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Multi-Band Double Inverted L-Slot Patch Antenna for Wireless Applications

Kamal Kant[1], Gaurav Sharma[2], Sandeep Kumar[3]
[1, 2]Mewar University, Chittorgarh, Rajasthan
[3]JEMTEC, Greater Noida

***Abstract-* This paper presents multi-band double inverted L-slot patch antenna for wireless applications. This antenna structure is build by cutting double inverted L-slots in the patch. This structure has the following advantages: (1) the feed is coaxial probe (2) the antenna has single-layer, (3) the structure of the antenna is simple (4) the antenna is inexpensive. Five resonating modes are excited when doubled inverted L-slots are cut on patch with achievement of 4dBi gain. The surface current distribution of this antenna alters radiating fields and achieves wideband of 1.2GHz within range of 15.3-16.5GHz. The design guideline for the proposed antenna is given and the acceptability of the design is verified by other scenarios.**
***Keywords*— Coplanar strip line; Millimeter wave (MMW); CMOS power amplifier (PA)**

I. INTRODUCTION

Microstrip patch antennas are an attractive choice in modern wireless communication because they have advantages such as low profile, conformal, low cost and robust. Microstrip patch antennas are in demand now-a-days for use in wireless applications due to their low-profile structure [1-4]. Therefore they are compatible for embedded antennas in modern wireless devices. Microstrip antennas are thin and conformal. In Satellite communication they have also been used successfully. However, at the same time they have limitations of low gain, narrow bandwidth, single operating bandwidth, and cross polarized radiation. Many research works have been developed for improving these parameters of the conventional microstrip patch antenna (MPA) [5-7]. The concept of multi-band communication, multifunction application and miniaturization has been proposed many years ago. The advantage of multi-band system is that, when there is interference in one band system, the other can still work normally. Another typical advantage is that it can form complementary function. Multi-band slot patch antenna is also useful when one has to simultaneously deal with uplink and downlink data in satellite communications [8]. It has great potential in modern communication systems. During the past decade, multi-band performances at different bands were integrated into one antenna by employing multilayer, cutting slots on the patch. Recently, several techniques have been proposed to enhance the bandwidth. A novel single layer wide-band rectangular patch antenna with achievable impedance bandwidth of greater than 20%has been demonstrated [9]. Utilizing the shorting pins or shorting walls on the unequal arms of a U-shaped patch, U-slot patch, or L-probe feed patch antennas, wideband and dual-band impedance bandwidth have been achieved with electrically small size [10-11]. Other techniques involve employing multilayer structures with parasitic patches of various geometries such as E, V and H shapes, which excites multiple resonant modes. However, these antennas are generally fabricated on thicker substrates. In this paper, multi-band double inverted L-slot patch antenna is proposed for wireless applications. This antenna achieved at central frequencies of 11.3GHz, 12.7GHz, 15.5GHz, 16.3GHz and 17.5 GHz with gains of 4dBi, 2.9dBi, 1.1dBi and 3.7dBi, respectively.

II. SLOT ANTENNA DESIGN ANALYSIS

The slotted antenna has become the best known and most widely used planar transmission line for RF and Microwave circuits. This popularity and widespread use are due to its planar nature, ease of fabrication using various processes, easy integration with solid-state devices, good heat sinking, and good mechanical support. In this paper, we have design a rectangular patch antenna at 11GHz with new dimensions and simulated in ADS tool. This design work taken a RT durroid substrate with thickness of t = 0.545 mm at the height h = 25mil above a lossless ground conducting layer. The dielectric between metal layers is assumed to have ϵ_r = 2.36 and $\tan\delta$ = .002. At 11GHz, a 50Ω coaxial probe is used and the position of this probe calculated with help of equation. Fig1 and Fig2 show geometry of inverted single and double L-slot antenna while fig3 and fig4 also show surface current distribution of inverted single and double slot on the patch respectively.

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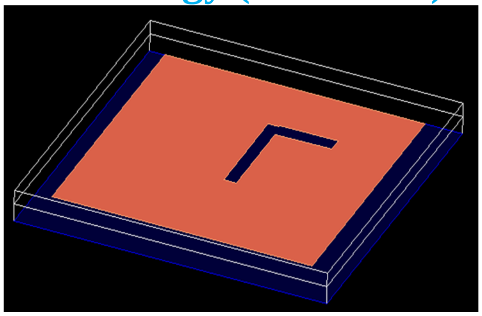

