DUAL BAND L-SHAPED MICROSTRIP PATCH ANTENNA FOR 5/9 GHZ

Meenaxi[1], Pavan Kumar Shukla[2]

[1]*Department of Electronics and Communication Engineering, Shri Venkateshwara University, Gajrola, U.P. (India)*

[2]*Department of Electronics and Communication Engineering, Uttarakhand Technical University, Deharadun, Uttarakhand(India)*

ABSTRACT

This paper presents coaxial feed rectangular microstrip patch antenna. A narrow L- shaped microstrip antenna is fed at the corner using a coaxial feed to obtain a LP operation. Experiments are carriedout to investigate its return loss, its radiation and its time domain behavior, which exhibit good radiation pattern. The simple rectangular and compact L-shaped microstrip antenna is simulated with IE3D and their corresponding result is compared.

Keywords: Resonant, L Shaped Microstrip Antenna.

I. INTRODUCTION

Microstrip patch antennas (MPAs) are widely prefered due to their small size, light weight, low profile and low cost with the fact that they are simple to manufacture, suited to planar and nonplanar surfaces, mechanically robust, easily integrated with circuits, allow multifrequency operation to be achieved. A microstrip patch antenna is a good choice as fabricated with high gain, customizable beam and returns loss properties, and other unique features, at low cost.patch antenna is usually constructed on a dielectric substrate, using the same materials and lithography processes used to make printed circuit boards. In this design, LP operation is accomplished by forming the L-shape patch of unequal lengths for a square microstrip antenna using a coaxial feed. The two metal sheets together form a resonant piece. When feeding is connected to the patch, the patch would be treated as capacitor and the feeding as inductor thus a L-C circuit is formed, called resonant circuit. The L-shaped patch is used instead of the conventional rectangular micro strip patch antenna. The antenna is designed to function in the frequency band of 7-11GHz in [1]. With dielectric substrate of total thickness 4.15 mm, possibility of achieving better impedance bandwidth for VSWR <2. Now we have purposed an antenna of thichness 1.5 mm for dual band of 5 GHz and 9 GHz. This structure will improve the impedance bandwidth and gain of the antenna and will reduce the size of antenna.

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II. ANTENNA GEOMETRY AND DESIGN

We have purposed an antenna, fabricated on a 1.5 mm substrate FR-4 of dielectric constant equal to 3.4 and its front view is shown in Fig.1. A co-axial feed is used for purposed antenna. The ground plane is of size L_g* W_g = 28 * 35 mm. The patch is feed by co-axial cable. As per the cavity modal theory , a normal microstrip patch antenna can be modeled as parallel LC circuit. The current will flow from the feeding point to the patch and circulate in top and bottom edges of the patch. We can calculatev the value of L and C using current path length: The patch width, effective dielectric constant, the length extension and also patch length are given by

$$W = \frac{c}{2f\sqrt{\epsilon r}} \quad \text{.....(1)}$$

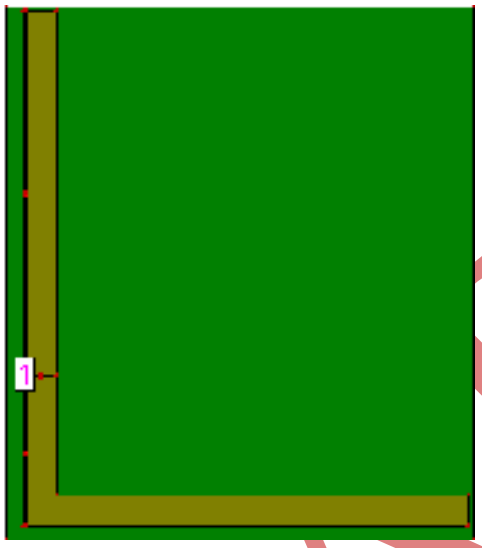

Fig.1 Geometry of purposed antenna

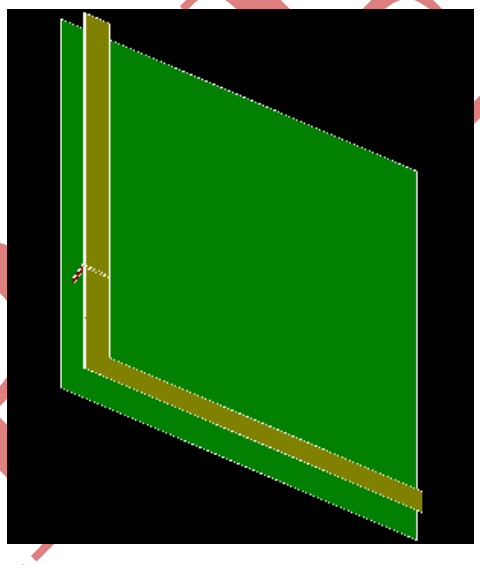

Fig.2 Side view of purposed antenna

Where **c** is the velocity of light, ε_r is substrate dielectric constant, f is the antenna working frequency, W is the patch nonresonant width, and the effective dielectric constant is ε_{eff}, is given below

$$\varepsilon_{eff} = \frac{\epsilon_r H}{2} + \frac{\epsilon_r H}{2}\left\{1 + \frac{10\,H}{W}\right\}^{1/2} \quad \text{.....(2)}$$

