Chapter Four

Results and Discussion

4.1 Overview:

This chapter presents simulation resultsof reconfigurable dual band rectangular microstrip patch antenna for WLAN and WiMaxapplications by using ON/OFF PIN diode switch. The simulation of reconfigurable dual-band patch antenna is achieved by using CST microwave studio simulator, which simulate the return loss, voltage standing wave ratio (VSWR), gain, radiation patterns and current distribution. The reconfigurability of the antenna is employed by inserting three PIN diodes (P1, P2, and P3) on the C-slots of the antenna patch. The simulated results concentrate on three statuses of the ON/OFF PIN diodes statues summarized in Table 4.1. Thus, the reconfigurable antenna operates at dual frequencies (3.5GHz & 5.2GHz) at same time, at 3.5GHz and at 5.2GHz.

Table 4.1: Frequency Bands and Gains Generated in ON/OFFPIN diodes Statues

P1	P2	P3	Frequency Bands	Gains
OFF	OFF	OFF	3.5GHz 5.2GHz	5.9dB 6.6dB
OFF	OFF	ON	3.5GHz	5.9dB
OFF	ON	OFF	5.2GHZ	6.3dB

4.2 Computer Simulation Technology (CST) Platform:

The electromagnetic simulation software CST Studio Suite is the culmination of many years of research and development into the most accurate and efficient computational solutions for electromagnetic designs. It comprises CST's tools for the design and optimization of devices operating in a wide range of frequencies from static to optical. Analysis may include thermal and mechanical effects, as well as circuit simulation. CST

Studio Suite benefits from an integrated design environment which gives access to the entire range of solver technology. System assembly and modeling facilitates multi-physics and co-simulation as well as the management of entire electromagnetic systems.CST Studio Suite can offer considerable product to market advantages such as shorter development cycles, virtual prototyping before physical trials, and optimization instead of experimentation.

4.3 Parameters Study:

The effective of antenna parameters on the performance of the proposed antenna are showed as:

4.3.1Patch Width (W):

Figure 4.1 shows the effect of the patch width on resonant frequencies and bandwidth response. When increase the width of the patch, the return loss response are changing at different frequencies. As well as, the upper return loss is offset with good response at 5.2GHz. Due to different widths, the antenna tuning at 3.5 and 5.2 GHz by using patch width 41.2 mm.

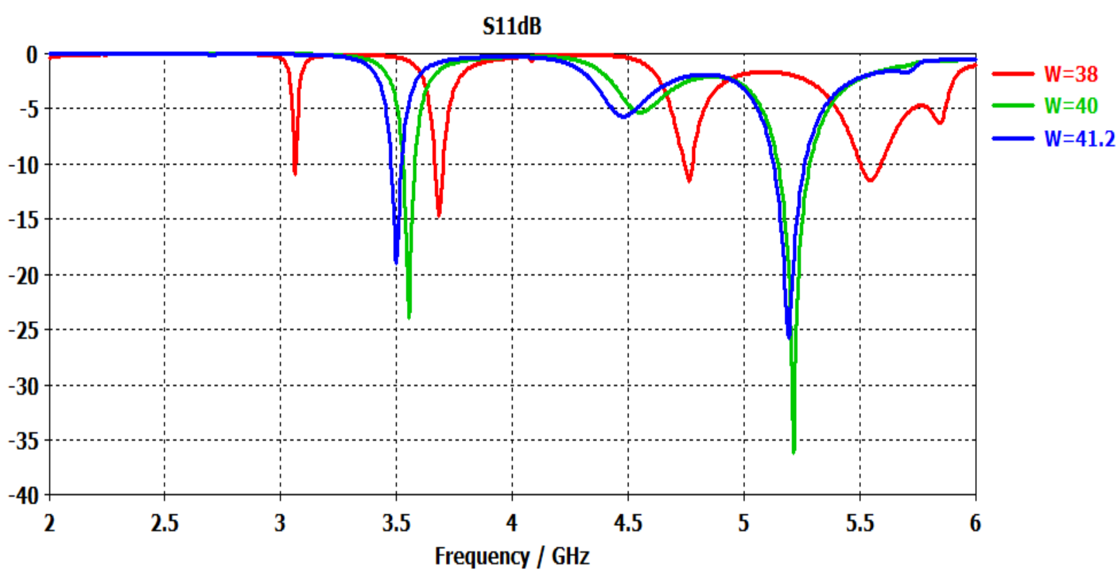


Figure 4.1: Return Loss with Different Patch Width.

4.3.2 Insert Microstrip Feed Line (Y):

Impedance matching of the feed line to the patch without any additional matching element is achieved by controlling the insert position and line dimensions. Insert feed line is placed on many different places as illustrated in Figure 4.2. Hence the most suitable insert point was on Y=6mm.

