

# Design A Low Profile Printed Monopole Antenna for RFID Applications

P.Prabhu<sup>1</sup>, C.Poongodi<sup>2</sup>, P.Sarwesh<sup>3</sup>, Dr. A. Shanmugam<sup>4</sup>

PG scholar, Dept. of ECE, Bannari Amman Institute of Technology, Tamil Nadu, India<sup>1</sup>

Associate Professor, Dept. of IT, Bannari Amman Institute of Technology, Tamil Nadu, India<sup>2</sup>

PG scholar, Dept. of ECE, K.Ramakrishana College Of Engineering, Tamil Nadu, India<sup>3</sup>

Principal, Bannari Amman Institute of Technology, Tamil Nadu, India<sup>4</sup>

**Abstract** :In this paper low profile printed monopole antenna for RFID applications is presented ,this antenna is designed for RFID coverage, In this work design and simulation confined RFID communication can be achieved with this antenna geometry ,a low profile RFID antenna is designed and resonant frequency is computed using Method of Momentum(MOM) in ADS software, by varying the dimensions of the proposed antenna can achieve resonant frequency ,the low profile printed monopole antenna achieves a desirable radiation characteristics with gain 3.8dBi for operating frequency 2.4GHz.

**Key words:** RFID antenna; monopole antenna; low profile; gain

## I. INTRODUCTION

Over the last few years lot of low profile printed monopole antenna have been developed for RFID antennas ,especially for RFID applications at 2.4GHz ,the printed monopole antenna are omnidirectional radiation pattern ,using for medium to large range range of RFID systems such as single frequency and narrow bandwidth applications[1][2],but with the radiation capacity and radiation pattern characteristics, low cost and easy to fabricate process, To increasing working bandwidth of the RFID antenna many improve structure used such printed metal wreath feed structure[3].multi antenna array wreath types of arms [4].These methods size of antenna complicate structure of the antenna ,we introduce the new structure the printed slotted monopole antenna .it will increase the radiation characteristics of antenna ,but the size of the antenna increase the compare to existing antenna s structure [7].It can increase the working bandwidth of an RFID antenna . RFID tag antenna operating with in the limited space, the simplified structure it have excellent radiation pattern.

To increase the bandwidth of the antenna with this simplified structure, In slotted printed monopole antenna patches are scattered electromagnetic waves.

The operating frequency for the RFID antennas allocated by the around 868-878 MHz and 2.4-2.45 GHz [8] .Thus, the low profile slotted printed monopole antenna, covers the 2.4 GHz.

## II. STRUCTURE DESIGN OF AN ANTENNA

In structural design of a printed monopole antenna slotted on the rectangular patch, according to the FCC RFID operating frequency ,we designed a low profile printed monopole antenna for RFID applications .propose antenna using Rogers\_Ro4003 dielectric substrate with thickness 2.0 mm and dielectric constant  $\epsilon_r=3.38$  ,

