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A Multi-Band Star Shape Microstrip Patch Antenna

Bashar B. Qas Elias
Department of Computer Engineering Techniques, Al Nisour University College, Baghdad, Iraq
(Basharbahaa1989@yahoo.com)

Abstract-Design of multiband microstrip patch antennas with low volume is of practical benefit in the field of wireless communication. The proposed microstrip patch antenna in this paper has been designed and can efficiently support to operate at the following center resonant frequencies (2.36, 2.54, 2.78, 2.97, 3.20, 3.47, 4.0, 4.15 and 4.53) GHz in S and C bands which it is work for various wireless services. The antenna structure consists of star shape patch plane, substrate layer with dielectric constant ε_r and infinite ground plane below them. The simulated results provide the antenna performance in term of return loss, gain, voltage standing wave ratio and current distribution. FEKO version 7.0 has been used as a software simulator to analyze the antenna which is based on Method of Moment (MOM). Coaxial cable has been used to fed the antenna.

Keywords- *patch, star, VSWR, FEKO, gain, return loss*

I. INTRODUCTION

Microstrip antennas have wide advantages and due to their good characteristics such as light weight, easy fabrication and low cost, they have been used in various applications in mobile communication systems [1-2].

In the last years, the request for low volume antennas on wireless communication has increased the interest of research work on design the microstrip antenna between wireless engineers and microwave, therefore, the compact microstrip antennas have more usage in wireless applications precisely in S and C band frequency range [٣-٨]. The development of an antenna for wireless communication also demand antenna with multi operating frequency more than one. This is due to several reasons, the essential reason because of different frequencies are used for telecommunication operators and different wireless communication systems. An antenna has a multi-band feature is more eligible than having one antenna for each frequency band [9].

The patch has different shapes such as circular, triangular, rectangular, elliptical, etc. In this paper star shape patch antenna has been proposed to design which each end of the star shape is created by different small rectangular arms with different lengths as it will be explained later. FEKO is a software tool used for simulation and it is suitable for different types of problems [10].

Different techniques can be used to fed the antenna which they are microstrip line feed, proximity coupled feed, aperture coupled feed and probe feed. Despite of all the advantages, there are some of drawbacks of using patch antenna which are narrow bandwidth, low efficiency and low gain.

Fig (1) show that the structure of the microstrip patch antenna includes four parts: patch plane, substrate layer, ground plane and feed line.

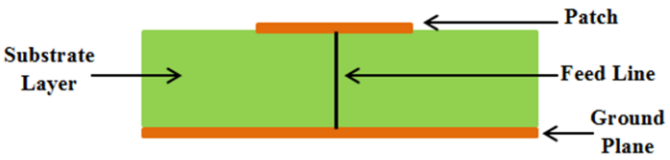

Figure 1. General structure of microstrip patch antenna

The configuration of the proposed antenna is shown in Fig 2 with L1= L2= L3= L4 = 36.45 mm and L5= 21 mm. The other parameters are shown in Table 1.

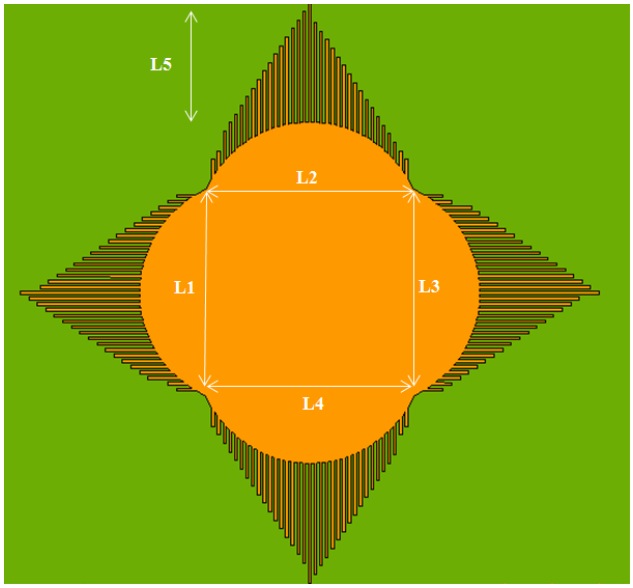

Figure 2. Star shaped microstrip patch antenna produced by FEKO

TABLE I. PARAMETERS VALUES OF PROPOSED ANTENNA

Parameter	Value
Dielectric Constant ε_r	2.2
Substrate Thickness	5.5 mm
Feed Point (Xf,Yf)	(0, 9)

II. SIMULATION RESULTS

A. *Reflection coefficient and Resonant frequency*

Simulated FEKO software version 7.0 results of return loss in proposed antenna are shown in Fig 3. Minimum value of return loss is 20.92 dB at resonant frequency 2.54 GHz. All the simulated results are summarized in the Table 2.

