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Reconfigurable Circular Microstrip Patch Antenna with Polarization Diversity and Radiation Pattern Selectivity

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Abstract: A novel single feed reconfigurable circular microstrip patch antenna with polarization and pattern diversity have been proposed. Antenna is simulated on HFSS11 and after fabrication tested on 'Antenna measurement System'. Good impedance bandwidth is achieved at 2.4 GHz for polarization and at 2.7 GHz for pattern reconfiguration.For polarization diversity, antenna can be switched between linear and circular polarization with gain of 2.1dBi. Pattern diversity is achieved with broadside and conical radiation pattern by exciting higher order mode T_{21}. Axial ratio bandwidth is found to be 2KHz. Reconfiguration can be achieved by implementing antenna with PIN diode.

Keywords: Reconfigurable antenna, polarization diversity, pattern selectivity, linear polarization, circular polarization, conical pattern, broadside radiation pattern.

I. Introduction

Due to the requirement of multiple functionality with less complexity in wireless communication system, reconfigurable antenna has attracted the researchers for many decades. Among the many reconfiguration system like frequency, space, angle of arrival, polarization and pattern diversity is focused largely to avoid signal fading loss and to cover large area respectively. In this paper circular microstrip patch antenna with polarization and pattern diversity have been proposed. Simulation and fabrication is done by considering small patch in place of PIN diode.

II. Antenna Design and Structure

Antenna is designed, simulated and fabricated on FR4 (4.4) substrate. Different antenna parameters are given in Table no. 1. To achieve circular polarization, perturbation that is rectangular slot is added on circular patch. Linear polarization can be achieved by filling this slot by another parasitic element. With dominant mode circular patch antenna radiate broadside radiation pattern. To radiate conical radiation pattern it is necessary to excite higher order mode T_{21}. By considering these two factor antenna is designed and fabricated.

Table 1: Design Parameters Of Antenna

Sr. No.	Parameter	Value
1	Frequency	2.4 GHz
2	Dielectric constant of substrate	FR4 (4.4)
3	Radius of patch	17.1 mm
5	Slot length	8 mm
6	Slot width	3 mm
7	Parasitic element width (inside slot)	1mm
8	Parasitic element length (inside slot)	4 mm
9	Height of the substrate	1.6 mm
10	Outer radius of ring patch	27.5 mm
11	Inner radius of ring patch	17.5 mm
12	Parasitic element width (Between two patch)	3 mm
13	Parasitic element length (Between two patch)	3 mm
14	Gain	10 dBi
15	VSWR	1

Figure 1 and Figure 2 indicates structure and return loss of Antenna1respectively. Antenna1 is the configuration for circular polarization and broadside radiation pattern. Figure 3 and and Figure 4 indicates structure and return loss of Antenna2respectively. Antenna2 is the configuration for linear polarization and conical radiation pattern.

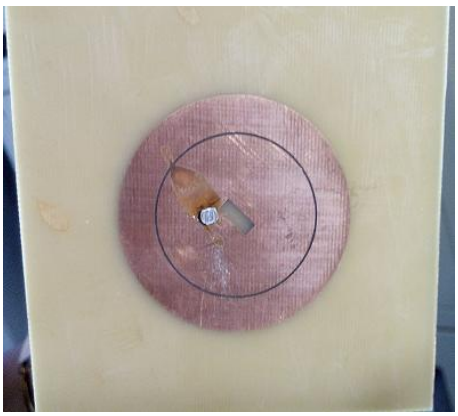

Figure 1: Antenna 1

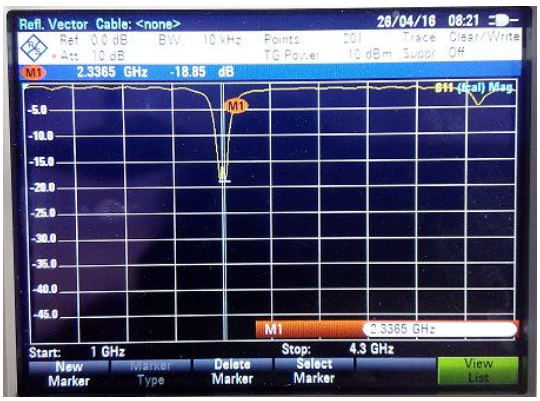

Figure 2: $S_{11}$of Antenna1

Figure 3: Antenna2

Figure 4: $S_{11}$of Antenna2

III. Result and Discussion

Antenna 1 is designed and fabricated to excite T_{11} mode and to radiate circular polarization. Figure 5 and 6 shows simulated and experimental radiation pattern which is nothing but broadside radiation pattern. As co and cross polarization pattern of Antenna 1 are showing same receiving power and also from Figure 6 we can observe that antenna is radiating circular polarization.

