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DESIGN OF A WIDE SLOT ANTENNA FOR BANDWIDTH ENHANCEMENT

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Abstract — Microstrip printed wide slot antenna with a fork like tuning stub for bandwidth enhancement is proposed in this paper. By applying fork like tuning stub to the microstrip wide slot antenna instead of line feed, it is experimentally found that operating bandwidth can be enhanced. Experimental results indicate that the impedance bandwidth, defined by -10dB return loss, of the proposed wide slot antenna can reach operating bandwidth of 3.1 GHz at operating frequency about 2 GHz which is 6 times greater than conventional wide slot antenna.

Index Terms — *Fork like tuning stub, Bandwidth enhancement*

I. INTRODUCTION

Microstrip-line-fed printed wide slot antennas have received much attention because of their comparably wider operating bandwidth. By applying fractal geometry in microstrip antennas significance properties of antenna can be improved, such as smaller size, multiband operation, wide bandwidth and low mutual coupling in array structure [1-11]. In recent years several fractal geometries have been designed for various antenna applications. Some of these geometries have been particularly useful in reducing the size of the antenna [7]
. In [8], microstrip line fed printed wide slot antenna with rectangular fractal shaped was introduced and it achieved very good bandwidth at 3rd iteration. By rotating the slot around the centre of the slot [11], bandwidth can be enhanced but in this technique the optimization of rotating angle is required, which is somewhat difficult. Several fractal antenna configurations have been reported in recent years. The fork-like tuning stub studied here is all positioned within the slot region in the opposite side of the printed wide slot. Through proper selection of the parameters of the fork-like tuning stub, it can be expected that the coupling between the microstrip line and the printed wide slot can be controlled more effectively, which makes possible significant bandwidth enhancement of the printed wide-slot antenna. This paper introduces wide slot antenna with fork like tuning stub. In this paper the proposed design is fed by fork like tuning stub instead of simple line feed. The feeding mechanism is called fork like tuning stub because shape of feed is look like fork. The simulation results are shown for this geometry. In section II proposed designs are discussed while the simulation results are discussed in section III.

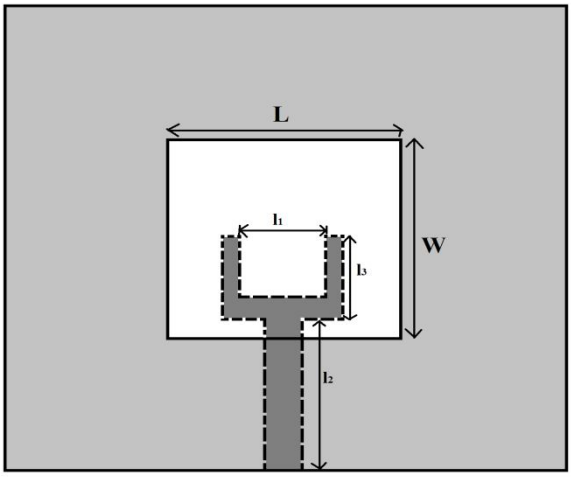

Fig. 1 Geometry of the proposed microstrip printed wide-slot antenna with fork like tuning stub

II. ANTENNA CONFIGURATION

The configuration of proposed antenna is shown in figure 1. The proposed wide slot has dimension of L W and is printed on a substrate of thickness h and relative permittivity =4.4. The printed wide slot is etched on ground substrate. The wide slot is fed by a 50- microstrip line with a fork-like tuning stub, which is printed on the opposite side of the microwave substrate and placed symmetrically with respect to the centerline (y axis) of the wide slot. The original wide slot is chosen to be square in order to excite two modes with close resonant frequency. The dimension of ground plane is 110 mm x 110mm. The basic rectangular slot microstrip-line-fed printed wide-slot antenna design-1 is shown in Figure 1.For exciting the operating frequency at around 2 GHz, the dimension of the square slot can be roughly determined by

Where c is the speed of light in the air, is the effective relative permittivity and L is the length of the square slot. The fork-like tuning stub is composed of a straight section of length l_2 and two branch sections of equal lengths l_3, and the spacing between the edges of the two branch sections is l_1 . The widths of these sections are all the same and equal to that of the 50- microstrip line. By selecting proper dimensions of the fork-like tuning stub, good impedance matching of the printed wide-slot antenna across a much enhanced bandwidth can be obtained. For design simplicity, the width of the tuning stub is chosen to be the same as that of the 50 Ω microstrip line.

