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RECTANGLE SEMICIRCULAR ANTENNAS FOR WIRELESS COMMUNICATION

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***Abstract*— A rectangle semicircular antenna is developed for mobile communication systems. The antenna is made up of a pair of folded semicircular dipoles which are coupling fed by a micro strip line.**

The planar antenna achieves a bandwidth of 53% for dB, covering the frequency range 1.25–2.1 GHz for mobile applications. The antenna gain of the broadband antenna element is about 7dBi. Gain and bandwidth enhancement is achieved using fabry perot cavity between reflector and planar antenna. The FR4 dielecric is used which is low in cost, simple to fabricate and easily available, while presence of air between feed antenna and parasitic patches increases the efficiency of the structure.

Effects of variation in various parameters like dimensions of feed, parasitic patches, feed point, inter-element spacing and reflector height are analyzed. By decreasing the reflector at 120mm the gain of about 7dBi is obtained. Various gain flattening techniques are also proposed in this project. The proposed antenna with modified dimensions and spacing between the elements is fabricated and tested..

Index terms- **Rectangle semi circular antenna, FR4 dielectric, Fabry- perot cavity, reflector.**

I. INTRODUCTION

In this report, a broadband planar antennas with L shaped rectangular and semi circular parasitic elements is considered and investigated theoretically and experimentally.

Broadband planar rectangular antenna:

Figure 1.1 shows the actual geometry of the antenna. The antenna consists of a pair of folded dipoles connected in parallel through a coplanar stripline. The folded dipoles are coupling fed by an L-shaped microstrip line. The dipoles are printed on the back side of the substrate while the L-shaped microstrip line is etched on the front side of the same substrate. The inner conductor of a flexible 50- coaxial cable is connected to the L-shaped microstrip line while the outer conductor of the cable is soldered to the coplanar stripline which has a dielectric constant Er = 4.4 of and a thickness of t = 2.1mm. The planar antenna is placed above a shaped reflector for base station applications.

The width Wd of the slot of the coplanar stripline is an important parameter for impedance matching. An optimal value for is found to be 2.1 mm for the best impedance matching. The length (Ln + La) of the coupling microstrip line is another important parameter that affects the impedance matching. Without the coupling microstrip line, i.e., (Ln + La) = 0 and the antenna element is directly fed, the impedance matching is not very good. When the coupling microstrip line is introduced, the impedance matching is improved. The optimized value for the length of the coupling microstrip line is (L+ L/2) = 22.5 mm, which is approximately a quarter guided wavelength at 2.175 GHz. The height (H) of the antenna element above the reflector also has effect on the impedance matching of the broadband antenna element. The effect on the return loss caused by the height is depicted. The impedance matching is not good without the reflector. As the reflector is introduced, the impedance matching is improved.

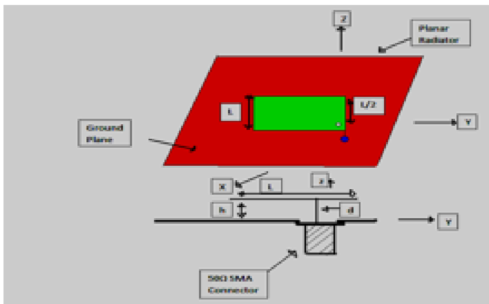

Figure 1.1 Geometry of Broadband planar antenna.

II. EXPERIMENTAL STUDY

The objective and scope of the present work are:

1. To design and develop broadband planar antenna for mobile application.

(a) GSM 900/ 1800, CDMA and PCS operate in the (890 – 960 MHz) and (1710-1920 MHz) bands

(b) 3G (1880-2170MHz) bands with

Return loss < -10 dB, antenna gain should be 8dBi and stable radiation pattern.

2. To analyze the effect of height, effect of width of strip, effect of ground plane length and width on impedance matching and return losses of antenna.
3. To design and develop high gain broadband antennas using reflector with gain > 8dBi.
4. To design a broadband rectangular/ circular monopoles antennas.
5. To analyse effect of reflector height on gain and radiation characteristics of antenna.
6. To analyse the structure of antenna for bandwidth enhancement.

