Dual Band Microstrip Patch Antenna With Stubs

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Abstract: In this paper, design of dual band microstrip patch antenna with stubs is presented. Microstrip patch antenna without stubs shows dual band character with resonating frequency 4.2 GHz and 7.0 GHz. With stubs the microstrip patch antenna resonant at 3.8 GHz and 7.3 GHz. Improvement in Return losses and bandwidth shows better matching of antenna with stubs.

1. INTRODUCTION

For any wireless communication system, antenna plays a crucial role. With the growth of technology there is continuous reduction in the size of devices and also they become multi-functioning. Therefore, to cope up with this there is always a requirement of reduction in size of antenna and it became multiband. There are number of techniques developed to configure antenna as multiband like cutting slots either in patch or in ground [1-3], using metamaterials [4-6], using stubs [7-8], etc. A four-band antenna loaded with metamaterial and slots is presented in [6]. In this paper, author placed a trapezoidal shaped slots in patch and rectangular shaped slots in ground plane. Also to make antenna multiband, two units of metamaterial are introduced in ground plane. In [7], author presented a multiband reconfigurable antenna with slots. Again, trapezoidal shaped slots in monopole and rectangular shaped slots in ground plane are placed to achieve multiband configuration of antenna. In [8], a compact planar multiband antenna with rectangular slot is presented. The antenna is loaded with a rectangular and two hook-shaped stubs to achieve multiband operation of antenna.

In this paper, dual band microstrip patch antenna with stubs is designed. To optimize the design parametric analysis of antenna with stubs is also done by varying the width of stubs. Enhancement of Return losses and bandwidth of antenna shows better matching of antenna with stubs. Ansoft HFSS (Finite Element Method) is used as simulation tool.

2. ANTENNA DESIGN

The structure of rectangular microstrip patch antenna without and with stubs on the radiating edge is shown in Figure 1(a,b). The dimensions of patch are: Length L = 19.8 mm and Width W = 15.9 mm. The length of both stubs is 4.05 mm. FR4 (Dielectric Permittivity $\varepsilon_r = 4.4$) is used as substrate. The length and width of substrate are 39 mm and 33 mm respectively. The thickness of substrate is 1.575 mm. The patch antenna is fed with coaxial excitation.

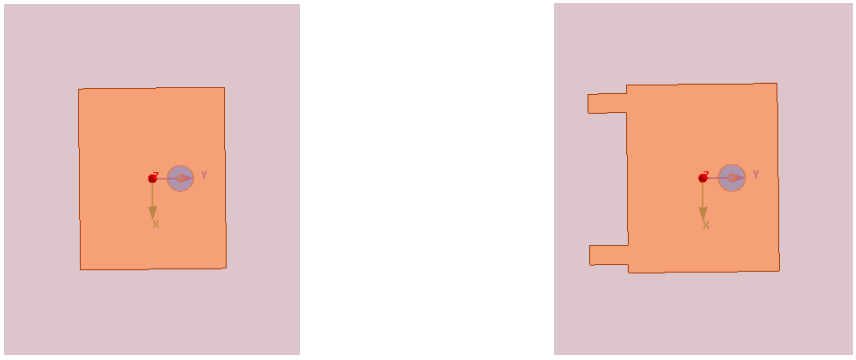


Figure 1: Structure of Rectangular Microstrip Patch Antenna (a) Without, (b) With Stubs

3. ANALYSIS AND DISCUSSION

The rectangular microstrip patch antenna without stubs resonant at 4.2 GHz with return loss S_{11} = -12 dB and at 7.0 GHz with return loss S_{11} = - 13.5 dB (Figure 2). The antenna has a gain of 4.6 dB with -10 dB bandwidth of 111 MHz at 4.2 GHz (Figure 3a) and gain of 5.7 dB with -10 dB bandwidth of 271 MHz at 7.0 GHz (Figure 3b) respectively.

