Pritam Singha Roy ,Rudra Prasad Biswas, Moumita Guha, Chandan Sinha Roy, Dr. Samik Chakraborty / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 3, Issue 2, March -April 2013, pp.845-848

Bandwidth and Gain Enhanced with I-slotted Microstrip Patch for Wireless Communication

Pritam Singha Roy[1] ,Rudra Prasad Biswas[2], Moumita Guha[3], Chandan Sinha Roy[4] , Dr. Samik Chakraborty[5]

[1,2]Department of Electronics, Dumkal Institute of Engineering & Technology, Murshidabad
[3]Department of Electronics, Jadavpur University, Kolkata, India
[4]Department of Computer Science, Govt. College of Engineering & Textile Technology, India
[5]Department of Electronics & Communication, Indian Maritime University, Kolkata, India

ABSTRACT

This paper describes the enhancement of rectangular patch for GSM band of frequency 5.3 GHz. An I–slotted Microstrip patch antenna has been designed and simulated using IE3D 14.10. The proposed Microstrip Patch antenna is designed to support modes with resonance at 5.3 GHz and it was found that an increase of bandwidth of 20.45 % and achieved gain is 7.24 dBi.The antenna design and performance are analyzed using Zealand IE3D software(VSWR≤2).The antenna can be used for many modern communication systems.

Keywords – **Bandwidth, Gain, I-slot, Return loss and wireless communication**

I. INTRODUCTION

Microstrip antennas have attracted a lot of attenuation due to rapid growth in wireless communication area. Several patch designs with single-feed, dual-frequency operation have been proposed recently. Microstrip patch antennas have drawn the attention of researchers over the past decades [4], [6], [8], [9]. However, the antennas inherent narrow bandwidth and low gain is one of their major drawbacks. These problems can be solved by introducing microstrip patch antenna. The major draws back of microstrip patch antenna are lower gain and very narrow bandwidth [1, 2, and 3]. Patch antennas are light in weight, small size, low cost, simplicity of manufacture and easy integration to circuits. This paper presents the use of transmission line method to analysis the rectangular microstrip antenna [5].

II. RECTANGULAR PATCH ANTENNA DESIGN

Designing of micro strip patch antenna depends on three parameters. In this paper, selected Resonance frequency at 5.3GHz, Duroid 5880 substrate which has a dielectric constant (ε_r) of 2.2 and height of the substrate is 0.858 mm. The width (W) and length (L) of antenna are calculated from conventional equations [10].

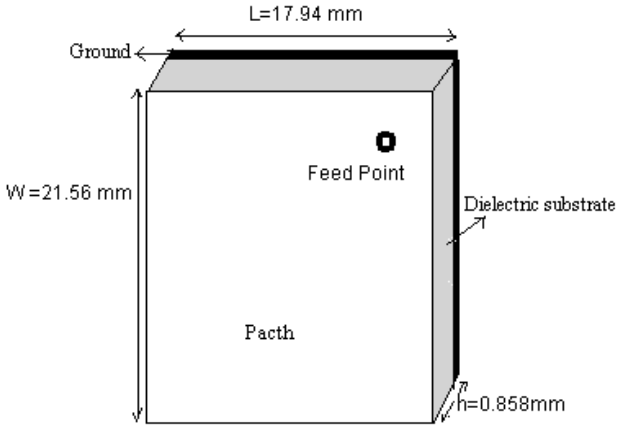

Figure.1. Rectangular Micro strip Patch Antenna

$$W = \frac{c}{2f_o\sqrt{\frac{(\varepsilon_r+1)}{2}}}$$

$$\varepsilon_{reff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left[1+12\frac{h}{W}\right]$$

$$L_{eff} = \frac{c}{2f_o\sqrt{\varepsilon_{reff}}}$$

$$(\Delta L) = 0.412h\frac{(\varepsilon_{reff}+0.3)\left(\frac{W}{h}+0.264\right)}{(\varepsilon_{reff}-0.258)\left(\frac{W}{h}+0.8\right)}$$

$$L = L_{eff} - 2\Delta L$$

Where Effective length = *Leff*, Effective dielectric constant = ε_{reff}. The length and width of the Rectangular microstrip patch antenna operating in frequency 5.3GHz are 17.94 mm and 21.56 mm respectively shown in fig.1

III. SIMULATED RESULTS AND DISCUSSION

Figure.2.represents the variation of return loss with Frequency plot shows resonant frequency at 5.3GHz minimum -28.37 dB return loss is available at feed location (3, 1).At this point calculated bandwidth is 88.0 MHz