IE3D is a full wave electromagnetic software. It solves Maxwell's equations which governs the electromagnetic phenomena. There is no assumption involved except the numerical nature of the method. Therefore the solution is extremely accurate. IE3D is a full wave, method of-methods based electromagnetic simulator solving the current distribution on 3D and multilayer structures of general shapes. It has been widely used in the design of MMIC'S, RFIC'S, LTCC circuits, microwave/ millimeter-wave circuits, IC connectors and packages, patch antennas, wire antenna, other RF/wireless antennas. IE3D is a unique EDA tool used in the recent advancement in microwave, wireless, RF and semiconductor technologies.

III. PROPOSED ANTENNA AND RESULTS

Bandwidth and gain can be enhanced by fabricating parasitic patch array on a dielectric substrate layer. These patches are good reflector of microwave frequency and therefore are used to enhance the reflection coefficient and the gain. Further, field amplitude and phase depend on dimensions and spacing between parasitic patches.

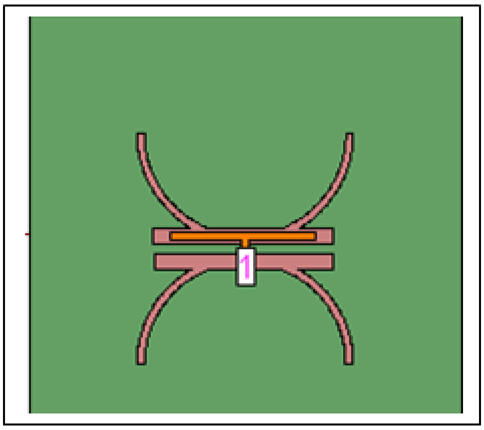

Fig.3.1 Proposed antenna design

The antenna is finally designed and fabricated by considering the reflector height at the dimension of 120mm*120mm keeping the antenna at the height of 50mm.The reflector material used is copper plate PCB with thickness of 0.5mm and by considering length and width of 120mm* 120mm.SMA connector is used and is connected from below the ground plane at the distance of 1mm from the feed point. The gain obtained is about 7dBi. If the height of the reflector increases then gain also increase but size of the antenna also increases. The frequency obtained varies from 1.25 GHz to 2.17GHz which is the desired frequency and is applicable for all mobile applications. Furthermore antenna efficiency is not affected much more by changing the reflector height. But the directivity of the antenna changes. The radiation pattern is also observed in E- plane and H-plane respectively. The smith chart is within VSWR= 2 circle i.e 1.65. The antenna and the ground plane will be integrated onto the same laminate; because of its material properties and low costs for the material FR4 substrate is chosen. As shown in fig.5.1the proposed antenna design is analyzed in Vector network analyzer where we are getting a frequency of 1.25GHz –2.175GHz respectively.