Fig.1 Geometry of the designed inverted L-slot antenna

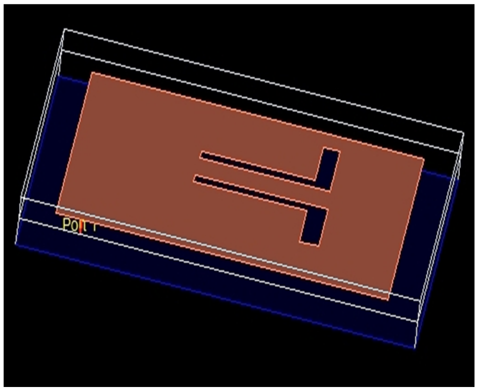

Fig.2 Geometry of the designed double inverted L-slot antenna

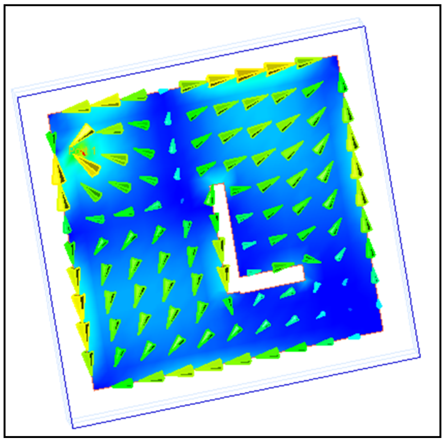

Fig.3 Surface current distribution inverted L-slot antenna

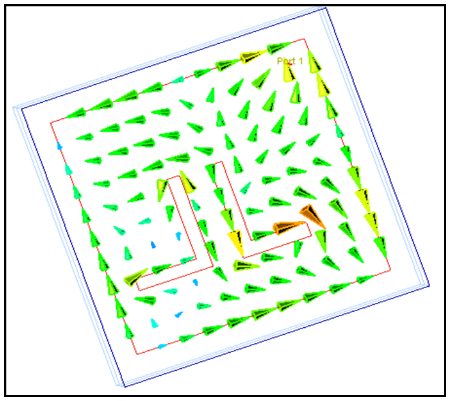

Fig.4 Surface current distribution double inverted L-slot antenna

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III. RESULT AND DISCUSSION

Simulated results of return loss of antenna structures are shown in fig5-6. A significant improvement of frequency reduction is achieved with simulated antenna compared to its conventional antenna counterpart. In this antenna, return loss of about -20 dB is obtained at 11.3GHz. For the simulated antenna there is a resonant frequency at around 17.3GHz with the return loss as high as -28.64 dB. Due to the presence of slots in simulated antenna resonant frequency operation is obtained with large values of frequency ratio. The first and second resonant frequency is obtained at f1= 11.3GHz with return loss of about -28.64 dB and at f2 = 17.3GHz with return losses -43.40 dB respectively. Corresponding -10dB bandwidth is obtained for Antenna 2 at f1 and f2 are 562.85 MHz and 1.17 GHz, respectively. The simulated E plane and H-plane radiation patterns are shown in Figure 7-9.

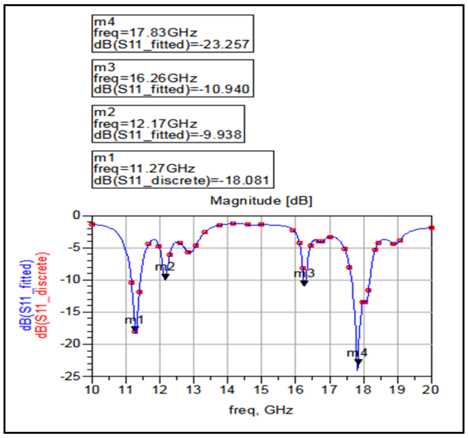

Fig.5 Return loss Vs frequency

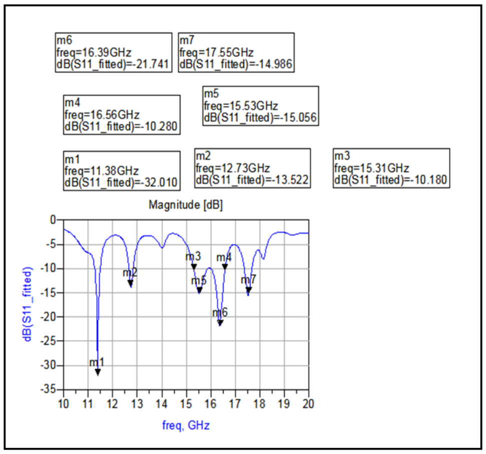

Fig.6 Return loss Vs Frequency

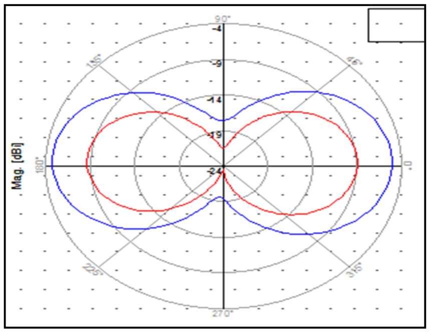

Fig.7 Radiation pattern at 11.2GHz for inverted L-slot antenna

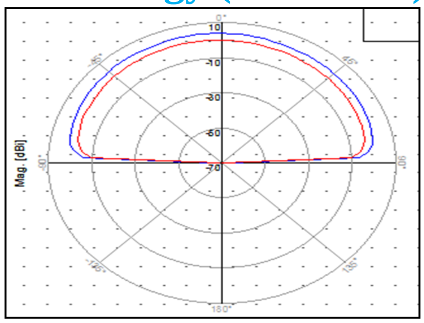

Fig.8 Radiation pattern at 11.2GHz for double inverted L-slot antenna

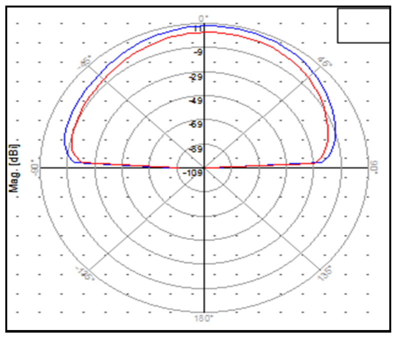

Fig.9 Radiation pattern at 17.5GHz for double inverted L-slot antenna

IV. CONCLUSION

In this paper, doubled L shaped slot antenna is designed which focus on multiband wireless applications. Five resonating modes have achieved with the help of these two L shaped slots on the patch antenna.

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