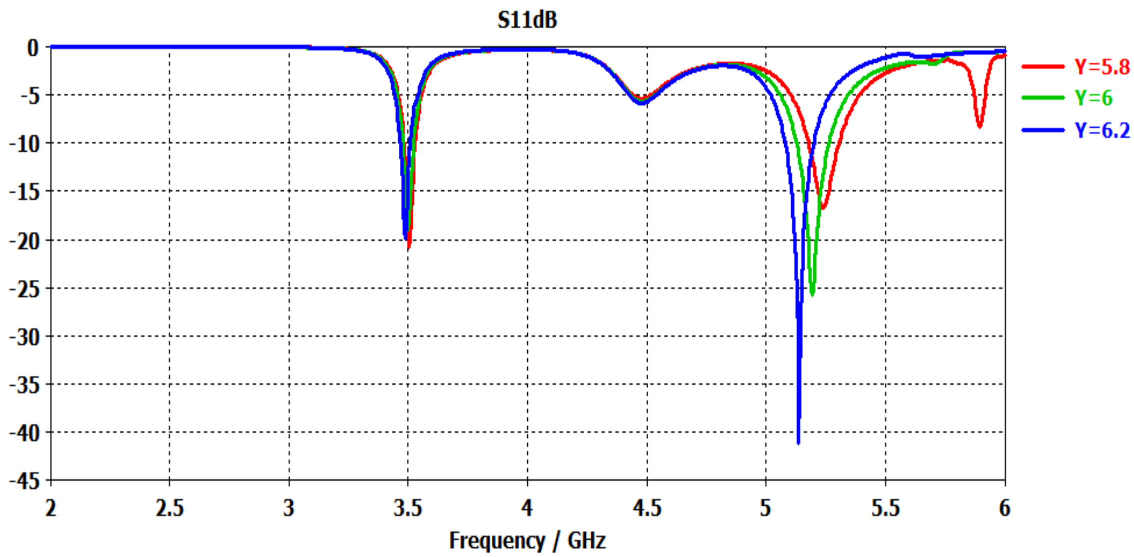


Figure 4.2: Return Loss with Different Insert Feed Line.

4.3.2 Microstrip Feed Line Width (WF):

The width of feed line is important parameter to line impedance study. However, the study is concentrate on different values for feed line width to enhance the return loss response. In Figure4.3, the better return loss showed at WF= 2.6mm.

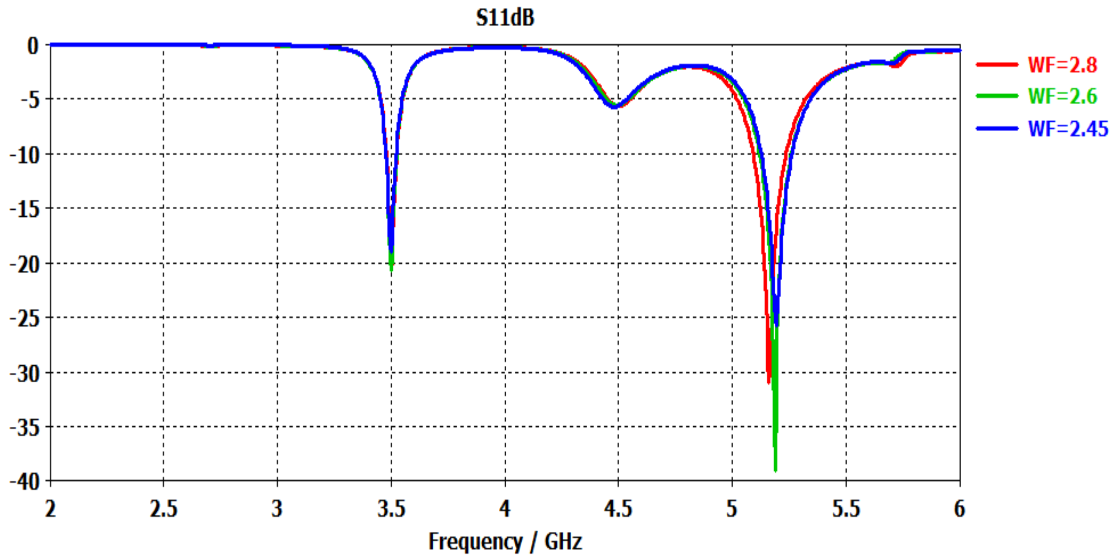
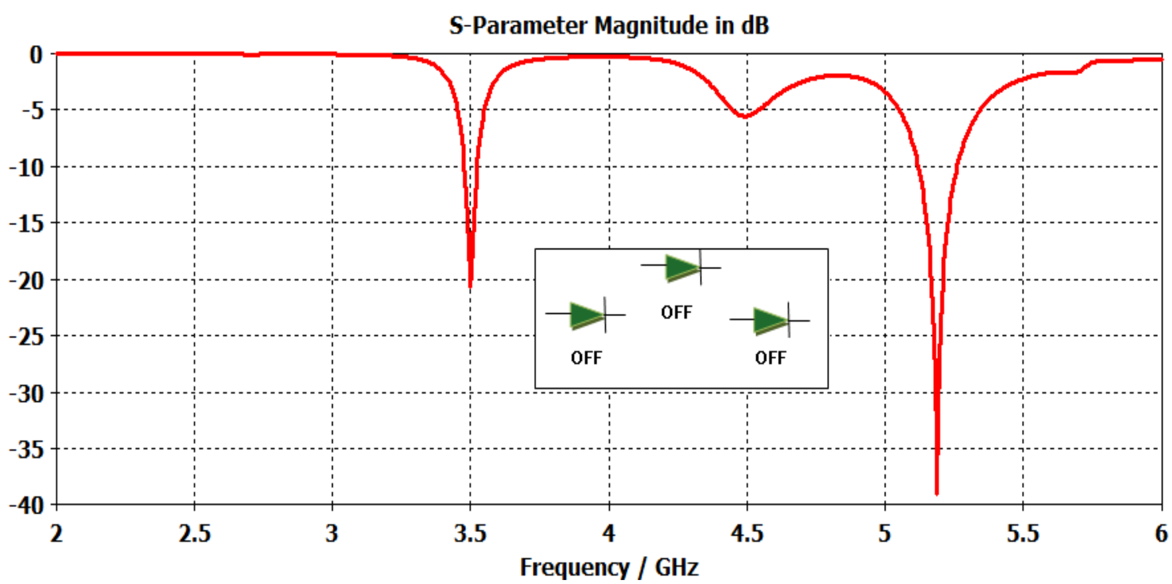


