Design and Optimization of Compact Inverted F Antenna for 2.5GHZ Applications

Ramya P, Valarmathi R S, Sritha P

ABSTRACT--- ***A new compact planar inverted-F antenna (PIFA) for 2.5GHZ application is presented. The antenna contains a ground plane with radiating strips. The bandwidth of impedance with return loss of -10 dB is around 200 MHz (2.380–2.530 GHz) for 2.5 GHz band. The radiation patterns of proposed antenna is approximately omnidirectional and give way a gain and directivity of 7.31dB and 7.76dB at 2.5GHZ band. Good reflection loss, gain , directivity and the radiation characteristics are achieved in the frequency band of interest.***

Keywords- ADS, PIFA, FR4, ISM band, Return loss

I. INTRODUCTION

The fast growth of the mobile and wireless communication technology, the future technologies need a compact antenna. Multiband antenna is used to reduce the number of antennas to transmit the data, video. The PIFA antenna is good candidate for mobile and wireless technology [1]. Many researchers have designed PIFA antenna with various structure and different techniques to enhance the impedance bandwidth also to achieve the multiband frequency using double U-slot [2]. Also, a wider impedance bandwidth has been achieved by using two shorting pins on the patch antenna [3]. Multiband mobile terminals use a multiband PIFA antenna [4]. PIFA is used in many wireless applications due to its radiation characteristics [9]. PIFA antenna is an low profile antenna fabricated on inexpensive FR4 substrate [10-14].

The PIFA antenna can operate on DCS, UMTS,WLAN,GPS and WIMAX applications.

In this article a single band Planar Inverted F antenna was designed for ISM band 2.5GHZ applications using ADS ver.10.

This article organized as follows. The proposed PIFA antenna and Design Procedure is presented in Section II and Section III discusses the analysis and simulation results. Section IV is a conclusion for this paper.

II. PROPOSED ANTENNA DESIGN

Fig.1and2 shows the construction of the proposed PIFA antenna .It is printed on an FR4 dielectric with 0.8 mm thickness, ε_r of 4.4 and loss tangent of 0.023. The optimized antenna size is 30.5 x 9 x 0.8mm^2 contain an antenna portion 9 mm x 9 mm and a ground plane 25mm x 9 mm

The optimized parameters of proposed antenna is shown in table 1

Parameter	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	L7
(mm)	36	9	1.5	2	5	4	1
Parameter	L8	L9	L10	W1	W2	W3	W4
(mm)	1	1	9	9	6	10	1
Parameter	W5	W6	W7	W8	W9	W10	W11
(mm)	2.2	2	2	3.5	4	1	1

Table 1: Dimensions of PIFA antenna

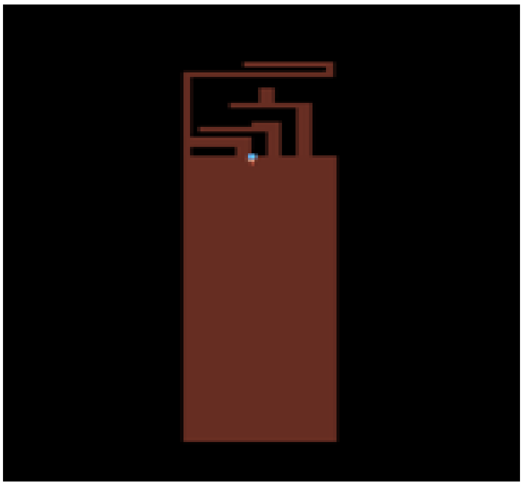


Fig1 PIFA antenna design using ADS

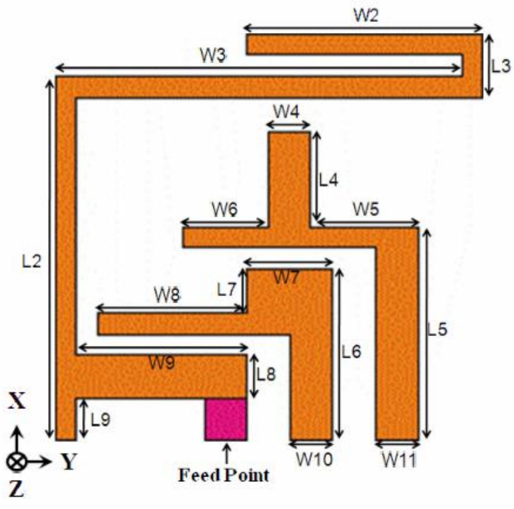


Fig2 Structure of PIFA antenna

Revised Manuscript Received on December 22, 2018.

