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Design of Horse Shoe Patch antenna for wireless Applications

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Abstract : This paper illustrates design and analysis of a horse shoe patch antenna and compares the results of antenna for Duroid (ε_r = 2.2), Rogers RO4350 (ε_r = 3.66) and FR-4 (ε_r = 4.3) as substrate material and other comparison is between proposed antenna with and without an upper layer of substrate (duroid). Substrate thickness taken for this antenna is 1.57mm and for substrate layer above patch, thickness is 0.2mm. Comparison of these different structures has been done on the basis of return loss, VSWR, efficiency and far-field. In these structures a horse shoe shaped patch is placed above substrate. The proposed antenna has been designed and simulated using CST microwave studio 2014. The proposed antenna design can be used for WLAN, WiMAX and IMT applications.

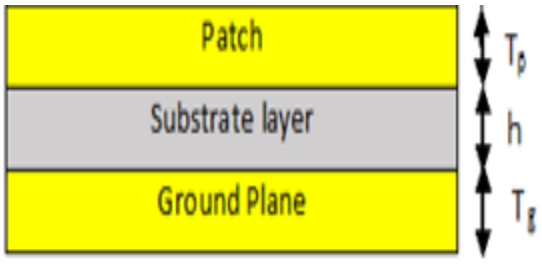
Keywords: Horse shoe patch, antenna, wireless, CST microwave studio.

I. INTRODUCTION

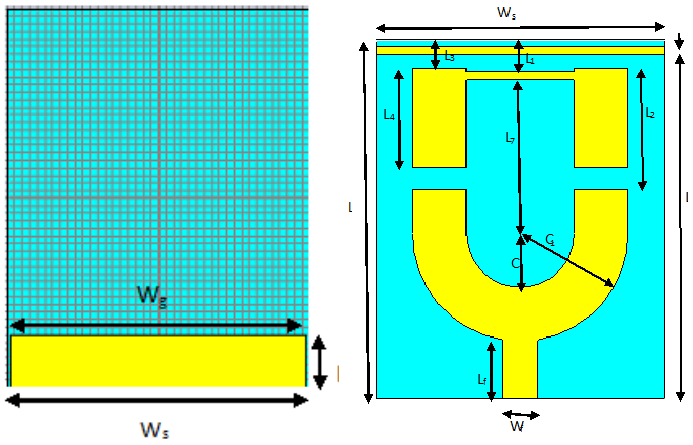
Many applications such as communication to spacecrafts, aircrafts require a small antenna having reasonable gain that is easy to mount on them. Microstrip patch antenna being a low-profile radiator is ideal option for that purpose. It can easily provide 5-6dB gain. Using array of patch antenna, we can increase the gain as required. Other advantages of patch antenna include easier fabrication, low cost and conformability. But it also has disadvantages such as narrow bandwidth, spurious feed radiation, surface waves, large size for higher frequency applications. Bandwidth can be increased using impedance matching, stacking and EBG structures. For its practical application there are many trade-offs

II. DESIGN PROCEDURE

In the proposed design a Horse-shoe shaped patch is printed above FR-4 substrate. The thickness for ground plane and patch is 0.02mm. structure of ground plane is shown in figure.



(a)



(b) (c)

Fig.1.The Horse Shoe Antenna (a) Cross sectional view, (b) Top view, and (c) Bottom view.

III. HORSE SHOE PATCH ANTENNA WITH FR-4, ROGERS RO4350 AND DUROID AS SUBSTRATE

For this comparison the substrate between patch and ground is changed among FR-4, Rogers RO4350 and Duroid. The performance is compared in terms of return loss, efficiency, VSWR and far field. The results are simulated using CST microwave studio 2014.

For FR-4 the parameters taken for the design are (in mm) –

C = 7.5	L_1 = 4.5
C_1 = 15	L_2 = 16.8
L = 50	L_3 = 4

$W_s = 40$ $L_4 = 13.8$
$L_g = 7$ $L_5 = 48$
$W_g = 39$ $L_6 = 1$
$L_f = 8$ $L_7 = 21.8$
$W_f = 3.035$ $h = 1.57$
$T_p = T_g = 0.02$ $T_s = 0.2$

For different substrates W_f is taken such that microstrip line impedance is 50Ω.