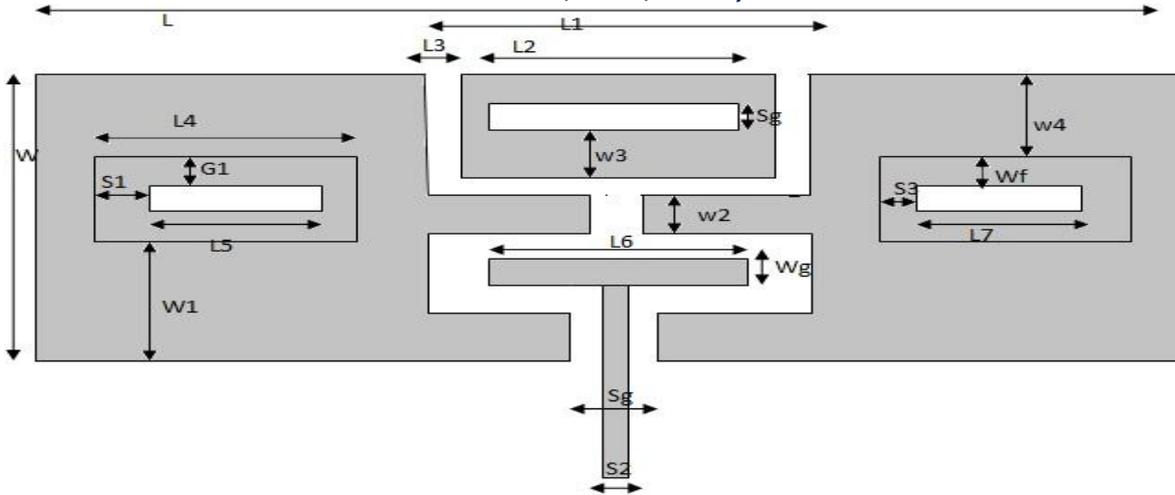


Fig.1 Antenna configuration structure Of The Low Profile Printed Monopole Antenna For RFID Applications

The proposed geometry size is L\*W is 95\*25 mm and patch and slot length is L1=17mm,L2=15mm,L3=1mm,L4=20mm,L5=14mm,L6=12mm,L7=14mm patch width of the antenna is W1=10mm,W2=3mm,W3=5mm,W4=8mm,S1=3mm, length of the ground plane is S2=1mm,S3=3mm,g1=3mm,Sg=3mm, in this above mentioned geometry of the antenna theoretically designed using following equations

The lower frequency equation is given below

$$f_l = \frac{7.2}{l + r + p} \text{GHz} \dots(1)$$

The effective dielectric constant is calculated by using this equation is

$$\epsilon_{ef} = \frac{(\epsilon_r + 1)}{2} \dots\dots (2)$$

Fundamental resonant length of the monopole arm is

$$l = 0.48\lambda F \dots\dots\dots (3)$$

Where,  $F = \frac{l}{l + 2r}$

From the alternative equation for the resonant frequency is

$$f_r = \frac{14.4}{l + 2r} \text{GHz} \dots\dots\dots (4)$$

To find the width of the antenna is using this equation is

$$W = \frac{c}{2.f_r \sqrt{\mu_0 \cdot \epsilon_0} \sqrt{\epsilon_r + 1}} \dots \dots (5)$$

Where,

$f_r$  = Resonant Frequency

$\epsilon_r$  = Relative dielectric constant

$\epsilon_0 = 8.9 \times 10^{-12} \text{ C}^2 / \text{Nm}^2$

$\mu_0 = 4\pi \cdot 10^{-7} \text{ Tm/A}$

Antenna length here denote as 'L' is designed by following equation

$$L = \frac{c}{2.f_r \sqrt{\epsilon_{eff}} \sqrt{\mu_0 \cdot \epsilon_0}} - 2\Delta l \dots \dots (6)$$

Where,

$f_r$  = Resonant Frequency

$\epsilon_r$  = Relative dielectric constant

$\epsilon_0 = 8.9 \times 10^{-12} \text{ C}^2 / \text{Nm}^2$

$\mu_0 = 4\pi \cdot 10^{-7} \text{ Tm/A}$

### III. SIMULATED RESULTS AND DISCUSSIONS

Simulated return loss of the slotted printed monopole antenna is shown in fig.2, from the figure the operating frequency at 2.4GHz which return loss  $S_{11}$  is -17 dB. In this resonant frequency 2.4 GHz perfectly suitable for the RFID applications .In proposed antenna using microstrip feed line to exciting the monopole antenna it will scattering the electromagnetic waves in a slot of the antenna, slot of the printed antenna and microstrip fed line with  $50 \Omega$  achieves the impedance matching, the proposed antenna acquired efficient radiation characteristics such as E-plane polarization, H-plane polarization, gain and directivity. In this proposed antenna operating at 2.4 GHz band for RFID applications, simulated using Method of momentum (MOM) in ADS simulator.