Figure 4.3: Return Loss with Different Feed Line Width.

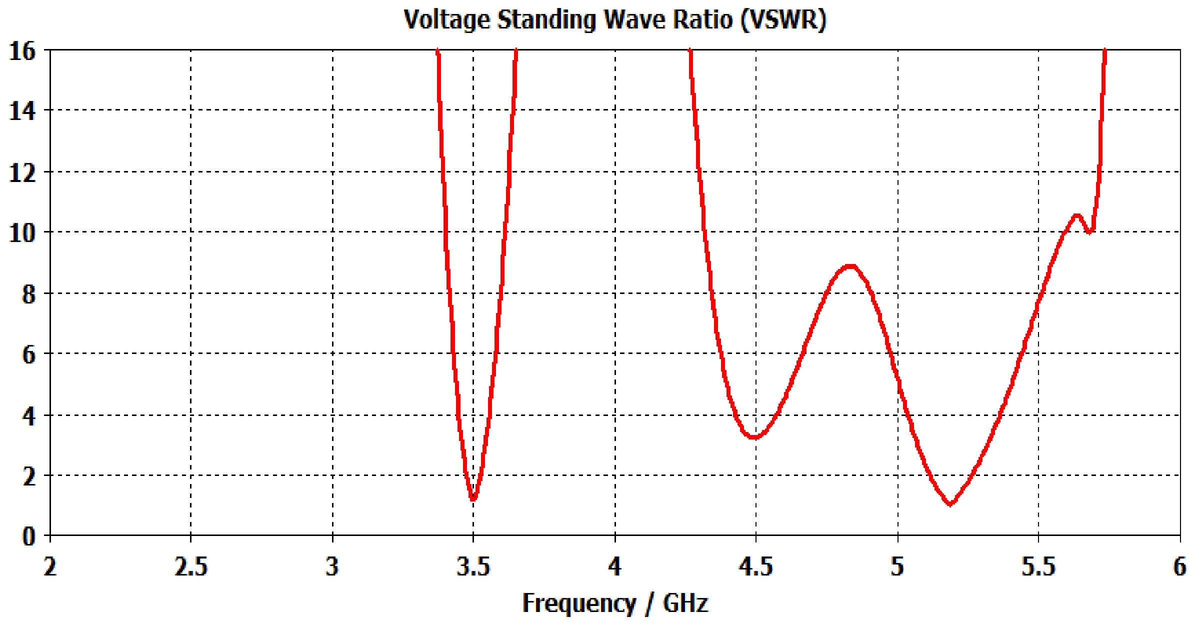
4.4 Simulation Results of Reconfigurable Antenna:

