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RESEARCH ARTICLE

A NOVEL L SHAPE MICROSTRIP PATCH ANTENNA.

Priyanka Jain¹, Vikas Maheshwari² and Vandana Vikas Thakre².

1. Deptt. of ECE, Amity School of Engg & Technology, Amity University Madhya-Pradesh, Gwalior, M.P., INDIA.
2. Deptt of ECE, Madhav Institute of Technology and Science, Gwalior, M.P., INDIA.

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Abstract

In this proposed design a Rectangular micro-strip patch antenna is present with cutting L shaped slots within the Rectangular patch which operate at four central frequencies 2.04,3.2,3.8,4.3GHz Which is a new multi-frequency microstrip antenna. By proposed antenna design and coaxial feeding at suitable place the resultant return loss, VSWR and bandwidth will be find out. For the propose microstrip antenna we have use FR-4 substrate which contain permittivity of 4.4 and thickness 1.5, loss tangent is 0.02. HFSS simulation software is used for designing and analysis. With slotted patch antenna and coaxial feeding at appropriate location better return loss, VSWR bandwidth and multiband performance will be obtained.

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Introduction:-

In recent instance the requirement for the multi mode antenna is demanded for person to person communication network which have been rising. The growing amount of mobile services incorporated into particular telecommunication system which has made multiband function an important characteristic of mobile phone antennas [1]. In current years, the dual-band or multi-band antennas contain a huge awareness for application towards multimode communication systems [2]. It is finely known that standard of microstrip patch antennas are smart explanation of lot of wireless communication which demand due to their low-priced, average, comfortable, and easy-to-manufacture structural design [3]. On the other hand, the bandwidth of the main configuration in a lot of application is not enough to wrap up the needed functioning frequency range.

The patch antennas typically have narrow bandwidth and regarding the bandwidth enhancement several techniques have been proposed, including the use of an impedance matching network, the use of multiple resonators, thick substrate, planar inverted F antenna, the shorted L-probe or U-slot antennas [4]. While a microstrip patch antenna is overloaded by reactive element such as slot, stub or shorting pin, it give tunable or multi frequency antenna features. For the most part a well-liked method for obtain multi-frequency behaviour is to introduce the slots lying on a single patch [5].

In this paper, a multiband L-shape microstrip patch antenna is proposed. The modified multiband L-shape microstrip patch antenna shows the ability to create multi-bands at different frequencies. The multiband behaviour of the modified L-shape microstrip patch antenna is described in terms of the number of return losses. The radiation patterns of the measured modified L shape microstrip patch antenna clearly show the power radiated by an antenna at different frequencies [6].

Corresponding Author:- Priyanka Jain.

Address:- Deptt. of ECE, Amity School of Engg & Technology, Amity University Madhya-Pradesh, Gwalior, M.P., INDIA.

The proposed design presents an approach of the rectangular patch with three L-type slot of different size, based with the commercial electromagnetic simulation tool, the FEM based software, HFSS by ANSOFT. Section II describes the antenna design and analysis for microstrip patch antenna. Simulations and results of antenna are projected in Section III. Conclusion is followed by the Section IV.

Antenna design and analysis:-

The proposed antenna construction is given away in Fig. 1. The rectangular microstrip patch of measurement $W \times L$ in print on the grounded substrate, which contain a relative permittivity ϵ_r and also consistent by width h , the dielectric material is theoretically nonmagnetic by means of permeability μ_0 . The L-shaped slot with two small L-shaped slots among measurement $(L1, W1), (L2, W2), (L3, W3)$ is preset in a rectangular patch (see Figure 1), the L-shaped patch rectangular antenna characteristics multi-band behaviour. The patch is feed with coaxial probe (50Ω) which is easy to formulate and have simulated radiation. In proposed feeding method, the coaxial connector with the inside conductor extend as of ground from end to end the substrate and is soldered to the radiating patch, whereas the external conductor extend from ground up towards substrate .

The propose mathematical design of the practical antenna is given below

a. Effective Dielectric Constant:

$$\epsilon_{reff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} [1 + 12 \frac{h}{W}]^{-0.5} \quad (1)$$

b. Fringes Factor:

$$\Delta L = 0.412h \frac{(\epsilon_{reff} + 0.3)(\frac{W}{h} + 0.264)}{(\epsilon_{reff} - 0.258)(\frac{W}{h} + 0.8)} \quad (2)$$

c. Calculation of Length:

$$L = L_{eff} - 2\Delta L \quad (3)$$

Where

$$L_{eff} = \frac{c}{2f_r \sqrt{\epsilon_{reff}}} \quad (4)$$

d. Calculation of Width:

$$W = \frac{c}{2f_r \sqrt{\frac{\epsilon_r + 1}{2}}} \quad (5)$$

e. Calculation of Ground Plane Dimensions:

$$L_g = L + 6h, W_g = W + 6h \quad (6)$$

Where W is width of patch and h is the height of substrate, L is length of patch ΔL is extension in length due to fringing effect and c is speed of light in free space f_r is resonant frequency [5].

