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Design of Microstrip Patch Antenna with Specific Structure i.e. Circular Patch with Multiple Fused Rectangular Slot

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Abstract: The accessibility and enlargement in development of economical, less weight, highly reliable antennas are required for wireless communication, it poses new challenges for the design of antenna in wireless communication. The micro strip patch antenna (MPA) used for these communications, because they will provide high frequency and less bandwidth. This paper presents a design and simulation of Microstrip patch antenna with specific structure i.e. circular patch with multiple fused rectangular slot. We will also analyse comparison over conventional circular patch antenna near resonance frequency at 2.4 GHz.

Keywords: Microstrip Patch Antenna (MPA), specific structure, Patch

I. INTRODUCTION

A Microstrip patch antenna consists of a very thin patch that is very small fraction of a wavelength fabricated over conducting ground plane. There is dielectric between the patch and the ground plane. The patch conductor is generally made up with copper and can be of any shape but for simplification of the analysis, in this project circular patch will be used. One of the important parameters is relative permittivity of the substrate that is used. It is so because the relative permittivity is used to enhance the fringing fields. Microstrip patch antennas primarily radiates because of the fringing fields, this is the field between the edges of the patch and the ground plane. For better antenna performance, a thick dielectric substrate with a low dielectric constant is preferred since it provides better efficiency, larger bandwidth, and good radiation. However, the drawback is a larger antenna size. Thus, design and simulation of Microstrip patch antenna with specific structure i.e. circular patch with multiple fused rectangular slot, substrate with large dielectric constants is used that is less efficient and also have narrower bandwidth. Hence a compromise must be reached between antenna performance and antenna dimension. Here I am presenting the optimized structure of circular patch with multiple fused rectangular slot which performance will be compared with general circular shape structure.

II. PROPOSED STRUCTURE

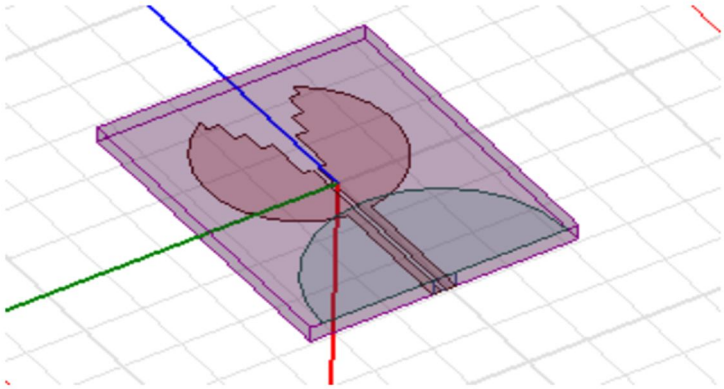

Fig 2. Microstrip patch antenna with specific structure i.e. circular patch with multiple fused rectangular slot

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III. DESIGN OF ANTENNA

Step 1:Determine the width of the microstrip patch antenna by equation(1)

$$W=\frac{\lambda 0}{fo\sqrt{(\varepsilon r+1)/2}} \quad (1)$$

Step 2: Determine effective dielectric constant, $\varepsilon reff$, using equation (2)

$$\varepsilon reff=\frac{(\varepsilon r+1)}{2}+\frac{(\varepsilon r-1)}{2}\left[1+12\frac{h}{w}\right]^{-\frac{1}{2}} \quad (2)$$

Step 3: Calculate the length extension ΔL,by using equation (3)

$$\frac{\Delta L}{h}=0.412\frac{(\varepsilon reff+0.3)(\frac{w}{h}+0.264)}{(\varepsilon reff-0.258)(\frac{w}{h}+0.8)} \quad (3)$$

Step 4: The patch length of the microstrip antenna is calculated by using equation (4)

$$L=\frac{\lambda 0}{fo\sqrt{\varepsilon reff}}-2\Delta L \quad (4)$$

Where the effective length(Leff) of the patch

$$Leff=\frac{\lambda 0}{fo\sqrt{\varepsilon reff}} \quad (5)$$

Step 5: The dimensions of ground is determine by

$$Lg=6h+L$$

$$Wg=6h+W$$

IV. RESULT AND DISCUSSION

In this project, work will be completed in two parts. In first part a Microstrip antennas will be designed using HFSS simulation with conventional circular patch structure. After that Microstrip patch antenna with specific structure i.e. circular patch with multiple fused rectangular slot is simulated. Performance characteristics of both the shape is analysed carefully. Initially, microstrip patch antenna is designed to operate at resonance frequency. After that in second part a simple and efficient technique of feeding microstrip line feed is used for an impedance matching for improve performance of the antennas. In third part using different methodology /technique Microstrip patch antenna with specific structure (circular patch with multiple fused rectangular slot) dimension and parameter will be enhanced without impacting the performance.

