Australian Journal of Basic and Applied Sciences, 7(4): 9-13, 2013
ISSN 1991-8178

Designing, Simulating and Fabricating a Novel E-Shaped Microstrip Antenna

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Abstract: The novel E-shaped microstrip antenna presented in this paper is in the frequency band of 5.15-5.35GHz .This frequency range may be used for WiFi application. In designing this antenna, RT duroid 5880 substrate with the height of 31 mil has been used. The simulation of this antenna has been performed using ADS and HFSS10 softwares. The antenna has been fabricated by making use of optimized sizes and then has been tested. At frequency of 5.25 GHz, the effective results of the antenna are: Return loss=-21.5 dB, VSWR=1.446 and maximum gain=7.27 dB. A good radiation pattern is achieved for the band 5.15-5.35 GHz. In this design, the edge of the horizontal arms have been widened which leads to an increase in the bandwidth.

Key words: ADS, Bandwidth, HFSS, Microstrip Antenna

INTRODUCTION

Microstrip antennas are used in airplanes, satellites, and rockets where cost, size, weight, the simplicity of installation and aerodynamic profile cause limitations They are also used in radio, mobile and wireless communications.

A few of their operational limitations are: their low efficiency; quality factor, sometimes more than 100, weak polarization purity, and very narrow frequency bandwidth which is usually a fraction of a percent and a few percent at most. These antennas are used in some applications such as: governmental security systems in which narrow bandwidths are desirable. There are; however, some ways, such as: increasing the height of the substrate, to increase the efficiency up to 90 percent (if surface waves don t interfere) and to increase the bandwidth (1).

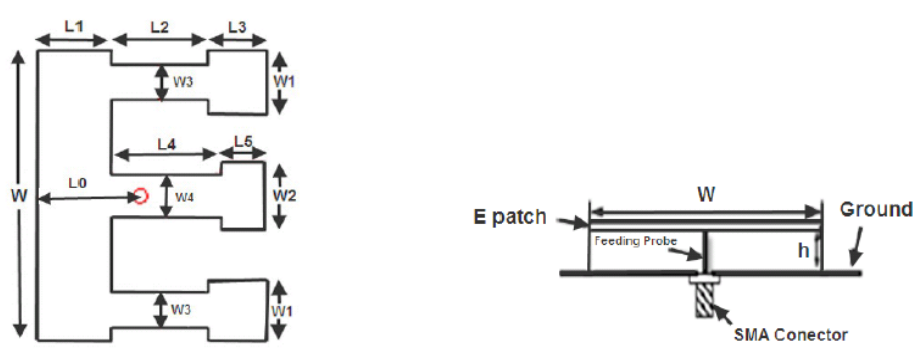
To improve the bandwidth, different slot structures have been used such as: square (2), triangular (3), circular (4), V-shaped (5), elliptical (6) and E-shaped (7),(8).

In this paper a new E-shaped antenna has been presented in which the edges of the antenna has been widened to increase the bandwidth.

Antenna Design:

The E-shaped antenna designed in this paper has been presented in Figure. 1**.** Its dimensions are 21*mm*×16*mm*. This figure consists of a patch, RT duriod 5880 substrate with the height of 31 mil,
loss tangent <0.0009, and $\varepsilon_\gamma = 2.2$ which is located on a ground plane.

Four feeding methods are used to feed microstrip antennas called: microstrip line, aperture coupling, coaxial probe and proximity coupling. The coaxial probe feeding method has been used in this paper whose interal and external diameters are 1.3mm and 4.6mm respectively.



(a) top view (b) side view

Fig. 1: E-shaped microstrip antenna.

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The feeding point is shown in table 1, at the distances of 6 mm and 10.5 mm from the edges of the optimized dimensions of the antenna.

Table 1: Optimized parameters for E-shaped patch antenna.

Ant	W	W1	W2	W3	W4	L1	L2	L3	L4	L5	h	L0
Dimensions(mm)	21	4.5	5	2.8	3.2	5	6.5	4	7.4	3	31 mil	(6,10.5)

Results:

The suggested antenna in this paper was initially simulated and then fabricated and measured. In this section, the results of the simulation and the antenna measurement are presented.

