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Circularly Polarized Patch Antenna with Shorted Strip

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ABSTRACT: A novel design of a circular polarized patch antenna for GNSS application. The proposed antenna generates four resonant frequencies. With the proposed antenna wide operating bandwidth covers several wireless communication system including GSM (880 ~960 MHz), DCS (1710~1880 MHz), PCS (1850 ~ 1990 MHz), UMTS (1920 ~2170 MHz), WiBro (2300 ~ 2390 MHz), GLONASS (1602 ~ 1615.5 MHz).

KEYWORDS: Axial ratio, circular polarization, return loss, shorted strip.

1 INTRODUCTION

The rapid evolution of mobile environment demand of the mobile phone is to support various communication networks. To fulfill their requirement multiband antenna is necessary. Hence a monopole multiband has been developed with circular polarization antenna which covers bandwidth for several communication system such as GSM (880 ~960 MHz), DCS (1710~1880 MHz), PCS (1850 ~ 1990 MHz), UMTS (1920 ~2170 MHz), WiBro (2300 ~ 2390 MHz), GLONASS (1602 ~ 1615.5 MHz).

In market number of antennas have been developed to achieve circular polarization such as patch antenna [8], helical antenna [3], and slot antenna [9]. In helical antenna is the forms of straight rod are conventicle to the GPS handset. These antennas are difficult to integrate to mobile phone because it requires large space. Planar monopole [1] antenna widely used in many phone and also lot of advantage such as small size and low cost. In recent studies found that planar monopole antenna can achieve a circular polarization for GNSS [5] application. For generation of circular polarization planar antenna is slotted. But the radiator of this antenna is quite large about 0.25λ x 0.25λ. Hence there is another way to achieve a circular polarization by using a parasitic [1] element to the ground plane.

2 DESIGN CONSIDERATION

The proposed compact circular polarization [5] patch antenna with shorted strip is illustrated in Fig.1 which is printed on a FR4 substrate with a thickness of 1.6mm and its relative permittivity of 4.4. The dimension of substrate is 110 mm x 50 mm antenna and ground plane printed on the different sides of substrate. In order achieve circular polarization ground plane is not designed as a regular polarization. Details of the proposed antenna shown in Fig.2. In that point A is feeding point and point B is shorting point via to the ground. A strip line is mounted at the corner of the ground plane and feeds a strip branch monopole directly. At the other side of the ground plane, a tuning stub is mounted. In between stub and strip a short strip is mounted. There are four resonant path including AE, AF, AG and BD which generates 4 resonant frequencies with a 0.25 λ mode.

The proposed antenna covers wide operating band such as GSM (880~960 MHz), DCS (1710~1880 MHz), PCS (1850~1990 MHz),UMTS (1920 ~2170 MHz),WiBro (2300~2390 MHz),and ISM (2400 ~2483 MHz) and also covers COMPASS (1559.052 ~1591.788 MHz), GPS(1575.42 ± 5 MHz), GLONASS(1602 ~ 1615.5 MHz).

