Design of a Rectangular Micro strip Patch Antenna with Defected Ground Structure for WLAN

Venkatesh Gudamsetty[1], Addanki Shesa Sai[2], Kammili Leela Venkata Surya Teja[3]
[1,2,3] *Student, St. Ann's College of Engineering and Technology, Chirala, INDIA*

***Abstract*- :- A rectangular microstrip patch antenna for WLAN application resonating at the frequency range of 5.725GHz – 5.85GHz is developed in this paper. The proposed antenna resonates at 5.78 GHz frequency giving an excellent isolation of -37.10dB at -10dB return loss. The performance of antenna in terms of impedance bandwidth is analyzed by varying the position of the slot. The developed antenna system can be widely used for the WLAN application.**

***Index Terms*- impendence band width, microstrip, return loss, WLAN.**

I. INTRODUCTION

Numerous Microstrip patch antennas turned enormously popular in mobile and radio wireless communication. This is because they can be printed directly on to the circuit board, comfort of investigation and their fascinating radiation features. It is because of fringing fields between the patch edge and the ground surface, the microstrip patch antennas radiate. With the rapid development of wireless communication systems and increase in their applications, compact and wideband antenna design has become a challenging issue [1].Printed slot antennas are being used in a vast variety of communication systems as they have two orthogonal resonance modes, which are merged to provide a wide impedance bandwidth [2].

Patch antennas are being widely used since 1970s due to their special features like low profile, light weight, compact size and amenable to low-cost PCB (Printed Circuit Board) fabrication processes. However, patch elements basically resonate at a single frequency and typically have less than 2% bandwidth [3]–[6], which limits their applications in wireless communications. A lot of techniques are used to enhance the bandwidth of patch antennas. A simple technique to increase the bandwidth of patch antenna is to use substrates with low dielectric constant [7].

There are several feeding techniques available such as Microstrip line feeding ,Coaxial cable or probe feeding, Aperture Coupled Feed, Proximity coupling Feed available to feed or transmit electromagnetic energy to a microstrip patch antenna. Out of the various feeding techniques, Microstrip line feed and Co-axial feed are most commonly used in the design of the patch antennas.

In co-axial feeding, the inner conductor of the coaxial connector propagates through the dielectric and soldered to the radiating patch, while the outer conductor is connected to the ground plane. The main advantage of this type of feeding scheme is that the feed can be placed at any desired location on the patch in order to match with its input impedance. This feed method is easy to fabricate and has low spurious radiation

In Microstrip Line Feeding technique, a conducting strip is connected directly to the edge of the Microstrip patch. The conducting strip is smaller in width as compared to the patch and this type of feed arrangement has the advantage that the feed can be placed on the same substrate to provide a planar structure. The purpose of the inset cut in the patch is to match the impedance of the feed line to the patch without the need of any additional matching element. This is achieved by properly controlling the inset position. Hence this is an easy feeding technique, since it provides ease of fabrication and simplicity in modeling as well as impedance matching [8]-[9].

II. ANTENNA DESIGN

The Figure 1 shows the structure and dimensions of the proposed antenna. A thick dielectric substrate having a low dielectric constant is desirable as it provides better radiation, larger bandwidth and better efficiency. Here, the substrate selected for the design

of the proposed antenna is FR-4(loss free) with thickness 1.6 mm and with low permittivity (ε_r=4.3). The dimensions of the substrate are taken as 40 × 35 × 1.6 mm^3.

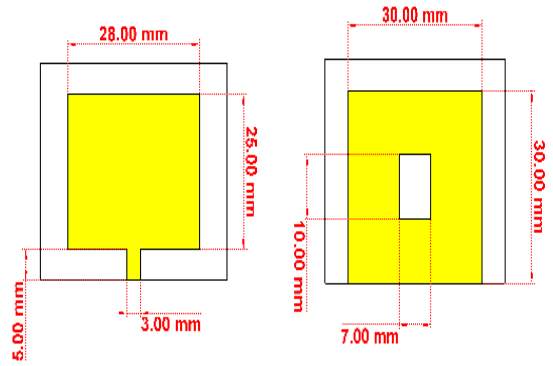

Fig. 1 :- Rectangular patch antenna with defective ground structure

A rectangular patch of size 28 × 25 mm^2 of thickness 0.03 mm is placed on a substrate and ground patch of size 30×30mm^2 of thickness 0.03mm. Slot of length 7 mm, width 10mm and thickness of 0.03 mm are cut on the ground as shown in the above figure. By providing slots, the lengths of the current paths on the patch are increased, leading to the bandwidth and gain improvement. The proposed antenna is excited by using microstrip feeding technique. The microstrip feed line is a conducting strip, usually of much smaller width compared to the radiating patch. The feed line of size 3 × 5mm^2 is connected to the patch.

