

# E Shaped Patch Antenna: Analysis

Ammu Fredy  
Department of Electronics  
Toc H Institute of Science & Technology  
Ernakulam, India

Prof. A .K .Prakash  
Department Of Electronics  
Toc H Institute of Science & Technology  
Ernakulam, India

**Abstract**— The microstrip patch is low profile and low fabrication cost antenna .It have many wider application such as satellite communication, RFID tag, radar application GPS system application. Major disadvantage of patch antenna is narrow bandwidth .So in this paper tells the details about to make patch antenna with wider bandwidth by providing slots to the patch. Two parallel slots are provided in the rectangular patch, so it looks like an E shape. Details about the microstrip patch and its feeding techniques are also included.

**Keywords**—microstrip patch antenna, E shape patch antenna, feeding techniques

## I. INTRODUCTION

Microstrip patch antenna is a low profile planar configuration, with low fabrication cost, light weight, support both linear and circular polarization their major application is for missile, satellite .due to tremendous growth the importance of microstrip patch increases daily and many study are done. But he major disadvantages are narrow bandwidth and low efficiency, low power handling and surface wave excitation. So it is very important to increase the bandwidth, the methods available to increase bandwidth are increase substrate thickness. Introducing parasitic elements either in coplanar or stack configuration or modify the shape of a common radiator patch by incorporating slots[3]. By increasing the substrate thickness the surface wave increase which reduces the efficiency of patch antenna .the stack configuration will increase the spurious radiation and complexity. So the third method to provide slots in patch is easier and less complex method.

The shape of slots that can be provided in the patch can be U,E,S,H. but the results shows that E shape(30%) more enhanced bandwidth than other shapes[5].so in this paper a survey is done on the e shaped patch antenna .this paper tells about the parameters that have influence on the E shape patch antenna.

## II. MICROSTRIP PATCH

### A. Structure of microstrip patch antenna

Microstrip patch antenna is like a parallel plate capacitor with two parallel plates of metal layer with dielectric layer sandwiched between them. In this one metal plate is infinitely extended than the other, to form the ground plane, the smaller metal plate is the radiating patch. The shape of radiating patch can be several but square, rectangular, circular shapes are commonly used[2].

Charge gets distributed below the underside of patch and ground plane as the patch is excited by the feed line. At the side of the edge of the patch a large charge density appear due to the attractive force between the underside of patch and the ground plane

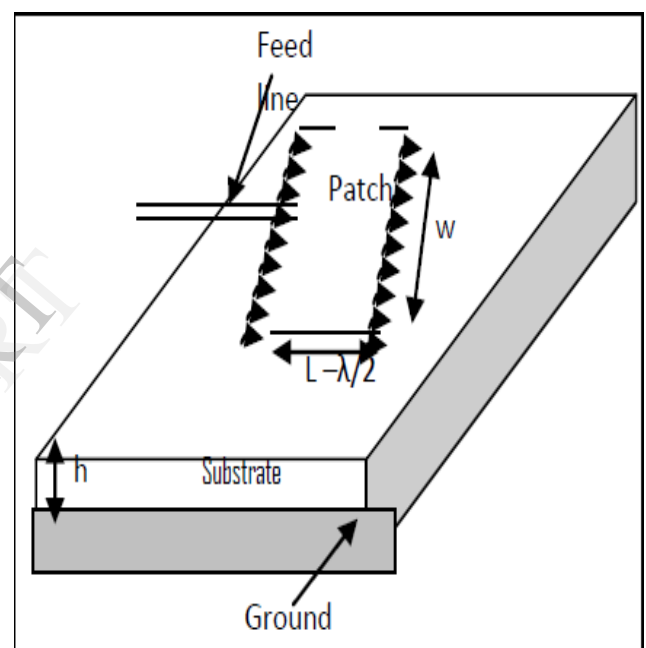


Figure 1. Radiation Mechanism Associated With Microstrip Patch

Source of radiation in microstrip patch is due to the fringing field between the periphery of the patch and the ground plane. Assume if there is no variation of electric field along the width and the thickness of microstrip patch. At the edges of the patch field can be resolved in to normal and tangential components with respect to ground plane. The normal components are 180° out of phase because the patch is  $\lambda/2$  long. So the normal components will cancels .the tangential components that are parallel to the ground plane are in phase so the resulting filed combine to give minimum radiated field normal to the surface of the structure.