4.4.1 OFF/OFF/OFF PIN Diode Status:

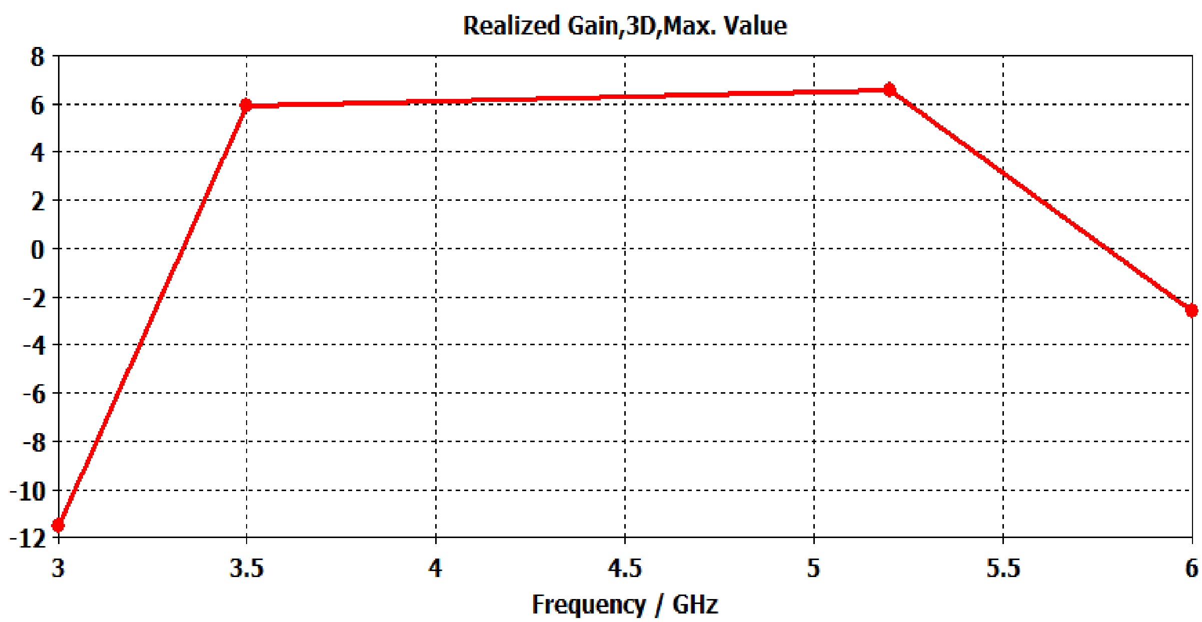
In OFF/OFF/OFF status, the dual-band is obtained at 3.5GHz and 5.2GHz with return loss -20dB and -39dB and bandwidth 48MHz and 156MHz respectively and also takes voltage standing wave ratio (VSWR) less than two as shown in Figure 4.4(a), (b). The good gain measured 5.9dB& 6.6dB at 3.5GHz and 5.2GHzrespectively as shown in Figure 4.4 (c)



(a)



(b)

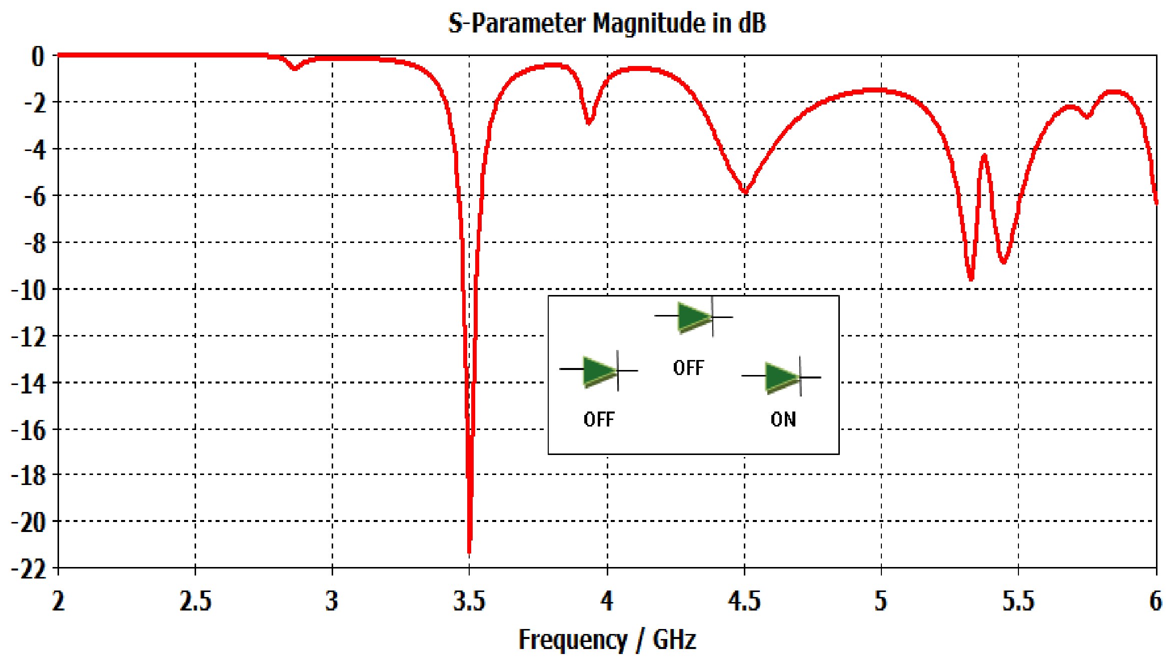


(c)