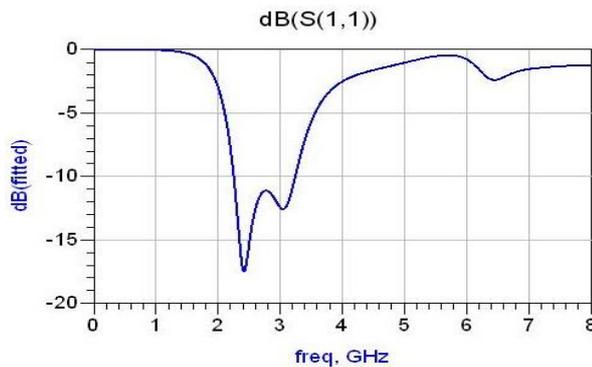


Fig.2 Return Loss Of Low Profile Printed Monopole Antenna for RFID Applications



Fig .3(a)

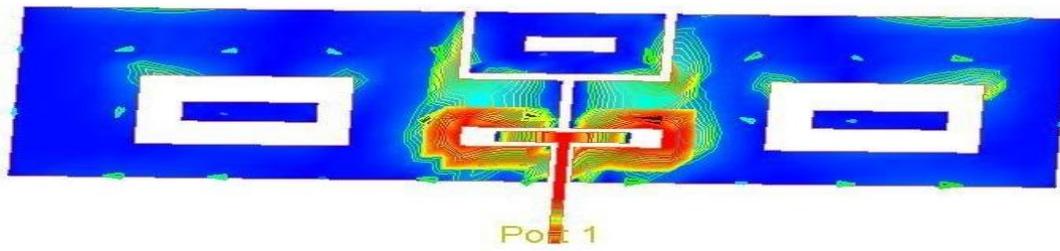


Fig .3(b)

Fig 3. (a) and Fig.3.(b) Surface Current Distribution of Low Profile Monopole Antenna For RFID Applications.

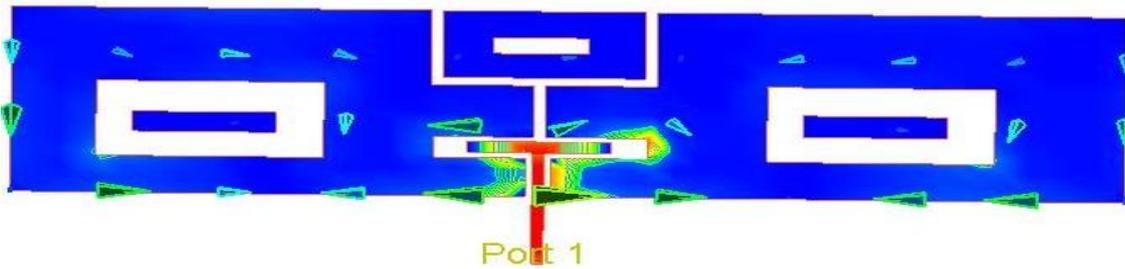


Fig.4(a)

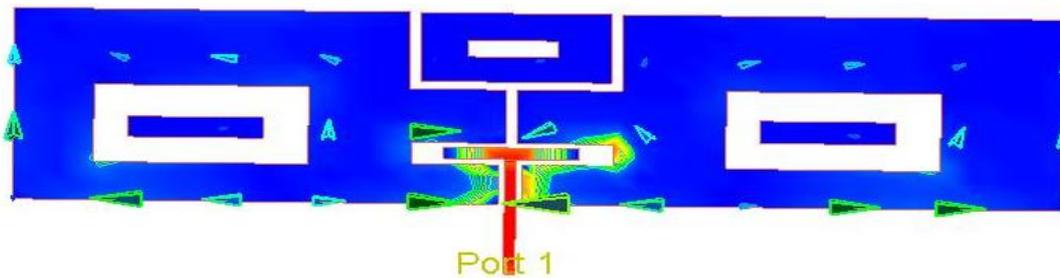
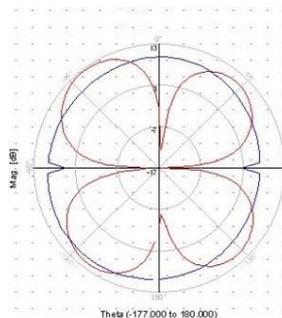
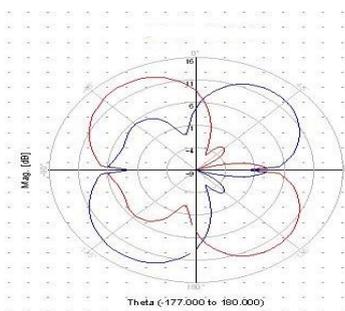


