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Compact Novel Multiband Slotted Microstrip Patch using Grounded Asymmetric Coplanar Strip (GACS) for WLAN and WiMAX Applications

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Abstract: ***A compacted multiband antenna using grounded asymmetric coplanar strip (GACS) propounded in this paper for multiband applications. The GACS techniques is used to miniaturization of antenna. It has compact size is 19 mm × 19 mm × 1.6 mm^3. The suggested antenna has been design on FR4 material with εr =4.4 with 1.6 thickness. The monopole antenna is modified by adding L and F strips elements in radiating structure of patch to obtain multiband band resonance. The proposed antenna has application in the bands of WLAN (2.4 GHz-2.5 GHz), Wi-MAX (3.3 GHz-3.6 GHz) and Both WLAN/Wi-MAX (5.5 GHz-5.8 GHz) band. The bandwidth of antenna getting 100MHz, 240MHz and 350MHz at 2.45GHz, 3.55GHz and 5.56GHz. All the three band has VSWR less 1.4.***

Keywords : Monopole, Multiband, GACS, ACS, Wi-MAX, WLAN and L shape.

I. INTRODUCTION

Many paper has been study on multiband applications. This can be obtained using different techniques like fractal slotted patch and meander line structure etc. Apart from the multiband application, antenna requires compact and better accuracy. Recently, CPW have great techniques for multiband due to their wideband performance. Recently several work on CPW and Asymmetric Coplanar Strip (ACS) has been study which include different structure like T-shape, F- Shape, S-shaped and inspired metamaterial structure etc. were design to satisfied wireless applications. CPW antenna offers better impedance matching and great isolation Asymmetric Coplanar Strip (ACS) fed technique is modified of CPW and it has 50% less than ground area with relate to CPW structure.

In this paper, a compact GACS microstrip patch antenna is proposed. In proposed antenna covers 3 frequency bands of 2.4GHz,3.5GHz and 5. 5GHz.A compact multiband antenna with good impedance bandwidth is proposed.

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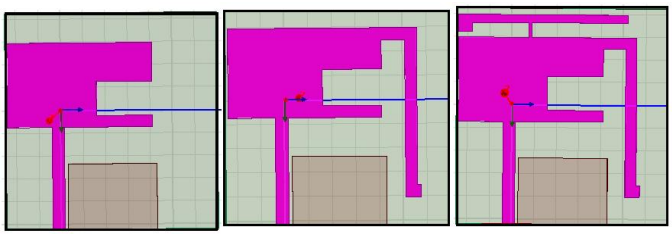
II. ANTENNA CONFIGURATION

The proposed GACS antenna has been designed by introducing the L- strip and inverted F shape strip at edge of monopole antenna as shown in Fig. 2 The proposed GACS antenna has been designed by introducing the L- strip and inverted F shape strip at edge of monopole antenna as shown in Fig. 2. We take simple monopole antenna 1 to generate 5.5GHz freq in Fig 1. (a), Next Antenna 2 we attached L shape strip at side edge of monopole antenna as shown in Fig. 1. (b) which produce dual frequency 2.4GHz and 5.5GHz. The final antenna 3 design is obtained by introducing inverted F shape strip at upper edge of monopole antenna as shown in Fig.1.(c) which generate middle resonant freq at 3. 5GHz.In this model, the proposed antennas were designed using FR4 Substrate with εr=4.4 and thickness (h) is 1.6mm. In this antenna asymmetric coplanar strip (ACS) feeding techniques is used. At the bottom side of antenna having extra gnd plane to get better performance. The dimensions of monopole antenna length (L) =7.4mm and width (W)=13mm at resonant frequency of 5.56GHz has been calculated by using the equations 1 to 3. The proposed GACS antenna are shown in figs of 1, 2 below.

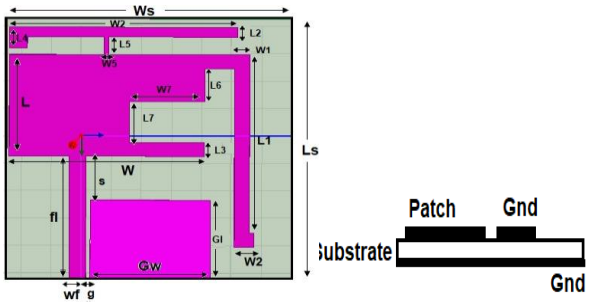
$$Width = \frac{c}{2f_o\sqrt{\frac{\varepsilon_R+1}{2}}}; \qquad \text{------- (1)}$$

$$\varepsilon_{eff} = \frac{\varepsilon_R+1}{2} + \frac{\varepsilon_R-1}{2}\left[\frac{1}{\sqrt{1+12\left(\frac{h}{W}\right)}}\right] \qquad \text{------- (2)}$$

$$Length = \frac{c}{2f_o\sqrt{\varepsilon_{eff}}} - 0.824h\left(\frac{(\varepsilon_{eff}+0.3)\left(\frac{W}{h}+0.264\right)}{(\varepsilon_{eff}-0.258)\left(\frac{W}{h}+0.8\right)}\right) \qquad \text{--- (3)}$$



