

Reconfigurable Patch Antenna

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Abstract: In this paper a design of reconfigurable patch antenna is presented. Four small patches of dimension 1 cm^2 are used at each corner of the main patch. These small patches can be connected to main patch by using RF MEMS switches. The main patch antenna resonant at 1.94 GHz and switched to 1.48 GHz when all switches are ON.

Keywords: Reconfigurable Antenna, microstrip, RF MEMS switch.

INTRODUCTION

In the revolutionary world of wireless communication, there is always a requirement of an antenna that can be reconfigured in terms of frequency, radiation pattern or polarization or combination of more than one. The reconfiguration of antenna can be achieved by redistribute the antenna current either by changing the physical structure of an antenna, implementing the antenna arrays or using tunable material. Switches like PIN diode, varactor diode, RF MEMS switches can also be used to provide reconfigurability. The choice of reconfiguration method is directly tied to the design requirements and desired performance levels. Patch antenna is most suitable candidate for reconfigurable antenna because of light weight, simple fabrication method. Dual frequencies with a linear polarisation (LP) characteristic of an antenna are suggested in [1]. Stacked patches [2-3], arrays [4], or a single patch but with complex structures or slow-speed operations [5] are implemented for Broad band and multi-frequency modes. It is explained in [6] how the antenna can be reconfigured at different frequency bands depending on the state of an embedded switch, which is implemented by using a PIN diode. A reconfigurable antenna with a controlled radiation pattern by using PIN diodes to shorten an annular slot antenna is presented in [7]. In [8] matching stubs and PIN diodes are used to obtain Pattern and frequency reconfigurable slot antenna.

A compact hexagonal patch antenna with T shaped slot for frequency switching and conical radiation is presented in [9]. To change the configuration of slot PIN diode is implemented. By controlling the status of PIN diode, the purposed antenna is capable of operating at two different resonant frequencies 2.29 and 2.11 GHz, respectively without special matching network and gives conical radiation patterns at these two frequencies. Authors have also shown that as length of slot increases the resonant frequency decreases and as slot width decreases the resonant frequency increases. The purposed antenna has potential to be used in indoor wireless communication applications because of its low profile, switchable resonant frequency, and approximations to conical beam patterns.

In this paper, a reconfigurable patch antenna is presented. Here the physical structure of the antenna is changed by using RF MEMS switches. By making RF MEMS switches ON/OFF the antenna is made to resonant to different frequency. Finite element based electro-magnetic mode solver Ansoft HFSS is used for designing and analysis of the antenna.

This paper is organized in three sections. Section 1 present the introduction, design parameters and analysis is presented in section 2 and section 3 respectively. Section 4 gives conclusion of this work.

DESIGN

Figure 1 shows the structure of reconfigurable patch antenna. Rogers RT/duriod 5880 with relative permittivity of 2.2 is used as substrate. The thickness of substrate is 1.57 mm. The dimensions of patch are 4.98 cm width and 5.93 cm length. Four small patches of dimensions $1\text{ X }1\text{ cm}^2$ are placed at a distance of 0.235 cm at each corner of main patch. RF MEMS switches are placed in the gap of main patch and small patches. The ON position of RF MEMS switch is implemented by considering a metal strip in the gap connecting the main patch to small patches and OFF position of RF MEMS switch is implemented by considering no metal strip so there is no connection between main patch and small patches. Antenna is feeded by probe feeding.

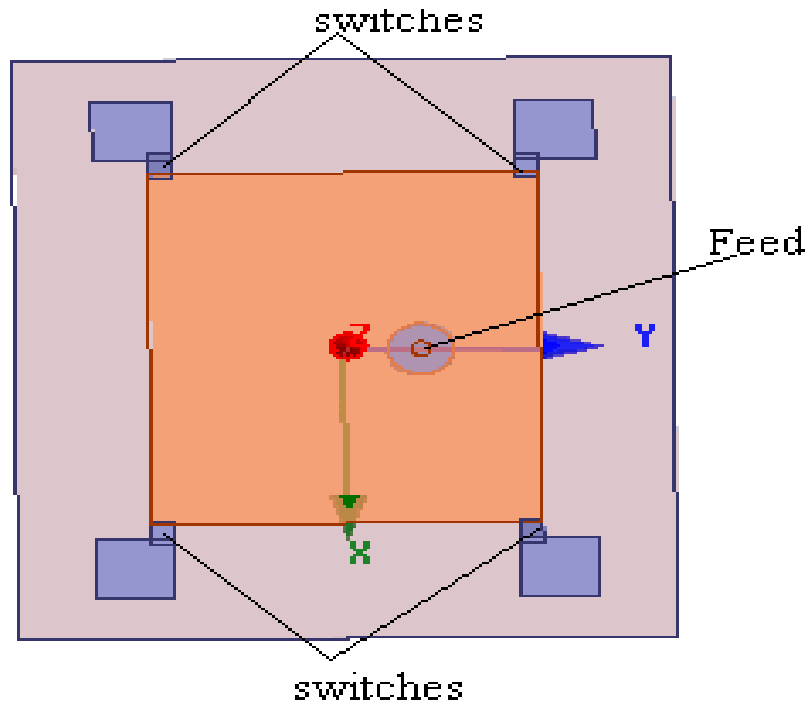


Figure 1: Structure of reconfigurable antenna

ANALYSIS

When all the switches are OFF, i.e. small patches are not connected to main patch so only patch structure is operating. In this case the resonant frequency of patch antenna is 1.94 GHz with a gain of 7.8 dB (as shown in figure 2 and 3).

