International Journal of Innovation and Applied Studies
ISSN 2028-9324 Vol. 4 No. 3 Nov. 2013, pp. 497-501

http://www.issr-journals.org/ijias/

P-shaped Wearable Antenna for ISM band at 2.45 GHz

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ABSTRACT: A P-shaped wearable antenna is proposed for the application of ISM (Industrial Scientific Medical) band at frequency 2.45 GHz. This proposed antenna is studied using different numerical techniques. Those techniques are Method of Moment (MoM) and Finite Element Method (FEM). This proposed structure is a high directive gain, low-cost, low weight base station antenna. The characteristic analysis such as return loss (RL), VSWR and radiation pattern of this antenna has been investigated numerically. Numerical study has been carried out by using Ansoft HFSS V13 simulating software.

KEYWORDS: Patch antenna, ISM band, Return loss, VSWR, Radiation Pattern.

1 INTRODUCTION

Over the last two decades, microwave resonators have become very important subject of interest. Recent years have observed the demand for reconfigurable antennas, these are used in a variety of applications, including sensors, filters, oscillators, frequency meters and tuned amplifier [1]-[4]. Resonator elements based on microstrip antenna technology are conformable and have minimized shape, low weight and cost. Hence, these are commonly used in many commercial applications in the industry, such as mobile satellite communications or direct broadcast satellite services etc. In this paper, modeling and study of P-shaped wearable antenna is investigated at frequency 2.45 GHz. The geometry of wearable antenna is shown in the Fig.1. For achieving best performance of this antenna, a parametric study has been performed. The antenna parameters, such as length (L), width (W), slot dimensions etc are also shown in the Figure 1. In order to satisfy IEEE 802.11 a standard, the proposed antenna should operate at 2.45 GHz. Therefore, slotted antennas for WLAN applications become a research point in the past decades and many different technologies for miniaturized antenna have been proposed [5]-[22] and also slotted antennas for ISM band become a hot research point in the past decades and many technologies for miniaturized antenna have been proposed. This proposed antenna is simulated by Ansoft HFSS V13 simulating software, based on method of moment (MoM). In this article, a study for optimizing the performance of the proposed wearable antenna has been carried out by varying the slot dimension (P) as illustrated in the Fig.1. The best performance is achieved for P=2mm. The simulated results offer VSWR of 3.5, and return loss (RL) of -17.25dB. To meet the actual design requirements i.e. operating frequency 2.45 GHz, band width and the radiation efficiency, some approximation has been used. The dimension of the wearable antenna has been calculated based on transmission line model. The substrate duroid (tm) of dielectric constant 2.2 has been taken in this design. The low-profile P-shaped wearable antenna is presented in this paper. It is also very helpful to understand the interaction and performance of the antenna and the communication system in ISM band. The results and design details on the antenna presented here, can be chosen as the initial design for professionals interested in utilizing low-profile integrated antenna. A numerical study has been done to find out the exact feed location and it is found that at (-44.59, 1.85, 0). Duroid (tm) substrate with electrical properties, ε_r of 2.2, thickness of 1.52mm have been used. In this paper a new wearable antenna is design and simulates is used in the Industrial, Scientific and Medical ISM band operating at the frequency 2.45 GHz as a P shaped wearable antenna with micro strip line feed.

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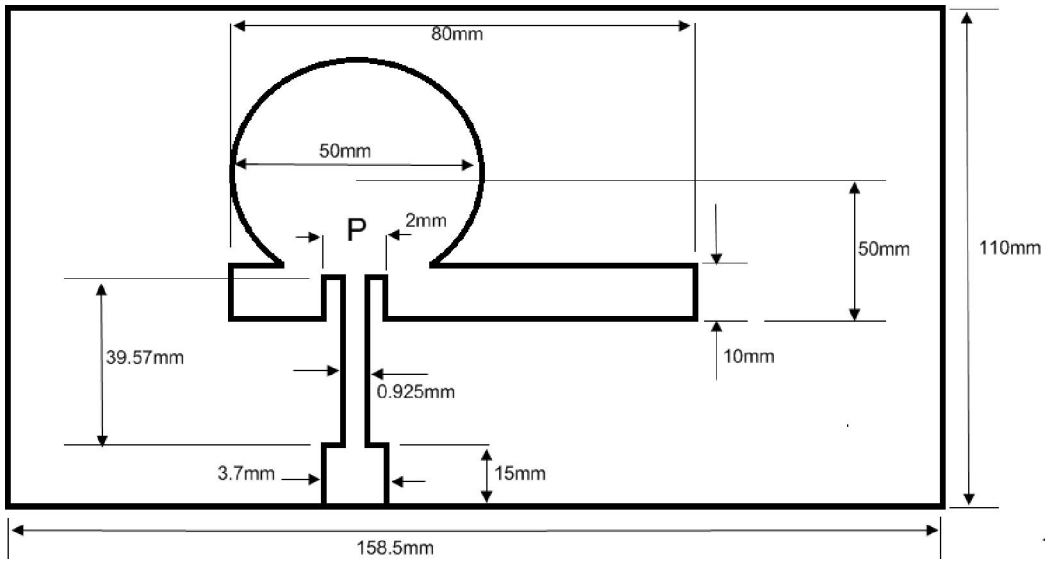