III. RESULTS & DISCUSSION

The S_{11} plot for the slot patch antenna designed in this paper is shown in Fig.2. The dimensions of the antenna are selected such that the antenna resonate frequency of 5.78 GHz with an impedance bandwidth of 11.529 MHz's. The antenna is analyzed by varying the slot position. The difference of the S_{11} plots for with slot and without slot are shown in Fig 2 & Fig 3. From Fig.3, it can be observed that the impedance bandwidth is maximum with slotted ground. The impedance bandwidth of the antenna without slotted ground is 6.785MHZs. The impedance bandwidth of the proposed antenna(with slotted ground) is 11.529MHZs. In order to operate an antenna efficiently, maximum power must be transferred between the transmitter and the antenna. Maximum power transfer can take place only when the impedance of the antenna is matched to that of the transmitter. The higher the VSWR, the greater is the mismatch. VSWR plot for the proposed antenna is shown in Fig.4. From the plot, it can be observed that VSWR is less than or equal to 2 in the radiating frequency. Thus, the mismatch is very less in the radiating band.

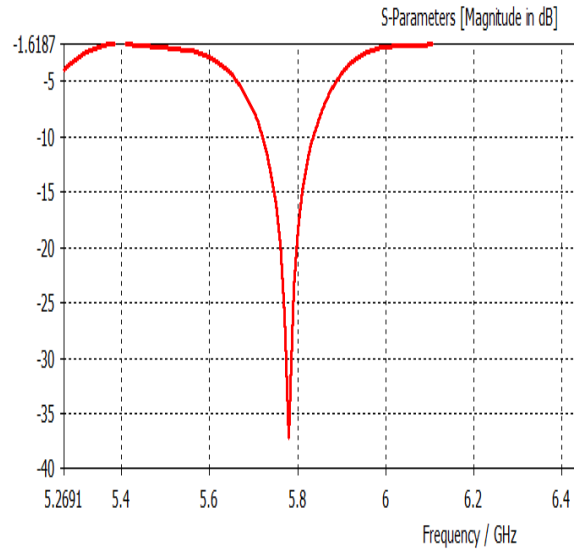

Fig. 2:- S-paramaters of rectangular patch antenna with defective ground structure

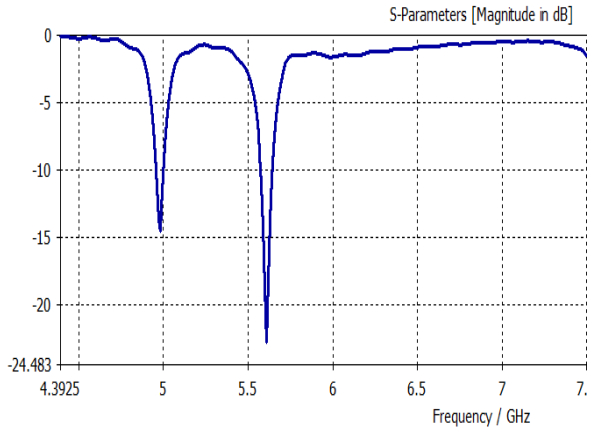

Fig3:- S-paramaters of rectangular patch antenna with out defective ground structure

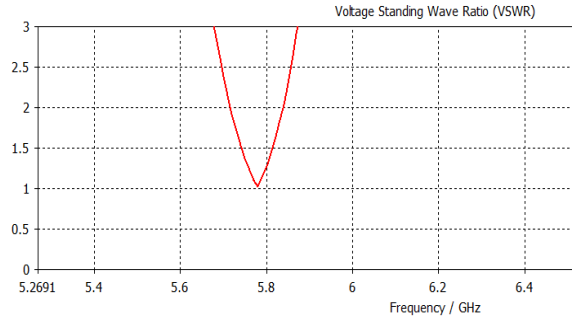

Fig 4: VSWR plot

The radiation pattern of an antenna is a plot of far-field radiation properties of an antenna as a function of the spatial co-ordinates which are specified by the elevation angle θ and the azimuth angle φ. The radiation patterns for the proposed antenna at resonating frequency 5.78GHz are shown in Fig.5. From the figures, it can be observed that the radiation is maximum at an angle -45^{o} at resonating frequency 5.78GHz

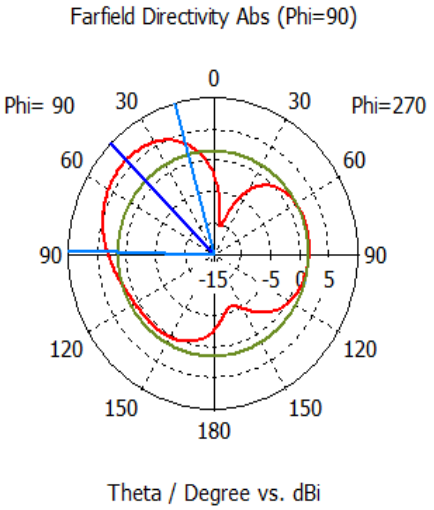

Fig5:-Radiation Pattern

IV. CONCLUSION

In this paper, design of microstrip patch antenna for WLAN is designed and simulated. The proposed antenna produces a resonates at 5.78GHz.The bandwidth of the antenna is improved by placing the slots. The proposed antenna is expected to have numerous applications in the modern communication system. The proposed design is desirable for stationary terminals of various indoor wireless communication networks.

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