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A Microstripe Slotted Patch Antenna Using Amc

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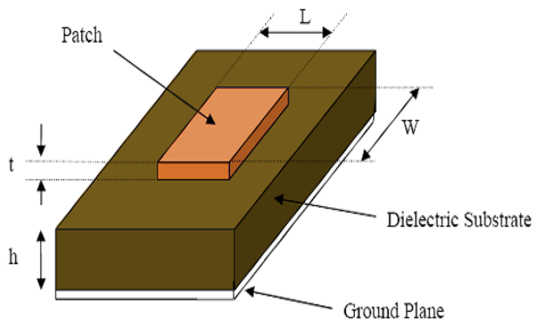
Abstract
Microstrip patch antenna offer an attractive solution to compact and ease-low-cost design of modern wireless communication system due to their many advantages as light weight and low volume, low profile, planer configuration which can be easily made conformal to low fabrication cost and capability of obtaining dual and triple frequency operations. A microstrip patch antenna with bandwidth enhancement by means of artificial magnetic conductor (AMC)/electromagnetic band-gap structure (EBG) is studied in this paper. The three different geometry shapes, the U, E and H are developed from rectangular patch. The antennas studied in this paper are simulated using sonnet software and results compared with the conventional rectangular patch antenna. The results obtained clearly shows that , bandwidth of conventional rectangular microstrip antenna can be enhanced has been studied
Keywords*- Microstrip* patch antenna, Bandwidth, AMC, EBG, Frequency, Wireless communication system

I. INTRODUCTION

Microstrip antenna structures are most common option used to realize millimeter wava monolithic integrated circuits for microwave, radar and communication purposes [1]. Patch antennas play a very significant role in today's world of wireless communication systems. A microstrip patch antenna is very simple in the construction using a conventional microstrip fabrication technique. Microstrip patch antenna consists of a radiating patch on one side of a dielectric substrate which has a ground plane on the other side. The patch is generally made of conducting material such as copper or gold and can take any possible shape as shown in figure 1. The radiating patch and the feed lines are usually photo etched on the dielectric substrate. In order to simplify analysis and performance prediction, the patch is generally square, rectangular, circular, triangular and elliptical or some other common shape. To simplify analysis and performance prediction, the patch is generally square, rectangular, circular, triangular and elliptical in shape. The radiating patch and the feed lines are usually photo etched on the dielectric substrate. In order to simplify analysis and performance prediction, the patch is generally square,rectangular, circular, triangular and elliptical or some other common shape.[2]



Microstrip antennas are relatively inexpensive to manufacture and design because of the simple 2-dimensional physical geometry. They are usually employed at UHF and higher frequencies because the size of the antenna is directly tied to the wavelength at the resonant frequency. A single patch antenna provides a maximum directive gain of around 6-9 dB. It is relatively easy to print an array of patches on a single (large) substrate using lithographic techniques. Patch arrays can provide much higher gains than a single patch at little additional cost; matching and phase adjustment can be performed with printed microstrip feed structures, again in the same an array of patch antennas is an easy way to make a phased array of antennas with dynamic beam-forming ability. An advantage inherent to patch antennas is the ability to have polarization operations that form the radiating patches. The ability to create high gain arrays in a low-profile antenna is one reason that patch arrays are common on airplanes and in other military applications[3]. Such diversity Patch antennas can easily be designed to have vertical, horizontal, right hand circular (RHCP) or left hand with asymmetric patch structures. This unique property allows patch antennas to be used in many types of communications links that may have varied requirements. Microstrip patch antennas can be fed by a variety of methods. These methods can be classified into two categories-contacting and non-contacting. In the contacting method, the RF power is fed directly to the radiating patch using a connecting element such as a microstrip line. In the non-contacting scheme, electromagnetic field coupling is done to transfer power between the microstrip line and the radiating patch. Non-contacting feeding methods such as proximity/aperture coupled can be used to improve the impedence bandwidth, but this is difficult to fabricate. The four most popular feed techniques used are the microstrip line, coaxial probe (both contacting schemes), aperture coupling and proximity coupling (both non-contacting schemes)[4]. For a rectangular patch, the length L of the patch is usually $0.333\lambda o < L < 0.5\lambda o$, where λo is the free space wavelength. The patch is selected to be very thin such that the patch thickness $t \ll \lambda o$. The height h of the dielectric constant of the substrate ($\mathcal{E}\, r$) is typically in the range $2.2 \leq \mathcal{E}r \leq 12$. The microstrip patch antennas radiate primarily because of the fringing fields between the patch edge and the ground plane. For good antenna performance, the choice of substrate used is an important factor. There are numerous substrates that can be used for the design of microstrip antennas within the dielectric constants range of $2.2 \leq \mathcal{E}r \leq 12$. The low dielectric constant $\mathcal{E}r$ is about 2.2 to 3, the medium around 6.15 and the high approximately above 10.5[2]. A thick dielectric substrate having a low dielectric constant is desirable since this provides better efficiency, larger bandwidth and better radiation. However, such a configuration leads to a larger antenna size. In order to design a compact microstrip patch antenna, substrate with higher dielectric constants must be used which are less efficient and result in narrower bandwidth. Hence a trade-off must be realized between the antenna dimensions and antenna performance [4].

