Micro-strip Patch antenna designing using multiple Arrays

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ABSTRACT

An antenna is a special part of the communication system. An antenna is termed as a metallic device for getting or transmitting radio waves in RF system. With the appropriate design of the antenna, system requirements can be reduced. Various antenna configurations have been planned. Microstrip patch antenna taken a firm place in the communication system as its attractive features and essentially used in many commercial applications. Unfortunately, it suffers from disadvantages like contracted bandwidth, lower gain, and low efficiency.

Microstrip antennas are implemented usually in military and industrial applications. It includes a metallic patch with the grounded substrate. It has used in various configurations. Rectangular and circular configurations are basically used due to their agreeable radiation properties, low cross-polarization, low profile, and comfort in planar also in non-planar configuration can be mounted on stiff surfaces. These can be fixed on satellites, military devices, automobiles, and also in handheld devices[1]. To achieve high directivity number of single elements arranged in an array fashion. The proposed work consists of a rectangular Microstrip patch antenna array. An array is designed for an operating frequency of 2.40 GHz uses two microstrip patch antenna elements and its performance is improved using uniform electromagnetic band-gap (EBG) configuration at 2.45 GHz.

Keyword: - *Aperture coupling, Array, Bandwidth, Band-gap, Microstrip patch antenna, Microwave frequencies, Patch antenna*

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1. INTRODUCTIN

An Antenna is a special part in communication system. Antenna is termed as a metallic device for getting or transmitting radio waves in RF system. With appropriate design of antenna, system requirements can be reduced. Various antenna configurations have been planned. Microstrip patch antenna taken firm place in communication system as its attractive features and essentially used in many commercial applications. Unfortunately, it suffers from disadvantages like contracted bandwidth, lower gain, and low efficiency [6][9]. Micro strip antennas are implemented usually in military and industrial applications. It includes metallic patch with the grounded substrate. It has used in various configurations. Rectangular and circular configurations are basically used due to their agreeable radiation properties, low cross-polarization, low profile and comfort in planar also in non-planar configuration, can be mounted on stiff surfaces. These can be fixed on satellites, military devices, automobiles and also in handheld devices [9].

A patch excited by micro strip line feed is shown in Fig 1 (a). Feed arrangement having advantages like it can be etched on same substrate hence structure remains planer[4]. But disadvantage due to radiation from feed line, which leads to increase cross polar level. In addition, the millimeter-wave range and the size of the feed line is proportional to the patch size, leading to increased undesired radiation. For dense substrates, commonly use to achieve wide BW, both of the above MSA feeding methods have problems [12]. In the case of a coaxial feed, increased probe length makes the input impedance more inductive, leading to the matching problem. For the micro strip feed, an increase in the substrate thickness increases its width, which in turn increases the undesired feed radiation. The indirect feed, discussed below, solves these problems. An electromagnetically coupled RMSA is shown in Figure 1.3(b). The electromagnetic coupling in other way called as proximity coupling. The feed line is keeps in between the patch and ground plane, by separating two dielectric media. This feed configuration include the elimination of spurious feed-network radiation; the choice between two different dielectric media, separately for the patch and the feed line to optimize the individual performances by improving in the BW due to the escalate the

overall substrate thickness of the MSA. The disadvantages are that the two layers need to be aligned properly and that the overall thickness of the antenna increases [1].

Aperture coupling is another method for indirectly exciting a patch employs [6]. In the aperture-coupled MSA configuration, the field is coupled from the micro strip line feed to the radiating patch through an electrically small aperture or slot cut in the ground plane, as shown in Figure 1.3(c)[5]. The coupling aperture is usually cantered under the patch, resulting in lower cross-polarization due to symmetry of the configuration. Physical appearance structure [3][4] and location of the aperture decide the amount of coupling from the feed line to the patch. The slot aperture can be either resonant or non-resonant [5]. The resonant slot provides another resonance along with the patch resonance therefore increasing the BW at cost of an increase in back radiation. As a result, a no resonant aperture is normally used. The performance is relatively insensitive to small errors in the alignment of the different layers. Same to the electromagnetic coupling method, the substrate parameters of both layers can be select individually for perfect antenna performance. This feeding method gives increased BW [12].

