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MICROSTRIP PATCH ANTENNA OPERATING AT DUAL RESONANT FREQUENCY WITH PROBE FEEDING FOR WIRELESS APPLICATIONS

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ABSTRACT

In this paper, a microstrip patch antenna with enhanced bandwidth is presented .It has been shown that by cutting a slot in the radiating patch the antenna resonates at dual frequency of 4.03 GHz and 3.42 GHz. The impedance bandwidth determined from the -9.55 dB return loss is from 4.21 to 3.27 GHz, equivalent to 0.94 GHz or about 25.1% with respect to the centre frequency at 3.74 GHz, and is sufficient to fully cover the desired bands required for wireless applications.

KEYWORDS: Microstrip Patch Antenna, Dual Resonant Frequency, Wide Bandwidth, Wireless Application

INTRODUCTION

The current demand of wireless communication systems and their miniaturization, antenna design[1] becomes more challenging in present days[2][3]. The main reason of microstrip patch antenna to attract wide interest is because of its inherent characteristics such as light weight, low profile, low cost, mechanically robust, simple to manufacture, easy to be integrated with MIC/MMIC and others RF devices [4][5][6]. In spite of its several advantages, microstrip patch antennas suffer from low gain and a narrow impedance band width[6].

TECHNOLOGY

It is observed that by cutting a slot inside or along the periphery of the RMSA (Rectangular Microstrip Antenna), various compact configurations are realized[7][8]. If the resonance frequency[9] of the slot and the patch[10] are close to each other then broad bandwidth could be obtained.

A very promising configuration that yields broad bandwidth [11] is a RMSA with a U- shaped slot. A resonant U-slot is cut symmetrically around the center of the patch. When a slot is cut inside the patch the resonance frequency of the patch changes slightly in comparison with the resonance frequency of the slot.

ANALYSIS OF THE PROPOSED WIDE BANDWIDTH RESPONSE OF THE ANTENNA

The geometry of the proposed antenna is given in Figure 1. It consists of a rectangular patch loaded in the centre with a U-shape slot and separated from the ground plane by two PTFE substrate ($\varepsilon_r = 3.2$) having thickness 0.79 mm and an air substrate which is situated between the two PTFE substrates.

The thickness of the air substrate is varied in our design. The patch has dimensions 36 mm x 26 mm. Note that the width of the patch is much greater than its length. The patch is fed at the centre by a 50 Ω coaxial probe.

A 2 mm wide U-shaped slot of dimensions 14 mm x 16 mm is cut at the centre of the patch. The ground plane has dimensions 80 mm x 70 mm. The simulation of U-slot RMSA is done for thickness of air substrate Δ=6mm (Δ=thickness of the air substrate).

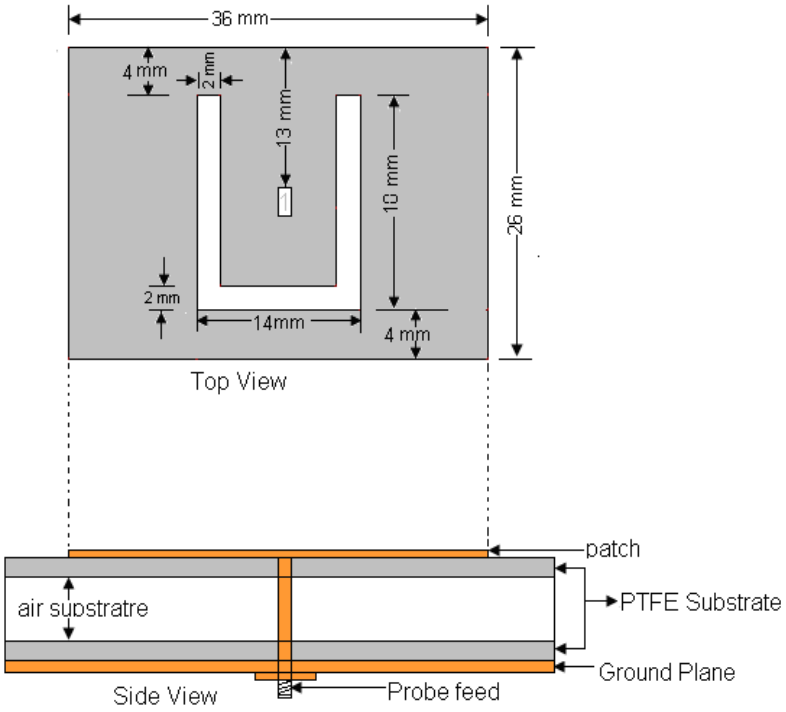


Figure 1: Geometry of a Broadband Probe-Fed Rectangular Microstrip Proposed Antenna with a U-Shaped Slot

