Design and Simulation of Different Shapes Microstrip Antennas a Literature Review

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Abstract— The area of microstrip antennas is one of the most dynamic fields of antenna theory and has seen some inventive work in recent years. The increasing need for mobile communication and the emergence of newer technologies require an efficient design of antenna of smaller size for wider frequency range applications such as Wi-Max. In this work, the aim of this paper is to design and simulate different shapes of Microstrip antenna.

Key words: Microstrip Antenna, Return Loss, VSWR, Bandwidth Percentage

I. INTRODUCTION

Patch antennas play a really vital role in today's world of wireless communication systems. A Microstrip patch antenna is so easy in the construction employing a conventional Microstrip fabrication technique. The widely used Microstrip patch antennas are rectangular and circular patch antennas. These patch antennas are most widely used for many applications.

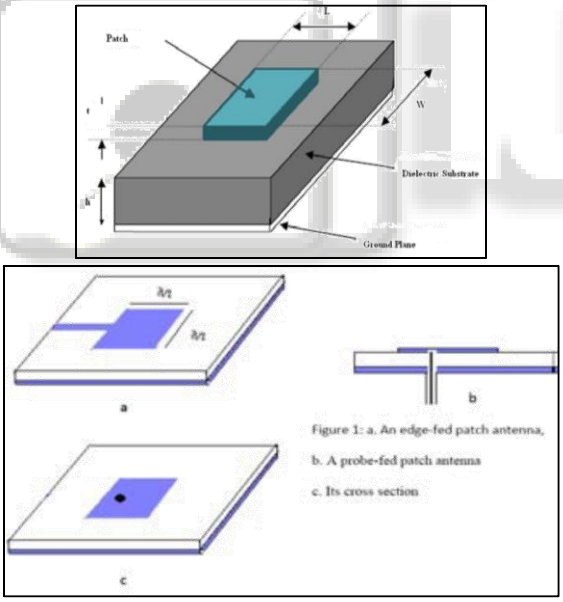

Fig. 1: An edge fed Patch Antennas

II. FEEDING MECHANISM

There are many techniques present to feed or transmit electromagnetic energy to a microstrip antenna. The four most well liked feeding strategies are the microstrip line, coaxial probe, aperture coupling and proximity coupling.

A. Microstrip Line Feed

In this feed technique a conducting strip is connected directly to the edge of the microstrip patch as given in Figure 1. Width of the conducting strip is smaller as compared to the patch and this type of feed arrangement has the advantage that the feed can be etched on a similar substrate to give a coplanar structure .The aim of the inset cut within the patch is to match the impedance of the feed line to the patch while not the requirement for any extra matching element. This is often achieved by properly dominant the inset position. Therefore this is a simplest feeding scheme, since it provides simple fabrication and ease in modelling moreover as impedance matching. Because the thickness of the dielectric substrate being employed, increases, surface waves and spurious feed radiation will increases that hampers the bandwidth of the antenna. The feed radiation conjointly results in unwanted cross polarized radiation.

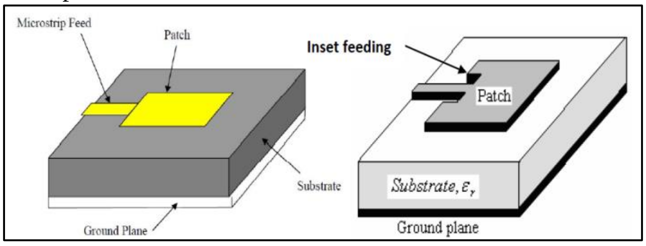

Fig. 2: Rectangular Microstrip antenna Microstrip Line feeding

B. Coaxial Probe Feed

The coaxial feed or probe feed is a quite common technique used for feeding microstrip patch antennas. As seen from Figure 2, the inner conductor of the coaxial connector extends through the dielectric and is soldered to the radiating patch, whereas the outer conductor is connected to the bottom plane. The most important advantage of this sort of feeding theme is that the feed may be placed at any desired location within the patch so as to match with its input impedance. This feed methodology is simple to fabricate and has low spurious radiation. However, its major disadvantage is that it provides narrow bandwidth and is troublesome to model since a hole should be drilled in the substrate and also the connector protrudes outside the bottom plane, so not creating it utterly two-dimensional for thick substrates (h>.02λo). Also, for thicker substrates, the enlarged probe length makes the input impedance a lot of inductive, resulting in matching issues [24]. It's seen on top that for a thick dielectric substrate, that provides broad bandwidth, the microstrip line feed and also the coaxial feed suffer from various disadvantages. The non-contacting feed techniques that are mentioned below, solve these issues.