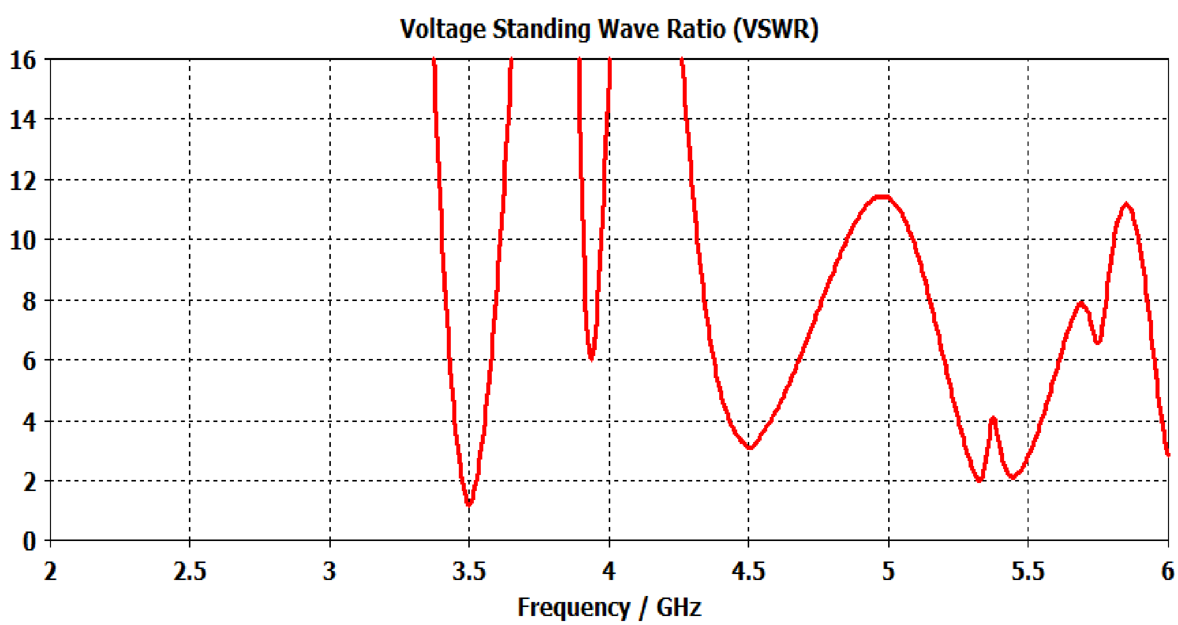
Figure4.4:OFF/OFF/OFF diode status: (a) Return Loss, (b) VSWR, (c) Gain.

4.4.2 OFF/OFF/ON PIN Diode Status:

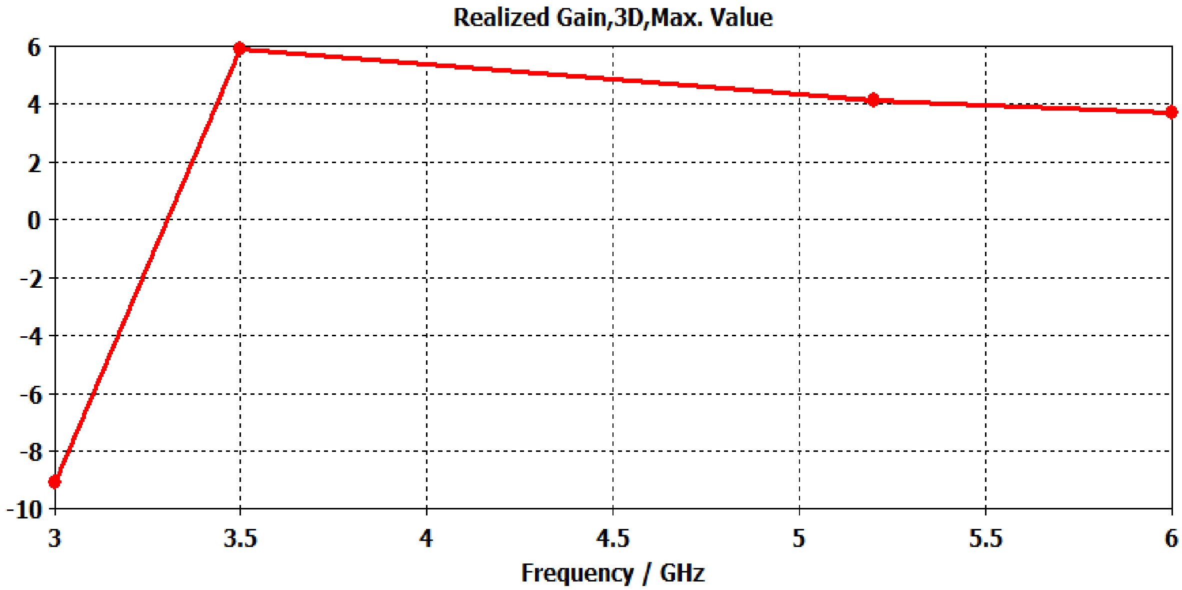
In OFF/OFF/ON status, the single-band is obtained at 3.5GHz with return loss -21dB bandwidth 48MHz, because the small current through on P3. And also takes voltage standing wave ratio (VSWR) less than two as shown in Figure 4.5(a), (b). The good gain measured 5.9dB at 3.5GHz, but it measured high gain at 5.2GHzas shown in Figure 4.5 (c).