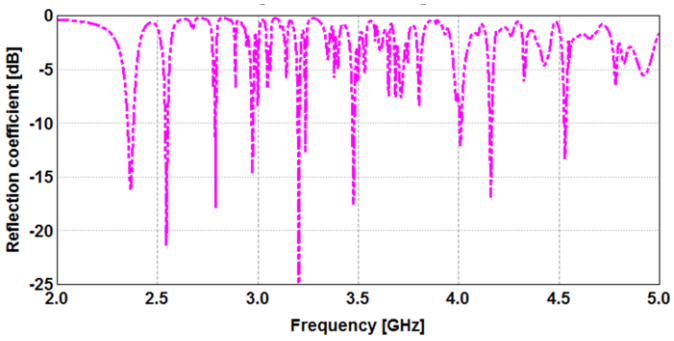

Figure 3. Reflection coefficient of proposed microstrip patch antenna

TABLE II. RESONANT FREQUENCY AND REFLECTION COEFFICIENT RESULTS OF PROPOSED ANTENNAS

Resonant Frequency (GHz)	Reflection Coefficient (dB)
2.36	-15.81
2.54	**-20.92**
2.78	-17.22
2.97	-13.79
3.20	-19.78
3.47	-16.95
4.0	-12.05
4.15	-15.09
4.53	-12.74

B. *Standing Wave Ratio (VSWR)*

The minimum value of the voltage standing wave ratio is found 1.57 dB at the resonant frequency 1.57 GHz. This parameter can be describes as the ratio between the maximum to minimum voltage of antenna. All the simulated results produced by FEKO are shown in Fig 4 and Table 3.

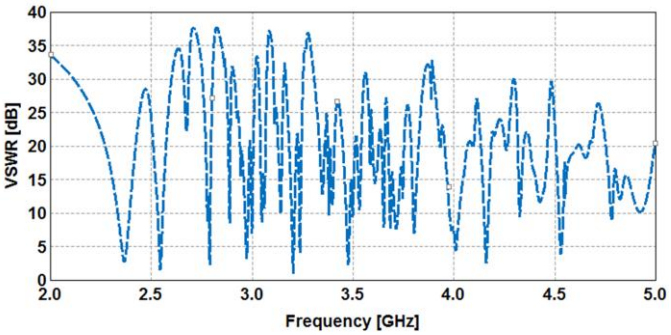

Figure 4. Resonant frequency and VSWR of proposed antennas

TABLE III. RESONANT FREQUENCY AND VSWR RESULTS OF PROPOSED ANTENNAS

Resonant Frequency (GHz)	VSWR (dB)
2.36	2.84
2.54	**1.57**
2.78	2.52
2.97	3.67
3.20	2.21
3.47	2.51
4.0	4.43
4.15	3.13
4.53	4.09

C. *Gain and current distribution*

It is observe that the maximum value of gain is achieved at the resonant frequency 2.54 GHz which is 10 dB .On the other hand the maximum value of the current distribution is. All the simulated results are summarized in the Figures and Tables below.

