DESIGN OF PLANAR REFLECTOR ANTENNA

A PROJECT REPORT
(Project Work I Phase I)

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in partial fulfilment of the requirements
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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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PERUNDURAI, ERODE – 638060

JULY 2022

BONAFIDE CERTIFICATE

This is to certify that the Project Work I Phase I report entitled is **DESIGN OF PLANAR REFLECTOR ANTENNA**being submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering is the original work carried out by us. It has not formed the part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

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DECLARATION

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ABSTRACT

The wireless communication applications include military, aerospace, medical, education and so on. In Radio Frequency (RF) field, the microwave components such as filters, couplers, and antennas are employed, but the key challenges for engineers in radio frequency (RF) research in recent years have been to achieve high performance with compact size, cheap cost, and ease of integration. In this latest advance of study, microstrip planar antennas are crucial. When incorporated into an antenna assembly, the reflector works to change the antenna's emission pattern and boost gain in a certain direction. It is made up of a primary antenna and a reflecting surface that is used to focus energy in a particular direction. In the proposed design of planar reflector antenna, the rectangular patch antenna is designed using FR4 substrate. The partial ground plane is placed below the substrate. The dimensions of the antenna is 39 x47.6 x1.6mm^3. The Length and width of the patch is 29x 38mm^2. The reflector plane is placed as the second layer of the patch antenna with a distance of 12 mm. through via. Reflector plane consist of ground plane at the bottom side of substrate and top layer as the perfectly conducting layer.

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LIST OF ABBREVIATIONS

ANSYS	Analysis System
ACS	Asymmetric Coplanar Strip
DGS	Defective Ground Structure
EM	Electro magnetic
FR4	Flame Retardant
HFSS	High Frequency Structure Simulator
IEEE	Institute of Electrical and Electronics Engineers
ISM	Industrial, Scientific, Medical
MOM	Method Of Moments
MSA	Micro Strip Antennas
PCB	Printed Circuit Board
POM	Phase Only Optimization
TM	Transverse Magnetic
UWB	Ultra Wide Band
VSWR	Voltage Standing Wave Ratio
WBAN	Wireless Body Area Network
WiFi	Wireless Fidelity

CHAPTER 1

INTRODUCTION

Information can be transmitted from one location to another location without the use of physical mediums like wires or cables or other connections. A physical channel such as coaxial cables, twisted pair cables, optical fiber links, etc., serves as the medium in wired communication and directs the signal as it travels from one point to another. Wireless communication, on the other hand, doesn't need a physical medium because the signal is spread throughout the space. Wireless communication provides flexibility and convenience of use in addition to mobility, which is why it is growing rapidly every day. Wireless communication, like mobile telephone, enables extremely high throughput performance anywhere and at any time. Another important point is infrastructure. In wired communication the setup and installation of infrastructure is an expensive and time-consuming job. Wireless communication infrastructure is inexpensive and easily installable. Wireless communication has grown rapidly over time and is now utilized in practically every industry.

1.1 PLANAR ANTENNA

A directional antenna known as a planar antenna has all of its components in one plane. Planar antennas are two-dimensional because both the active and passive elements are on the same plane. Microstrip and printed circuit board antennas are examples of planar antennas. The "patches" of the antennas can be triangular, square, or round. Ultra-wideband planar antennas are inexpensive, particularly when manufactured in large quantities using printed circuit board technology. They may be rather small, which makes them perfect for wireless applications. The aperture of planar arrays is big. By varying the phase of each element directional beam control can be achieved in planar antenna. Planar antennas have a low profile. Since a planar antenna on a thin, flexible substrate doesn't affect the aerodynamics of the vehicle, they have been employed on aircraft for a long time. They are strong when mounted on a solid surface. For instance, heat sinks could be incorporated into the planar form, In case of using PCB (Printed Circuit Board) technology to create a planar antenna. It is not difficult or expensive to integrate the antenna with other electronic components at the same time. An integrated planar antenna may be fed directly or indirectly by the transmission lines. Depending on the design, they can accommodate both linear and circular polarization. In wireless applications, planar antennas are frequently employed, particularly when the wireless devices may operate on a variety of frequencies. A multi-band WiFi network is the standard illustration of this. In software defined radio, ultra-wideband planar antennas are frequently employed. Spectrum analyzers, signal sources, and other devices can all use wideband planar antennas.

1.2 REFLECTOR ANTENNA

In reality, the reflector antenna principle was initially demonstrated in 1963 by Berry et al. By calibrating the reflected vector, it is possible to independently change the guided guide's length. The physical curvature of the paraboloid is used to compensate for the spatial phase delay from the feed to the plane wave front in conventional parabolic reflector antennas, which typically consist of a parabolic reflector with an illuminating feeding antenna situated near the paraboloid's focal point. Therefore, the reflector must be able to correct for the associated phase in order to achieve such an effect utilizing a planar reflector. Reflector antennas are antennas created to reflect incident electromagnetic waves coming from a different source. It is made to function at a high microwave frequency. These antennas are into the group of radiating devices with a high degree of directionality. In order to handle signals that operate in the microwave frequency ranges, reflector antennas are quite important. It has been in use ever since electromagnetic wave propagation was first discovered. In the year 1888, Hertz put forth the concept of electromagnetic wave propagation. However, during World War II, these antennas became far more prevalent in radar systems. The electromagnetic wave behaves like a light wave at high frequencies. As a result, when it hits a polished surface, it is reflected. This is how a reflector antenna works in general. A significant distinction to make in this case is that a reflector antenna combines a feed element and a reflecting surface. This means that a reflecting surface and an antenna element are needed in the case of a reflector antenna in order to excite the reflecting element. This indicates that it is made up of both active and passive components. The active element is the antenna that is utilized to generate excitation. The passive element, which is nothing more than the reflecting surface, is the one that reflects the energy that the active element emits. Therefore, it is clear that the reflector is a passive element while the feed is an active element. The active elements used to excite the reflector antenna are typically dipole, horn, or slot antennas. The passive element is sometimes referred to as the secondary antenna, whilst the active element is occasionally referred to as the primary antenna. As it alters the radiation pattern of the radiating elements, the reflector antenna plays a very important part in the propagation of radio waves. It works by directing energy from the feed toward the reflecting surface that is strategically placed. After receiving the energy, the reflector directs it in that direction further. While the radiation pattern coming from the reflector is referred to as a secondary pattern, the radiation pattern coming from the feed is referred to as a primary pattern.

