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# Analysis of Microstrip Line Fed Shorted Patch Antenna

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***Abstract:*** *Compact Microstrip antennas have recently received much attention due to the increasing demand of small antennas for personal communication equipment. The problem of achieving impedance bandwidth greater than or about 10% for present day cellular communication systems for a compact microstrip antenna is becoming an important topic in microstrip antenna design. A study of low cost Microstrip line fed shorted patch antenna has been presented in this paper. Because both shorted patch and 50Ω microstrip feed line have an air substrate, the material cost is reduced to a minimum. Also a comparative study of the antennas without and with slots of different geometries has been presented. The proposed antenna without slot has a band width of 18.5%. A Considerable size reduction is obtained with the vertical slots and an enhanced bandwidth of 25.2% with the inclined slots. The designs are suitable for applications in DCS (Digital Communication Systems) base station.*

***Key Word****: Microstrip antenna, Compact antenna, Shorted patch, Microstrip line fed*

## I. Introduction

With the ever increasing demand for mobile communication and emergence of many systems, it is important to design broadband antennas to cover wide frequency range [1]. The design of an efficient wideband small size antenna for recent wireless applications is a major challenge. Microstrip patch antennas have found extensive application in wireless communication system owing to their advantages such as low profile, conformability, low cost fabrication and ease of integration with feed networks [2]. However, conventional Microstrip patch antennas suffer from narrow bandwidth. This poses design challenges for the designer for broad band applications [3]. There are well known methods to increase the bandwidth of antennas including increase of the substrate thickness, the use of dielectric substrate of low dielectric constant, the use of various impedance matching and feeding techniques and use of slot antenna geometry[4,5].

In this paper, construction of the prototype of low cost Microstrip line fed shorted patch antenna with and without slots and their comparative study has been presented. The radiating patch is shorted to ground with the help of shorting plates of suitable width. Both Microstrip feed line and shorted patch have air substrate of different heights. The results are indicated by the frequency versus return loss curves obtained and the measured radiation patterns in the H plane.

## II. Antenna Geometry

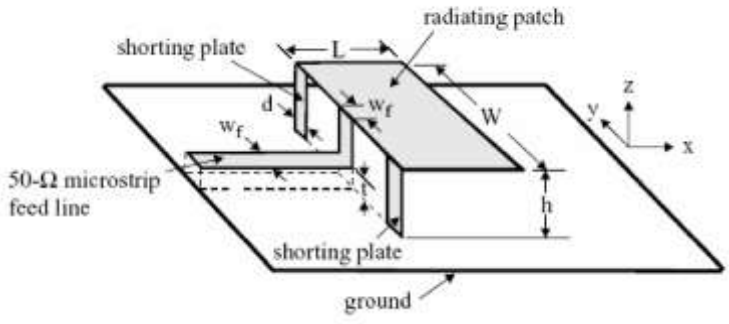



**Figure 1**(a) Geometry of Broadband Microstrip line fed shorted patch antenna

Figure 1(a) shows the antenna geometry. The radiating patch has length 'L' and width 'd'. It is supported by plastic posts above the ground plane. The distance of the radiating patch to the ground plane is 'h'. The radiating patch is short circuited to the ground plane by using identical shorting plates of width 'd' placed at two ends of one of the patch's radiating edges. At the centre of the patch edge with shorting plates, a 50Ω Microstrip feed line is used to directly feed the radiating patch. The strip of the feed line has a width 'Wf' and is connected to the radiating patch at the patches shorted edge by using conducting strip of same width 'Wf'. The air substrates of shorted patch and feed line have heights 'h' & 't' respectively. By selecting suitable value of

'h' a wide impedance bandwidth can be obtained. Good impedance matching of the proposed antenna is easily achieved by adjusting width of the shorting plates.

For the present prototype which may be used for DCS base station application, the following design parameters have been chosen.

L=23.5mm, W=54mm, d=5.5mm, Wf=16mm, h=8mm, t=3.2mm.

The rectangular slots of size 5mm x 15mm are made parallel to the shorter edge of the radiating patch as shown in Figure 1(b).

