International Journal of Electronics Communication and Computer Engineering
Volume 5, Issue (4) July, Technovision-2014, ISSN 2249–071X

Technovision-2014: 1st International Conference at SITS, Narhe, Pune on April 5-6, 2014

Extended Arm Dipole Multiband Antenna

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***Abstract* – A simple extended dipole antenna is presented in this paper. Proposed antenna is designed using FR-4 and RT duroid substrate. Design of three arm elements are used for multiband operation. Each arm is extended and folded, simulation of antenna is done using an soft HFSS. Variations in the dimensions of antenna element and substrate affects characteristics and that can be illustrated using return loss curve and radiation pattern. Antenna operates at multiple frequencies with better bandwidth. Actual geometry, return loss curve and radiation pattern are presented using HFSS.**

***Keywords* – Multiband Antenna, Straight Dipole Antenna, CPW.**

I. INTRODUCTION

Small size antenna are increasing demand for wireless communication. Mobile computing and public safety needs compact Antenna design. Military, medical, monitoring application demands wearable communication electronic devices and this can be possible using small size equipments. The micro strip patch antenna are easy to design and fabrication it have also features to adjust with shaped surface and compatibility with integrated technology. On other side some designs have disadvantage of narrow. Bandwidth[4]. Researchers have did large efforts to take the full advantage of micro strip patch antenna it is found that MPA has variety of applications in commercial and military application.MPA normally designed rectangular circular, and equitriangle shapes. Coaxial feed line, aperture coupled feed and stripline feed feeding techniques normally used in micro strip antenna. Koch Fractal antenna [1-2] reduces antenna size and also used for multiband operation. Antenna with small size are not efficient [5] which rapidly increase stored reactive energy. So CPW-straight dipole antenna is designed. The requirement of antenna has capability to integrate with the wireless communication network and devices which operates on the determined frequency. Designed CPW Antenna does not operate at multiple frequencies so for multiband operation the simple extended dipole antenna with strip line feed is presented.

II. ANTENNA DESIGN AND CONSIDERATION

Folded diploe antenna design, is shown in Fig.2. FR-4 is used as substrate with thickness of 0.7 and dielectric constant of 4.4. copper is used as conducting material with thickness of 0.11mm and conductivity of 5.88x107 simens/m. Initially simple straight dipole antenna is designed each arm element is extended and folded along the x-direction. Dimensions of the arm elements are calculated using equation (1) Dimensions of the antenaa are optimized using HFSS the dimensions of total substrate is 132 x 32 mm Extended dipole antenna [2] resonates at multiple frequencies .To design straight dipole antenna, dimensions of the antenna are calculated. The length, of conventional straight dipole antenna, is determined by [2-6],

$$L = 0.5 \times C / f\sqrt{\varepsilon} \qquad (1)$$

Where L is the length of total dipole arm, c, velocity of light, f, the determined resonant frequency and ε , the dielectric constant of substrate material In other case, structure of antenna is slightly changed gap between two dipole arms is 5 mm .50 ohm impedence matching is possible by tuning gap between two dipole sides and width of feed line. Length of arm is extended to get better return loss curve so that antenna can oprerate at multiple frequencies.

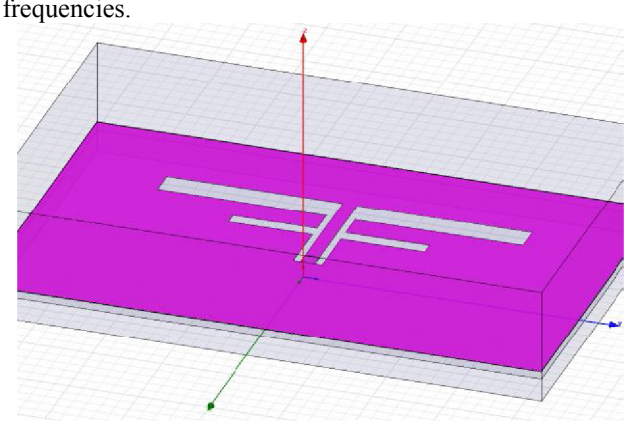

Fig.1. CPW Antenna Design

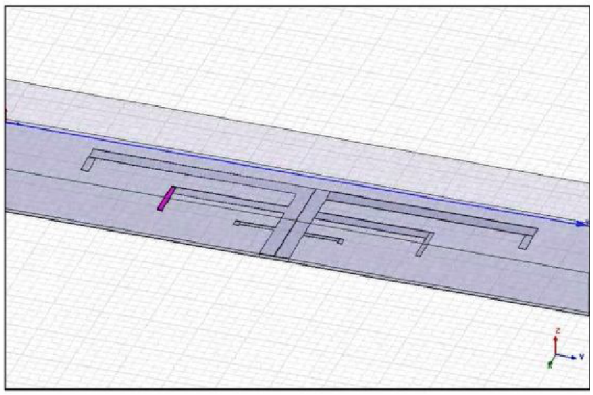

Fig.2. Folded dipole antenna design.

