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Frequency Reconfigurable Microstrip Patch Antenna for Cognitive Radio Applications

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ABSTRACT: In today's world, communication becomes indispensible in day to day routine. Antenna technology is a key constituent in wireless communication system. In this paper, an electronically frequency reconfigurable patched microstrip antenna is postulated. These antennas have capability to reconfigure it's attributes like frequency, bandwidth, polarization. Reconfigurable antennas gained a lot of inquisitiveness due to instigation of future wireless communication areas such as cognitive radio which engages with sensing and reconfiguring microstrip antennas. Here, in the proposed antenna seven reconfigurable frequencies are attained by three switches and switching action is procured by pin diodes. The frequency bands of the antenna can be varied from 2.0 GHz to 4.8 GHz. It was established that directional patters are obtained at all frequencies. The return losses which were simulated along with radiation pattern of antenna proposed are attached and compared.

KEYWORDS: patched microstrip antenna , slotted microstrip antenna , PIN diode , cognitive radio ,frequency reconfigure

I.INTRODUCTION

Due to extensive rise in demand for authentic wireless communication, requirement for effective use of electromagnetic spectrum is escalating. Traditional broadband antennas are unable to gratify these expectations. Reconfigurable antennas had exhibited cogent potent in the area because of its minimum prize and flexibility[1].These antennas have capability to reconfigure it's attributes like frequency, bandwidth, polarization etc., in today's world reconfigurable antennas gained a lot of inquisitiveness due to instigation of future wireless communication areas such as cognitive radio which engages with sensing and reconfiguring microstrip antennas[2]. Reconfigurable antennas also have upper hand in producing good radiation pattern with better bandwidth

Beside all the advantages of reconfigurable antennas frequency reconfigurable antennas to bring down the size of front end system and permit prefiltering at the receiver therefore it assists many wireless applications in a single terminal system[3].

If we look into the past background of reconfigurable antennas, it was first come into sight in 1930. In 1970's for satellite communications, a pattern reconfigurable antenna was designed[4]-[6]. The postulated antenna in the paper is proficient to reconfigurable seven different beam angles. In general, effective length of radiator is a paramount in governing the resonance of antennas like Dipole antenna, Monopole antenna, loop antenna, slot antenna and Microstrip antenna. It also plays a vital role in deciding operating frequency from these; we come to a conclusion that by controlling the effective length, we can attain reconfiguration in frequencies.

In general, switches are used to vary the effective length of the antenna. There are different switching mechanisms used in the reconfigurable antennas for providing different frequencies. Electronic switching mechanisms use pin diodes, FETS, and RFMEMS as their switches. For frequency switching, even though RFMEMS has a numerous advantages, Pin Diodes are used as they are beneficial to analyzers because of its acceptable performance, minimum prize and flexibility in fabrication[7]-[8].

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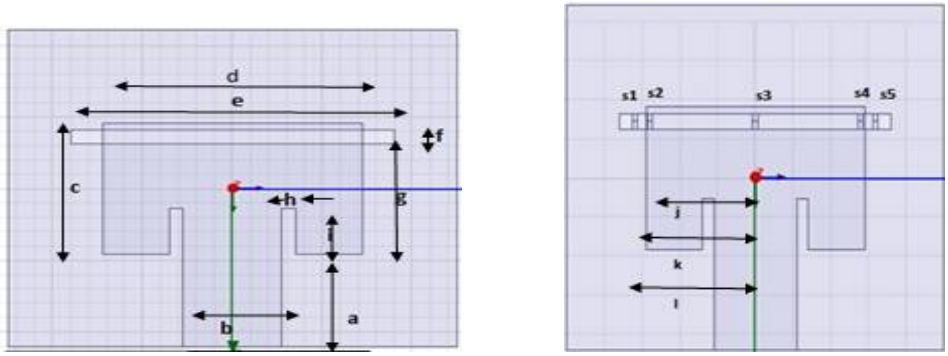
II.DESIGN

The designed antenna possess a patched microstrip antenna and slotted microstrip antenna. The slotted microstrip antenna is placed at ground plane bellow the patch. Five switches are positioned in the slot.