Fig. 1. Geometry of the P-shaped wearable patch antenna

2 SIMULATION RESULTS AND ANALYSIS

2.1 RADIATION PATTERN

This wearable antenna radiates normal to its patch surface. So the elevation pattern for ϕ= 0 and ϕ= 90 degrees are important for measurement. Figure 2 below shows the radiation pattern at 2.45 GHz. The maximum gain is obtained at design frequency for the P-shaped wearable antenna is 6.5 dBi for both ϕ= 0 and ϕ= 90 degrees. The 3D view of the polar plot is shown in Figure 3.

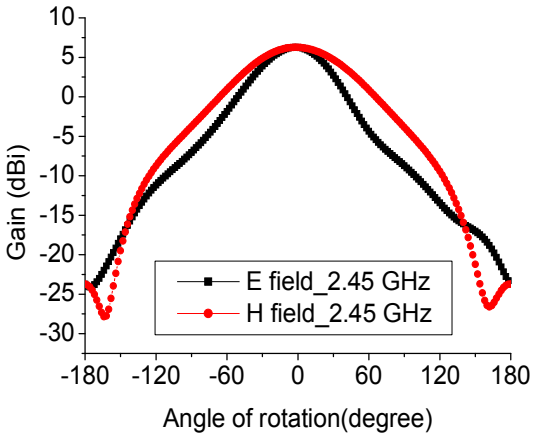

Fig. 2. Simulated result of radiation pattern at 2.45GHz

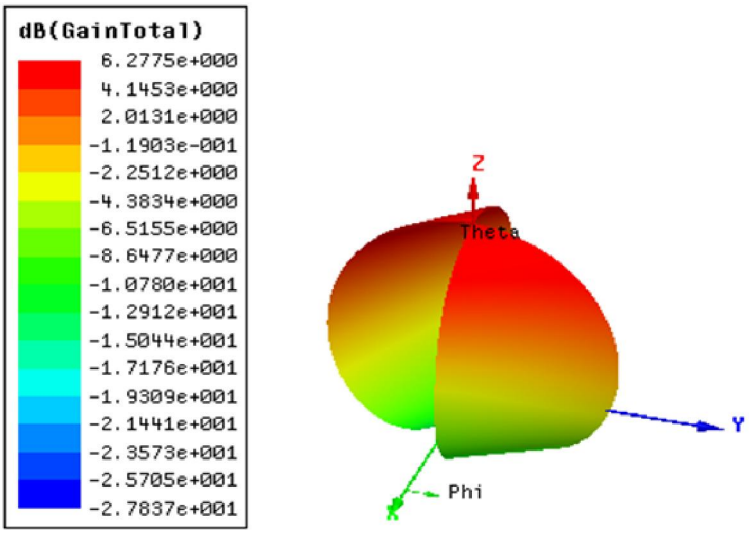

Fig. 3. 3D view of polar plot of the proposed P shaped wearable antenna

2.2 RETURN LOSS AND VSWR

The Return loss characteristics are shown in the Fig. 4. From Return loss (RL) curves it is observed that the optimized RL at 2.45 GHz is -17.25 dB. It has been observed that as the feed location is moved away from designed location, the center frequency deviates slightly but return loss changes noticeably. The optimum VSWR of the proposed antenna at 2.45 GHz is 3.5 as shown in Fig.5.

