

Frequency Reconfigurable Compact Antenna for Multiband Wireless Communication Application

Mallikarjun C Sarsamba, Raju Yanamshetti



Abstract: This pioneering work suggests a reconfigurable multiband frequency antenna for applications in wireless networking. The miniaturization and multi-band function of the mounted antenna is done by inserting a rectangular hole, and the reconfiguration of the frequency is achieved by utilizing two PIN diode switches. The ON and OFF state of the PIN diode determines the surface current distribution of the radiating patch resulting in the multiband resonance and reconfiguration of the proposed device. Application and analysis dependent on parameter of the antenna such as lack of return loss, VSWR, gain, and radiation pattern. The developed antenna is used for the intended application of wireless communication. Simulation is performed using Ansys HFSS.

Keywords: MSPA, slot, PIN diodes, Wireless communication, and Reconfigurable antenna.

I. INTRODUCTION

Recent years have seen significant technical advances in state-of-the-art wireless networking technologies, with a clear continuing focus in multiband antenna science. Higher spectral performance and the need to accommodate large data speeds, multimedia-based compact-sized networks present significant technological challenges in traditional antennas. In this respect, the multiband antenna proved to be an outstanding choice due to its capacity to incorporate more than one connectivity protocol into a single compact device, in addition to its low cost and fast data rate functionality. Nevertheless, antenna architecture development also needs to face the technological challenges presented by that frequency ranges, bandwidth fragmentation, interference, and so on. The antenna may be reconfigured by adjusting its frequency, polarization or radiation characteristics by utilizing some form of switching system, such as pin diodes, RF MEMS, Varactor diodes, etc. Microstrip antennas are widely used to provide reconfigurability due to their advantages of low profile, light weight, low manufacturing cost, and ease of RF device integration. Frequency reconfigurability can be accomplished by changing the shape of the radiant element by altering the resonant frequency. Switches are used to achieve selectivity of frequencies by manipulating switch status; switches can be pin diode, varactor diode or RF MEMS. In [3] this paper presents a new, reconfigurable, single-feed, dual-frequency, dual-polarized function of a square microstrip antenna packed with hexagonal slots.

The size reduction up to 61% to 26% and bandwidth 3.3% and 4.27%. In [4] this study, a lightweight WLAN dual-band frequency reconfigurable antenna is proposed. Miniaturization and dual-band activity is carried out in the built antenna through the addition of hexagonal slots and frequency reconfiguration is accomplished through two PIN diode switches assisted by their bias circuits. In [5] this paper discusses a reconfigurable microstrip slot antenna configuration and analysis utilizing RF PIN diodes as S and C-band switching devices. Here, the reconfigurable pattern and frequency of the microstrip antenna is built by adjusting the duration of the ground plane slot by six MPP4203 PIN diodes. In [6] this paper suggests a parallel dual-band, Shaped microstrip patch antenna reconfigurable bandwidth. The antenna would automatically turn all frequency bands at the same time without the requirement for an additional coordinating network. If the PIN diodes are 'OFF' (reverse bias) which are reconfigured to 3.1 GHz and 7.2 GHz while the PIN diodes are turned 'ON' (forward bias) the suggested antenna resonates at 3.5 GHz and 8.1 GHz. In [7], this paper presents the concept of a frequency reconfigurable E-shaped patch antenna utilizing particle swarm optimization. Ideal switches are used to show evidence of the principle of reconfiguration of the frequency. A slotted patch antenna configuration which can be reconfigured with a new frequency is given here in [8]. The slots created on the aperture of the antenna are designed to orient by having their orientation, either clockwise or counter-clockwise, a reference point. Such direction distributes the surface currents in a number of directions, resulting in a shift in their resonance strength. In [9] this paper describes a reconfigurable square slot antenna. The planned antenna consists of a square slot on one side of the substrate, and a micro strip feed on the other. In this article, the PIN diode was used to illustrate the idea of an X-band frequency reconfigurable patch antenna. In order to understand the influence of the PIN diode on antenna parameters, a square slot has been added. In [11] this paper proposes a multiband frequency reconfigurable antenna for intelligent transport system (ITS) applications. The reconfigurability is based on a PIN-diode. Center frequencies are 1.38, 1.98, 2.89, 3.86, and 4.34 GHz in Diode "ON" mode, and 1.56, 2.16, 2.88, 3.91 and 4.45 GHz in "OFF" condition. The average bandwidth obtained is 18 percent. The proposed antenna's nominal gain is 2.7 dBi in "ON" state, and 3.95 dBi in diode "OFF" state. In [12] this letter suggests a lightweight frequency reconfigurable slot antenna for applications for LTE (2.3 GHz), AMT fixed range (4.5 GHz), and WLAN (5.8 GHz). In order to perform dual-band operation a U-shaped slot with short ends and an L-shaped slot with open ends are etched in the ground plane. By inserting two PIN diodes within the slots, three frequency bands can easily be reconfigured over a frequency ratio of 2.62:1.