Two software packages of ADS and HFSS have been used to emphasize on the accuracy of the results of the simulations. Both of the packages show approximately the same results which approves that the results of the simulations have acceptable accuracies.

At first the results of the S11, VSWR, radiation pattern parameters obtained from HFSS software are shown. Ansoft HFSS microwave studio package uses finite element technic for simulation.

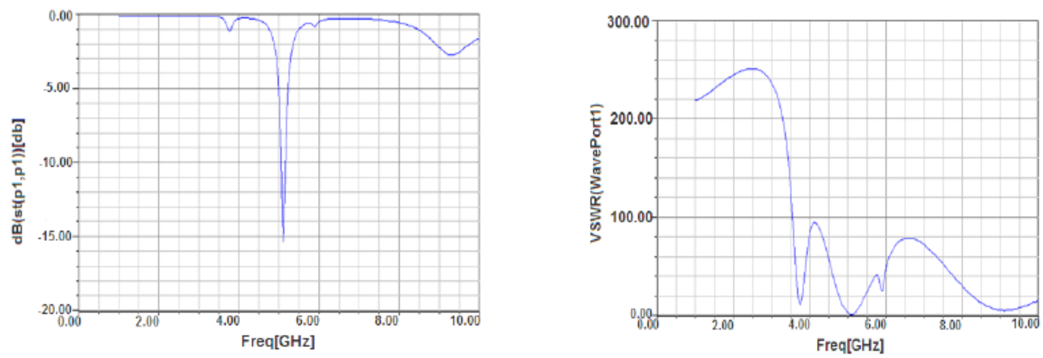


Fig. 2: Simulated return loss and VSWR results versus frequency using HFSS software.

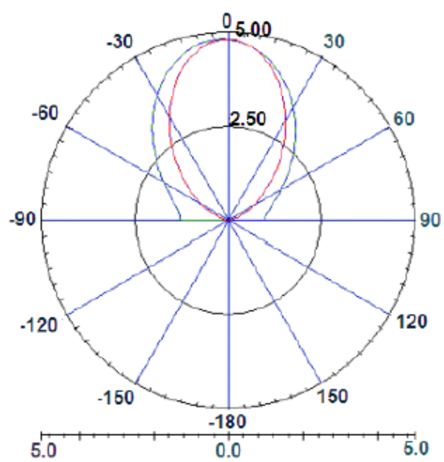


Fig. 3: Radiation pattern of gain using HFSS.

In this section the Figures of S11, VSWR, gain and microstrip antenna radiation pattern results are shown respectively using ADS software.

The measured return loss of the antenna, gain and radiation pattern of the fabricated E-shaped antenna are presented in figures 6(a), 6(b) and 7 respectively. The photograph of the fabricated Eshaped antenna is shown in 8(a). The comparison between the result of the fabrication and simulation using ADS software is shown in Figure 8(b). As you see there is a suitable similarity between the results.

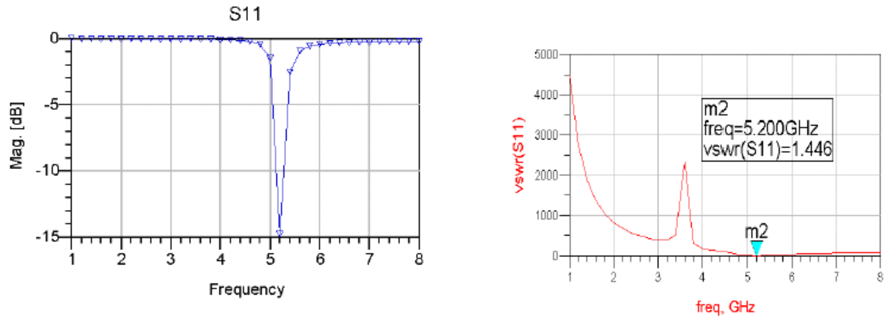
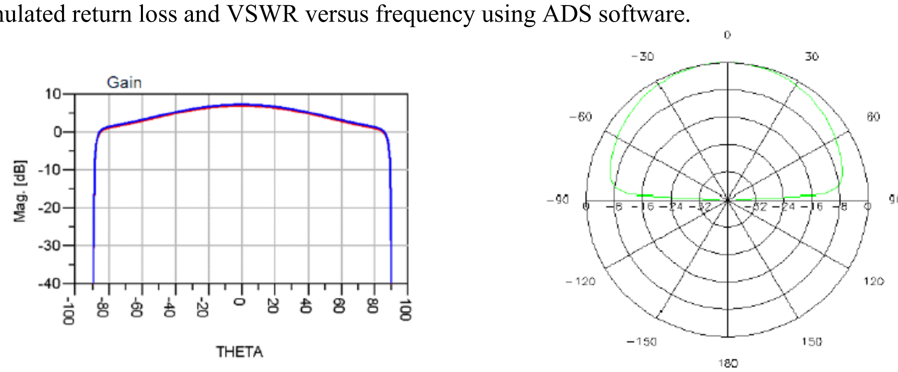


