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Cross Slot Rectangular Microstrip Patch Antenna for WLAN Application

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ABSTRACT

The paper presents an X slot rectangular microstrip patch antenna with quarter wave feed technique that operates in wireless local area network applications. Microstrip antenna with X slot is proposed to achieve circular polarization, reduce the size and widen the bandwidth. The antenna is operated at 3.5 GHz. The impedance bandwidth (VSWR < 2) is 230 MHz and the directive gain is 7.29 dBi. The proposed antenna also provides low return loss (S11=-37.34 dB). The proposed structure is designed and simulated by using Ansoft HFSS software. The simulated results give significant improvement in terms of directive gain and bandwidth.

Key words: Cross slot, microstrip, impedance bandwidth, quarter wave feed

INTRODUCTION

Microstrip patch antennas have inherent capabilities such as low profile, light weight, and low cost, as well as ease of fabrication. As a consequence they have been a common choice for applications in modern communication systems that require compact radiators with sufficiently high gain. However, conventional microstrip patch antenna suffers from narrow bandwidth typically a few percent and low gain which poses a design challenge for the microstrip antenna designer to meet the broadband requirements [1-2]. There are numerous methods in literature to increase the bandwidth of antennas, including increase of the substrate thickness, the use of low permittivity substrate material, use of various impedance matching and feeding techniques, use of multiple resonators and the use of slotted antenna geometry with slots in patch or in ground plane [3-8].

In this paper the X slot antenna has been considered for applications in wireless communications system. One of the main advantages of this antenna is its reduced size, compared to the microstrip patch antenna. The analysis is performed using Ansoft HFSS [9]. Furthermore the effect of the feed position and square slot size on resonant frequencies is investigated using the Ansoft HFSS and at last the best feed position and size of the slot has been used in this paper.

DESIGN AND ANALYSIS OF CROSS SLOT MICROSTRIP PATCH ANTENNA

The geometry of the X slot rectangular microstrip patch antenna is shown in Fig.1 (a & b). The feed position is positioned at the best place to achieve the perfect impedance matching [3-4] and the X slot dimension is 9 mm* 1 mm for the microstrip antenna. The length and width of the patch is 26.25 mm and 35 mm respectively. The simple rectangular patch antenna without slot has resonated at little higher frequency with slight deviation in return loss and bandwidth.

Table – 1 Design Parameter of Proposed Geometry

Length of Patch	26.25mm
Width of Patch	35.00mm
Length of X slot	9.00mm
Width of X slot	1.00mm

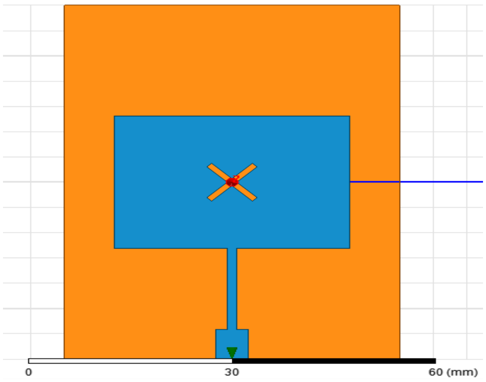

Fig. 1 (a) Top view of antenna model

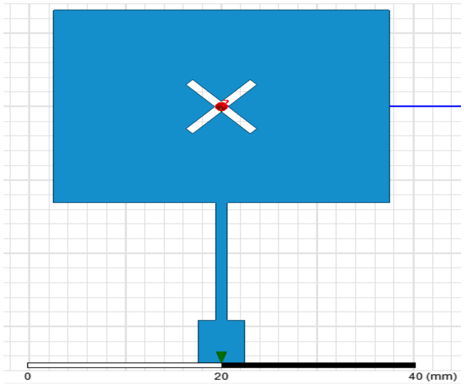

Fig. 1 (b) Patch of the model with X slot

RESULTS AND DISCUSSION

The proposed prototype has been simulated on HFSS 13 using proper boundary conditions. The variation of reflection coefficient versus frequency and VSWR of prototype design are shown in Fig. 2 & 3. The impedance bandwidth at resonant frequency 3.5GHz is 230 MHz and the VSWR is maintained below 2 within the required frequency band, which shows the good impedance matching of antenna with feed network.

The simulated E plane far field elevation patterns of proposed antenna at resonance frequencies 3.5 GHz is shown in Fig. 4, which depicts that the direction of maximum radiations is normal to patch geometry and pattern is symmetrical in nature. The simulated total field gain of the antenna is around 7.29dBi and it is more or less unaffected within the frequency range of interest as shown in fig. 5. The directivity of the proposed model is shown in Fig. 6.