(a) Antenna 1 (b) Antenna 2 (c) Antenna 3
Fig. 1. Design steps of the multiband monopole antenna



(a) (b)

Fig.2. Geometry of the proposed GACS-fed multi band antenna (a) Top View (b) Side View

Table 1: Optimized Parameter Value

Parameter	Dimensions (mm)	Parameter	Dimensions (mm)
L	7.4	L6	2.4
W	13.0	L7	3.0
L1	13.0	W1	1.0
L2	0.7	W2	1.3
L3	1.0	W5	0.4
L4	1.5	W7	5.0
L5	1.3	g	0.4
Fl	9.0	s	3.2
wf	1.2	Ls	19.0
Gl	5.8	Ws	19.0
Gw	8.0		

III. RESULT AND DISCUSSION

The simulated return loss of all three designs is shown in fig.3 Green graphs (Antenna 1) getting single freq at 5.58GHz, Blue graphs (Antenna 2) getting dual band 5.55GHz and 2.48GHz and red graph (Antenna3) getting multiband 2.45GHz,3.50GHz and 5.56GHz.

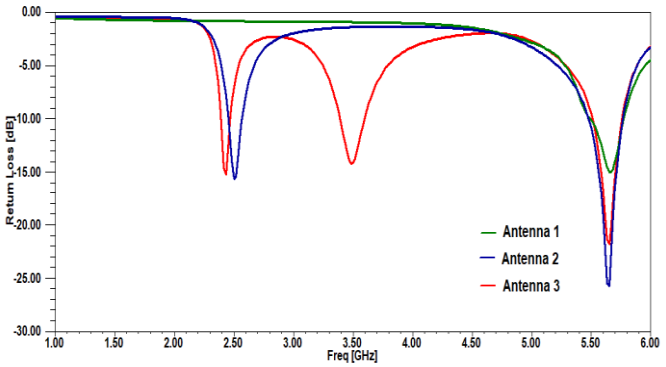
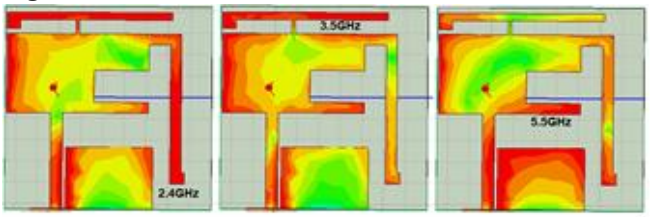


Fig 3: Simulated return loss of all three antenna structure



(a) (b) (c)

Fig.4 Surface current (a) 2.45GHz (b) 3.50GHz and (c) 5.55GHz

The Antenna has been tested on Agilent Network Analyser N9923A series.

The simulated and fabricated S11 of the proposed GACS antenna is shown in fig. 5.

The Simulated Vs measured radiation pattern at different resonance frequencies is shown in fig. 6.

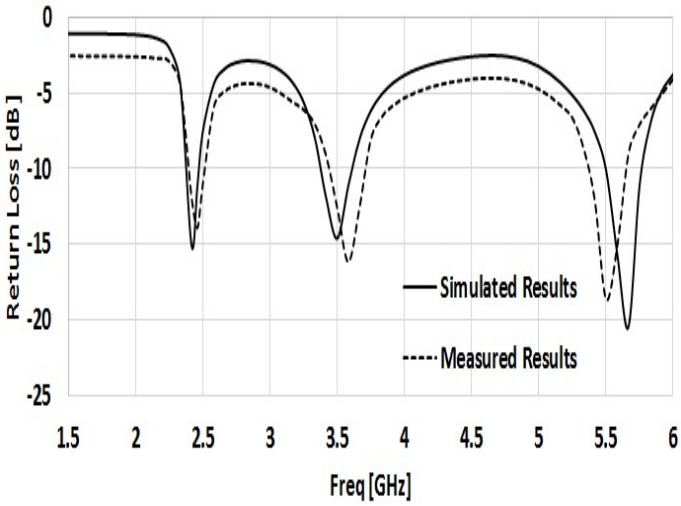
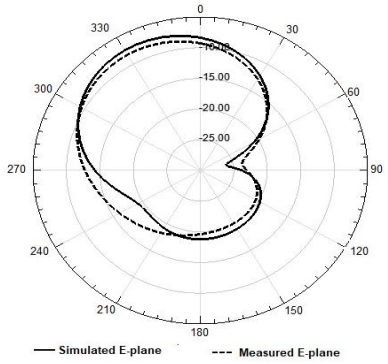
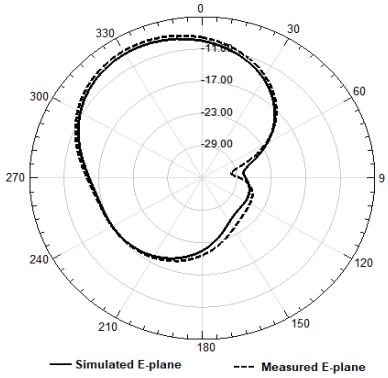