V. CONCLUSION

In this work we have optimized the basic characteristic of microstrip patch antenna using different technique in design, different shape of patch, different feeding technique and different type of substrate use in the design for reducing size and weight and increasing bandwidth, gain etc. Microstrip antenna is useful in wireless communication, RADAR, WLAN etc due to their small size, weight, specific structural compatibility and flexibility. Number of parameters such as bandwidth, return loss, VSWR, Radiation pattern, can be improved by changing the parameters such as operating frequency, type of substrate dimensions, feeding techniques etc.

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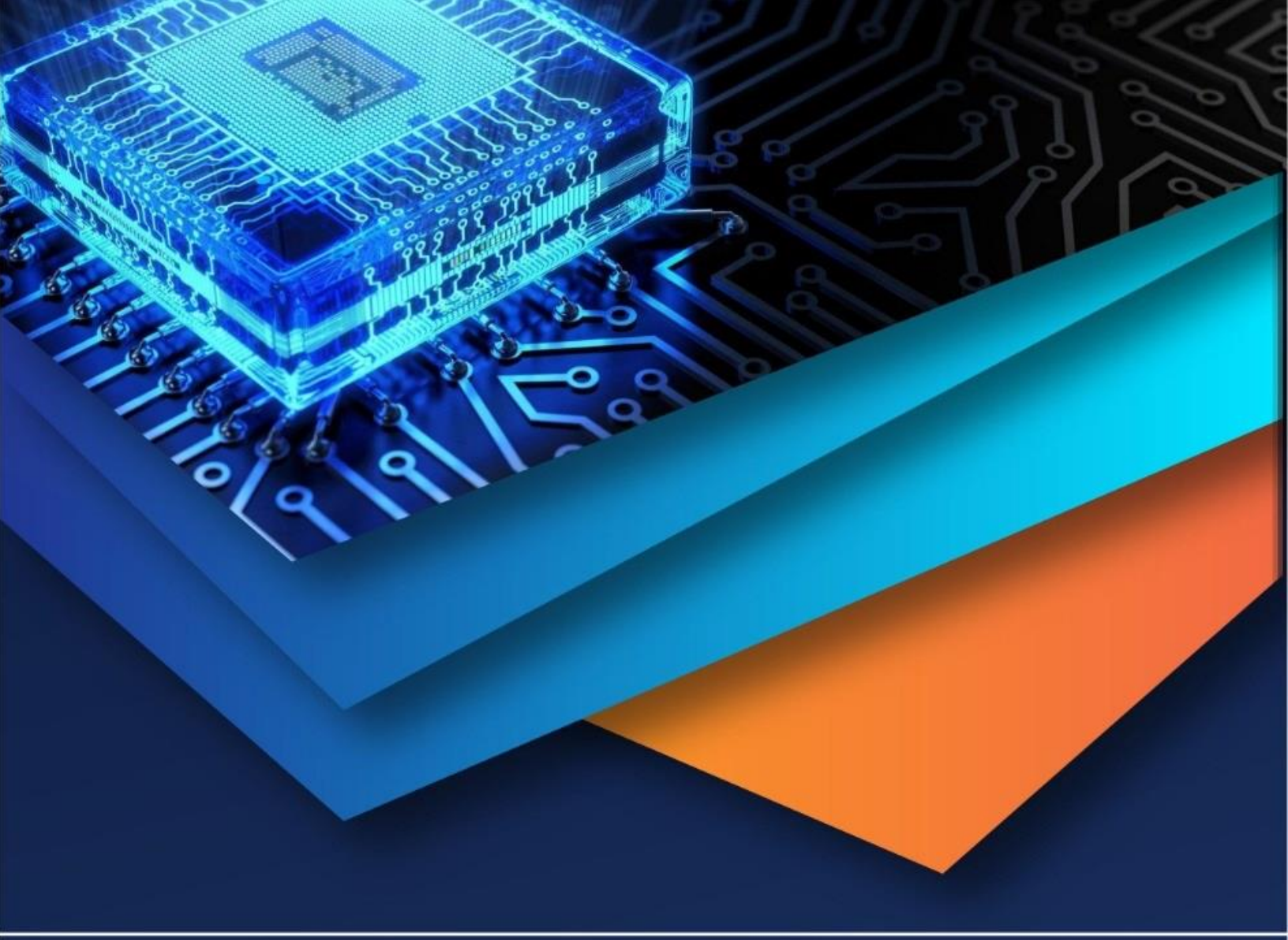

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