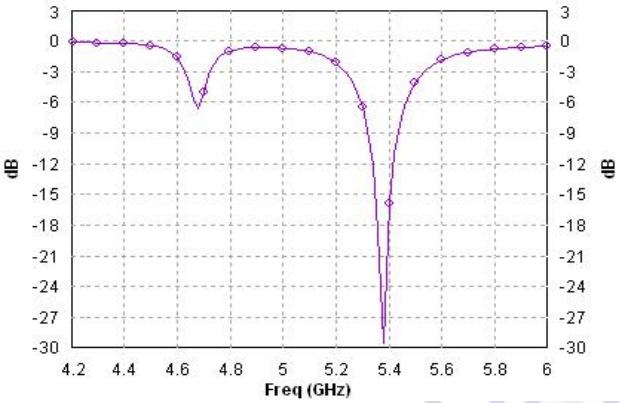

Figure.2. Return loss vs. Frequency plot for Table 1

Table -1
Performance for Microstrip Patch Antenna

Feed location	Return Loss (dB)	Frequency (GHz)	Band width (MHz)	Gain (dBi)
(3,1.5)	-28.12	5.3	85.0	6.77
(3,0)	-23.10	5.3	83.2	6.91
(3,1)	-28.37	5.3	88.0	7.10
(3,2)	-24.94	5.3	86.3	6.70

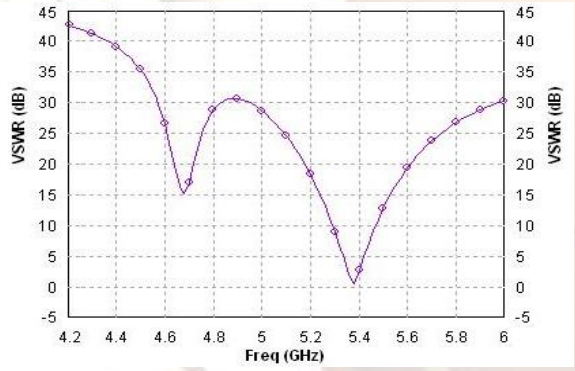

Figure.3. VSWR vs. Frequency plot for Table 1, VSWR is 1.2 at this location (3, 1)

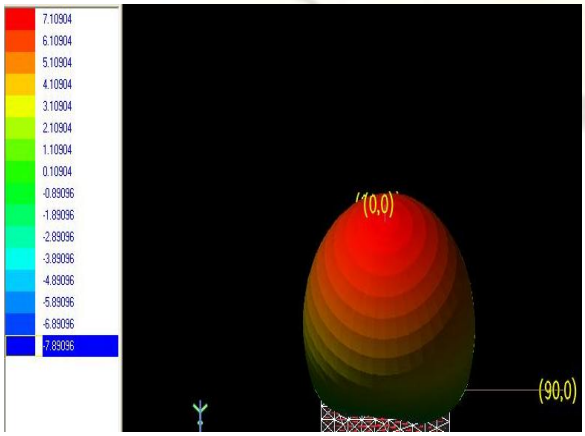

Figure.4. 3D-Radiation pattern, gain 7.10dBi

IV. I-SLOTTED MICROSTRIP ANTENNA DESIGN

In this paper, the I - shaped slot is cut in microstrip patch for wide band width. I-slot formed by cutting two sections from lower and upper side of the patch shown in fig.5. Selected Resonance frequency at 5.5 GHz, Duroid 5880 substrate which has a dielectric constant of 2.2 and height of the substrate is 0.858 mm.