The extension length is calculated as

$$\frac{\Delta}{H} = \frac{(\varepsilon eff + .300)(\frac{W}{H} + .262)}{(\varepsilon eff - .258)(\frac{W}{H} + .813)} \quad \text{.....(3)}$$

By using above equation we can find the value of actual length of the patch is

$$L = W - 2\Delta \quad \text{.....(4)}$$

W is the width and L is the length and H is the thickness of microstrip patch antenna. W is the width and L is the length andh is the thickness of rectangular microstrip patch antenna. The co-axial feed is located at the corner of

the L-shaped rectangular microstrip antenna. Now we have taken small value of substrate thickness is 1.5 mm then after calculation we got width and length of the patch are 33.71 and 26.60 mm of proposed antenna.

III. RESULT AND DISCUSSION

Based on the parametric studies of a L-shape antenna, the simulated S11 parameter is shown in Fig. 3. We can see clearly that two separated resonant modes at the desired operating frequencies are successfully excited with co-axial feed. From the measured results, the lower resonant frequency has a -10dB impedance bandwidth of 1400 MHz (28%), which is sufficient to cover 5 GHz band for WLAN & UNII operation. For the second resonant frequency, the measured -10dB impedance bandwidth is (17.9%) to cover the 8.9 GHz frequency band which is suitable for SAR and PSA. Simulated return loss is shown in Fig.3.

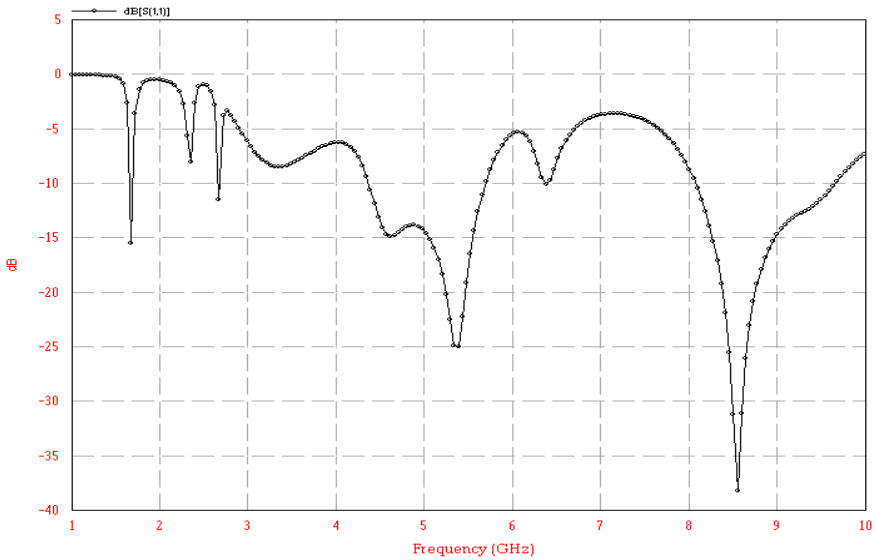

Fig.3: Return lossVs frequency plot of L-shaped on IE3D

We can see that for the purposed antenna VSWR is less than 2 in Fig.4

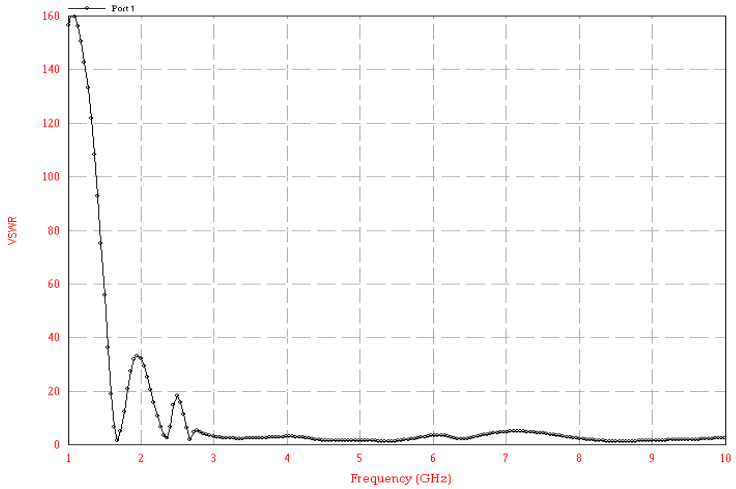

Fig.4: VSWR of optimized L-shape antenna

Simulated smith chart shows the impedance matching criteria of proposed antenna as shown in Fig.5