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2. FEEDING TECHNIQUES

The coplanar waveguide feed, shown in Figure 1, has also been used to excite the MSA. In this method, the coplanar waveguide is etched on the ground plane of the MSA. Coaxial feed use to exciting line and also terminated by a slot, which length is selected in between 0.25 and 0.29 of the slot wavelength[5][7]. The main disadvantage of this method is the high radiation from the rather longer slot, leading to the poor front-to- back ratio. The front-to-back ratio is improved by reducing the slot dimension and modifying its shape in the form of a loop [5].

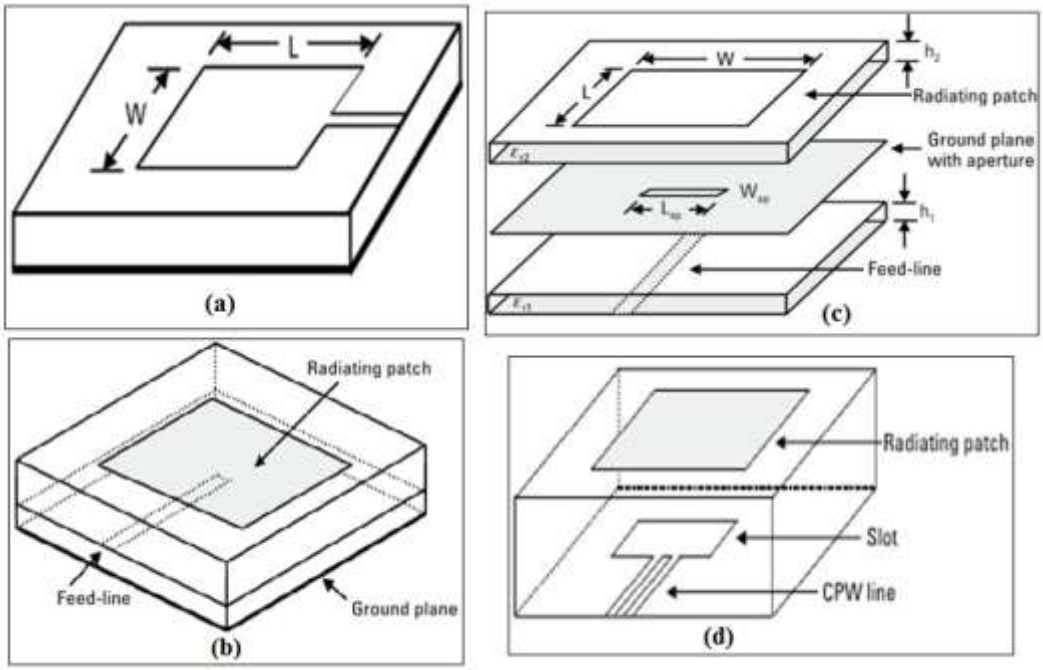

Fig -1. MSA of Rectangular shape fed by
(a) Microstrip line, (b) electromagnetic coupling, (c) aperture coupling, (d) coplanar waveguide (CPW).

In most of the applications for large distance communication it is basic need to propose antennas with high gains. It is conceivable by reconfiguration of the electrical measurements for the particular antenna. Another path by congregation of transmitting elements in geometrical and an electrical arrangement formation of new antenna configuration due to multi-elements called as an array for directive antenna,[11] field from array are added constructively to the needed directions and cancelled in the other space. Five controls can be modelled to reform the beam of the antenna [2][11]. These are amplitude, phase, relative pattern and the respective displacement of the elements. Antenna arrays can be used for commercial, personal and defense applications which include loops, dipoles, micro strip, reflector, horn and so on.

Electromagnetic has gained a lot of attraction among investigators due to its civil and defense applications. Micro strip patch antennas are popularly used today due to their merits of lighter weight, less volume, lower cost, easy to install and easily compatible with integrated circuits[12]. In a communication system, some applications require smaller configuration of micro strip antenna to make it suitable for that application. From last four years, significant improvement in the configurations of microstrip patch antennas have been presented so different aspects or methods have come forward to fulfill this purpose. An idea of SIW rises from the microstrip and waveguide. Microstrip antenna usually refers as an antenna manufactured by use of small strip techniques on a printed circuit board. It is a kind of internal antenna. They are mostly used at microwave frequencies. An individual microstrip antenna consists of a patch of metal foil of various shapes also called a patch antenna on the surface of a printed circuit board, using metal foil for ground plane for other side of the board. Most microstrip antennas designed with multiple patches in a various structural two-dimensional array [8]. The antenna is usually connected to the transmitter or receiver through foil micro strip transmission lines. The radio frequency current is feed also in receiving antennas the received signal is generated between the antenna and ground plane [7].

