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A Novel Design of Hybrid H-Slot Triple Band Monopole Antenna for GPS, WLAN and C-Band Applications

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ABSTRACT: In this paper a novel design of a hybrid semi-circular coupled H-slot loaded monopole antenna for triple band operation. The proposed antenna is constructed by a combination of both circular and rectangular patches are superimposed together and formed as hybrid H-slot shape antenna. The proposed antenna has a size of 40 × 60 × 1.6 mm^3 including partial truncated ground plane on bottom of the substrate. This antenna resonates for three resonating frequencies which covers 1.82, 3.5 and 4.826GHz for GPS, WLAN,C-band applications respectively. The proposed antenna is printed on low cost modified glass epoxy substrate material. The antenna is excited through 50Ωmicrostrip line. The simulated and experimental results are demonstrates that the proposed antenna satisfied the -10dB impedance bandwidth. And also provides a broadside radiation patterns at respective triple frequencies.

Keywords: Hybrid H-slot monopole antenna, triple band. GPS, WLAN and C-band

I. INTRODUCTION

A few decades after the earliest investigation of wideband wireless systems, a wide range application have been identified. They include ground penetrating radars, biomedical imaging systems, high data-rate short range wireless local network, communication systems, medium and large range, radars for military purpose and others because of their spatial temporal resolution [1]. With advance in wireless systems, the need of broading techniques bandwidth and sharing multifrequency bands has increased, several conventional antennas such as helical, horn and monopole [2-7], wide slot [8-9], electrical-magnetic dipole [10], are also available for wide impedance bandwidth application. Additionally, multiband and resonance can be achieved by adding parasitic element to the main monopole patch [11-12]. Hybrid antenna with parasitic element can be used as triple band antennas. This investigation presents a design of H-slot loaded hybrid microstrip antenna with a wide application of GPS (1.57 GHz), ISM (2.77 GHz) and Radar (4.826 GHz) bands. The performance of the proposed antenna is both calculated and measured is good aggregate each other.

II. DESIGN OF THE ANTENNA

Figure 1 shows the top and side view geometry of the proposed antenna H-slot loaded hybrid shaped microstrip antenna (HSHRMSA). The antenna consists of an H-slot loaded hybrid shaped radiating patch. The proposed antenna is fabricated on modified glass epoxy with relative permittivity of 4.2 and having loss tangent 0.02, and thickness of 1.6mm the length and width of the substrates is 40 × 60 mm. This antenna structure is named as hybrid because the rectangular and circular geometry are combined together. By H-slot inserted on the radiating patch the triple bands are obtained. The antenna is excited through 50Ω microstrip feed line having width of $W_f$is 3.17 mm and length L_f is 24 mm for the impedance matching. The radius of notch is 15.5 mm. At the bottom surface of the ground plane a partially truncated ground plane is etched which is slightly below the radiating patch to get desired operating bands. The offset gap d = 0.5 mm between the radiating patch and bottom ground plane. Finally optimized designed values of the antenna parameters are specified in Table. I. The photographs of the proposed antenna are as shown in Fig. 2.

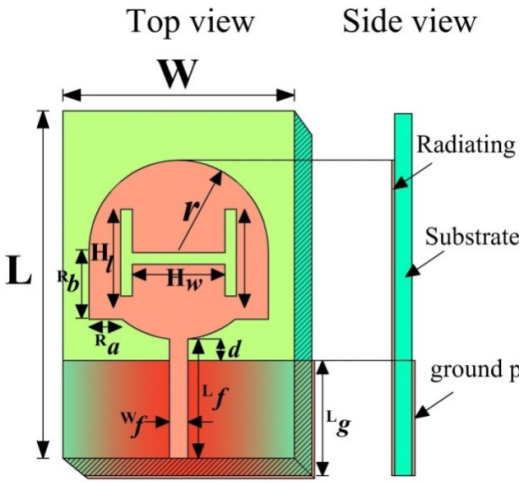
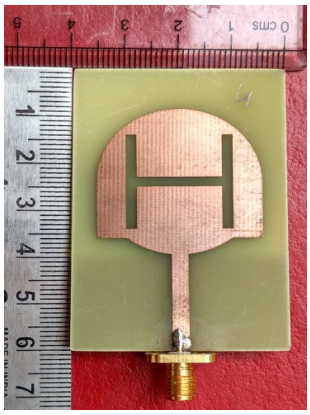
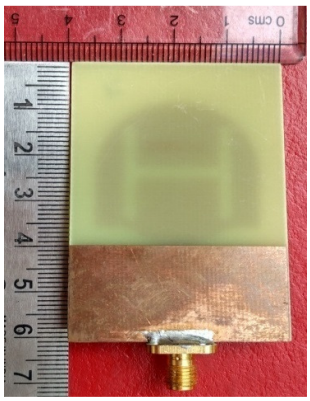


