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Optimization with I-slotted Microstrip Patch Antenna for Wireless Communication

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ABSTRACT

In this paper a new design of Microstrip antenna has been proposed. An I-slotted Shaped Microstrip Antenna has been designed and designed structured antenna is simulated using IE3D14.10 software. This designed antenna operates at 5.1GHz with minimum return loss and increase the band width of 21.80% and maximum achieved gain of 7.25 dBi.Feed point on patch that gives a good match of 50 ohm. In this investigation. The parameter was found to be less than 2 within the operating frequency range. The antenna can be used for many modern communication systems.

Keywords: Bandwidth, Gain, I- slot, Return loss and wireless communication.

1. INTRODUCTION

Microstrip antennas have attracted a lot of attenuation due to rapid growth in wireless communication area. Microstrip patch antennas are increasing in popularly for use in wireless applications due to their low-profile structure [4], [6], [8], [9]. However, the antenna inherent narrow bandwidth and low gain is one of their major drawbacks [1, 2, and 3]. These problems can be solved by introducing Microstrip patch antenna. The Microstrip 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].

2. RECTANGULAR PATCH ANTENNA DESIGN

Designing of micro strip patch antenna depends on three parameters. In this paper, selected Resonance frequency at 5.1GHz Duroid 5880 substrate which has a dielectric constant (ε_r) of 2.2 and height of the substrate is 0.551 mm. The width (W) and length (L) of antenna are calculated from conventional equations [10].

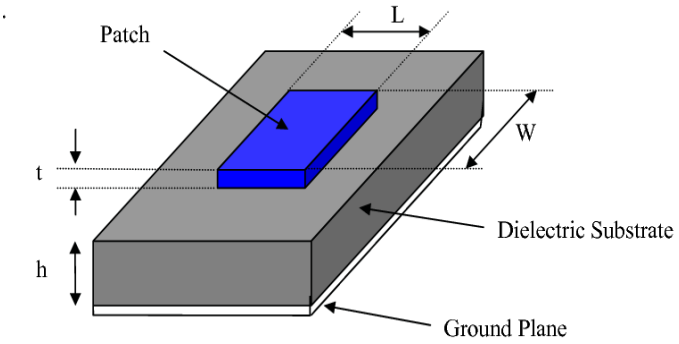

Figure.1. Microstrip patch antenna

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

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

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

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

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

Where Effective length = *Leff* , Effective dielectric constant is ε_{reff}. The length and width of the Rectangular microstrip patch antenna operating in frequency 5.1GHz are 19.97mm and 23.71mm respectively shown in fig.1

3. SIMULATED RESULTS AND DISCUSSION

The proposed antenna has been designed and simulated using Zeland IE3D 14.10 software. We have optimized the different parameters such as gain, bandwidth, return loss etc

Table -1 Performance for Microstrip Patch Antenna

Feed location	Return Loss (dB)	Frequency (GHz)	Band width (MHz)	Gain (dBi)
3,2	21.40	5.1	57	5.6
3.2,2.2	-30.21	5.1	62	5.5
3.5,2.3	-20.01	5.1	64	6.9
3.5,2.5	-19.50	5.1	60	5.3
3,1	-27.12	5.1	53	5.2

Figure.2. represents the variation of return loss with Frequency. Plot shows resonant frequency at 5.1GHz minimum -20.01 dB return loss is available at feed location (3.5, 2.3).At this point calculated bandwidth is 64 MHz.

