Design and Optimization of Double L-Slot Square Patch Antenna with Probe feed for Wireless Applications

[1]Pinki Devi
Student (M.Tech, ECE)
ACE, Ambala, Haryana, India

[2] Sukhwinder Singh Dhillon
Senior Assistant Prof., ECE Department
ACE, Ambala, Haryana, India

[3]Anupama Marwaha
Associate Professor, ECE, Department
SLIET, Longowal, Punjab, India

[3]Sorabh Malthora
Senior Assistant Prof. ,ECE Depatment
ACE, Ambala, Haryana, India

***Abstract*-This paper describes a microstrip patch antenna. This paper presents a triple band antenna. A single probe feed square microstrip patch antenna with reduced size has been proposed. In this double L-shaped slot is formed on square patch. This antenna is simulated in IE3D software. In this the performance of microstrip patch antenna is investigated by using of L-shaped slot and by applying DGS (Defected Ground Structure). In this U shaped DGS (Defected Ground Structure) is formed in the ground plane. This triple band antenna operate at 5.5GHz , 7GHz , 9.5 GHz with 420MHz ,360MHz ,510MHz .**

Keywords- L-shaped slot; DGS; Microstrip Patch antenna; Multiband

I. INTRODUCTION

Microstrip patch antenna is used for wireless application because microstrip patch antenna has various advantages such as low profile, light weight and easy fabrication. But micro strip patch antenna has some disadvantage like low bandwidth, low gain, poorpolarization, high Q and low efficiency. So for improving the performance of microstrip patch antenna defected ground structure and cutting is formed. Microstrip patch antenna consists of radiating patch ,ground plane and dielectric substrate. In microstrip patch antenna conducting patch is placed on one side of dielectric substrate and ground plane on the other side of dielectric substrate. The patch consist of conducting material such as copper and gold and can take any shape such as square,rectangular,circular ,triangular or some other shape. In this paper square shaped patch is used . Square shaped patch antenna is mostly used in microwave application.. In this initially a square patch is taken and double L-shaped slot is formed in the patch. The size of antenna is reduced by cutting L-shaped slot. A DGS (Defected Ground structure) is formed in ground plane for improvement of bandwidth. In this paper probe-feed is used. There are many feed techniques to feed microstrip antenna like microstrip line feed, coaxial line feed probe feed and inset feed. Microstrip patch antenna is used in Aircraft, spacecraft, satellite and missile application. There are means other government and commercial applications such as mobile radio and wireless communications.

II. LITERATURE SURVEY

A double L-slot microstrip patch antenna [1] array with CPW feed technology has been proposed for microwave access and wireless local area network applications. This paper results in smaller size antenna with good omnidirectional radiation characteristics for all operating frequencies. A microstrip slot antenna [2] fed by a microstrip line has been proposed. In this bandwidth of antenna has been increased. This antenna was presented for WLAN and satellite application. A simple configuration and low profile antenna [3] was proposed with two L-slot introduced at right edge of the patch to reduce the resonant frequency. This antenna design was developed to operate in WiMAX and WLAN application. A compact and single probe feed rectangular patch antenna [4] with reduced size has been proposed by cutting rectangular sites at two sides of the ends covering WiMAX and WLAN applications. The performance properties of rectangular patch antenna [5] have been analyzed by varying the width to length ratio of patch. In this it is observed that the patch length changed approximately 10micrometer with increasing width. This paper [6] has been proposed for describing various feeding techniques. This paper describes a good impedance matching condition between the line and the patch without any additional matching elements. A novel small sized, low profile coaxial fed patch antenna[7] has been proposed for Bluetooth application at 2.4GHz frequency. The patch shape was similar to I and different parameters like return loss, bandwidth, gain and directivity. A compact

rectangular patch antenna [8] has been proposed for Wi-max and WLAN application. This antenna has simple structure and suitable for all frequency bands of Wi-max and WLAN applications. A novel compact triple-band microstrip antenna [9] has been proposed for WLAN applications. A compact broadband and reduced size probe fed microstrip patch antenna [10] for bandwidth improvement. In this paper substrate thickness was increased for the bandwidth improvement. This design has been achieved by inverted U-shaped microstrip patch antenna with a W-ground plane.

III. ANTENNA DESIGN

Initially a square patch has been taken. Then double L-slot on the patch is formed. So area of patch decreases . Probe feed has been applied to the antenna as shown in figure 1.