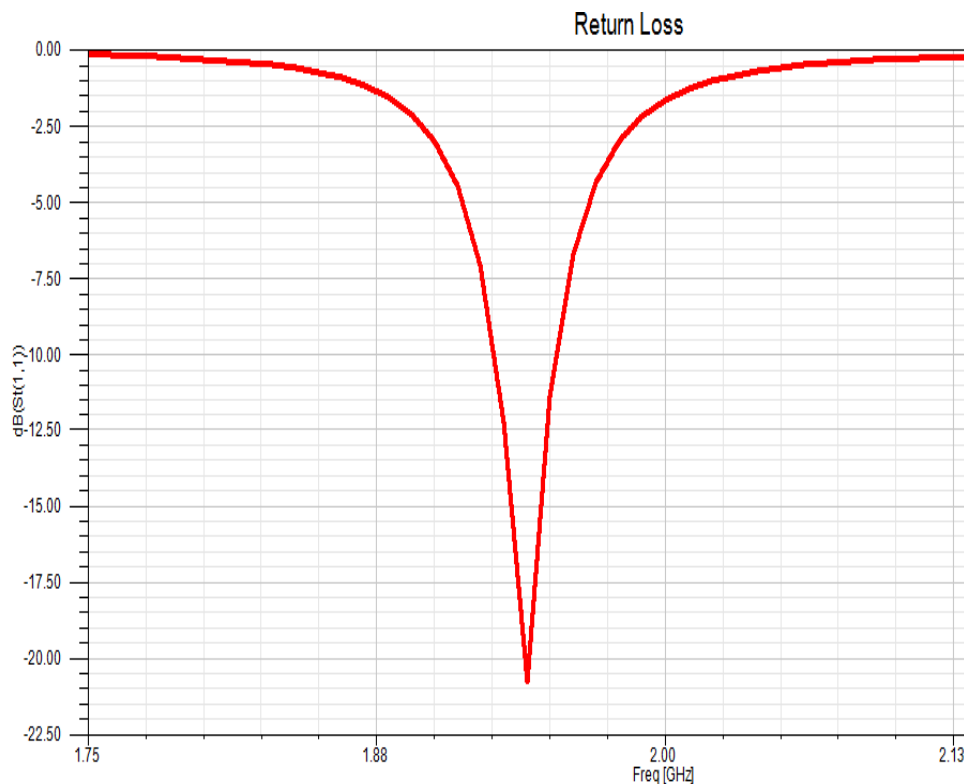


Figure 2: Return loss of Patch antenna when all switches are OFF.

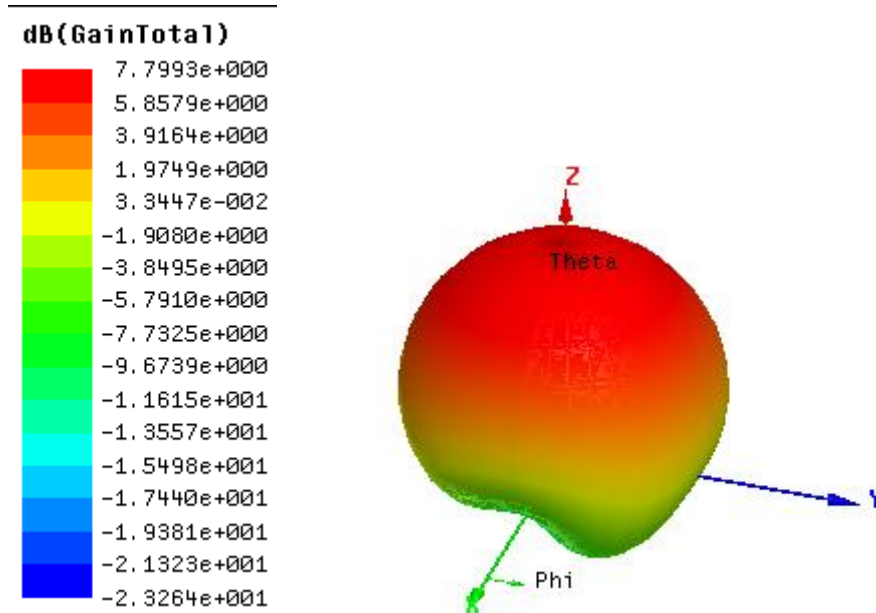


Figure 3: Gain of Patch antenna when all switches are OFF.

When all the switches are ON, i.e. small patches are connected to main patch so whole structure is operating. In this case the resonant frequency of patch antenna is 1.48 GHz with a gain of 3.5 dB (as shown in figure 4 and 5).

