

Design of Meta Material Inspired Series and Corporate Feed Network Antenna



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Abstract. *The present techniques are in the form of open literature used to work on selected frequency that has eight and sixteen rectangular patches. The size of it has become compact. Each approach offers different advantages, depending on the required applications. An array antenna is designed and analyzed using series and corporate feed network. The FR4 substrate material which is of low cost and easily available in market is used to design the array antenna. An analysis is carried out for both series and corporate feed array antenna in terms of return loss, peak gain, VSWR, directivity, and bandwidth. The antenna's size is reduced to a very compact size using optimization techniques without degrading the performance characteristics. The design is implemented to work for the multiband applications rather than a single application. Simulation is carried out in HFSS (High Frequency Structure Simulator) software tool. The design proposed is analyzed based on the performance and then it is fabricated.*

Keywords: *Micro strip patch antenna, array antenna, corporate feed array, series feed array, Micro strip line feed array, return loss.*

I. INTRODUCTION

As the world changes rapidly in wireless communication systems, the multiband antenna plays an important role in wireless service requirements. There is a need to for the commercial and official government communication to develop a low cost, less weight, low profile antennas which has capability to maintain the high performance over a large spectrum of frequencies. Through the years, micro strip patch antenna is the most common option available to realize millimeter wave monolithic integrated circuits for microwave, communication purpose and for the radar purpose. Between the ranges of frequencies selected, the antenna should have stable response in terms of gain, radiation pattern, directivity etc. At the same time, it should of small size, low cost and should be easily integrated into the RF circuits onto the circuit boards directly we can print the micro strip patch antennas. Since in the design of the antenna requires few materials, it should be of low cost, easy to manufacture and lightweight.

These Characteristics which involves the patch antenna should be in the use of portable devices like cell phones and small voltage electronic devices.

Each and every antenna has dielectric substrate which consists of ground plane on the other side. It plays the major role in the wireless communications. Due to its features, such as less weight, suited to use in many wireless applications. Such as Medical, WLAN, Radar and the satellite applications. In this paper series and corporate rectangular patch array antennas are designed with meta materials inspired by periodic structures like splitting resonators to enhance the performance of the antenna. The main purpose of using this meta material is to work for multiple frequency bands can be used for medical applications as well as satellite communications.

II. LITERATURE SURVEY

The Rectangular Micro Strip Patch Antenna with Photonic Band Gap Crystal is used for 60GHz Communications. The photonic band gap structure is used to enhance the radiation and bandwidth. By using the periodic structures the frequency bands can be opened up within which the propagation of EM waves are forbidden with irrespective of direction of the propagation. Using the CST Microwave studio the designed antenna model is optimized for 60 GHz applications. As the air gaps are incorporated in the substrate and the antennas bandwidth is increased. The size of the waveguide devices in the order of the wavelength of light and it can be realized by using the strong confinement light by the photonic band gap [4]. In fact, many micro scale photonic crystal optical waveguide devices have been proposed. By using the Optimization Program in Java, the rectangular and U slotted micro strip Patch can be designed and analysis for UHF Applications bandwidth enhancement techniques such as use of various substrate with low relative dielectric constant (ϵ_r), size of antenna as well as U slotted patch antenna with coaxial probe feed technique are discussed technique as well as U slotted patch antenna with coaxial probe feed technique are discussed and explained using program in java and the genetic algorithm is developed [6]. In order to introduce the appropriate in designing of the antenna, it is necessary to determine the dielectric layer effect and antenna parameters shapes in order to introduce the appropriate correctness in the antenna design. To improve antenna element performances and to reduce the mutual coupling of the micro strip antenna array. To solve out many problems which degrades the functional efficiency of the system by using the EBG technology. Throughout the operating frequency band which is defined by characteristics of return loss, the beam peak directions, F/B ratios, cross-polarization and gain are good [8].

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The effects of reflection phase profiles of EBG structures which consists of dipole antenna have been studied. The first part of the study includes the dipole driving-point impedance characterization and bandwidth as a function of a hypothetical EBG structure which provides a constant reflection phase.

III. EXISTINGSYSTEM

In existing work technological trend to design, antennas are focused much into the micro strip patch antenna. In this manner rectangular patch antennas are designed and simulated by using the HFSS software. An soft-High Frequency Structure Simulator (HFSS) analysis is carried out by comparing the two elements, four elements and eight elements in the series feed network and the corporate feed network. This analysis is carried out in the form of return loss, gain and directivity. Details of obtained results were discussed and by using the RT-DUROID substrate. In that, the analysis of series feed which is used in every sub array which is presented with the emphasis on ensuring the proper phasing and power distribution equally for each element. In series feed network the feed width depends on patch edge width which directly related to impedance of both patch and feed. By reducing the width of the patch, the radiation conductance is insufficient to match the input network. The characteristics impedance of the connecting feed lines have no effect at center frequency. You have to match the impedance of the patch which is directly attached to SMA connector. The matching can be done through inset feed method or using matching transformer.