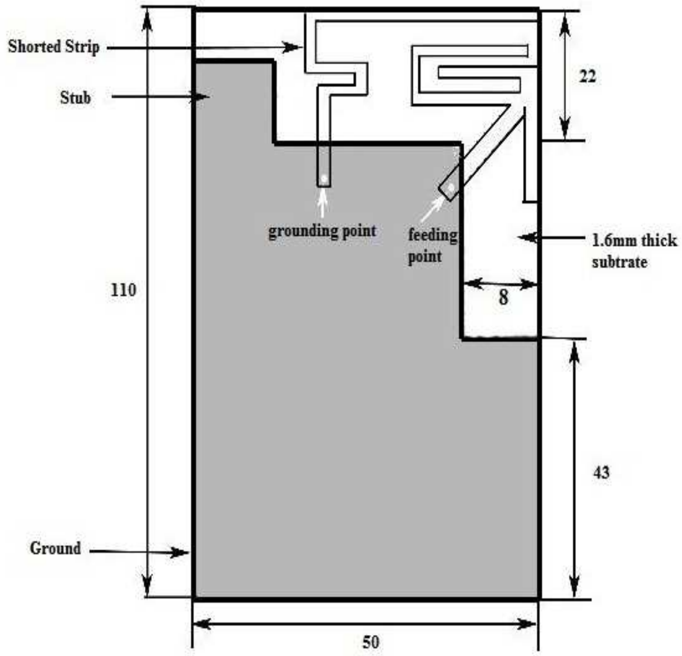


Fig.1. Geometry of the proposed design

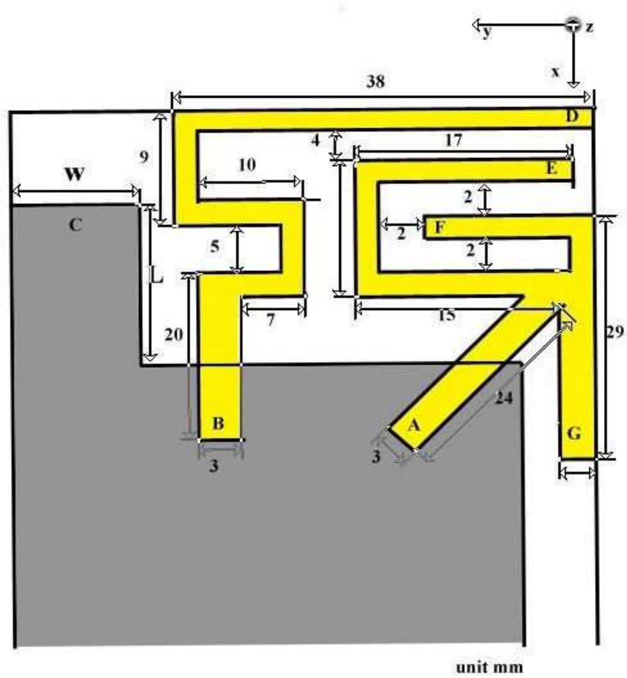


Fig.2. Detailed dimension of the proposed design

3 GENERATION OF CIRCULAR POLARIZATION

In general circular polarization [6] is generated by two orthogonal E vector with equal amplitudes and 90^o phase difference. It is defined as

$$E = E_{Hor} + e^{j\varepsilon} E_{Ver}$$

Where E is the instantaneous electric field vector, E_{Hor} and E_{Ver} respectively, denotes the electric field vectors in horizontal and vertical planes and δ is phase difference. In addition, axial ratio (AR) represents the characteristics of the polarization. If the AR value is 0 dB then polarization is circular. In practical circular polarization is typically defined based on a axial ratio value [7] of less than 3dB.

In Fig.4 it can be seen that the circular polarization frequency falls when the width of the tuning stub W decreases. In the Fig.5 when the length of the tuning stub L increases, the circular polarized frequency falls. Both the decreases of the width and the increase of the length make the stub less capacitive. Thus the corresponding changes of the circular polarized frequency are in consistency with each other