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In [13] it proposes a simple and compact slot antenna with a very large tuning range. At the edge of the ground is etched an open slot of 25 mm (approximately equal to $\lambda/8$ where λ it corresponds to the highest frequency of the tuning range). Only two lumped elements are used in the framework for achieving the tunability, namely a PIN diode and a varactor diode. The slot antenna will resonate as regular slot (when the switch is on) or half slot (when the switch is off) by flipping the PIN diode located at the open end of the slot. In [14] this article, a C-shaped patch fitted with a dipole antenna is suggested for the multiband antenna. The antenna can be reconfigured as a single band at 1,2275 GHz in the UHF (850 MHz–930 MHz) and ISM (2,41 GHz–2,54 GHz) bands provided by RFID applications for GPS applications and dual-band frequencies. In [15] this paper an analysis is carried out on rectangular microstrip antenna using proximity feeding technique. The designed antenna uses a two-layer substratum with the micro strip line on the lower layer and the upper layer patch antenna, so that the feed line ends under the patch in an open end. The organization of paper is first introduction, second antenna design and parameter, third proposed antenna, fourth proposed antenna using slot and diodes, fifth result and discussion and sixth one conclusion.

II. PARAMETER AND ANTENNA DESIGN

In this paper the RF switch (PIN-diode) was incorporated into the antenna cluster design. A BAR50-02 PIN-diode is used to monitor the electrical length of the antenna to allow operation at different frequency bands, while the antenna's physical dimension remained unchanged. The corresponding PIN-diode circuit is shown in Fig. 1. PIN-diode has two states: state "ON" and state "OFF." The diode makes current flow when RF energy is blocked in "ON" state, but not in the other when it is in "OFF" state. PIN-diode is loaded in the simulation by using the RLC boundary layer. PIN-diode is modeled in "ON" state as a series combination of resistance (R_f) and inductance (L_f). The resistance value is 4.5 ohm (Ω) and the inductance is 0.6 nH, the parallel capacitance and resistance value is 0.15 pF and 5K Ω in the "OFF" state.



Fig.1.1. PIN-diode identical circuit (a) ON state (b) OFF state

The geometry of conventional square micro strip antenna is as shown in Fig 2. Antenna design using basic antenna design equations. This geometry has dimensions of patch length (L) = 29.1998mm and patch width (W) = 29.1998mm which has dielectric material FR-4 epoxy constant of ϵ_r = 4.4, substrate thickness is 1.6mm and tangential loss of $\tan \delta$ = 0.02. A 50 Ω micro strip line of dimensions $L_f \times W_f$ (L_f = 15.1562mm and W_f = 0.7185mm) feed the antenna

through a quarter wave transformer of dimension (L_q = 15.0288mm and W_q = 3.1642mm) for providing good impedance match. The designed operating frequency of 2.4GHz and the resonant frequency at 2.4GHz is as shown in Fig 3. It is observed that the resonant frequency at 2.4GHz which is equal to the designed frequency of 2.4GHz. The conventional antenna gain 2.143dB, Fig 4, radiation pattern Fig 5 and VSWR Fig 6.