Microstrip antennas are popular

Microstrip antennas have much appreciated in recent years due to its thickness that can attract users towards it, defense appliances like aircraft and missiles where this antenna fit properly and securely, and the possibility of adding active devices such as microwave integrated circuits to the antenna itself to make active antennas [10]. From signal patch antenna we can get maximum directive gain near about 6-9 dBi. Using Lithographic techniques it is comparatively easy to print an array of patch on large single substrate. Microstrip patch arrays comparatively can provide much higher gains as single patch at additional charge. At another side phase adjustment and matching also performed with printed microstrip structure, in same operations that form the radiating patches. Patch arrays are commonly used on airplanes and military applications due to ability of creating high gain arrays in low profile antenna.

This type of array patch antennas is an easy way to make phase array of antenna using dynamic beam forming property [11][2]. Also in additional patch antennas are having ability to have polarization diversity. Patch antennas can easily be designed which having vertical, horizontal, right hand circular (RHCP) also left hand circular (LHCP) polarizations, by applying multiple feed points, as well as single feed point with asymmetric patch structures. Due to unique property of patch antennas they used in many types of various communication applications with rise in requirements.

3. DESIGNING

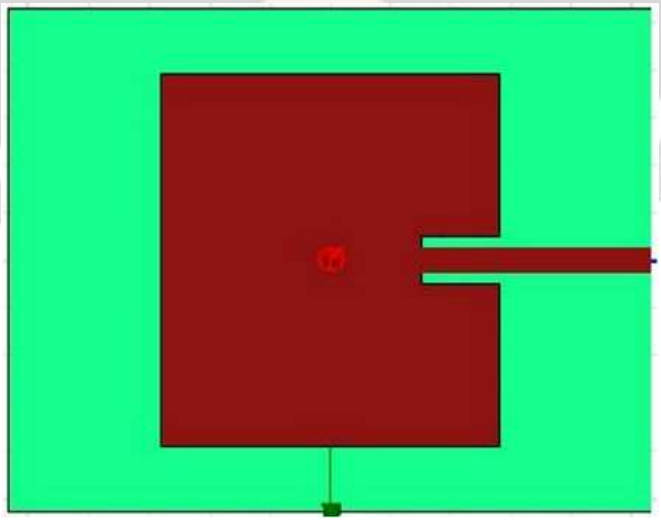

Fig -2. Microstrip patch antenna

A simple rectangular microstrip patch antenna is designed in HFSS simulation software to operate at 2.4GHz, with FR4 epoxy dielectric constant as substrate material. FR4 epoxy dielectric substrate having advantages like economical, thin, loss less over other. The length and width of the patch are 38mm and 29mm respectively. The feed point is 7.5mm from the center of the patch as shown in fig 2.

