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REVIEW OF DESIGNING TECHNIQUES OF APERTURE COUPLED MICROSTRIP PATCH ANTENNA

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***Abstract*- This paper presents a comparative study of patch antenna with aperture coupled feed structures. That includes microstrip line feed, inset feed, coaxial feed, aperture coupled feed and proximity coupled feed. The popular line feeds include coaxial type APC feed and proximity coupling. Matching between the patch antenna and the feed network heavily depends on the feed technique used. In this work various feeding techniques have been reviewed to provide an understanding of the important design parameters and their effects on the bandwidth, gain and the other important antenna characteristics.. Recently published in research jounrnals of global repute are covered. Modern time is marked by the role of polarized antenna in many wireless communication system , navigation system such as GPS etc. Micro strip antennas are suitable and favourable for such applications due to their low profile, and easy to fabricate. The feeding method like aperture coupling has been deeply investigated in this review paper.**

Keywords- **Aperture coupled, Line feeding, Fabricate, Polarized, Profile, Parameters**.

I. INTRODUCTION

This paper reviews the current status of aperture coupled micro-strip antennas. Since its inception in mid eighties the features offered by this antenna element have proved to be useful in a wide variety of applications, and the flexibility of the basic design have led to an extensive amount of development and design variations by engineers throughout the world. We begin with the early development of this antenna, and discuss its main features relative to other types of microstrip antenna feeding methods. It is then discussed the basic operating principles of the aperture coupled antenna, followed by a summary of the extensive development that this antenna has undergone, in terms of both practical design features and modeling techniques. [1]

The microstrip patch antenna offers the advantages of low profile, ease of fabrication, and compatibility with integrated circuit technology. Active and passive circuit elements can be etched on the same substrate. It can also be made conformal to a shaped surface. Its main drawback is narrow bandwidth, typically less than 5%. It is useful for aeroplanes or space exploration vehicles.Thus, it very clear that the early applications of MPA were in the military sector. With the development of techniques such as broadband and size reduction, the MPA soon found extensive applications in the commercial sectora swell, and it is probably not an exaggeration to say that this type of antenna has become the favourite of antenna designers.

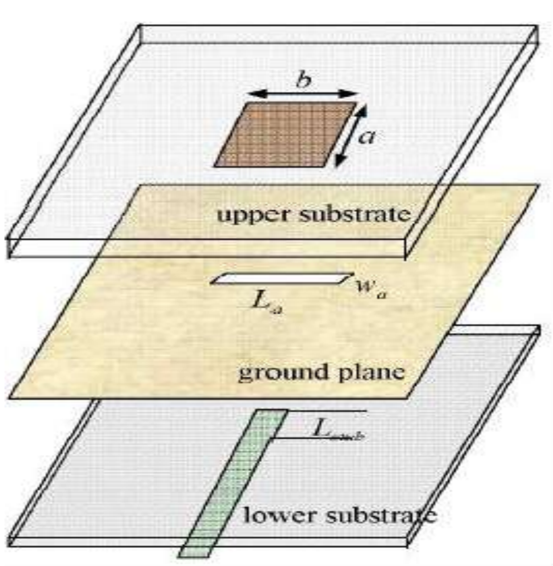

Fig.1. Isometric View of Aperture Coupled Antenna

II. FUNCTIONING OF APERTURE COUPLED ANTENNA

Fig.1.Shows the construction of the aperture type antenna. The patch & feed line are the copper etching. The thickness and dielectric constant of the substrate is directly proportional to the resonant frequency and bandwidth. The aperture coupled

microstrip antenna using different material and dimensional parameters [2]. The dielectric constant The dielectric constant of substrate reduces the energy level increases the bandwidth and thickness also does the same. The geometry of the patch affects the impedance. The patch with rectangular shape has lower cross polarization. If one needs the cross polarizationthen square patch must be used. If the substrates are thin then the noise is reduced. The coupling depends on the cut size in the ground plane. The aspect ratio of slot should be 1:10 for proper impedance matching. The feedline and slot must be orthogonal for maximum coupling. The feedline must be thin for effective coupling. The movement of the slot in E plane direction reduces the gain Han Wah Lai et. al[4] the authors have proposed a patch antenna with circular polarization. The geometry consists of hook shaped with 47 slots. The antenna has an impedance bandwidth of 16.5%, an avail ratio bandwidth of 13.5% & average of the order .084λ. Gain enhancement & back lobe radiation suppression by placing reflector at an optimized position. The parametric study is carried out using genetic algorithm. The axial ratio & SWR of antenna is automatically calculated by the simulator. The impedance bandwidth increases with the thickness of substrate. The center frequency of axial ratio becomes lower & vice versa. The patch length is half the wavelength a center frequency .the slot length of T shaped coupling of feed line with the radiating patch. The coupling does not affect the center frequency but the axial ratio bandwidth is optimized at L_c =17.5mm.

A. Wideband characteristics-

CP antenna structure is simple. The axial ratio bandwidth of this antenna is increased to 4.6%. The difference of the coupling slots results in improvement of bandwidth 65% to 90%.