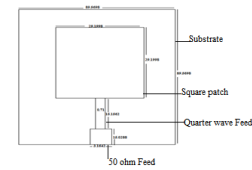


Fig .2 .Conventional Micro strip patch antenna

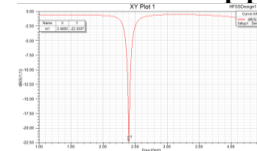


Fig .3. Return loss characteristics at 2.4GHz

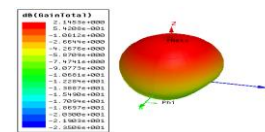


Fig. 4 .Gain characteristics at 2.4GHz

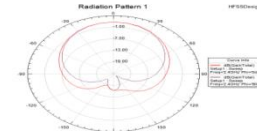


Fig .5 .Radiation pattern characteristics at 2.4GHz

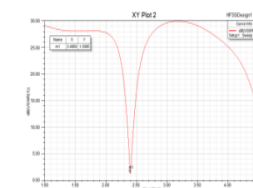


Fig. 6. VSRW characteristics at 2.4GHz

III. PROPOSED ANTENNA USING RECTANGULAR SLOT

The projected microstrip patch antenna is a rectangular slot cut in center of the patch of antenna shown in Figure 7. The 14 mm and 27 mm rectangular slot width and length. The frequency resonates at 1.31 GHz, 3.88 GHz and 4.66 GHz start operation.

The 1.33 GHz resonance frequency, which functions as receiver and reams two resonate frequencies such as 3.88GHz and 4.66 GHz, acts as transmitter. Return loss, gain, radiation pattern and VSWR display below all at the specific frequency shown in the figures.

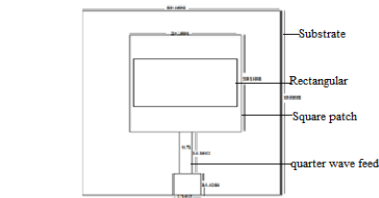


Fig. 7. Rectangular Slot Antenna

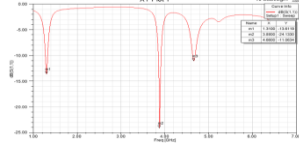


Fig. 8. Returnloss characteristics at1.31GHz, 3.88 GHz and 4.66GHz

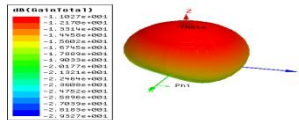


Fig. 9. Gain characteristics at 1.31GHz

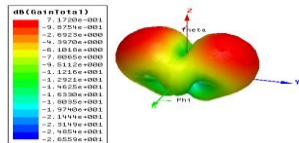


Fig. 10. Gain characteristics at 3.88GHz

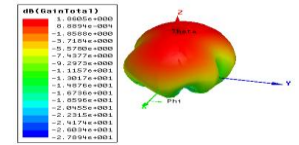


Fig. 11. Gain characteristics at 4.66GHz

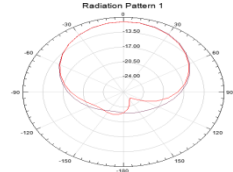


Fig. 12. Radiation pattern characteristics at 1.31GHz

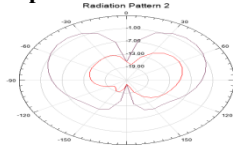


Fig. 13. Radiation pattern characteristics at 3.88GHz

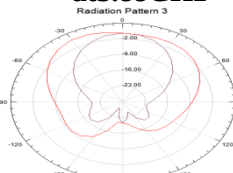


Fig. 14. Radiation pattern characteristics at 4.66GHz.

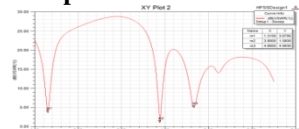


Fig. 15. VSWR characteristics

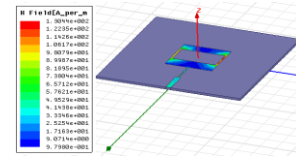


Fig. 16. Current distribution at 1.31 GHz

IV. PROPOSED ANTENNA USING PIN DIODES

(a) Diode –D (Single)-ON

The antenna proposed that uses single and double diodes. First we study how it operates in the (single) diode as shown in Fig 17. The diode works ON condition antenna frequencies i.e. 1.31 GHz, 3.99 GHz, 4.74 GHz and 7.02 GHz. The figures shows return loss of antenna, gain, radiation pattern and VSWR.