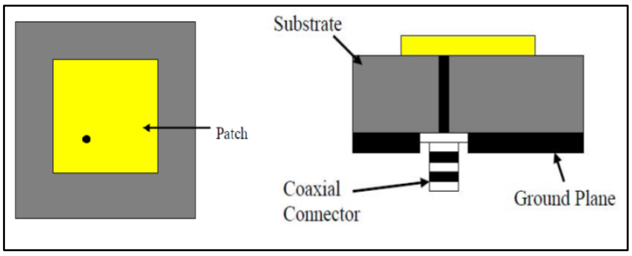

Fig. 3: Rectangular Microstrip antenna coaxial

C. Aperture Coupled Feed

During this variety of feed technique, the radiating patch and also the microstrip feed line are separated by the bottom plane as shown in Figure 3 .Coupling between the patch and also the feed line is created through a slot or aperture within the ground plane. The coupling aperture is typically centred beneath the patch, resulting in lower cross polarization because of symmetry of the configuration. The number of coupling from the feed line to the patch is decided by the shape, size and location of the aperture. Since the bottom plane separates the patch and also the feed line, spurious radiation is reduced. Generally, a high dielectric material is employed for the lowest substrate and a thick, low dielectric constant material is employed for the top substrate to optimize radiation from the patch [8]. The main disadvantage of this feed technique is that it's troublesome to fabricate because of multiple layers that additionally will increase the antenna thickness. This feeding scheme additionally provides narrow bandwidth (up to 21%).

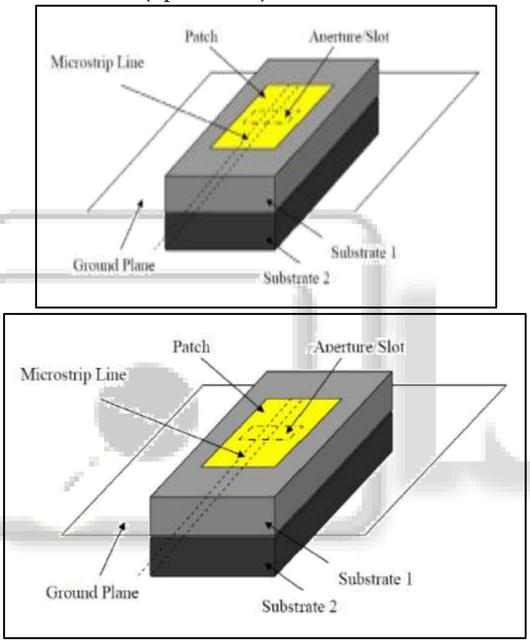

Fig. 4: Feeding Scheme

III. LITERATURE REVIEW

A. Study of Reference Papers

1) Research Paper 1

Pawankumarpunia, Ria kalra and B. Mohapatra "Inset Fed Rectangular Microstrip Patch Antenna for UHF Radio frequence Identification" International Journal of Engineering Research & Technology (IJERT)ISSN: 2278-0181Vol. 4 Issue 08, (August-2015) describe a 0.92 GHz inset line fed rectangular microstrip patch antenna has been designed for UHF RFID(Radio Frequency Identification) application with return loss over -32db, bandwidth 2.71 % and VSWR 1.0473 .This paper uses substrate having relative permittivity (εr) = 4.5 and thickness (h) = 1.5mm with Tangent (tanδ) = 0.002.The length (L) of patch antenna is seventy seven millimeter and its breadth (W) is 98mm.The inset feed line (Zp) is seven millimeter, with feed line breadth (Wg) of one millimeter and inset gap ($L1$) is three millimeter. Here the input resistivity is 51.21Ω and VSWR is 1.0473. Fig.3 shows return loss and VSWR for UHF Radio frequency Identification

