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Design and Analysis of Active RFID Tag Antenna For UHF Band

Hetal Vasava[1], Vivek Varma[1,*], Vaibhav Patel[1], Chintan Parmar[1], Dr. J M Rathod[2]

[1] Research Scholar, Birla Vishvakarma Mahavidyalaya Engg College,V V Nagar, Anand, Gujarat, India

[2] Associate professor , Birla Vishvakarma Mahavidyalaya Engg College,V V Nagar, Anand, Gujarat, India

ABSTRACT: After doing the market survey we have came to the importance of Bandwidth (BW) in a Hi-Tech world and we decided to do further research on how BW can be enhanced of Active RFID tag Antenna for UHF band. The antenna is proposed in High-frequency simulator software (HFSS v.14) and the design consists of two parts First part that consist of stacked shorted patches and a ground plane with a slot in it and the second part is an active tag circuit mounted on the bottom of the antenna (i.e. ground). The simulated results are discussed in this paper as Operating BW is 101.6 MHz in frequency range from 860.1 to 961.7 MHz which covers almost whole RFID Technology band which is allotted in UHF band for, VSWR as 1.44 for the operating frequency 910 MHz and total Gain is 2.5dB.

Keywords: RFID, Patch Antenna, UHF Band, Active Tag Antenna, BW, HFSS.

1. Introduction

RFID (Radio Frequency IDentification) technology has spanned across many areas like Radio propagation, Sensor design, CMOS design, Data-management, Integration, Encryption, and Network engineering are some examples from these we can say that “RFID technology is a futuristic technology”. In Recent year’s many researchers are focusing on the development of RFID system due to its extraordinary advantages over the other existing identification and data capturing technologies. The technology has some discrepancies but researcher’s community are doing their best to solve these discrepancies and supporting the rapid growth of the RFID technology. As technology expands then countries like India and china can be the best place to exercise business because they have a huge market to capture. [1][2][3].

RFID System mainly consists of Tag, Reader and Host computer. Further, it can be assorted based on shape, the power provided, cost and application. But, at the highest level, we can classify RFID system into two categories viz. Active and Passive. a) Active tags require a power source and they have a limited lifetime as energy stored in battery source is limited and it has fixed number of read operation while. b) Passive tags don't require batteries and maintenance. These tags have a large operational life. The Active or Passive design is based on power transferring principle. These two fundamentally design approaches exist for transferring power from the reader to the tag to wit magnetic induction (for near field communication) and electromagnetic wave capture (for far field communication). Both of this design can transfer enough power to a remote tag to perform its operation depending on the type of tag we select.

* Corresponding author e-mail: vivekvrm427@gmail.com
Tel.: +91 7096105919

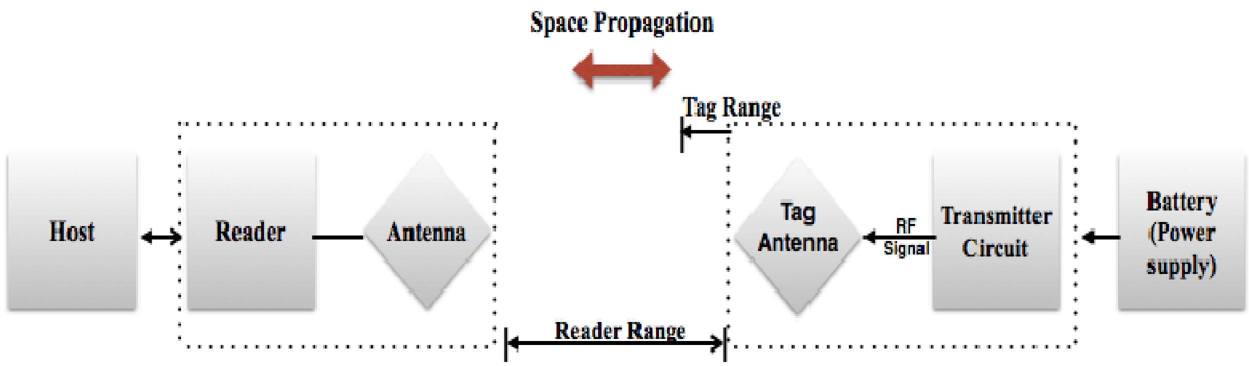


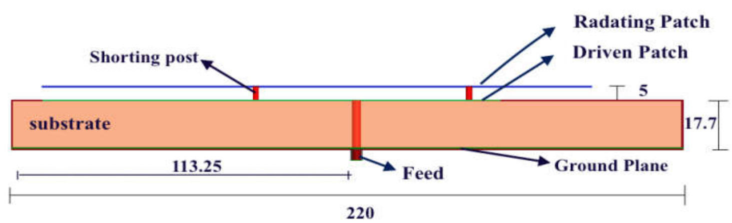
Fig.1 - Basic working block diagram of RFID System

