Compact Dual Band Printed Dipole Antenna for Wireless Communication Systems

Sunkaraboina Sreenu, Sekhar M

Abstract- A dual band printed dipole arm compact antenna has been proposed for the wireless communication systems in this paper. Proposed antenna radiates at the dual frequencies of 1.91GHz and 4.68GHz which are useful in Radiolocation and satellite mobiles. To design the antenna a low cost glass epoxy FR4 substrate has been utilised. The overall dimension of the antenna is 42mm×42mm×1.6mm. Microstrip line feed is used to feed the dipole arms. A considerable gain of 4.2dB and 2.3dB is observed at the two resonating frequencies. The antenna structure consists of three printed dipole arms of which two are useful for the resonance and the remaining arm is used to achieve proper impedance matching.

Key words- Dual Band, Compact, Printed Dipole

I. INTRODUCTION

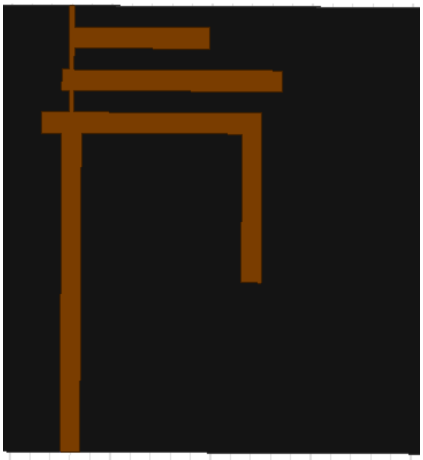
With the growing needs of the users to have multiple applications in a single device need for multiband antenna is growing day by day. The major challenge for the antenna designers is to design a compact antenna for the multiple applications which can serve the system requirements. Antenna should be compact and should be easy to integrate in any PCB so that the overall system size will not be effected by the antenna. To address all these issues microstrip antenna is a promising candidate which can meet all the requirements[1].

A limitation which is to be addressed for a microstrip antenna is low bandwidth which can be overcome by implementing the Partial grounding technique to achieve the necessary bandwidth[2]. Many researchers proposed different techniques[3-6] to develop multi band antennas like placing slots in the radiating element, stacked patch technique etc but in all these one or the other limitation will be there like poor radiation characteristics at higher frequency of operation in slotted antenna and high profile to antenna in stacked patch technique.

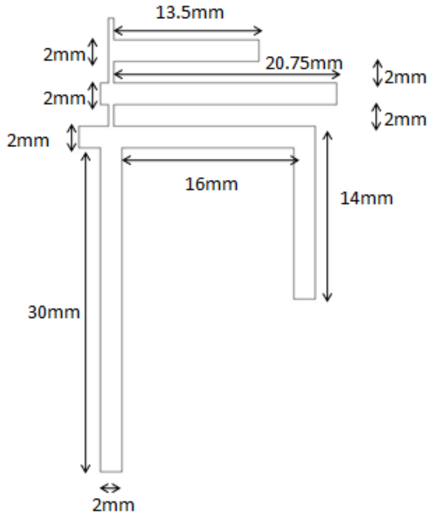
A compact antenna with dual band properties has been proposed, to achieve compactness printed dipole arms are been used as radiating elements. Microstrip line with coupling structures has been used to excite the dipole arms of the proposed antenna.

II. ANTENNA DESIGN AND CONFIGURATION

Proposed antenna is a printed dipole arm antenna with three arms which are interconnected by small coupling structures[7]. A microstrip line of 50Ω impedance has been used to feed the antenna. The lower arm is a L-shaped printed dipole arm of 60mm length. The middle arm is a rectangular printed dipole arm of 20.75mm length and the upper arm is a printed rectangular arm of 13.5mm length. The lower arm is connected to the remaining two arm by using coupling structures. The arms are protruded outside so as to achieve proper resonating frequency of operation. Out of the three arms middle and lower dipole arms are responsible for resonance at 1.91GHz and for the resonance at 4.68GHz the lower arm alone is responsible.



(a) Simulated antenna (Front View)



(b) Schematic of Patch

Fig. 1 Proposed antenna element

Proposed antenna make use of FR4 material as substrate and overall dimension of antenna is 42mm×42mm×1.6mm. To achieve a considerable bandwidth a partial ground plane

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has been considered for this a portion of ground has been removed exactly below the middle and top arms of the radiating patch[8-10]. The simulated antenna structure of the proposed printed dipole arm antenna elements are shown in the figure 1,2 respectively. Figure 1(a) depicts the front view of the simulated antenna and figure 1(b) presents the final optimized dimensions of the designed patch. Figure 2 here presents the rare view of simulated antenna.