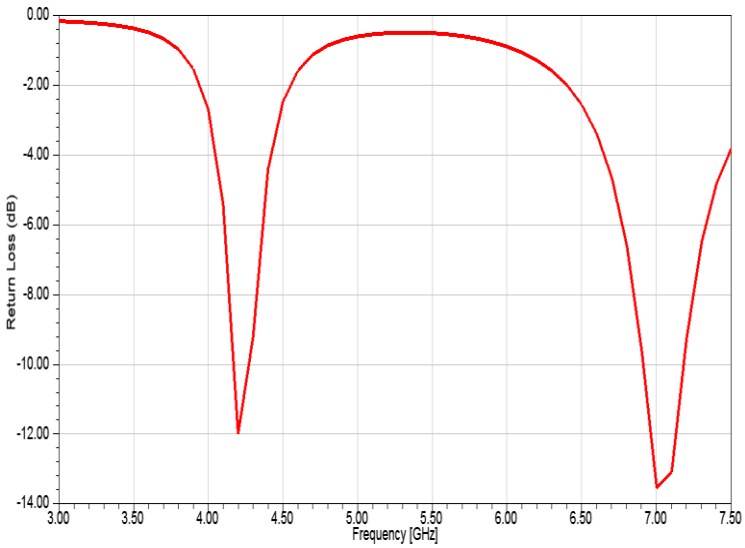
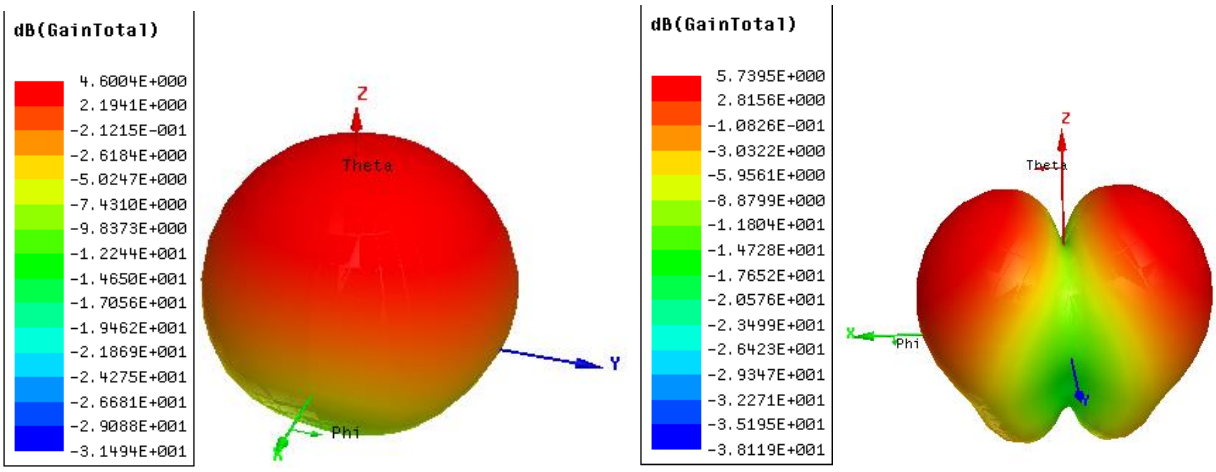


Figure 2: Return Loss of Microstrip Patch Antenna without stubs



(a) (b)

Figure3 : Gain of Microstrip Patch Antenna without stubs (a) at 4.2 GHz, (b) at 7.0 GHz

To improve the characteristics of patch antenna two stubs are added on the radiating edge of patch antenna. Parametric analysis of rectangular microstrip patch antenna with stubs is done by varying the width of stubs to obtain the optimum design as shown in Figure 4. The width of both stubs is varied from 3 mm to 8 mm.