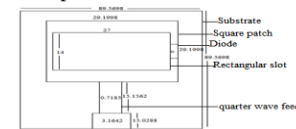


Fig. 17. Proposed antenna using single diode

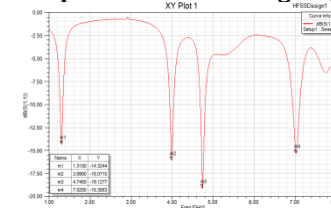


Fig. 18. Return loss characteristics at 1.31 GHz, 3.99 GHz, 4.74 GHz and 7.02 GHz

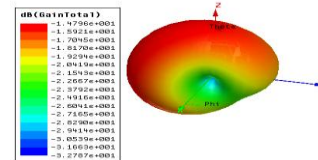


Fig. 19. Gain characteristics at 1.31 GHz

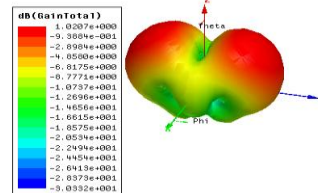


Fig. 20. Gain characteristics at 3.99 GHz

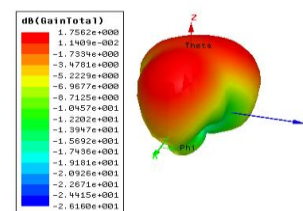


Fig. 21. Gain characteristics at 4.74 GHz

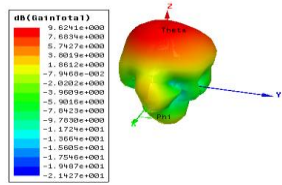


Fig. 22. Gain characteristics at 7.02 GHz

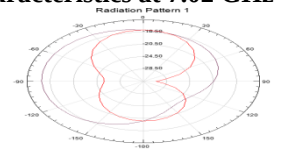


Fig. 23. Radiation pattern characteristics at 1.31 GHz

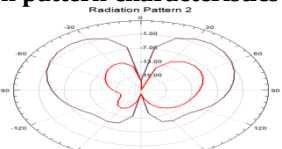


Fig. 24. Radiation pattern characteristics at 3.99GHz

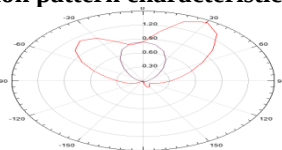


Fig. 25. Radiation pattern characteristics at 4.74GHz

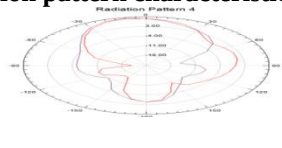


Fig. 26. Radiation pattern characteristics at 7.02GHz



Fig. 27. VSRW characteristics
(b) Diode-D(Single)-OFF

When the diode D off condition the antenna operates following resonate frequency and gain, radiation pattern and VSWR shown in figures.

