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Study of Frequency and Polarization Reconfigurable on Square Patch Antenna

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ABSTRACT

A frequency tuning with polarization microstrip patch antenna design with varactordiode is presented. The frequency reconfigurability is achieved by varying the varactordiode capacitance. The proposed square patch antennahas the impedance 2.13 GHzto 2.29 GHz by varying the capacitance value between 0.07pFto0.57pF.TheRight-handedcircularpolarization(RHCP)andLeft-handedcircularpolarization (LHCP) are realized by keeping two coaxial feed with ±900 time phase difference. The radiation patterns are remains same on varying of frequency. The biasline is used at the top of the substrate to connect DC power supply in order to control the varactordiode.

Keywords : Varactordiode, CircularPatch, Probefeed, Frequency, reconfiguration.

I. INTRODUCTION

Due to requirement of integrating multiple wireless standards into a single wireless unit, reconfigurable antenna has attached a lot of attention. Reconfigurable antenna provides a single antenna that can be used for multiple applications. Reconfigurable antenna can be classified into four types such as Frequency, polarization, radiation and multiple reconfigurable antennas [1]. Compared to other antennas, reconfigurable antennas have more advantages and better prospects. They are light in weight, smaller in dimension and lower in price. Moreover, the reconfigurable antenna reduces the complexity of hardware and cost of the system. Reconfigurable antennas are controlled by PIN diodes, MEMS or varactors diodes [2]-[6].These diodes provide either ON or OFF mode mechanism to change the resonance of the antenna. Thus, the current distribution will be changed over the volume of the antenna and results in the reconfigurability. The frequency reconfigurable Bow –Tie antenna developed for the reconfigurability, Wimax, WLANachievedbyembeddingpositive-intrinsic-negative (PIN) diode over the bow-tie arms. The effective electric length of theantennacanbechangedleading nonelectrically tuneable operating band[7]. A frequency reconfigurable U-slot micro strip patch antenna is presented to reduce thecrosstalkfrom adjacent channels in multichannel system and implemented by placing a variable chip capacitor (trimmer) and an inductor at antenna input as to vary the antennaimpedancematching frequency[8]. The polarization reconfigurable mechanism is the time varying direction and relative magnitude of the electric field vector either linear, left-handedcircularpolarization, Right-handedcircularpolarization based on ±90 phase difference. If the path of electric field vector is back and forth along a line it is said to be linear polarized wave. A left hand circular polarized wave is one in which the wave rotates counter clockwise whereas right handcircularpolarizedwaveexhibitsclockwisemotion. Areconfigurablemicrostripantennaforswitchablepolarization[9]isproposedbycornertruncatedsquareradiating patch and independent biased PIN diode to form linear polarization, $\varphi=45^0$LHCP and $\varphi=90^0$RHCP.It forms solution to the problem of changing in impedance, inwhichpolarizationdiversitycountertheeffectoffadingincommunication.Reconfigurable rhombus shaped patch antenna with Y-shaped feed for polarization diversity [10] is proposed by modes on rhombus shape patch antenna in which the antenna become asymmetrical structure. It form LHCP in which electric current rotate clockwise and RHCP in which electric current rotate in counter clockwise when one diode ON and another OFF. Both diodes in OFF or ON then exhibit symmetric andformlinearwherethefrequencyremainsconstant.

In this paper a frequency reconfigurable varactor diode loaded microstrip antenna with simultaneous polarization reconfiguration is presented for square patch. The proposed have the impedance bandwidth (-10dB) of 2.13GHz to 2.29GHz frequency for square patch. By varying the capacitance of varactor diode reconfigurability achieved dual coaxial feed is located on X and Y axis of the patch to form circularpolarization and excite a mode (TM01). The proposed antenna is simulated usingAnsys/AnsoftHFSSv15whichis a full wave analysis tool.

if pertinent, provide illustrations of the modifications. In Section 3 (**Result and Discussion**), present your research findings and your analysis of those findings. Discussed in Section 4(**Conclusion**) a conclusion is the last part of something, its end or result.

II. SQUAREPATCHANTENNAGEOMETRY

The geometry of proposed antenna is shows in Figure 5. It is built on 100×100 mm^2substrate FR4_epoxy (Relative permittivity $\varepsilon r=4.4$ of dielectric constant 0.02) with athickness 1.6 mm. The antenna is fed using a 50 Ω co-axial connector and the feed point is*x = 5 mm, y =0 mm* in X axis *and x=0, y=5mm* in Y axis. The proposed antenna has square patch of L1=W1=30, L2=W2=32, L3=W3=40 and the design equation are given in [11]. The gap between inner square patch and outer patch is=2mm. The square patch is connected to the outer patch through varactor diode, placed on gap. The varactor diode is a bridge between the patch. The varactor diode is connected with DC-blocking capacitors which are part of the biasing network. The bias line along with resistor and inductor are placed on top of the substrate at a distance from the patch to prevent antenna performance. The variable capacitor is in series with capacitance of patch is connected. By varying varactor diode capacitance, resonantfrequencyofthe antennaisvarying.

