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Dual Band Microstrip Patch Antenna for IEEE802.11b Application

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***Abstract*—**In this paper, the design of a coaxial feed single layer rectangular microstrip patch antenna for IEEE802.11b application is presented. The proposed antenna is designed by using substrate FR4_epoxy having permittivity of about 4.4 and tangent loss of 0.013. The characteristics of the substrate are designed and to evaluate the performance of modeled antenna using HFSS v.11 EM simulator, from Ansoft. The proposed antenna dual resonant frequency has been achieved in the band of 1.57GHz-1.68GHz (with BW 30 MHz) and 2.25 GHz -2.55GHz (with BW 40MHz). The simulation results with frequency response, radiation pattern and return loss, VSWR, Input Impedance are presented with appropriate table and graph.

***Keywords*—**Microstrip, Radiation Pattern, Return Loss, Tangent Loss, VSWR.

I. Introduction

MICROSTRIP patch antenna are widely used in communication system because it has many merits such as the low profile, light weight, low cost, planner and ease of integration with microwave circuitry. However the microstrip patch has many major disadvantage and one of these is narrow bandwidth and there is a trade-off between bandwidth and size (thickness, W and Substrate) of the patch. Microstrip antenna is also referred to as patch antenna. The radiating element and feed line are usually photo etched on the dielectric substrate. The radiating patch may be square, rectangular, circular, triangular etc. Out of these the rectangular patch is by far most widely used configuration. It is easy to analyze by transmission line and cavity model. [1]- [7]

The huge application of wireless communication require an antenna can operate with more than one operating frequency, that why dual band and multiband characteristics feature is more desirable and that is achieved by introducing the slot on the patch at appropriate position. In this paper presented a rectangular microstrip patch antenna insert two slots in shape of L and I around the probe feed to operate the antenna in dual frequency. The slots are adjusted with various attempts to improve the parameter like return loss, radiation pattern, VSWR all data are obtained by simulation using HFSS v. 11. the dimension of patch are calculated by simple MATLAB programming.

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II. Antenna Structure

When the slot of either quarter wave in length or half wave in length is cut at an appropriate position inside the patch, it will excite another mode near the fundamental mode of the patch and gives another resonant frequency. [8] The schematic diagram of conventional antenna is shown in Fig. 2 the dimension of rectangular patch is 20.5mmx44mm (W x L). The substrate for this antenna is FR4_epoxy with dielectric constant 4.4 and the height of the substrate h=1.5875mm.A 50 ohm input impedance coaxial fed radius 0.7mm at a point (-5.9, 0) where the centre of the patch is consider at a point (0, 0).

Fig. 1 shows the same configuration of patch with addition of L and I shape slot on the rectangular patch.

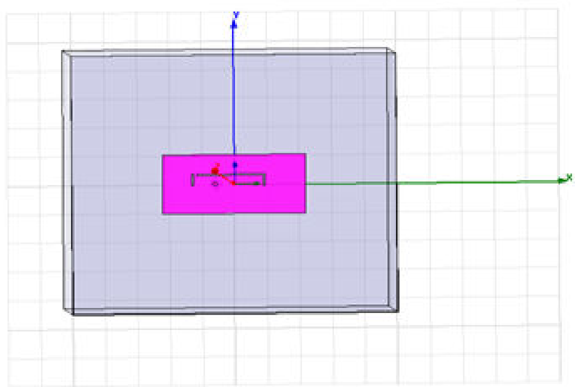

Fig. 1 Proposed antenna configuration

The optimal values of ‘m’, ‘n’ and ‘p’ are ‘4mm’,’21.2mm’ and ‘4mm’ respectively of the antenna 2.

Fig. 3 shows the configuration of slotted antenna which is same patch size 20.5mmx44mm (W x L) and similar substrate.

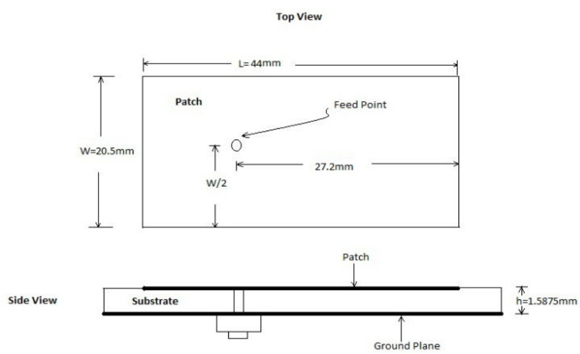

Fig. 2 Schematic diagram of antenna1

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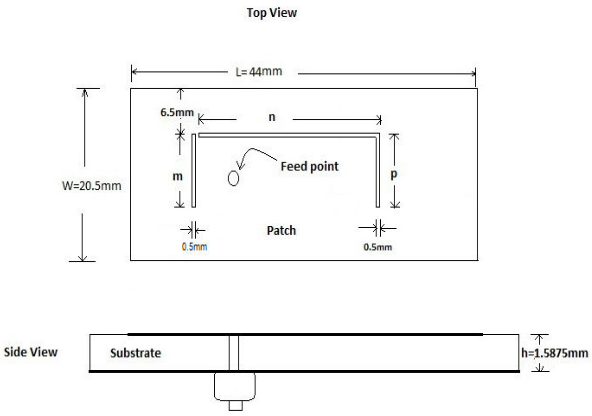

Fig. 3 Schematic diagram of antenna2

III. Simulated Result

The simulated result is carried out by the help of HFSS v 11 EM simulator. The input impedance, VSWR, Return Loss, Radiation Pattern of conventional antenna are illustrated in Figs. 4 (a)-(d). In conventional antenna return loss found of about -33.63 dB at resonant frequency 1.63GHz and corresponding bandwidth is 27 MHz.