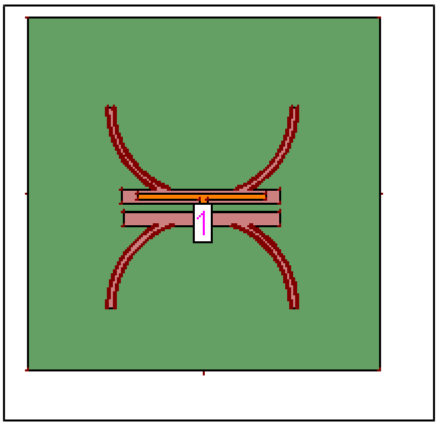

Fig. 3.1.1 Antenna with reflector height at 120mm

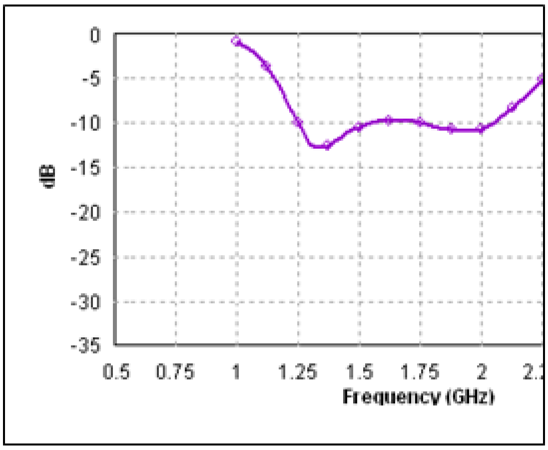

Fig. 3.1.1 S11 vs. Frequency

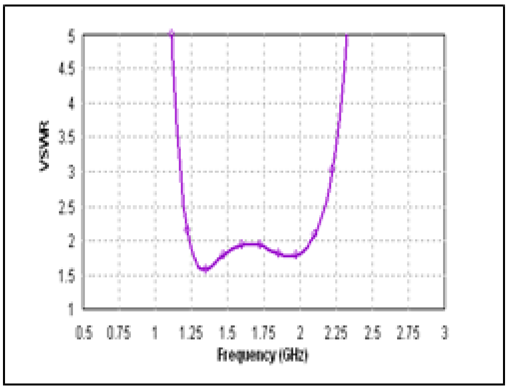

Fig. 3.1.2 VSWR vs. Frequency

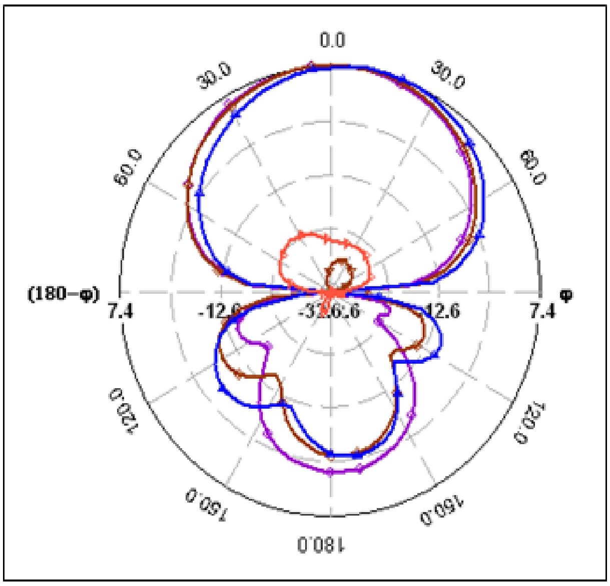

Fig. 3.1.3 Radiation pattern

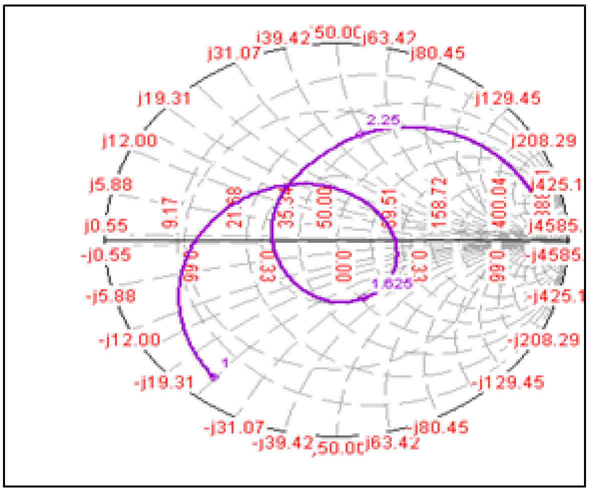

Fig. 3.1.4 Smith Chart

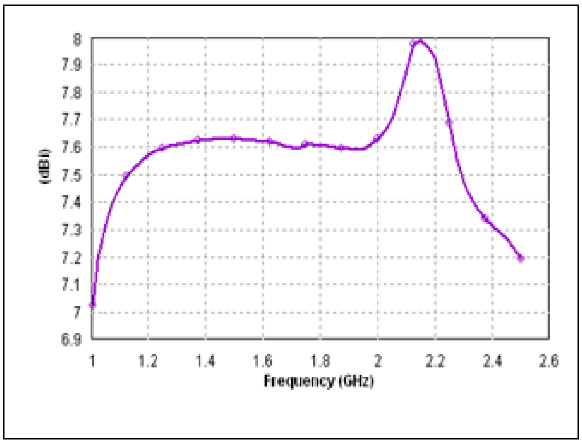

Fig. 3.1.5 Directivity vs. Frequency

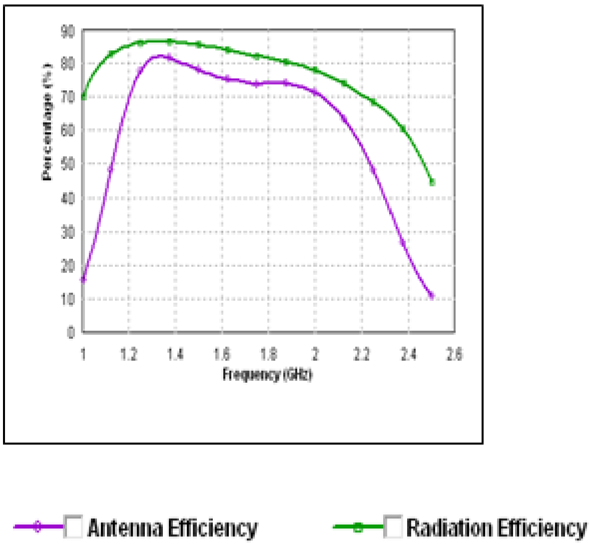

Fig. 3.1.6 Antenna Efficiency vs. Frequency

IV. CONCLUSION

The various advantages of broadband planar antennas such as high efficiency, cost effective, low profile and conformability to the planar and non planar structures has resulted in their wide range applications in mobile applications. In this thesis rectangular semicircular antenna is designed to provide high gain and wide bandwidth (1.25GHz-2.1GHz) covering GSM and CDMA band. The bandwidth can be enhanced by introducing a reflector comparing with different height having close resonant frequency giving a large resultant bandwidth. The gain and bandwidth can be increased by using the Fabry-Perot cavity concept consisting of perfect reflecting ground plane. The structures are simulated using IE3D 14.0, Zealand software.

Investigations are carried out with different parametric studies. The structures are designed in different configurations considering different reflector height. Low cost easily available FR4 substrate is used. Air is used as a dielectric medium between feed patch and ground plane to achieve high efficiency.

A study has been conducted to analyze (i) the effect of feed point position with half patch (ii) the effect of feed point position with full patch length by considering different length of patch (iii) the effect of reflector (iv) the effect of reflector height.