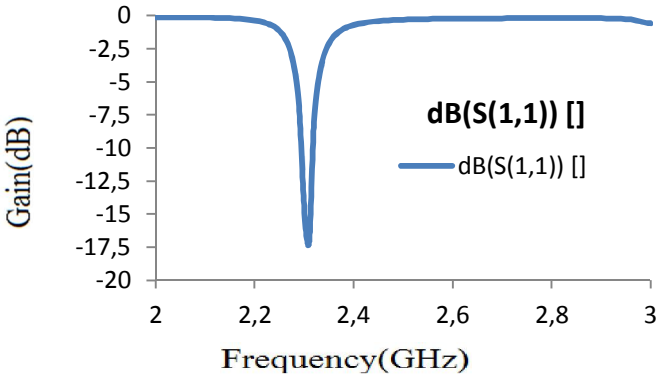

Fig. 4. Simulated result of RL. at 2.45GHz

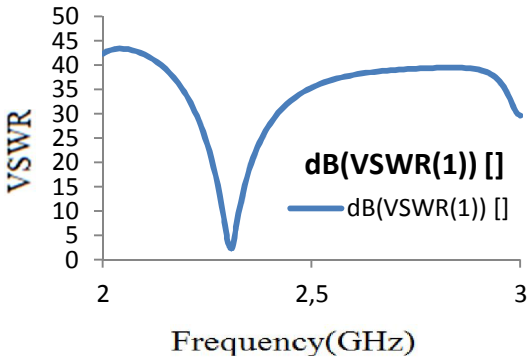

Fig. 5. Simulated result of VSWR at 2.45GHz

2.3 CURRENT DISTRIBUTION

The Current Distribution of proposed antenna is shown in the Fig. 4.

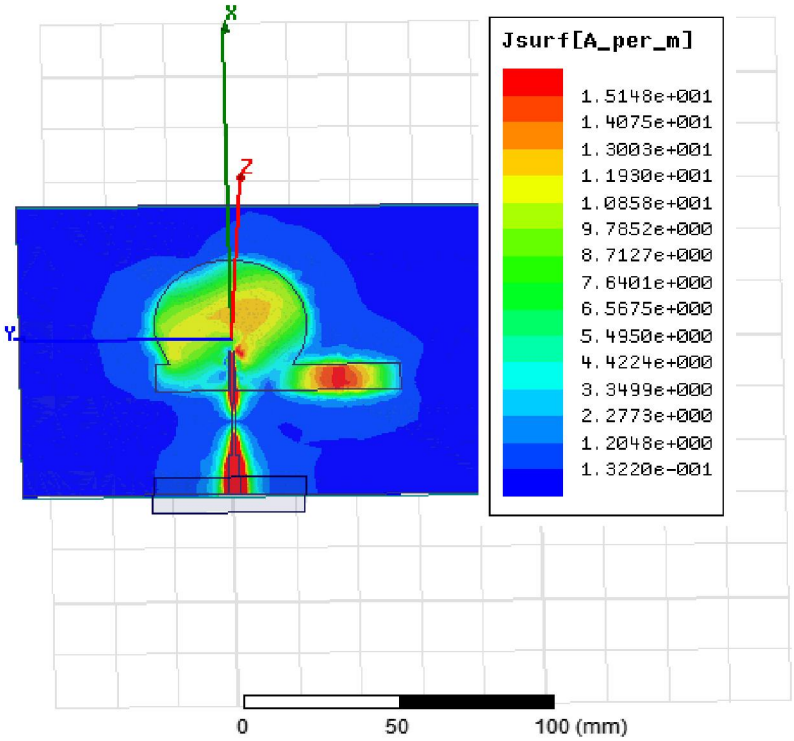

Fig. 6. Simulated Current Distrubution at 2.45GHz

3 CONCLUSION

In this investigation, A new wearable antenna has been design and simulates to use in the ISM band at the center frequency of 2.45 GHz. The proposed slotted antenna is applicable for ISM band. The P-shaped wearable antenna is electrically small and it is suitable to handle easily. If the dielectric constant is high, the electrical length of the antenna will be reduced but the bandwidth would be narrow. It is clearly observed that the bandwidth, radiation efficiency and VSWR improve by introducing P-shaped wearable antenna at the receiver or transmitter ends.

ACKNOWLEDGEMENT

The authors like to acknowledge Dr. B. C. Roy Engineering College, Durgapur, India and Bengal Engineering and Science University (BESU), Shibpur, India for providing necessary support during this research work.

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