TABLE IV. RESONANT FREQUENCY AND GAIN RESULTS OF PROPOSED ANTENNAS

2.36	5
2.54	**10**
2.78	10
2.97	5
3.20	5
3.47	5
4.0	5
4.15	5
4.53	5

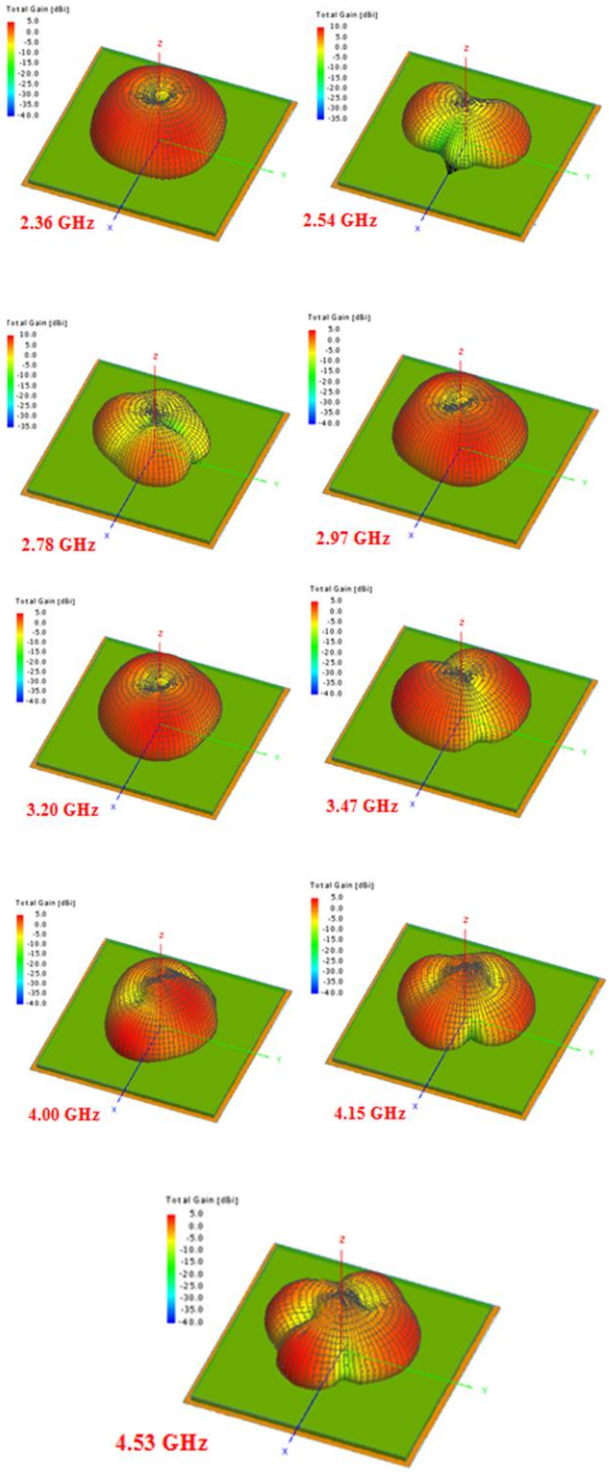

Figure 5. Gain results in x-y plane produced by FEKO

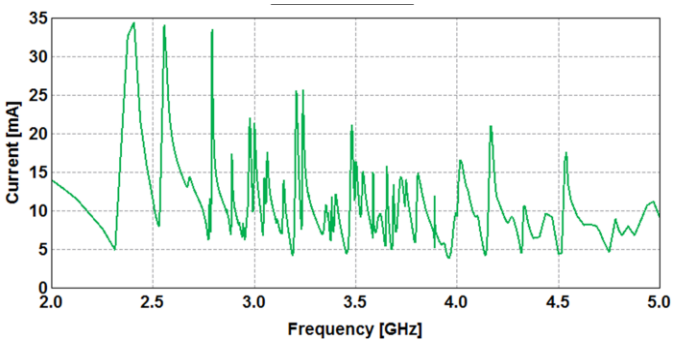

Figure 6. Current distribution of proposed microstrip patch antenna

D. Electric Field

The simulated E field radiation of simulated antenna for all the resonant frequencies in the proposed antenna is shown in Fig 7.

