A BROADBAND MICROSTRIP ANTENNA WITH CAPACITIVE COUPLING FOR C-BAND APPLICATIONS

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Abstract: In this paper we present the design and simulation of co-axial fed microstrip antenna for C-Band (4-8 GHz) application with capacitive coupling technique. The antenna designed from antenna theory (calculation) for centre frequency 5.6 GHz and later optimized for broadband using HFSS software. Dielectric substrate FR-4 proxy having dielectric constant 4.4 is used. The proposed antenna exhibits a much higher impedance bandwidth 53% (S11<-10dB).

***Index Terms*: C-Band, impedance bandwidth, Co-axial feed**

I. INTRODUCTION

Wireless technology is one of the principal areas of research in the world of communication systems today and a study of communication systems is incomplete without an understanding of the operation of radiating systems especially planar antennas. With the rapid advancement of various applications, these antennas need to work at several frequency bands such as dual, triple, and sometimes multiband operations are needed. Therefore, antennas capable of operating at these bands are suitable candidates to meet such requirements. Hence, in this paper one such effort has been made to design and develop broad band antenna.

II. DESIGN THEORY

This paper demonstrates the design, optimization, of co-axial fed microstrip antenna for broadband operation. The proposed antenna is excited by a co-axial feeding and the technique of capacitive coupling being used. The SMA connector is used to connect the rectangular patch which couples the energy to a radiating patch by co-axial feed. The length and width are designed to obtained broad band frequency range. The proposed antenna has been successfully optimized using HFSS simulation software. As shown in the Figure 1.

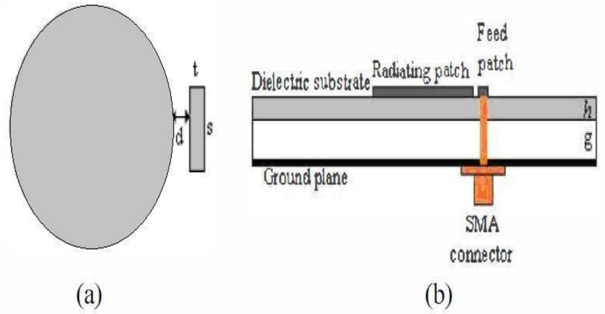

Fig.1. Feed Structure (a) top view (b) side view

Since the dimension of the patch is treated a circular loop, the actual radius of the patch is given by (Balanis,1982)

$$a = \frac{F}{\left\{1 + \frac{2h}{\pi \varepsilon_r F}\left[\ln\left(\frac{\pi F}{2h}\right) + 1.7726\right]\right\}^{1/2}} \tag{1}$$

$$F = \frac{8.791 \times 10^9}{f_r \sqrt{\varepsilon_r}} \tag{2}$$

Equation (i) does not take into consideration the fringing effect. Since fringing makes the patch electrically larger the effective radius of patch is used and is given by (Balanis, 1982)

$$a_e = a\left\{1 + \frac{2h}{\pi \varepsilon_r a}\left[\ln\left(\frac{\pi a}{2h}\right) + 1.7726\right]\right\}^{1/2} \tag{3}$$

Hence, the resonant frequency for the dominant TMz110 is given by (Balanis, 1982)

$$(f_r)_{110} = \frac{1.8412 v_0}{2\pi a_e \sqrt{\varepsilon_r}} \quad (4)$$

where v_0 is the free space speed of light.

III. OPTIMIZATION

The antenna designed from antenna theory (hand calculations) for Centre frequency 5.6 GHz and later optimized for broadband using HFSS software. Parameters taken for optimization include 1. Radius of the Circular Patch (R) 2. Length of the feed strip (s) 3. Width of the feed strip (t) 4. Separation of feed strip from the patch 5. Air gap between substrates (g). Optimized results are shown in figures (2), (3) & (4).

TABLE-I shows the initial values and optimized values for proposed design.

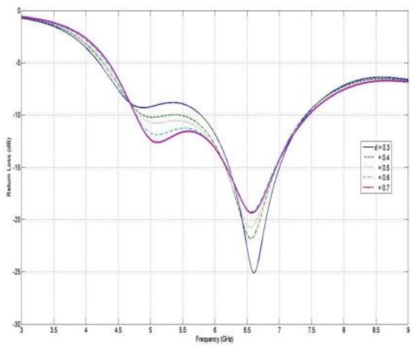

Fig.2. Return loss for variation of d (separation of feed strip from patch)

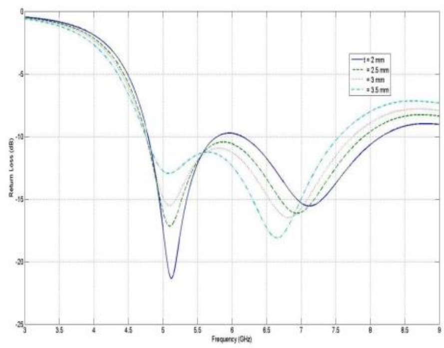

Fig.3. Return loss for variation of t (Width of feed strip)

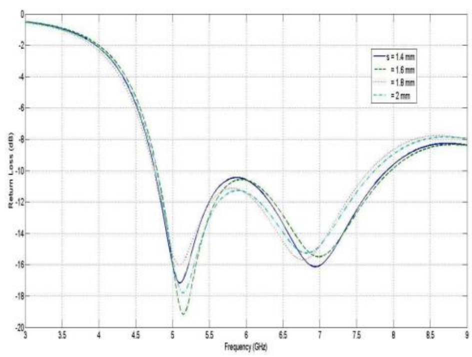

Fig.4. Return loss for variation of s (Length of feed strip)

TABLE-I

S.no	Parameters	Calculated Values (in mm)	Optimized values (in mm)
1	Radius of the Circular Patch (R)	8.0	8.0
2	Length of the feed strip (s)	1.4	1.4
3	Width of the feed strip (t)	3	4
4	Separation of feeds strip from the patch (d)	0.5	0.5
5	Air gap between substrates (g)	4	4
6	Substrate thickness (h)	1.6	-
7	Dielectric constant	4.4	-
8	Loss tangent (tan d)	0.02	-

IV. CONCLUSIONS

The coplanar capacitive coupled circular patch antenna has been presented. Proposed geometry is very simple and compact in size and has very less parameters to optimize. The proposed antenna exhibits the return loss below -10 dB. With optimum dimension antenna offers an impedance bandwidth of 53% (BW <-10 dB). Broadband characteristics, which is very useful for various wireless applications, where compact antenna is required.

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