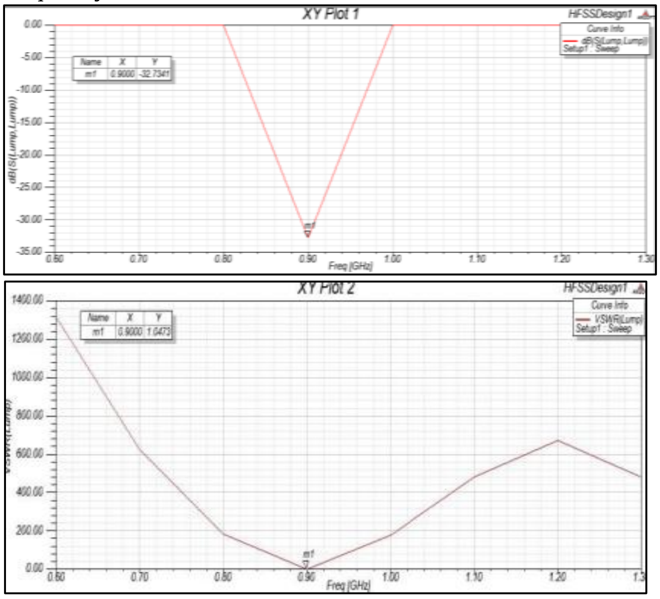

Fig. 5: Return loss and VSWR for UHF Radio Frequency Identification

2) Research paper 2

Pawankumarpunia, Ria kalra and B. Mohapatra "Inset Fed Rectangular Microstrip Patch Antenna for UHF Radio frequency Identification" International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181Vol. 4 Issue 08, (August-2015) describe a 0.92GHz inset line fed rectangular microstrip patch antenna has been designed for UHF RFID(Radio Frequency Identification) application with return loss over -32db, bandwidth 2.71 % and VSWR 1.0473 .This paper uses substrate having relative permittivity (εr) = 4.5 and thickness (h) = 1.5mm with Tangent (tanδ) = 0.002.The length (L) of patch antenna is seventy seven millimeter and its breadth (W) is 98mm. The inset feed line (Zp) is seven millimeter, with feed line breadth (Wg) of one millimeter and inset gap ($L1$) is three millimeter. Here the input resistivity is 51.21Ω and VSWR is 1.0473. Fig.3 shows return loss and VSWR for UHF Radio frequency Identification

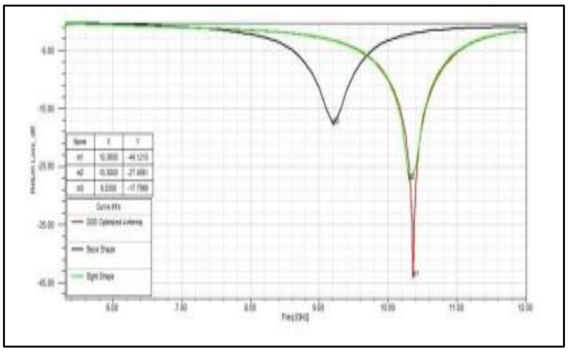

Fig. 6: Return loss plot for base shape, 8–shaped and DGS optimized antenna

3) Research Paper 3

Srikanta Patnaik, Mihir Narayan Mohanty "Optimization of Z-Shape Microstrip Antenna with I- slot Using Discrete Particle Swarm Optimization (DPSO) Algorithm" 2nd International Conference on Intelligent Computing, Communication & Convergence (ICCC-2016) describes discrete particle swarm optimization technique has been used in HFSS software for optimization of the Z-shape patch antenna with I- slot dimensions so as to achieve return loss, VSWR, directivity and gain. The designed antenna is to operate in Wi-Max / S- band and C- band satellite application with the centre frequency at 3.5GHz and 4.3GHz and different important performance metrics of the patch antenna are analysed for performing arts comparative analysis between un-optimized patch antenna and optimized patch design.

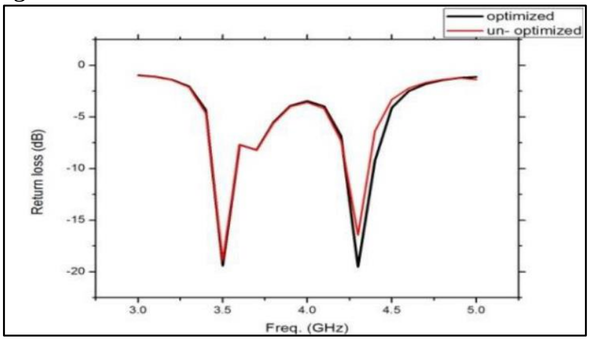

Fig. 7: Return loss plot of optimized and un-optimized Z-shape patch antenna with I-slot

In this paper FR4 epoxy dielectric material of relative permittivity 4.4 and loss tangent of 0.02. With the thickness of 1.6mm is used as a substrate of the antenna. The dimension of patch of length 38.04mm and width 29.44mm. At this configuration the optimized Z- shape patch antenna with I-slot exhibits return loss of -19.4077 dB at 3.5 GHz and -19.5182 dB at 4.3 GHz. Whereas the return loss plot of the un-optimized Z- shape patch antenna with I-slot is -18.88 dB at 3.5 GHz and -16.42 dB at 4.3 GHz. The un-optimized Z-shape patch antenna with I-slot has VSWR of 1.25 and 1.35 and the optimized Z- shape patch antenna with I-slot has a VSWR of 1.23 at 3.5 and 4.3 GHz. The directivity and gain for un-optimized Z- shape patch antenna with I-slot has 5.67dBi and 1.34dB respectively and directivity and gain for the optimized Z- shape patch antenna with I-slot has 5.93dBi and 1.53dB respectively. Fig. 2.