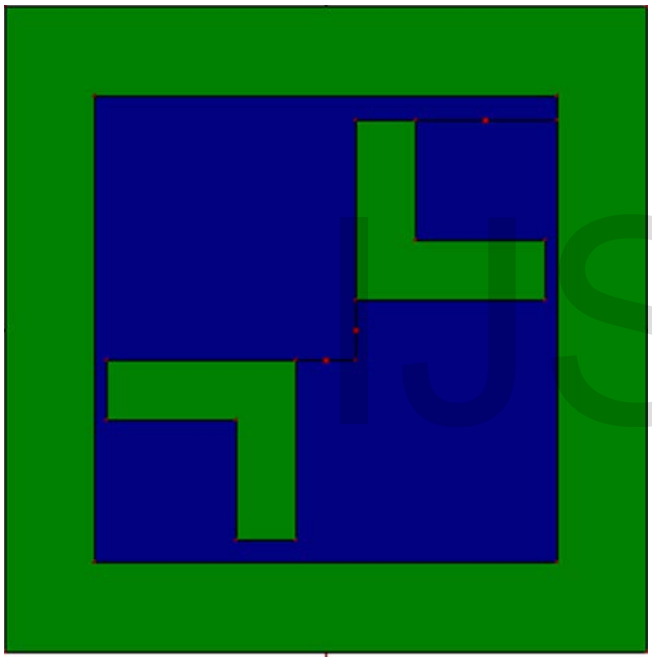

Fig 1. Antenna Patch with L-Slot

There is no DGS (Defected Ground Structure) applied in the above structure. In this patch have dimensions of 23.27 mm by 23.3 mm. Here FR4 has been used as substrate having a thickness of 1.5 mm as shown in table 1.

TABLE. 1.ANTENNA DIMENSIONS

Parameter	Value
Length of patch	23.27 mm
Width of patch	23.3 mm
Thickness of Substrate	1.5 mm
Dielectric constant of substrate	4.4
Loss tangent of substrate	0.02
Feed to Patch	Probe Feed

In the fig.2 DGS (Defected Ground Structure has been applied in the ground plane. By applying DGS bandwidth of antenna increases. Defected groundstructure improves the antenna performance. DGS is realized by etching off a simple defect from the ground plane, Dependingon the shape and dimension of the defect, the shielded current distribution in the ground plane is distributed. Hence in this way by applying L shape slot on patch and DGS on ground plane characterstics of antenna improve. Here results are compared in terms of return loss, gain, directivity and bandwidth.

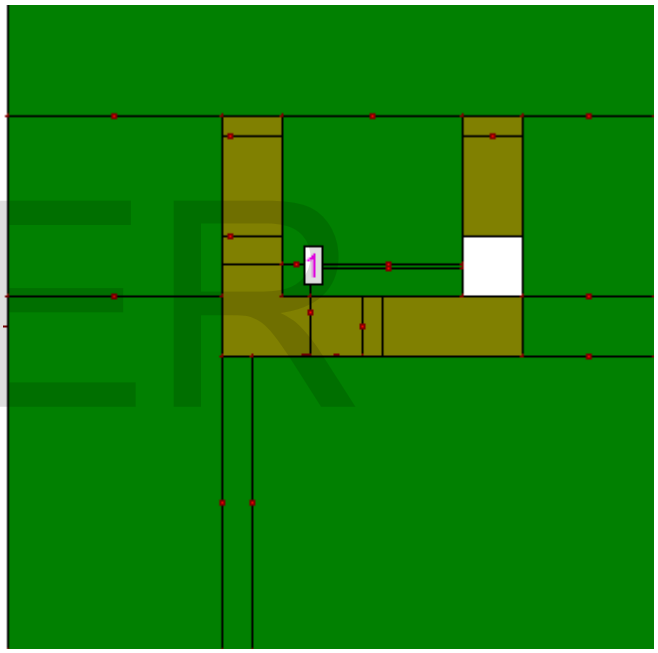

Fig 2. Antenna with DGS

. In fig. 3 probe feed is applied in the antenna . The DGS is also applied in this structure . Here results of antenna are analysed. Here the antenna design is with two L slot cut and U DGS with pobe feed. In this design square shaped patch has been taken . Hence by applying L slot cut and DGS in the ground plane , a triple band antenna had been proposed . This triple band antenna provide less loss and high bandwidth and

high gain. By applying defected ground structure in the ground the antenna performance, antenna gain and bandwidth increases.