SIMULATED RESULTS

For Δ=6mm, the simulated results are shown in Figure 2

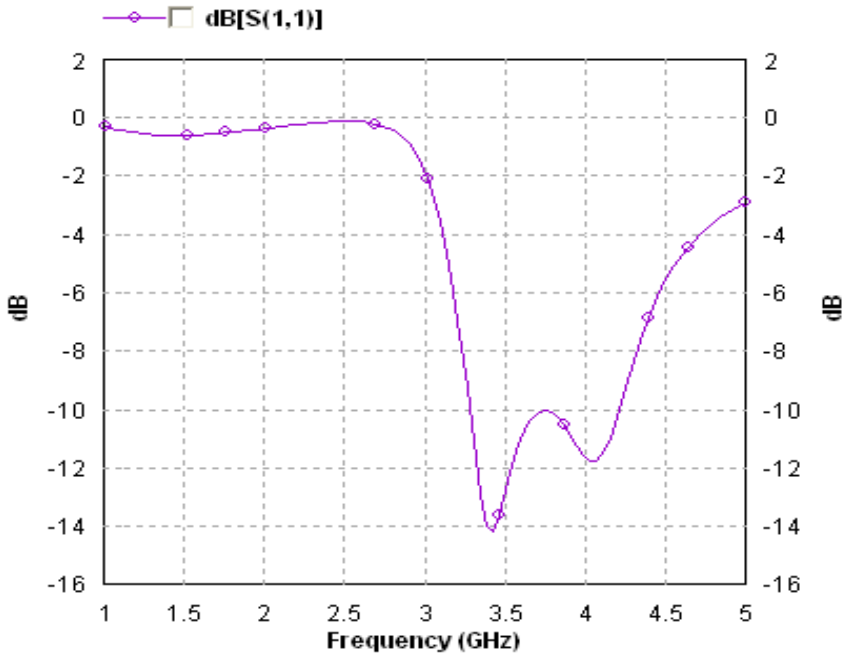
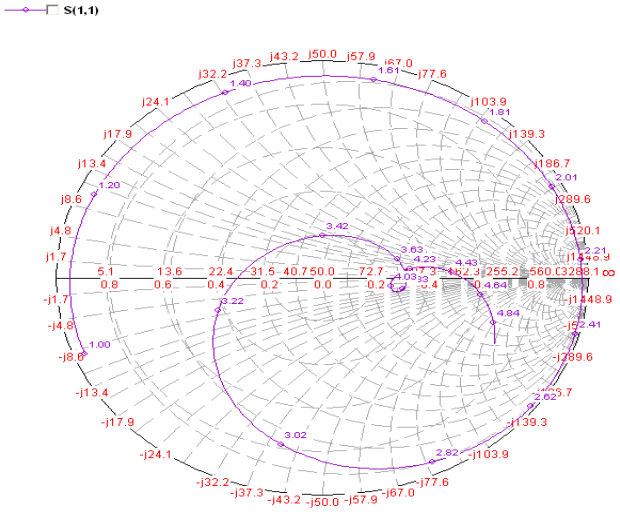
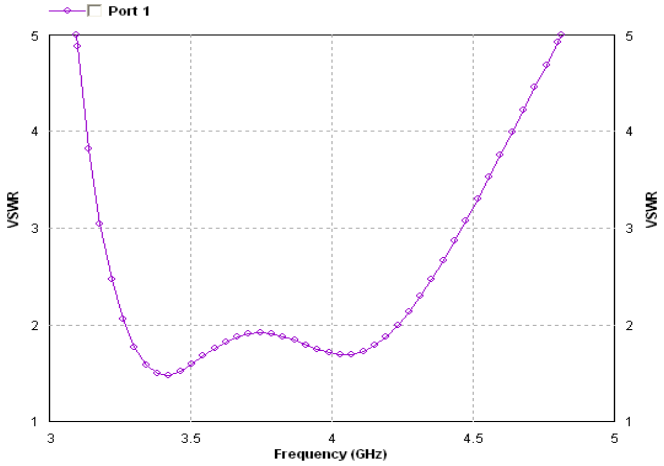


Figure 2: Return Loss Vs Frequency (Simulated) Δ=6mm for U-Slot Proposed Rectangular Patch Antenna

From the simulated results in Figure 2, it is clearly shown that two resonant frequencies are excited, which lead to a wide bandwidth. The two resonant frequencies observed in the range of return loss <-10 dB are at 4.03 GHz and 3.42 GHz. The impedance bandwidth determined from the -9.55 dB return loss is from 4.21 to 3.27 GHz, equivalent to 0.94 GHz or about 25.1% with respect to the centre frequency at 3.74 GHz, and is sufficient to fully cover the desired bands.