Fig. 1. Top and bottom geometry of proposed HSHRMSA.



(a) Top view



(b) Bottom view

Fig. 2. Photographs of HSHRMSA.

The top and bottom view photographs of HSHRMSA is as shown in Figure 2 (a) and 2 (b) respectively. The antenna parameters are measured experimentally by using network analyser.

Table 1: Antenna Parameters.

Antenna Parameters	Dimensions in mm
W	40
L	60
H_l	20
H_w	2
R_b	07
R_a	1.94
W_f	0.317
L_f	2.4
L_g	1.9
d	0.5
r	1.55

III. RESULTS AND DISCUSSION

From the simulated and measured results, the measured -10dB bandwidth of three frequency bands are 1.82 GHz (1.6 - 2.2 GHz), 3.5 GHz (2.53-4.20 GHz) and 4.82 GHz (4.67 – 5.09 GHz), which are wide enough to covers GPS, WLAN and C-band applications. A good agreement between simulated and measured results can be observed that shows the practicability of the proposed antenna.

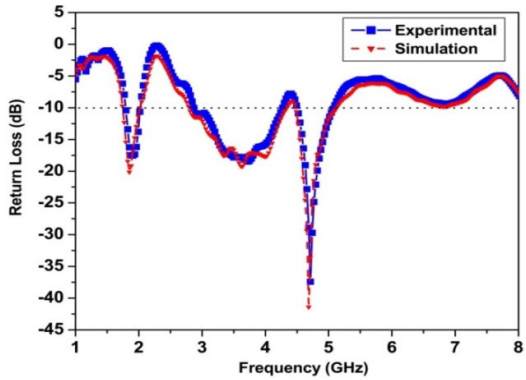
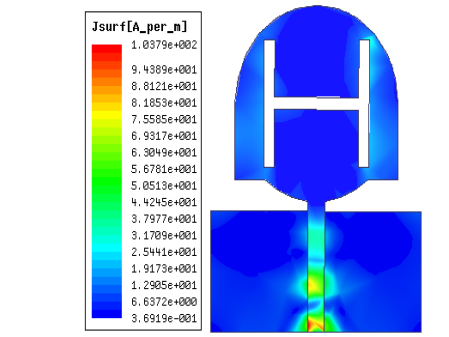


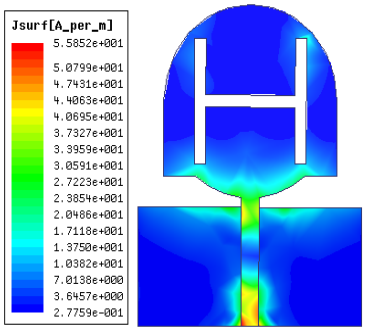
Fig. 3. Variations of return loss versus frequency of HSHRMSA.

To demonstrate the resonance mechanisms of the proposed antenna, the simulated current distribution at three corresponding frequencies of 1.82, 2.77 and 4.82 GHz are depicted in Fig. 4 (a), (b) and (c) respectively. The more current distributions are mainly observed in Fig. 4(a) concentrated feed line and in Fig. 4 (b).