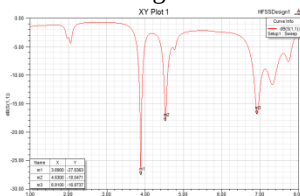


Fig. 28. Returnlosss characteristics at 3.89GHz, 4.53GHz, 6.91 GHz

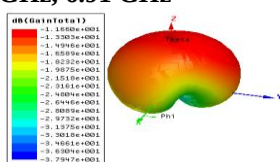


Fig 29 Gain characteristics at 3.89 GHz

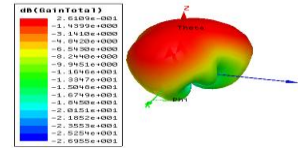


Fig. 30. Gain characteristics at 4.53 GHz

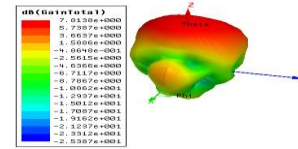


Fig. 31. Gain characteristics at 6.91 GHz

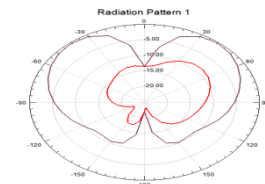


Fig.32.Radiationpattern characteristics at3.89GHz

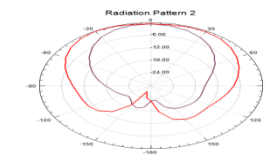


Fig.33.Radiationpattern characteristics at4.53GHz

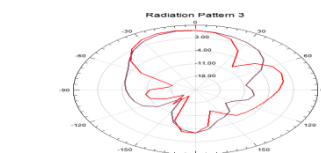


Fig.34.Radiation pattern characteristics at6.91GHz

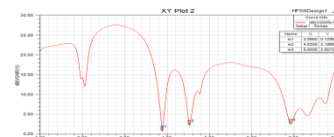


Fig. 35. VSRW characteristics

(c) Diode-D1and D2 -ON

The hypothetical reconfigurable antenna will be worked in four separate modes. It is achieved by switching on and off the two PIN diode switches. In our design, we have selected PIN diode switches for frequency reconfiguration because they give several advantages over other switches (such as bulk diode, FET switch, MEMS switch, etc.). While the diode changes the appropriate ON and OFF frequencies at which the antenna resonates under varying switching conditions as seen in Table 1 and Table 2. Table 1 shows resonant frequency and return loss relative to the switch position, and Table 2 displays Cost, Bandwidth and VSWR.

