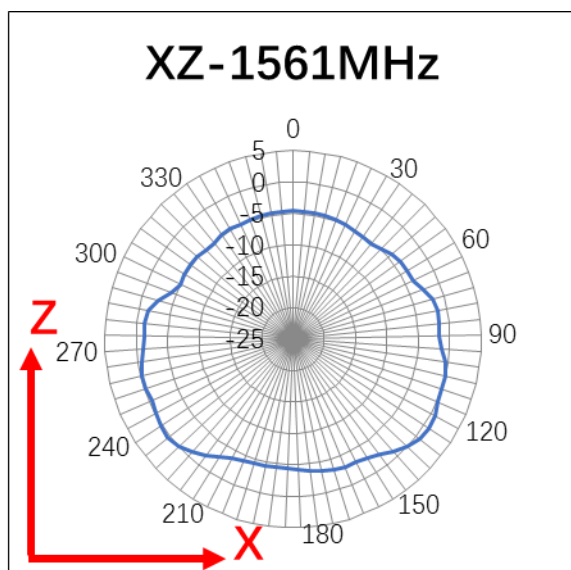
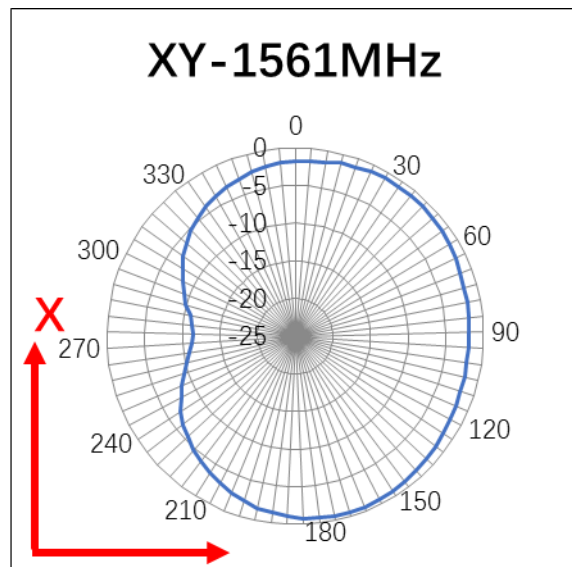
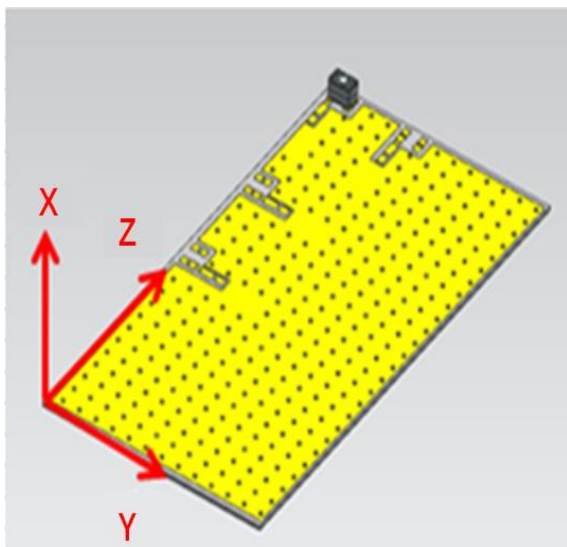


FIGURE 4.6.1 2D RADIATION PATTERN OF ANTENNA AT 1561MHZ IN FREE SPACE

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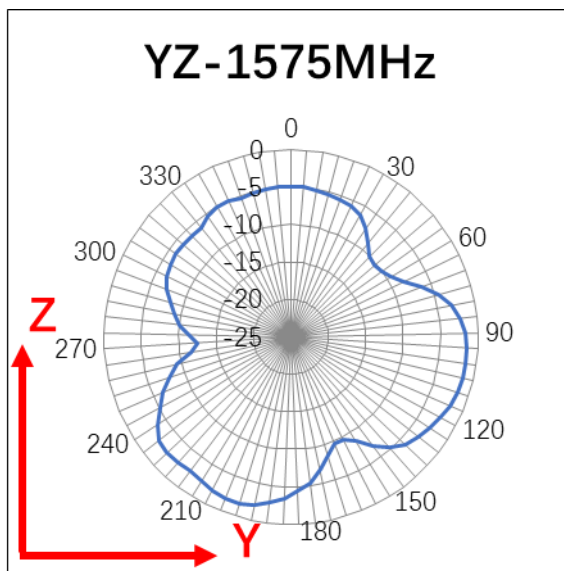
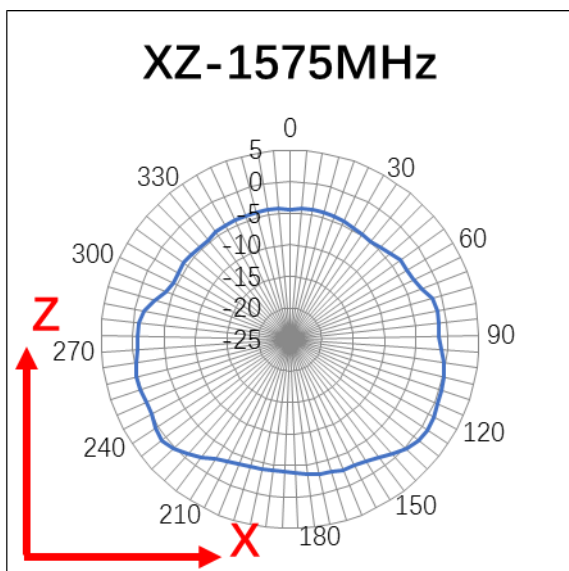
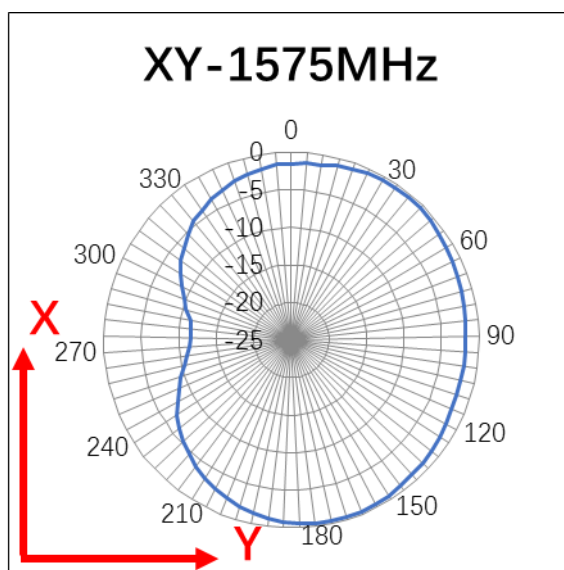
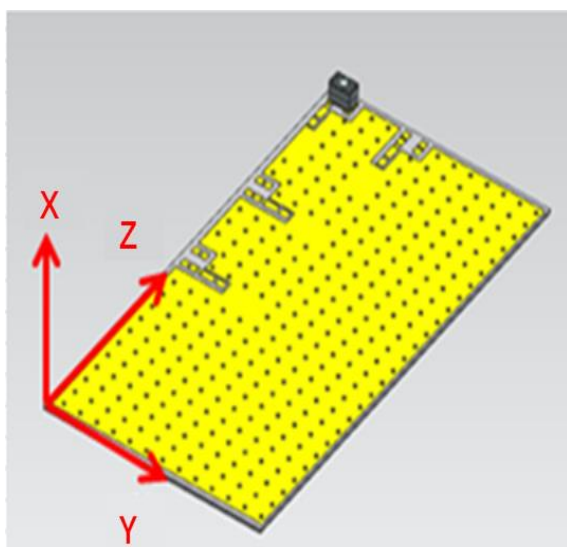