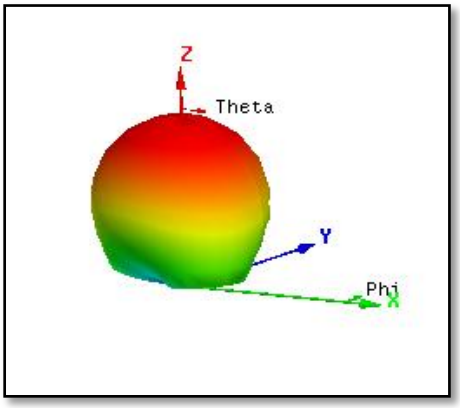

Figure 5: Radiation pattern Antenna1

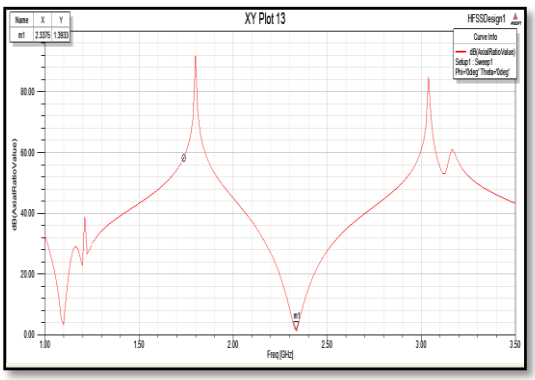

Figure6: Axial ratio Antenna1

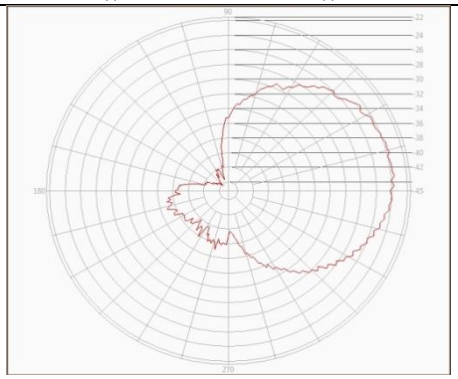

Figure7: Co- Polarization Antenna1

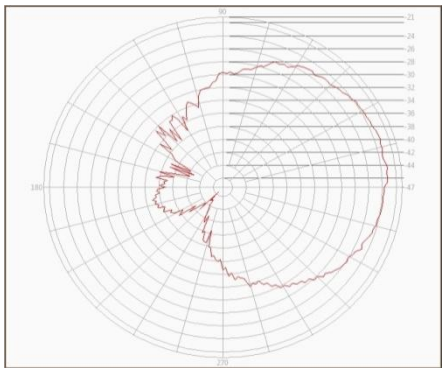

Figure8: Cross- Polarization Antenna1

It can be seen from Antenna2 structure that four parasitic element of same size (3mm X 3mm) are added to Antenna1. As the dimension Antenna2has been increased due to the inclusion of ring patch, it is radiating T_{21} mode. Figure 10 and 11 are simulated and fabricated radiation pattern, which indicate conical radiation pattern. Alsodue to inclusion of small patch on rectangular slot Antenna2 is radiating linear polarization.

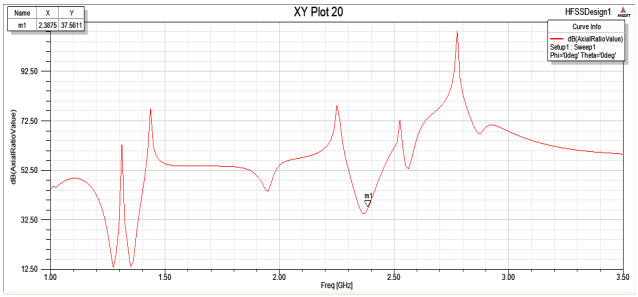

Figure9: Axial ratio Antenna2

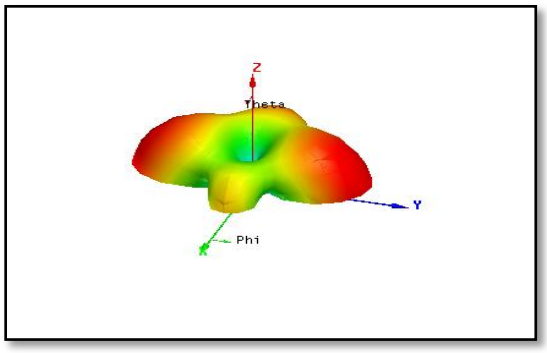

Figure10: Simulated radiation pattern Antenna2

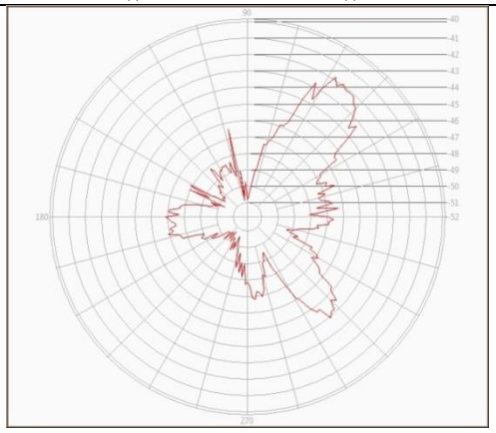

Figure11: Radiation pattern Antenna2

IV. Conclusion

Single feed antennas with polarization and pattern diversity at 2.4 GHz have been proposed. Antenna is radiating circular polarization with good axial bandwidth. By combining these two structures reconfigurable antenna can be easily implemented with PIN diodes in place of parasitic element. Also by switching the diodes with different combinations, different configurations can be achieved for different applications. The proposed antenna is useful in wireless communication where polarization and pattern diversity with less complexity is needed.

V. References

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