Fig. 2 Simulated antenna (rare View)

III. SIMULATION RESULTS

Performance of printed dipole arm antenna is analysed using Ansys HFSS software. Antenna parameters such as impedance matching, near field and far field characteristics, current distribution were studied. All the above mentioned parameters were analyzed for both the operating frequencies. Figure 3 below depicts the impedance matching plot of the antenna.

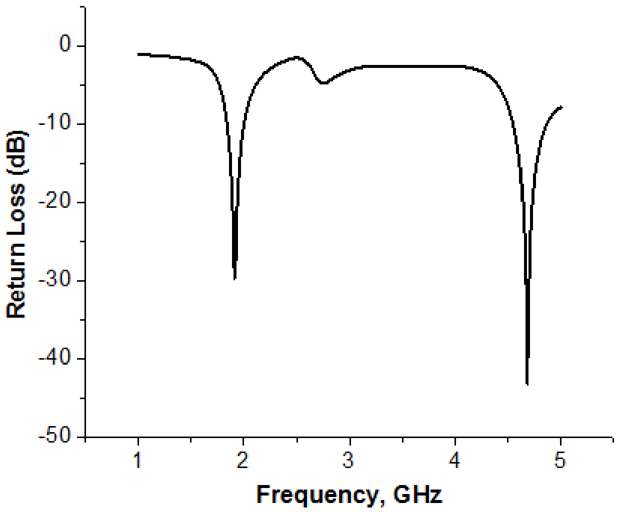


Fig. 3 Return loss of antenna element

Observed a return loss of -30dB for 1.91GHz and -45dB for 4.68GHz. From the return loss values achieved we can clearly observe, at the two resonating frequencies there is a good match of impedance between the feed line and the radiating patch. Figure 4 below depicts the VSWR of the antenna at the required operating frequency bands. Observed a VSWR of 0.6dB for 1.91GHz and 0.2dB for 4.68GHz.

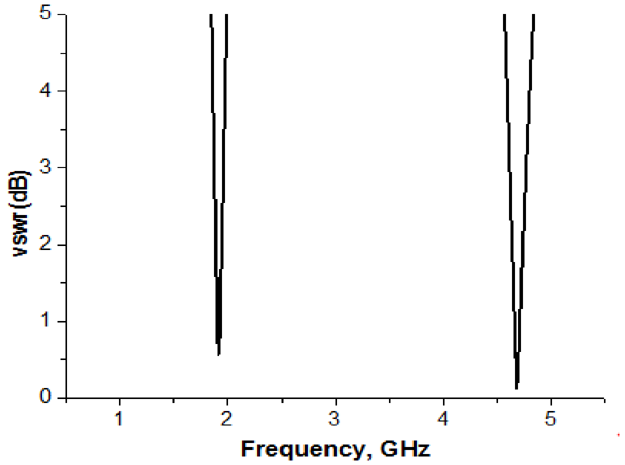
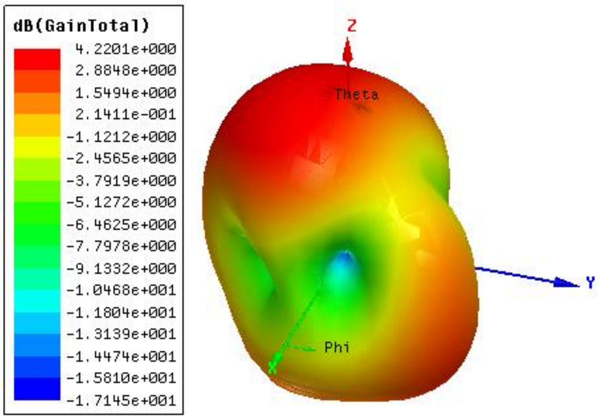
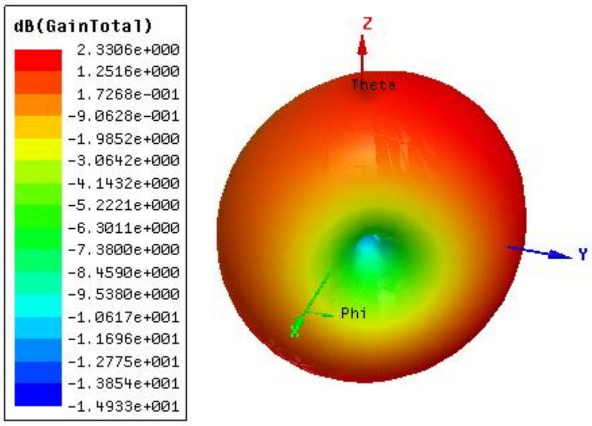


Fig. 4 VSWR of antenna element

Figure 5 below depicts the Gain of the antenna for both operating frequencies. Observed a gain of 4.22dB for 1.91GHz and 2.33dB for 4.68GHz.