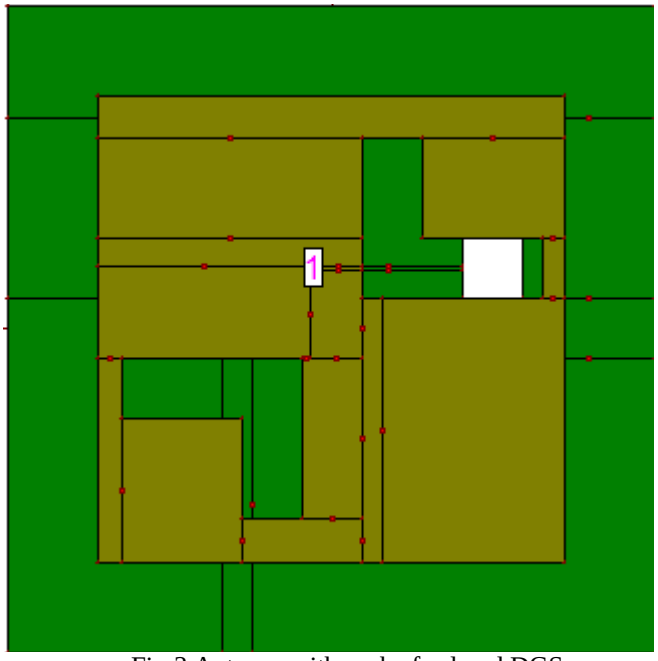

Fig 3 Antenna with probe feed and DGS

IV. RESULTS AND DISCUSSIONS

Here the return losses of this design have been described. This antenna provide three band antenna. From this return loss figure, we has been concluded that less loss and good bandwidth has been obtained by applying DGS in the ground plane. From the curve it has been concluded that by applying DGS in ground plane there is so much good performance .So it has been concluded that here bandwidth is good by applying DGS.

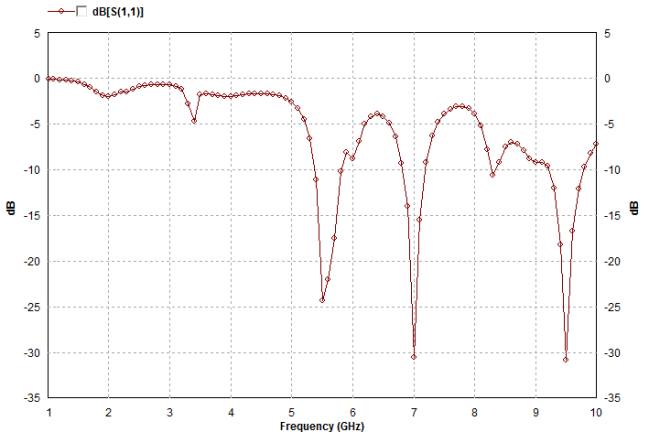

Fig 1. Return Loss Vs Frequency

So from this return loss figure it has been concluded that we can get good bandwidth and less loss with DGS. From this antenna design it has been concluded that loss decreases and bandwidth increases.

.

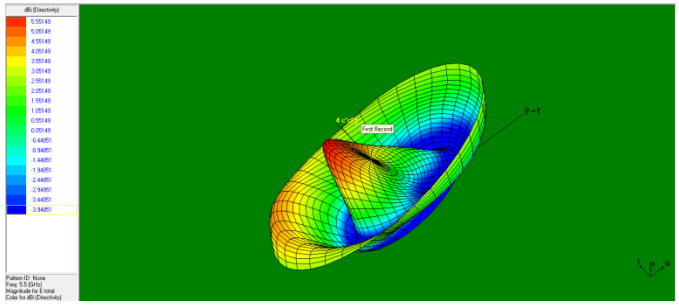

Fig 2. Radiation Pattern at 5.5GHz

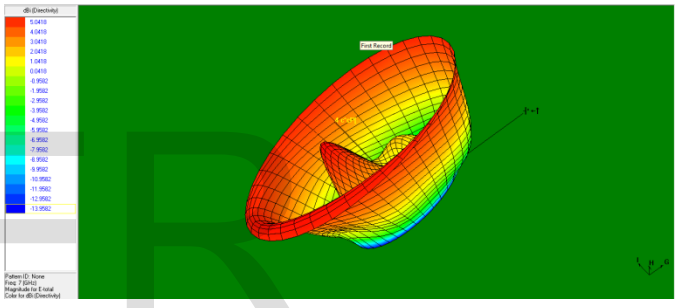

Fig 3. Radiation Pattern at 7GHz

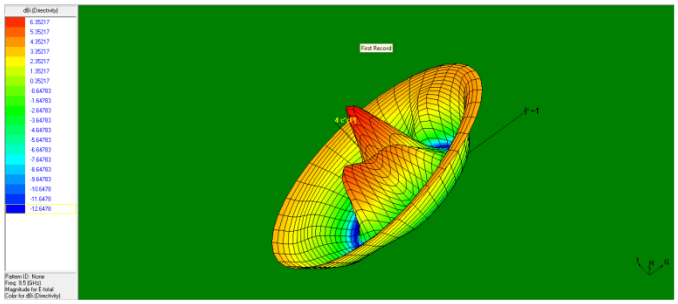

Fig 4. Radiation Pattern at 9.5 GHz

Fig. 2 indicate the radiation pattern at 5.5 GHz ,Fig. 3 indicates radiation pattern at 7GHz and fig. 4 indicate radiation pattern at 9.5 GHz. Here by applying DGS (Defected Ground Structure) in the ground plane , we also get good radiation pattern with good bandwidth. Here by applying DGS in the ground plane bandwidth increases and loss decreases.