When Active RFID tag is powered by battery then the transmitter generates electromagnetic waves and these are transmitted through tag antenna. The channelized wave consists the information (need to transfer), which is gathered by RFID reader, and the received information is stored in Database system (Host), which is easily apprehended from figure1 [4].

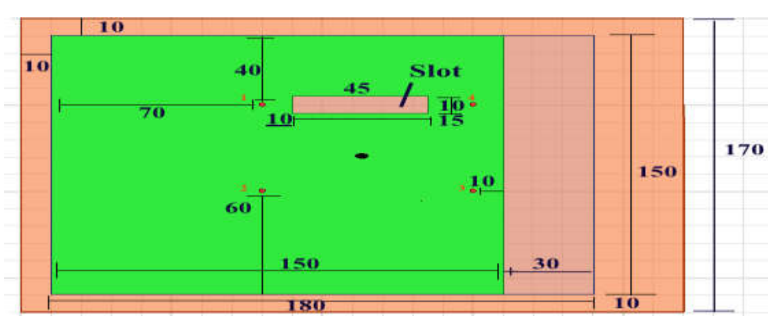
The selection of active and passive tag for application is a crucial component of the architectural design strategy, as the architectural design of RFID network is quite essential when it comes to development of RFID system. So, we have proposed an Active tag antenna with enhance BW during stimulation which is 101.6 MHz

2. Methodology

The Active RFID Tag antenna is designed in HFSS Software. The design of the antenna is inspired from W.J. Wu & Y.Z. Yin [5]. The design comprises of stacked shorted patches and a ground plane. The design can be achieved by following the steps as given below.



a) Front view



b) Top view
Fig. 2 – Viewing sides and dimensions of proposed tag antenna

Table 1: Dimensions with its coordinates for proposed Antenna

Parameters	Dimensions (mm)	Shorting Post	Co-ordinates (X, Y)
Ground Plane	220*170	Shorting Post 1	80, 110
Substrate	220*170*17.5	Shorting Post 2	80, 60
Driven Patch	150*150	Shorting Post 3	150, 60
Radiating Patch	180*150	Shorting Post 4	150, 100
Slot (on Driven Patch)	45*10		90, 105
Feed Point (RF Signal)			113.25

Steps need to follow for designing:

1. Draw a ground plane of a given size L*B and then intersect a circle of diameter d1 (3mm) such, that the hole formed in the ground plane and through which RF signal can be supplied to the antenna.

2. Place an FR-4 substrate of given dimension above the ground plane so that driven patch can lay on it.

3. Now construct a driven patch of given size above the ground plane and maintain the height h1 (17.7mm) between the driven plane and ground plane.

4. Create a Radiating/parasitic patch above the height of h2(5 mm) from driven patch of given size and short both Radiating patch and Driven patch by using shorting posts of diameter d2 (2 mm)

5. By using the feeding probe as a coaxial cable of diameter d3 = d1 (3mm) provide RF signal as an input to the design

6. Now obtain the result and analyse it.

Note: The radiating patches, ground plane, feeding probe and two shorting posts are all made up of copper.

Results

After the simulation is done in Ansoft High Frequency Structure Simulator (HFSS.14) which is based on the Finite element method (FEM) [6]. The obtained results are expressed in figure i.e. Return-loss (S1,1),VSWR,Radiation pattern and Gain.