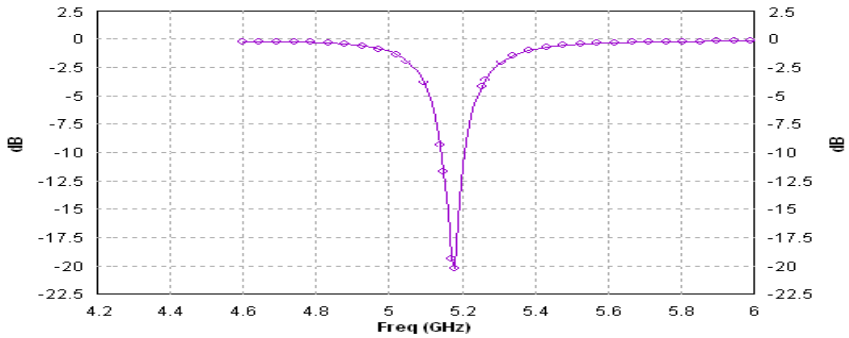

Figure.2. Return loss vs. Frequency plot for Table 1

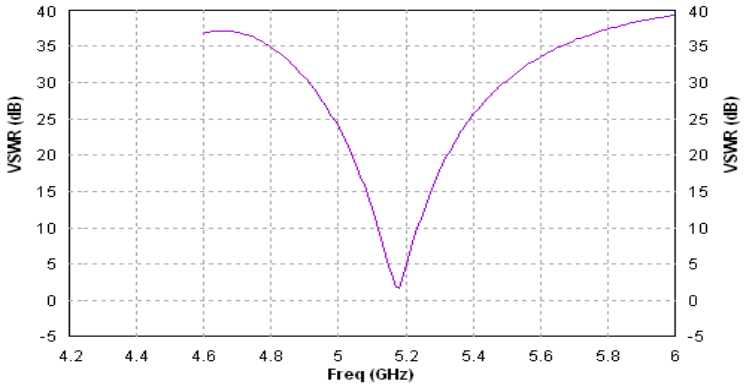

Figure.3. VSWR vs. Frequency plot for Table 1, VSWR is 1.8 at this location (3.5, 2.3)

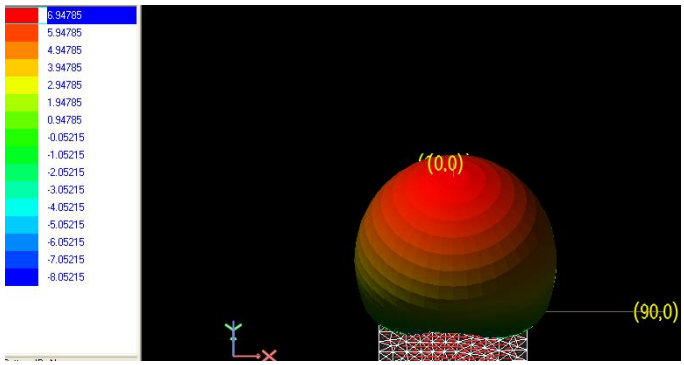

Figure. 4(a). 3D-Radiation pattern, gain 6.94 dBi

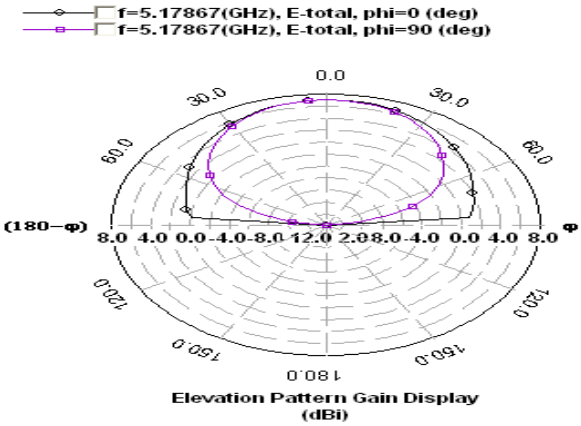

Figure.4(b). 2D-Radiation pattern, gain 6.94dBi

4. I-SLOTTED PATCH ANTENNA AND RESULTS

In this paper, the I - shaped slot is cut in microstrip patch for wide band width. I-slot formed by cutting two sections from the both side of width at dimension (5 mm X 8 mm) of the patch shown in fig.5.