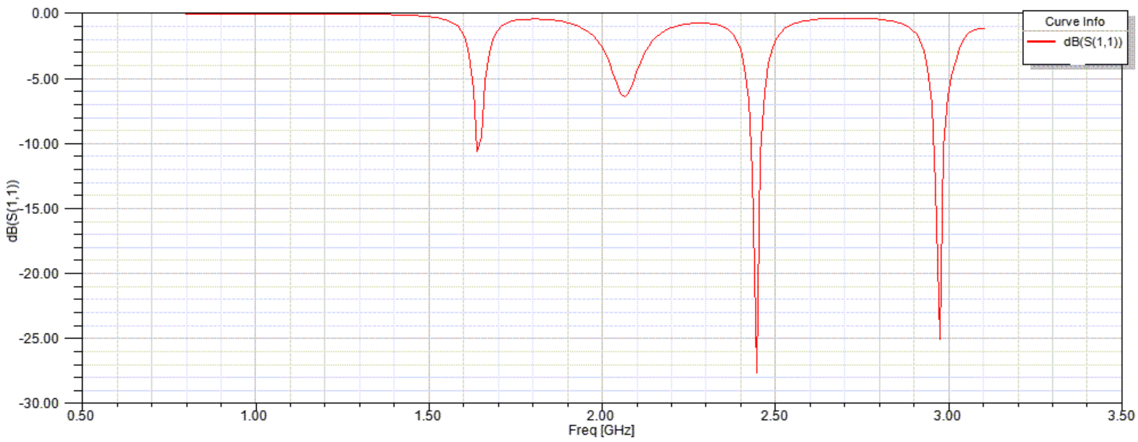


Fig.3. Simulated return loss for proposed antenna

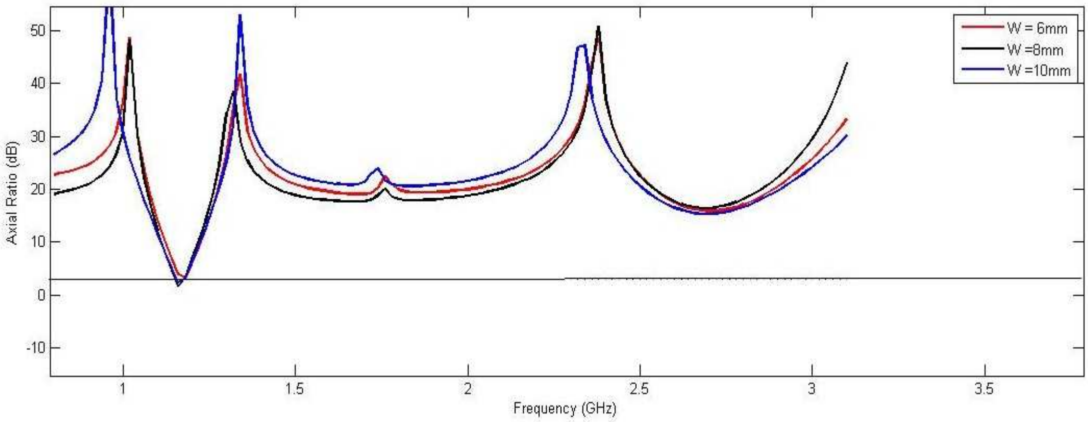


Fig.4. Simulated axial ratio for different stub width

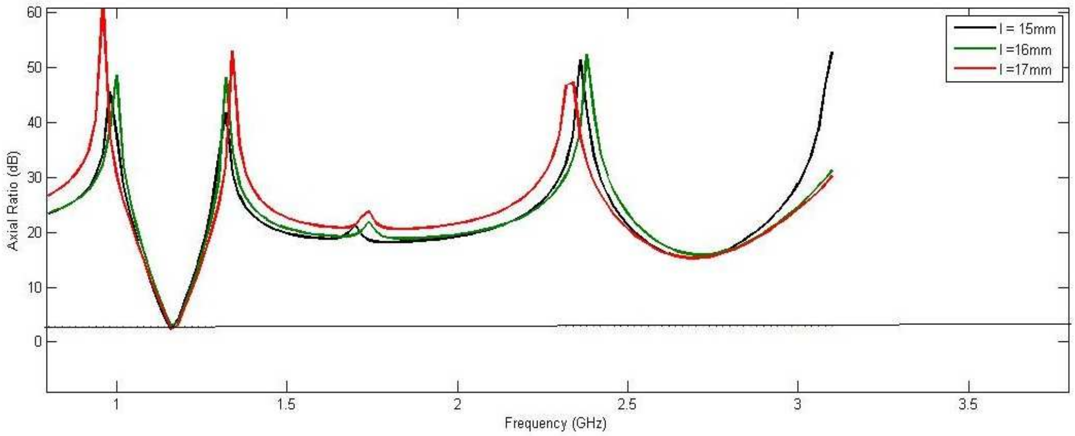
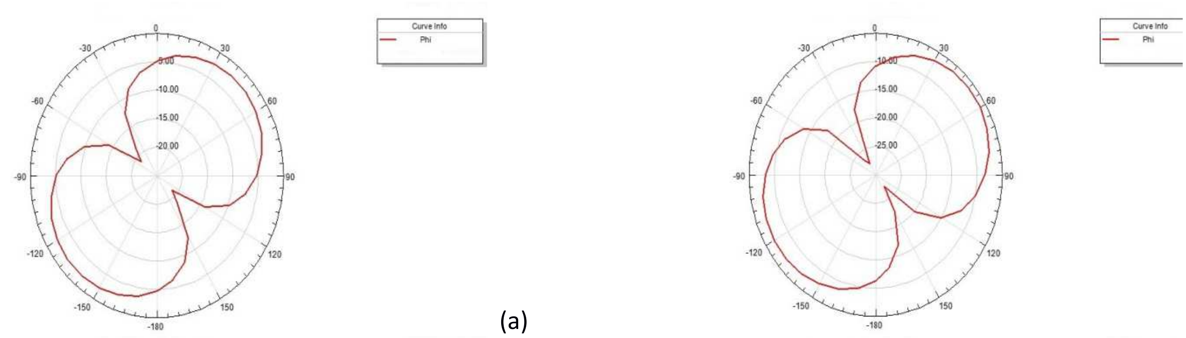