Fig.5. Simulated Vs Measured Return loss of proposed antenna

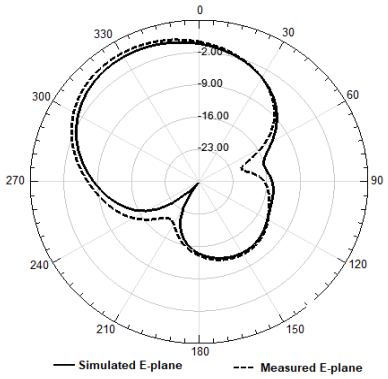
Fig. 6(a)-(c) shows the E-plane of proposed antenna at 2.45 GHz, 3.55 GHz and 5.55 GHz. The good matching observed between simulated and measured radiation patterns.



(a) 2.45GHz



(b) 3.55GHz



(c) 5.55 GHz

Fig. 6. Radiation Patterns of proposed antenna at (a) 2.45 GHz, (b) 3.55 GHz and (c) 5.55GHz

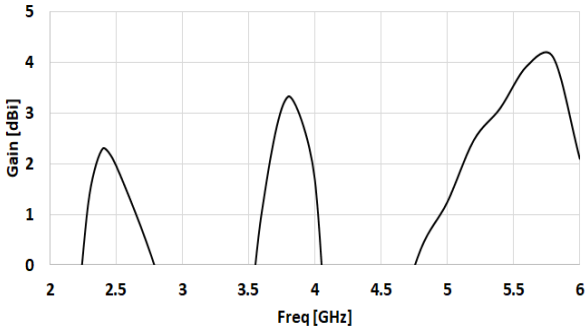
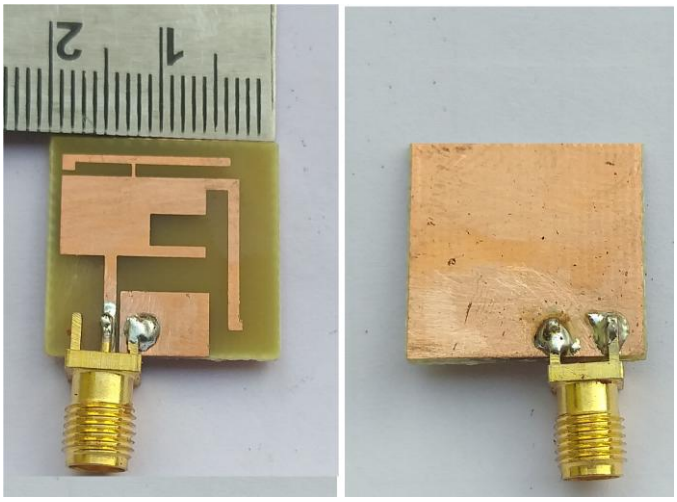


Fig. 7. Measured average gain of the proposed antenna



(a) TOP View **(b) BOTTOM View**

Fig.8. Prototype Proposed GACS Multiband antenna

IV. CONCLUSION

A compact GACS fed slotted monopole multiband antenna is presented for WLAN and Wi-MAX applications. The overall size of antenna is very small 19×19×1.6 mm^3. In design steps of multiband antenna started with simple GACS fed monopole for 5.5 GHz is designed and then and adding L and F strips structure in radiating monopole patch structure to obtain multiband band resonance. The frequency and bandwidths of the bands can be adjusted by tuning the lengths of the attached strips of monopole. Radiation pattern is stable all the three frequency bands with good gain. The experimental and simulated results observed good matching except some slight variation.

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