The gain of the antenna depends on patch dimensions, spacing between patches, effect of reflector and reflector height. It results in off resonance conditions such that different elements resonate at different frequencies close to central frequency. It is also observed that the gain and bandwidth of the antenna increases with increase in reflector height. Various gain flattening techniques to reduce the gain variations are studied.

REFERENCES

[1] K. Fujimoto, “Antennas for base stations,” in *Mobile Antenna Systems Handbook*, 3rd ed. Boston, MA, USA: Artech House, 2008, pp.141–211.

[2] C. L. Mak, K. M. Luk,K. F.Lee, andY. L. Chow, “Experimental study of a microstrip patch antenna with an L-shaped probe,” *IEEE Trans.Antennas Propag.*, vol. 48, no. 5, pp. 777–782, May 2000.

[3] Y. Liu, K. M. Luk, and H. C. Yin, “Bowtie patch antennawithelectricdipole on a HIS substrate,” in *Proc. Int. Conf. on Microwave andMillimeterWave Technology (ICMMT)*, 2010, pp. 278–280.

[4] U. K. Revankar and Harishchandra, “Printed dipole radiating elements for broadband and wide scan angle active phased array,” in *Proc. IEEEInt. Symp. on Antennas Propag. Society*, July 2001, vol. 4, pp. 796–799.

[5] R. L. Li,T.Wu, B.Pan, K. Lim, J.Laskar, andM.M.Tentzeris, “Equivalent- circuit analysis of a broadband printed dipole with adjusted integrated balun and an array for base station applications,” *IEEE Trans.Antennas Propag.*, vol. 57, no. 7, pp. 2180–2184, Jul. 2009. [6] Z. W. Zhou, S. W. Yang, and Z. P. Nie, “A novel broadband printed dipole antenna with low cross-polarization,” *IEEE Trans. AntennasPropag.*, vol. 55, no. 11, pp. 3091–3093, Nov. 2007.

[7] H. Wong, K.-L. Lau, and K.-M. Luk, “Design of dual-polarized L-probe patch antenna arrays with high isolation,” *IEEE Trans.Antennas Propag.*, vol. 52, no. 1, pp. 45–52, Jan. 2004.

[8] Y.-X. Guo, K.-W. Khoo, and L. C. Ong, “Wideband dual-polarized patch antenna with broadband baluns,” *IEEE Trans. Antennas Propag.*, vol. 55, no. 1, pp. 78–83, Jan. 2007.

[9] H.-W. Lai and K.-M. Luk, “Dual polarized patch antenna fed by meandering probes,” *IEEE Trans. Antennas Propag.*, vol. 55, no. 9, pp.2625–2627, Sept. 2007.