Fig. 4: Simulated return loss and VSWR versus frequency using ADS software.



(a) (b)

Fig. 5: (a) Simulated gain variation versus theta and (b) the radiation pattern at 5.25 GHz using ADS software

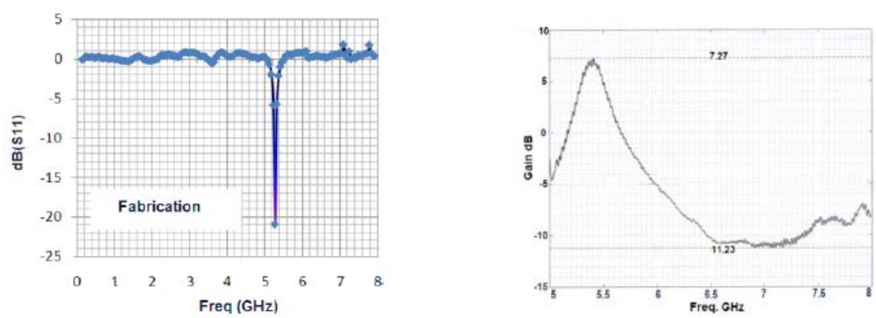
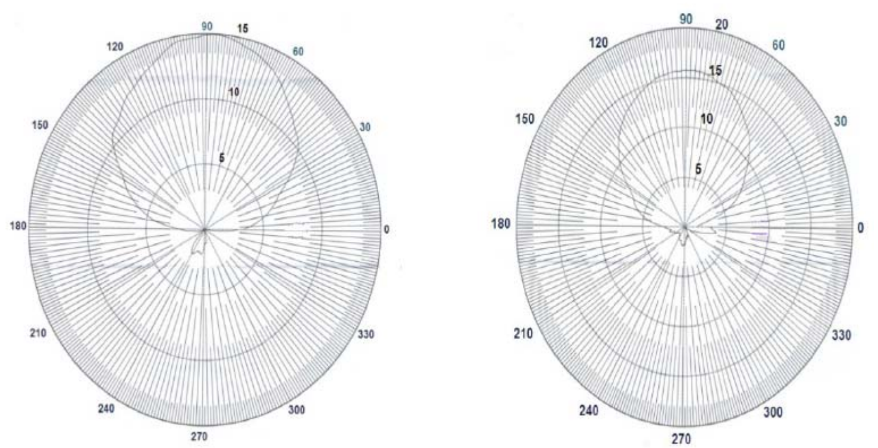
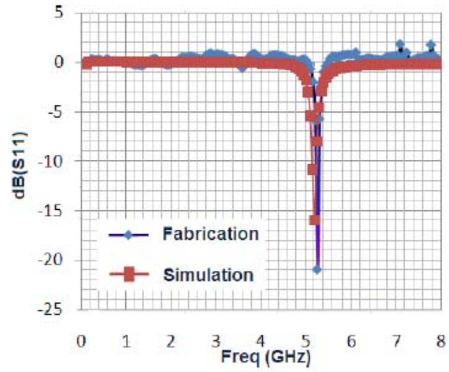


Fig. 6: (a) The measured return loss of the antenna (b) The measured gain variation versus Frequency.