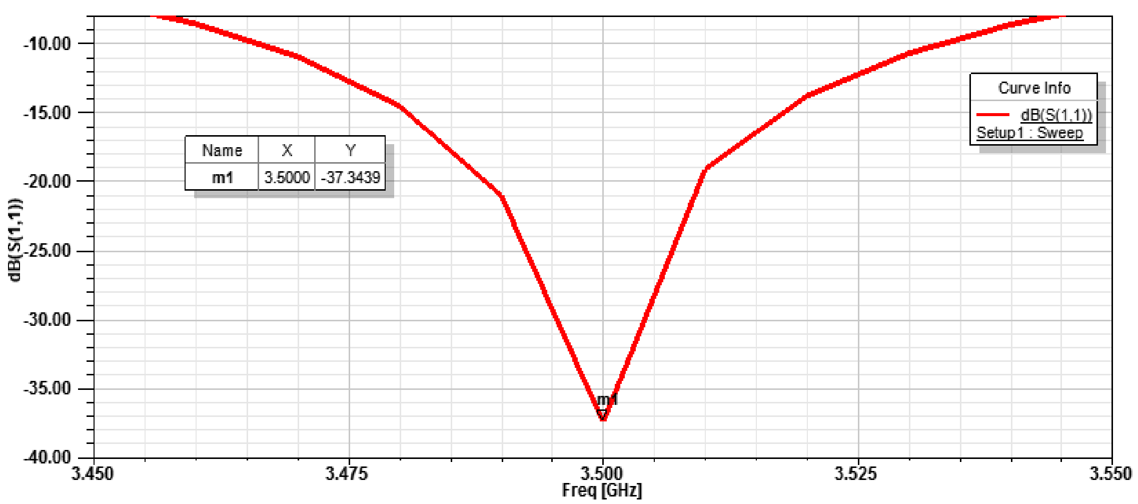

Fig. 2 Variation of reflection coefficient versus frequency

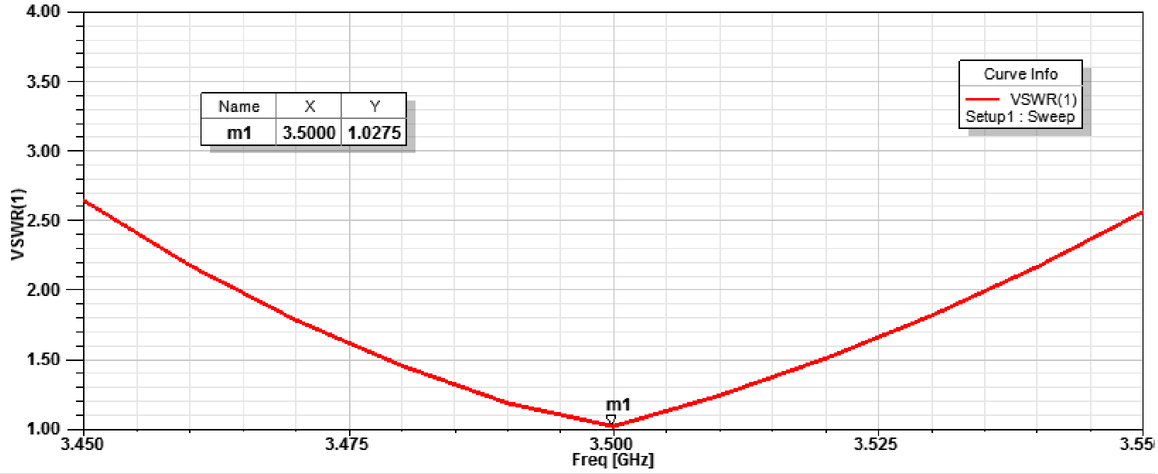

Fig. 3 Variation of input impedance versus frequency for proposed geometry

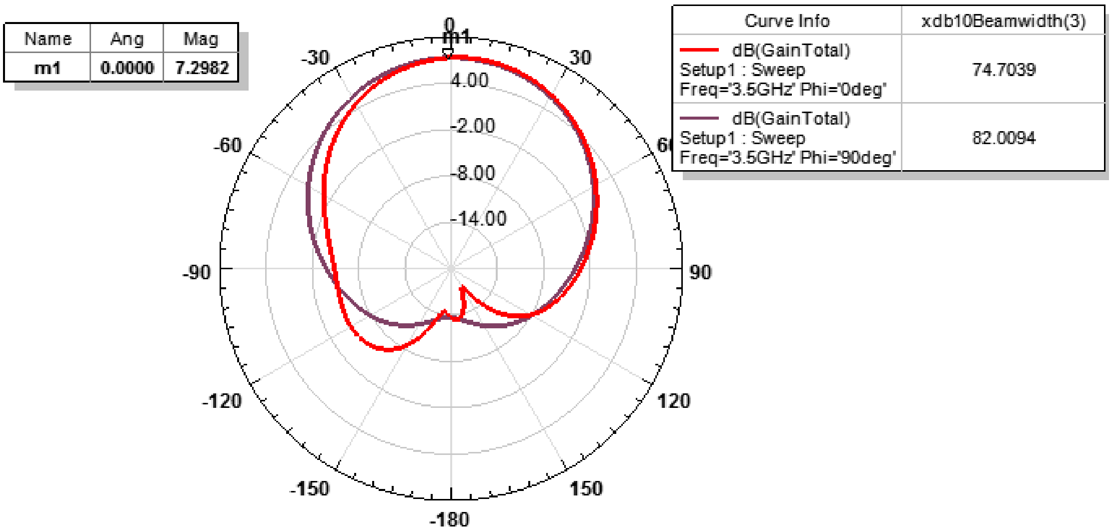

Fig. 4 Radiation pattern at 3.5 GHz for proposed geometry

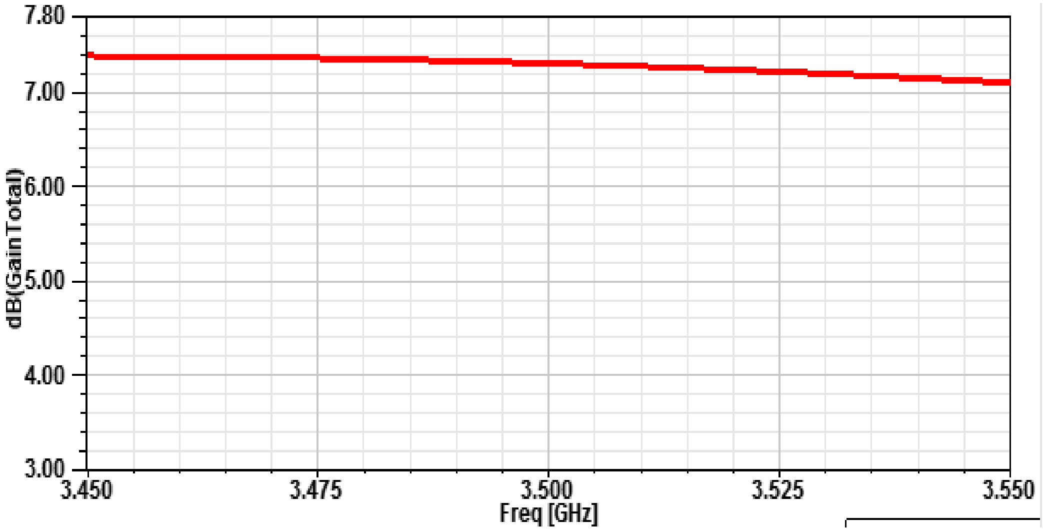

Fig. 5 Variation of Gain versus frequency for proposed geometry

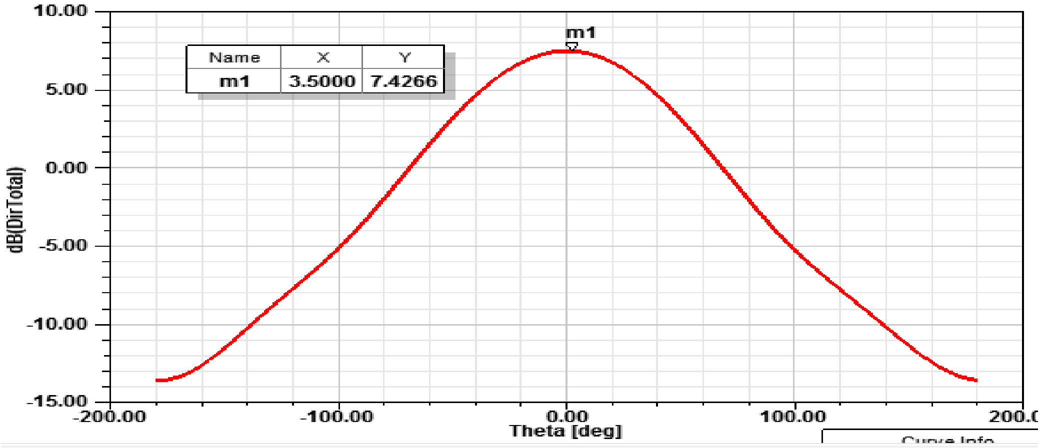

Fig. 6 Directivity for proposed geometry at 3.5 GHz

CONCLUSION

This paper presents a rectangular microstrip patch antenna with X Slot for WLAN Application. The simulated VSWR, return loss and gain variation of the antenna with frequency are shown as the characteristics of antenna, due the limitation of resources the measurement results are not presented. The antenna is compact in size. The X slot increases the impedance bandwidth of the antenna in comparison to unslotted geometry.

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