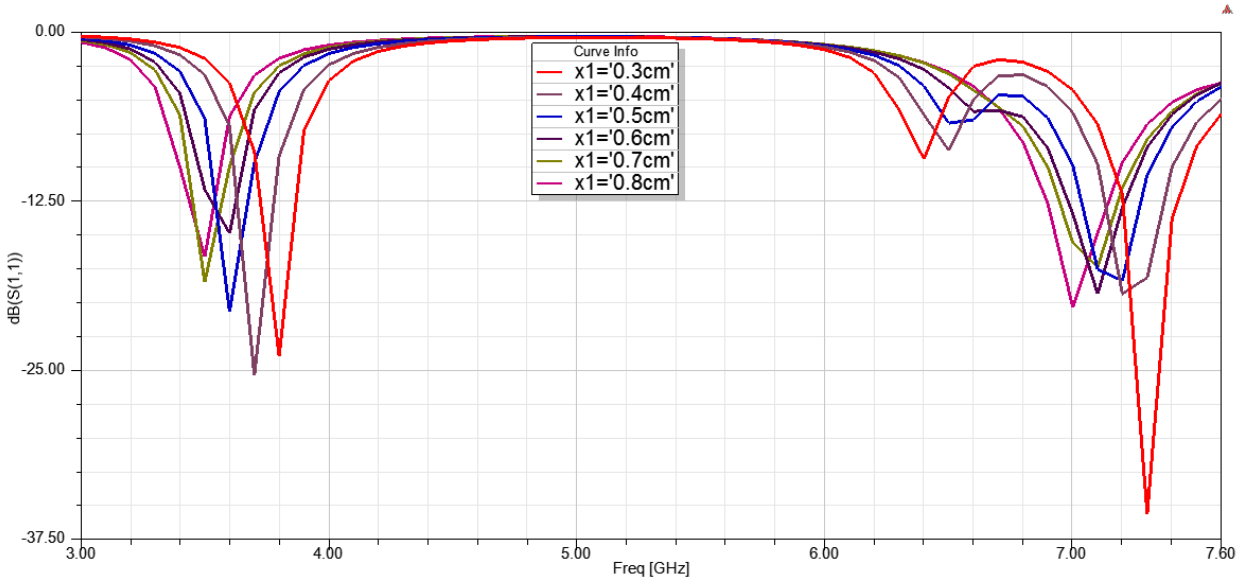


Figure 4: Parametric analysis of Microstrip Patch Antenna with stubs for various stubs width.

Optimum result is obtained for width of 3 mm of both stubs. The return loss of optimized microstrip patch antenna with stubs is shown in Figure 5. The rectangular microstrip patch antenna with stubs resonant at 3.8 GHz with return loss S_{11} = -23.9 dB and at 7.3 GHz with return loss S_{11} = -35.6 dB.