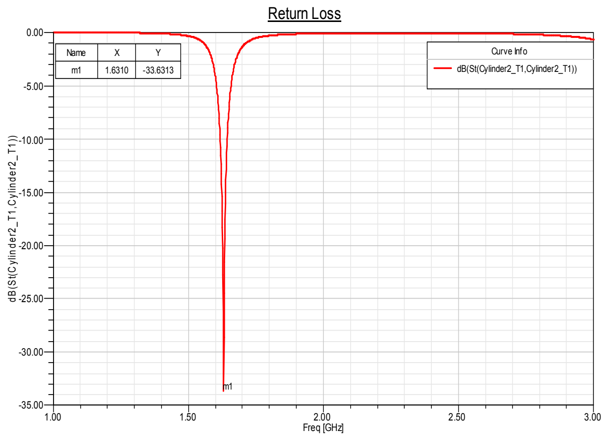

Fig. 4 (a) Simulated return loss for antenna 1

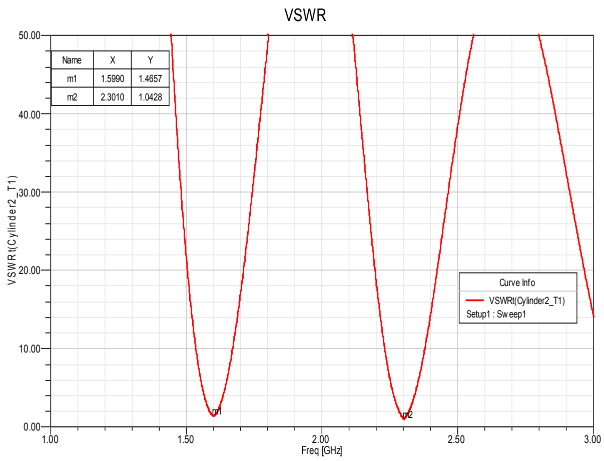

Fig. 4 (b) Simulated VSWR against freq. for antenna1

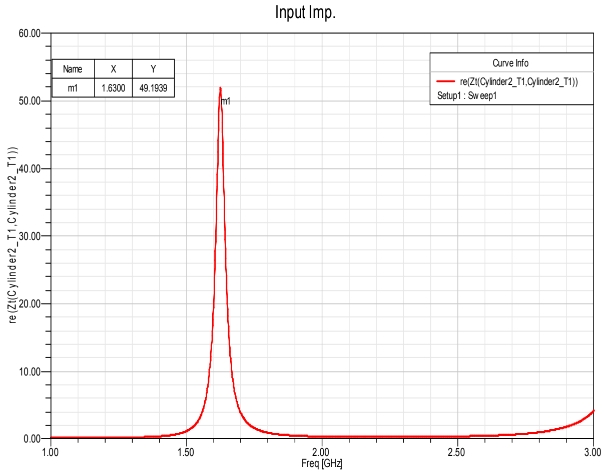

Fig. 4 (c) Simulated Input Impedance against freq. of antenna 1

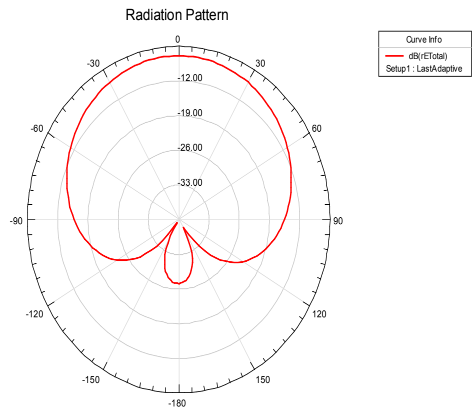

Fig. 4 (d) E-plane radiation pattern for antenna1

For the proposed antenna resonant frequencies are 1.62GHz and 2.47GHz with return losses are -36.33dB and -47.45dB respectively. The simulated 10dB bandwidths are 30 MHz and 40MHz respectively.

Hence introduce a slots can achieved desirable resonant frequencies of 1.62GHz and 2.47GHz. In Figs. 5 (a) & (b) shows the result of optimal return loss, radiation pattern of slotted antenna respectively.