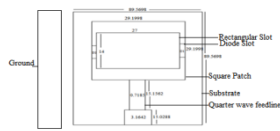


Fig.36. Proposed rectangular slot antenna using two diodes

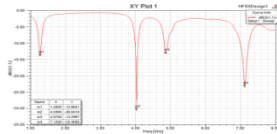


Fig.37. Returnloss characteristics at 1.28GHz, 4.03GHz, 4.87GHz and 7.12GHz

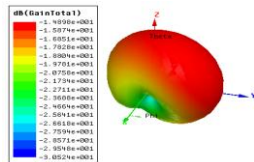


Fig.38. Gain characteristics at 1.28 GHz

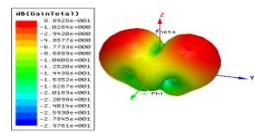


Fig.39. Gain characteristics at 4.03 GHz

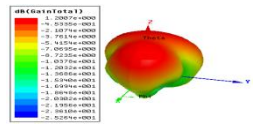


Fig.40. Gain characteristics at 4.87 GHz

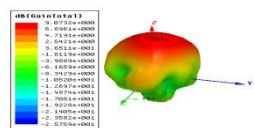


Fig.41. Gain characteristics at 7.12 GHz

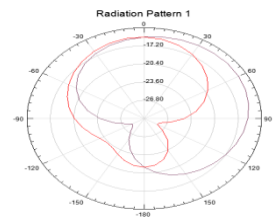


Fig.42. Radiation pattern characteristics at 1.28GHz

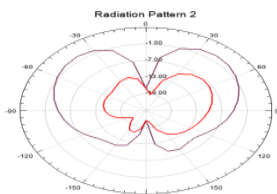


Fig.43. Radiation pattern characteristics at 4.03GHz

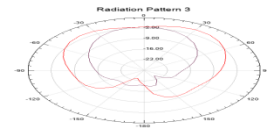


Fig.44. Radiation pattern characteristics at 4.87 GHz

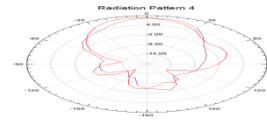


Fig.45. Radiation pattern characteristics at 7.12GHz

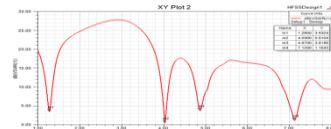


Fig.46. VSRW characteristic

(d) Diode-D1 and D2 –OFF

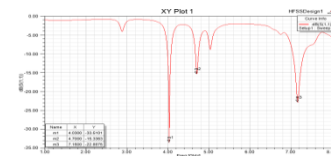


Fig.47. Returnloss characteristics at 4.03GHz, 4.7GHz, 7.16GHz

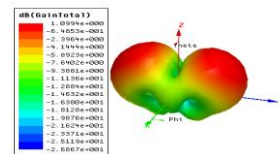


Fig.48. Gain characteristics at 4.03 GHz

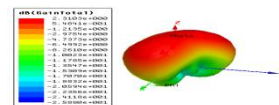


Fig.49. Gain characteristics at 4.7 GHz

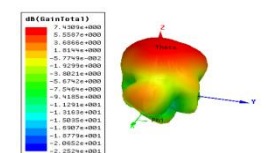


Fig.50. Gain characteristics at 7.16 GHz

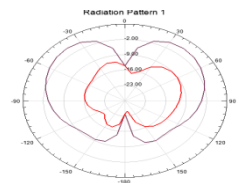


Fig.51. Radiation pattern characteristics at 4.03 GHz

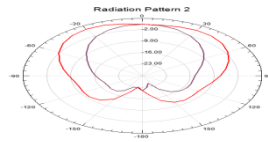


Fig.52.Radiationpattern characteristics at 4.7 GHz

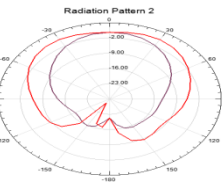


Fig.59.Radiation pattern characteristics at 4.58 GHz

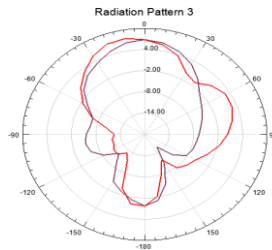


Fig.53.Radiation pattern characteristics at 7.12 GHz

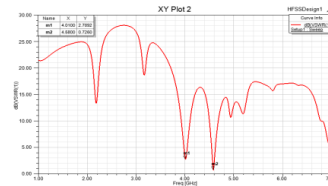


Fig. 60. VSRW characteristic

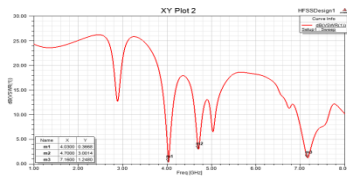


Fig. 54. VSRW characteristic

(f) Diode-D1-OFF and D2 –ON

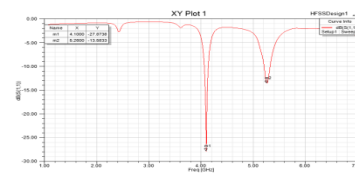


Fig.61.Returnlosss characteristics at 4.1GHz, 5.26GHz

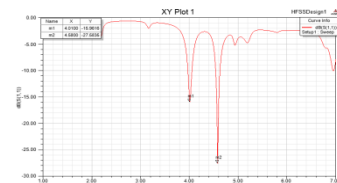


Fig.55.Returnlosss characteristics at 4.01GHz, 4.58

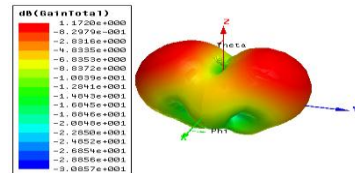


Fig. 62. Gain characteristics at 4.1GHz

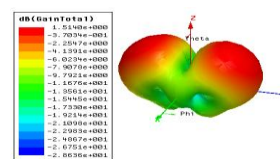


Fig. 56. Gain characteristics at 4.01 GHz

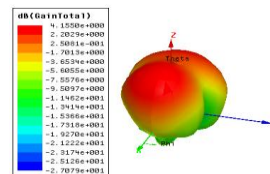


Fig. .63 .Gain characteristics at 5.26GHz

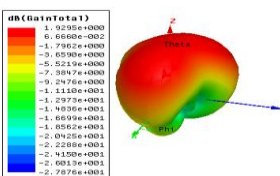


Fig. 57. Gain characteristics at 4.58 GHz

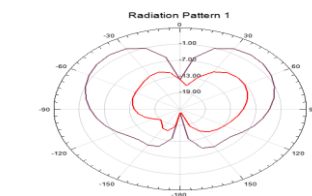


Fig.64.Radiation pattern characteristics at 4.1GHz

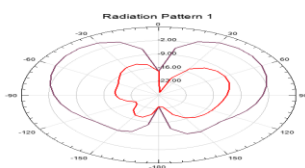


Fig.58.Radiation pattern characteristics at 4.01 GHz