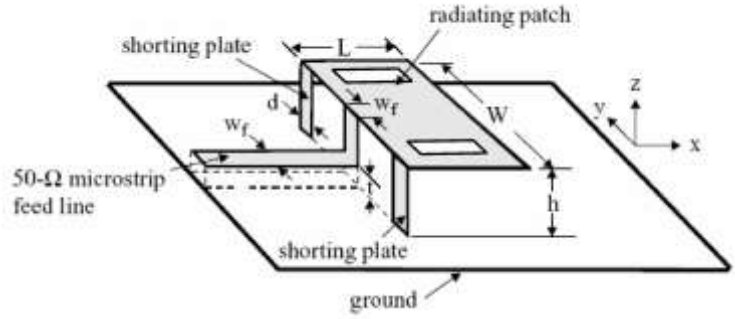



**Figure 1(b)** Microstrip line fed shorted patch antenna with vertical slots.

Also in another antenna design rectangular slots of size 2mm x 10mm inclined at an angle of 45 degrees, on the top left and bottom right corners are made as shown in Figure 1(c).

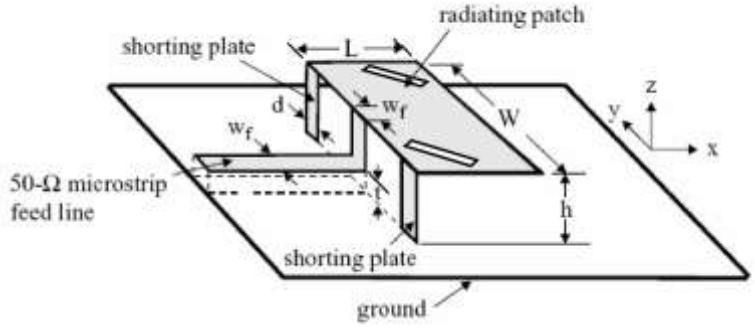



**Figure 1(c)** Microstrip line fed shorted patch antenna with inclined slots.

## III. Result

Measurements for the return loss and the radiation pattern of the antennas are made with the Vector Network Analyzer (ROHDE & Schwarz, German made SVK Model- 1127.8651). Figure 2(a, b, c) show measured return loss against frequency plots.