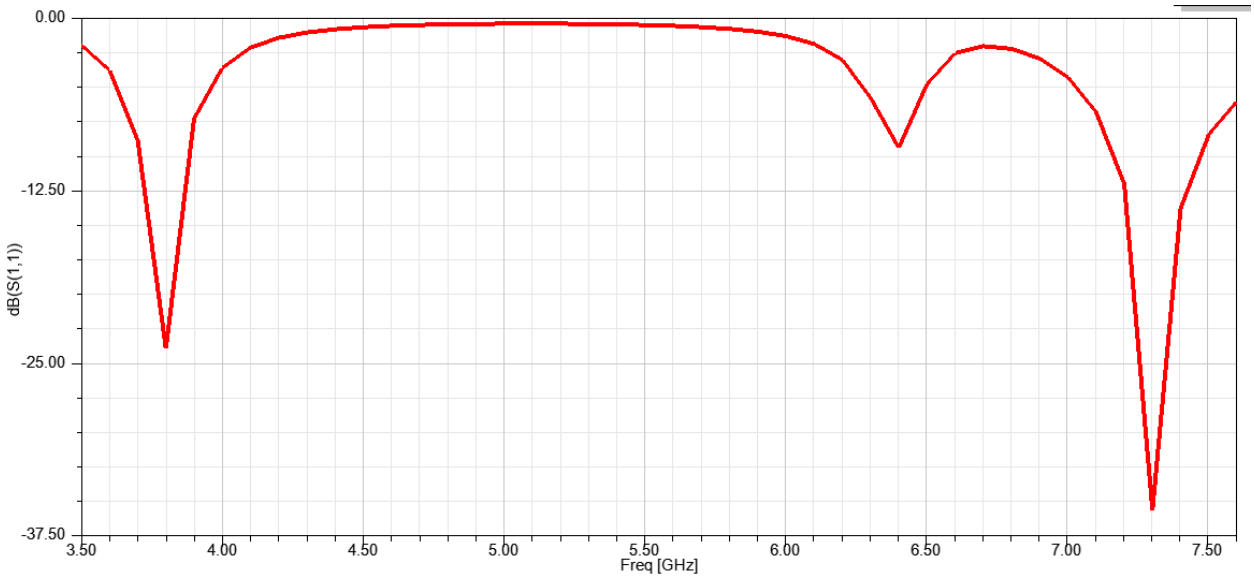


Figure 5: Return Loss of optimized Microstrip Patch Antenna with stubs

The antenna has a gain of 3.84 dB with -10 dB bandwidth of 150 MHz at 3.8 GHz (Figure 6a) and gain of 3.86 dB with -10 dB bandwidth of 300 MHz at 7.3 GHz (Figure 6b) respectively. Improvement in return loss and bandwidth shows better matching of antenna with stubs.

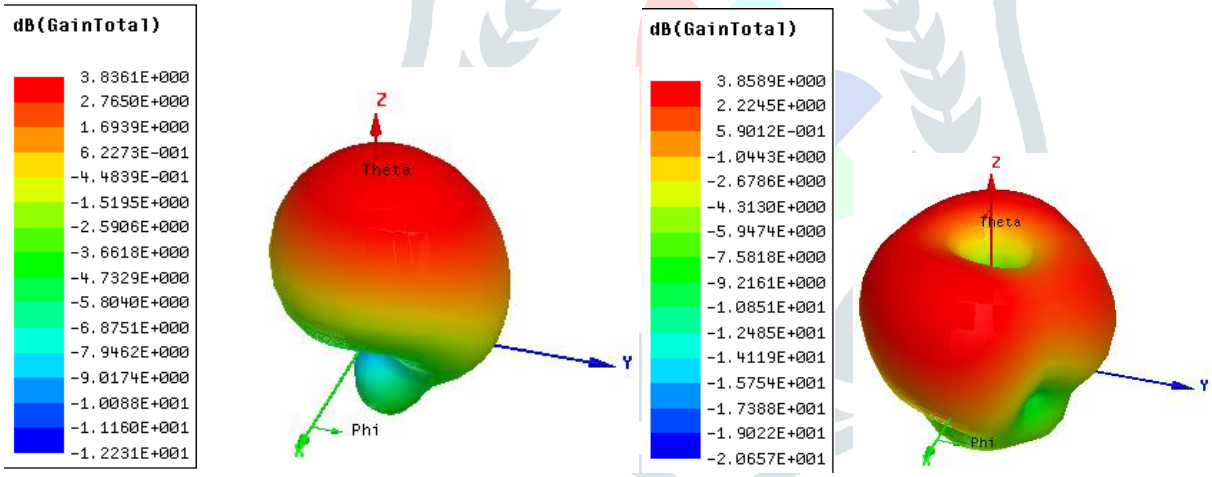


Figure 6: Gain of Microstrip Patch Antenna with stubs (a) at 3.8 GHz, (b) at 7.3 GHz

4. CONCLUSION

A design of dual band microstrip patch antenna with stubs is presented. Parametric analysis of patch antenna with stubs is also done to obtain optimized result. First, microstrip patch antenna without stubs has been designed and analyzed. The antenna shows dual band nature resonating at 4.2 GHz and 7.0 GHz. Then two stubs are connected to microstrip patch antenna on its radiating edge. Parametric analysis of patch antenna with stubs has been done to obtain optimized result by varying the width of stubs from 3 mm to 8 mm. Optimum result is obtained for width of 3 mm of both stubs. The optimized patch antenna shows dual band nature at 3.8 GHz and 7.3 GHz. The optimized antenna has shown enhancement in return loss and bandwidth, which signifies that the matching of antenna has improved by adding stubs to the antenna.

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