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DESIGN & SIMULATION OF 8-SHAPE SLOTTED MICROSTRIP PATCH ANTENNA

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ABSTRACT

This paper presents an 8 shape slotted microstrip patch antenna. The antenna is fed by microstrip transmission line. The proposed antenna is simulated using IE3D software. The antenna is designed by FR4 substrate and ground plane with an area 50mm x 40mm x 1.60mm. The designed antenna generates three resonant modes at 2.4GHz, 4 GHz and 11.5 GHz respectively. The return loss characteristics for the three bands are -21.9dB, -17dB, -17.5dB respectively. The 3D radiation pattern and Current distribution pattern of the proposed antenna are provided in the paper.

Keywords: FR4 substrate * 8 shape slotted patch * Microstrip patch antenna * IE3D software

INTRODUCTION

Antennas are defined as a means for radiating or receiving radio waves. There are various types of antennas: Wire Antennas, Aperture antennas, Microstrip antennas, Reflector antennas, Lens antennas etc. Among all of them, microstrip antennas became very much popular for space bourne applications. Microstrip patch antennas consist of a dielectric substrate with a ground conducting plane on the other side. It consist of a metallic patch on the grounded substrate. The configuration of patch may differ upon the applications and operating frequencies. The proposed antenna consist of the rectangular patch. The dimension of the patch is defined by the patch length(L) and width(W). The choice of substrate is also important. The essential factors like temperature, humanity and environmental ranges of operation should be considered. The thickness of the substrate(h) plays a significant role on the resonant frequency(fr) and bandwidth of the antenna.

The desirable advantages of microstrip patch antenna makes them useful in many wireless communication applications. They have low profile, lightweight, low volume, easy fabrication with low cost and supports both linear and circular polarization, easily integrated with microwave integrated circuits, capable of dual and triple frequency operations, mechanically robust. They are well suited for applications like wireless communication systems, cellular phones, pagers, radar

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systems and satellite communication system. The most important advantage is the design of microstrip patch antenna using mictrostrip transmission line feeding technique is so much easy to fabricate and easy to match them by inset position control and to model. However narrow bandwidth, low efficiency, large ohmic loss, capability to handle low RF power and low gain in microstrip patch antenna are considered as the main disadvantages. The bandwidth of microstrip patch antenna can be increased by increasing the thickness of the substrate but within permissible limit.

In this paper and 8 shaped slot microstrip patch antenna is designed. It is simulated using IE3D software and applicable for various wireless communication applications with overall dimensions 50mm x 40mm x 1.60mm.

ANTENNA DESIGN METHODOLOGY

The design specifications of the antenna are noted as follows:

- The antenna is designed with a ground plane with an area 50mm x 40mm x 1.60mm.
- The dielectric material which is selected for proposed antenna design is FR4.
- The dielectric constant of the material is 4.40.
- The height of the substrate of the proposed antenna is 1.60mm.