1.3 PLANAR REFLECTOR

One of the simplest reflectors that points the electromagnetic wave in the right direction is the planar reflector, also known as the flat sheet reflector. It is nothing more than a flat, metallic sheet that is set back from the feed. It serves as a plane mirror for the incoming radio waves, allowing reflection through it. It should be noted that a plane reflector has trouble collimating the total energy moving forward. Thus the polarization of the active element and its position with respect to the reflecting surface are employed to manage the impedance, pattern characteristics, gain, and directivity of the system. The image of plane reflector is shown in figure 1.1.

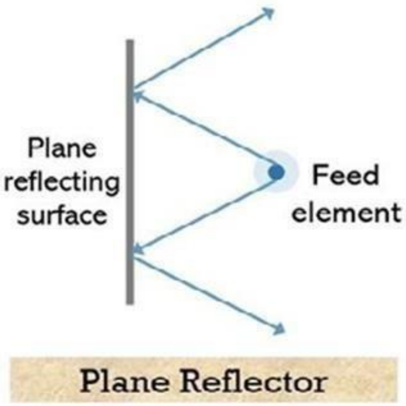

Figure 1.1 Plane reflector

CHAPTER 2

LITERATURE REVIEW

Ali K JassimAl, and Raad Thaher has proposed a paper on “Design and analysis of microstrip antenna with reflector to enhancement gain for wireless communication (2020)”. In this paper, The method of phase-only optimization (POM) is proposed, This method is used to design the reflector antenna that consists of elements arranged in a square grid and have a regular periodical pattern is observed. The obtained value of gain in this method is 7.15dB. [7]

Arrebola, M., Hu, W., Cahill, R., Encinar, J. A., Fusco, V., Gamble, H. S., Alvarez, Y., & Las-Heras, F. (2009) presented a paper titled on “94 GHz dual-reflector antenna with reflect array sub reflector. IEEE Transactions on Antennas and Propagation”. Dual reflector antenna is designed by using the method of moments (MoM) technique. To demonstrate the gain pattern of the designed antenna numerical simulations were presented. It was shown that implementing a progressive phase shift across the reflect array's aperture allows the high gain pattern of the antenna to be tilted to a specific angle. [19]

Balzovsky, E., Buyanov, Y., Gubanov, V., Efremov, A., Koshelev, V., Nekrasov, E., & Stepchenko (2018), has proposed a paper on “A High-Power Source of Ultrawideband Radiation with Reflector Antenna”. In the paper, it was looked into how a compact Ultra Wide Band (UWB) combination antenna irradiated an offset-parabolic reflector to provide a source of linearly polarized ultrawideband (UWB) pulse radiation. A bipolar voltage pulse with an amplitude of upto 100 kV and a length of 1 ns at a pulse repetition rate of 200 Hz was used to excite the feed antenna. The source was created for use in high-resolution radar and for testing radio-electronic systems. [2]

Debbarma, K., & Bhattacharjee, R. (2019) has proposed a paper on, “Microstrip patch antenna feed for offset reflector antenna for dual band application”. In this paper, By illuminating the reflector with fields from the suggested dual band feed configuration, low cross-polar levels in the reflector pattern are attained. [3]

Er-rebyiy R , J.Zbitou, M. Latrach, A. Tajmouati, A. Errkik, and L. EL Abdellaoui hasproposed a paper on “New Miniature Planar Microstrip Antenna Using DGS (Defective Ground Structure)for ISM (Industrial, Scientific, Medical) Applications (2020)”. This paper describes the miniaturization of a circular microstrip patch antenna which is operating at 2.45GHz frequency utilizing a novel defective ground structure design. In order to accomplish this goal of size reduction of an antenna, first created a circular patch antenna resonating at 5.8 GHz. Next, modified the antenna's ground plane by adding a new defective ground structure (DGS). When appropriately created, this aperture shape aids in increasing the current path within the patch region. This aids in lowering the microstrip patch antenna's resonance frequency, which in turn results in size reduction. [4]

Fernandesa.M, Da Silvaa, and Da Silva Briggs has proposed a paper on “2.4–5.8 GHz dual band patch antenna with FSS reflector for radiation parameters enhancement (2019)”. In this proposed method, The design and optimization of a band stop reflector was done based on frequency selective surfaces (FSS). The radiation properties were enhanced as a result of a decrease in sidelobe levels and a rise in main lobe gain. [5]

Mahmoud Wagih, Yang Wei, and Steve Beeby has proposed a paper on “Flexible 2.4 GHz Node for Body Area Networks with a Compact High-Gain Planar Antenna (2018)”.In this paper ,offered an adaptable single-layer monopole antenna-equipped 2.4 GHz wireless sensor node that is tailored for on-body operation in wearable applications. Multiple design approaches of an antenna have been investigated. Three antenna designs each trying to attain the best on-body performance utilizing a different design strategy, were put forth and further optimized through simulation. First, an inverted-F that has been proposed for efficiency. This inverted-F was originally intended to be a quarter-wavelength monopole, with a total radiator length of 3.1 cm. By adjusting the radiator length to the specifications the antenna is adjusted to resonate at 2.4 GHz frequency. In order to take into account the simulation-observed human-proximity effect, a single-layer patch with a ground shorting line on the same layer has been built using design-aid equations. Based on the outcomes of simulations of inverted-F antennas, a dual arm planar inverted-F antenna (PIFA) with an additional director arm inspired by the Yagi antenna has been developed. The dual radiators are designed to widen the bandwidth at 2.4 GHz and, as a result, lessen detuning susceptibility. [21]

Navjot Kaur, Jagtar Singh Sivia, and Mahendra Kumar has proposed a paper on “A Design of Planar Monopole Antenna for Wireless Applications (2022)”. The design of a planar monopole antenna with a small size and good gain for wireless applications is illustrated in this work. In this design, the rectangular patch is given a partial ground plane and semi-circular slots. The suggested antenna has a resonance frequency of 2.5 GHz and is constructed on a low-cost 1.6 mm thick FR4 glass epoxy substrate. The main objective was to achieve the size decrease without sacrificing the other antenna properties. In order to design the proposed monopole antenna, semi-circular slots are etched from the rectangular patch, and a partial ground plane has also been included to enhance the antenna performance parameters such as VSWR and return loss. The suggested monopole antenna demonstrates the better results in return loss and VSWR when the length of the partial ground plane and the radius of the semi-circular slots are changed. [8]