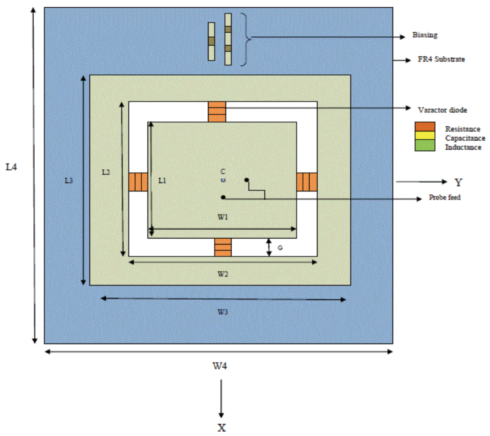
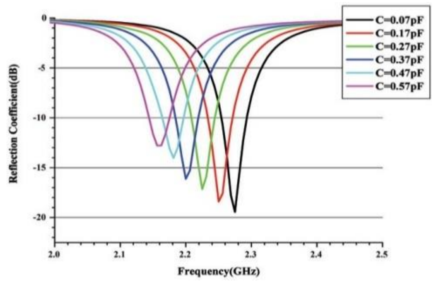


Figure1 : GeometryoftheAntennaTopView.Theparameterofthe antennaareL1=W1=30, L2=W2=32, L3=W3=40, L4=W4=100mm, G=2mm.

III. RESULTS AND DISCUSSION

By varying the capacitor value, the frequency is tuned and resonating up to 2.26GHz band. Figure 2 shows the reflection coefficient (S11) of proposed antenna. Itcan be seen that by varying the capacitance from 0.07pF to 0.57 pF, the resonant frequency of the patch is controlled from 2.26GHz to 2.15 GHz. In addition, it shows the compactness of the proposed antenna. Figure 3 shows the axial ratio of the square patch in which impedance bandwidth(-10dB) of frequency are below1dB on varying of different capacitance value and it proves that the antenna isresonatingincircularpolarizationingoodperformance.Figure4showstheradiationpatternofproposedantennaat2.15GHzand2.26GHz.Itisobservedthatradiationpatternremains almostinvariantasfrequencyisvaried.



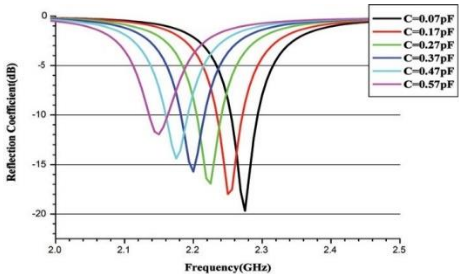


Figure 2: Reflection coefficient (i) S11 (ii) S22 for ideal different capacitance value (0.07 pF to 0.57 pF) considering packaging parasitic components and bias network components.

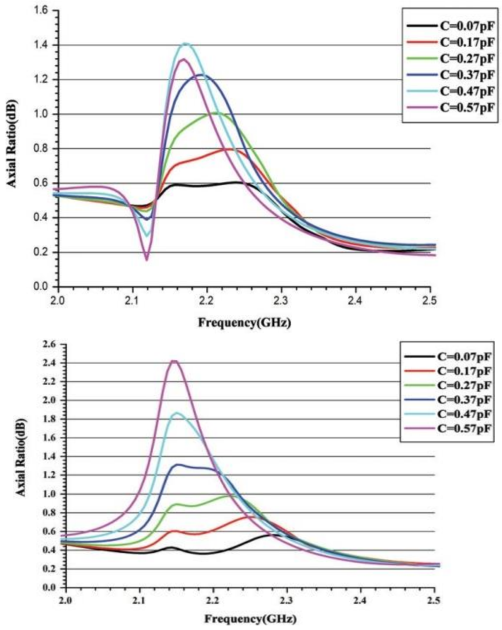


Figure3:AxialRatioofsquarepatch(a)LHCP(b)RHCP

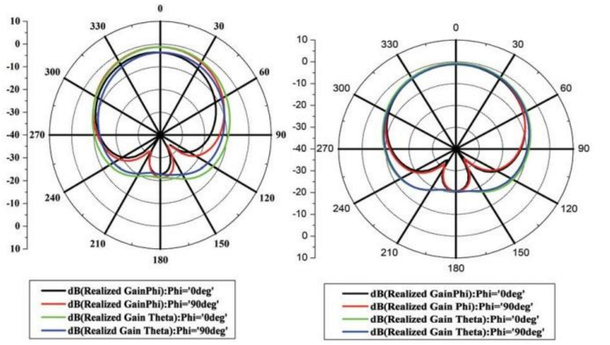


Figure 4: Radiation Pattern for two different Capacitance value (a) C=0.07pFat2.26GHz(b)C=0.57pFat2.15GHz

IV. CONCLUSION

It is observed that the frequency variation is from 2.15 GHz to 2.2642 GHz for the varactor capacitance values. It can be predicted that the antenna efficiency and realized gain would be affected also which are not shown here for the sake of brevity. From the Skyworks manufacture data sheet for varactor diode, packaginginductance and resistance is given as LP=0.7nH and RP=4.8Ω [SMV2019 fromSkyworks]The inductor and capacitor of DC blocking Network are given asLp=0.287nHandRp=0.2Ω respectively.

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