FIGURE 4.6.2 2D RADIATION PATTERN OF ANTENNA AT 157MHZ IN FREE SPACE

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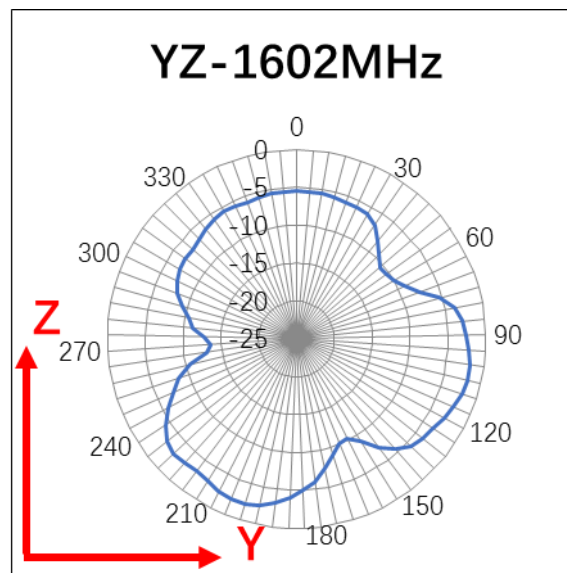
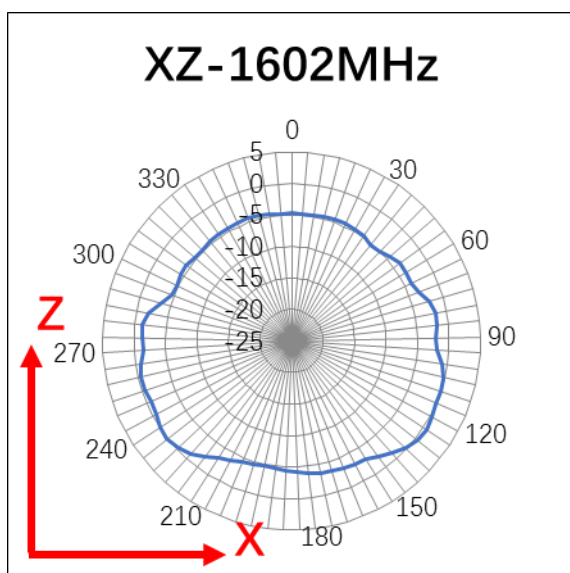
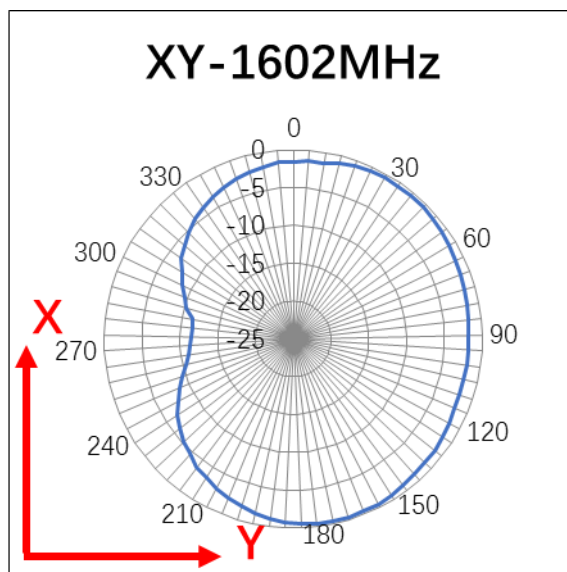
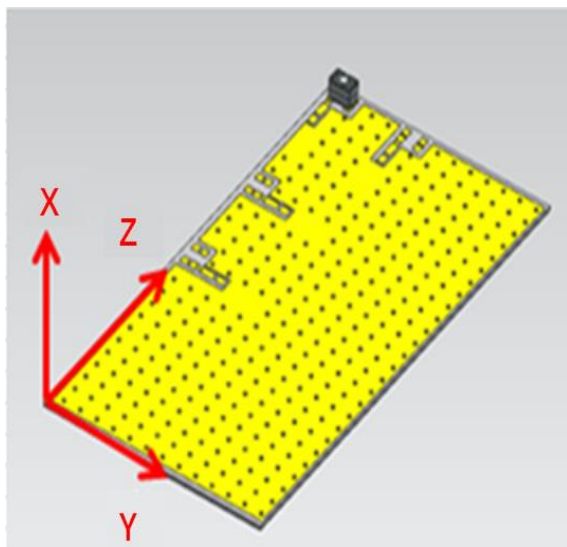


FIGURE 4.6.3 2D RADIATION PATTERN OF ANTENNA AT 1602MHZ IN FREE SPACE

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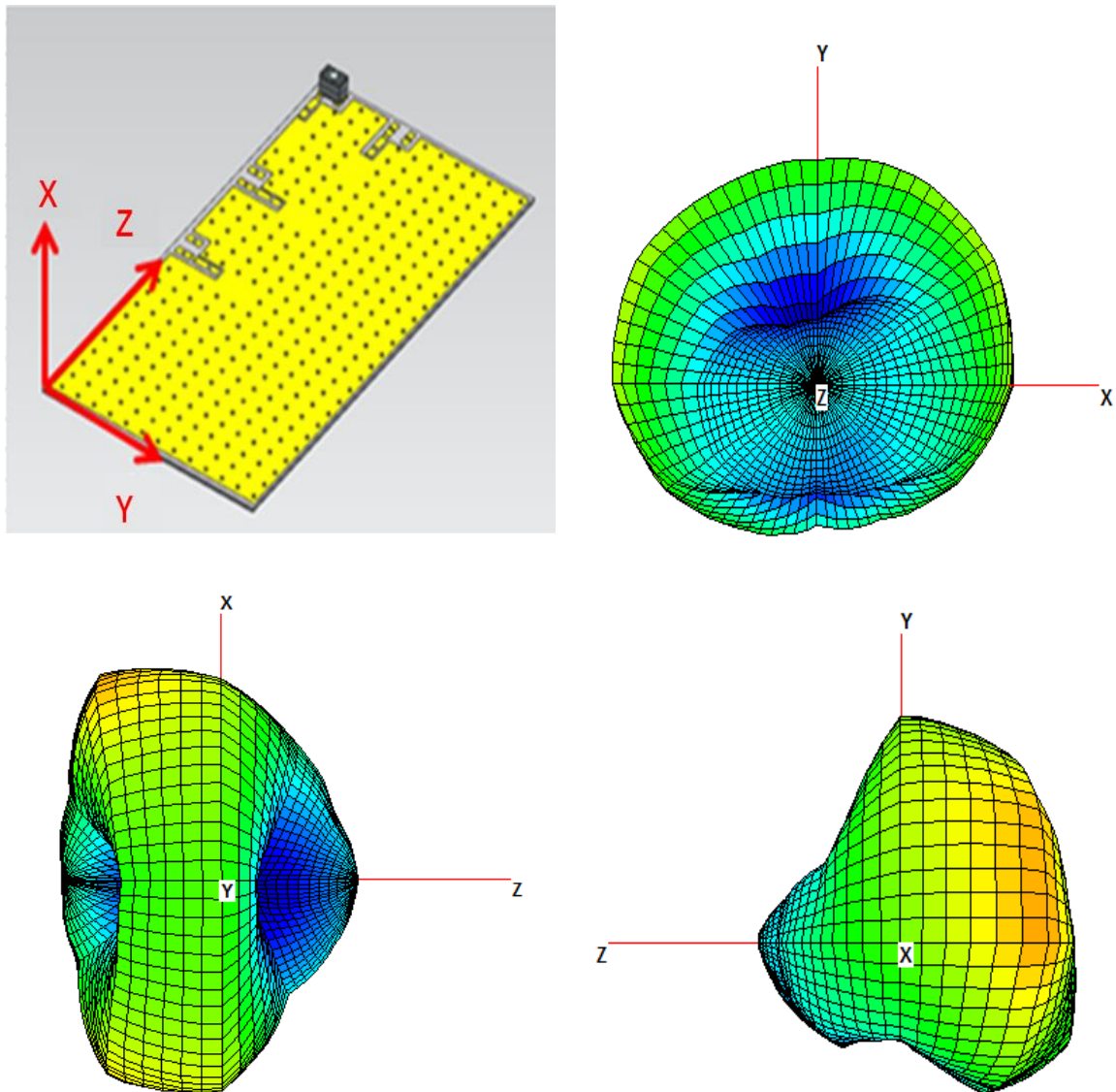