Ouyang J, Y. M. Pan, S. Y. Zheng, and P. F. Hu has proposed a paper on “An Electrically Small Planar Quasi Isotropic Antenna (2018)”. Investigated a singly fed, electrically tiny, planar antenna that produces a quasi-isotropic radiation pattern. A single-layer printed circuit board's top and bottom surfaces are used to print a pair of capacitively loaded loops (CLLs), a coplanar strip line, the folded dipole (CPS) that make up the antenna. Therefore, by merging the two orthogonal dipoles with the identical radiation intensities and quadrature phases, a quasi-isotropic radiation pattern can be created. A 2.4 GHz prototype is created, made, and tested in order to validate the theory. In this paper, studied a quasi-isotropic antenna consisting of a folded dipole and two CLLs. A pair of CLL elements can effectively increase the amplitude of the magnetic dipole mode to produce a quasi-isotropic radiation pattern. It has been demonstrated that the folded dipole can generate a stronger electric dipole mode and a weaker magnetic dipole mode. The antenna is precisely developed and fed in a single direction on a single-layer printed circuit board. [13]

Prasannakumar, P. V., Elmansouri, M. A., & Filipovic, D. S., has presented a paper titled on, “Broadband Reflector Antenna with High Isolation Feed for Full-Duplex Applications (2018)”. According to this paper, The axis symmetry reflector antenna is feed with a dual-polarized coaxial cavity antenna. By extending the coaxial cavity antenna's inner conductor, the feed and reflector are integrated, negating the need for mounting struts. [14]

Praveen Vummadisetty Naidu, Arvind Kumar, Rengasamy Rajkumar has proposed a paper on “Design, analysis and fabrication of compact dual band uniplanar meandered ACS fed antenna for 2.5/5 GHz applications (2018)”. In this proposed paper, A simple dual band structured asymmetric coplanar strip (ACS) supplied antenna is suggested. This designed antenna obtained impedance bandwidth from 2.5 GHz to 2.7GHz with the help of small ground plane. Microstrip feed line method also implemented and results are observed. Both these feeding method gives same results of VSWR, gain, radiation pattern and return loss [12].

2.1 SUMMARY

- Partial ground plane technique can be used to decrease the value of return loss and VSWR.
- Reflector plane can be used to modify the radiation pattern in desired direction.
- Defective Ground Structure technique is useful in size reduction of the antenna.

CHAPTER 3

PROPOSED METHOD

The proposed work is to design a compact planar reflector antenna with frequency range of2 GHz to 3 GHz resonating at 2.5 GHz frequency using FR4 (Flame Retardant) substrate and obtain the VSWR value of 1.05 to 1.08.

3.1 ANTENNA WITH PARTIAL GROUND PLANE

Modern communication systems use microstrip antennas (MSAs) because of their planar structure, low cost and light weight. Surface wave excitation is one of the main issues in practical microstrip antenna design. When an microstrip antenna is constructed on a substrate, surface waves significantly reduce its performance. Surface waves on a finite ground plane travel until they encounter an edge, at which point they are reflected back and diffracted by the edges. Due to surface wave diffraction from the antenna ground plane's edges, the back radiation pattern of the patch antenna increases, especially when it is printed on high dielectric substrates. Earlier, many attempts were made to reduce the surface waves on an microstrip antenna. One approach is, use a partial ground plane in an antenna which helps to reduce the surface wave excitation. By this return loss can be reduced. Incorporating partial ground plane helps to reduce the amount of reflected signal to the source, results in reduced value of Voltage Standing Wave Ratio (VSWR).

3.2 ANTENNA WITH REFLECTOR PLANE

Over the past ten years, planar reflector antennas have drawn a lot of attention from designers. The antennas are just as effective as conventional curved reflector antennas, but they have the benefit of being inexpensive and simple to design and produce. In this proposed method simple reflector antenna is used. A feed element and a reflecting surface combine to form a reflector antenna. The antenna element and the reflecting surface is needed to excite the reflecting element. This indicates that reflector antenna is made up of both active and passive components. Active element is used to provide excitation. The reflecting surface is known as passive element that reradiates the energy emitted by the active element So, simply we can infer that the active element is feed while the passive element is reflector.

CHAPTER 4

DESIGN AND RESULTS

In this proposed work, a planar reflector antenna with a partial ground plane is designed. At the top of the substrate, a rectangle shaped patch is placed and at the bottom side of the substrate, a partial ground plane is designed. The antenna is fed using a microstrip feed line. In this proposed work, various design methodologies are used to design a planar reflector antenna with VSWR of 1.05 to 1.08. In all the designs FR4 is used as a substrate. Initially rectangular patch antenna was designed and then partial ground plane is incorporated in it to obtain better results. Later designed reflector and placed above the initial design. Planar reflector antenna consists of primary antenna and reflecting surface. With this arrangement, it is useful to radiate Electro Magnetic (EM) energy in the desired direction. Figure 4.1 and 4.2 shows the top and bottom view of the antenna respectively.

4.1 ANTENNA DESIGN CALCULATION

Frequency = 2.5GHz

Dielectric constant = 4.4

Height = 1.6 mm

Width of the patch(L)

$$w = \frac{c}{2f_0\sqrt{\frac{\Sigma_R+1}{2}}} \tag{4.1}$$

$$= \frac{3*10^8}{2*2.5G\sqrt{\frac{4\cdot4+1}{2}}}$$

$$= 38 \text{ mm}$$

Effective dielectric constant

$$\Sigma_{eff} = \frac{\Sigma_r+1}{2} + \frac{\Sigma_r-1}{2}\left[\frac{1}{\sqrt{1+12\frac{h}{w}}}\right] \tag{4.2}$$

$$= \frac{5\cdot4}{2} + \frac{3.4}{2}\left[\frac{1}{\sqrt{1+12(\frac{1.6mm}{38mm})}}\right] = 4.08$$

