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A Parametric Study of with Capacitive Feed Patch Antenna

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ABSTRACT

The parametric analysis of capacitive fed Microstrip antenna suspended above the ground plane has-been presented in this paper. Parametric study of capacitive coupled shorted patch antenna at C-band has been presented. Due to their significant merits, Microstrip patch antennas have widely been used in various communication systems. These antennas, being low profile and light-weight, are becoming popular for various applications. In this paper, the parameter which affect the gain and return loss characteristic f the Microstrip circular patch antenna, the geometry of the frequency selective surfaces (FSS) elements is the most important one.

Keywords: Parametric, Antenna, Frequency, Microstrip, Edge, Wideband.

1. INTRODUCTION

Antenna is an indispensible part of any communication system. Coplanar-fed Microstrip patch antennas with inductive and capacitive coupling are extensively studied with the help of a numerical model. Parametric Study, design and implementation of single patch, wide band Aperture coupled Microstrip patch antenna for 2GHz frequency range. So the parametric study, design fabrication and testing of with wideband aperture coupled antenna has been attempted in this research paper.

2. Parametric Study

The key design parameters are air gap at which antenna substrate is located above the ground plane, the distance between radiator patch and the feed strip, probe diameter and the dimension of feed strip.

a. Effect of air gap (h)

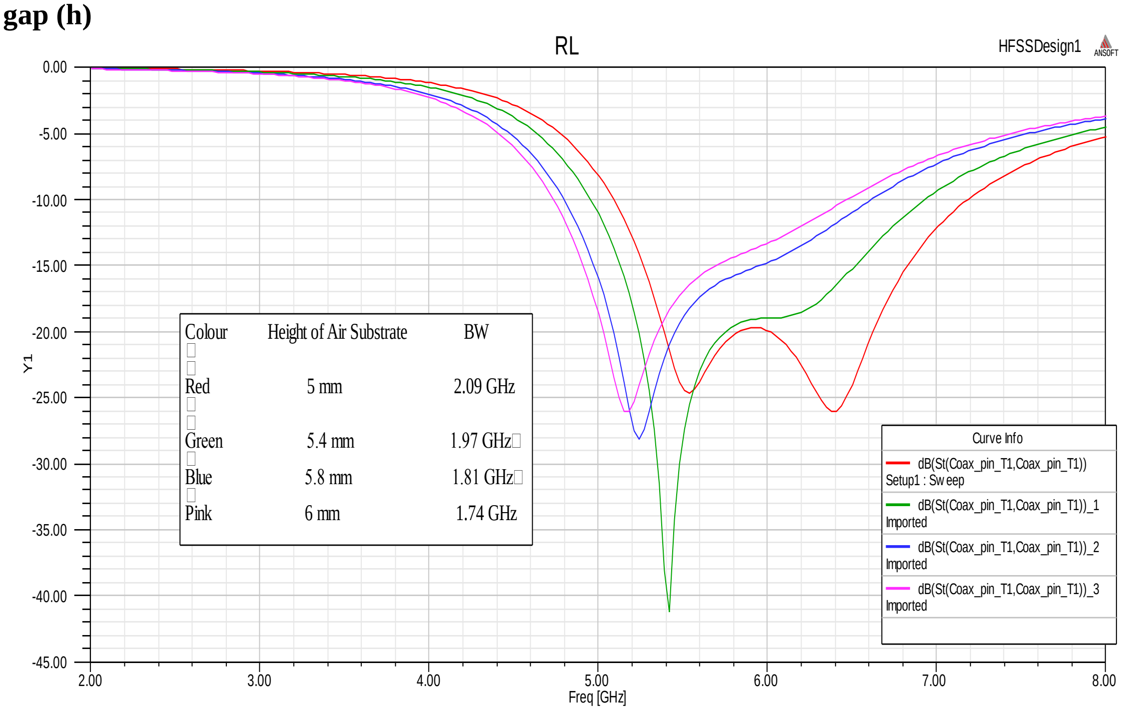

Figure 1: S11 of various size of substrate

The fringing fields from the edges increases as height of the substrate is increased. Here air gap has used along with substrate which leads to increases height of substrate. It is well known that whenever the effective substrate height increases or permittivity decreases, it result into wider bandwidth. It may be noted that increasing the air gap results in reduction of the effective permittivity for the patch and change in the feed reactance. Hence the dimensions of the feed strip are adjusted for the best impedance match for each case presented Figure 1 shows the S11 parameter when Height of substrate is changing. As it can be seen from the above set of curves, we get best results when Height (h) is 5 mm than we get wider bandwidth than previously used Height of 6mm.Table 1 shows various Heights and their respective bandwidth calculation through which we get wider bandwidth antenna.