FIGURE 4.6.4 3D RADIATION PATTERN OF ANTENNA AT 1561MHZ IN FREE SPACE

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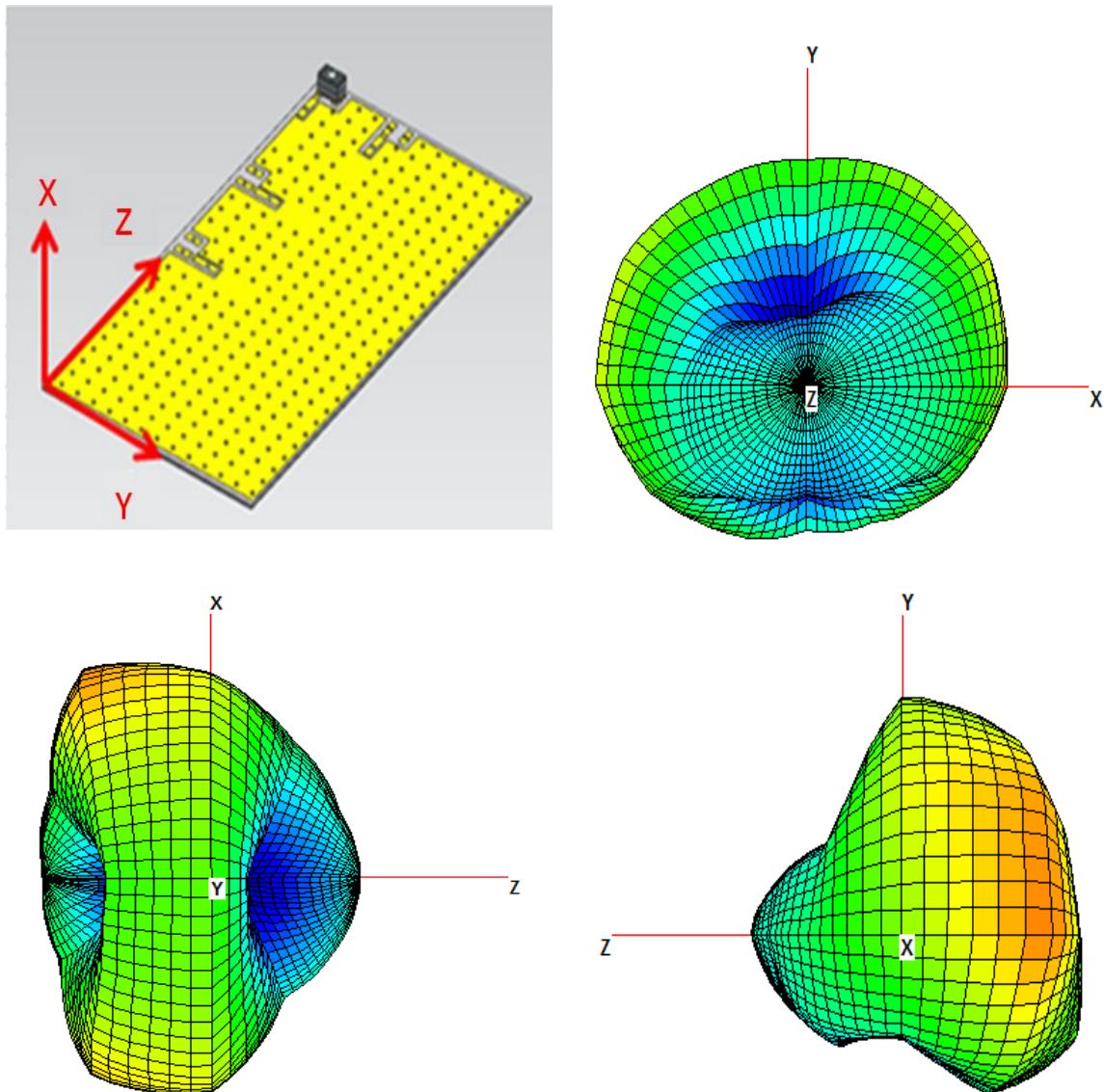


FIGURE 4.6.5 3D RADIATION PATTERN OF ANTENNA AT 1575MHZ IN FREE SPACE

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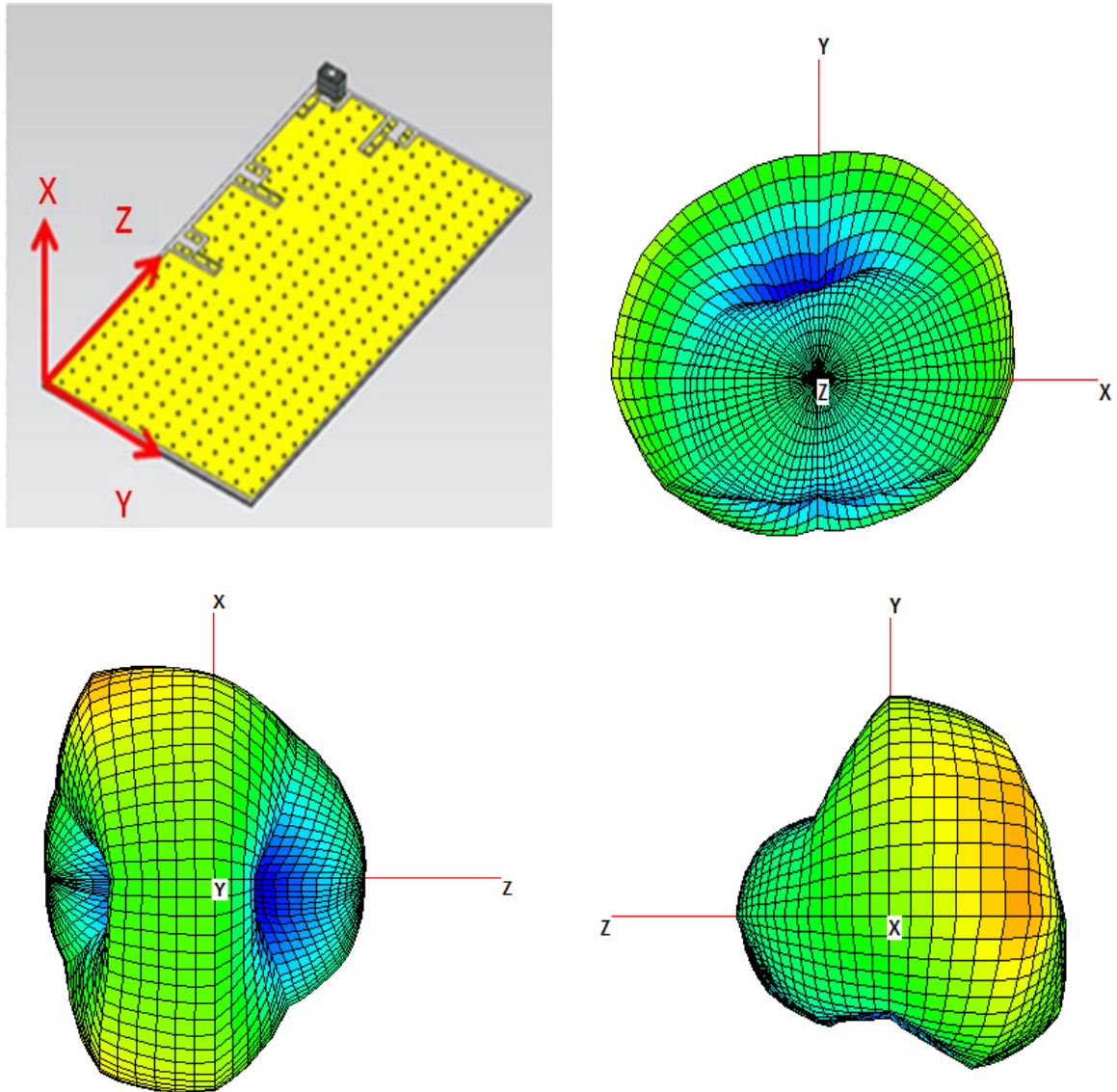


FIGURE 4.6.6 3D RADIATION PATTERN OF ANTENNA AT 1602MHZ IN FREE SPACE

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5.0 MATCHING NETWORK DESCRIPTION

The recommended matching network shown in Figure 5.1-5.2.

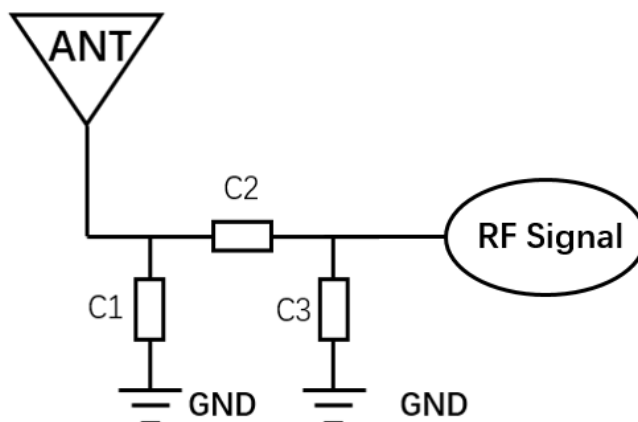
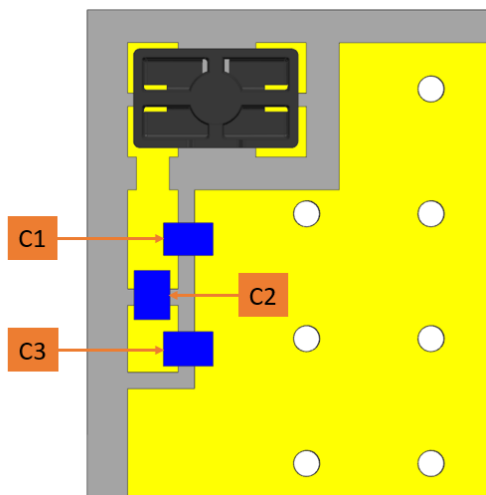


FIGURE 5.1 RECOMMENDED MATCHING CIRCUIT SCHEMATIC



Component	Application 1
C1	NA
C2	5.1nH
	Murata (PN: LQG15HS5N1B02)
C3	1.8nH
	Murata (PN: LQG15HS1N8B02)

FIGURE 5.2 RECOMMENDED MATCHING CIRCUIT

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6.0 RF PERFORMANCE AS A FUNCTION OF IMPLEMENTATION

6.1 ANTENNA RF PERFORMANCE AS A FUNCTION OF LOCATION ON THE PCB

Four locations have been evaluated RF performance and these locations are show in figure 6.1.1. Figure 6.1.2, Figure 6.1.3 and Figure 6.1.4 comparatively present the return loss efficiency and Peak Gain at GPS band at four locations while. Entire tests are with any matching network.