II. Methodology

3.1 Feeding Technique: Microstrip patch antennas can be fed by a number of methods. These methods can be classified as contacting and non-contacting. The R.F power is fed directly to the radiating patch using a connecting element such as a microstrip line. In the non-contacting scheme, electromagnetic field coupling is done to transfer power between the microstrip line and the radiating patch[1]. The four most popular feed techniques used are the microstrip line, coaxial probe (both contacting schemes), aperture coupling and proximity coupling (both non-contacting schemes)..

3.2 Method of Analysis: There are a number of methods of analysis for m,icrostrip antenna.The most popular models are the cavity, full wave and transmission-line. The easiest of all is the transmission-line model, it gives good insight and is adequate for most engineering purposes and also require less computation. However it is less accurate. The cavity model is more accurate and gives good physical insight but is complex [5]. The full-wave models are very accurate, versatile and can treat single elements, stacked elements, finite and infinite arrays and coupling. However, they are the most complex models and usually give less physical insight.

3.3 Bandwidth: The most serious limitation of the microstrip antenna is its narrow bandwidth. The bandwidth can be defined in terms of its VSWR (voltage standing wave ratio) or input impedence variation with frequency or in terms of radiation parameters. For circularly polarized antenna, bandwidth is defined in terms of Axial Ratio. VSWR is a popular parameter for determining the bandwidth of a particular antenna configuration. Bandwidth is presented more concisely as a percent where[6]

$$\%BW = \Delta f / fo \times 100$$

3.4 Return Loss: Another way of expressing the is the return loss. It is a logarithmic ratio measured in Db which compares the power reflected by the antenna to the power that is fed into the antenna from the transmission line. The relation between VSWR and return loss is given by

$$Return\ loss\ in\ dB = 20 log10(\ VSWR/VSWR-1)$$

III. Antenna Design and Analysis

MPAs have been studied extensively over the past two decades because of its low profile structure, light weight and low cost. They have many advantages over conventional antennas, which make them suitable for a wide variety of applications. However, narrow bandwidth has been a major drawback for this type of antennas, so the second part of this paper is investigating the MPAs have been studied extensively over the past two decades because of its low profile structure, light weight and low cost. They have many advantages over conventional antennas, which make them suitable for a wide variety of applications. However, narrow bandwidth has been a major drawback for this type of antennas, so the second part of this paper is investigating the antenna performance and improving antenna bandwidth by applying the three spiral shapes ground plane using the three feeding techniques for MPA namely inset, offset and center line feed

In this design, we have study three different geometry shapes the U, H and E from a patch of width (W) = 32mm and length (L) =24mm. The three proposed antennas are simulated using Sonnet software, and results compared with the conventional rectangular patch antenna, and the shape with improve bandwidth is adopted, and implemented. The bandwidth was obtained where return loss is less than -10dB which is an acceptable level to describe the loss of the power which reflects back from the antenna without being radiated. Figure 2, shows the geometry of conventional rectangular microstrip antenna (RMSA). The antenna is designed for the resonance frequency of 2GHz. It consists of radiating patch of length *L* and width *W*.