(a) (b)

Figure1. Structure of proposed antenna, (a) front view without switches, (b) front view with switches

Here pin diodes act as switch. When the pin diode is on state, it will be equivalence to a series combination of inductor and resister of inductance 0.6nh and resistance 0.8ohm respectively and in off state it will be equal to a series combination of inductor of inductance 0.6nh and parallel combination of resister and capacitor of resistance 10kohm and capacitance 0.35ph respectively. Through the switching action, we can vary the effective length of slot antenna and thereby we can produce seven different bands of reconfigurable frequencies. The design of the described antenna begins with the construction of patched microstrip antenna. Fig. 1A illustrates the structure and design of antenna with a slot placed at ground plane. The substrate of the antenna is designed with Taconic RF35 and has permittivity and thickness of about 3.5 and 3.04 respectively.

The design of the described antenna begins with the construction of patched microstrip antenna. Fig. 1A illustrates the structure and design of antenna with a slot placed at ground plane. The substrate of the antenna is designed with Taconic RF35 and has permittivity and thickness of about 3.5 and 3.04 respectively. For matching the impedance between the patch and the transmission line, we use insert feed. Best return losses at desired frequencies are obtained by having proper impedance matching. Optimization of the position of slot (g) and insert feed (i) produces the best return losses. By inserting the slot in the ground plane of the patched microstrip antenna, the slot resembles the radiator and the patch resembles the feeding network.

Table 1. Dimensions of desired antenna

parameter	Dimensions (mm)
a	13.00
b	09.00
c	18.30
d	29.00
e	36.00
f	03.00
g	14.05
h	01.50
i	06.40
j	13.95
k	16.00
l	18.00

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The antenna is of size 80mm×60mm, the length of the slot is 36mm while its width is 3mm and the patch is of size d=29mm×c=18.3mm . The width and height of the insert feed is given by i=1.5mm and a=6.4mm respectively while the feed line length and width is given by 13mm and 9 mm respectively.

III.RESULT

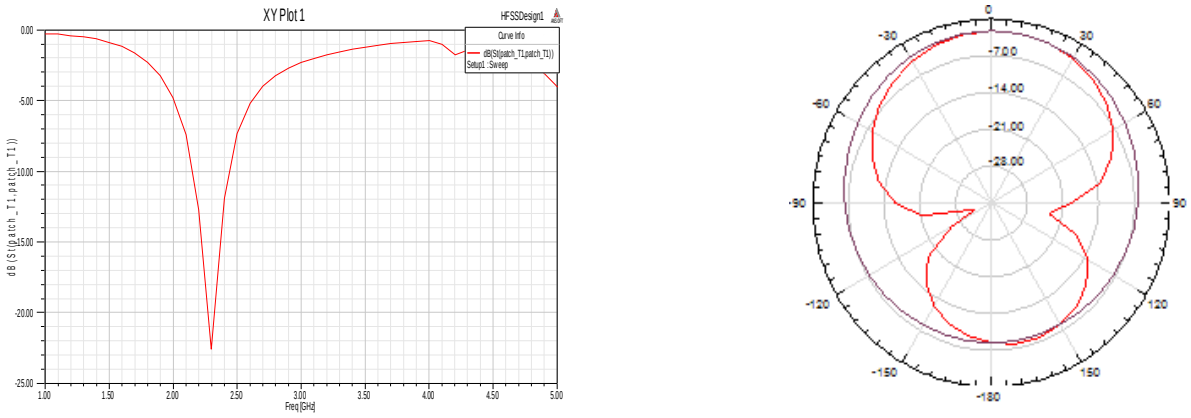
The return losses which are simulated are shown in the figure below and we have all return losses less than 10 db at bands of all frequencies.

Table 2 .configuration of switches and resonant frequency of proposed antenna

s.no	frequency	S1	S2	S3	S4	S5	Resonant frequency	Return losses
1	F1	✓	✓	✓	✓	✓	4.8	-17.80
2	F2	×	×	✓	✓	✓	3.7	-11.13
3	F3	✓	✓	×	✓	✓	2.6	-12.80
4	F4	✓	×	×	✓	✓	2.5	-12.50
5	F5	×	×	×	✓	✓	2.3	-12.80
6	F6	×	×	×	×	✓	2.2	-11.5
7	F7	×	×	×	×	×	2.0	-10.3

✓ = ON, × = OFF

Table 2 gives the detailed description of simulated resonance frequencies. The proposed antenna has a resonant frequency of 2.3 GHz and return losses of -23 db when all the switches are absent.