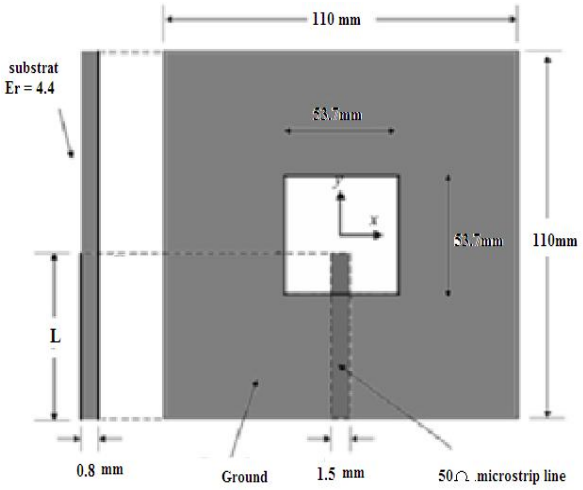

Fig. 2 Geometry of the microstrip printed wide-slot antenna with simple tuning stub

From the simulation it is observed that conventional square slot antenna gives good result for tuning stub length L = 53mm. The dimensions of the references antenna are same as the proposed antenna. The references antenna is shown in the figure 2.

III. RESULTS AND DISCUSSION

The basic rectangular slot microstrip printed wide-slot antenna as shown in Figure 1 and 2 has been simulated by considering the finite ground plane and dimension of ground plane is 110 mm x 110 mm. The simulated return loss plot is as shown in the Figure 3. The basic microstrip line fed printed wide slot antenna gives optimal result for length of tuning stub of 53 mm. The graph for it shows an impedance bandwidth of 0.5 GHz (1.7 – 2.2 GHz) that corresponds to 26.64% of the centre frequency as shown in figure (3).If we apply fork like tuning stub to the same design instead of simple tuning stub bandwidth can be enhanced. As shown in figure 1 for the fork like tuning stub there are three main dimension parameters l_1,l_2 and l_3.For achieve good bandwidth I have tried for different values of this parameters. It gives good results for l_1= 15m,l_2= 30.15 and l_3= 14.5. The return loss plot for proposed design is shown in figure 4.It shows an impedance bandwidth of 3.1 GHz (1.9 – 5.0 GHz) that corresponds to 89.85 % of the centre frequency.

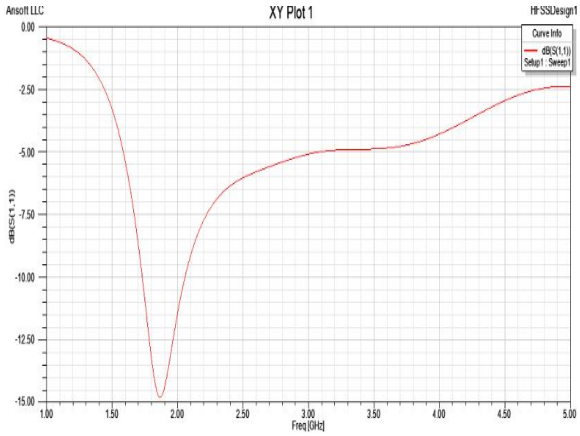

Fig. 3 Simulated return loss performance of conventional square slot antenna

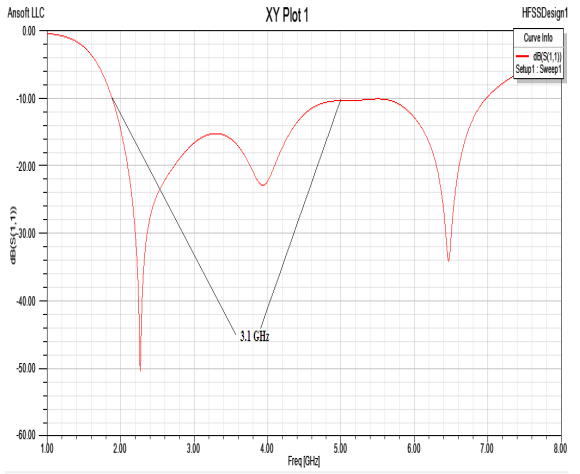

Fig. 4 Simulated return loss performance of proposed design

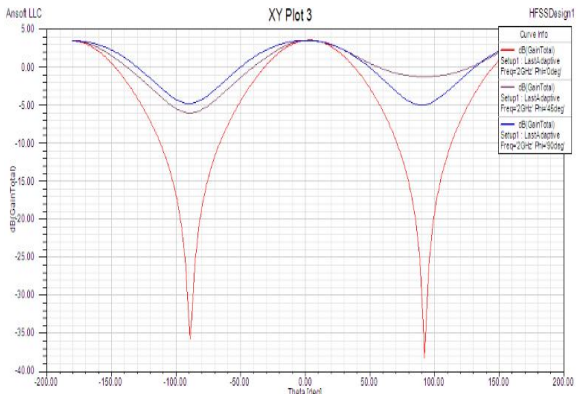

Fig. 5 Simulated gain performance of proposed design

IV. CONCLUSION

In this paper, a printed wide slot antenna fed by a fork like tuning stub has been demonstrated. Experimental results indicates that impedance bandwidth of the printed wide slot antenna can be significantly improved by applying fork like tuning stub to wide slot in the ground plane. For the optimal results the impedance bandwidth determined by -10 dB reflection coefficient can reach 3.1 GHz for the proposed design at operating frequency around 2 GHz which is about 6 times than conventional printed wide slot antenna.

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