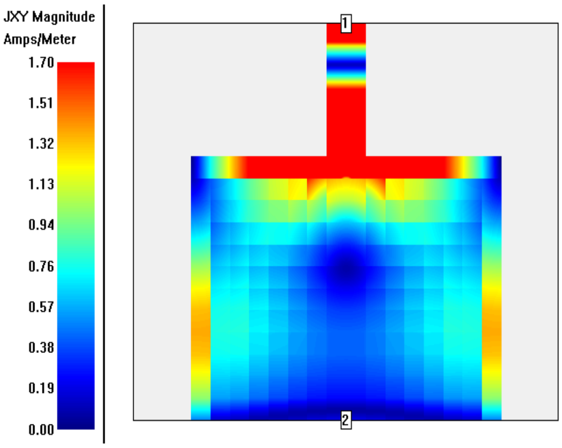


Figure 2. Rectangular Patch shape with Current distribution and feed points

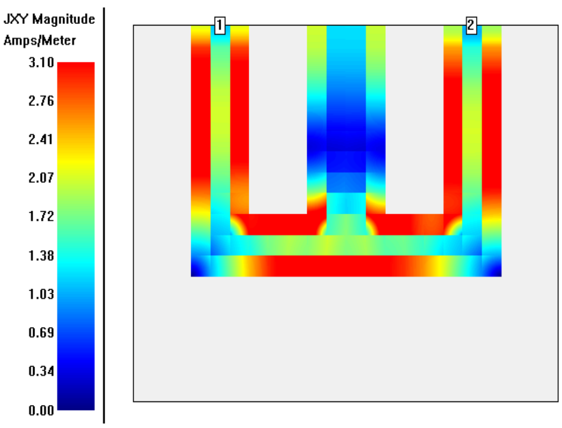


Figure 3. E-Patch shaped and with current distribution feed points

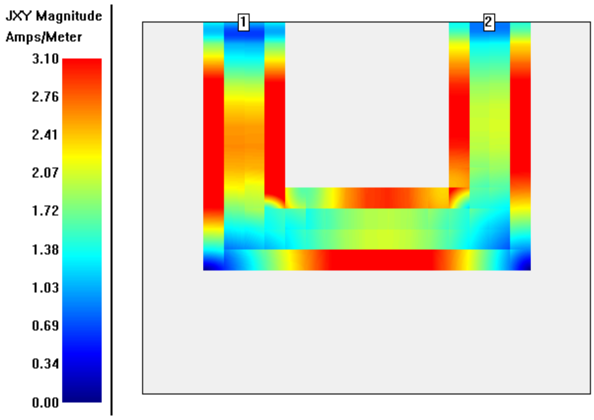


Figure 4. U- Patch shape Antenna with Current distribution and feed points

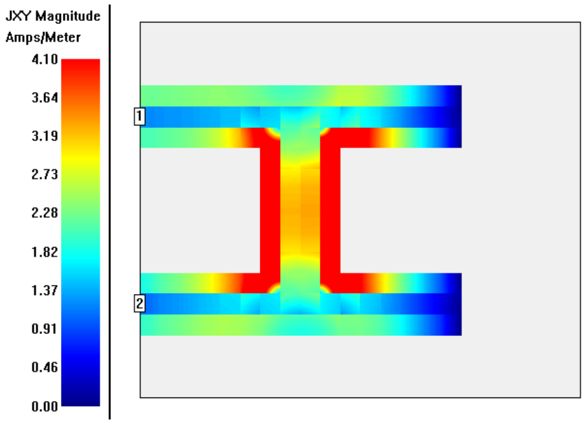


Figure 5. H-Patch shape Antenna with Current distribution and feed points

Fig. 6, shows the variation of return loss versus frequency plot of RMSA resonate at 2.1 GHz of frequency which is close to the designed frequency of 2GHz.