The location which gives the best RF performance is location 1. Location 1 (corner location) is the recommended location for the antenna.

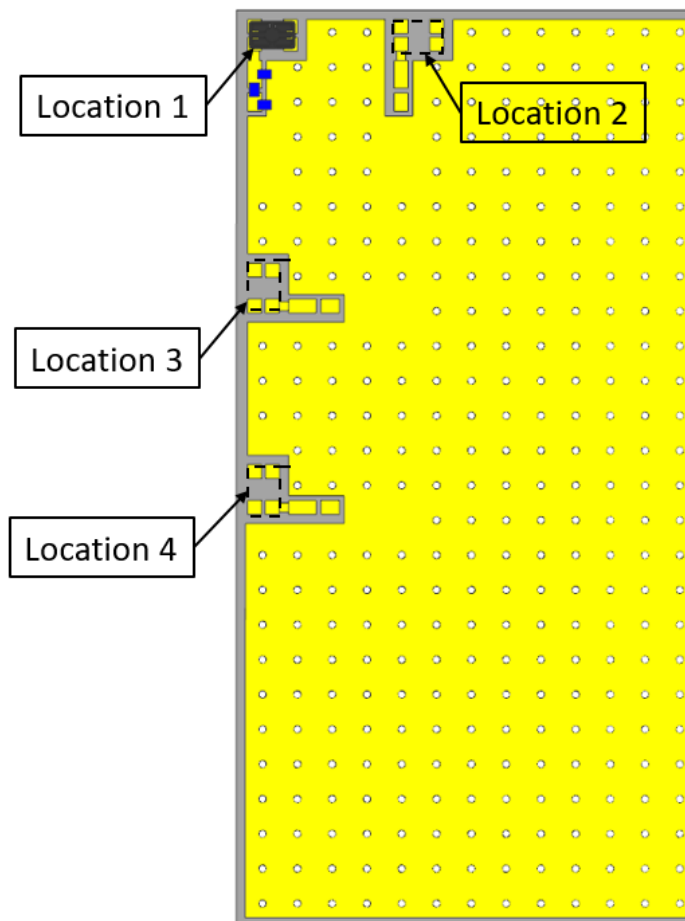


FIGURE 6.1.1 FOUR LOCATIONS ON REFERENCE PCB

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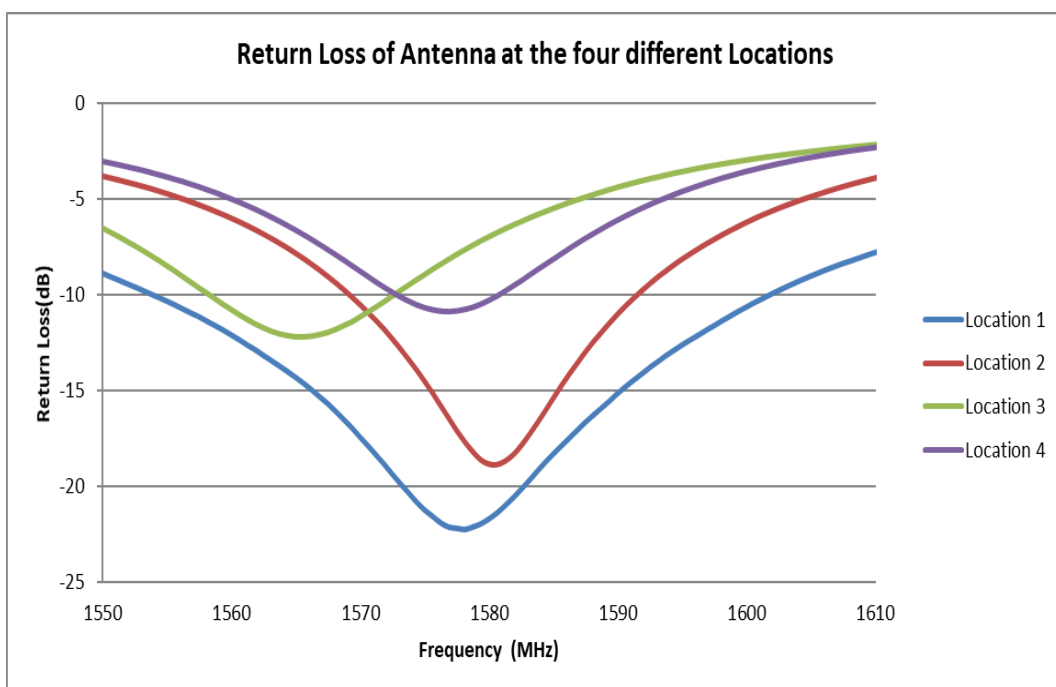