Ramya P, Department of Electronics and Communication Engineering, Bannari Amman Institute of Technology, Sathyamangalam-638401, Erode, Tamil Nadu. ramyap@bitsathy.ac.in

Valarmathi R S, Department of Electronics and Communication Engineering, Bannari Amman Institute of Technology, Sathyamangalam-638401, Erode, Tamil Nadu. (valarmathis@bitsathy.ac.in)

Sritha P, Department of Electrical and Electronics Engineering. Bannari Amman Institute of Technology, Sathyamangalam-638401, Erode, Tamil Nadu. (srithap@bitsathy.ac.in)

III. RESULTS AND DISCUSSION

A. Reflection Coefficient

In this section, the simulated and experimental S_{11} and radiation pattern results of PIFA antenna is presented. The effect of the antenna performance based on the various paramerters are investigated. Fig 3 represents the S_{11} response of the PIFA antenna it covers the single frequency band 2.5 GHZ.

B.Current Distribution

The antenna performance is further analysed using surface current distribution.Fig 4 shows the surface current distributions of proposed antenna at frequency of 2.5Ghz.It shows that the current path is formed along the strips .the length of this current path can be changed with gap between the strips.

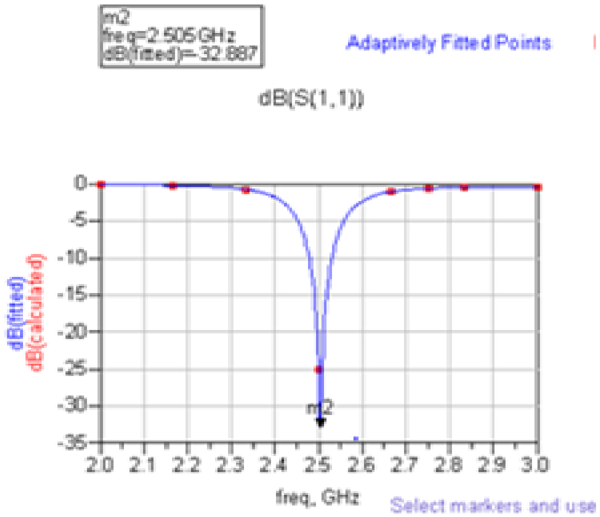


Fig3.Simulated S11 for the PIFA antenna

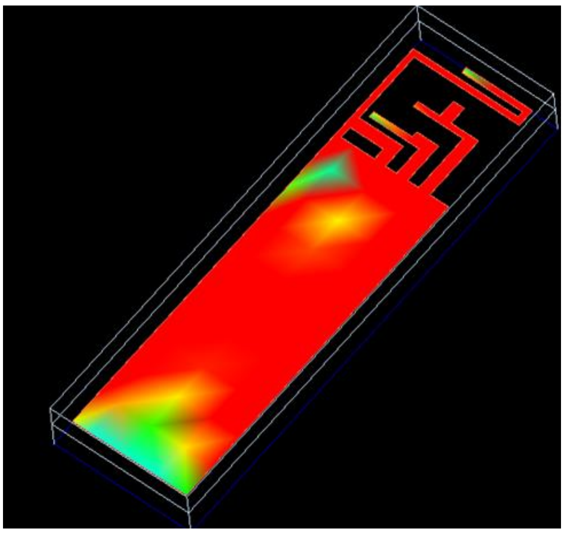
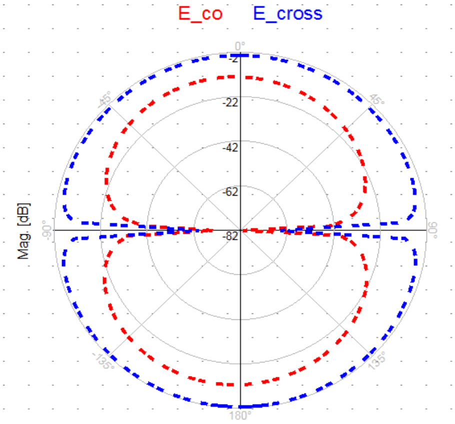