In this proposed design the computation of length and width are done by given formulas. The dimension of antenna is given by table 1. As shown in the figure.1 the patch has three types of L shaped slot their dimensions are also given in table1. We used ‘FR4’ material for substrate which has dielectric constant 4.4 and height for this material is 1.5. Figure.2 shows the design of antenna in software.

variable	L	W	L1	L2	L3	W1	W2	W3	C1	C2	C3	C4	C5	C6
value	16	36	10	4	4	30	10	10	1	1	2	4	2	4

Table 1:- Dimensions of the Microstrip Patch Antenna

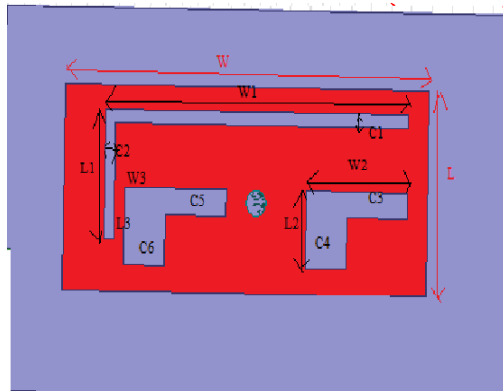


Fig. 1 Image of patch antenna

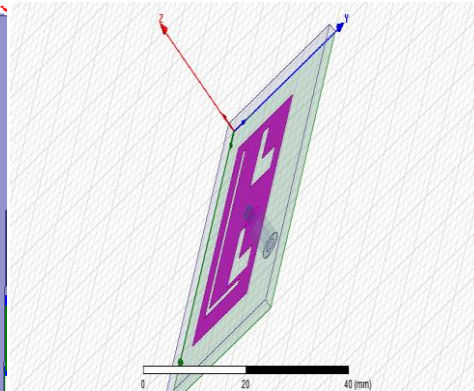


Fig. 2 Antenna design in software

Simulation and result analysis:-

HFSS simulation software is use for the simulation of micro-strip patch antenna. The deviation of return loss with frequency is shown in figure (3) of rectangular patch antenna through these L shaped slots. The proportion ratio of the Fourier transform of the incident pulse and the reflected signal is defined as the return loss which is an essential factor for antenna design. Figure (4) shows the VSWR graph for L shaped slotted rectangular patch antenna which is below than 2 for this multiband antenna. The VSWR indicate the difference among the transmission line and the antenna and for perfect matching the VSWR value must be close to unity. The return loss for the multiband microstrip patch antenna is shown in the figure (3) by which the four band is getting by this proposed design these are (2.04,-15.14), (3.2,-20), (3.8,-16.6) (4.3,-16.9). The bandwidth is calculate at the frequency range where the return loss is just about below the -10dB and by the calculation it is given as 294MHz, 1773MHz, 311MHz, 226MHz. Gain and directivity of antenna is shown in figure5 and 6. Figure (7) shows the simulated radiation pattern in 3D and the Smith chart is shown in figure (8) for the L shaped Slotted rectangular micro-strip patch antenna.

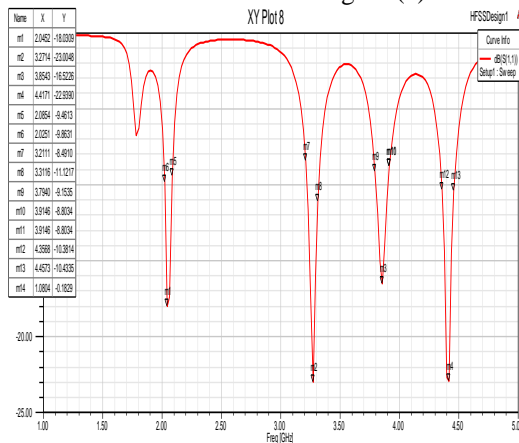


Fig. 3 Return Loss Of Antenna

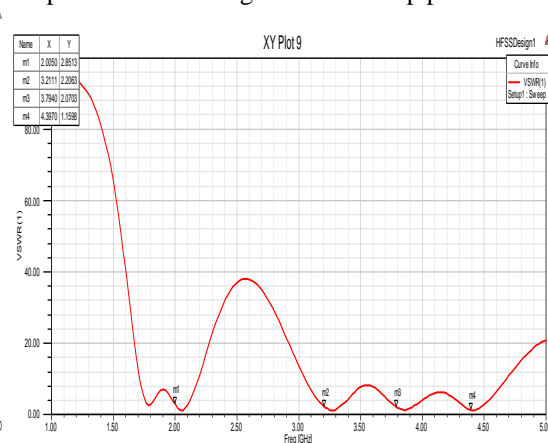


Fig. 4 VSWR Of Antenna

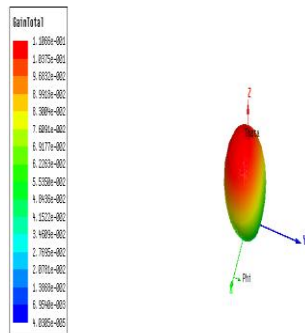


Fig. 5 Gain Of Antenna

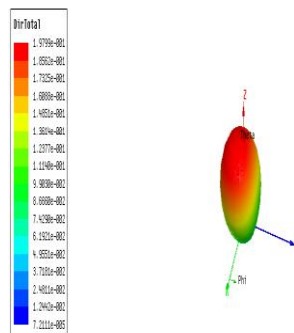


Fig. 6 Directivity Of Antenna

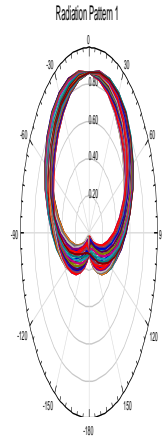


Fig: 7 Radiation pattern Of Antenna

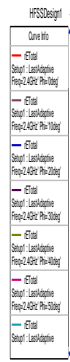


Fig: 8 Smith chart representation Of Antenna

Conclusion:-

The proposed L-shaped slot loaded rectangular microstrip patch structure can operate on more than two resonance frequencies and consequently this design can be used for multi band Operation. The properties of different physical parameter of antenna are investigated on the characteristics of this configuration. The present configuration could be capable of to meet up the requirement of different frequencies of wireless communication systems directly beside introducing slots of l-type in the dimension of the main antenna. Mathematical result show that in cooperation with the upper and lower resonant frequencies, the band widths relate to the dimension of the slot, by appropriately choosing the position of feed point and the slots multi bands can be achieved and controlled.

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