FIGURE 6.1.2 RETURN LOSS OF ANTENNA AT GPS BAND AT FOUR LOCATIONS

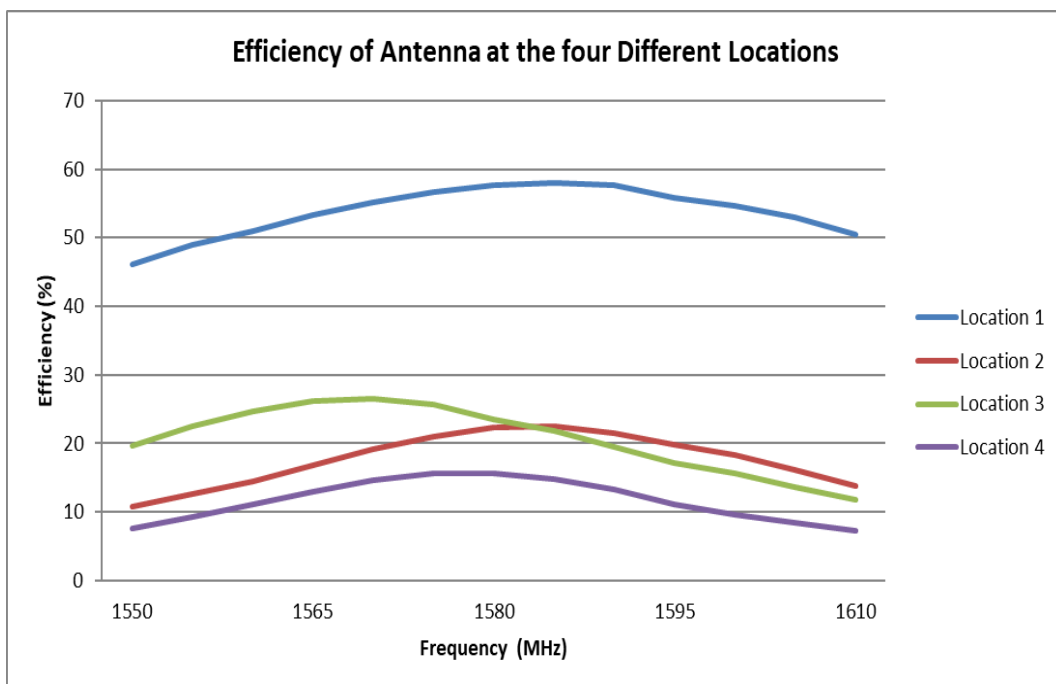


FIGURE 6.1.3 EFFICIENCY OF ANTENNA AT GPS BAND AT FOUR LOCATIONS

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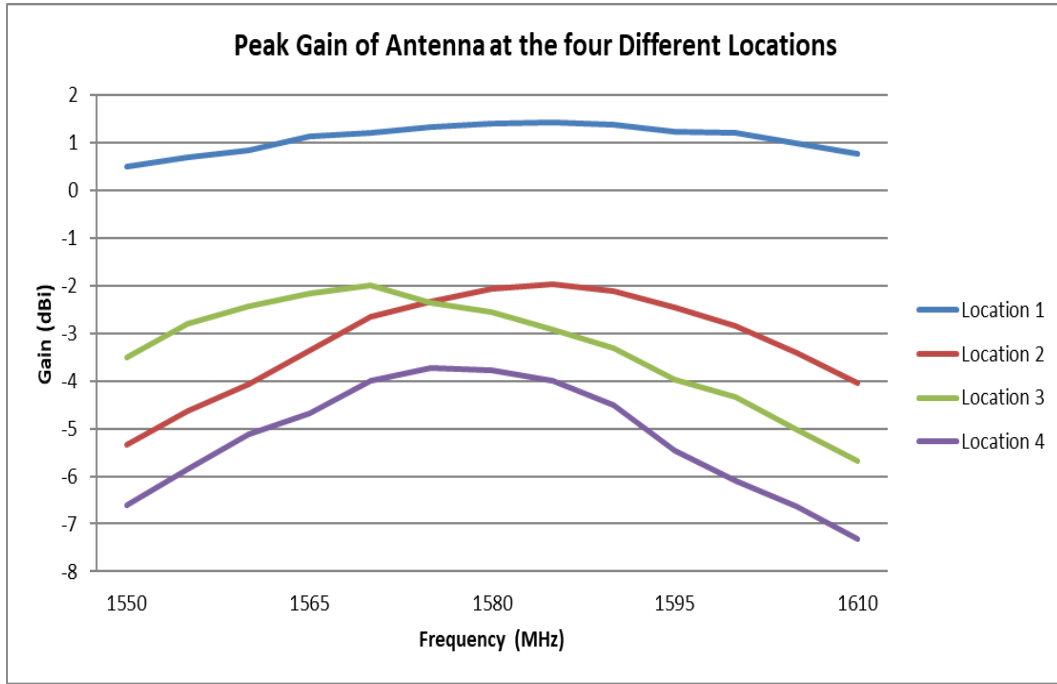


FIGURE 6.1.4 PEAK GAIN OF ANTENNA AT GPS BAND AT FOUR LOCATIONS

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6.2 ANTENNA RF PERFORMANCE AS AN EFFECT OF NEARBY SHIELDING CAN

An evaluation was done with 3 different distances from the antenna which located at the recommended location to the shielding can. The 3 distances are as following: 1mm, 3mm and 5mm.

From the study, we can say that a shielding can (30mm x 30mm x 2mm) should be placed 5mm away from the antenna. At distances less than 5mm the antenna performance will be significantly degraded. Refer to figure 6.2.2- 6.2.4

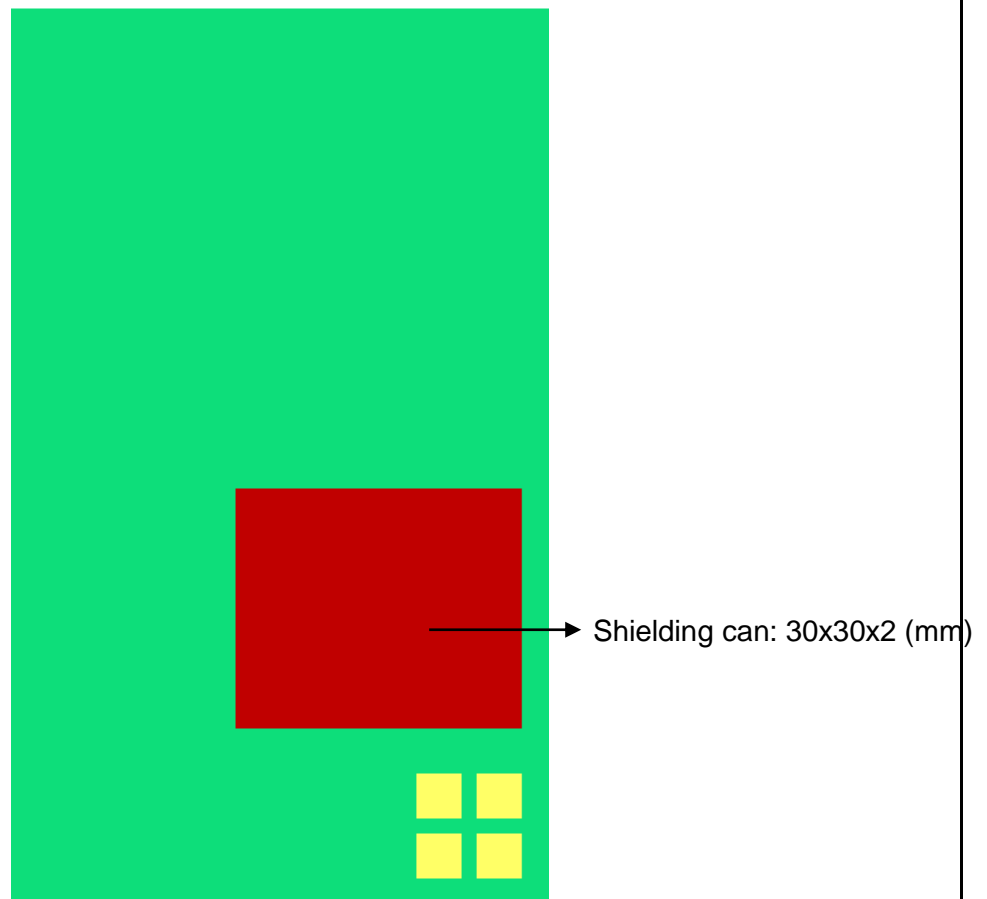


FIGURE 6.2.1 SHIELDING CAN FIXED ON REFERENCE PCB

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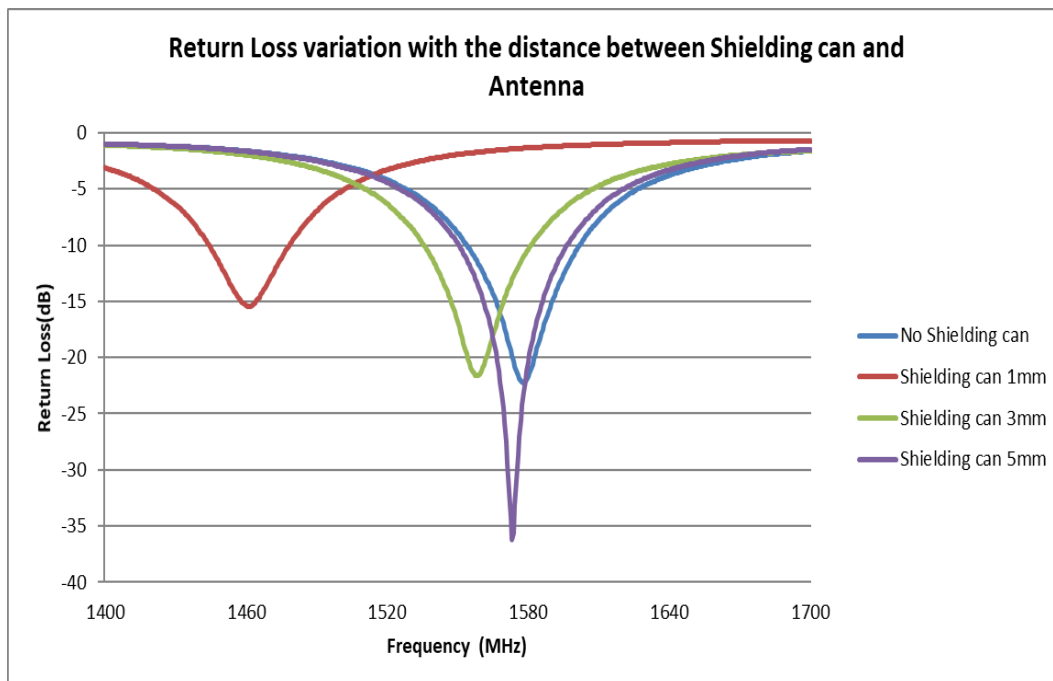