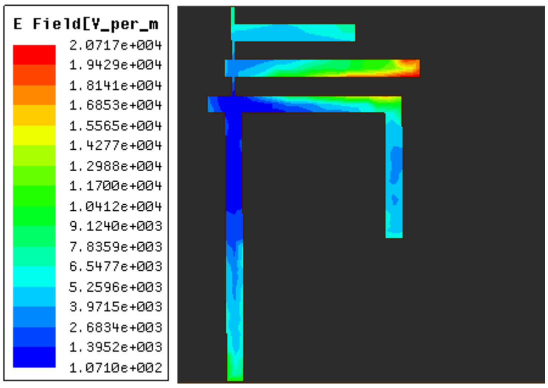
(a) Gain at 1.91GHz



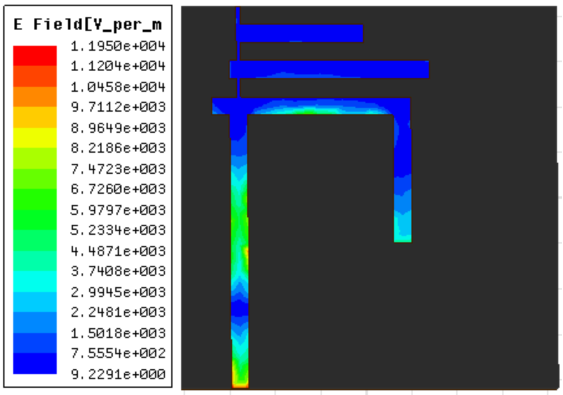
(b) Gain at 4.68GHz

Fig. 5 Gain of antenna

Figure 6 below depicts the plots of distribution of currents at different operating frequencies in the antenna. From the plots we can observe that for the resonance at 1.91GHz middle and lower dipole arms are responsible and for the resonance at 4.68GHz the lower arm alone is responsible.



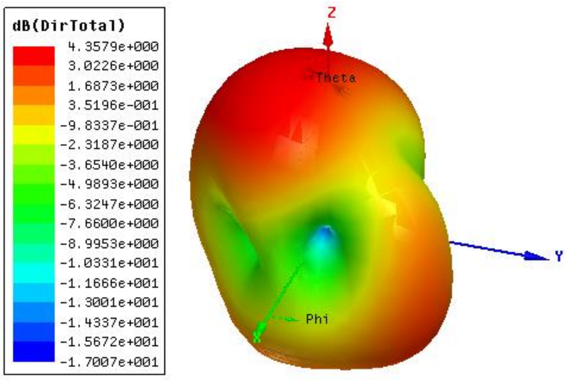
(a) 1.91GHz



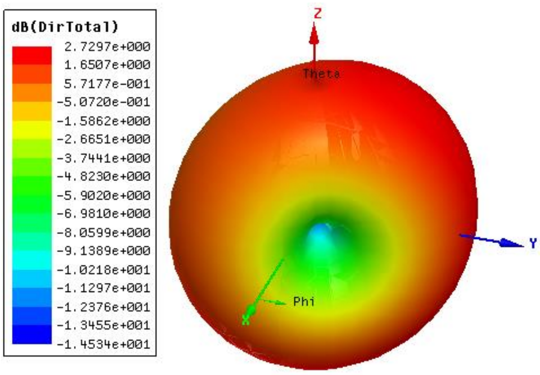
(b) 4.68GHz

Fig. 6 Current Distriution of antenna

Figure 7 below depicts the Directivity of the proposed antenna. Observed a directivity of 4.35dB for 1.91GHz and 2.72dB for 4.68GHz.