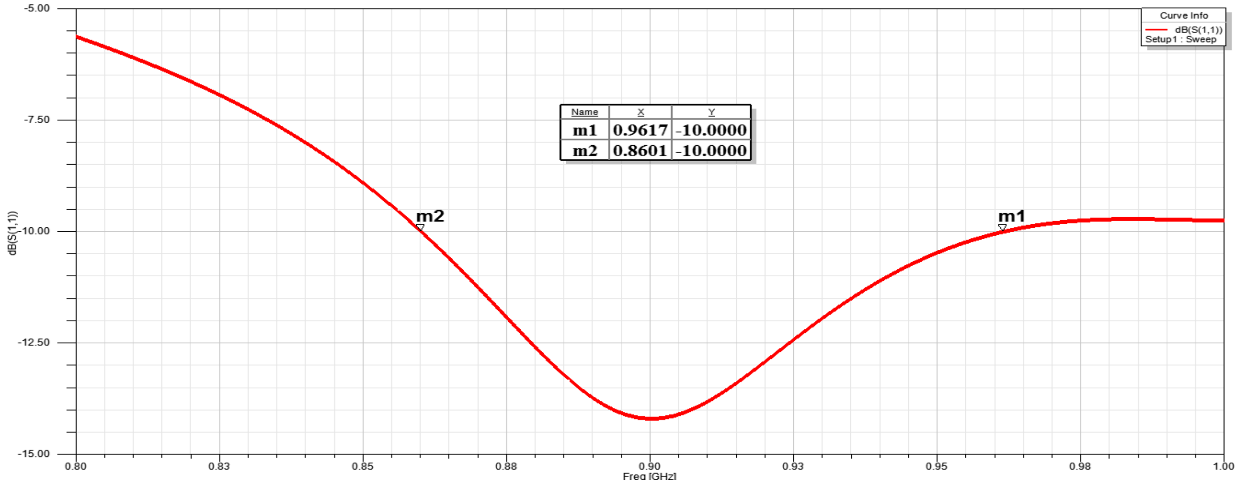


Fig. 3 – Return loss (S1,1) Vs Frequency.

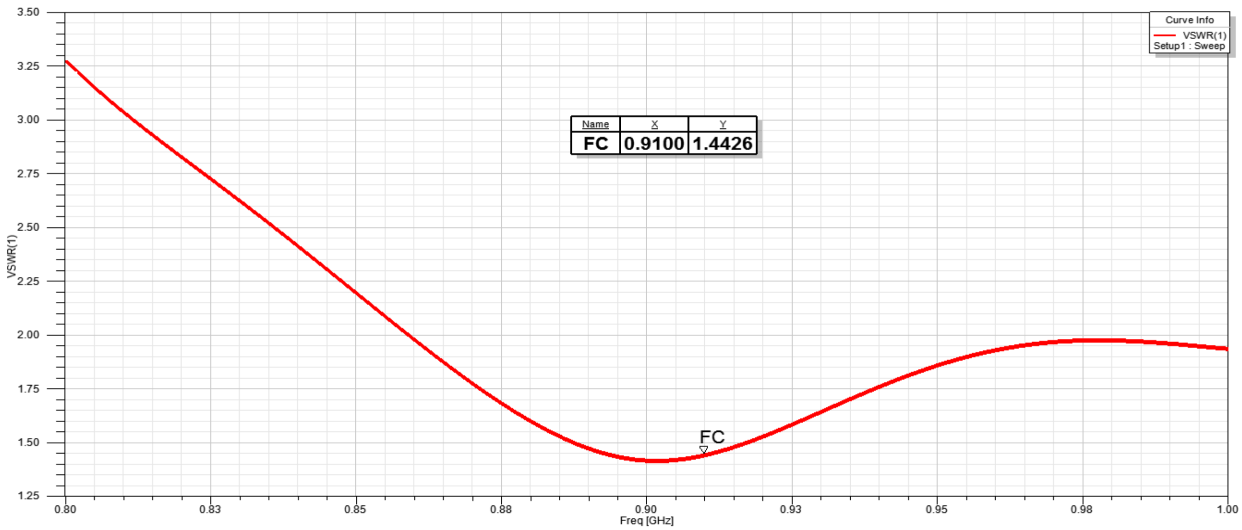


Fig.4 - VSWR at operating frequency.