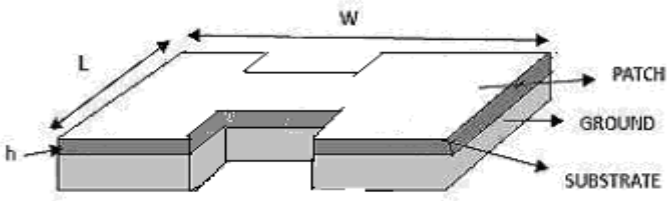

Figure.5. I -slotted Microstrip Patch Antenna

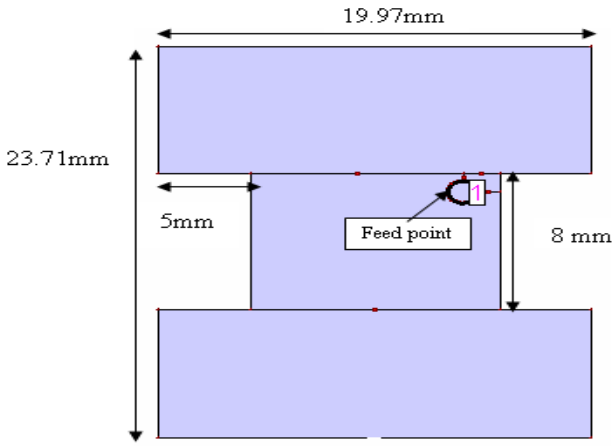

Figure.6. IE3D view of I -slotted Patch Antenna

Table -2: Performance for I -slotted Microstrip patch antenna

Feed location	Return Loss(dB)	Frequency (GHz)	Band width (MHz)	Gain (dBi)
3.5,2.3	-17.17	5.59	54	6.5
3.7,2.5	-22.29	5.59	60	6.9
3.9,2.7	-32.89	5.59	68	7.18
3.9,2.9	-43.20	5.59	78	7.25
3.9,3.2	-32.6	5.59	72	7.05

Return Loss is -43.20dB at frequency 5.59GHz calculated bandwidth is 78MHz which is 21.80% more than that of rectangular Microstrip patch antenna shown fig.7

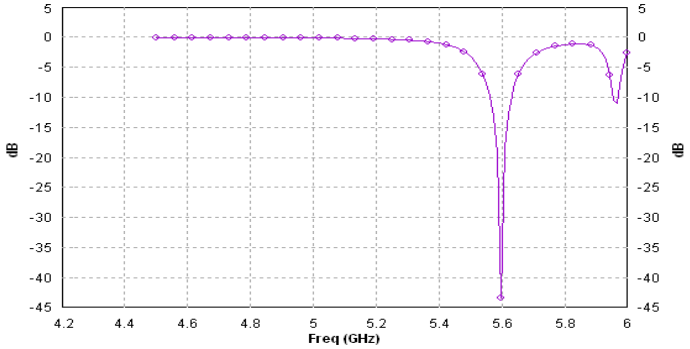

Figure.7. Return loss vs. Frequency plot for Table 2

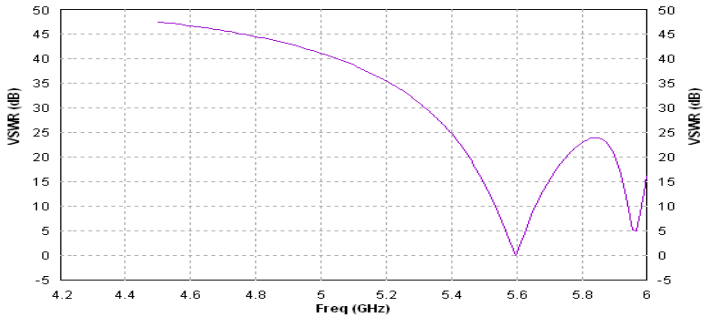

Figure.8. VSWR vs. Frequency plot for Table 2 VSWR is 0.68 at frequency 5.59 GHz

The calculated gain for I-slotted shaped micro strip patch antenna is 7.25dBi which is more than rectangular Microstrip patch antenna. Shown in fig 9