While in case of extended dipole antenna design. Two elements are placed back to back to form a dipole antenna on asubstrate. Three arm elements for multiband operation are used ,length of each arm is calculated with the help of equation (1) and optimized using HFSS(High Frequency Simulation Structure).Miniaturized first arm length L1 is 43, second arm length L2 is 23.2,third arm length L3 is7.2 Gap between dipole arm element Ga is 5mm,width of first arm W1 is 3 ,width of second arm W2 is 2.5 ,width of third arm W3 is 1, gap between two dipole sides is Gs 0.05mm, all these three arms are extended and folded towards wave port using ansoft HFSS. Feed line is located at the end of antenna using microstripline feeding technique. 50ohm impedance matching is obtained by tuning gap between arm elements and width of feed line. The dimensions of arm element is adjusted to get better results for multiple frequencies.

III. Results and Discussion

Folded/Exteded dipole antenna [2] is design, simulated using Ansoft HFSS. The radiation pattern and return loss curve for CPW antenna design are shown in fig.3 and fig.4 antenna is analyzed with two different substrate material a substrate with different dielectric constant changes the operating frequency. It is observed that antenna characteristics such as return loss curve and radiation pattern affects strongly. Thickness of antenna is kept small, designed antenna is not bulky. Here aim is to find antenna characteristics using different substrates. It is found that antenna characteristics changes with respect to changes in substrates material. A slight variation in length and position of arm also affects the return loss curve. The dielectric constant of substrate material affects more on the characteristics of antenna design. A substrate with high dielectric constant reduces the dimensions of antenna [3] but it also affects on antenna performance. So due to the tradeoffs between antenna size and performance, in this paper two substrates materials are analyzed for the same design. Antenna used in communication system should not bulky. So height of antenna kept small. In a simulation of extended dipole antenna using FR-substrate, antenna resonates at multiple frequencies Return loss curve crosses the -10dB line for these frequencies is shown in Fig.5. When for a same design roger RT duroid 5880 (tm) substrate material is used with dielectric constant of 2.2 antenna resonates at other frequencies. Is shown in Fig.6.

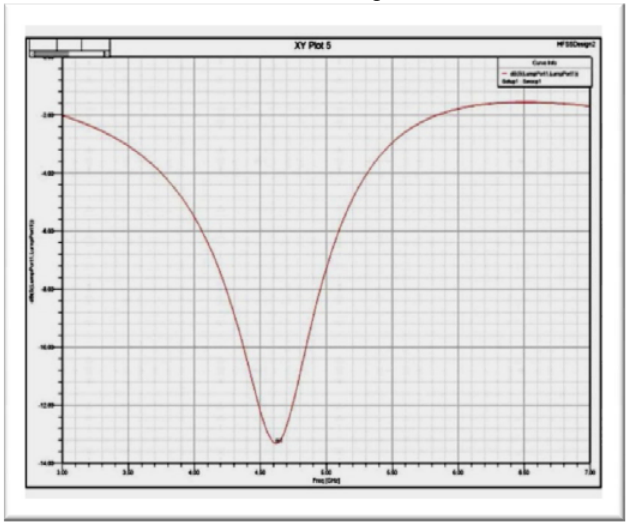

Fig.3 Return loss curve of CPW antenna.(using FR-4)

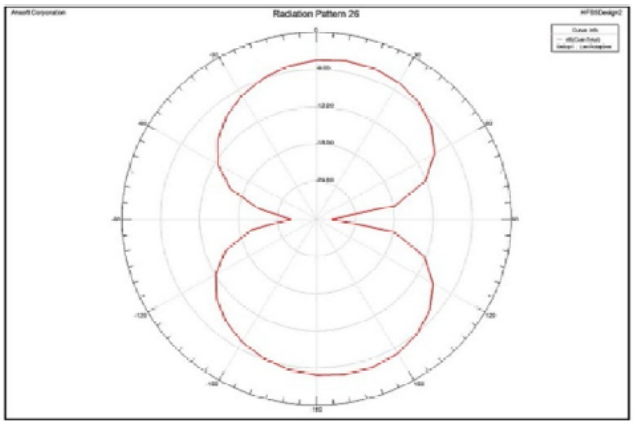

Fig.4 Radiation pattern of CPW antenna.(using FR-4 substrate)

