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An Innovative Attempt for Improvement of Gain and Bandwidth By Means of Dual E-Shaped Microstrip Antenna

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ABSTRACT: The paper represents the designing and study of a dual E-shaped microstrip patch antenna. The major purpose following the designing of this kind of an antenna arrangement is to function in a number of frequency bands which effects in increasing the usefulness of the antenna for numerous purposes. With the purpose of instilling this objective a dual E-shaped microstrip antenna is designed which enhances the bandwidth and the gain of the antenna. The dual E-shape Microstrip antenna is built by utilising an air gap between the ground plane and the fed patch plane. The designed antenna arrangement introduces different methods like dual E-shaped patch structure, stacked antenna structure, probe feeding etc. so as to improve gain of the configuration compared with the usual antenna. The simulated effects illustrate increase of gain with bandwidth in comparison with usual rectangular microstrip antenna. Additionally parametric analysis is done so as to assist in the design and optimization procedure.

KEYWORDS: Microstrip Patch Antenna ,Dual E-Shaped , ,co-axial feed, IE3D .

I. INTRODUCTION

The radical and active progress in the domain of wireless communication guides to smallness of the device dimension without negotiation with its attributes. Antenna is one of the necessary requirements for some wireless communication method. Due to the reduction of the size of the communication system, the antenna structure utilization in it should also be decreased without influencing its quality of function. A lot of usual antennas similar to Yagi Uda, Parabolic Reflector, Helical, Horn etc possess broader bandwidth and gain but huge size of these antennas limit their utilization in different applications. As a result these antennas cannot be utilized in the devices which are smaller in size and are made use of as a moving entity [2]. In order to meet this necessity of wireless communication microstrip antennas are extensively used which satisfies the requirements of the wireless communication system. In modern years, many methods have been described to attain broadband patch antenna for recent wireless communication devices. A single layer broadband E-shape rectangular patch antenna with attainable good impedance bandwidth has been exhibited. The patch substrates of these type of antennas are non-inverted.

In order to diminish the size of antennas by attaining dual band or broad bandwidth, shorting pins or shorting walls on the irregular arms of a U-shaped patch, L-strip patch, U-slot patch and L-probe patch are used. Moreover researchers utilized stacked antenna configuration, antenna array, suspended ground plane, inverted antenna arrangement etc. to develop the bandwidth and gain of the antenna arrangement. Innovative ideas are even being discovered and utilized to increase the antenna gain and bandwidth. Microstrip antenna possessing small size and two dimension arrangements are extensively utilized for it. Along with this small size and two dimensional arrangement of microstrip antenna possess a few other benefits like low manufacturing cost, simple to fabricate etc [3].

II. ANTENNA CONFIGURATION

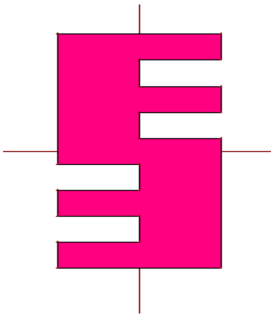

Fig.1 (a) Geometry of dual E-shape

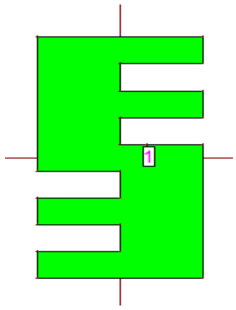

Fig. 1 (b) Antenna Structure of Dual Shape

The antenna geometry illustrated in Fig.1 (a) has just one patch, which is easier than conventional broad-band microstrip antennas. Antenna is devised by using line feed to resonate at frequency of 2.4 GHz. The patch is mounted on a glass substrate along with comparative permittivity, ε_r as 2.2 mm, length of patch as 27.4 mm height of patch as 2 mm and width of patch as 49.4mm.The antenna shown above in Fig.1 (b) includes the arrangement of designing of Microstrip Patch antenna The feeding strip is joined with an additional strip that goes right through a layer of air linking to a 50 Ohm microstrip co-axial feed point at 4.57 mm from source.

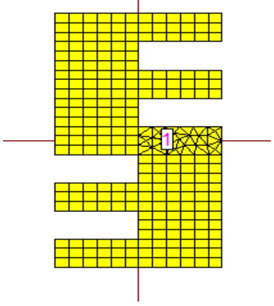

Fig. 1 (c) Meshed Patch of dual E-shape

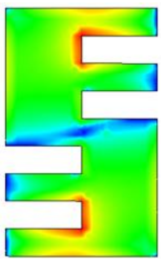

Fig. 1 (d) Current Density of dual E-shape

The Fig. 1 (c) portrays the dual E-shape antenna at 2.4 GHz frequency with 50 cells for every wavelength which looks like a meshed structure .On the whole it is done so as to enhance the bandwidth and diminish the cross polarization of the antenna dimensions of gain. The figure characterized in Fig.1 (d) demonstrates the current distribution performance of dual shaped E-shape Antenna at 2.4 GHz excitation. The important alteration in radiation pattern of arrays can be attained by altering current distribution array of the antenna, including phase delay among elements, variation in the radiation features of distinct radiating structure in an array, modification in the geometry of the array and by altering the inter-element spacing.