(a) (b)

Figure2: simulated results of proposed antenna at 2.3 GHz (a) Reflection coefficient (b) Radiation pattern

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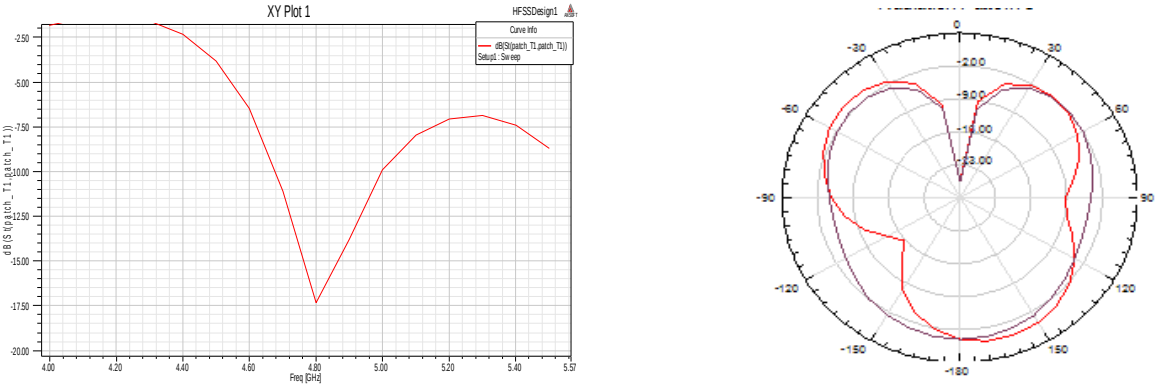
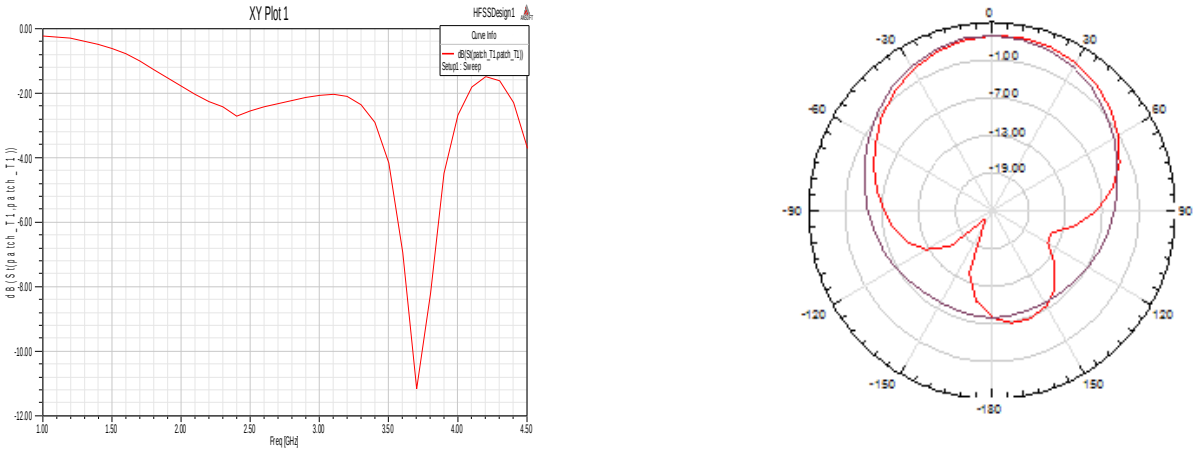