Length of the patch(L)

$$L = \frac{c}{2f_0\sqrt{\Sigma_{eff}}} - 0.824h\left[\frac{(\Sigma_{eff}+0.3)\left(\frac{w}{h}+0.264\right)}{(\Sigma_{eff}-0.258)\left(\frac{w}{h}+0.8\right)}\right] \qquad (4.3)$$

$$= \frac{3*10^8}{2*2.4*G\sqrt{3.7746}} - 0.842(1.6mm)\left[\frac{(4.0746)(24.014)}{(3.5166)(24.55)}\right]$$

$$= 29 \text{ mm}$$

Length of the substrate (Lg) = 6h+ L (4.4)

= 6*1.6 + 29

= 38.6 mm

Width of the substrate (Wg) = 6h+W (4.5)

= 6*1.6+ 38

= 47.6 mm

Table 4.1 Specifications of antenna

Antenna type	Planar reflector antenna
Substrate	FR4
Dielectric constant	4.4
Loss tangent	0.02
Feeding	Micro-strip feed line

Table 4.1 shows the specifications of antenna like substrate material, dielectric constant, loss tangent and feeding techniques. The length and width of the patch is taken as 38mm and 29mm respectively. This can be derived from equation 4.1 and equation 4.3.

The Table 4.2 shows the dimensions used for the design of an antenna. It shows that the substrate length and width is taken as 39mm and 47.6mm respectively.

these values are calculated using equation 4.4 and 4.5 respectively. The size of the ground is 31mm x 36mm. The length of the feed line is given as 16.43 mm and width is given as3.05mm.

Table 4.2 Dimensions of antenna

Labels	Values in mm
Substrate length	39
Substrate width	47.6
Patch length	29
Patch width	38
Length of ground plane	31
Width of ground plane	36
Height of the substrate	1.6

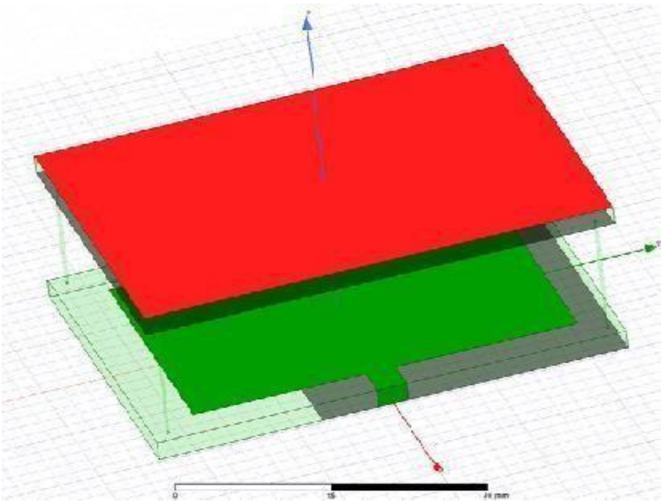

Figure 4.1 Top view of antenna

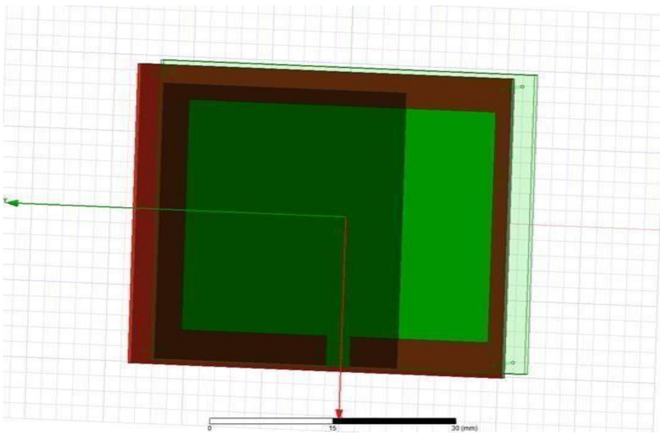

Figure 4.2 Bottom view of antenna

4.2 SIMULATION RESULTS FOR PLANAR REFLECTOR ANTENNA WITH PARTIAL GROUND PLANE

Figure 4.3 shows the design of an antenna with partial ground plane. The antenna is simulated using Analysis System (ANSYS) High Frequency Structure Simulator tool (HFSS) and the following results are obtained. Return loss is obtained as -26.28 dB at 2.5 GHz as shown in the Figure 4.4. The voltage standing wave ratio (VSWR) is obtained as 1.15. This is shown in the Figure 4.5. The Maximum gain obtained is 2.7dB. And directivity of 5.83 dB is obtained.