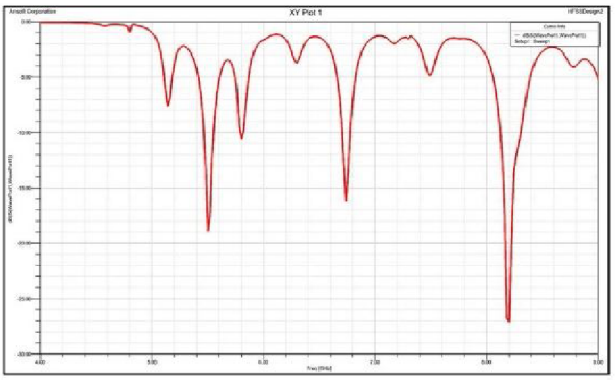

Fig.5 Return loss curve of folded dipole antenna (FR-4).

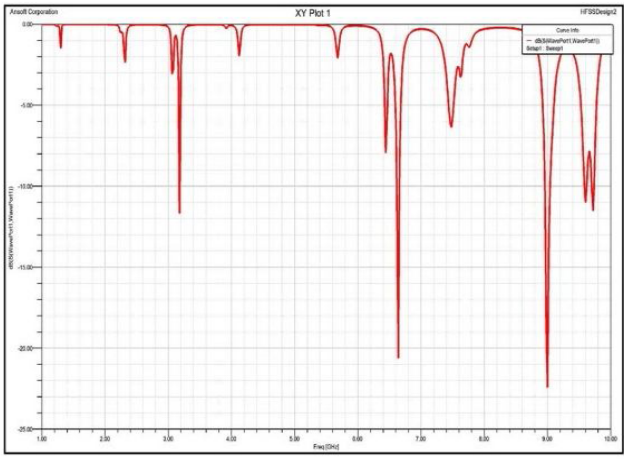

Fig.6 Return loss curve of folded dipole antenna (RT-Duroid)

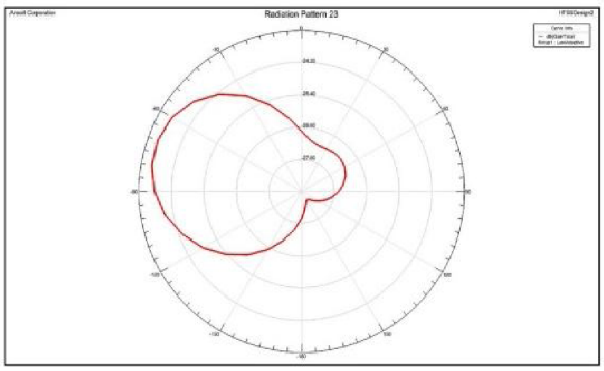

Fig.7 Radiation pattern of Extended arm dipole antenna. (FR-4 substrate)

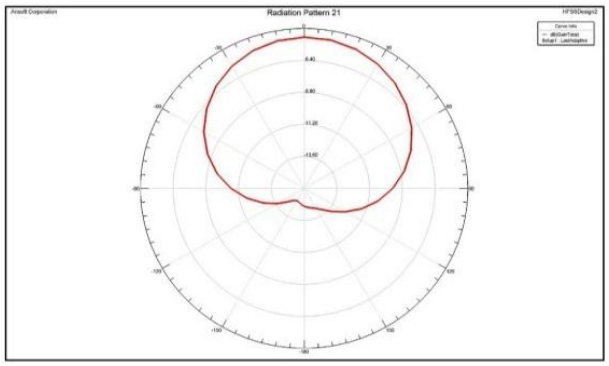

Fig.8 Radiation pattern of Extended arm dipole antenna. (using RT-Duroid substrate)

IV. Conclusion

Antenna characteristics are analyzed for different substrates and different design, antenna size can be reduce by using different types of antenna such as CPW, Straight dipole antenna Extended dipole or other. Multiband operation can be possible by varying number of arm elements and extending length of arm. Return loss curve crosses 10dB line at multiple frequencies. So proposed antenna can be used for multiple frequency for wireless communication.

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