International Journal of Electronic Networks, Devices and Fields.
ISSN 0974-2182 Volume 6, Number 1 (2014), pp. 27-31

http://www.irphouse.com

Design and Analysis of a Microstrip Antenna having Compact Circular Patch with a Diamond Slot

Chandan Kumar Jha [1], Monika Kukreja[2,] Gourav Rajput [3,] Neelkamal Rajput [4,] Shilpi Singh [5]

[1]Assistant Professor, Department of EC, IITM, Gwalior
[2, 3, 4, 5] Final Year Student, Department of EC, IITM, Gwalior
Email id: monikakukreja1991@gmail. com

ABSTRACT

A circular patch microstrip antenna with a diamond slot has been designed and radiation performance has been presented in this paper. The designed antenna is compact in size and can be used for mobile communication. For simulation purpose CST microwave Studio Software has been used and later the hardware implementation was done using the FR-4 substrate. The optimization of side lengths and angles of diamond slot is performed to achieve improved bandwidth of the proposed antenna. Due to its compact size and ease of design the proposed antenna is applicable to use in the mobile communication.

Keywords: Broadband antenna, Circular patch antenna, Compact size, Diamond slot

I. INTRODUCTION

The invention of the microstrip antenna has attributed to the various applications in the field of telecommunications. Due to its light weight, low volume, low cost, low profile, smaller in dimension and ease of fabrication and conformity, it has made great progress in recent years. Compared with conventional antennas, microstrip patch antennas have more advantages and better prospects. Microstrip patch antennas are increasing in popularity for use in wireless applications due to their low-profile structure. Therefore they are extremely compatible for embedded antennas in handheld wireless devices such as cellular phones, pagers etc. The telemetry and communication antennas on missiles need to be thin and compact in size and are often in the form of microstrip patch antennas.

Another area where they have contributed is in the field of satellite communication. In case of satellite communication circularly polarized radiation

patterns are required and can be realized using either square or circular patch with one or two feed points. The fabrication technology based on photolithography enables the bulk production of microstrip antenna with repeatable performance at a lower cost in a lesser time frame as compared to the conventional antennas.

It is found that in the treatment of malignant tumors the microwave energy is said to be the most effective way where the design of the particular radiator to be used should posses light weight, easy in handling and to be rugged. Only the patch radiator fulfils these requirements.

For this microstrip radiator for inducing hyperthermia was based on the printed dipoles and annular rings which were designed and later on the design was based on the circular microstrip disk. Microstrip patch antennas are also used in telemedicines applications.

In this paper, the design of compact size circular patch antenna with a diamond slot has been proposed and its simulation and its radiation performance have been presented. The designed circular patch microstrip antenna has found its application in the field of mobile communication as it presents the desired performance and improved bandwidth and gain.

2 Circular patch antenna with a diamond slot

The circular patch antenna has been modified by inserting a diamond slot for the efficient bandwidth and improved gain and its radiation performance. The circular patch was designed on the CST STUDIO SOFTWARE where the radius of the circular patch was 16. 94mm.

The equation 1 and equation 2 through which the radius of the circular patch and factor F was calculated is given below:

$$a=\frac{F}{1+\left\{\frac{2h}{\pi\epsilon}\right\}\sqrt{\left[\left\{\ln\left(\frac{\pi F}{2h}\right)+1.7726\right\}\right]}} \quad (1)$$

$$F=\frac{8.791*10^{9}}{f_{r\sqrt{\varepsilon_r}}} \quad (2)$$

Where the resonant frequency was taken as 2. 4 GHz where this frequency was proposed so that it could be used in mobile communications. The dimensions of the diamond slot are given in the table 1 below used in the CST SUITE STUDIO SOFTWARE.

Table 1: Shows co-ordinates of the diamond slot in the circular patch of the designed antenna

X	Y
-5-2	0
0-2	5
5-2	0
0-2	-5

The circular patch within infinite ground plane was designed using the glass epoxy FR-4 substrate. The design of the circular patch antenna with a diamond slot has been shown in figure 1.