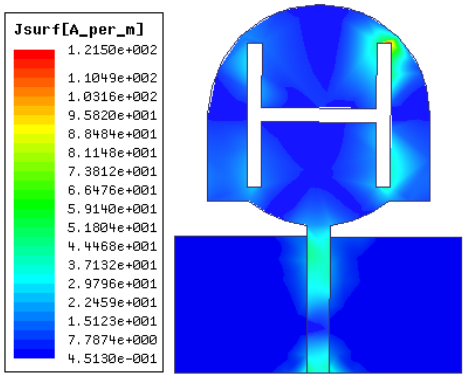
The current distribution is appears on bottom surface of the radiating patch and feed line and Fig. 4(c) which indicates that the antenna is operating for triple-wide band of frequencies. The E- and H-plane radiation patterns of the proposed antenna which are measured at 1.82, 3.5, and 4.71 GHz is as shown in Fig. 5. From the Fig. 5 it is observed that, the obtained radiation patterns are showing a good omnidirectional in H-plane and bidirectional in E-plane.



(a)

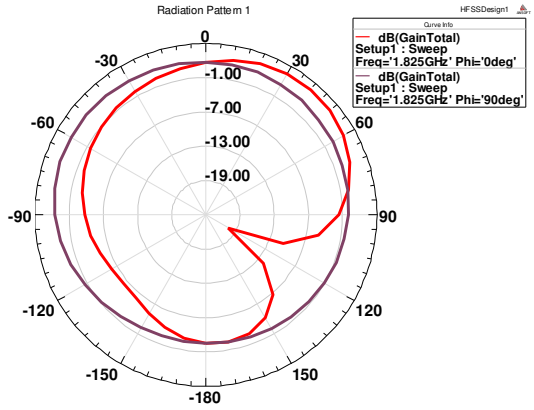


(b)

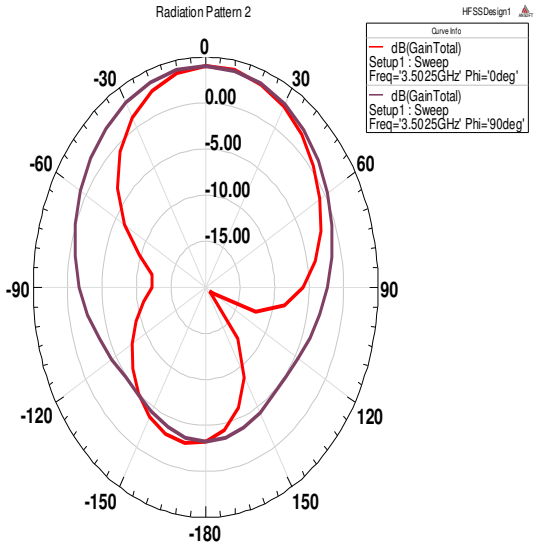


(c)

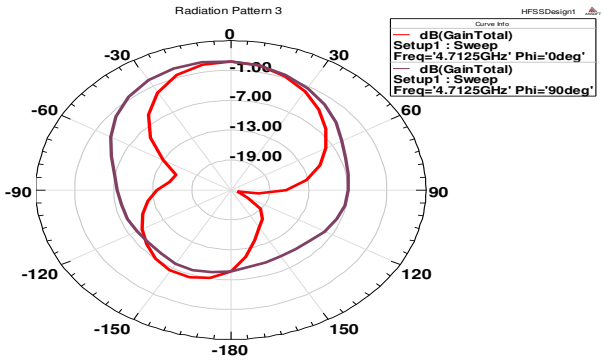
Fig. 4. Current distributions of HSHRMSA observed at (a) 1.82 GHz, (b) 2.77 GHz and (c) 4.82 GHz.



(a)



(b)



(c)

Fig. 5. Radiation pattern of HSHRMSA observed at (a) 1.82GHz, (b) 3.5 GHz and (c) 4.72GHz.

IV. CONCLUSION

In this paper, a novel design of HSHRMSA has been proposed for triple wide band operations which cover the GPS, WIMAX and C-band Radar applications. The geometry of antenna is hybrid in nature and having slot inside it. By suitably varying the structure and dimensions of the H-slot, the designed antenna is resonant for triple band operations. The proposed antenna is compact in its structure and designed using low cost FR4 substrate which is fed by a simple 50Ω microstrip line feed. The antenna also shows a good omnidirectional and bidirectional radiation pattern. The measured and simulated results are in good agreement with each other. The antenna shows good radiation pattern. The proposed antenna is a good candidate for triple band application due to its advantages of compact, planar, low cost and ease of construction.

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