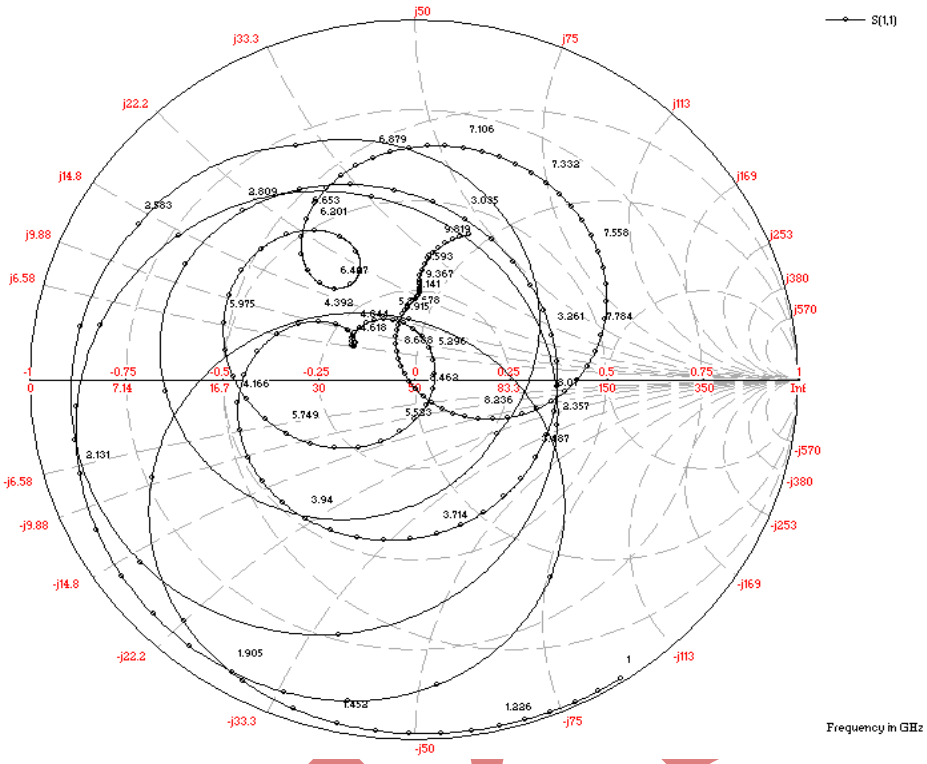

Fig.5: VSWR of optimized L-shape antenna

Gain vs. Frequency chart of proposed antenna as shown in Fig.6

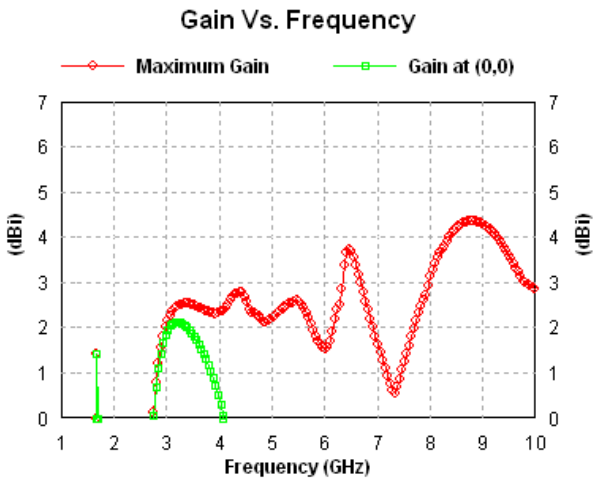

Fig.6: Gain vs. Frequency curve

IV CONCLUSION

A compact, coaxial feed, linear polarized, L-shape microstrip antenna has been designed, and simulated using IE3d. After comparison the proposed antenna gives better gain and bandwidth as compared to normal

rectangular microstrip antenna. The size of antenna is reduced. This proposed L- shaped microstrip antenna is suitable for WLAN & UNII operation (5 GHz) and SAR & PSA (9 GHz). The wide impedance bandwidth was presented with VSWR of less than 2 ($S11 < -10$ dB).

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