(a) (b)

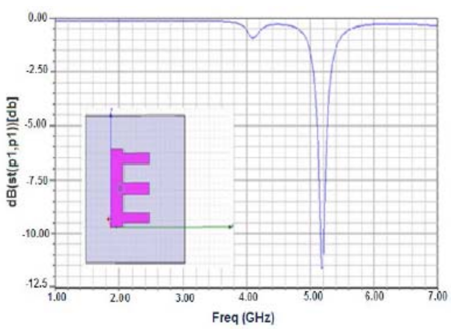
Fig. 7: Measured radiation patterns (a) E-plane at 2.25 GHz (b) H-plane at 5.25 GHz.

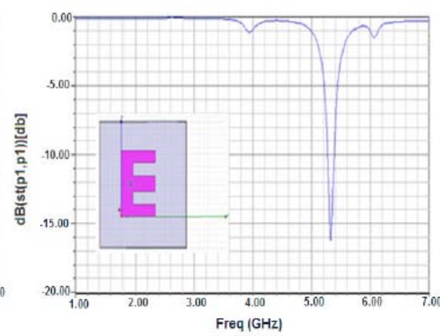


(a) (b)

Fig. 8: (a) The photograph of the fabricated antenna with optimal dimensions (b) Measured and simulated return losses of the antenna.

In figures 9(a) and (b) ordinary E-shaped antennas without widened edge are shown with their obtained S11 diagrams using HFSS10. In Figure 9(a) the bandwidth is between 5.16-5.22 GHz, and in Figure 9(b) is between 5.27-5.37 GHz. Based on this fact, we can come to the conclusion that the bandwidth of the antenna designed in this paper has increased by 300 MHz, in comparison to the other two antennas. The widths of the horizontal arms of the two antennas shown in Figures 9(a) and (b) are respectively the minimum and maximum sizes of the width of the horizontal arms of the antenna designed in this paper.





(a) (b)

Fig. 9: (a),(b) **.** E-shaped antennas with the minimum and maximum sizes of the width of the horizontal arms of the antenna designed in this paper.

Conclusion:

The suggested E-shaped antenna in this paper is used for WiFi application in the frequency range of 5.15-5.35 GHz. This antenna has feeding with coaxial probe. The measured result of the fabricated antenna has 170 MHz bandwidth from 5.21-5.38 GHz for RL<-10 dB and maximum gain is 7.27 dB in this range of frequency. A good radiation pattern is achieved for the WiFi band (5.15-5.35 GHz) range. At frequency 5.25 GHz, the effective results of the antenna are: Return loss=-21.5 dB, VSWR=1.446, Directivity=7.27 dB. The edges of the antenna arms have been made into widened forms which leads to an increase in the bandwidth comparing to ordinary E-shaped antennas. This antenna also has a small size. This antenna has been designed using two softwares ADS and HFSS and there is an appropriate similarity between the results obtained from the simulations using the two softwares and those obtained from the fabrication.

REFERENCES

Ang, B.K. and B.K. Chung, 2007. A wideband E-shaped microstrip patch antenna for 5-6 GHZ wireless communication Progress In Electromagnetics Research. PIER, 75: 397-407.

Balanis, C.A., 1992. Antenna Theory: A Review Proc. IEEE, 80(1): 811-815.

Chen, W.S. and F.M. Hsieh, 2005. A broadband design for a printed isosceles triangular slot antenna for wireless communications, *Microw. J.*, 48(7): 98-112.

Chiou, J.Y., J.Y. Sze and K.L.Wong, 2003. A broad-band CPW-fed striploaded square slot antenna, *IEEE Trans. Antennas Propag.*, 51(4): 719-721.

Dastranji, A. and H. Abiri Bandwidth, 2010. Enhancement of Printed E-shaped Slot Antennas Fed by CPW and Microstrip Line IEEE Trans. on Antennas *Propag*, 58(4).

Denidni, T.A. and M.A. Habib, 2006. Broadband printed CPW-fed circular slot antenna, *Electron. Lett.*, 42(3): 135-136.

Li, P., J. Liang and X. Chen, 2006. Study of printed elliptical/circular slot antennas for ultrawideband applications, *IEEE Trans. Antennas Propag.*, 54(6): 1670-1675.

Row, J.S., 2005. Dual-frequency triangular planar inverted-F antenna, *IEEE Trans. Antennas Propag.*, 53: 874-876.