Fig. 1: Eight-Shaped Microstrip patch antenna fed by Transmission line

W1	40mm
L1	50mm
W2	20mm
L2	30mm
W3	10mm
L3	09mm
W4	10mm
L4	09mm
W5	02mm
L5	10mm

Table 1: Detailed dimensions of the proposed antenna

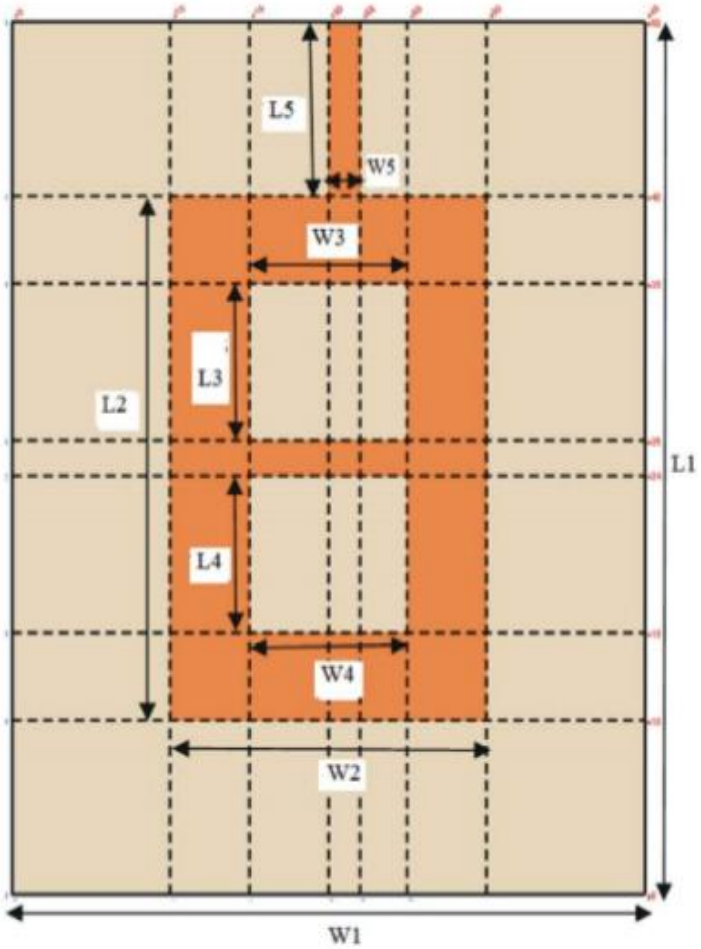

Fig. 2: Geometry & dimensions of the proposed antenna

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Steps involved in microstrip line feed:

1. Open a new file in MGrid
2. Select meshing frequency as 3GHz.
3. Under the substrate layer set the following parameters
   Ztop= 1.6
   εpsr= 4.4
4. Design microstrip patch antenna with design parameters as given in Table 1.
5. Define the port.
6. Mesh the structure.
7. Simulate the design and observe the output.
8. Also observe the Radiation pattern and Current distribution pattern.