IV. PROPOSEDSYSTEM

The rectangular patch high bandwidth and high gain antennas were designed by using met materials concepts. The dielectric substrate consists of rectangular array patches on one side and ground plane on the other side in the Micro strip antenna. The substrate material used here to design is FR4 epoxy which consists of relative permittivity of value 4.4 and loss tangent of 0.02. The thickness given to substrate is 1.6mm. The antenna designed by using HFSS software. The inset feed is used. The length and width of the rectangular patch are 3cm and 2cm. The meta material is designed to have the properties which cannot be found on the materials that can be naturally occurred. The materials are usually arranged in repeating patterns, so that they can derive their required properties from the newly designed structures but not from the base materials.

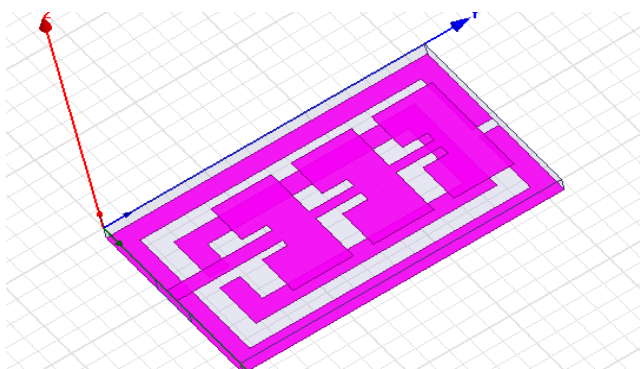


Figure 1: Rectangular patch array antenna with a series feed

A series feed micro strip antenna array is formed with meta material to the ground in the form of splitting resonator by all the elements interconnecting. Where in set feed is used for the proper impedance matching and high impedance transmission line and feeding the power at the first element.

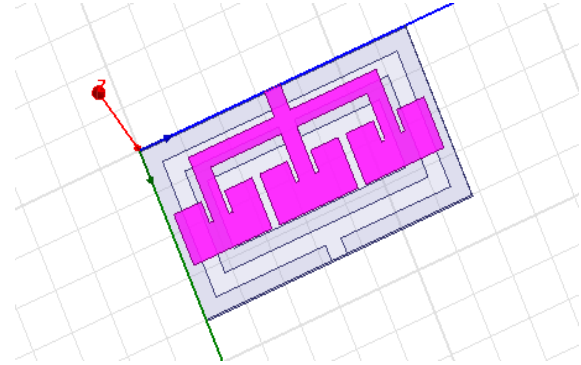


Figure 2: Rectangular patch array antenna with a corporate feed

A corporate feed is most popularly used parallel feed configuration and the power is equally distributed. The elements are feed by power divider network 1:n with identical path lengths from the input power source through transmission line feed. The meta material used in this is to enhance performance characteristics

V. SIMULATION RESULTS

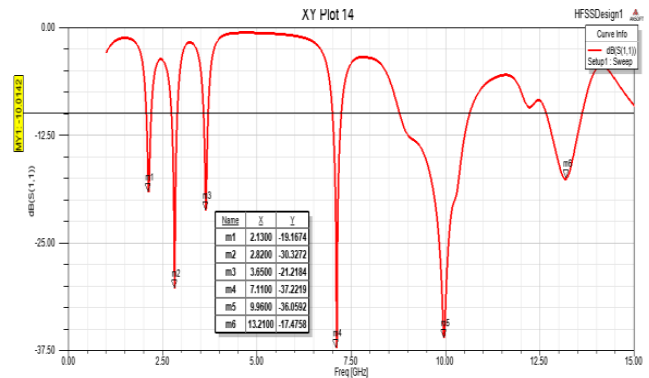


Figure 3: Return loss for rectangular patch series feed

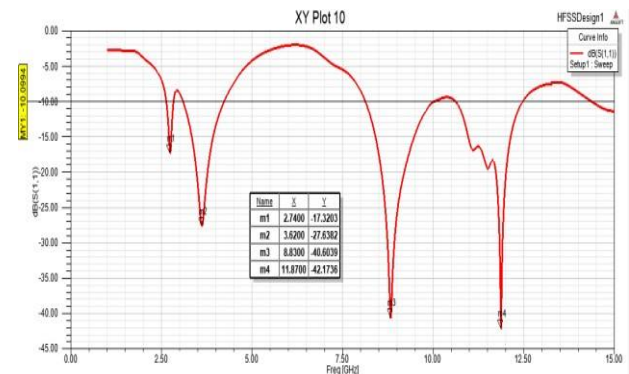


Figure 4: Return loss for rectangular patch corporate feed

The simulation results had obtained for the proposed design of a rectangular patch array antenna by using meta materials as shown.