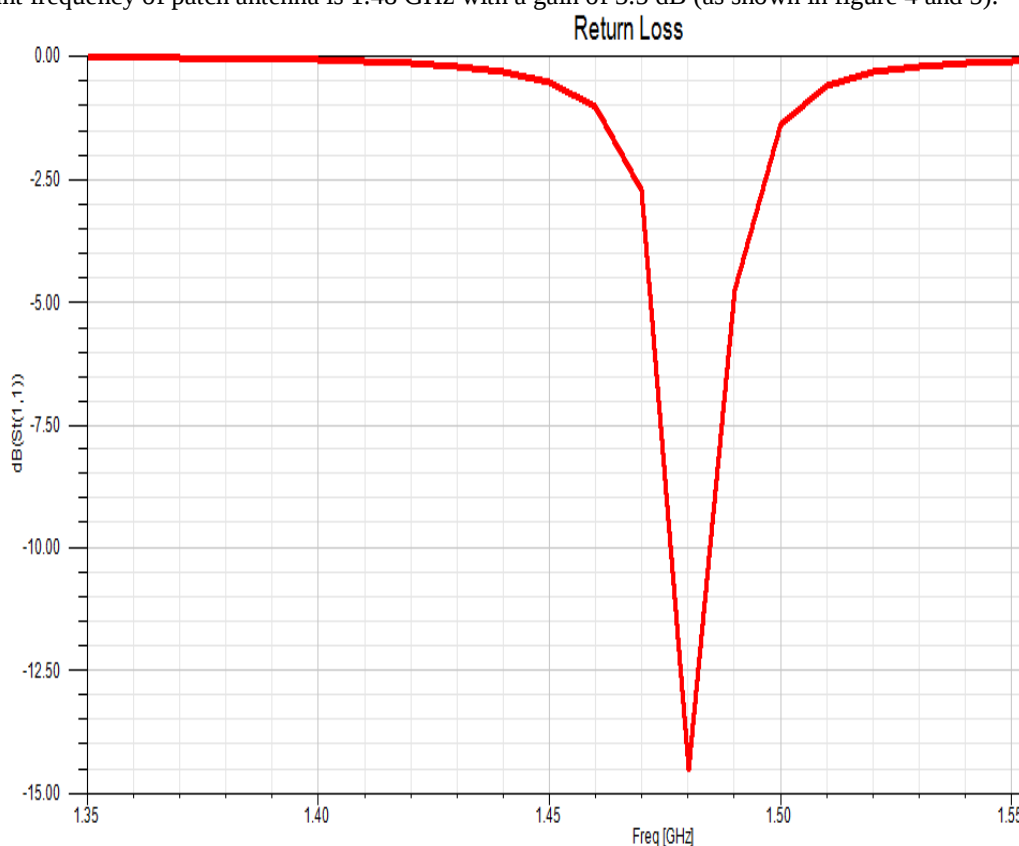


Figure 4: Return loss of Patch antenna when all switches are ON.

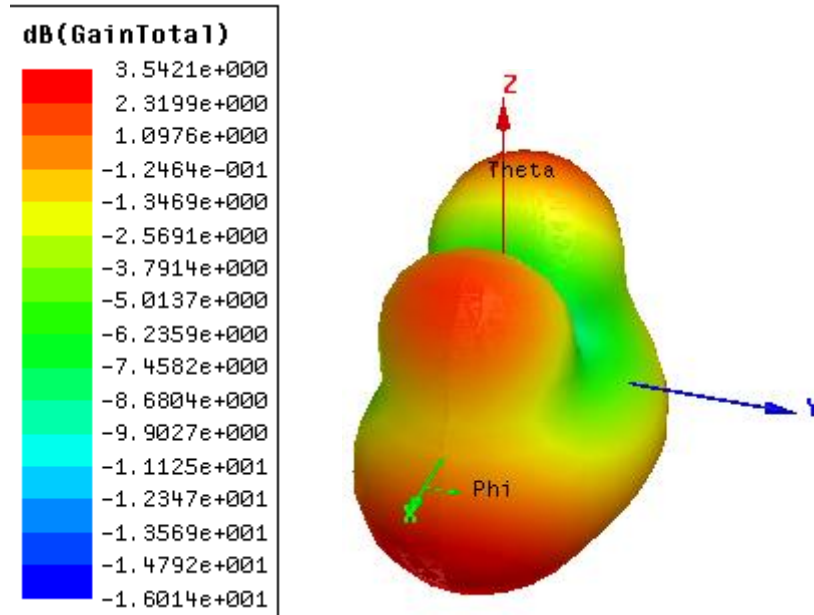


Figure 5: Gain of Patch antenna when all switches are ON.

CONCLUSION

A design of reconfigurable patch antenna is presented in this paper. Four small patches of dimension 1 cm^2 are used at each corner of the main patch. These small patches can be connected to main patch by using RF MEMS switches. The main patch antenna resonant at 1.94 GHz with a gain of 7.8 dB and switched to 1.48 GHz with a gain of 3.5 dB when all switches are ON.

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