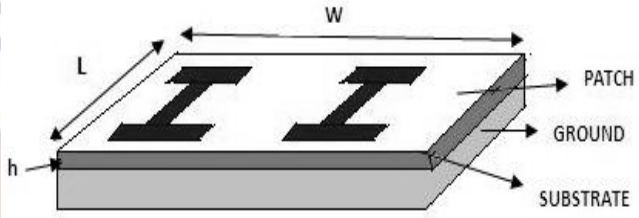

Figure.5. I -slotted Microstrip Patch Antenna

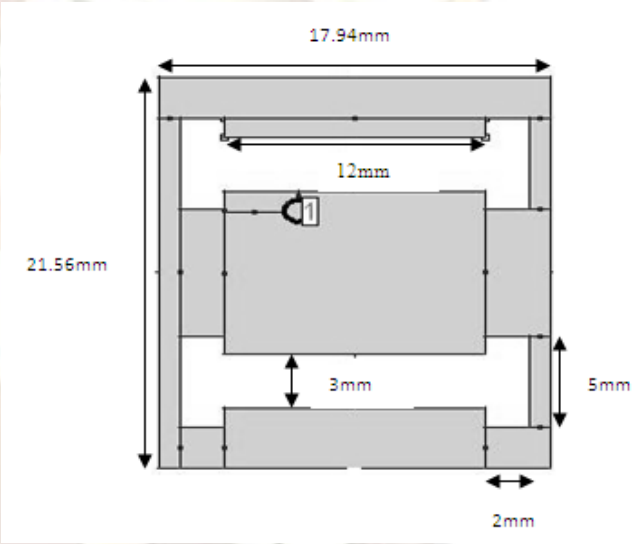

Figure.6. IE3D view of I -slotted Patch Antenna

V. RESULTS AND DISCUSSION

Table -2
Performance for I -slotted Microstrip patch antenna

Feed location	Return Loss(dB)	Frequency (GHz)	Band width (MHz)	Gain (dBi)
-2.5,3.5	-23.33	5.3	78.2	7.12
-2.5,3.5	-23.54	5.3	78.4	7.11
-2.6,3.4	-28.81	5.3	85.0	7.07
-2.6,3.4	-33.66	5.3	106	7.24

Return Loss is -33.66dB at frequency 5.3GHz calculated bandwidth is 106MHz which is 20.45% more than that of rectangular Microstrip patch antenna shown fig.7

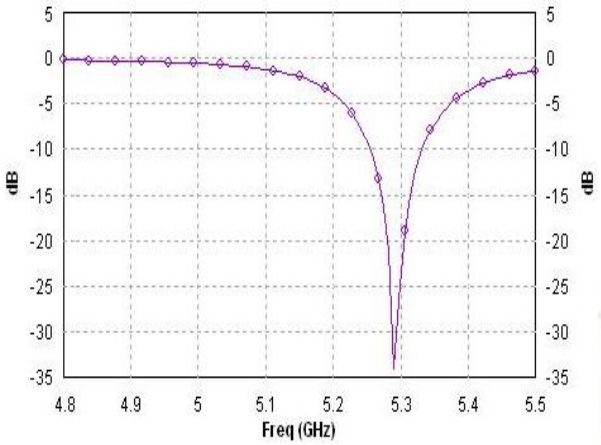

Figure.7. Return loss vs. Frequency plot for Table 2

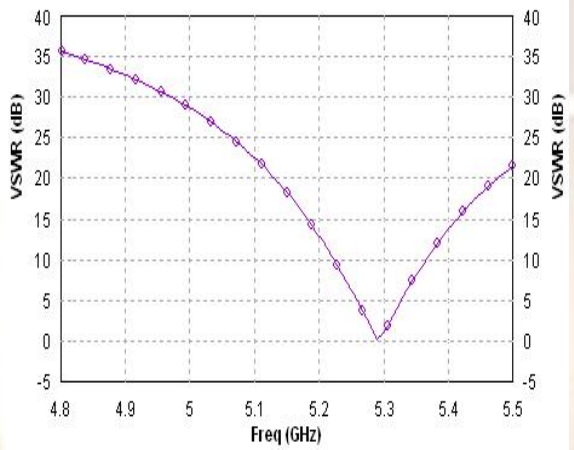

Figure.8. VSWR vs. Frequency plot for Table 2 VSWR is 0.98 at frequency 5.3 GHz

The calculated gain for H-slotted shaped micro strip patch antenna is 7.24dBi which is more than rectangular Microstrip patch antenna. Shown in fig 9