The performance characteristics like return loss, VSWR. Since the return loss in series feed obtained is -37.22 dB at resonating frequency 7.1 GHz and incorporate feed return loss is -42.1736 dB at the resonating frequency is 11.8GHz. By this we can say that input power given to the antenna is almost accepted and where less amount it is get reflected back and we say that input feed line is perfectly matched with the patch.

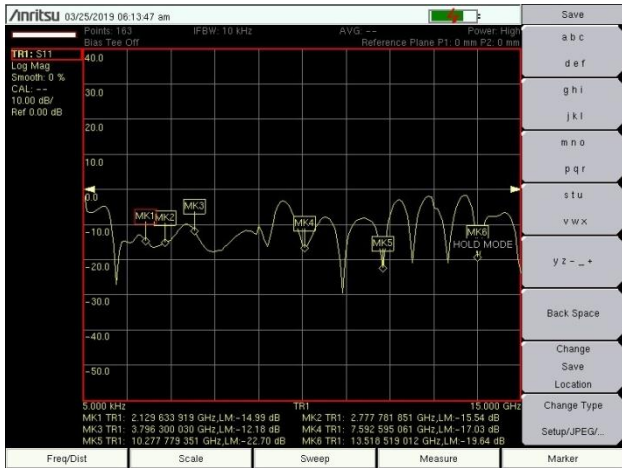


Figure 5: Return loss for series feed tested antenna

From Fig 5 shows the testing results for the series feed network with meta materials. When we compare testing results and the simulation results the resonating frequencies and the return loss values are approximately same.

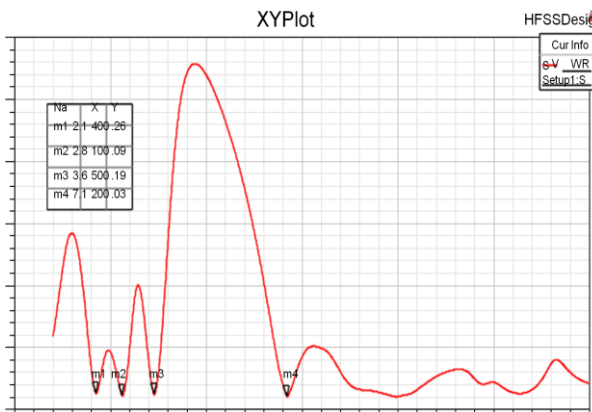


Figure 6: VSWR of rectangular patch series feed

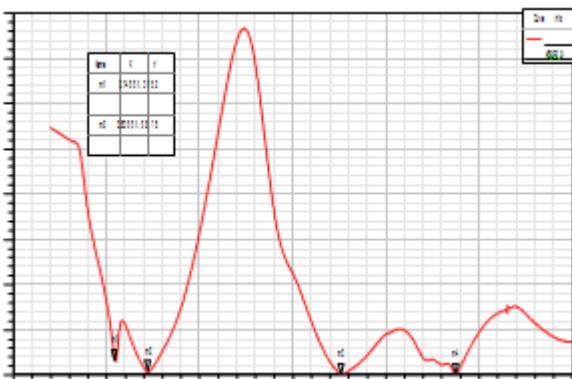


Figure 7: VSWR of rectangular patch corporate feed

The VSWR is the measure of how efficiently power is transmitted from a power source, through a transmission line and find whether it is perfectly matched or not. If the value of VSWR is equal to 1 then it is perfectly matched. In this design from figure 5,6 the value of VSWR is 1.0316 and 1.0188 so we can say that proposed design feed and the patch is perfectly matched.