4) Research Paper 4

Ali HanafiahRambe, Eddy Marlianto, Nasruddin M.N., FitriArnia "Optimizing Rectangular Patch Antenna with Microstrip Line Feed Using Single Stub" International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181Vol. 2 Issue 12, December – 2013 describe Microstrip Line Feeding in Rectangular Patch Antenna with Dielectric constant of the substrate εr = 4.4 and Height of dielectric substrate 1.6mm taken. Here the length of patch is 38.04mm and width of patch is 28.44mm.The return loss of Microstrip Line Feed rectangular micro-strip patch antenna is -45.61dB at 2.38GHz. The bandwidth percentage is 4.45% and Gain is 5.6dB. Fig.6 shows Simulated Return Loss vs. Frequency of Simple RMPA.

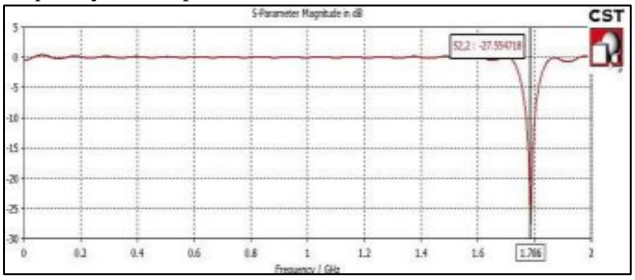

Fig. 8: Simulated Return Loss vs. Frequency of Simple RMPA is 27.554dB at 1.786GHz

5) Research paper 5

Liton Chandra Paul, Nahid Sultan, "Design, simulation and performance analysis of a line feed rectangular micro-strip patch antenna" International Journal of Engineering Sciences & Emerging Technologies, Volume 4, Issue 2, pp: 117-126 (Feb. 2013) describe a line feed rectangular micro-strip patch antenna with Dielectric constant of the substrate εr = 4.4 and Height of dielectric substrate 1.3mm taken. In this paper micristrip line feed method is used. Here the length of patch is 23.5mm and width of patch is 30.4mm. The return loss of line feed rectangular micro-strip patch antenna is -8.314dB at 2.937GHz. At this configuration of patch antenna Directivity Bandwidth percentage and gain 4.154dBi, 2.6515% and 2.059dB respectively. Fig. 5 shows S-parameter plot for Return loss v/s frequency for rectangular micro-strip patch antenna (RMSA).

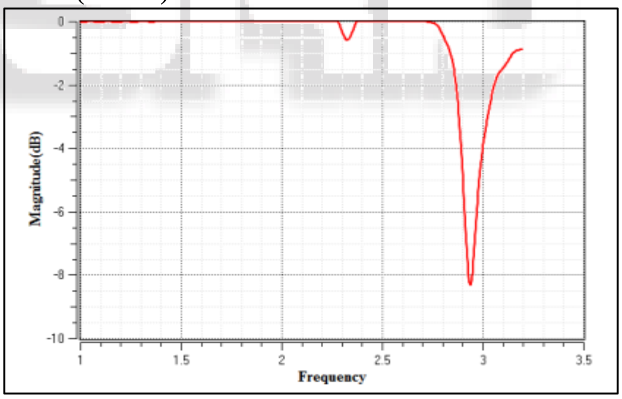

Fig. 9: S-parameter plot for Return loss v/s frequency for RMSA

S. No.	Paper	Freq.	Return Loss (DB)	BW	BW%	VSWR	Gain
1	"Inset Fed Rectangular Microstrip Patch Antenna for UHF Radio Frequency Identification	0.98	-32		2.71%	1.047	-
2	Design & Simulation of 8–Shaped Coaxial Feed Patch Antenna	10.36	-44.12	-	6.68%		-
3	"Optimization of Z-Shape Microstrip Antenna with I- slot Using Discrete Particle Swarm Optimization (DPSO) Algorithm	4.3	-19.51		-	1.35	1.34
4	Optimizing Rectangular Patch Antenna with Microstrip Line Feed Using Single Stub"	2.38	-45.61	-	4.45%		-
5	Design, simulation and performance analysis of a line feed rectangular micro-strip patch antenna	2.937	-8.31	-	2.65%		2.059

Table 1: Comparison of Different Shape Micro Strip Antenna

IV. CONCLUSION

In this paper we present a survey in the comparison of different microstrip antenna .Here we found Return loss ranging from -16dB to -44dB, Bandwidth percentage 2% to 6%, VSWR (voltage standing wave ratio) < 2 and Gain 3dB to 12dB for different shape Rectangular Microstrip patch Antenna with. This antenna can be used for satellite and wireless communication. Concentrating on theoretical models and performance characteristics of different microstrip patch antenna. Improvement can be done by changing shape as 'U', 'E' ,T, L , H and changing material so that Return loss(RL), Gain, VSWR(voltage standing wave ratio) Bandwidth, Bandwidth percentage all can be improved.

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