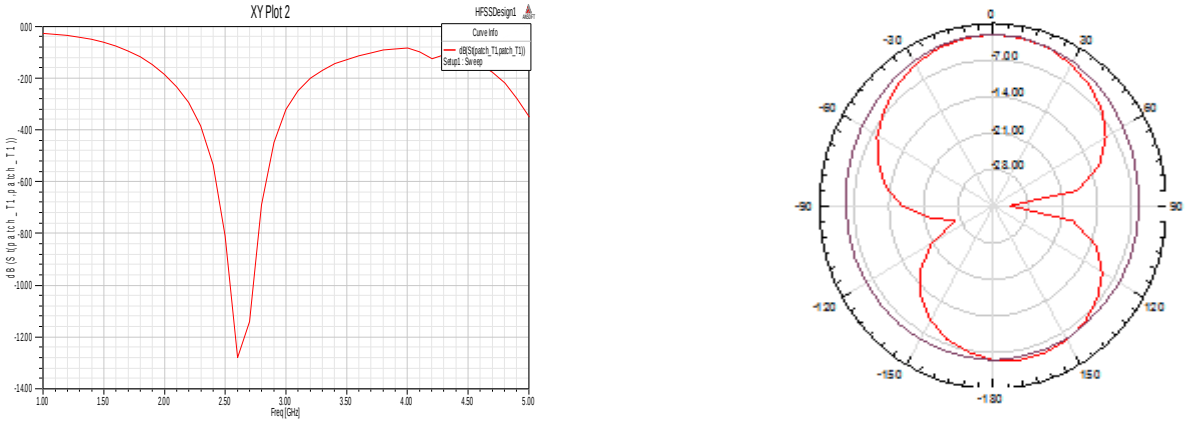
(a) (b)

Figure3: simulated results of proposed antenna at 4.7 GHz (a) Reflection coefficient (b) Radiation pattern



(a) (b)

Figure4: simulated results of proposed antenna at 3.7 GHz (a) Reflection coefficient (b) Radiation pattern



(a) (b)

Figure5: simulated results of proposed antenna at 2.6 GHz (a) Reflection coefficient (b) Radiation pattern

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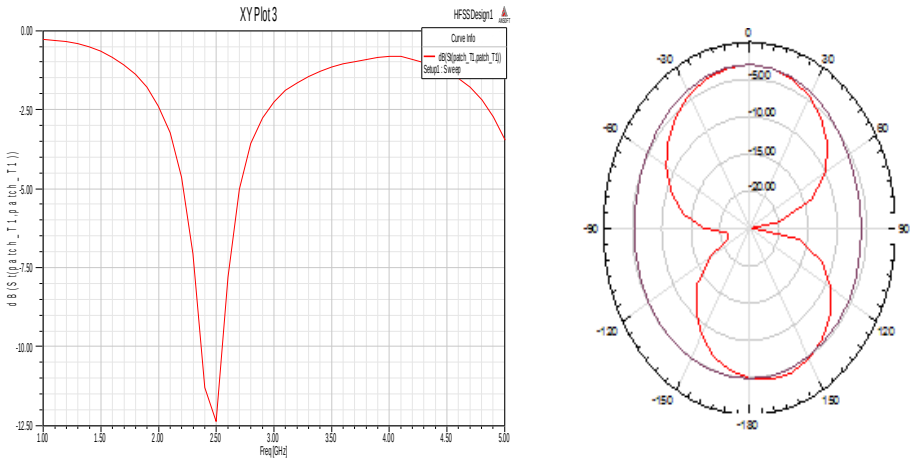
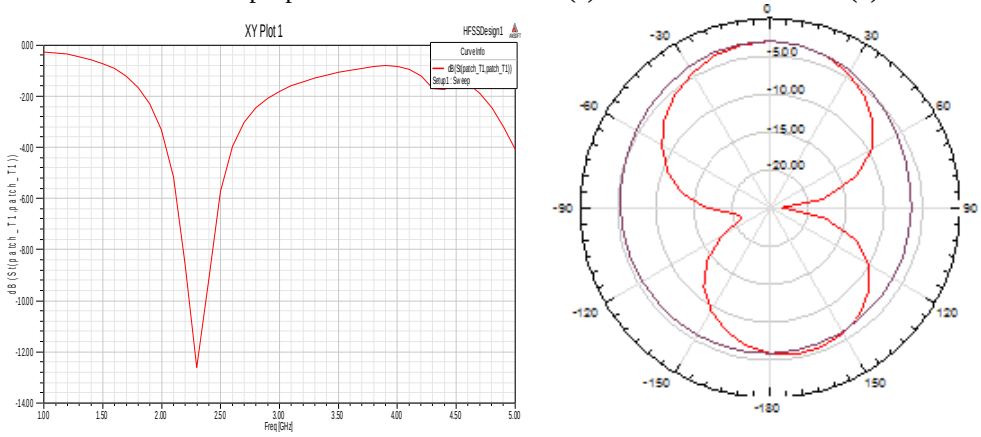