III. DESIGN SPECIFICATIONS

[a] Design Equations:

1. Calculation of width (w) of patch computed by the formula

$$w = \frac{v_0}{2 f_r}\sqrt{\frac{2}{\varepsilon_r + 1}} \qquad (1)$$

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Where, v_0= speed of light in free space, ε_r =dielectric constant of patch

2. Calculation of effective dielectric constant ε_{reff} computed by the formu

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{w}\right]^{-\frac{1}{2}} \qquad (2)$$

Here, h and w signify the height of the patch, width of the patch respectively.

3. Calculation of extension of length (Δl) of patch computed by the formula

$$\Delta l = 0.412\frac{(\varepsilon_{reff} + 0.3)(\frac{w}{h} + 0.264)}{(\varepsilon_{reff} - 0.258)(\frac{w}{h} + 0.8)} \qquad (3)$$

4. Calculation of length (l) of patch computed by the formula

$$l = \frac{1}{2 f_r \sqrt{\varepsilon_{reff}}\sqrt{\mu_0 \varepsilon_0}} - 2\Delta l \qquad (4)$$

Here, f_r , ε_{reff} , μ_0 , ε_0 signify the resonant frequency of antenna, efficient dielectric constant of antenna, permeability of the substrate, permittivity of the substrate respectively. The vital parameters for the design Microstrip Patch Antenna are as follows: f= 2.4 GHz, ε_r = 2.2, h=2mm. We have obtained the feed point at 4.57mm from centre. After substituting the vital parameters in the above design equations we get the length l=27.4mm and width w=49.4mm respectively.

IV. PERFORMANCE EVALUATION

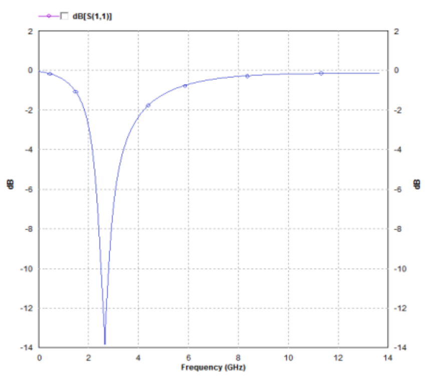

Fig. 2 (a) Return Loss characteristics of dual E-Shape Antena

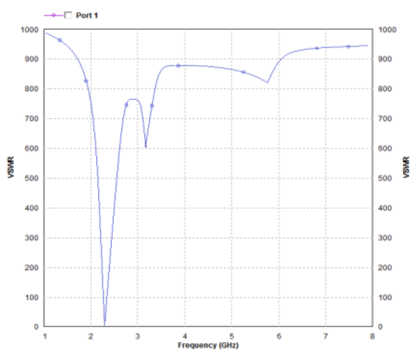

Fig. 2 (b) VSWR characteristics of dual E-shape

The graph in Fig. 2 (a) explains the Return loss attained at 2.4 GHz frequency which is about -13.88 dB. Return loss is correlated to both standing wave ratio (SWR) and reflection coefficient (Γ). It is a determination of how fine devices or lines are matched. Above graph in Fig. 2 (b) describes the VSWR (Voltage Standing Wave Ratio)of the antenna attained at 2.4 GHz which is around 1.3 .VSWR is a measure of the quantity of power delivered to an antenna. The VSWR is also a determination of how nearly the source and load impedance are matched.

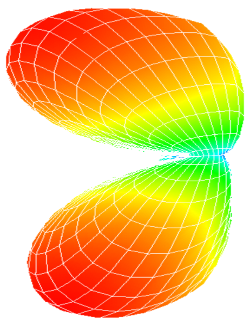

Fig.2 (c) 3-D Gain Pattern of dual E-shape

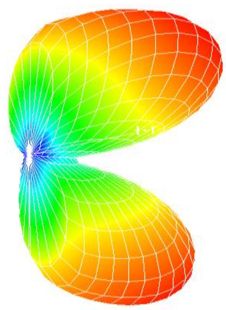

Fig.2 (d) 3-D Directivity Pattern of dual E-shape

Above diagram in Fig. 2 (c) signifies the three dimensional gain pattern of the antenna. Antenna directivity is the ratio of maximum radiation intensity (power per unit surface) emitted by the antenna in the maximum direction divided by the intensity radiated by a hypothetical isotropic radiating the same total power as that antenna .Above Fig. 2 (d) illustrates the three dimensional pattern of directivity in dB scale for the antenna. Gain as a parameter determines the directionality of a specified antenna. An antenna having a low gain emits radiation in all directions uniformly, while a high-gain antenna will preferentially radiate in specific directions.

V. DISCUSSION

A single air space, dual E-Shaped antenna is devised and simulated over IE3D version 12. Such a designed antenna structure consists of probe feeding technique for the feeding requirement. This antenna structure offers a excellent amount of gain. The optimum consequences of recommended antenna is demonstrated and tested by using IE3D SIMULATOR. Although the effectiveness of the antenna is not at its maximum, in spite of that it can be utilized in different applications. The increase in the effectiveness is a parameter which is under investigation.

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