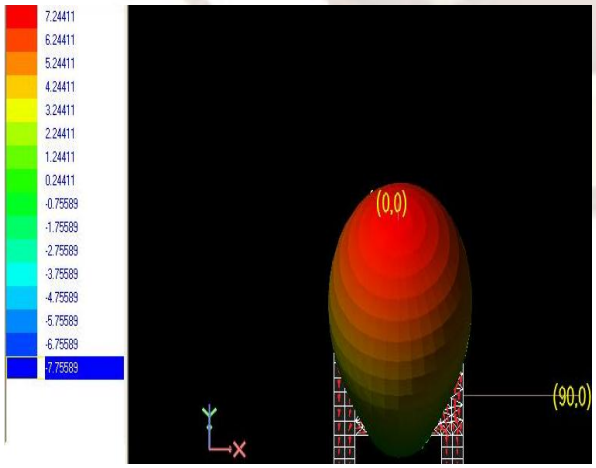

Figure.9. 3D-Radiation pattern at 5.3GHz

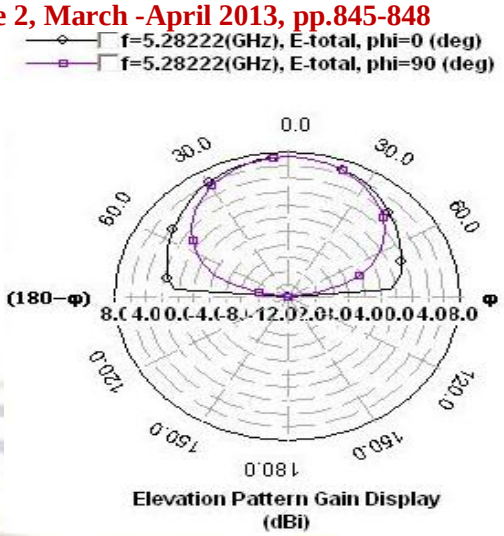

Figure.10. 2D radiation pattern at 5.3GHz

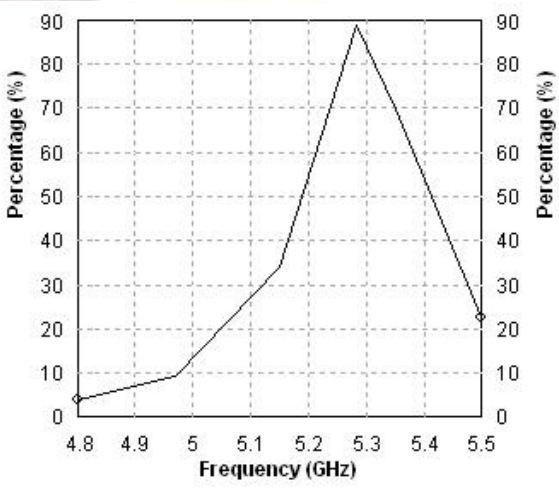

Figure.11. Antenna efficiency is 88.31 % at 5.3GHz

VI. CONCLUSION

The Rectangular Micro strip Patch antenna has been analyzed. From the result of IE3D simulation, it has been observed that the bandwidth increased 20.45% and maximum achieved gain is 7.24dBi in I - slotted shaped Microstrip Patch Antenna. This designed antenna can be improved the VSWR which is 0.98 and efficiency is 88.31% at operating frequency 5.3GHz.The patch antenna has been rapidly used in various fields like space technology, wireless communication ,aircrafts, missiles, mobile communication, GPS system, and broadcasting.

REFERENCES

[1]. I.J.Bahl and Bhartia,Microstrip Antenna,Artech House,1980

[2]. G.Kumar And K.P.Ray,Broadband Microstrip Antennas,First edition,USA,Artech House,2003

[3]. R.G.Voughan.1988.Two-port higher mode circular microstrip antennas.IEEE, Trans.Antennas Propagat, 36(3):309-321.

[4]. Multi-slotted Microstrip antenna for wireless communication,M.T.Islam Institute of space science(Angkasa) Universiti Kebangsaan Malaysia Bangi UKM 43600, Selangor

[5]. D.E, Malaysia M.N.Shakib and N.Misran Electrical, Electronic and system department Universiti Kebangsaan Malaysia Bangi UKm 43600, Sellangor D.E, Malaysia.

[6]. Prabhakar H.V and U.K.2007.Electronics Letters,2nd August.43(16)

[7]. Pozar David M.1998.Microwave Engineering .john Wiley, New York, NY, USA, 2nd Ed.

[8]. Ramesh Garg, Prakash Bhartia, Inder Bhal and Apisak Ittipiboon. 2001. Microstrip Antenna Design Handbook.Artech-House Inc. India.

[9]. I.Puri, A.Agarwal, Bandwidth and gain increment of microstrip patch antenna with shifted elliptical slot, 7th July, 2011.

[10]. Pozar David M.1998.Microwave Engineering .john Wiley, New York, NY, USA, 2nd Ed.

[11]. C.A.Balanis,"Antenna Theory and Design", 2nd Edition, New York, Wiley 1997.

[12]. IE3Dversion 14.10, Zeland software, May 2008.