(a) **Return loss**

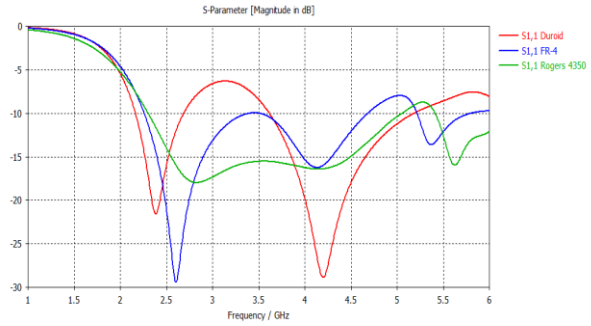


Fig.2. Return loss comparison for Duroid, FR-4 and Rogers 4350 as substrate

(b) **Efficiency**

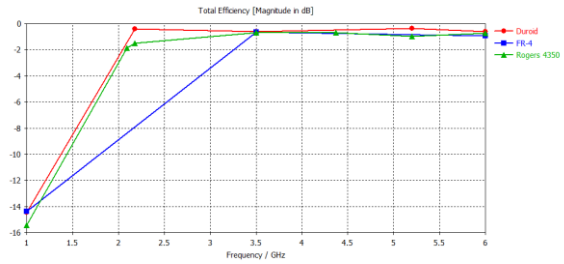


Fig.3. Efficiency comparison for Duroid, FR-4 and Rogers 4350 as substrate

(c) **VSWR**

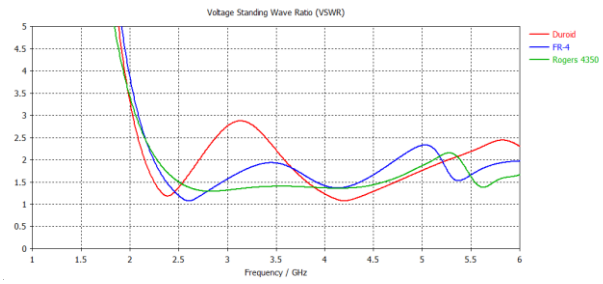
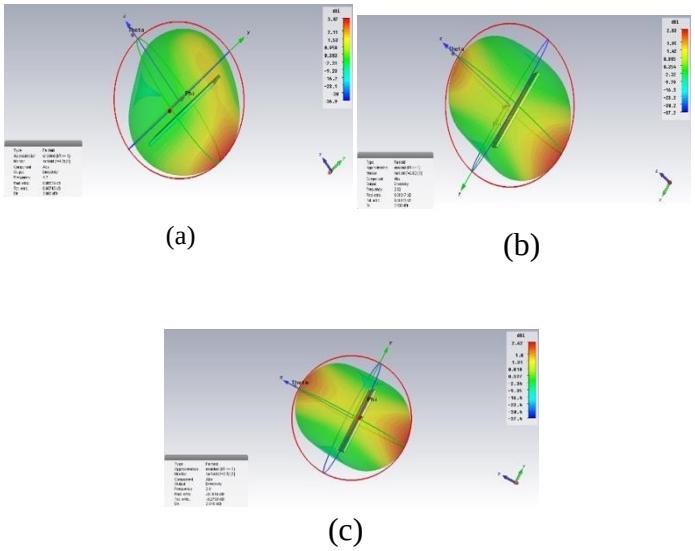


Fig.4. VSWR comparison for Duroid, FR-4 and Rogers 4350 as substrate

(d) **Far-Field**



(a) (b)

(c)

Fig.5. Far field (a) for Duroid substrate at 4.15GHz, (b) for Rogers 4350 substrate at 2.82GHz, (c) for FR-4 substrate at 2.6GHz

IV. HORSE SHOE PATCH ANTENNA WITH AND WITHOUT DUROID AS SUBSTRATE LAYER ABOVE PATCH

For this comparison as the substrate between patch and ground once FR-4 is used. For first case a layer of Duroid of thickness 0.2mm is placed above patch and in the second case this layer is removed and there is only air above patch. The performance of both structures is compared in terms of return loss, efficiency, VSWR and far field. The results are simulated using CST microwave studio 2014.