FIGURE 6.2.2 RETURN LOSS COMPARISON AT GPS BAND OF SHIELDING CAN DISTANCE FROM ANTENNA

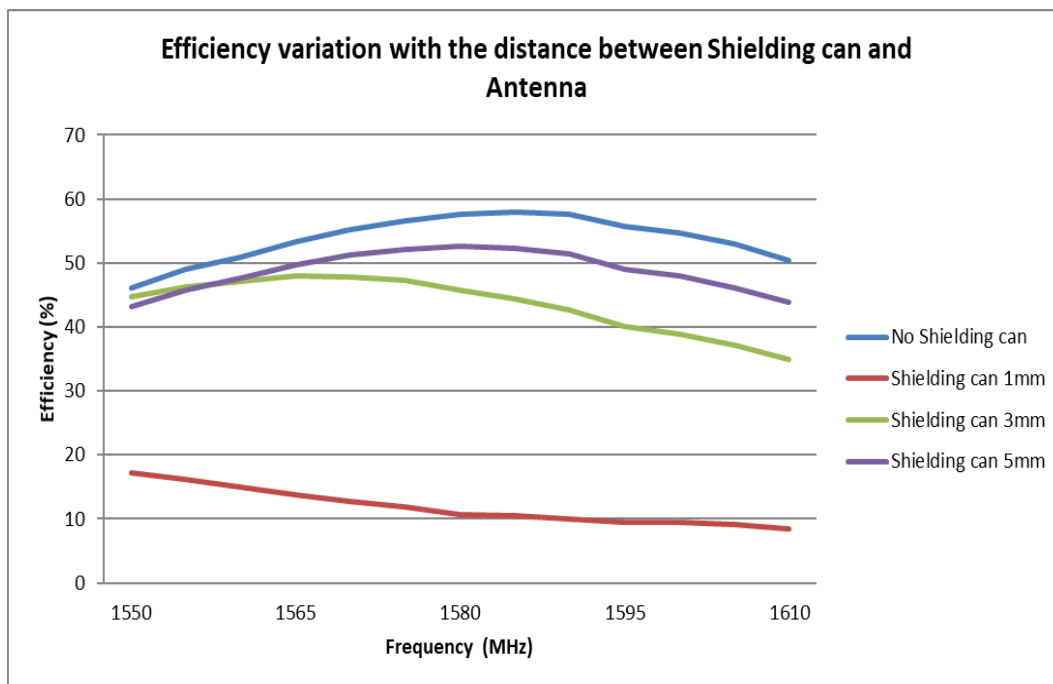


FIGURE 6.2.3 EFFICIENCY COMPARISON AT GPS BAND OF SHIELDING CAN DISTANCE FROM ANTENNA

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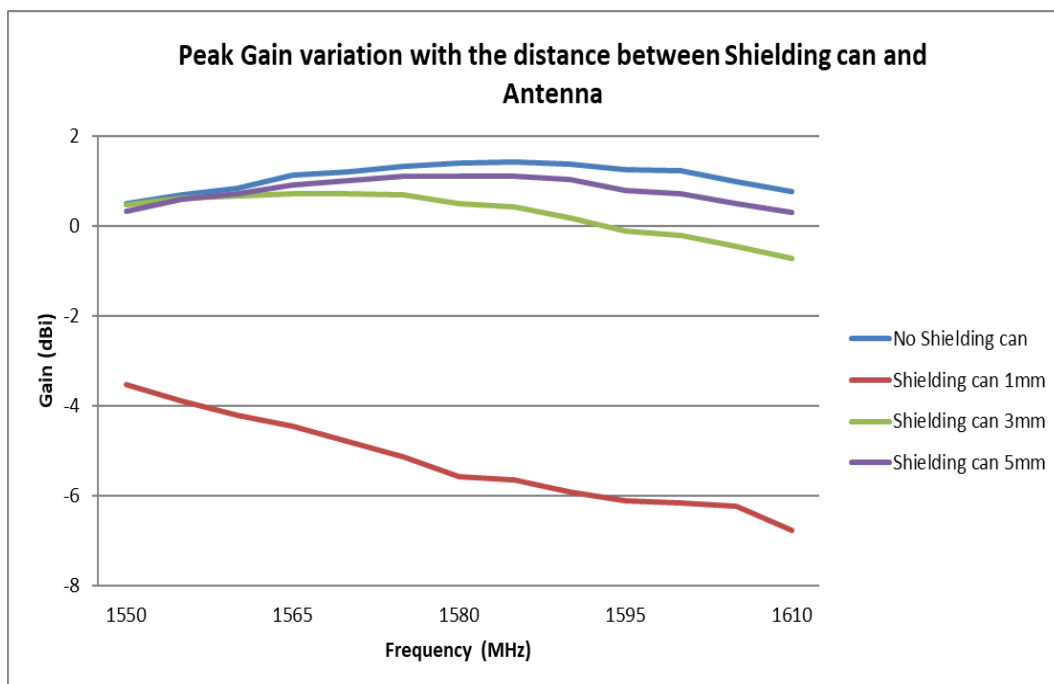


FIGURE 6.2.4 PEAK GAIN COMPARISON AT GPS BAND OF SHIELDING CAN DISTANCE FROM ANTENNA

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6.3 RF PERFORMANCE AS AN EFFECT OF NEARBY BATTERY

An evaluation was done with 3 different distances from the antenna which located at the recommended location. The 3 distances are as follow: 1mm, 3mm and 5mm.

From the study, we can say that a battery (30mm x 60mm x 3mm) should be placed at least 5mm away from the antenna. At distances less than 5mm the antenna performance will be degraded significantly. Refer to figure 6.3.2-6.3.4

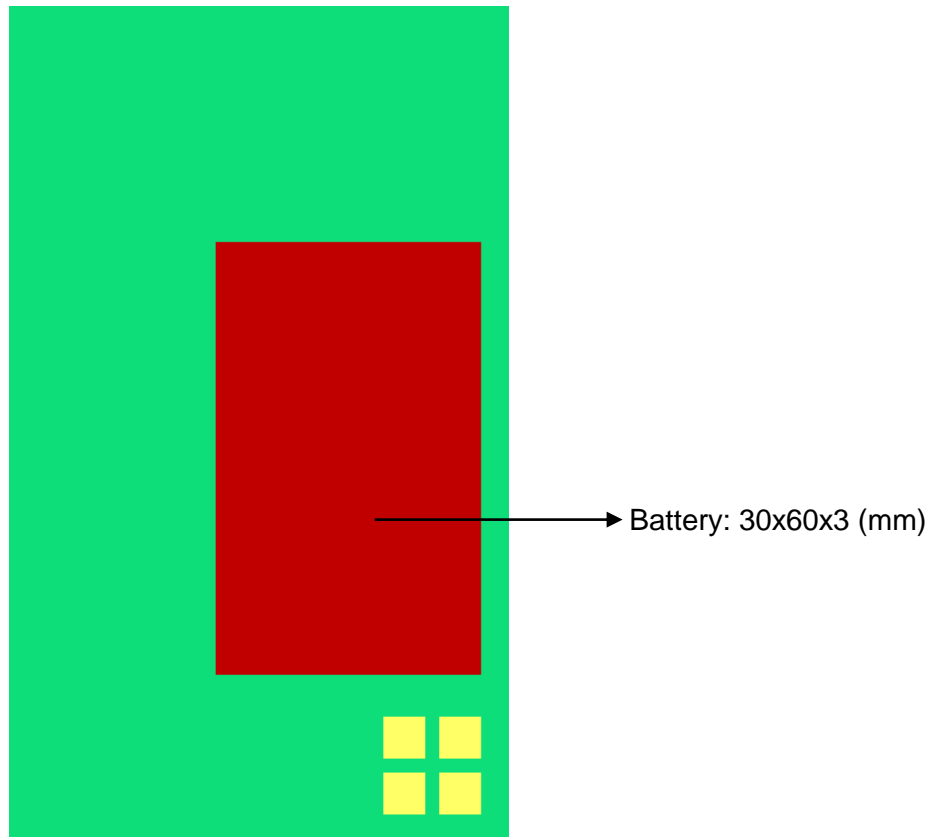


FIGURE 6.3.1 BATTERY FIXED ON REFERENCE PCB

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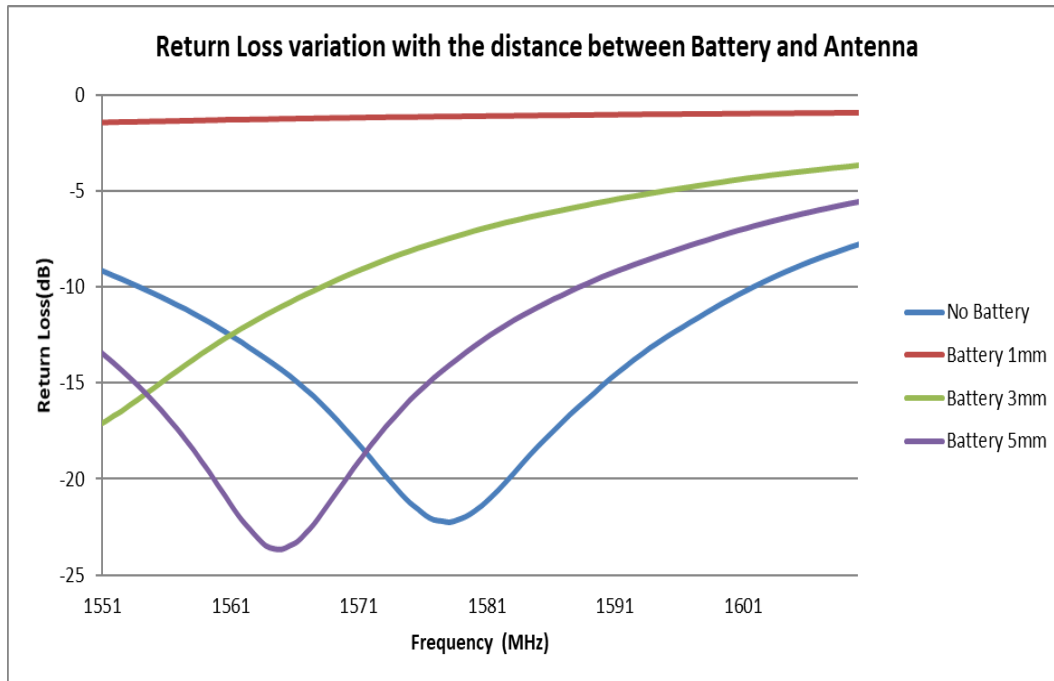