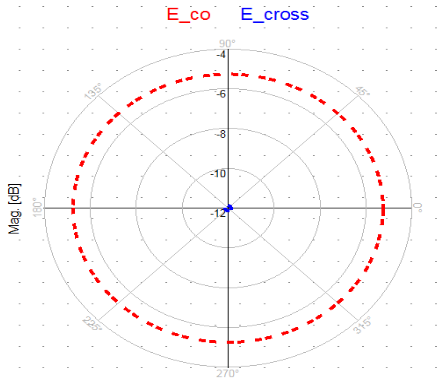
Fig 4. Surface current distribution

C.Radiation Parameters

The antenna parameters such as radiation pattern, gain, directivity and efficiency are investigated using ADS .



a. E plane ϕ=0



b. H Plane ϴ=0

Fig 5. Radiation Patterns of proposed PIFA antenna (a) E plane ϕ=0 (b)H plane ϴ=0

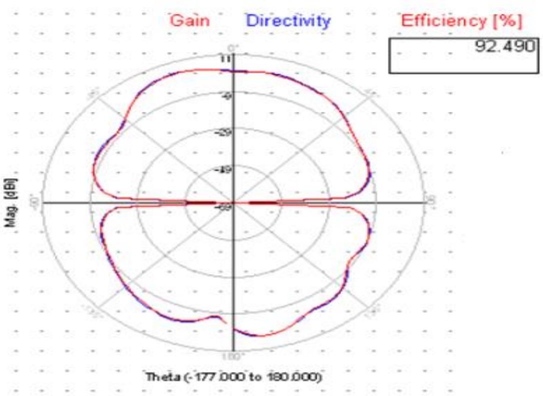


Fig 6 Directivity, Gain of proposed antenna

The the antenna efficiency is theoretically computed using the equation .

$$\eta = \frac{G(\theta,\phi)}{D(\theta,\phi)}\left(1-|\Gamma|^2\right)$$

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Where Γ is the voltage of reflection coefficient ,G is the gain and D is the directivity respectively,these are the functions of spherical coordinate angles ϴ&ф. Fig 5 shows the radiation patterns of proposed antenna for co and cross polarizations at the frequency of 2.5Ghz . Fig 6 show the gain and directivity of proposed PIFA antenna.The simulated efficiencies are 92.49% with the corresponding gain and directivity of 7.36 and 7.31dB it is higher than existing antenna.

IV. CONCLUSION

A new compact planar inverted-F antenna (PIFA) proposed and simulated in this article.The antenna wrap the frequency range from 2.45GHz to 2.55GHz.It is capable of WLAN(2.5GHz). The proposed antenna covers the area of 30mm×9mm on an low cost FR4-substrate of thickness 1.6mm and this miniaturize antenna can be used for mobile applications.

V. REFERENCES

1. Kasra Payandehjoo ; Ramesh Abhari "Compact Multi-Band PIFAs on a Semi-Populated Mobile Handset With Tunable Isolation" IEEE Transactions on Antennas and Propagation, Vol. 61, No. 9, February 2013
2. Roberto Caso ; Andrea D'Alessandro "An Integrated Dual-Band PIFA for DVB-T and WiMAX Applications," IEEE Antennas and Wireless Propagation Letters, Vol. 13, February 2014
3. H.W. Liu and C.F. Yang "Miniature PIFA without empty space for 2.4GHZ ISM band applications," Electronic letter ,January 2010.
4. Óscar Quevedo-Teruel ; Luis Inclan-Sanchez, "Soft Surfaces for Reducing Mutual Coupling Between Loaded PIFA Antennas" IEEE Antennas and Wireless Propagation Letters, Vol. 9,2010
5. Viet-Anh Nguyen,Rashid-Ahmad Bhatti, "A simple PIFA based tunable internal antenna for personal communication handsets " IEEE Antennas And Wireless Propagation Letters, Vol. 16, No. 2, 2008.
6. C. R. Rowell and R. D. Murch, "A capacitively loaded PIFA for compact mobile telephone handsets," IEEE Trans. Antennas Propag., vol. 45, no. 5, pp. 837–841, May 1997
7. D.-u. Sim ; J.-i. Choi" A Compact Wideband Modified Planar Inverted F Antenna (PIFA) for 2.4/5-GHz WLAN Applications, IEEE Antennas and Wireless Propagation LettersVolume: 5,2006
8.
9. J.-S. Row "Dual-frequency triangular planar inverted-F antenna"IEEE Transactions on Antennas and Propagation, vol. 53, 2005
10. Do-Gu Kang ; Y. Sung., " Compact Hexaband PIFA Antenna for Mobile Handset Applications" IEEE Antennas and Wireless Propagation Letters, Volume: 9, 2010.