4. SIMULATION

4.1 For single radiating element

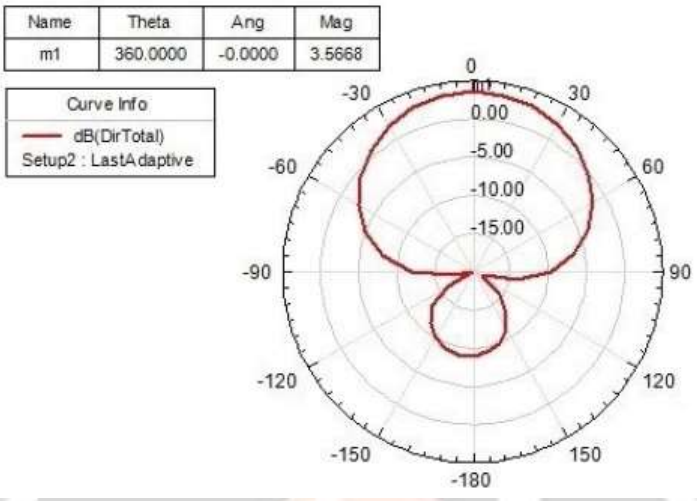

Fig -3. Radiation Pattern For single radiating element

4.2 For 2X1 Rectangular antenna Array

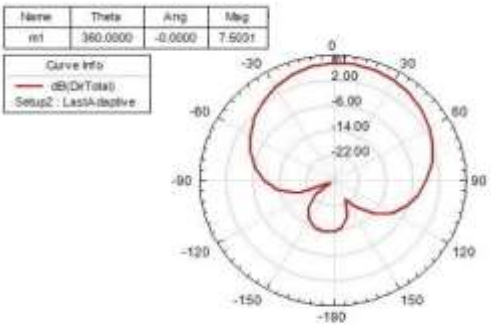

Fig -4. Radiation Pattern

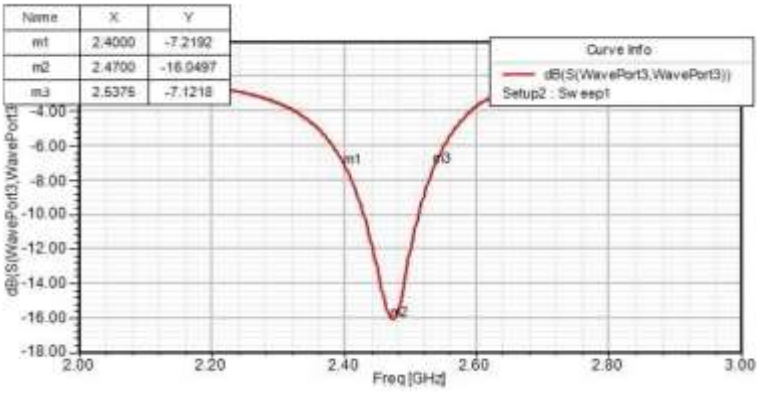

Fig -5. Return loss

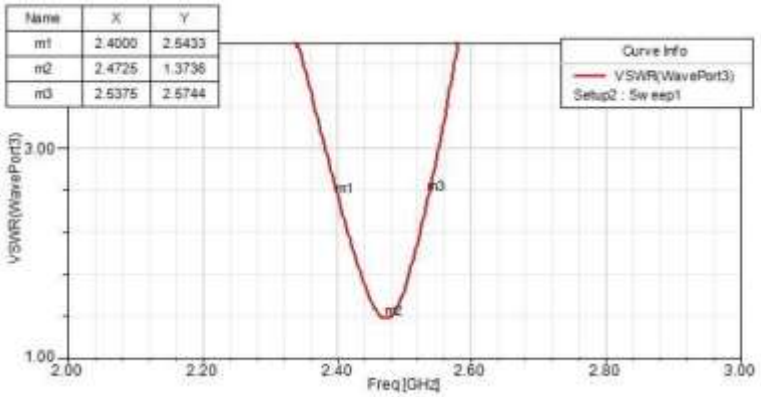

Fig -6. VSWR

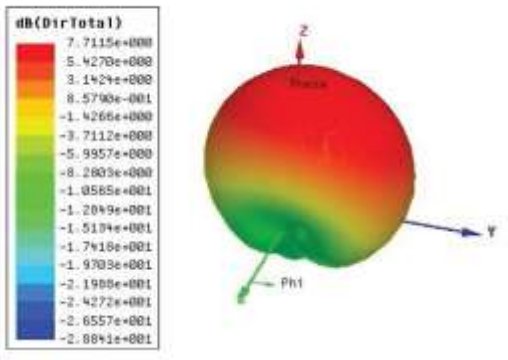

Fig -7. Directivity

5. CONCLUSIONS

From the simulation result single radiating element and 2X1 microstrip patch antenna array using HFSS simulation software is implementation has been completed hence from the result 2X1 microstrip patch antenna giving better performance therefore antenna array can be use for longer distance communication applications

6. ACKNOWLEDGEMENT

I am extremely grateful to **Prof. Dr. D. J. Garkal** , Principal, Jaihind College of Engineering , Kuran, Pune- 410511 and **Dr.(Mrs.) V. M. Dhede,** Head of Department, Department of Electronics and Telecommunication**,** for providing all the required resources for the successful completion of my Project. My heartfelt gratitude to my Project guide **Dr.(Mrs.) V.M.Dhede ,** Head of Department, Department of Electronics and Telecommunication, for her valuable suggestions and guidance in the preparation of the Project report. Many thanks to all the staff and friends for all the help and coordination that has been made in delivering this work successfully on time. Also I like to grateful thanks to the authors of the references and other literatures referred to in this Project. Last but not least; Many thanks to my parents for guiding me in all the steps I took.

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