(a)



(b)

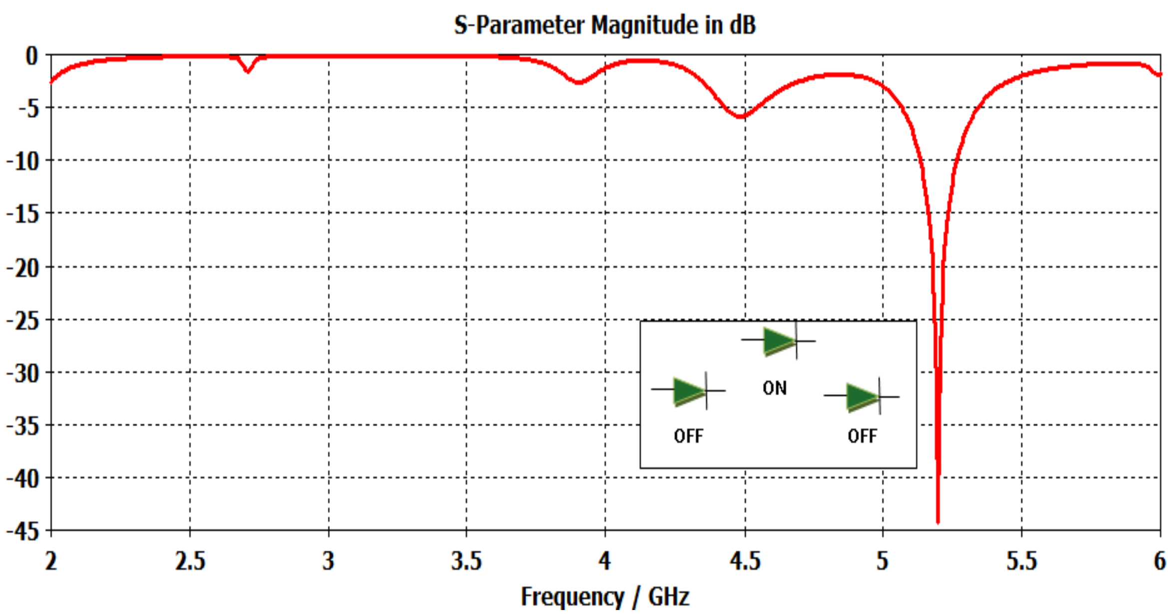


(c)

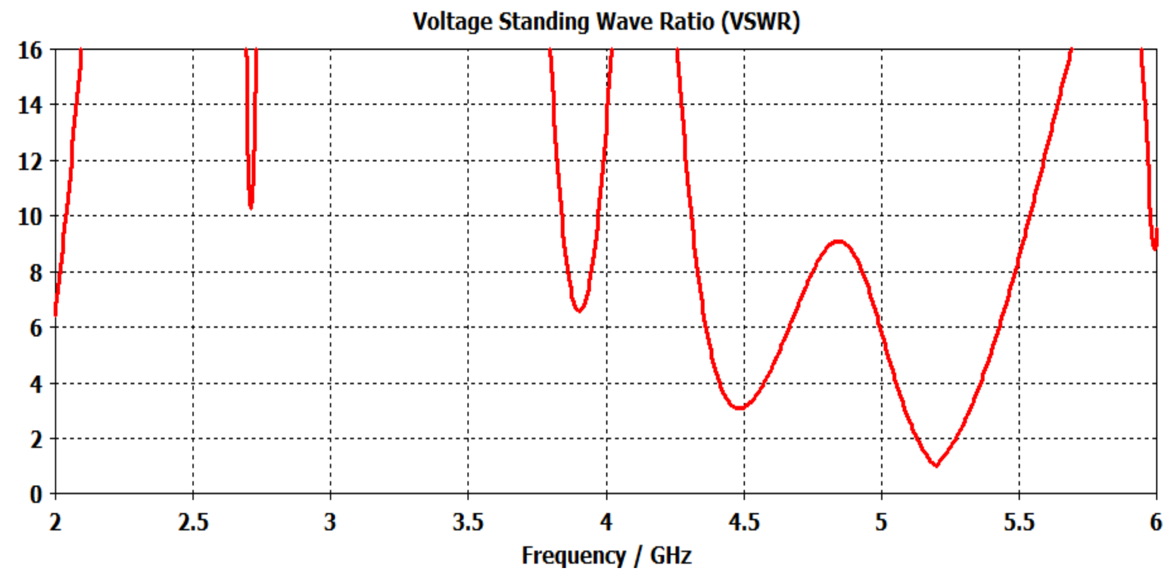
Figure4.5:OFF/OFF/ON diode status: (a) Return Loss, (b) VSWR, (c) Gain.