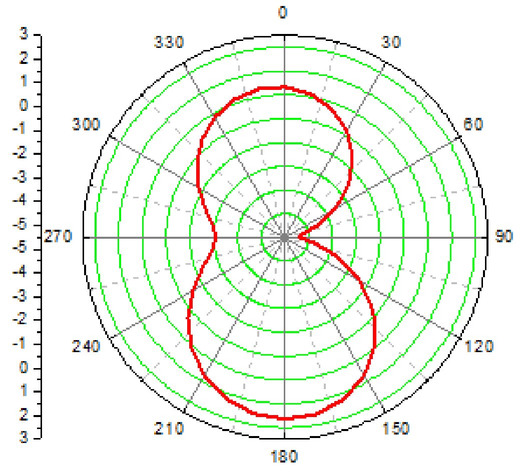
(a) 1.91GHz



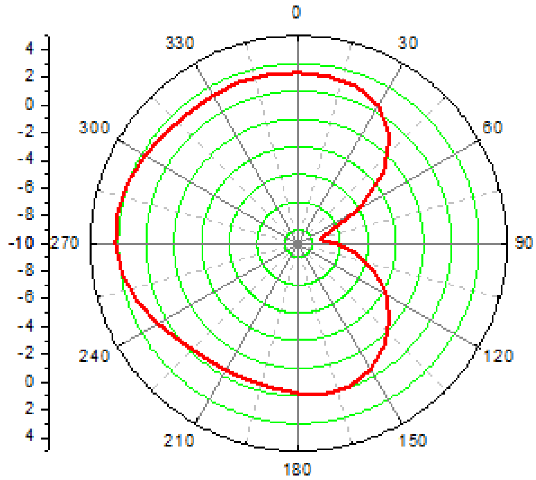
(b) 4.68GHz

Fig. 7 Directivity of antenna

Figures 8,9 below depicts the elevation plane and azimuthal plan patterns of the antenna. Observed a uniform radiation pattern without any nulls at both the operating frequencies in both the planes.

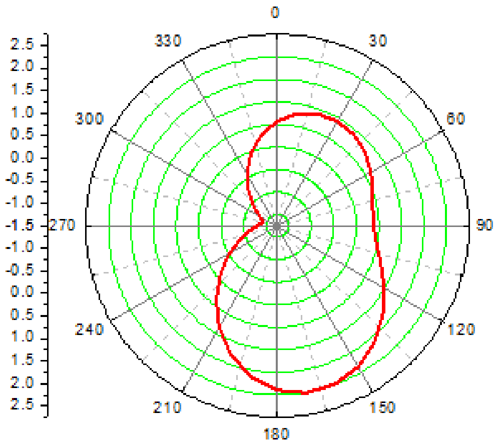


(a) 1.91GHz



(b) 4.68GHz

Fig. 8 Elevation Palne Pattern



(a) 1.91GHz

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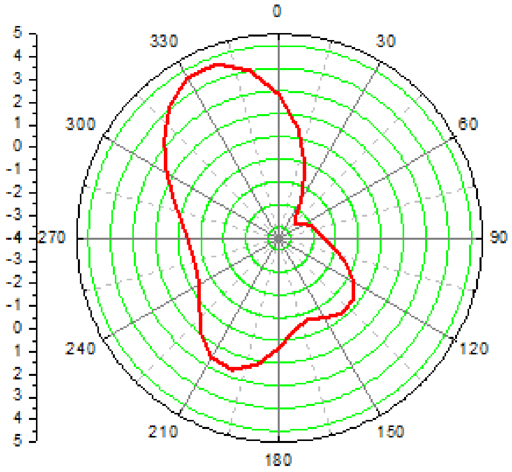

(b) 4.68GHz

Fig. 9 Radiation Pattern(Azimuthal Plane)

Figure 10 below depicts the smith chart for the designed antenna. From the plot we can observe that at both resonating frequencies there is a proper impedance matching which is very essential for power transfer.

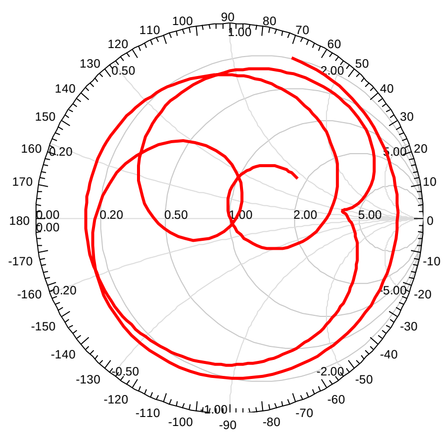

Fig. 10 Smith Chart of antenna element

IV. CONCLUSION

In this paper, a simple compact dual frequency printed dipole arm antenna is presented and the performance is analysed. The antenna resonates at the frequencies of 1.91GHz and 4.68GHz. The radiating element is having three dipole arms and each arm is responsible for different resonating frequency. The arms are interconnected by a small coupling structures and the arms are protruded to achieve necessary frequency of operation. To achieve a considerable bandwidth a partial ground plane has been considered. The antenna is fed by a microstrip line feed. From the obtained results it is evident that the proposed antenna is best suited for the radiolocation and satellite mobile applications.

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