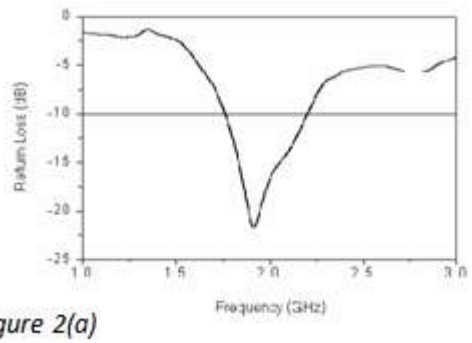



*Figure 2(a)*

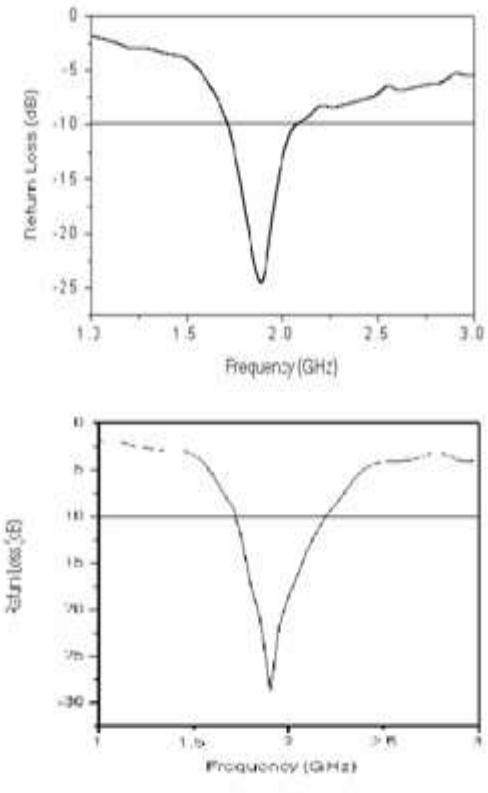



**Figure 2(c)**

**Figure 2** Return loss vs. frequency plots for Antennas 1(a, b, c) respectively

It is clearly seen that an impedance bandwidth of 22% covering the bandwidth requirement of 1920-MHz band (1765MHz-2200MHz) is obtained. The similar prototype with the vertical slots along the shorter edge of the patch shows a reduction in size. An enhanced bandwidth of 25.2% is obtained for the antenna with the inclined slots. Typical measured radiation patterns for antenna geometries with slots are presented in fig 3. Good broadside patterns are obtained in the H plane. A relatively lesser cross polarization radiation is observed for the antenna with inclined slots.

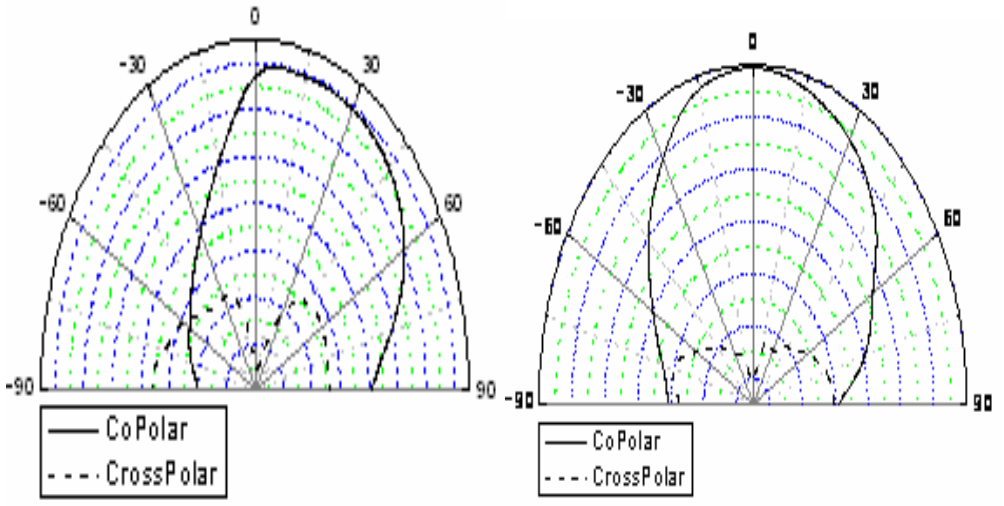
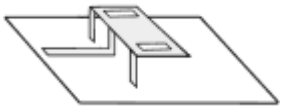
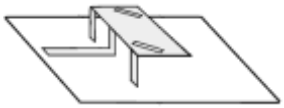



Fig. 3(a) Fig. 3(b)

**Figure 3** Radiation Pattern for Antenna with Vertical and Inclined slots

**Table 1** Results Obtained for Microstrip Line Fed Shorted Patch Antennas

| Sl. No. | Antenna Structure | Resonant Frequency | Return Loss | Bandwidth | Bandwidth Percentage | Radiation Pattern |
|---|---|---|---|---|---|---|
| 1 |  Shorted Patch Antenna | 1.92 GHz 1920 MHz | -22.19 dB | 1765-2200 MHz | 22% | Broadside |
| 2 |  With Vertical Slots | 1.895 GHz 1895 MHz | -26.87 dB | 1715-2065 MHz | 18.5% | Broadside |
| 3 |  With Inclined Slots | 1.905 GHz 1950 MHz | -28.84 dB | 1715-2195 MHz | 25.2% | Broadside |

## IV. Conclusion

The proposed design of the shorted patch antenna without slots provides improved return loss and impedance bandwidth of 22% with respect to the centre frequency of 1920MHz. Similar prototype with vertical slots show a size reduction, an improved return loss, and an impedance bandwidth of 18.5% with a centre frequency of 1895MHz. The prototype with inclined slots shows further improvement in the return loss and also enhanced bandwidth of 25.2% at a centre frequency of 1950MHz. The antennas with slots provide good broadside radiation patterns. Substantial reduction in cross polarization radiation is observed with slotted antenna geometry. The results show that the proposed antenna may conveniently be used for DCS base station applications.

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