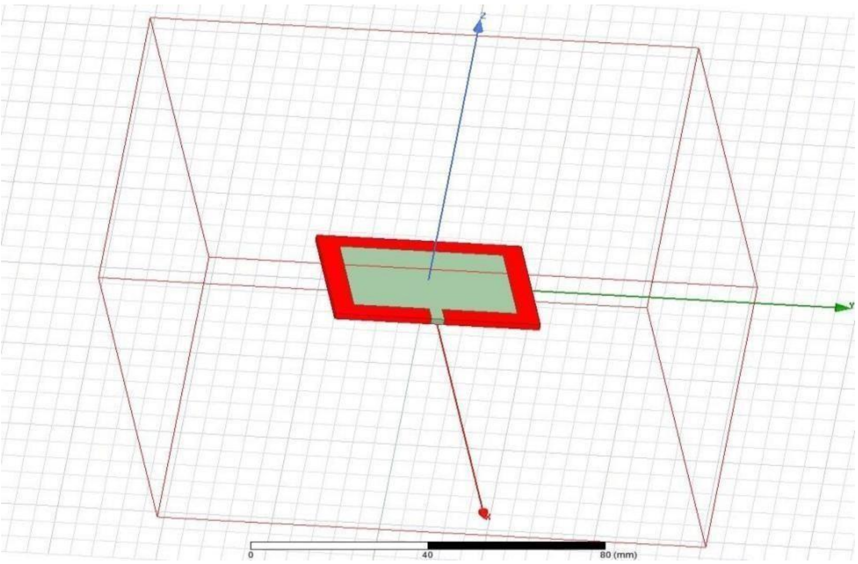

Figure 4.3 Design of an antenna with partial ground plane

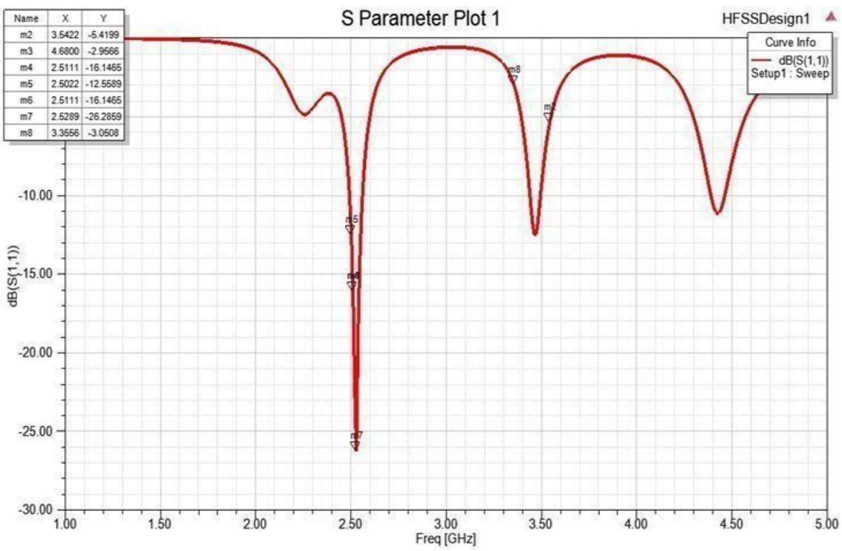

Figure 4.4 S11 vs frequency plot of the antenna with partial ground plane

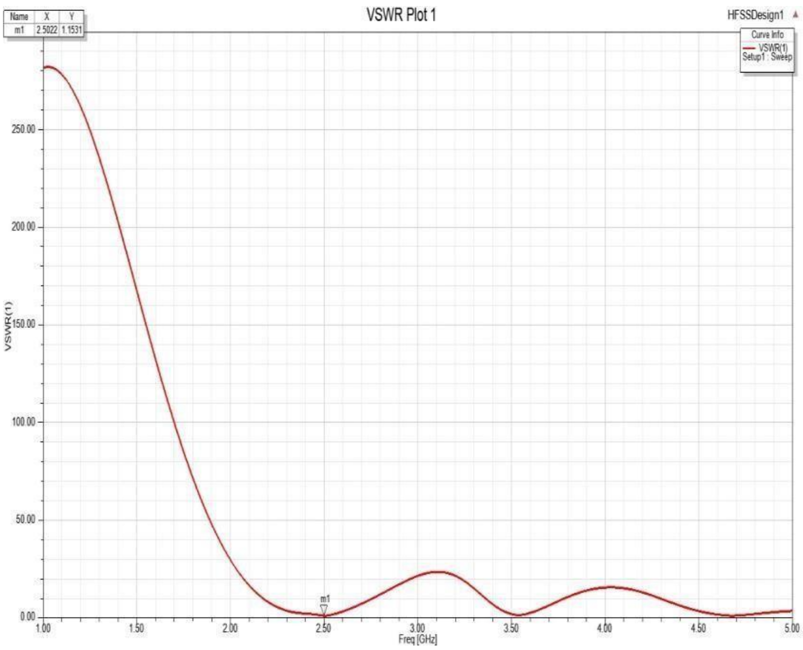

Figure 4.5 VSWR plot of the antenna

In the figure 4.6, the 3D gain plot of the antenna is shown. The gain is obtained as 2.7dB and the directivity is obtained as 5.83 dB This can be observed in the figure 4.7. Radiation pattern of an antenna is in the reverse direction.

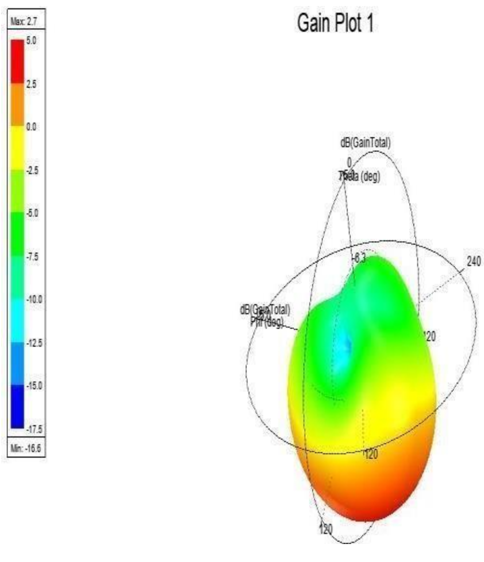

Figure 4.6 3D gain plot of the antenna

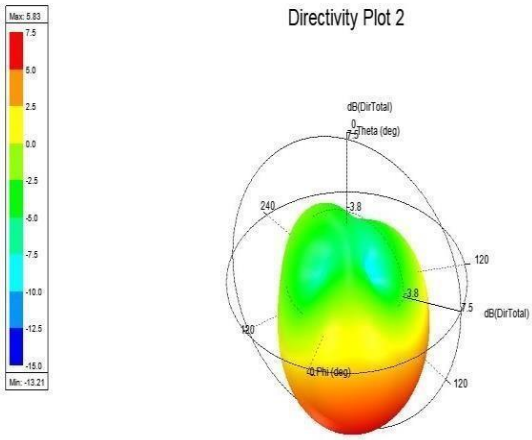

Figure 4.7 3D directivity plot of the antenna

4.3 SIMULATION RESULTS AFTER PLACING REFLECTOR PLANE

Results after inserting the reflector plane above the patch antenna design. Figure 4.8 shows the design of an antenna.