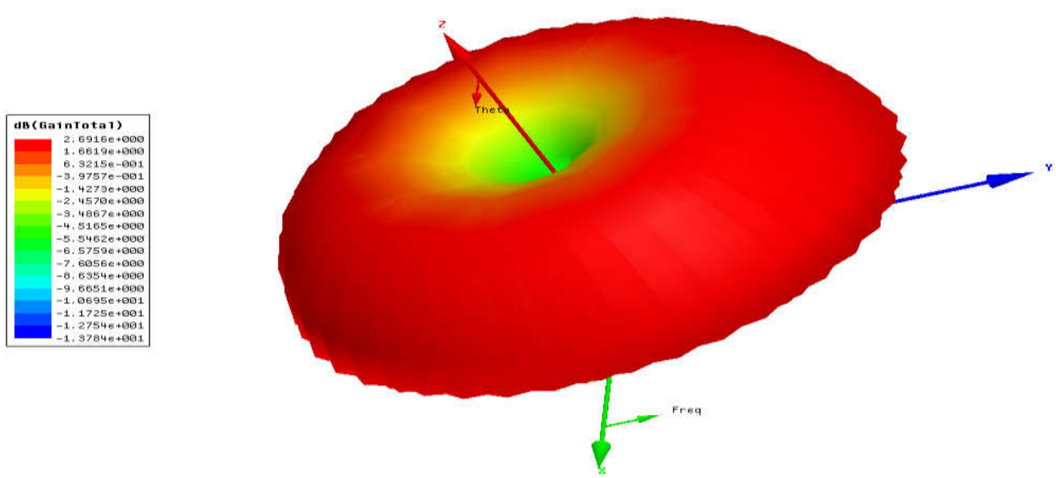


Fig.5 -Total Gain is 2.5db.

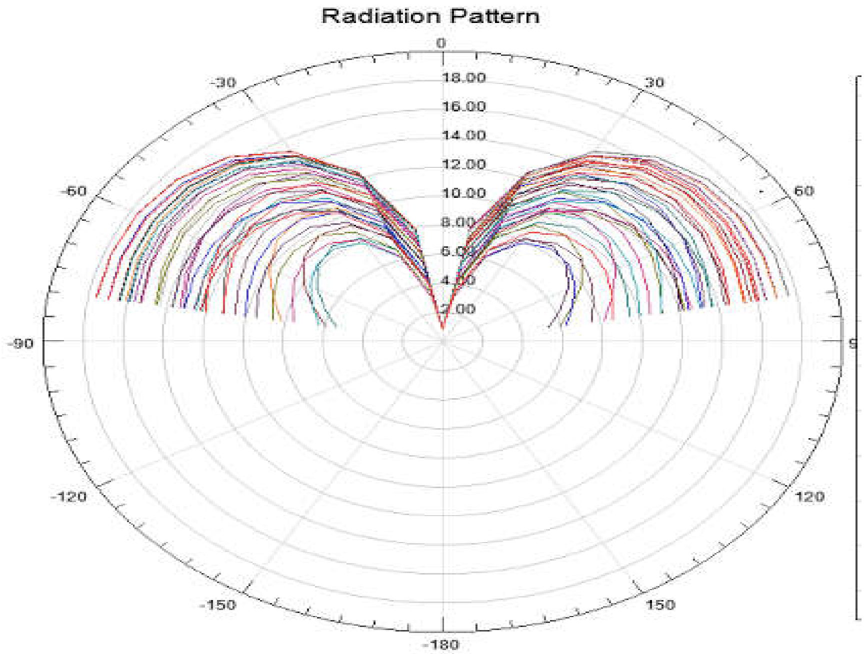


Fig.6 - Radiation Pattern at different values with Gain

Now we discuss how BW can be optimized by different methods. To optimise the BW, we must control the coupling between the driven patch and parasitic patch. Coupling is depends on the distance between distance between shorting posts and the radiating edges of the patches [7]. The size of the slot made on driven patch has an effect on BW [8].

Compression

Parameters	Reference Tag [5]	Proposed Tag
BW	42 MHz	101.6 MHz
Gain	-7.19dBi	2.69 dB

Conclusion

The parametric studies have revealed that the effects of the distance of the shorting posts, the size of the slot made on Driven patch and the size of the ground plane effects on the performance of the proposed tag antenna. Further, for enhancement of BW we have utilized a four offset shorting posts for shorting the patches has been implemented in the design. The experimental results reveal the antenna features like Return loss (S1,1) at -13.5db which is less than -10dBi and the obtained BW is from 860.1 to 961.7 MHz i.e. 101.6 MHz which covers whole RFID band which is allotted to UHF band.

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