Scientific Journal of Impact Factor (SJIF): 4.72
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 4, Issue 8, August -2017

Reconfigurable Slotted Patch Antenna

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Abstract: *In this paper a design of slotted reconfigurable patch antenna is presented. A slot of 4 X 0.25 cm^2 is cut in main patch. Along with main patch four small patches of dimension 1 cm^2 are used at each corner of the main patch. This main patch can be connected to these small patches by using RF MEMS switches that are placed in gap between main patch and small patches. The slotted main patch antenna resonant at 1.78 GHz and tuned to 1.45 GHz when all switches are ON.*

Keywords: *Reconfigurable patch Antenna, RF MEMS switch.*

INTRODUCTION

In the innovatory world of wireless communication, single-antenna structures operating over a defined bandwidth are losing interest. So there is need of an antenna that can be reconfigured. Reconfigurability of an antenna means to achieve modification in antenna's operating frequency, polarisation or radiation characteristics dynamically. This modification in characteristics of an antenna is achieved by redistribution of current in antenna. There are many techniques by which the antenna current can be redistributed, either by altering the antenna geometry or by changing the electrical properties of antenna. For this RF switches, varactors, or tunable materials can be used.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.

In [10], the design of reconfigurable patch antenna with a switchable V slot is presented. A switching diode (PIN diode) is inserted between the two arms of a V-slot cut on the patch to control the antenna operation status. The antenna resonates at two different frequencies by making switch ON/OFF. Also effect of variation in the feed point, slot position, and slot length on antenna parameters is studied. As the slot length increases the resonant frequencies decreases for both ON and OFF modes. Then antenna is optimized in terms of return loss, bandwidth, gain and required frequency ratio.

In this paper, a reconfigurable slotted patch antenna is presented. Here the physical structure of the antenna is changed by using RF MEMS switches. The antenna is made to resonant to different frequency by making RF MEMS switches ON/OFF. 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 slotted 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 by 5.93 cm . A slot of 4 X 0.25 cm^2 is cut in main patch. At a distance of 0.235 cm from each corner of main patch four small patches of dimensions 1 X 1 cm^2 are placed. In the gap of main patch and small patches, RF MEMS switches are placed. 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. Co-axial probe feeding is used to feed Antenna.

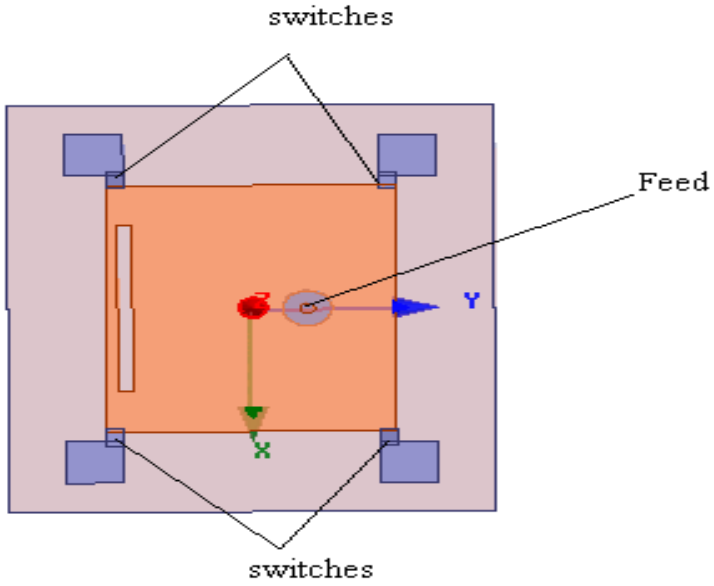

Figure 1: Structure of reconfigurable antenna

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 slotted patch antenna resonant at frequency 1.78 GHz with a gain of 7.5 dB and 10dB beamwidth of 81.76^0 (as shown in figure 2, 3, and 4).