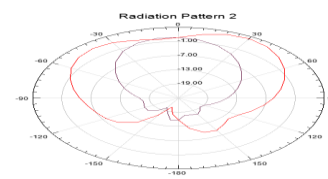


Fig.65.Radiation pattern characteristics at 5.26GHz

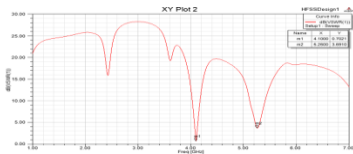


Fig. 66. VSWR characteristics

In this section the results obtained from simulating such antennas with different configurations are discussed. 1. Conventional antenna, 2. Proposed square patch antenna contain rectangular slot, 3. Proposed square patch antenna and contain rectangular slot with one PIN diode, 4. Proposed square patch antenna contain rectangular slot with two PIN diode. The operation of all above antennas shows in table 1 and table 2 with shown in figures all operation

V. RESULT AND DISCUSSIONS

Table.1 Comparison with resonant frequency and return loss

S.no	Antenna Type	Switch Position	Resonate Frequency GHz	Return Loss dB
1	Conventional Antenna	-	2.4	-22.3337
2	Square patch Rectangular Slot Antenna	-	1.31 3.88 4.66	-13.6119 -24.1333 -11.0634
3	Proposed Square patch Rectangular Slot Antenna with one diode	D-ON	1.31 3.99 4.74 7.02	-14.3244 -16.0710 -19.1277 -15.3063
4	Proposed Square patch Rectangular Slot Antenna with one diode	D-OFF	3.89 4.53 6.91	-24.5363 -18.0471 -16.8731
5	Proposed Square patch Rectangular Slot Antenna with two diode	D1-D2-ON	1.28 4.03 4.87 7.12	-13.9541 -30.6418 -13.2967 -23.4885
		D1-D2OFF	1.03 4.7 7.16	-33.5101 -15.3363 -22.8875
		D1-ON D2-OFF	4.01 4.58	-15.9616 -27.5835
		D1-OFF D2-ON	4.1 5.26	-27.8738 -13.5833

Table.2 Comparison with Bandwidth, Gain and VSWR.

S.No	Antenna Type	Switch Position	Band Width%	Gain	VSWR
1	Conventional Antenna	-	2.17	2.14	1.33
2	Square patch Rectangular Slot Antenna	-	3.99 1.63 1.18	-1.10 7.17 1.86	3.67 1.08 4.99
3	Proposed Square patch Rectangular Slot Antenna with one diode	D-ON	5.19 4.36 4.51 5.42	-1.47 1.02 1.75 9.62	3.38 2.75 1.92 3.01

4	Proposed Square patch Rectangular Slot Antenna with one diode	D-OFF	3.43	-1.68	0.72
			3.32	2.61	2.18
			3.23	7.61	2.50
5	Proposed Square patch Rectangular Slot Antenna with two diode	D1-D2-ON	5.10	-1.48	3.53
			8.16	8.89	0.61
			6.06	1.20	3.81
			8.53	9.07	1.16
		D1-D2-OFF	8.06	1.09	2.06
			7.57	2.31	3.00
			5.81	7.43	1.24
		D1-ON D2-OFF	4.344	1.51	2.78
			5.949	1.92	0.72
		D1-OFF D2-ON	3.878	1.17	0.70
			4.199	4.15	3.09

VI. CONCLUSION

The experimental study shows that the antenna is fairly simple in design and quite effective in increasing the bandwidth at the resonating frequency, providing a better pattern of broadside radiation.

The other parameter of antenna such as gain, VSWR, and loss of return are found to be good for this antenna. This antenna is better because it uses low cost substrate material and finds uses GPS, WLAN, AMTS, WiMAX and C band frequency ranges such as in modern wireless communication systems.