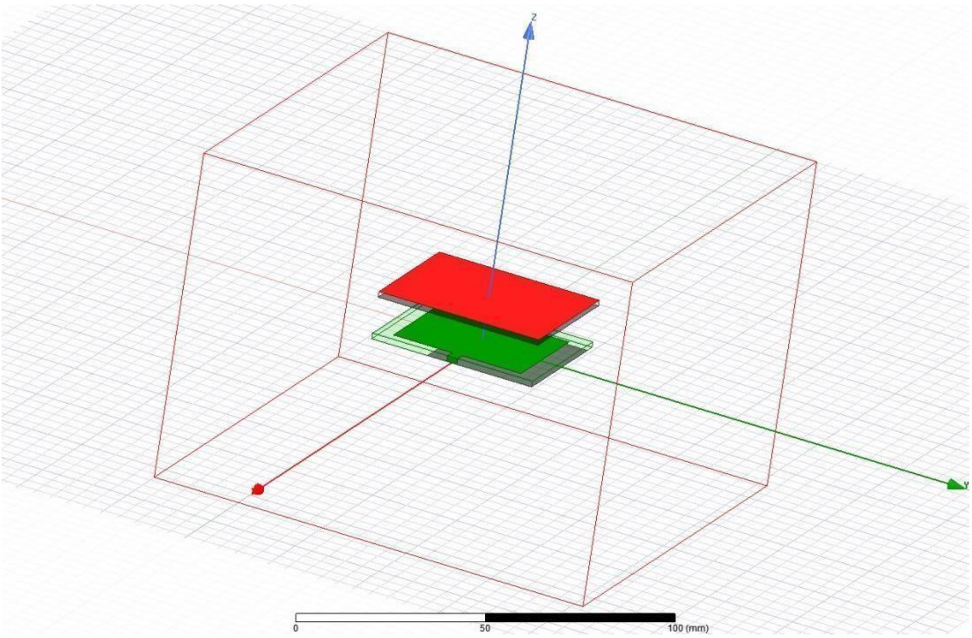

Figure 4.8 Antenna design with reflector plane

Design Specification for the reflector plane is given in the table 4.3.

Table 4.3 Specifications of reflector plane

Substrate	FR4
Dielectric constant	4.4
Loss tangent	0.02
Length of the substrate	39 mm
Width of the substrate	47.6 mm
Height of the substrate	1.6 mm
Length of the ground	39 mm
Width of the ground	47.6 mm
Length of the top layer	39 mm
Width of the top layer	47.6 mm
Distance between antenna and reflector	12 mm

The following figures shows the simulated output for planar antenna with reflector plane. The return loss is obtained as -23.56 dB at 2.53GHz. The voltage standing wave ratio is obtained as 1.15 at 2.53GHz. This can be observed in the figure 4.9 and 4.10 respectively.

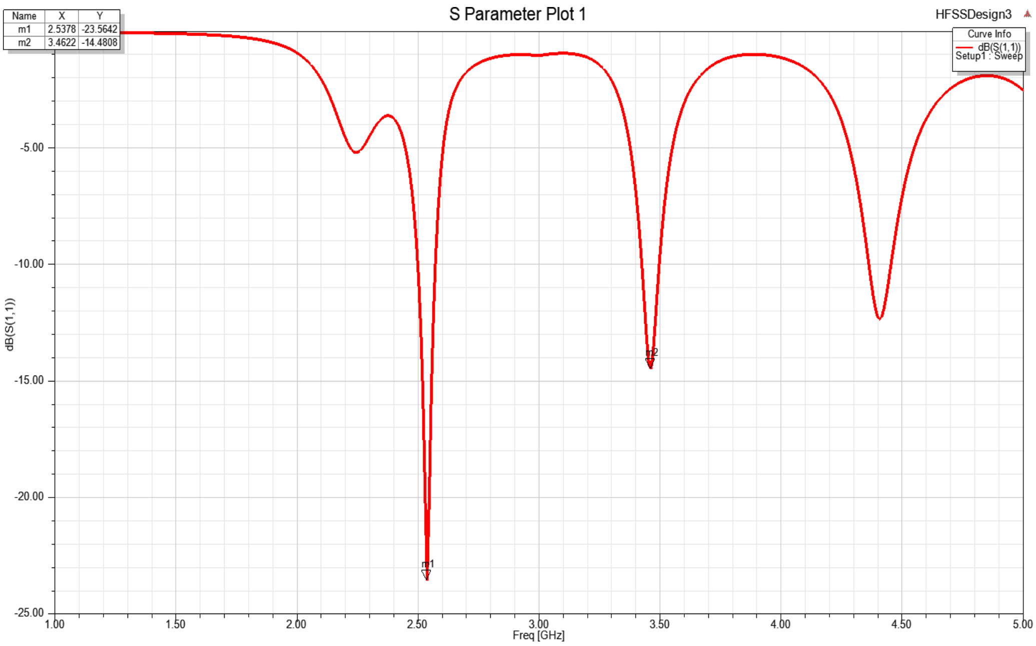

Figure 4.9 S11 Vs Frequency plot of the antenna with reflector plane

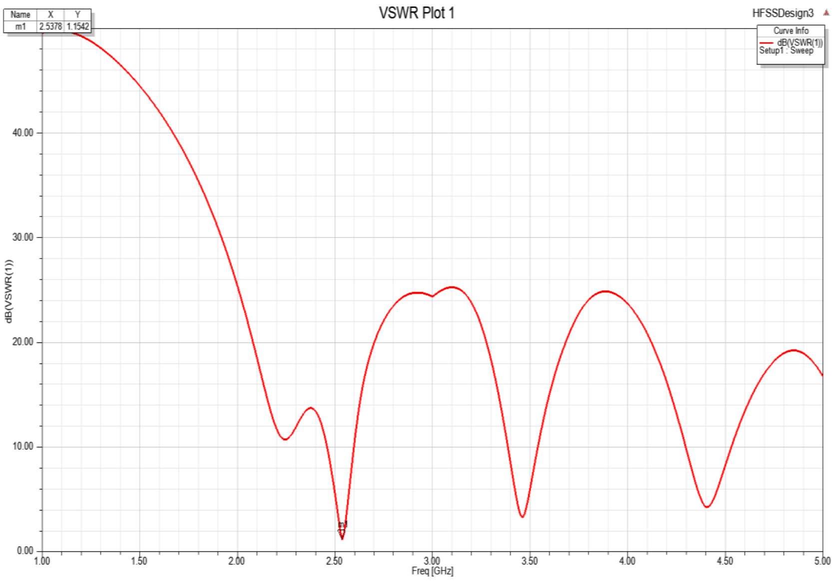

Figure 4.10 VSWR plot of the antenna with reflector plane

In the figure 4.11, the 3D gain plot of the antenna is shown. The gain is obtained as 3.2dB. The directivity is obtained as 5.3 dB. This can be observed in the figure 4.12. We can observe that gain is increased from 2.7dB to 3.2dB after incorporating the reflector plane.