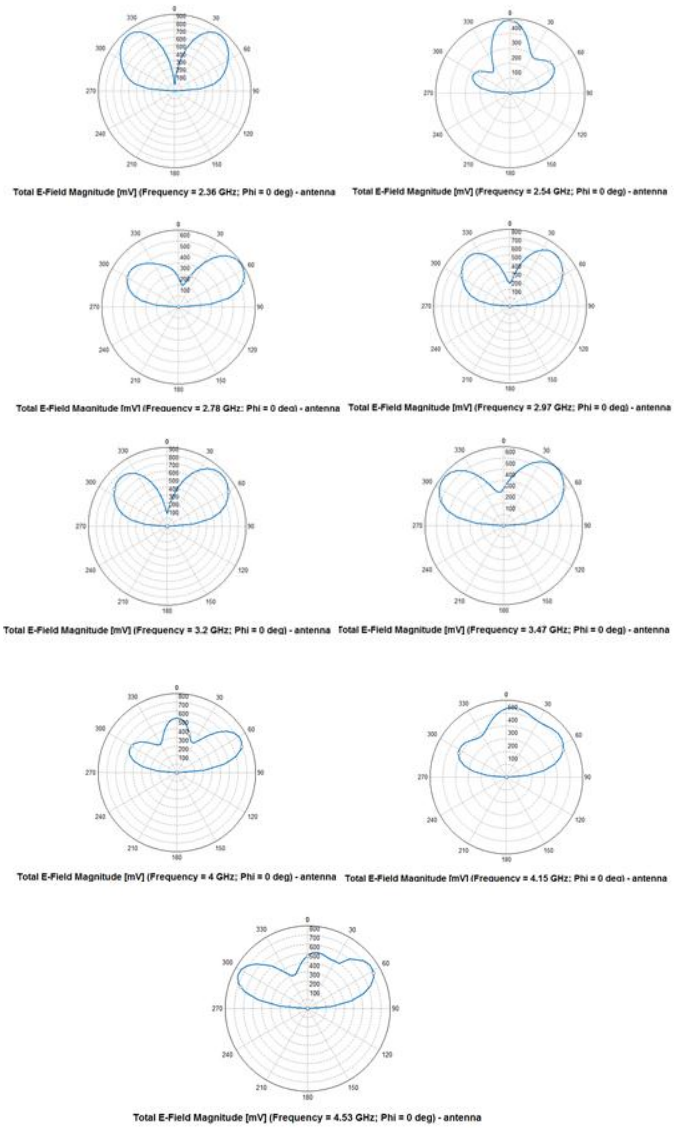

Figure 7. Total E- field magnitude produced by FEKO

III. CONCLUSIONS

Simulation results studies of a star patch plane single feed coaxial cable at feed point (0, 9) mm from the center of the patch and the antenna have been carried out using FEKO software based on Method of Moment (MOM). Multi-band of frequencies have been achieved in the single antenna covered both of S and C bands which they are useful to use in different wireless applications.

It is observed that the minimum value of return loss, VSWR and high value of gain have been presented in this research at resonant frequency 2.54 GHz which they were 20.92 dB, 1.57 dB and 10 dB respectively.

REFERENCES

[1] Bashar B. Qas Elias and Hussein Mohammed," Bandwidth Enhancement of A microstrip Patch Antenna for C-band and X- band By Using New Structure of Defected Ground Technique", IJCSMC, Vol.4, Issue.1, 426-432, January 2015.

[2] Bashar B. Qas Elias and Hussein Mohammed," Microstrip Patch Antenna Implementation for WiMAX/GPS/WLAN Applications ", IJEDR, Vol.3, Issue.1, 106-109, 2015.

[3] Rohit K. Raj, Monoj Joseph, C.K. Anandan, K. Vasudevan, P. Mohanan, " A New Compact Microstrip-Fed Dual-Band Coplaner Antenna for WLAN Applications", IEEE Trans. Antennas Propag., Vol. 54, No. 12, December 2006, pp 3755-3762.

[4] Zhijun Zhang, Magdy F. Iskander, Jean-Christophe Langer, and Jim Mathews, "Dual-Band WLAN Dipole Antenna Using an Internal Matching Circuit", IEEE Trans. Antennas and Propag.,VOL. 53, NO. 5, May 2005, pp 1813-1818.

[5] J.-W. Wu, H.-M. Hsiao, J.-H. Lu and S.-H. Chang, "Dual broadband design of rectangular slot antenna for 2.4 and 5 GHz wireless communication", IEE Electron. Lett. Vol. 40 No. 23, 11th November 2004.

[6] U. Chakraborty, S. Chatterjee, S. K. Chowdhury, and P. P. Sarkar, "A comact microstrip patch antenna for wireless communication," Progress In Electromagnetics Research C, Vol. 18, 211-220, 2011.

[7] I.Sarkar, P.P.Sarkar, S.K.Chowdhury "A New Compact Printed Antenna for Mobile Communication", 2009 Loughborough Antennas & Propagation Conference, 16-17 November 2009, pp 109-112.

[8] S. Chatterjee, U. Chakraborty, I.Sarkar, S. K. Chowdhury, and P.P.Sarkar, "A Compact Microstrip Antenna for Mobile Communication", IEEE annual conference. Paper ID: 510.

[9] Bashar B. Qas Elias and Hussein Mohammed," Multi-Band Microstrip Slotted Patch Antenna for Application in Microwave Communication ", IJSAT, Vol.2, Issue.9, 91-95, 2012.

[10] Overview of FEKO [Online], http://feko.info/product-detail/overview-of-feko.

Bashar B. Qas Elias Completed his B.Sc. in Electrical Engineering from AL-Mustansiriya University 2011, Baghdad, Iraq. M.Sc. in Electrical and Electronic Engineering from Eastern Mediterranean University, 2014, Famagusta, North Cyprus. Now he is Assistant lecturer in Al Nisour University College, Department of Computer Engineering Teqniques in Baghdad, Iraq. He has many research papers in the field of antenna design.