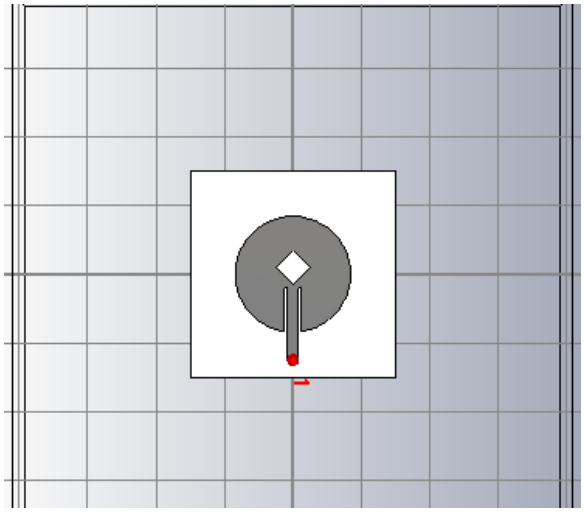


Fig 1-geometry of the circular patch antenna with a diamond slot designed on CST STDIO SUITE SOFTWARE

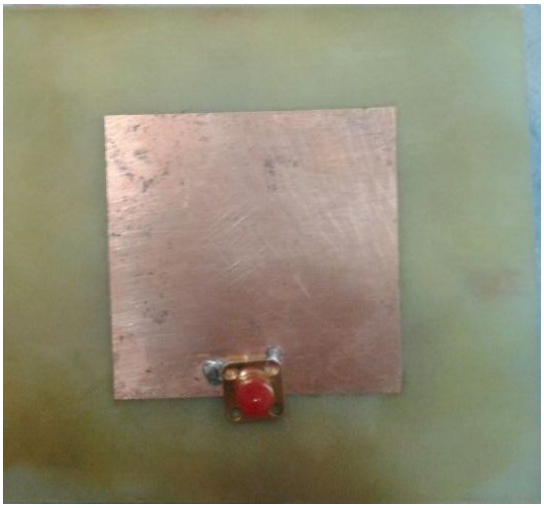


Fig2. (a) **Fig 2. (b)**

Fig 2 (a) shows the design of ground with a SMA Connector and (b) shows the design of circular patch antenna with a diamond slot.

3 Result

The designed antenna has been tested at MITS I Gwalior where we got better reflection co-efficient at the frequency of 2. 49GHz in comparison with the

conventional circular patch. Reflection coefficient at the resonant frequency of 2. 49 calculated is-41. 3dB. The figure 3 below shows the simulation of the proposed antenna designed using the CST STUDIO SUITE SOFTWARE.

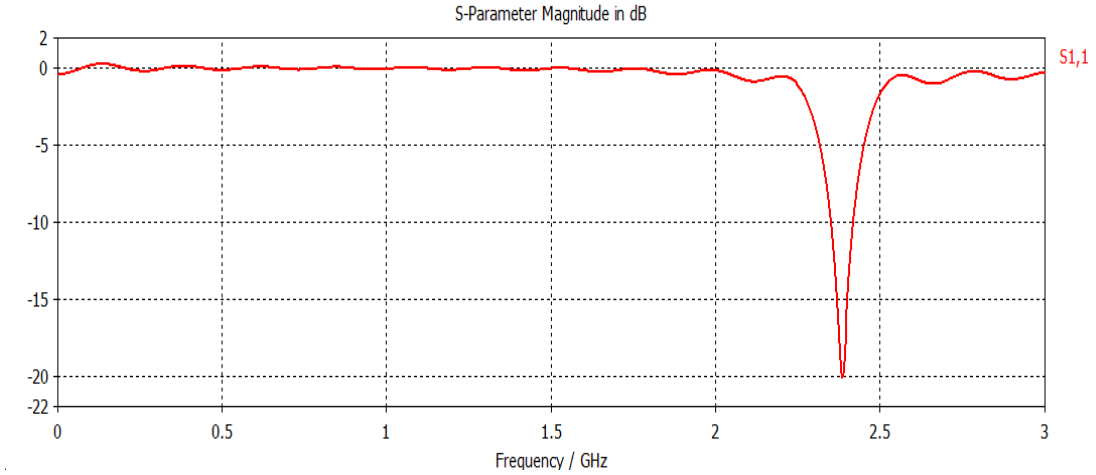
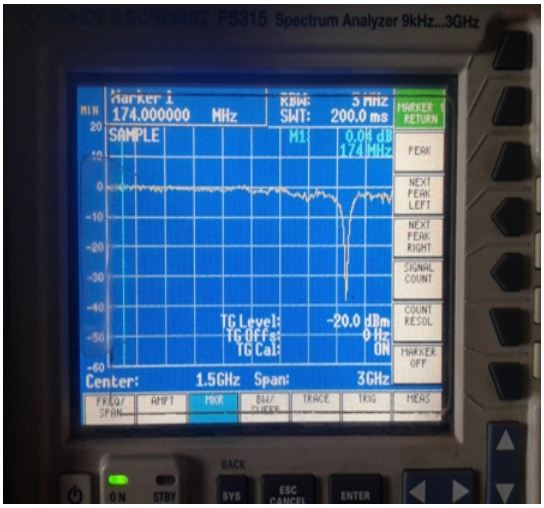