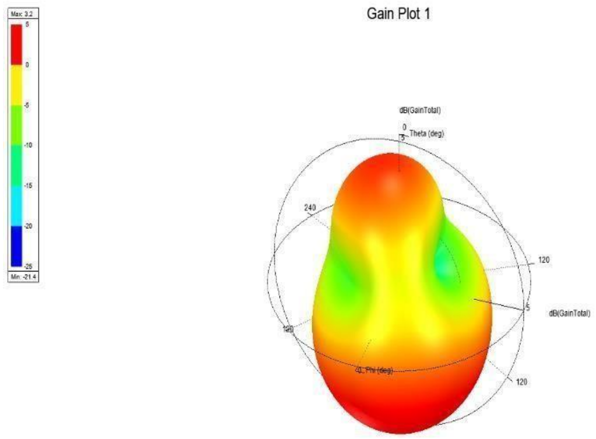

Figure 4.11 3D gain plot of the antenna with reflector plane

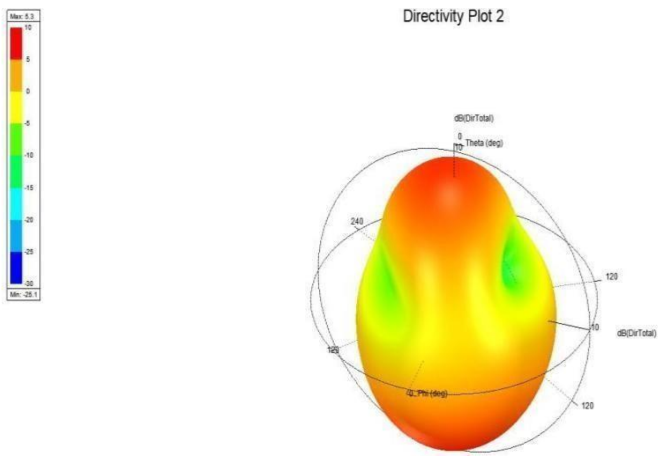

Figure 4.12 3D directivity plot of the antenna with reflector plane

4.4 SIMULATION RESULTS AFTER OPTIMIZING THE DESIGN

The via is added between antenna and reflector plane in four corners of the antenna. Following are simulation results after optimizing the design. Figure 4.13 shows the design of an antenna.

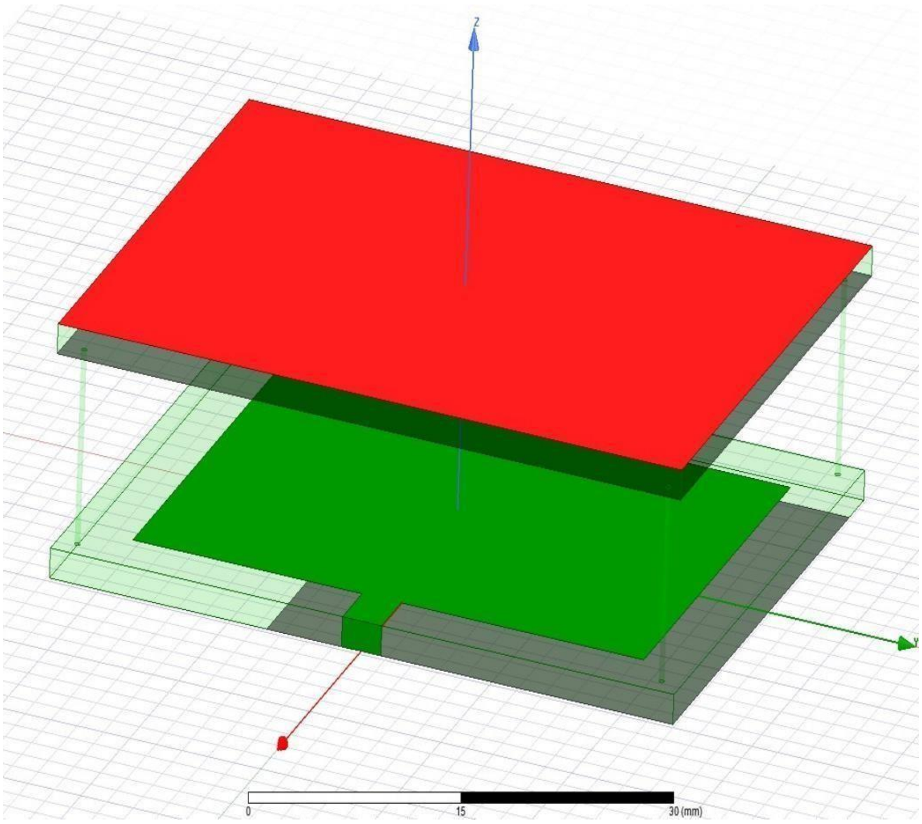

Figure 4.13 Antenna design (Via added)

Table 4.4 Specifications of antenna after optimization

Labels	Values in mm
Substrate length	39
Substrate width	47.6
Patch length	30
Patch width	39
Length of ground plane	31
Width of ground plane	36
Height of the substrate	1.6

The following figures shows the simulated output for planar antenna after optimization. The return loss is obtained as -40.54 dB at 2.46GHz. The voltage standing wave ratio is obtained as 1.01 at 2.46GHz. This can be observed in the figure 4.14 and 4.15 respectively.