Table 1: Effects of variation of air gap on the bandwidth of the antenna

Graph Colour	Height of Air Substrate	BW
Red	**5 mm**	**2.09 GHz**
Green	5.4	1.97 GHz
Blue	5.8	1.81GHz
Pink	6	1.74 Hz

b. Effect of probe diameter (Pr)

Effect of variation of probe diameter on bandwidth of antenna is listed below.

Table 2: Effect of variation of probe diameter on vswr bandwidth of antenna

Probe Radius (Pr)	0.35 mm	0.4 mm	0.45 mm	0.50 mm
Graph Colour	Green	**Pink**	Blue	Red
Bandwidth (GHz)	1.56 GHz	**1.74 GHz**	1.65 GHz	0.70 GHz

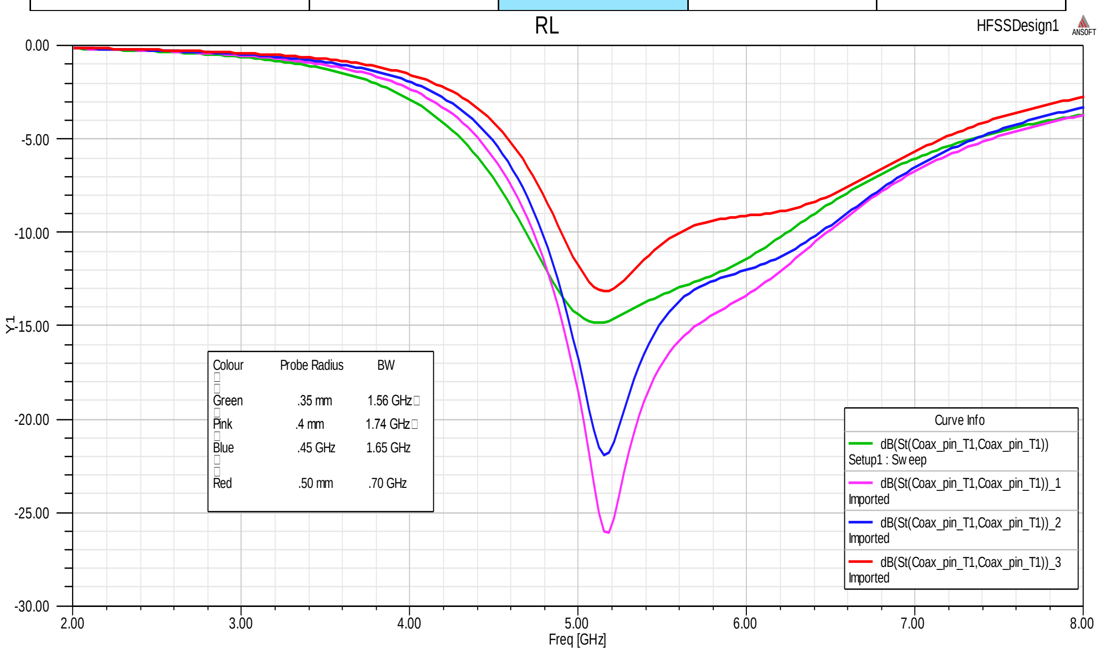

Figure 2: S11 parameter of various probes Radius (Pr)

Figure 3.2 shows the S11 parameter when Probe Radius is changing. As it can be seen from the above set of curves, we get best results when Probe Radius (Pr) is 0.4mm than we get wider bandwidth of 1.74 GHz.Table 2 shows various probe Radius and their respective bandwidth calculation through which we get wider bandwidth antenna.

c. Effect the separation distance between feed strip and radiator patch (d):

The dimensions and location of the feed strip play a important role in obtaining the wide bandwidth for the proposed antenna as distance between radiators Patch and the feed strip (*d*) on the impedance bandwidth of antenna. Actually the separation distance d is very small but variation in it affects the input impedance of an antenna. As the separation distance is increased, the resistive part decreases and the reactive part increase. So, double slots (U-shaped) have proved to balance the resistive part and reactive part. The effect of variation of separation distance is listed below.