Fig 3-Simulation result of the circular patch microstrip antenna with a diamond slot



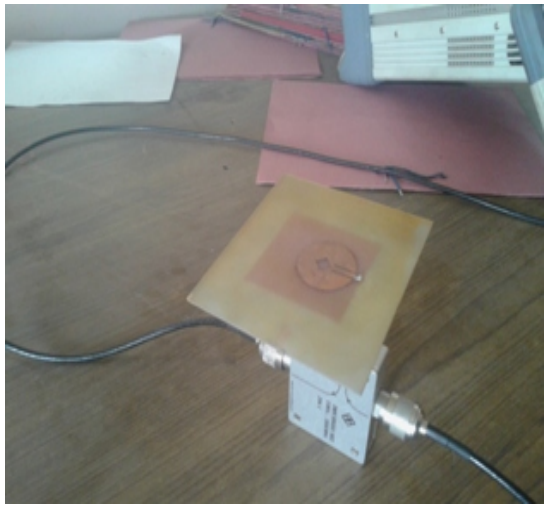


Fig 4(a) Fig 4(b)

Fig 4 (a)-graph shown during testing of designed antenna (b) Shows the designed antenna being tested using the Network Analyser

4. Conclusions and Future work

The simulations results of the designed antenna was carried out on the CST STUDIO SUITE SOFTWARE. The antenna was designed using the FR-4 substrate PCB which is easily available and is less expensive. The designed antenna is compact in size and

offers improved gain suitable for mobile communications. The results indicates that the geometry of the designed antenna fulfills the requirements needed for the mobile communication systems. The proposed antenna is expected to improve the cost of production due to its compact size. If we change the parameters of the designed antenna that is the radius of the circular patch and the dimensions of the diamond slot then the same designed antenna would work on other resonant frequencies that could be used for the satellite communications systems.

6 References

[1] K. M. Luk, C. L. Mak, Y. L. Chow, and K. F. Lee, Broadband microstrip patch antenna, Electron Lett 34 (1998), 1442–1443

[2] B. L. Ooi, C. L. Lee, and P. S. Kooi, A novel F-probe-fed broadband patch antenna, Microwave Opt Technol Lett 30 (2001), 355–356.

[3] G. A. Deschamps, “Microstrip Microwave Antennas, ” Presented at the Third USAF Symposium on Antennas, 1953.

[4] H. Gutton and G. Baissinot, “Flat Aerial for Ultra High Frequencies, ” French Patent No. 703 113, 1955.

[5] R. E. Munson, “Conformal Microstrip Antennas and Microstrip Phased Arrays, ” IEEE Trans. Antennas Propagat., Vol. AP-22, No. 1, pp. 74–78, January 1974.

[6] J. W. Howell, “Microstrip Antennas, ” IEEE Trans. Antennas Propagat., Vol. AP-23, No. 1, pp. 90–93, January 1975.

[7] 7. A. G. Derneryd, “Linearly Polarized Microstrip Antennas, ” IEEE Trans. Antennas Propagat., Vol. AP-24, No. 6, pp. 846–851, November 1976.