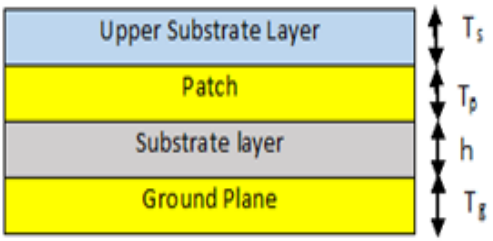


Fig.6. Cross sectional view of patch antenna with upper substrate

a) **Return Loss**

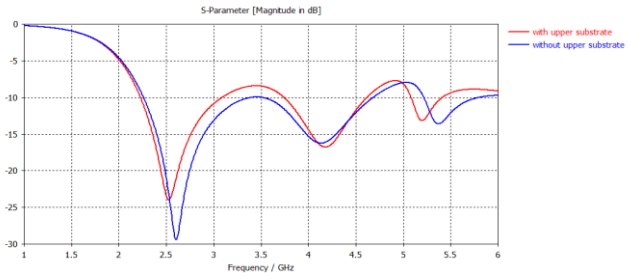


Fig.7. Return loss comparison for patch antenna with and without upper substrate

b) **Efficiency**

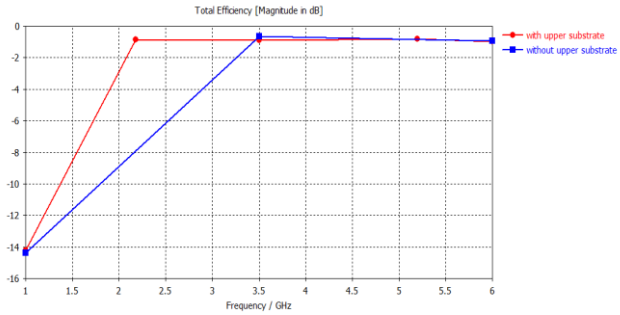


Fig.8. Efficiency comparison for patch antenna with and without upper substrate

c) **VSWR**

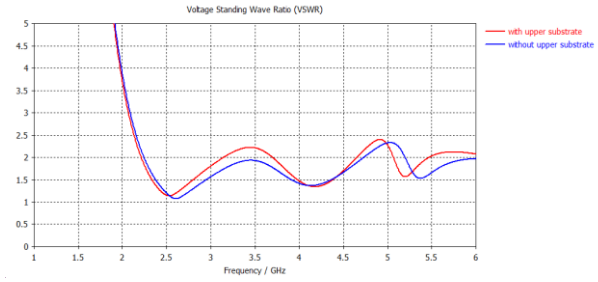
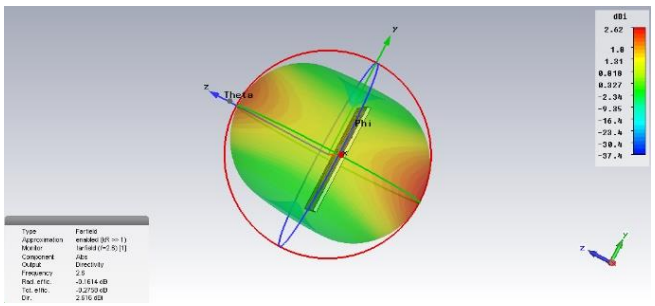
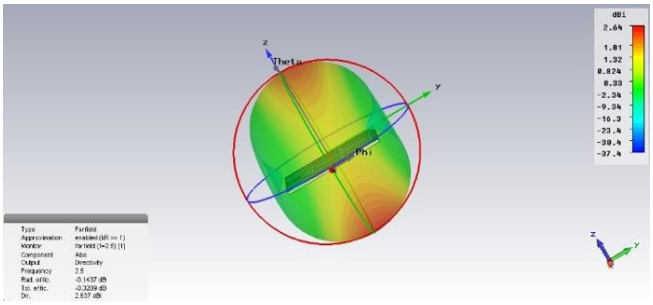


Fig.9. VSWR comparison for patch antenna with and without upper substrate

d) **Far-field**



(a)



(b)

Fig.10. Far field for patch antenna (a) without upper substrate at 2.6GHz, (b) with upper substrate at 2.5GHz

V. CONCLUSION

Horse shoe patch antenna with different substrates and with an upper substrate layer is compared successfully**.** The proposed antenna designs can be used for WLAN, WiMAX and IMT applications

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