Table 3: Effect of variation of separation distance on bandwidth of antenna

Distance (d)	0.55 mm	0.65 mm	0.75 mm	0.85 mm
Graph Colour	Red	Green	Pink	Blue
BW (GHz)	1.74 GHz	1.74 GHz	1.74 GHz	1.73 GHz
RL (dB)	-24.69	-25.4	-25.99	-25.90

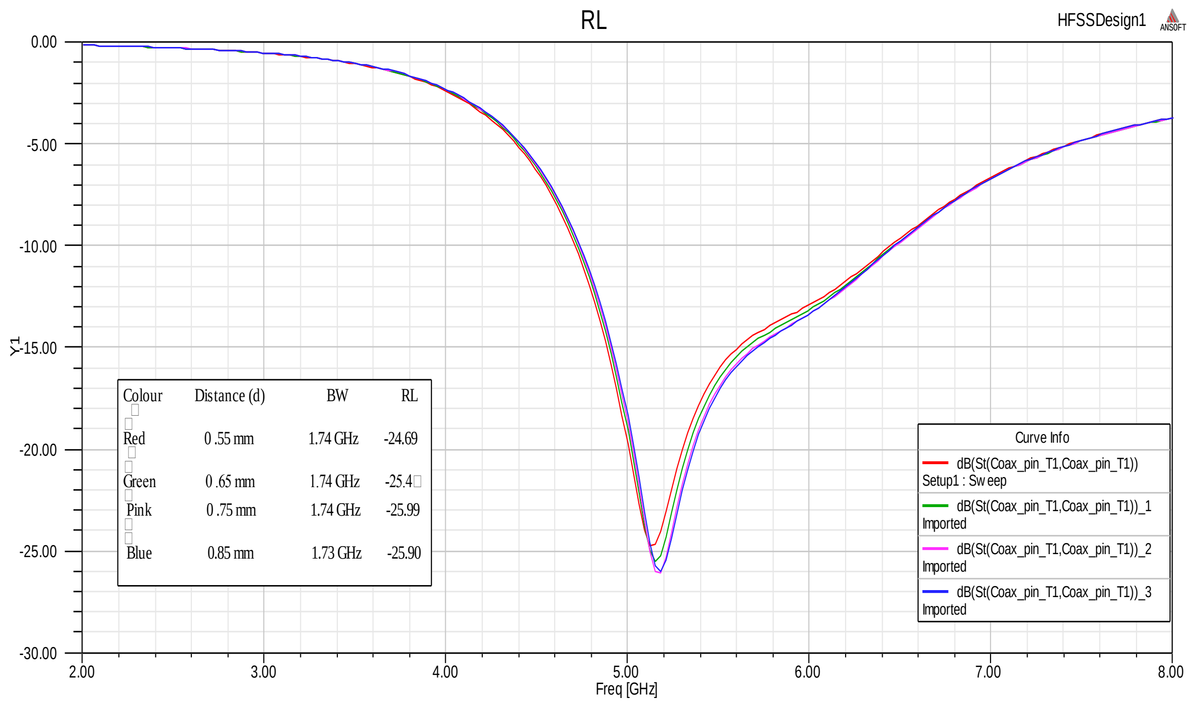

Figure 3: S11 parameter of various separation distances between feed strip and radiator patch (d)

Figure 3, shows the s11 parameter when separation distance between feed strip and radiator patch (d) is changing. as it can be seen from the above set of curves, that we obtain almost same BW till the separation distance of 0.75 mm and at 0.85 mm separation distance bandwidth decreases .we get best results when separation distance (d) is 0.75 mm than we get wider bandwidth of 1.74 GHz and best return loss of -25.99 db. Table 5 shows the effect of variation of separation distance on bandwidth of antenna and their respective bandwidth calculation through which we get wider bandwidth antenna.

d. Effects of the dimensions (width) of feed strip (t)

With increase in width of the feed strip the bandwidth slightly, if all other parameters are kept constant; but the bandwidth of antenna can be restored to the maximum value by decreasing the feed strip length (s). The resistive part of the antenna input impedance increases, whereas the reactive part decreases with increase in feed strip width. Table 4, shows various feed strip width (t) and their respective bandwidth calculation through which we get wider bandwidth antenna.