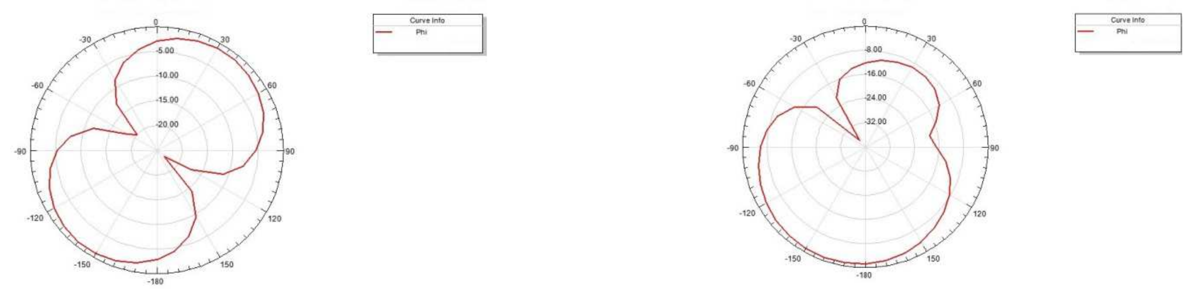
Fig.5. Simulated axial ratio for different stub length

4 RESULT

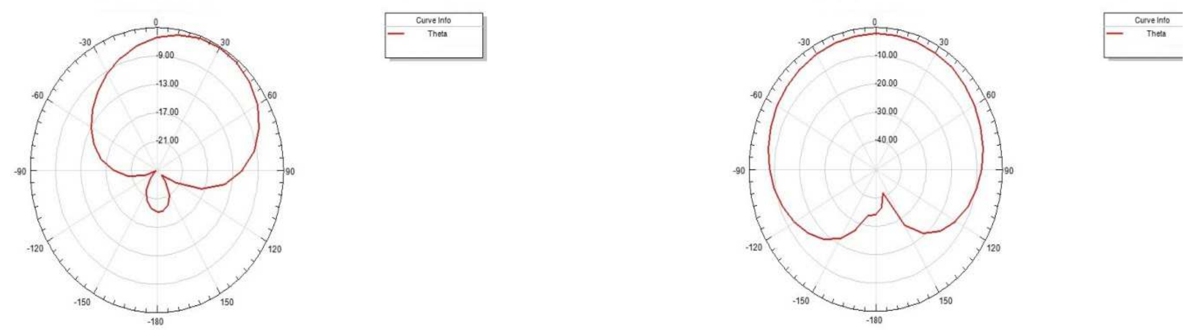
Fig.6. shows the simulated and measured radiation pattern at 900, 1900, 2050 and 2450 MHz of the proposed antenna for wireless communication system. Fig.6 (a) describes the radiation pattern at 900 MHz as good as these of conventional simple monopole antennas.



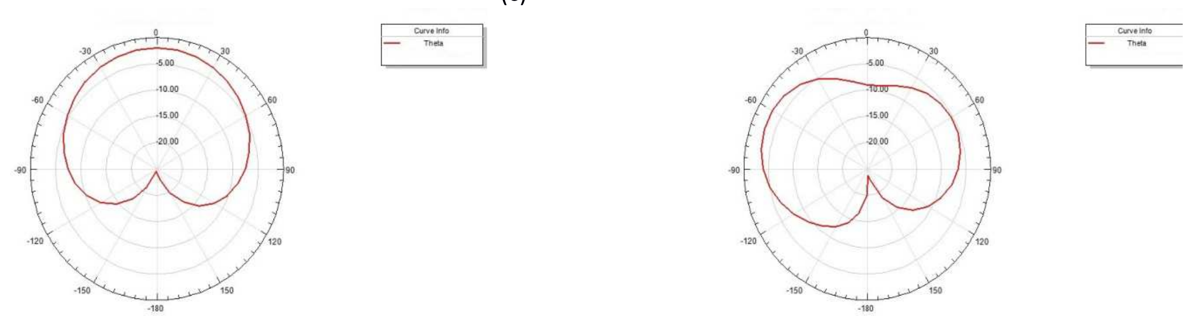
(a)



(b)



(c)



(d)

Fig.6. Measured radiation pattern for the proposed antenna

(a) 900 MHz (b) 1900 MHz (c) 2050 MHz (d) 2450 MHz

5 CONCLUSION

In this paper, a multiband antenna with circular polarization is presented. Branch lines and shorted parasitic strip are exploited to obtain a broad bandwidth, which including several communication system including GSM (880 ~960 MHz), DCS (1710~1880 MHz), PCS (1850 ~ 1990 MHz), UMTS (1920 ~2170 MHz), WiBro (2300 ~ 2390 MHz), and ISM (2400 ~2483 MHz) and also covers COMPASS (1559.052 ~ 1591.788 MHz), GPS (1575.42 ± 5 MHz), GLONASS (1602 ~ 1615.5 MHz).

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