FIGURE 6.3.2 RETURN LOSS COMPARISON AT GPS BAND OF BATTERY DISTANCE FROM ANTENNA

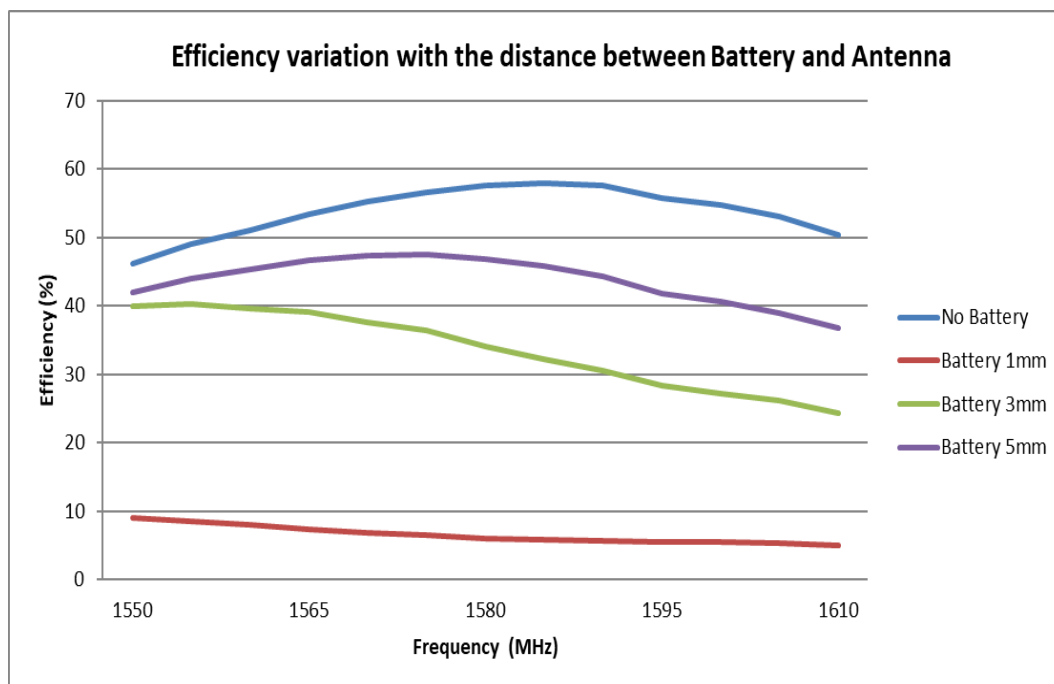
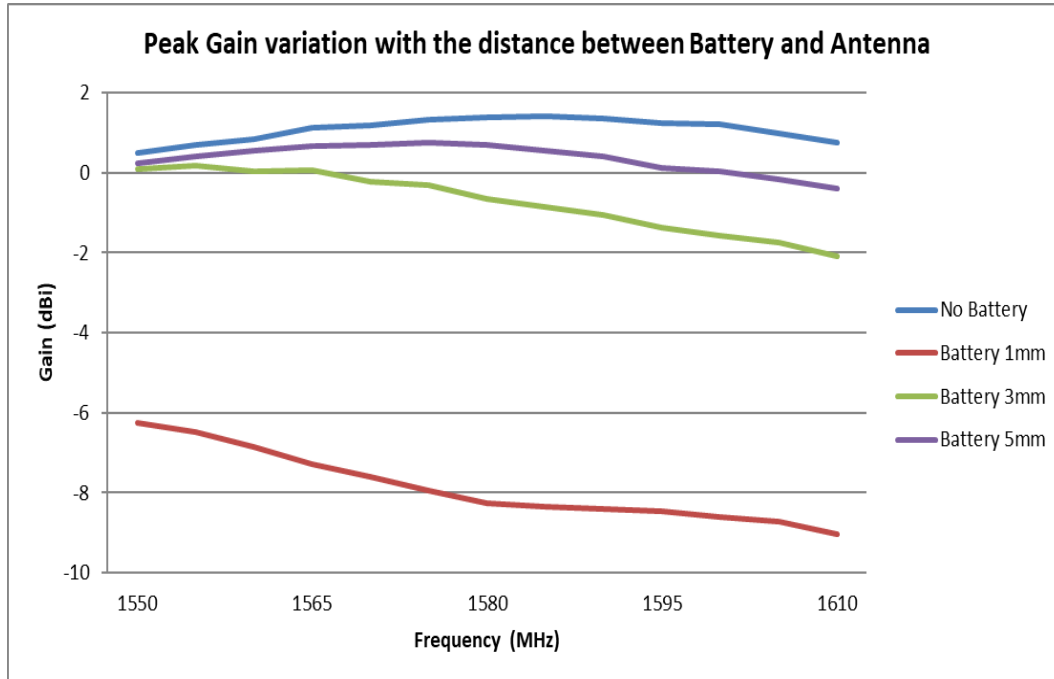


FIGURE 6.3.3 EFFICIENCY COMPARISON AT GPS BAND OF BATTERY DISTANCE FROM ANTENNA

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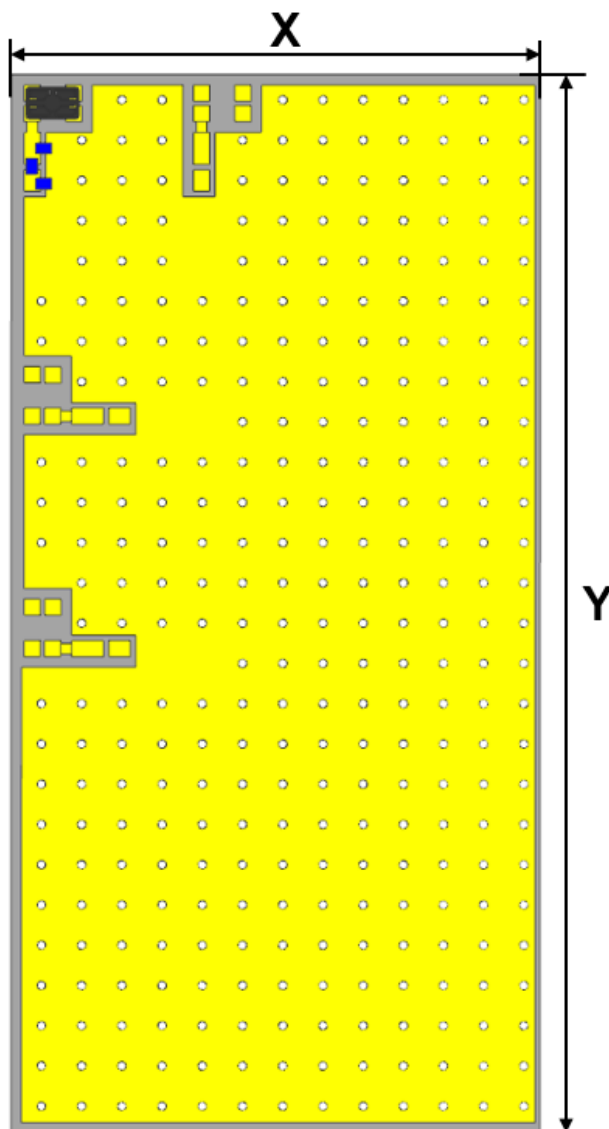


**FIGURE 6.3.4 PEAK GAIN COMPARISON AT GPS BAND
OF BATTERY DISTANCE FROM ANTENNA**

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6.4 RF PERFORMANCE AS AN EFFECT OF NEARBY BATTERY

4 kinds of ground plane size have been evaluated, and these configurations are show in figure 6.4. 1. The antennas meet the spec of the return loss, the efficiency and the peak gain specification at FIGURE 6.4.2-6.4.4. The minimum ground plane size for this antenna is recommended to be 100*50mm to meet the antenna specification.