4.4.3 OFF/ON/OFF PIN Diode Status:

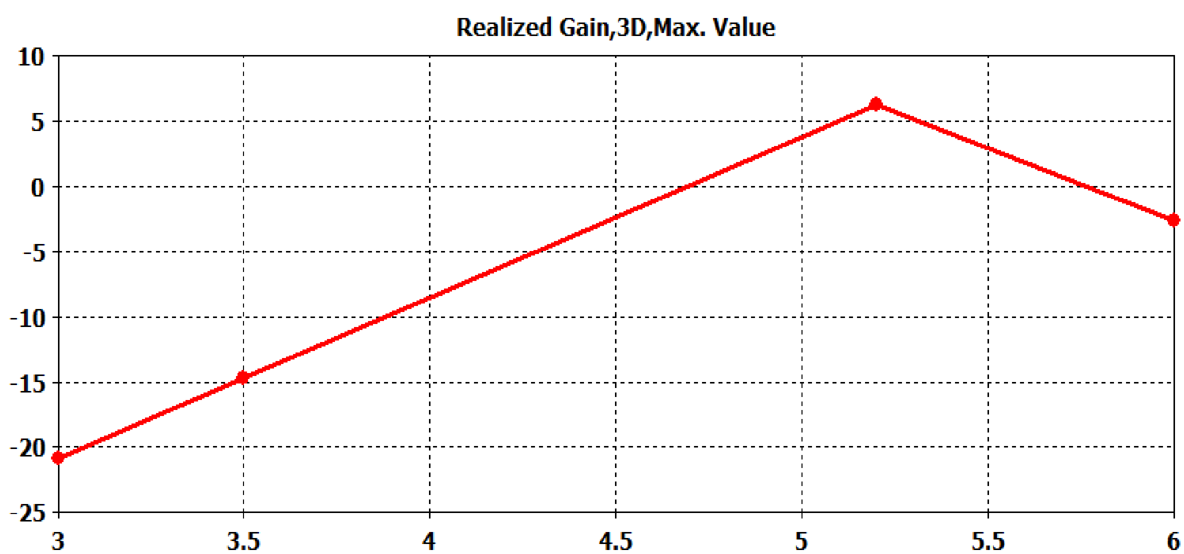
In OFF/ON/OFF status, the single-band is obtained at 5.2GHz with return loss -44dB bandwidth 156MHz, because the small current through on P2.And also takes voltage standing wave ratio (VSWR) less than two as shown in Figure 4.6(a), (b). The good gain measured 6.6dB at 5.2 GHz as shown in Figure 4.6 (c).



(a)



(b)



(c)

Figure4.6:OFF/ON/OFF diode status: (a) Return Loss, (b) VSWR, (c) Gain.

4.4.4Surface Current:

The current distributions on the proposed antenna at 3.5 GHz and 5.2 GHz are shown in Figure 4.7 (a), (b) respectively. Also in Figure 4.7 will show the effective of slots on surface current. Sine, any change on the radiation terminal (patch, ground) will create new current paths, which create new performances of the antenna.