Table 4: Effect of width of feed strip on bandwidth of antenna

Feed Strip Width (t)	1.2 mm	1.5 mm	1.8 mm	2.1 mm
Graph Colour	Red	Green	Pink	Blue
BW (GHz)	1.93 GHz	1.83 GHz	1.74 GHz	1.64 GHz

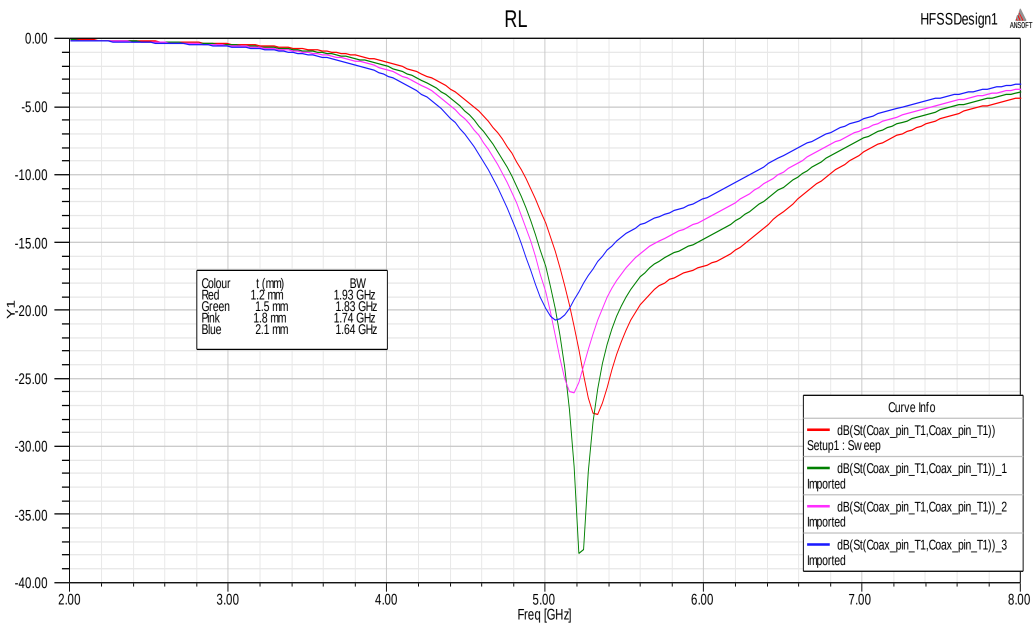

Figure 4: S11 parameter of various Feed strip width (t)

Figure 4 shows the S11 parameter when Feed strip width (t) is changing. As it can be seen from the above set of curves, we get best results when Feed strip width (t) is 1.2 mm than we get wider bandwidth of 1.93 GHz.

e. Effects of the dimensions (length) of feed strip (s)

The bandwidth reduction caused by increasing the strip width (t) can be restored to a great extent by decreasing its length. This is consistent with the bandwidth presented in Table 7. The variation of changing the feed strip width, antenna input resistance increases and the input reactance decreases with an increase in the length of the feed strip.

Table 5: Effect of length of feed strip on bandwidth of antenna

Feed Strip Length (s)	3.6 mm	3.7 mm	3.8 mm	4 mm	4.2 mm
Graph Clour	Black	Pink	Blue	Green	Red
BW(GHz)	1.76 GHz	1.74 GHz	1.71 GHz	1.64 GHz	1.59 GHz

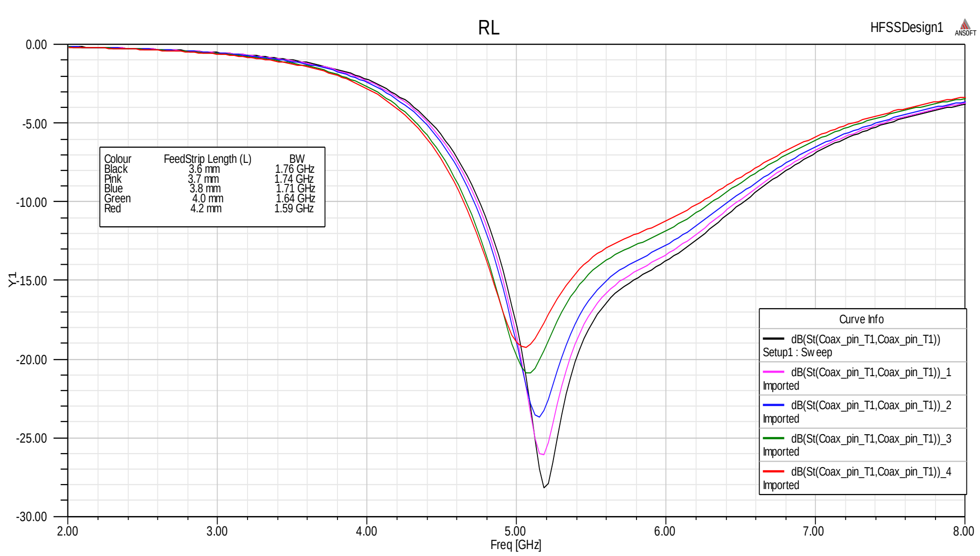

Figure 5: S11 parameter of various Feed strip Length (s)