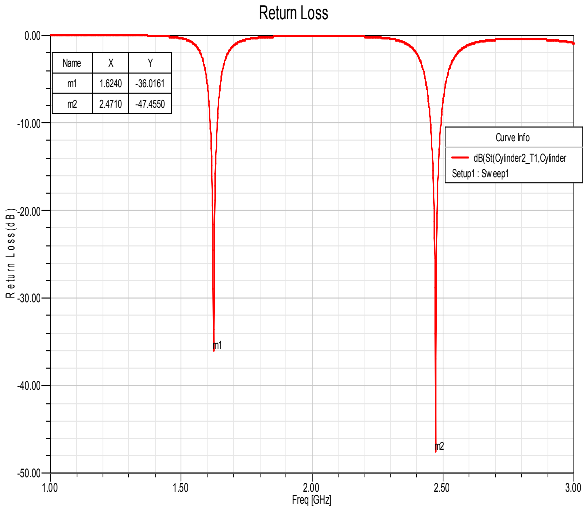

Fig. 5 (a) Simulated return loss for proposed antenna

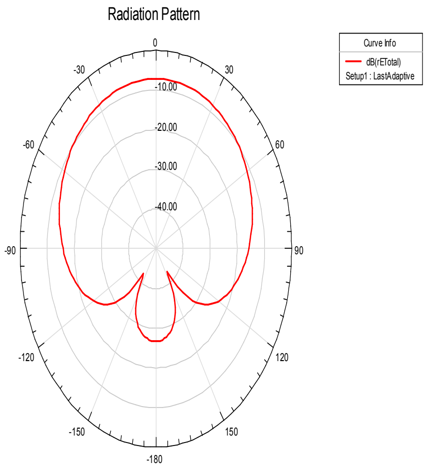

Fig. 5 (b) E-plane radiation pattern for proposed antenna

A. Effect of Parameter 'm' and 'p'

In the proposed antenna first fixed the value of n at 21.2mm the length of the slots 'm' and 'p' varies simultaneously. The simulation results are display in Fig. 6. If the value of 'm' and 'p' is made 8mm or greater than that return loss becomes just below -10dB and resonant frequency shifted away the band.

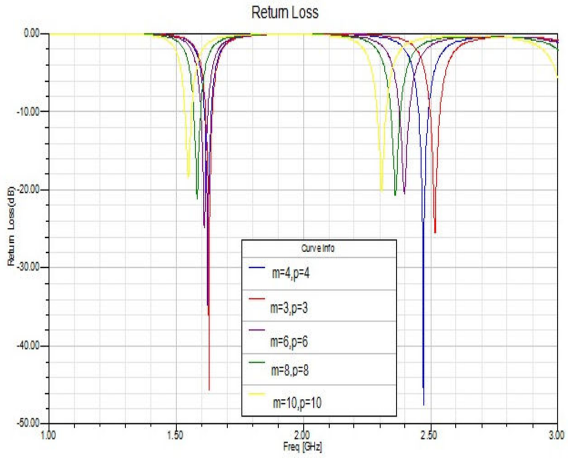

Fig. 6 Simulated return loss for different values of 'm' &'p'

B. Effect of Parameter 'n'

Now fixed the value of 'm' and 'p' at 4mm the length of slot 'n' varies and the simulation result are display in Fig. 7. If the value of 'n' is made lower than 20mm return loss of upper band decrease rapidly as well as upper resonant frequency shifted away the band and if 'n' is made lower than 18mm then both lower and upper resonant frequency shifted away which are clearly depicted in Fig. 7.

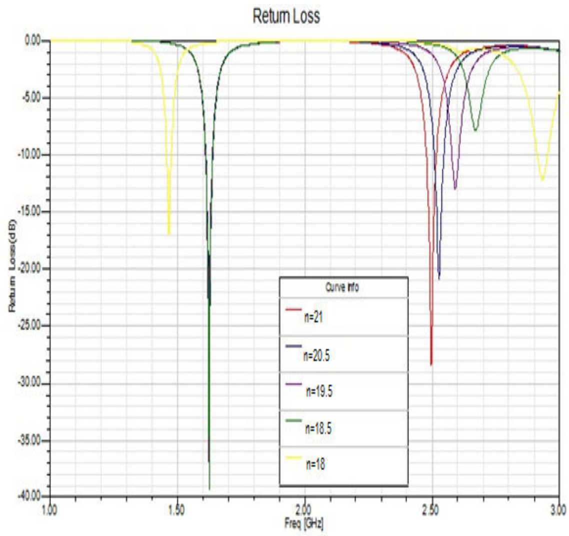

Fig. 7 Simulated return loss for different values of 'n'

IV. Conclusion

In this paper, single coaxial fed single layer slotted microstrip antenna with I and L slots has been proposed. The proposed antenna can operated in dual frequency band at IEEE 802.11b. The resonant frequency can be tuned by changing the slots length. The location and length of the slots are optimized in such a way that the antenna can operate in suitable band. It has been shown that the proposed patch antenna produce bandwidth of approximately 3% with suitable radiation pattern with in frequency range. The proper impedance matching of proposed antenna can be achieved by adjusting the coaxial feeding structure. A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

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