RESULTS AND DISCUSSION

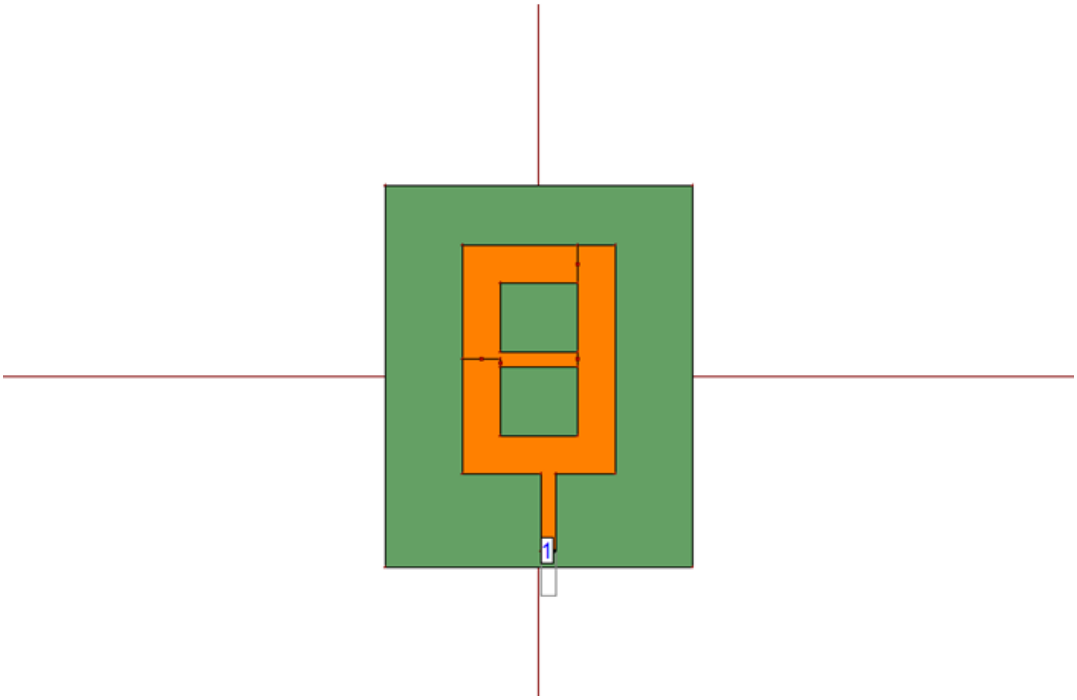

Fig 3: Designed Microstrip Antenna

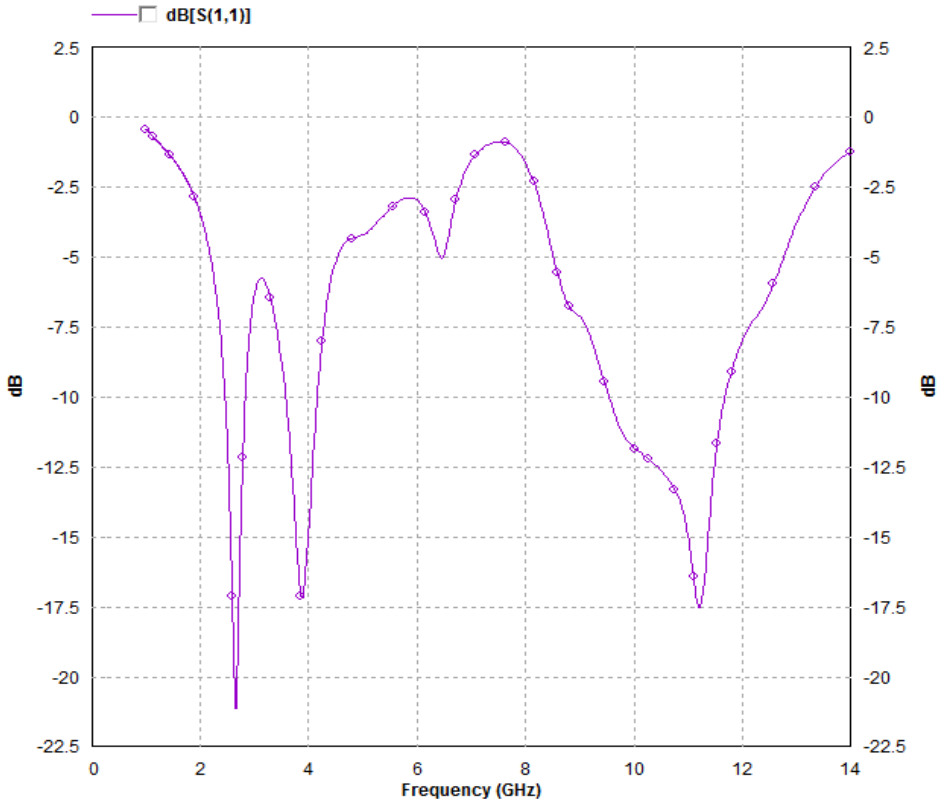

Fig 4: Simulation result of 8 shaped Microstrip Slot antenna(Return loss and Impedence bandwidth)