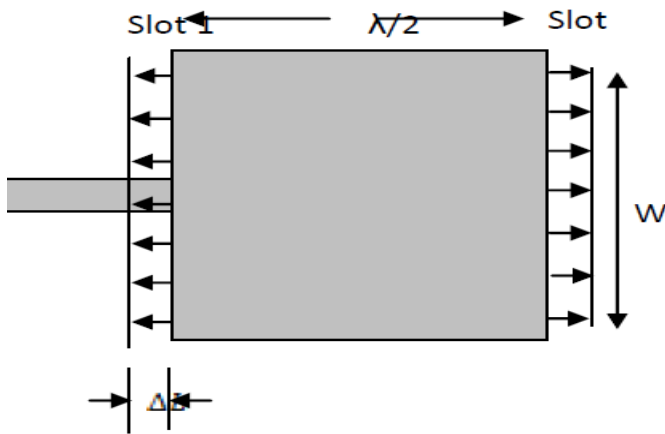


Figure 2 Increase in Length of the Microstrip Patch.

**B. Feeding Technique**

Antenna efficiency depends on the transfer of the power. so it is important to transfer the full power so there should be proper impedance match between the feed line and patch. Patch can be excited using a feed line by direct or indirect method. Most popular techniques are microstrip line, coaxial feedline, aperture coupling and proximity coupling[1,2].

In Coaxial feed line, there are two conductors. The outer conductor touches the ground plane where as the inner conductor is attached to the radiation patch. This method is easy to fabricate, easy to match, low spurious radiation and its disadvantage is narrow bandwidth, difficult to model for thick substrate.

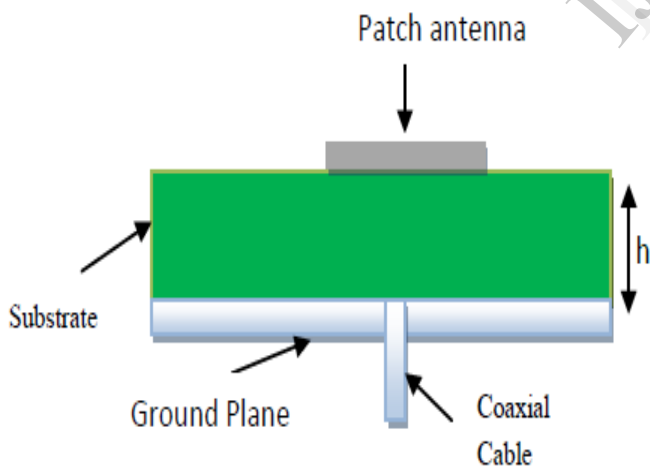


Figure 3.coaxial feed line

Microstrip line method is easy to fabricate .in this matching can be done more by controlling the inset position.it looks like extension of the patch because a conducting strip is attached to the patch .disadvantage of this method is substrate thickness increase ,spurious radiation and surface wave increases which limit the bandwidth

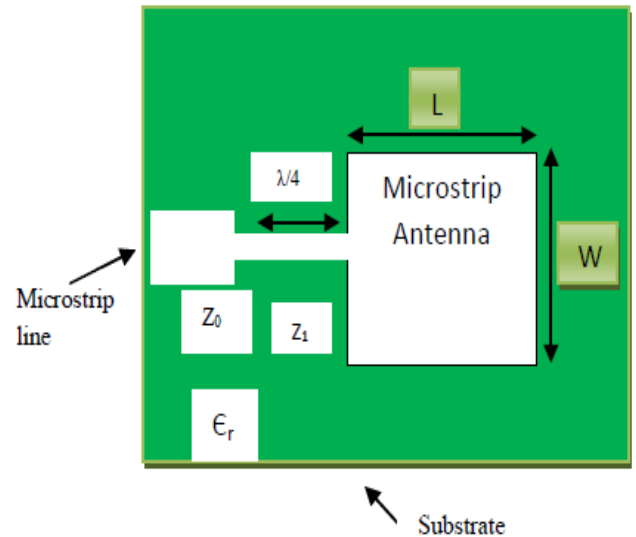


Figure 4.microstrip line feed patch antenna

In Aperture coupled feed consist of two different substrate separated by a ground plane. Bottom side of lower substrate is a microstrip feed line whose energy is coupled to patch through a slot in the ground plane separating two substrate. Ground plane which is in the middle isolate the feed and the radiation element and reduce spurious radiation. Advantage is allows independent of feed mechanism element.

