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Microstrip fed Key-Patched antenna for WLAN and WiMAX applications

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***Abstract*---the proposed design is for triple band monopole antenna. The antenna consists of a patch that is compared to a key shape. The multiband characteristics of antenna are obtained by rectangular patch with key shaped slot, also bandwidth is improved by adding patches of different shapes and widthsThe volume of proposed antenna is 30×30×0.8 which is quite compact and covers the operating band of (2.367-2.71 GHz)/2.475 GHz, (3. – 3.3 GHz)/3.15 GHz and (5.2 – 5.6 GHz)/5.4 GHz which covers operating bands for WLAN and WiMAX applications as per IEEE 802.11a/b/g/n standards with 14.1%, 9.1% and 7.4% of impedance bandwidth respectively**

I. INTRODUCTION

Microstrip patch antennas are printed directly on circuit boards which reduces the space requirements and cost making it much popular.

Due to its compact size the patch antennas hold a special place in the field of electronics like in mobile phones, satellites etc. wherever wireless communication is required..In present time we see the application of WLAN in schools, colleges, offices, in military. Hence WLAN is very important antenna application. According to IEEE standards 802.11 a/b/g/n operating bands for WLAN is 2.4 GHz (2.40–2.484 GHz), 5.2 GHz (5.15–5.35 GHz), 5.8 GHz (3.585–5.825 GHz) and operating bands for the WiMAX are 2.4 GHz (2.5–2.8 GHz),3.5 GHz (3.2–3.8 GHz)and 5.5 GHz (5.2–5.8 GHz).So there is need of antenna which can be operated on multiple frequencies. Compact size and low cost has always been a desirable feature in every system hence there is a need of antennas which can be used for multiple applications. This need can be fulfilled by using compact multiband antenna proposed in this paper.

Various designs applicable for WLAN and WiMAX applications uses meandering split ring slot[1], antenna consisting of L shaped slots [2].

Multiple frequency bands are obtained by adding rectangular patch. A compact antenna with simple design is offering good gain and radiation pattern have been presented in this paper.

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II. ANTENNA DIMENSIONS-

The antenna proposed in paper is as shown in figure 5(a) and figure 5(b). The dimensions of ground are Wg × Lg (30 × 2 mm^2) and then patches of different dimensions are made over the substrate of dimensions Wsub × Lsub (30 × 30mm^2) . The dimensions are referred with the help of the formula:

$W_p = c/2f_r\,(2/\epsilon_r + 1)^{1/2}$

$\varepsilon_{reff} = (\epsilon_{reff} + 1)/2 + (\epsilon_{reff} - 1)/2\,[1+12h/w_p]^{-1/2}$

$L_{eff} = c/2f_r(\epsilon_{reff})^{-1/2}$

$\Delta L = 0.412\,h[(\epsilon_{reff}+0.3)(w_p/h+0.264)]/[(\epsilon_{reff}-0.258)(w_p/h+0.8)]$

$L_p = L_{eff} - 2\Delta L$

Where, c (= 3×10^8 m/s) is the speed of light

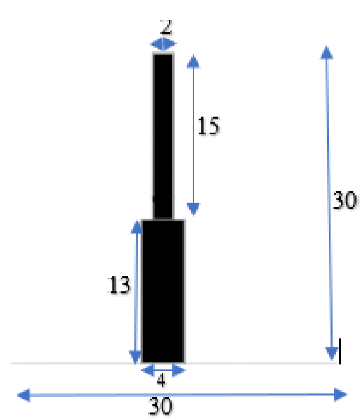

Figure. 1-first stage of the antenna .

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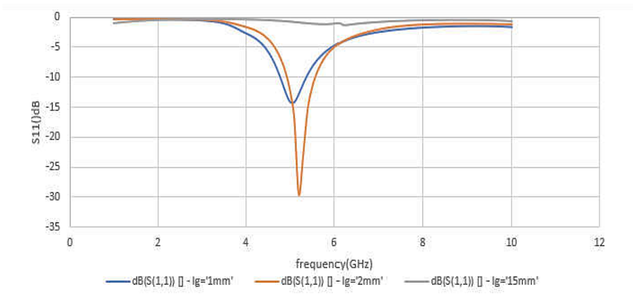

Fig.2:Return loss curve of stage 1

FR4_epoxy substrate is used for fabricating the antenna the thickness of the substrate is 0.8 mm and has the dielectric constant of 4.4. It is fed by 50 ohm microstrip line of dimensions W_f X L_f (4 X 13 mm_2) .All the dimensions of antenna are given in the diagram of antenna itself with substrate dimensions of 30X 30 mm2.