Fig.4(b)

Fig 4.(a) and Fig.4.(b) Surface Current Distribution in forward and reverse direction of Low Profile Monopole Antenna For RFID Applications.



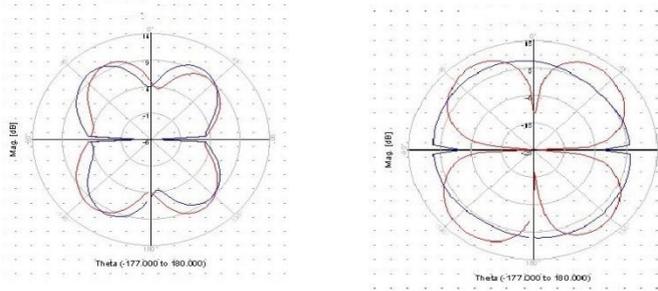


Fig .5. E Plane and H-Plane Radiation Pattern of Low Profile Monopole Antenna at 2.4GHz.

The proposed antenna radiated in the omnidirectional radiation pattern shown in fig.5, In this antenna achieves perfect radiation characteristics gain and directivity of the antenna at 2.4GHz is 3.41dBi and 3.1 dBi respectively. Simulated results of a proposed of Low Profile Monopole Antenna can operate at 2.4 GHz for RFID applications.

#### IV. CONCLUSION

A new type of low profile monopole antenna for RFID applications has been proposed and simulated all monopole antennas printed on the thin substrate, which is Rogers Ro4003 dielectric printed board used for this proposed antenna, In this proposed monopole slotted antenna achieved desired radiation pattern with gain of 3.41 dBi at 2.4GHz and return loss -17 dB at 2.4GHz, Thus it perfectly suitable for the short range of RFID applications.

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#### BIOGRAPHY



**POONGODL C** received B.E degree in Electronics and Communication Engineering from Bharathiyar University and M.E in Communication Systems from Anna University, Chennai. She is currently Associate Professor in the department of Information and Technology at Bannari Amman Institute of Technology, India. Her research interest includes Wireless communication, smart Antennas and Digital Signal Processing.



**SHANMUGAM.A** received the Ph.D. in Computer Networks from PSG College of Technology., Bharathiyar University, India, in 1994. From 1972 -1976 he served as a Testing Engineer at Test and Development Center, Chennai. Since April 2004, he assumed charge as the Principal, Bannari Amman Institute of Technology, India. he received “Best Project Guide Award” five times, “Best Outstanding Fellow Corporate Member Award”, “Jewel of India Award ”, “Bharatiya Vidya Bhavan National Award for Best Engineering College Principal 2005” and “Education Excellence Award”.



**PRABHU P** is a PG scholar doing his M.E communication system in Bannari Amman Institute of Technology. Earlier he has completed his undergraduate in the field of electronic and communication engineering in sudharsan engineering college india in 2010.he was worked as a service engineer from 2010-2011.



**SARVESH P** is a PG scholar doing his M.E communication system in K.Ramakrishan college of engineering. Earlier he has completed his undergraduate in the field of electronic and communication engineering in Annai madhammal sheela engineering college india in 2010.