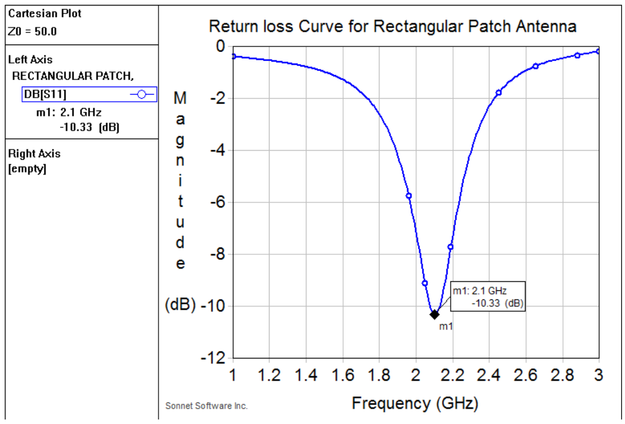


Figure 6. Simulated Return loss of Rectangular patch Antenna

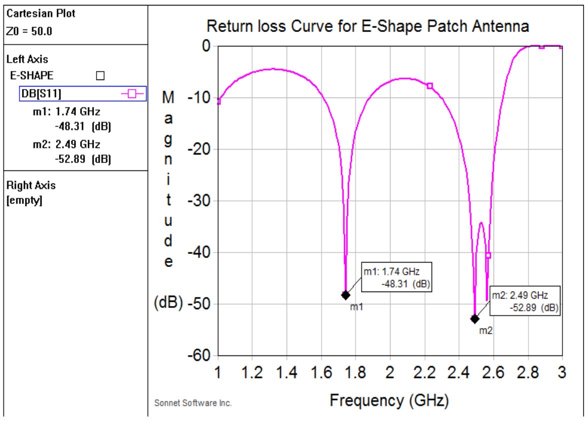


Figure 7. Simulated Return loss of E-patch Antenna

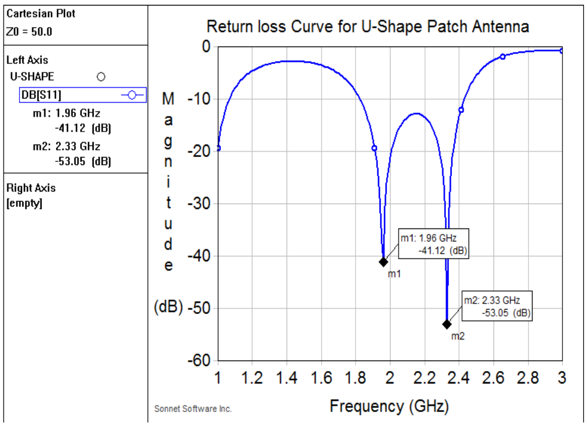


Figure 8. Simulated Return loss of U- shape Antenna

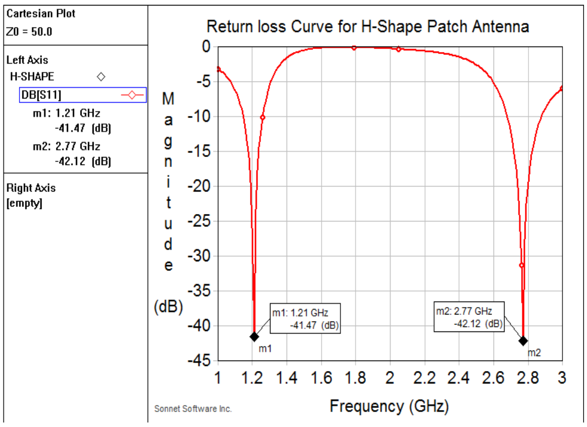


Figure 9. Simulated Return loss of H-shaped patch Antenna

The percentage bandwidth of the conventional RMSA (Rectangular Microstrip Antenna)is observed 4.81% with bandwidth of 100MHz from experi, shows the variation of return loss versus frequency of mental result.

Figure 6 E- shape patch antenna. The antenna resonates at two bands of frequencies 1.74GHz and 2.49GHz. This development is as a result of the slots. The overall bandwidth at (1.74GHz and 2.49GHz) is found to be 28.89% (that is 630MHz). Figure 7, shows the variation of return loss versus frequency of U-shaped patch antenna. The antenna resonates at two bands of frequencies at 1.96GHz and 2.33GHz, due to the U-slots. The overall bandwidth is 28.71 (that 610MHz). Figure 8, shows the variation of return loss versus frequency of H-shape patch antenna. The antenna resonates at two bands of frequencies at 1.21GHz and 2.77GHz. The overall bandwidth is 9.13% (that is 110MHz).[7].

Figure 6 and figure 7 give the highest bandwidth of 28.89% (630MHz) and 28.71% (610MHz) which is more than bandwidth of conventional RMSA. The more increment in bandwidth is result of insertion of slots used for the construction of E and U-shape patches when compare to RMSA. The current along the edges of the slot induces an additional resonance, which adds to the fundamental resonance of the radiating element that helps to increase bandwidth [8].

IV. Conclusion

In this paper the aim was targated at improving the bandwidth of microstrip antennas constructed with dielectric material with higher dielectric constant. We have selected three different patch antennas and the simulated results compare with the conventional microstrip patch antenna. The results obtained clearly shows that bandwidth of conventional RMSA(Rectangular Microstrip Antenna) made with dielectric substrates having higher dielectric constants can be improved using U and E-shaped patch antenna. We have observed that E-shaped patch antenna has highest bandwidth. In this paper the aim was targated at improving the bandwidth of microstrip antennas constructed with dielectric material with higher dielectric constant. We have selected three different patch antennas and the simulated results compare with the conventional microstrip patch antenna. The results obtained clearly shows that bandwidth of conventional RMSA (Rectangular Microstrip Antenna) made with dielectric substrates having higher dielectric constants can be improved using U and E-shaped patch antenna. We have observed that E-shaped patch antenna has highest bandwidth than U-shaped patch antenna and H-shaped patch antenna alone for image encryption so it can be used with other maps for efficient encryption.

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