B. Back radiation reduction-

The back radiation of an antenna is reduced by using reflector. The length of the square reflector (R_L) & the reflector between the antenna & reflector (R_s). The reflector increases the gain from about 5.5dB_{ico} to about 8.5dB_{ico} .the radiation pattern is further stabilized [8].

III. DESIGN METHODS OF THE APERTURE COUPLED MPA

Global development in recent years in Aperture Coupled MPA is summarized as under: Wideband aperture coupled microstrip antennas One of the useful features of the APCA has higher impedance bandwidth. The bandwidth is increased nominaly with single layer. To achieve higher bandwidth by stacking the patch elements have been demonstrated with bandwidths up to 10 - 15% with a single layer [7]-[9], and up to 30-50% with a stacked patch configuration[13]. This improvement in bandwidth is primarily a result of the additional degrees of freedom offered by the stub length and coupling aperture size. The inductive reactance is countered by tuning the stub length, that occurs when thick antenna substrates are used, and the slot can be brought close to resonance to achieve a double tuning effect. Use of a stacked patch configuration also introduces a double tuning effect[9].

Mohsen Jafari et. al [1] have investigated micro-strip path antenna with the aperture coupling using three resonant frequencies the balance between radiation characteristics & antenna band with is achieved. The three resonant frequencies are influenced by path' slot & feeding network. The authors have studied S11 parameter to find out the effect of clipping patch on the band with. The gain diagram displays the gain form conventional 7db to 9db by coupling through an aperture. The simulated radiation pattern versun angle (Q) with respect to z are investigated for different frequencies. The measured results confirm the simulation result.

IV. DUAL AND CIRCULARLY POLARIZED APERTURE COUPLED MICROSTRIP ANTENNAS

As with other types of microstrip antennas, The orthogonal fields are used for dual polarization of MPA. This has been established by Adrian and schaub.18 dB isolation was achieved, and circular polarization was demonstrated using an off-board 90° hybrid coupler. One problem with this approach was that there is a vice versa relationship between slotsize by asymetry of the slots (and thus the coupling level that could be achieved),and also limited the isolation and polarization purity. Another approach was suggested by Tsao, Hwang, Killburg, and Dietrich, whereby a crossed slot was used to feed the patch [10]. In this case 27 dB isolation was achieved, with very good bandwidth. The drawback in this case was the requirement for a crossover in the balanced feed lines that fed each arm of the crossed slot. This problem was solved by Targonski and Pozar [8], who used a different arrangement of feed lines with the crossed slot for circular polarization. This element led to a 3 dB axial ratio bandwidth of up to 50%, and a comparable impedance bandwidth is also possible. The cross over problem is resolved by two feed lines to avoid the crossover problem, as demonstrated in [11]. Circularly polarized aperture coupled elements can also be designed with a single diagonal coupling slot and a slightly nonsquare patch [12], similar to circularly polarized patches with a single probe feed, but the resulting axial ratio bandwidth is very narrow.

Somewhat improved axial ratio bandwidth can be obtained by using a crossed slot with a single microstrip feed line through the diagonal of the cross, and a slightly non-square patch [12].The MPA functions on single mode and radiates linearly. The patch supports orthogonal fields of same magnitude. This can be done by a single patch or by an array. . The circular polarization can be achieves by two methods. The single patch gives good results. CP using two types of feeding schemes. The first type is a dual-orthogonal feed, which employs an external power divider network and single feed. The divider network is effective with an antenna with a point feed at single location, CP radiation can be completed by disturbing the patch at some strategic point.

V. APERTURE COUPLED MICRO STRIP ANTEENA

Like other types of microstrip antennas, aperture coupled elements lend themselves well to arrays using either series or corporate feed networks. The two-sided structure of the aperture coupled element. The extra space facilitates the dual polarization. The ground plane shields between aperture and the feed One drawback is that the coupling apertures will radiate The back radiation are stopped by the ground plane Some examples of corporate-fed aperture coupled array antennas are given in references [4],[7] and [12]. In addition, series fed aperture coupled arrays have been demonstrated as in [9].

VI. CONCLUSION

Our work is a review on microstrip patch antenna with emphasis on broadband designs A microstrip antenna is made up of a radiating patch of copper on the substrate with ground plane and delivers 2-5% bandwidth which is not useful for wireless applications. With this basic geometry, only 2 – 5 % bandwidth is possible which is not fit for modern-day wireless communication technologies. The extensive research has been done in the last few decades on antenna performance improvement. The techniques have been developed to enhance the bandwidth. The bandwidth from 12 % to 182 % is achieved using various techniques; Impedance matching network technique provides 24%, patch geometry modification provides 58%, DGSs technique provides 84%, and the meta material resonators technique provides very high bandwidth. Many designs are discussed regarding reconfigurable antennas. It is the area of research. For broadband designs, methods are available but all result in increased volume of antenna diminishing its low profile advantage. Therefore, research for broadband, proficient, and low profile patch antennas still remains the topic of interest.

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