Figure 5 shows the S11 parameter when Feed strip Length (s) is changing. As it can be seen from the above set of curves, we get best results when Feed strip Length (s) is 3.6 mm than we get wider bandwidth of 1.76 GHz.

3. Effects of the dimensions of H-Shape (t)

Now we will study the effect the dimension of H shape antenna by changing the Length of 1st slot and 2nd slot to obtain maximum BW.

a. Length of First Slot (L1)

Figure 3.6 shows the S11 parameter of Various Length of Slot 1 (L1).We got max BW of 1.85 GHz at 6.2 mm Length .we don't use length=5.2 because of its resonance frequency.

Table 6: Effect of length (L1) of H shape on bandwidth

Slot Length L1 (mm)	5.2 mm	6.2 mm	7.2 mm	8.2 mm
Graph Colour	Blue	Red	Black	Pink
BW (GHz)	1.92 at 4.9 GHz	1.85	1.79	1.74

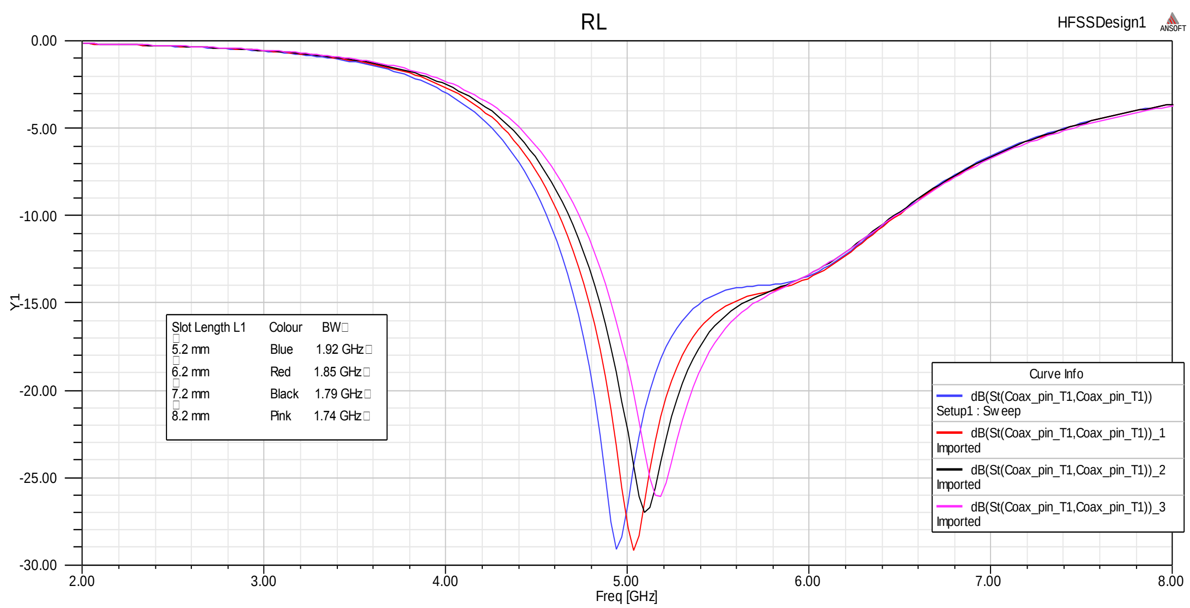

Figure 6: S11 parameter of various Lengths (L1) of Slot 1

b. Length of Second Slot (L2)

Figure 3.7 shows the S11 parameter of various Length (L2) of Slot 2 when L1=6.2 mm. We got max BW of 1.87 GHz at 4 mm Length (L2).