III. RESULTS AND DISCUSSION

The above proposed antenna is designed and simulated using HFSS 13.0 software, its characteristics are studied and analysed based on s11 parameters, current distribution and radiation pattern. Here in this section we have discussed the results at different stages of design with their return loss curves. Figure 1 shows the first stage of antenna and Fig.2shows the return loss curve for stage 1 at different values of Lg but this consists of only single band so is carried forward to obtain multiple bands.

Now one more rectangular patch is introduced to obtain multi band which is shown in fig.3return loss curve for second stage is shown in Fig. 4 at different values of Lg.

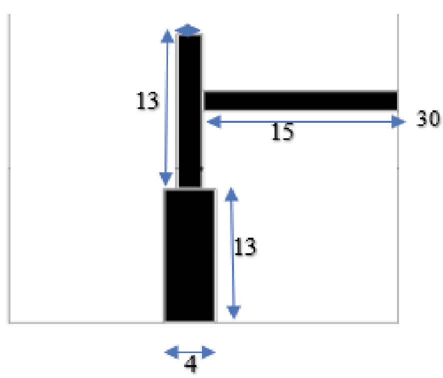

Fig.3:antenna in second stage

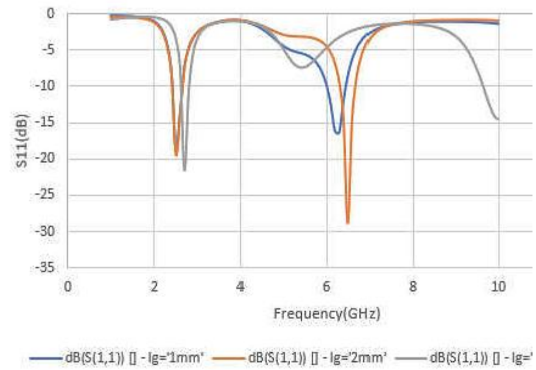

Fig 4 : Return loss curve of stage 2

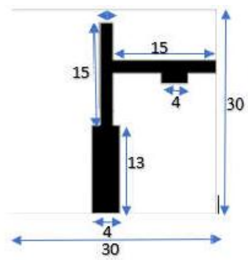

Fig.5(a)- Front view of antenna

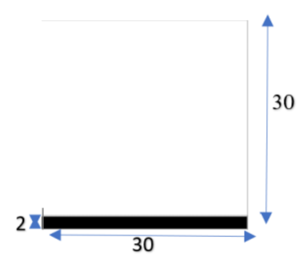

Fig.5(b) bottom view of antenna

Further to obtain a triple band a rectangular patch is added which gives the final design of proposed antenna at length of ground (Lg= 2mm)and is shown in fig 5(a) and fig 5(b) , its return loss curve is given below in Fig.6, the proposed antenna covers three bands with three resonant points. The frequency bands are obtained at (2.367-2.71 GHz)/2.475 GHz, (3– 3.3 GHz)/3.15 GHz and (5.2 – 5.6 GHz)/5.4 GHz which covers operating bands for WLAN and WiMAX applications as per IEEE 802.11a/b/g/n standards.

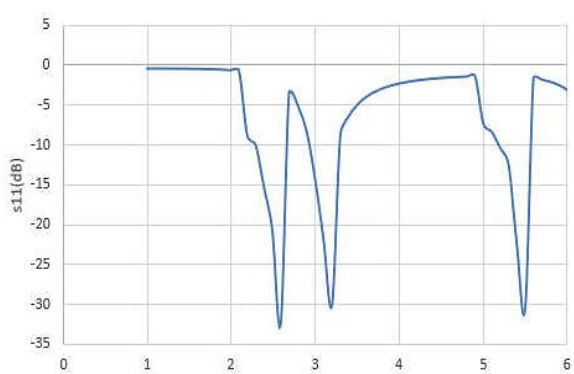

Fig.6:Return loss of proposed antenna

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To observe the effect of various changes in parameters parametric analysis is done, which can be observed from the return losses at different stages as a shift in band is observed each time using different value of Lg. The variations in length of ground plane Lg are done, so as to obtain a better return loss curve as at Lg =1mm but a frequency shift is obtained on varying the length of ground Lg. So, length of ground is kept to be 2mm which gives better results for all the three bands. Fig.7(a), Fig7(b), Fig(c), represents current distribution pattern on patch which shows variation in field distribution at 2.4 GHz, 3.2 GHz and 5.4GHz respectively.