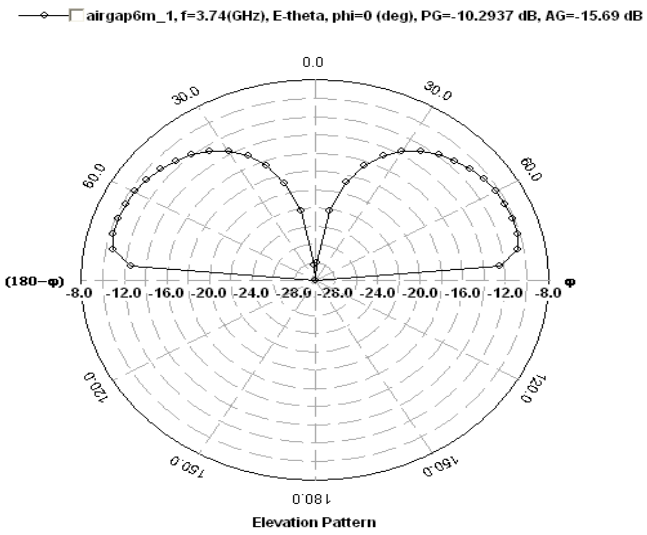
(a)



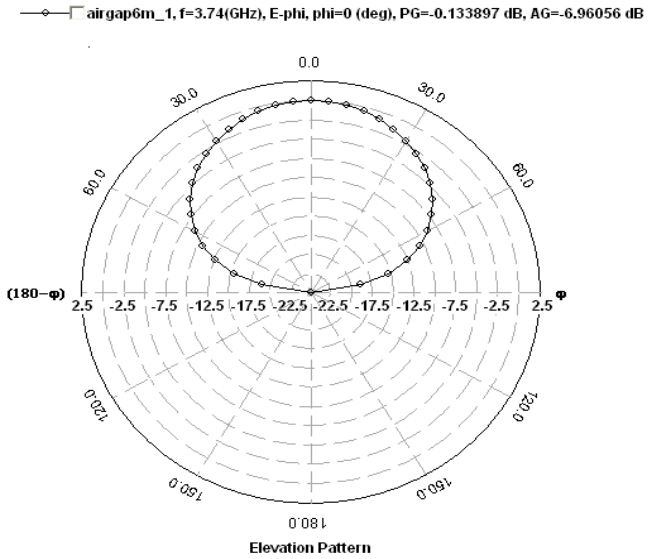
(b)

Figure 3: (a) Input Impedance & (b) VSWR Plot for U-Slot Rectangular Patch Antenna for air Gap, Δ=6mm

The input impedance variation & VSWR plot are shown in Figure 3 (a) & (b) respectively. It is seen that a loop is formed inside the loci of VSWR=2 circle. The reflection coefficient has a magnitude of <0.333. The radiation pattern of the proposed antenna at centre frequency 3.74 GHz is shown in figure 4 below.



(a)



(b)

Figure 4: (a) E Plane Pattern and (b) H Plane Pattern for Δ (Air Gap) =6mm of U-Slot Rectangular Patch Antenna

The simulated radiation patterns in the two principal planes at 3.74 GHz are shown in Figure 4(a) and 4(b). The E-plane pattern has peak gain -10.29 dB and H-plane pattern has peak gain -0.13 dB. Good broadside radiation pattern are observed. The Half Power Bandwidth in the H-plane is 88 degree at 3.74 GHz and in the E-plane is 49 degree at 3.74 GHz.

CONCLUSIONS

A very wide Impedance bandwidth can be achieved with the proposed rectangular patch loaded with a U-slot. The BW of U-slot depends on the substrate thickness. The U-slot appears to introduce a capacitive component in the input impedance of the antenna, counteracting the inductive component of the coaxial probe. Furthermore due to high bandwidth, it can be used for numerous applications in wireless transmission.

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AUTHOR DETAILS

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