FUTURE SCOPE

The reconfigurable antenna part designs described in this study can be improved by using MEMS switches instead of p-i-n diodes, due to their low losses in the antenna and their inherent low dc power consumption and strong linearity. We will also investigate the use of optical switches.

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REFERENCE

1. C.A. Balanis, Antenna theory, design. Hand book, NJ: Wiley Interscience, 2005.
2. Bahl I. J. and Bhartia P, Dedham, MA. "Microstrip Antennas", Artech House, 1980
3. Shynu S. V, Gijo Augustin, C.K. Aanandan, P. Mohanan, and K. Vasudevan, "A Reconfigurable Dual frequency Slot-Loaded Microstrip Antenna controlled By PIN diodes", Microwave and Optical Technology LEETTERS/Vol.44, No 4, February 20 2005.
4. Tanweer Ali and Rajashekhar C. Biradar, "A Compact Hexagonal Slot Dual Band Frequency Reconfigurable Antenna for WLAN Application", Microwave and Optical Technology LEETTERS/Vol.44, No 4, February 20 2017.
5. Nibash Kumar Sahu and Ashish Kumar Sharma, "An Investigation of Pattern and Frequency Reconfigurable Microstrip Slot Antenna Using PIN Diodes", 2017 Progress In Electromagnetics Research Symposium Spring (PIERS), St Petersburg, Russia, 22–25 May
6. Sajid M. Asif, Adnan Iftikhar, Saeed M. Khan, Muhammad Usman, "An E-Shaped Microstrip patch Antenna for Reconfigurable Dual-Band operation", Microwave and Optical Technology LEETTERS/Vol.44, No 4, February 20 2016.
7. Harish Rajagopalan, Joshua Kovitz, and Yahya Rahmat-Samii, "Frequency Reconfigurable Wideband E-shaped Patch Antenna: Design, Optimization, and Measurements", 978-1-4673-0462-7/12/\$31.00 ©2012 IEEE
8. K Satish Reddy, K Praveen Kumar, P Bhaskara Reddy, Harswaroop Vaish, "Novel Frequency Reconfigurable Slotted Patch Antenna: Design and Analysis", Procedia Materials Science 10 (2015) 660 – 665
9. Shajat Hassan, Zeba Egbal, Ruchi Varma, Jayanta Ghosh, "Frequency Reconfigurable Square Slot Antenna for Wireless Applications", Proc. of the 2017 IEEE Region 10 Conference (TENCON), Malaysia, November 5-8, 2017.
10. Anamiya Bhattacharya and Rajeev Jyoti, "Frequency Reconfigurable Patch Antenna Using PIN Diode at X-Band", 978-1-4799-8349-0/15/\$31.00 ©2015 IEEE.
11. Gaurav Upadhyay, Nandkishore, PrashantRanjan, V.S.Tripathi, Shivesh Tripathi, "Frequency Reconfigurable Multiband Patch Antenna Using PIN-Diode for ITS Application" International Journal of Electronics and Communication Engineering Vol: 12, No: 10, 2018
12. Liping Han, Caixia Wang, Xinwei Chen, and Wenmei Zhang, "Compact Frequency Reconfigurable Slot Antenna for Wireless Applications", 1536-1225 (c) 2015 IEEE.



13. Hui Li, Jiang Xiong, Yufeng Yu, and Sailing He. "A Simple Compact Reconfigurable Slot Antenna with a Very Wide Tuning Range", IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION, VOL. 58, NO. 11, NOVEMBER 2010
14. Norsuzlin Mohd Sahar¹, Muhammad Tariqul Islam¹, Norbahiah Misran¹, "A Reconfigurable Multiband Antenna for RFID and GPS Applications", ELEKTRONIKAIR ELEKTROTECHNIKA, ISSN 1392-1215, VOL. 21, NO. 6, 2015.
15. B.G.DINESHa, S.L.MALLIKARJUN, G.M. PUSH PANJALI, AND P. M. HADALGI, "DIAGONAL SLOT-LOADED RECTANGULAR MICROSTRIP PATCH ANTENNA", Proceeding of NCRIET-2015 & Indian J.Sci.Res. 12(1):214-216, 2015.