TABLE 2. PARAMETRIC ANALYSIS

Resonant Frequency (GHz)	Return Loss (dB)	Band width (MHz)	Gain	Directivity
5.5	-24.03	420	1.71	5.5
7	-30.5	360	1.25	5.04
9.5	-30.17	510	2.76	6.35

CONCLUSION

It has been concluded that by cutting L slot and applying DGS (Defected Ground Structure) return loss is less and bandwidth is high. The proposed design has return loss of-24.03 db at 5.5 GHz frequency with 420 MHz bandwidth. This design has loss of -30.5 db at 7GHz freq. with 360 MHz bandwidth. This design has return loss of -30.17db at 9.5 GHz freq. with 510 MHz bandwidth. This antenna is mainly applicable for WLAN wireless and WiMAX application.

REFERENCES

[1] R.Jothi Chitra,V. Nagarajan ,2013. "Double L-slot microstrip patch antenna array for WiMAX and WLAN applications", *IEEE Transactions on Antennas and Propagation*, Vol. 39, pp 1026-1041

[2] Xu-bao Sun ,Mao-Young Cao, 2012. "A rectangular slot with improved bandwidth", *Elsevier Science Direct*, Vol. 66, pp 465-466.

[3] Barun Mazumdar ,Ujjal Chakraborty, 2012. "Design of compact printed Antenna for WiMAX and WLAN applications", *Elsevier Science Direct*, Vol. 4, pp 87-91.

[4] Vivek Kumar Agarwal, Anand Kumar Shaw, 2012. "A novel compact dual frequency microstrip antenna", *Elsevier Science Direct*, Vol.4, pp 427-430

[5] B.T.P Madhav ,VGKM Pisipati, 2011. "Investigation of performance parameters by varying the dimensions of microstrip rectangular patch antenna", *Journal of emerging trends in comuting and information sciences* Vol. 2, pp 284-290

[6] Govardhani Immadi, M.S.R.S Tejaswi, 2011. "Design of coaxial fed microstrip patch antenna for 2.4 GHz Bluetooth Applications", *Journal of emerging trends in computing and information sciences*, Vol.2, pp 686-690

[7] Jadish M. Rathod, 2010. "Comparative study of microstrip patch antenna for wireless communication application", *International Journal of Innovation management and technology*, Vol.1 No. 2, pp 194-197

[8] Lin Dang, Zhenya Lei, 2010. "A compact microstrip slot Triple-band Antennna for WLAN / WiMAX applications", *IEEE Antennas and Wireless Propagation Letters*, Vol.9, pp 1178-1181

[9] Kaung Fuqiang, Shen Dongya, Xu Jie ,2011. "A triple-band microstrip antenna for WLAN application", *International conference on communications and mobile computing*, , pp 68-7

[10] T. Shanmuganantham S. Raghavan, 2009. "Design of compact broadband microstrip patch antenna with probe feeding for wireless communication", *Elseiver Science Direct*, Vol. 63, pp 653-659

ABOUT AUTHORS

PINKI DEVI

She received her B.Tech degree in ECE from JMIT, Radaur Currently pursuing M.Tech from Ambala College of Engineering and Applied Research, Devsthali, Ambala, Haryana. His research interests are DGS, slot antenna, Microstrip Patch antenna.

Email id: pinkichaudhry100@gmail.com

SUKHWINDER SINGH DHILLON

He received B.Tech degree in Electrical Engineering from PTU, Jalandhar, Punjab and M.Tech degree from PTU, Jaladhar. His research interests are Wireless and Mobile Communication, Microstrip antennas and Wind Energy Conversion Systems. He is currently working as an Senior Assistant Professor at Ambala College of Engineering and Applied Research, Devsthali Ambala, Haryana and pursuing Ph.D. in EIE from SLIET, Longowal, Sangrur, Punjab, India

Email id: sukhwinder2@rediffmail.com

ANUPMA MARWAHA

She has completed B.E. (Electronics and Communication) from Punjab Engineering College (PEC) in year 1990 and M.Tech. from REC Kurukshetra in year 1992 and PhD from Guru Nanak Dev University (GNDU), Amritsar in year 2003. Currently working as Associate Professor in the Deptt.of Electronics and Communication at SLIET Longowal. She is life member is life member ISTE (India) and member of Institution of Engineers (India). She has Published 25 research papers in National and International Journals and 50 research papers in National and International Conferences.

Email id: marwaha_anupma@yahoo.co.in

SORABH MALHOTRA

He has completed B.Tech (Electronics and communication) from SKIET ,kurukshetra. He has completed M.Tech (ECE) from NIT Kurukshetra. His research interests are microstrip patch antenna , fractal antenna and wireless communication. He is currently working as an senior assistant professor at ACE Ambala.