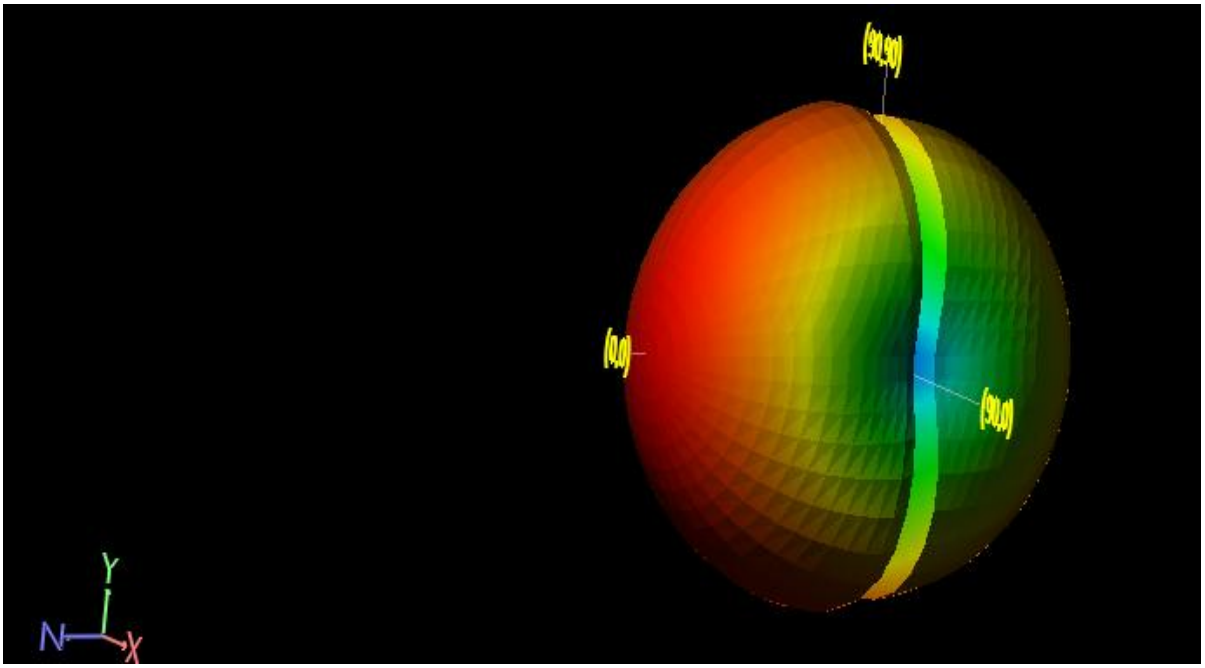

Fig 5: Radiation Pattern

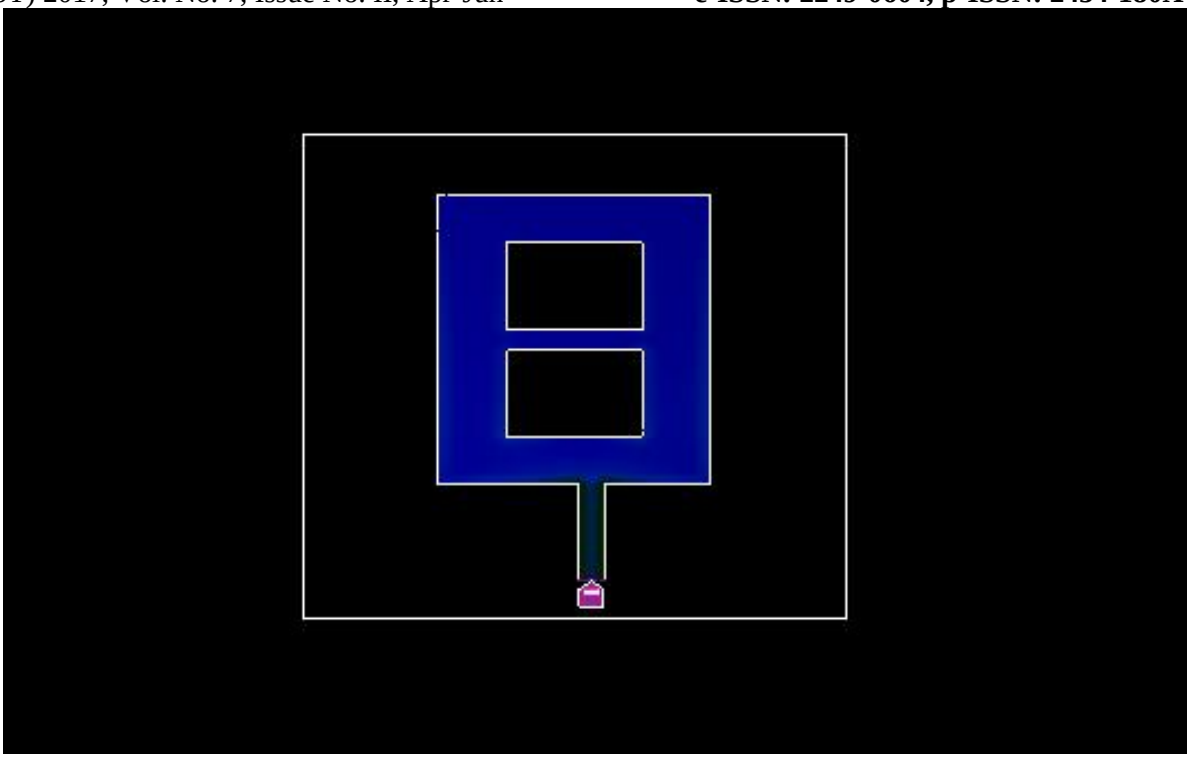

Fig 6: Current distribution pattern

Result of Simulation: The S parameter curve of the proposed antenna is shown in the figure 4. It shows that the antenna resonates at three different points with satisfactory return loss and impedence bandwidth. The three center frequencies of the antenna from the return loss curve are at 2.4 GHz, 4 GHz and 11.5 GHz.

At 3.2 GHz frequency:

- Gain = 4.07 dBi
- Directivity = 5.18 dBi
- Radiation efficiency = 50.37%
- Antenna efficiency = 77.35%
- Voltage source gain = 3.76 dBi

CONCLUSION

This paper presented the design and simulation of an 8 shaped slot Microstrip patch antenna. The triple band operation of the antenna is achieved at 2.4 GHz, 4 GHz and 11.5 GHz. The return losses of the antenna at three frequency bands are -21.9dB, -17dB and -17.5dB respectively. The antenna characteristics and radiation pattern is applicable for many wireless applications.

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