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# Broadband Cpw Fed Slotted Ground Antenna

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***Abstract:*** *In this paper, a broadband rectangular microstrip patch antenna fed by coplanar waveguide feed with two slots in the ground plane is proposed. Investigations are carried out using coplanar waveguide feed with slotting in the ground plane to optimize the broadband operation. A sensitivity analysis shows the variation of return loss with different antenna parameters. This design of broadband antenna is obtained by properly choosing the suitable shape of slots in ground plane and selecting proper shape and size of the radiating patch. The designed antenna gives a return loss of -61dB and impedance bandwidth of 1.02GHz. The simulated results for return loss, bandwidth, VSWR and radiation pattern are studied.*
***Keywords:*** *Broadband, bandwidth, CPW-feed, microstrip patch antenna, return loss,*

## I. Introduction

The broadband antennas arouse much interest in recent years for different wireless communication applications such as wireless local area network (WLAN), Wi-MAX and Bluetooth personal network. Therefore different designs have been proposed to enhance the bandwidth of the antenna. Microstrip patch antennas have attracted much attention due to their low profile, light weight, ease of fabrication and compatibility with printed circuits in wireless communication applications. However, they also have a major drawback of narrow bandwidth [1-5].

To enhance the bandwidth of microstrip patch antenna different techniques have been used. The factors affecting the bandwidth of microstrip patch antenna are primarily the shape of the radiator, the feeding scheme, the substrate and the arrangement of radiating and parasitic elements.

Height and dielectric constant of the substrate material affects the antenna impedance bandwidth. However, the improvement in the bandwidth is quite limited. By varying the shape of the radiating patch the impedance bandwidth can be improved but this may effect the other performance parameters.

The different feeding techniques are also used for enhancing the bandwidth of microstrip patch antenna, coplanar waveguide feeding is one of them. It has several advantages on any other feeding method such as low radiation loss, less dispersion, uniplanar configuration and easy mounting of shunt lumped elements or active devices without via hole as for the microstrip line. Coplanar waveguide (CPW) fed antennas have been increasingly studied in recent years. The antenna fed by a microstrip line may result in misalignment because of the required etching on both sides of the dielectric substrate. The alignment error can be eliminated if a CPW feed is used to excite the slot, since etching of the slot and feeding line is one sided [6].

Various shapes of CPW-fed slot antennas are proposed for bandwidth enhancement such as triangle-shaped, square slot antenna, circular slot, bow-tie slot, and hybrid slot. In [1], a large bandwidth CPW-fed wide slot antenna is proposed. By choosing a suitable combination of feed patch and slot shape, and also tuning their sizes, an optimum operating bandwidth of 131% is obtained. In [2], novel broadband design of a coplanar waveguide (CPW)-fed planar monopole antenna with double plus shape slots is proposed. The simulated result shows a broad impedance bandwidth of 30%, ranging from 4.789 GHz to 6.318 GHz. In [3], a CPW-fed loop slot antenna with a tuning stub to enhance the bandwidth is presented, where by properly adjusting the location of a widened tuning stub, wide bandwidth was obtained. Recently a [5] new broadband printed microstrip Antenna is proposed for UWB application and a impedance bandwidth of approximately 9GHz is obtained.

## II. Antenna Design

Fig. 1.1 shows the geometry of the proposed antenna.

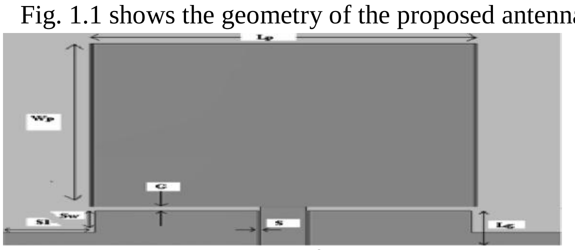

Fig. 1.1 Geometry of proposed antenna

The three essential parameters for designing the proposed antenna are
Resonate Frequency ($f_r$) = 2.45 GHz

Dielectric Constant ( [redacted] 2.2
Substrate Height (h) = 1.6 mm

The dimensions of the proposed antenna substrate are L,W, h that is 59.15mm, 98.15mm, 1.6mm. The proposed antenna has only a one layer of metallic structure on one side of the substrate because in coplanar waveguide feeding technique etching is one sided as the radiating patch and ground plane are on the same side of the substrate.

The length and width of the radiating patch is $L_p$ and $W_p$, where $L_p$ and $W_p$ has a value of 39.95mm and 78.95mm. The other geometrical parameters of the proposed antenna are width of CPW feed line ($W_f$) 2.47mm, gap between the feed and the ground plane (S) 0.4mm, length of ground 8.575mm, gap between the patch and the ground (G) 0.55mm, length of the ground slot (Sl) 9.825mm, width of the ground slot (Sw) 5.2mm. The proposed CPW fed antenna is simulated with CST microwave studio version 10.

## III. Results and Discussion

CST microwave studio is a specialized tool for the fast and accurate 3D EM simulation of high frequency problems. First the simulation was started with a simple coplanar waveguide fed microstrip patch antenna. Then in order to achieve broader bandwidth slots were added in the ground plane. The optimum performance results were obtained after a large number of iterations. The slot length and width were varied to achieve maximum bandwidth and return loss. The simulated and measured return loss and bandwidth of the above designed broadband microstrip patch antenna fed with coplanar waveguide feeding line is shown in figure 2. From simulation results it is seen that the proposed antenna has a good bandwidth of 1.02GHz ranging from 2.26GHz to 3.29GHz for S11 < −10 dB.