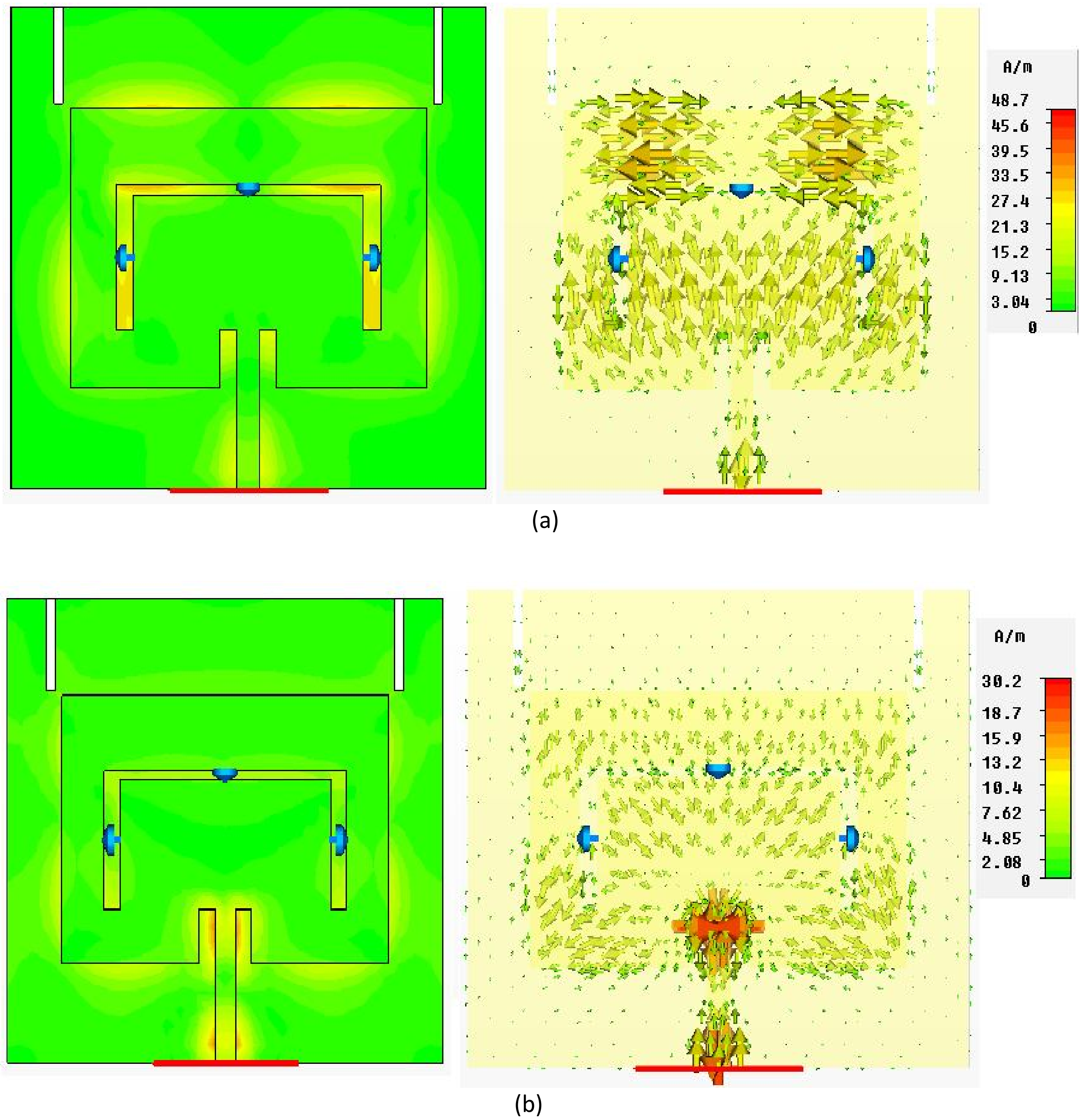
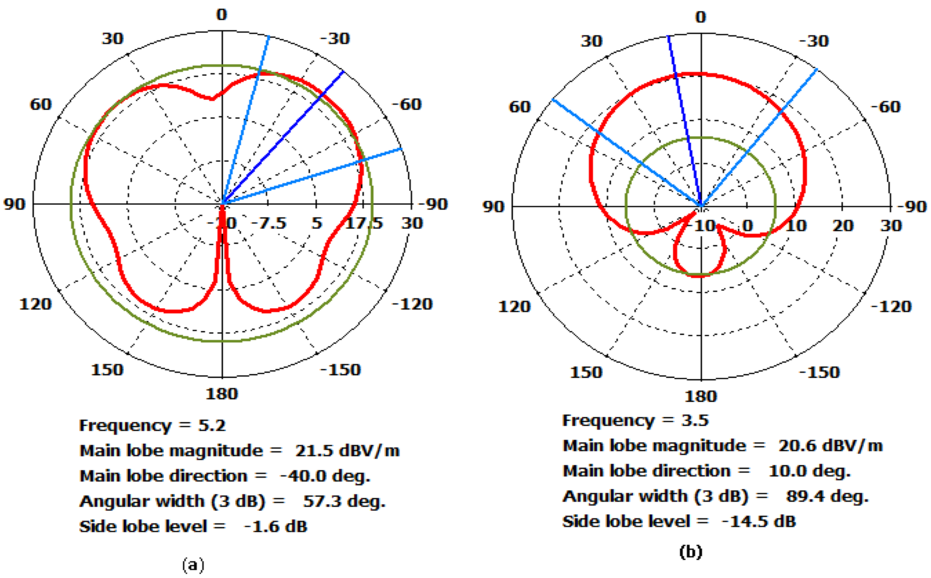


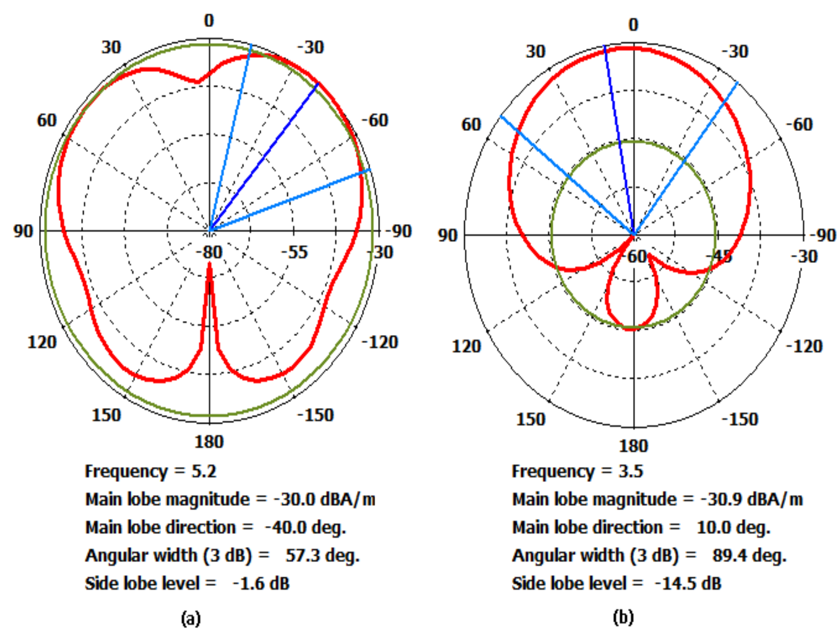
Figure4.7: Current Distributions at: (a) 3.5GHz, (b) 5.2GHz.

4.4.5Radiation Pattern:

The radiation patterns of the reconfigurable antenna are measured at resonant frequencies 3.5GHz and 5.2GHz. Also the directions are mainly in H-pane and E-plane, as shown in figure 4.8.



(a)



(b)

Figure4.8: Radiation Pattern: (a) E-Plane, (b) H-Plane.