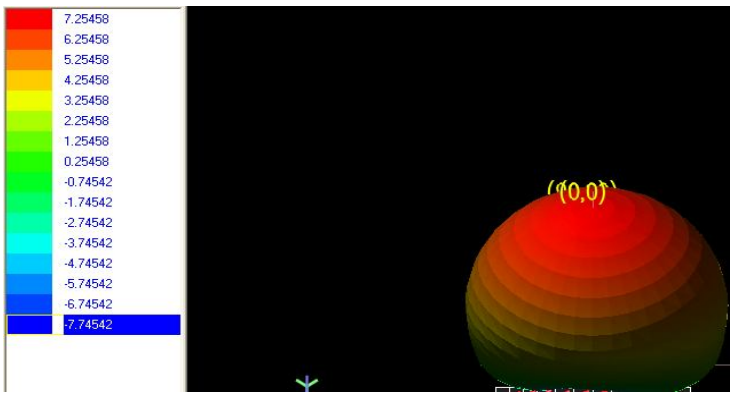

Figure.9. 3D-Radiation pattern at 5.59GHz

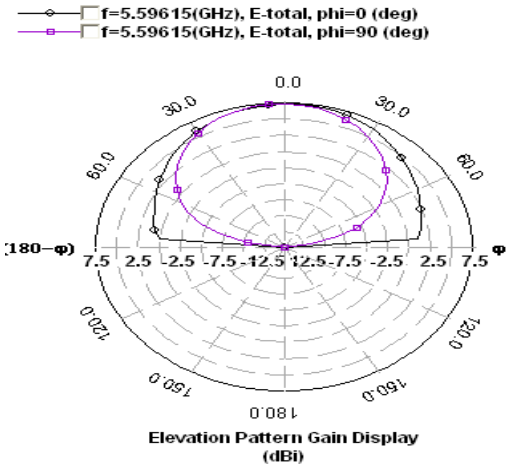

Figure.10. 2D radiation pattern at 5.59GHz

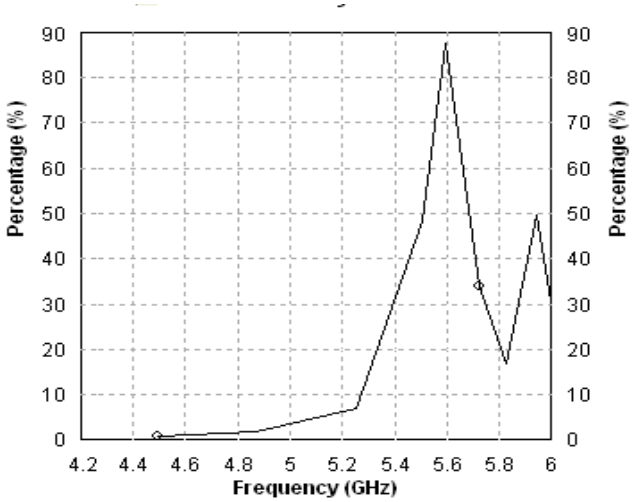

Figure.11. Antenna efficiency is 88.31 % at 5.59GHz

5. CONCLUSION

The Rectangular Micro strip Patch antenna has been analyzed. From the result of IE3D simulation, it has been observed that the bandwidth increased 21.80% and maximum achieved gain is 7.24dBi in I - slotted shaped Microstrip Patch Antenna. This designed antenna can be improved the VSWR which is 0.68 and efficiency is 88.31% at operating frequency 5.59GHz.The patch antenna has been rapidly used in various fields like space technology, wireless communication ,aircrafts, missiles, mobile communication, GPS system, and broadcasting.

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