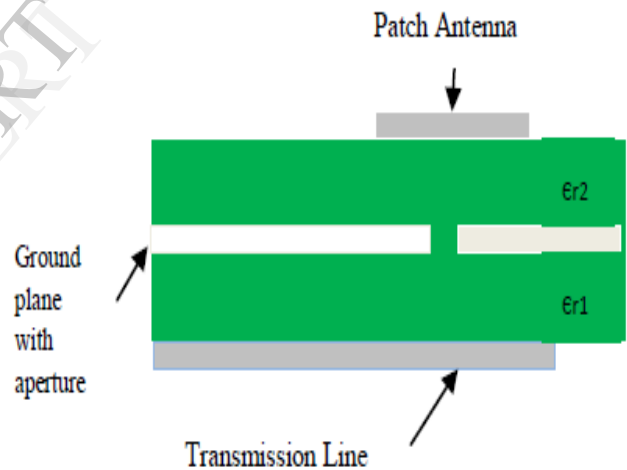


Figure 5. Aperture couple feed

In proximity coupling has large bandwidth ,low spurious radiation .length of feeding stub and width to length ratio patch is used to control the patch .disadvantage is difficult to fabricate and thickness of antenna increases.

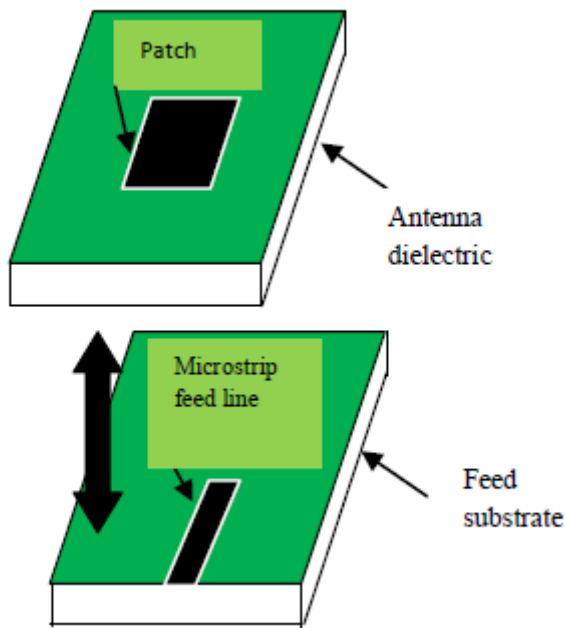


Figure 6. proximity coupled microstrip patch antenna

### III. E SHAPED PATCH ANTENNA

The main problem of a microstrip patch is narrowband so to increase the bandwidth one of the methods is to provide slots in the patch. Slots can be in the form of S, U, L, E or H .but the experiments shows [5] that E shape gives more enhanced bandwidth than other shape. To the rectangular patch size(L, W , h) fed by coaxial probe at (Xf ,Yf) two parallel slots are provided and positioned symmetrically with respect to the feed point [4]. For the E shape patch slot length, slot width, slot position are important parameters for increases the bandwidth.

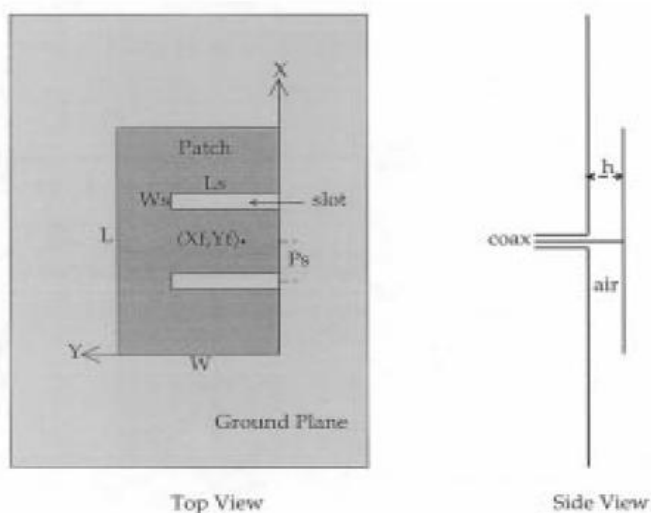


Figure 7. Geometry of a wide-band E-shaped patch antenna consisting of two Parallel slots in the patch