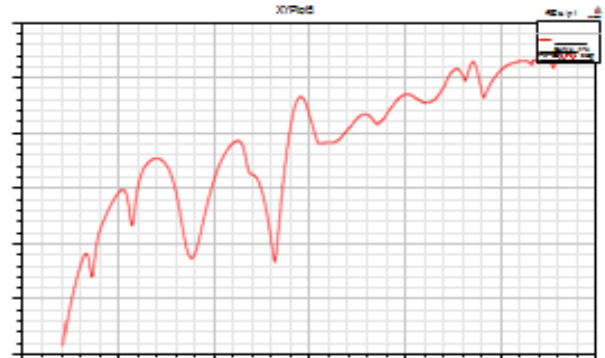


Figure 8: Peak gain of rectangular patch corporate feed

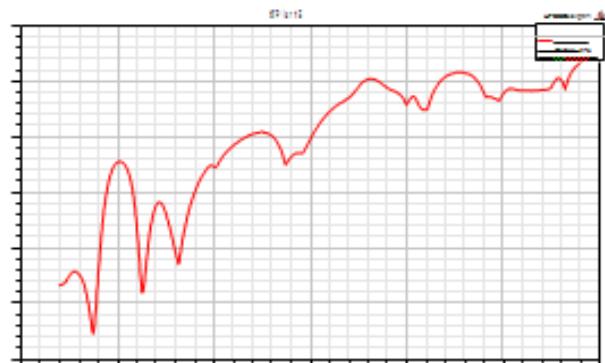
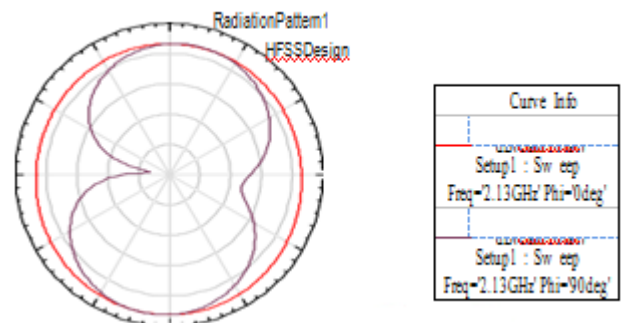


Figure 9: Peak gain of rectangular patch corporate feed

The product of efficiency and directivity of the antenna can be defined as the Gain whereas the antenna gains the ratio of power that is produced by antenna from a far field source on antennas beam to the power that is produced by lossless isotropic antenna. In transmitting antenna, the gain clearly represents that antenna converts the input power into radio waves which are headed in the specific direction. Gain or loss of the antenna is formulated as the $10 \cdot \log(P_{out}/P_{in})$ which can be measured in decibel (dB). For every increase of 3dB in the gain, the range of the antenna is doubled. Generally, it really does not “double” the range but it is like taking range from other direction and make that focus on desired direction.



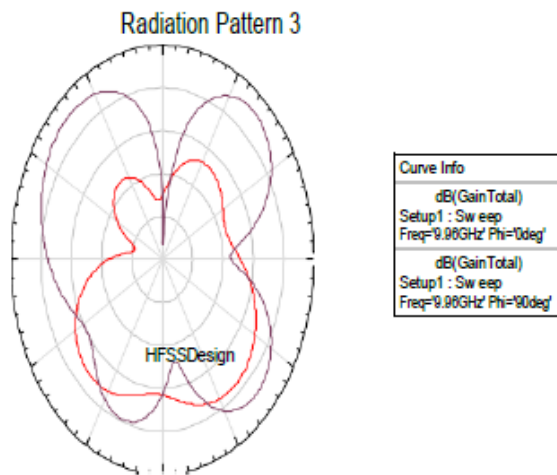
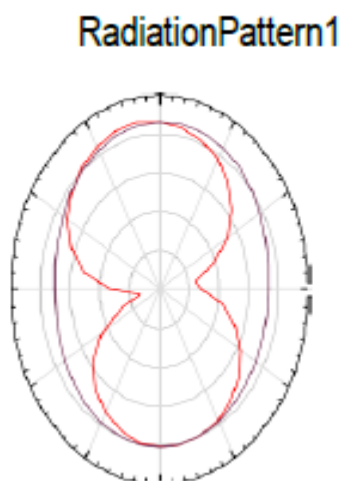


Figure 9: Radiation patterns of series feed



Antenna pattern shows the 3-D graphical representation of the antennas radiation in the function of a direction. It is the plot that represents the power which is radiated from antenna per unit solid angle which gives the intensity of antennas radiation. This radiation pattern gives the information about the antenna beam width, side lobes and antenna resolution.

VI. CONCLUSION

The reason to implement this micro strip patch antenna is to increase the gain performance. In this multiple band, operations have been obtained by using Meta materials below the substrate. In many applications it can be used like medical, radar and satellite communications. By using this we can design the antennas with high directive characteristics so that it can reach for long distance communication in the form of array antennas. For an array antenna where increases in a number of patches gain and directivity increases whatever the feeding method (series or corporate). Finally a series and corporate feed network with meta material has been designed and further simulated on the ground plane. It is concluded that in comparison of both the antennas the series feed network gives a better output performance for multiple frequencies.

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