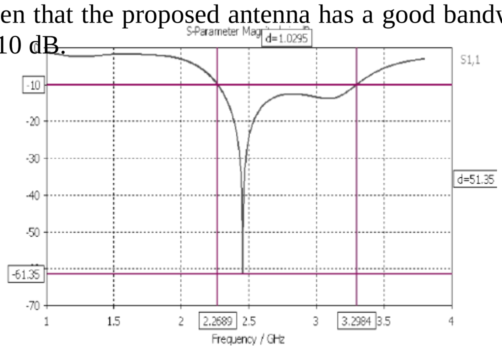


Fig. 2 return loss plot of proposed antenna

As seen the measured return loss is -61dB at the resonating frequency of 2.45GHz. The proposed antenna has a broader bandwidth covering the require bandwidths of IMT standard for 2300-2400MHz, 2700-2900MHz, WLAN standard for 2400-2484MHz, Bluetooth standard for 2400-2500MHz and Wi-MAX standard for 2500-2690MHz.

The simulation result of voltage standing wave ratio for proposed antenna is shown in figure 3. The VSWR for proposed antenna is very close to one over the entire operating band which means that antenna is perfectly matched and there is no mismatch loss.

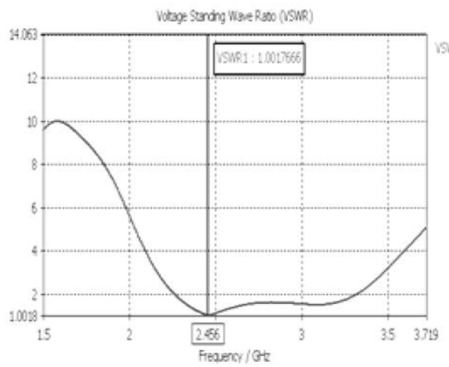


Fig. 3 VSWR plot for proposed antenna

The radiation pattern plot shows that how antenna radiates in different directions. The maximum gain is obtained in the broadside direction and this is measured to be 5.00 dB for φ = 90 degrees as shown in figure 4.

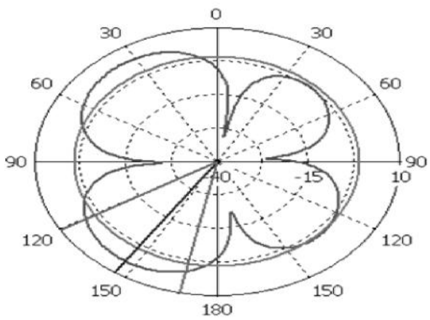


Fig.4 Radiation pattern plot for proposed antenna

## IV. Sensitivity Analysis

A numerical sensitivity analysis is done to demonstrate the effect of different parameters such as G, S, and $S_W$ on the performance of the designed CPW-fed patch antenna. These parameters are set as variable and their effects on impedance bandwidth and return loss are investigated.

The first parameter under study is the gap between the ground plane and radiating patch donated as G. Figure 5 shows the simulated return loss of the proposed antenna with varying feed gap (G) from 40mm to 42mm. The results show that the frequency corresponding to the upper edge of the bandwidth is clearly independent of the feed gap G, but the frequency corresponding to the lower edge is heavily dependent on this parameter. It is clear that G is an important parameter that influences the return loss.

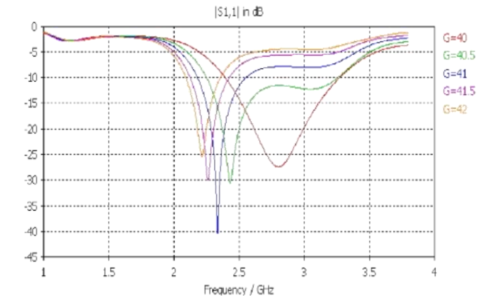


Fig. 5 Return loss plot for various values of G

The simulated return loss plot for various values of feed gaps S, the gap between the feed and the ground plane is shown in figure 6. The result shows that the frequency corresponding to the lower edge of the bandwidth is independent of the feed gap S, but the frequency corresponding to the upper edge is dependent on this parameter. The optimum value of S is 2.63 as shown in figure 6.

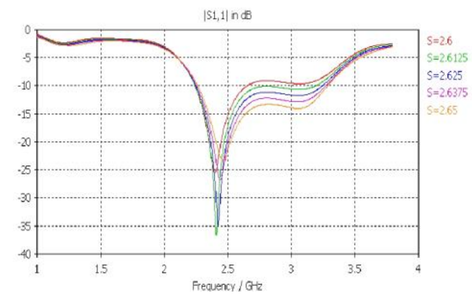


Fig. 6 return loss plot for various values of S

The simulated return loss plot of proposed antenna for various value of ($S_w$) width of slot in ground plane is shown in figure 7. This parameter mainly effect the high frequency performance , the low frequency performance is clearly independent of $S_{w.}$ based on these results the optimum value of $S_w$ is 45.7.

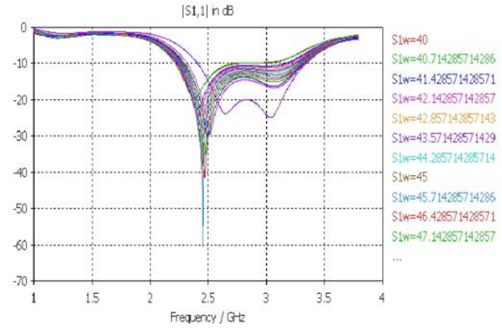


Fig. 7 Return loss plot for various values of $S_{w.}$

## V. Conclusion

The proposed broadband CPW fed antenna with two slots in the ground plane has been simulated. It is observed that broadband behavior of the designed antenna is mainly because of slotted ground plane. The proposed antenna has a impedance bandwidth of 42% ranging from 2.26GHz to 3.29GHz with a return loss value of -61dB and VSWR value 1.0017. The designed antenna can be used for WLAN, Wi-MAX and Bluetooth applications.

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