Table 7: Effect of length (L2) of 2nd Slot of H shape on bandwidth

Slot Length L2 (mm)	4 mm	5 mm	6 mm
Graph Colour	Green	Black	Red
BW (GHz)	1.87	1.86	1.85
Gain (dB)	5.12 dB	5.08 dB	5.07 dB
VSWR (dB)	0.66 dB	0.76 dB	0.66 dB

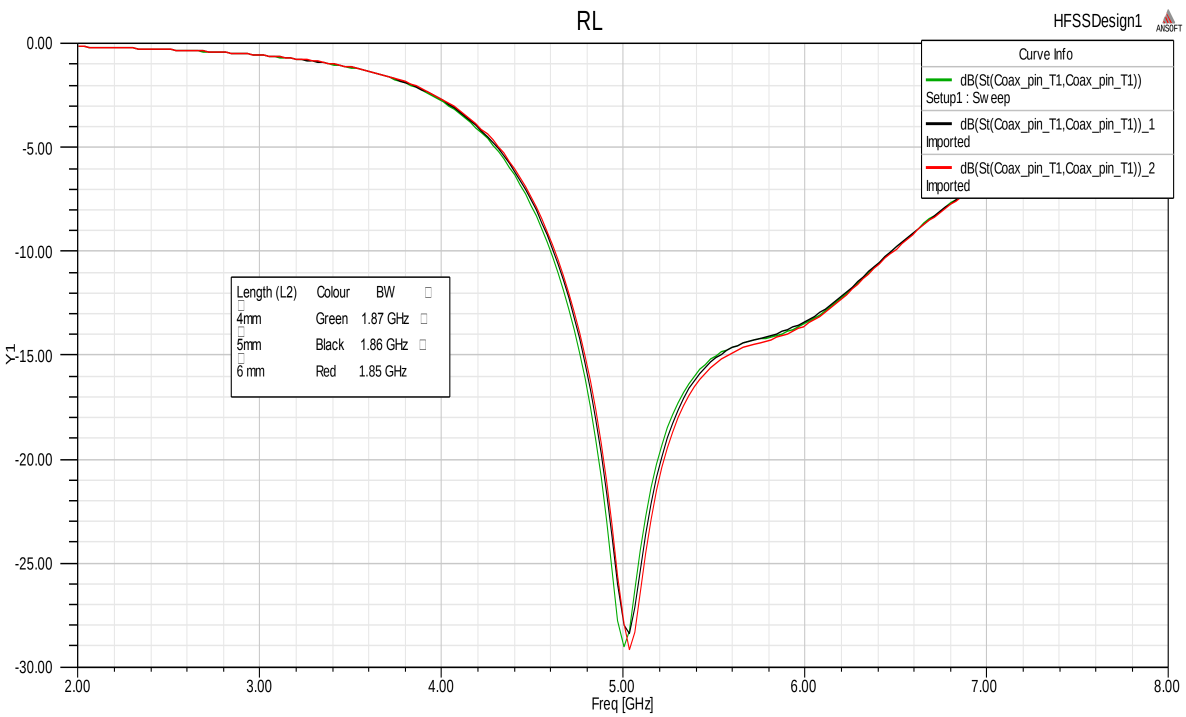

Figure 7: S11 parameter of various Length (L2) of Slot 2 when L1=6.2 mm

References

[1]. Guy A. E. Vandenbosch, and Antonie R.Van de Capelle, "Study of the Capacitively Fed Microstrip Antenna element," IEEE Trans. Antennas Propagat., vol. 42, no.12, pp. 837-842, Dec. 1994.

[2]Corbett R. Rowell, and D. urch, A Capacitively Loaded PIFA for Compact PCS Handsets," IEEE AP-S Int. Sym., pp. 742-745,Dec. 1991.

[3]. V. G. Kasabegoudar, D. S. Upadhyay, and K. J. Vinoy, “Design studies of ultra wideband Microstrip antennas with a small capacitive feed,”Int. J. Antennas Propag., vol. 2007, pp. 1–8.

[4]. K. Verma, N. V. Tyagi, and D. Chakraverty, “Input impedance of probe fed multilayer rectangular Microstrip patch antenna using the modified Wolff model, ”Microw. Opt. Technol. Lett., vol. 31, no. 3, pp. 237–239, 2001.

[5]. Veeresh G. Kasabegoudar and K. J. Vinoy,” Coplanar capacitively coupled probe fed Microstrip antennas for Wideband applications”, IEEE transactions on antennas and propagation, vol. 58, no. 10, October 2010.

[6]. R.Q. Lee , R.N. Simons . Coplanar waveguide aperture-coupled Microstrip patch antennas. IEEE Microw. Guided Wave Lett. , 4 , 138 – 139.