X*Y MM (50*40、75*50、100*50、150*100)

FIGURE 6.4.1 DIFFERENT GROUND PCB SIZE

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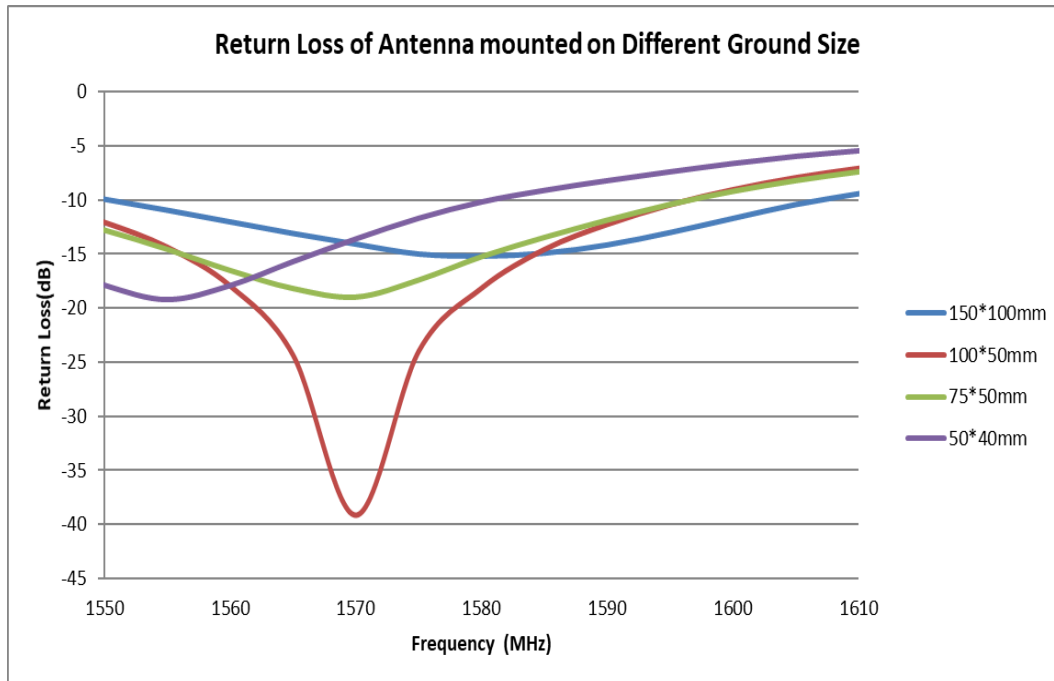


FIGURE 6.4.2 RETURN LOSS COMPARISON AT GPS BAND OF ANTENNA MOUNTED ON DIFFERENT GROUND SIZE

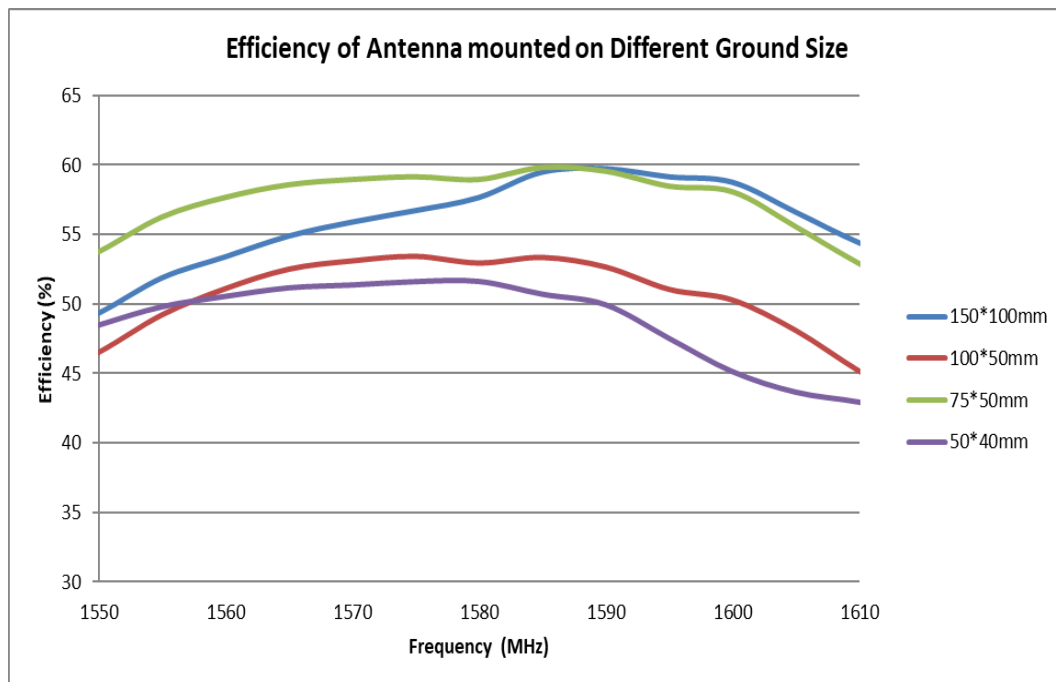


FIGURE 6.4.3 EFFICIENCY COMPARISON AT GPS BAND OF ANTENNA MOUNTED ON DIFFERENT GROUND SIZE

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DOCUMENT NUMBER: AS-1462350001	CREATED / REVISED BY: Liu Hai 2019/01/25	CHECKED BY: Cheng Kang 2019/01/25	APPROVED BY: Andy Zhang 2019/01/25

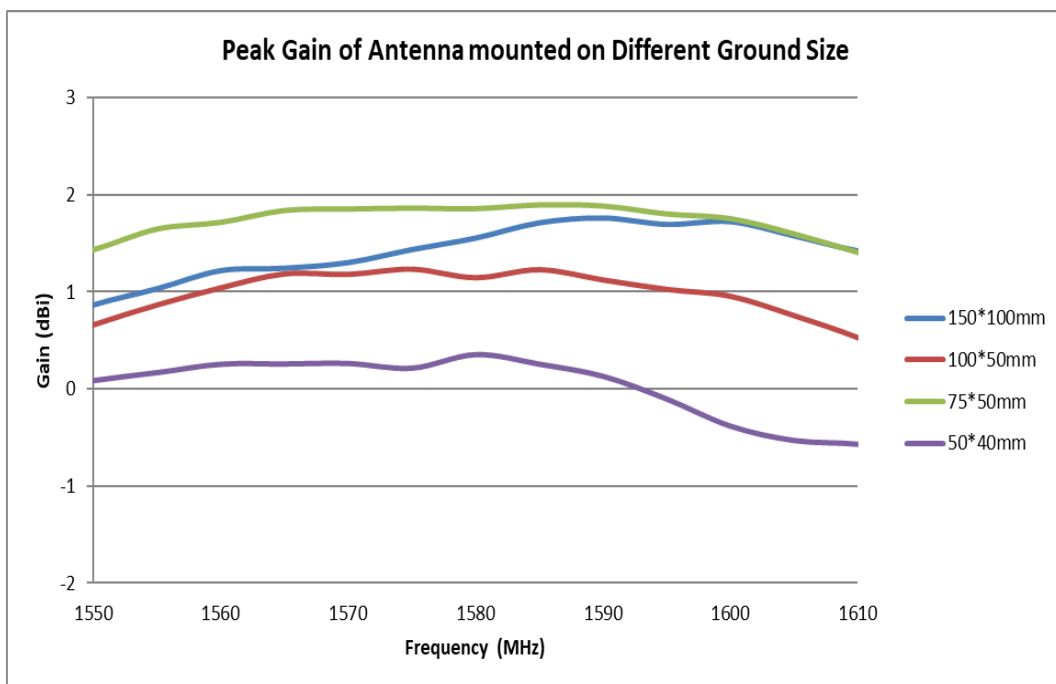


FIGURE 6.4.4 PEAK GAIN COMPARISON AT GPS BAND OF ANTENNA MOUNTED ON DIFFERENT GROUND SIZE

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APPLICATION SPECIFICATION

7.0 CHANGE HISTORY

CHANGE HISTORY		
REV	DATA	DESCRIPTION
A	2016/1/14	First Release/Liuhai
B	2016/3/17	Update performance/Liuhai
C	2020/1/18	Update file layout/Liuhai

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