E shape patch antenna can be represented using a simple LC resonant circuit. From the feed point the current flows to the edge parts .L and C values are determined by the current path length .At the middle part current flows like normal patch. So it represents the initial circuit and resonates at its initial frequency. At the edge part of the patch current has to take a longer route to reaches its edge .This cause and additional series inductance. So the equivalent circuit of the edge part resonates at lower frequency. so the antenna change from single resonant circuit to dual resonant circuit these two resonant circuit couple to form a wide bandwidth.

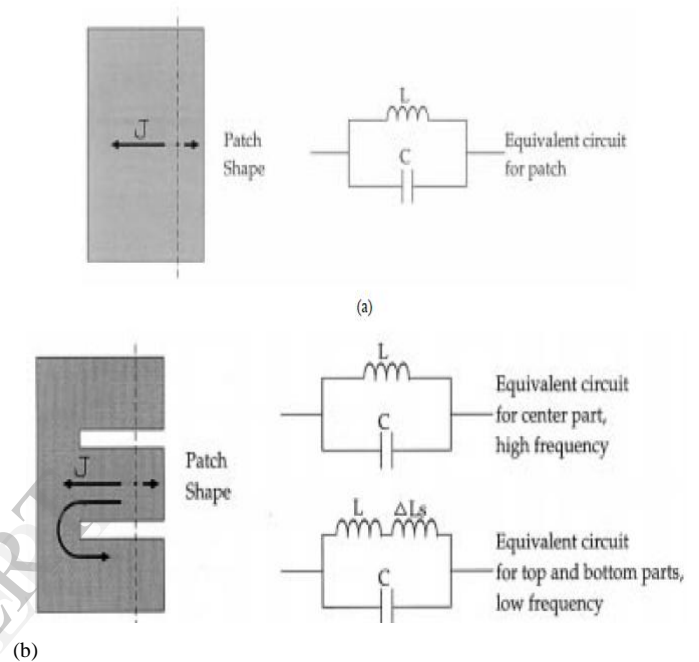


Figure 8. Dual resonance: the wide-band mechanism of E-shaped patches antennas. (a) The ordinary microstrip patch antenna. (b) The E-shaped patch antenna.

When the effects around the slots are studied the amplitude of currents varies with low resonant frequencies and high resonant frequency. At high frequency the amplitude of current around the slots are almost the same as those at left and right edge. So at the high frequency it works like normal patch and it is determined by the patch width. At lower frequency the amplitude of current is higher than lower frequency. Slots cause an additional series inductance effect. So it can be conclude that slots controls the lower frequency and higher frequency is controlled by slot width.

As the E shape patch antenna depends on the slot length, width, position. When these parameters are varied .it shows slot length has more effect on the resonant frequency than the slot width, position [6].

When slot width varied, as the width is increased higher the inductance so the resonant frequency is reduced. When the slot length is increased the inductance is increased, so the current around the slot will be more intensive .so resonant frequency is decreased. Centre arm of E shape is like a tuning capacitor so widening the centre arm capacitance increases but the resonant frequency will be reduced .

Reconfigurability can be applied to this antenna by providing PIN diode, Varactor diode or Mems switches. There are different type of reconfigurability .in frequency reconfigurability the frequency can be tuned. Frequency reconfigurability is used in the applications such as satellite communication and to tune dual band for mobile applications. Second type is radiation pattern reconfigurability .in this antenna can steer the beam to different directions. The third type is polarization reconfigurable antenna. This can provide improved signal reception in multipath fading environment.

#### IV. CONCLUSION

This paper contains details about the E patch antenna. As the microstrip patch has narrow bandwidth to make it to wide band slots are provided .so to create a E shape patch antenna first a rectangular patch antenna is created and two parallel slots are provided . The details regarding the microstrip patch antenna is included. Comparing to other shape E shape provide more enhance bandwidth. Slots in the rectangular patch are the reason for the dual frequency of E shape patch antenna. Lower frequency is controlled by the slots and higher frequency is controlled by the slot width. Reconfigurability can be added to the E shape antenna by adding PIN Diode, Varactor Diode or Mems Switches.

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