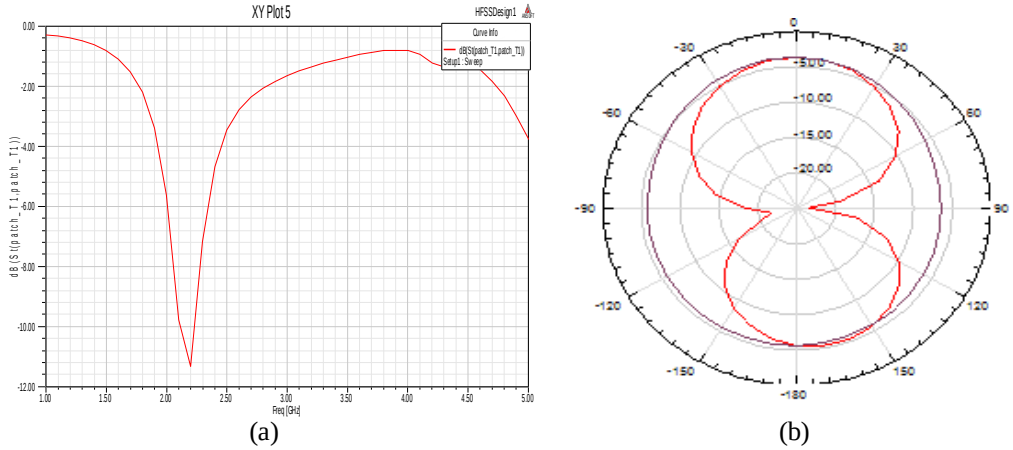
(a) (b)

Figure6: simulated results of proposed antenna at 2.5 GHz (a) Reflection coefficient (b) Radiation pattern



(a) (b)

Figure7: simulated results of proposed antenna at 2.3 GHz (a) Reflection coefficient (b) Radiation pattern



(a) (b)

Figure8: simulated results of proposed antenna at 2.2 GHz (a) Reflection coefficient (b) Radiation pattern

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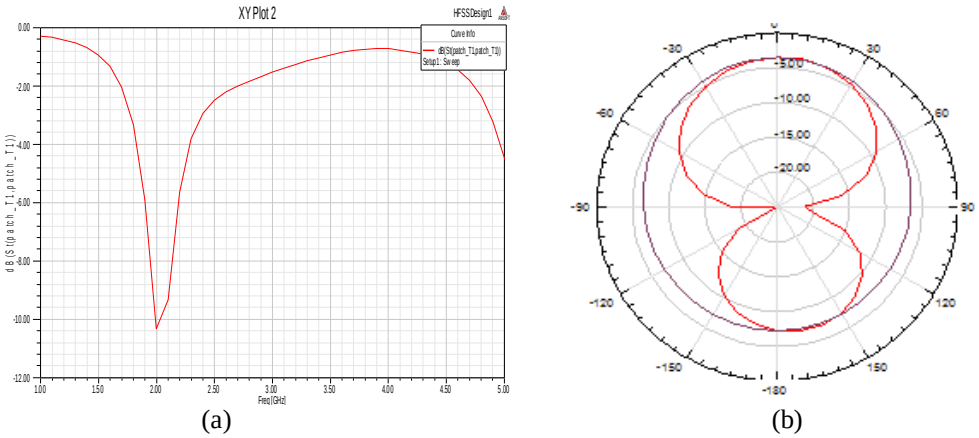

(a) (b)

Figure9: simulated results of proposed antenna at 2.0 GHz (a) Reflection coefficient (b) Radiation pattern

From the simulated result we can confirm that the design antenna has the capability to operate from 2 GHz to 4.8 GHz with seven different frequency reconfigurable bands. The reflection coefficients and radiation patterns which were simulated at 7 different frequency bands are illustrated in figure2 to 9.

IV.CONCLUSION

The reconfigurable frequency patched microstrip antenna has been designed and simulated. It was observed that seven different bands of frequencies can be reconfigurable using five switches. The antenna is relatively small and return losses which were obtained are good.

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