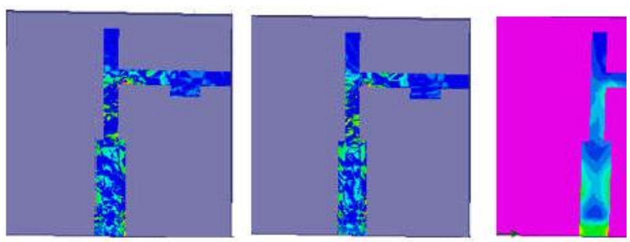

Fig 7(a) Fig .7(b) Fig.7(c)

The 2D radiation pattern were observed for the proposed antenna and are shown in figure 8(a), 8(b), 8(c) for frequencies 2.4GHz, 3.2GHz and 5.4GHz respectively.

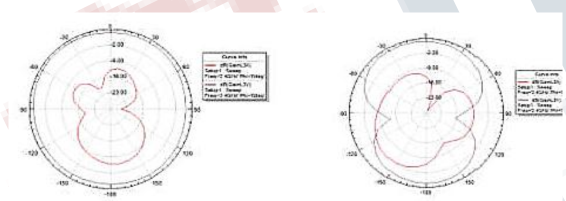

Fig 8(a): Radiation pattern at 2.4Ghz

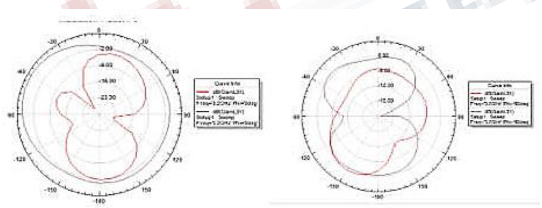

Fig 8(b): Radiation pattern at 3.2Ghz

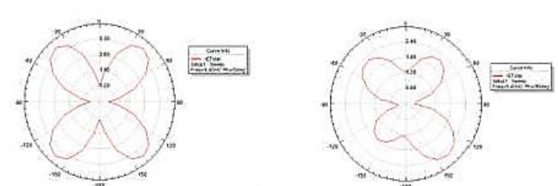

Fig 8(c): Radiation pattern at .5.4Ghz

Gain vs frequency curve is shown in Fig.9 in Gain vs Frequency curve of antenna. Maximum gain observed band1 (2.367-2.71 is 3.01dBfor GHz)/2.475 GHz, 4.5dB for band2 (3– 3.3 GHz)/3.15 GHz, 3.5dB for band3 (5.2 – 5.6 GHz)/5.4 GHz.

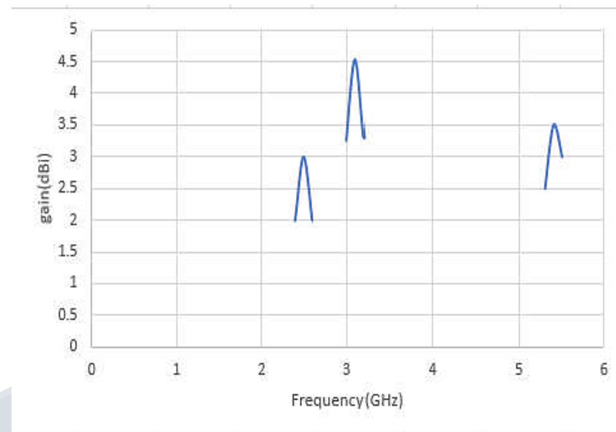

Fig 9: gain vs frequency curve

IV. CONCLUSIONS

A key patched microstrip antenna for WLAN and WiMAX applications has been designed and simulated successfully.The operating frequencies for proposed antenna are (2.367-2.71 GHz)/2.475 GHz, (3.–3.3 GHz)/3.15 GHz and (5.2 – 5.6 GHz)/5.4 GHz frequency bands. The gain of frequency band1 is 3.01dBi,4.5dBi for band2 and 3.5dBi for frequency band3.The antenna is proposed and best suited for WLAN and WiMAX applications.

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