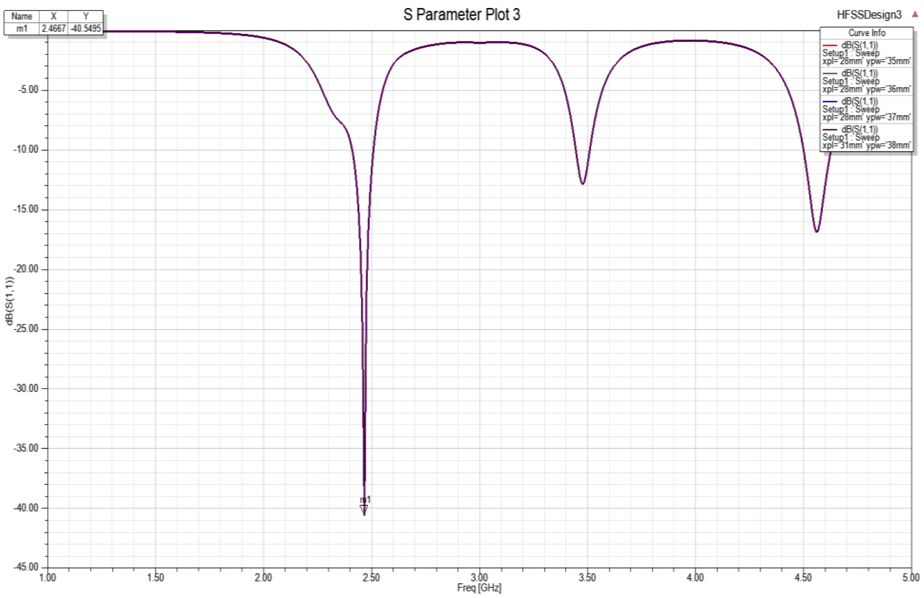

Figure 4.14 S11 vs frequency plot of the antenna

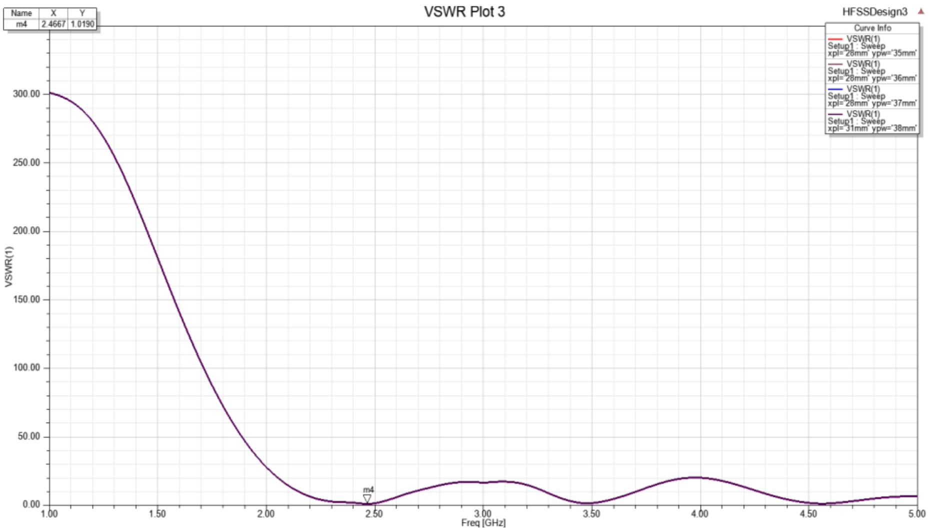

Figure 4.15 VSWR plot of the antenna

In the figure 4.16, the 3D gain plot of the antenna is shown, figure 4.17 shows the 3D directivity plot of the antenna. The obtained value of gain and directivity is 2.0 dB and 5.1 dB respectively.

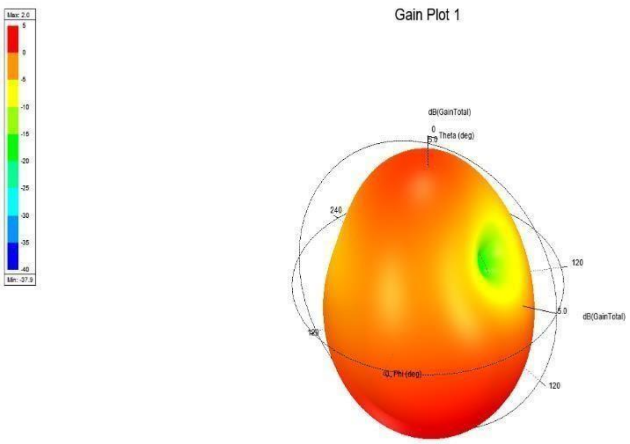

Figure 4.16 3D gain plot of the antenna with reflector plane

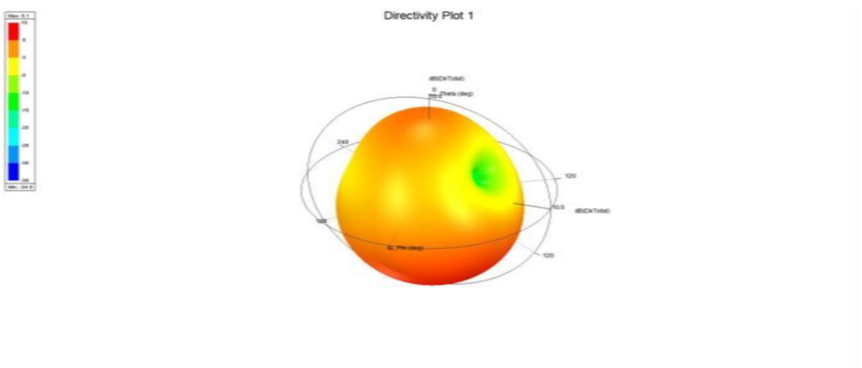

Figure 4.17 3D directivity plot of the antenna

Table 4.5 Comparison of results for various antenna design

PARAMETERS	RESULT (Without reflector)	RESULT (With reflector)	RESULT (After optimization)
Return Loss	-26.28 dB	-23.56 dB	**-40.54 dB**
Gain	2.7 dB Max	3.2 dB Max	**2.0 dB Max**
Directivity	5.83 dB	5.3 dB	**5.1 dB**
VSWR	1.12	1.15	**1.01**

From the above table 4.5 we can observe that, the antenna without reflector the following values are obtained. -26.28 dB return loss, 2.7dB gain value, directivity value is 5.83dB and VSWR value is 1.12. The antenna with reflector the following values are obtained. return loss is -23.56dB, gain value is 3.2dB, directivity value is 5.3dB and VSWR value is 1.15. After optimization process obtained return loss value is -40.54 dB, gain value is 2.0dB, directivity value is 5.1 dB and VSWR value is 1.01.

CHAPTER 5

CONCLUSION

Theoretical results for a planar reflector antenna have been presented. First a compact planar reflector antenna with partial ground plane is designed. At the top of the substrate, a rectangular patch is placed and at the bottom side, a partial ground is designed. The antenna is fed using microstrip line. The antenna is designed using FR4 substrate. The loss tangent of the substrate is 4.4. From this design obtained values of return loss and VSWR is -26.28 dB and 1.12 respectively. Obtained Gain value and directivity value for this design is 2.7 dB and 5.83dB respectively. Via is added between the reflector plane and patch antenna. Optimization of the design was done. After this the following results are obtained. Return loss and VSWR value is -40.54dB and 1.01 respectively. Obtained gain and directivity for this design is 2.0 dB and 5.83dB respectively.

CHAPTER 6

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