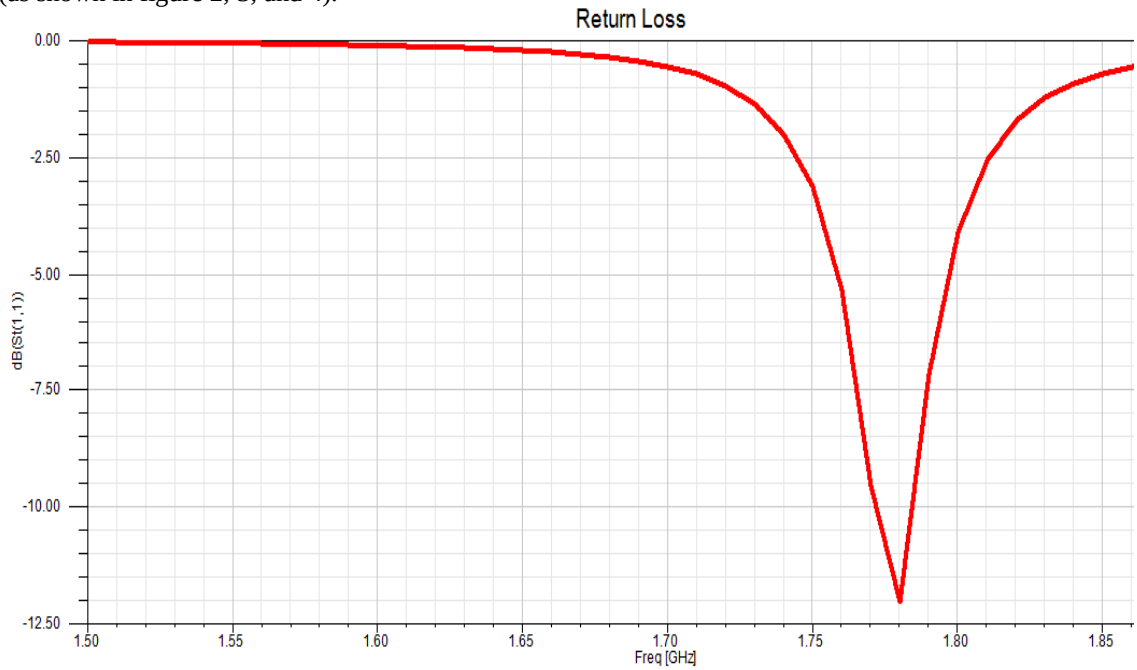

Figure 2: Return loss of slotted Patch antenna when all switches are OFF.

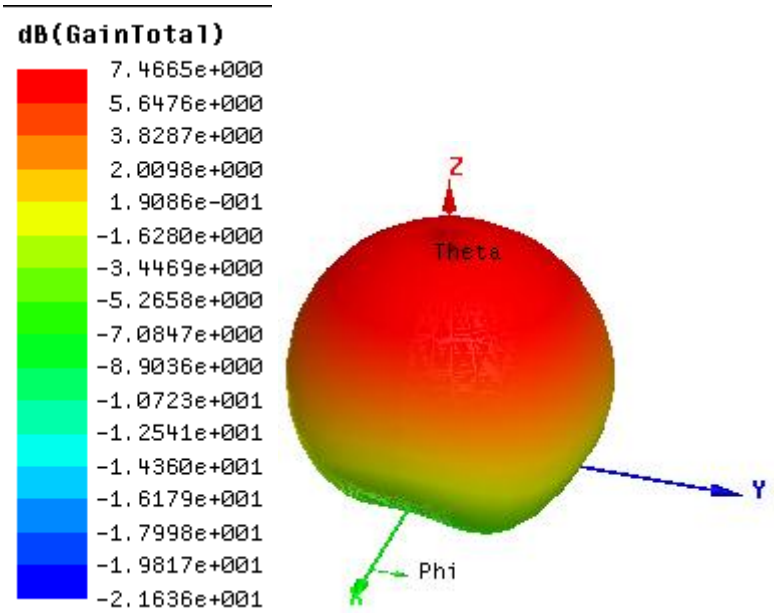

Figure 3: Gain of slotted Patch antenna when all switches are OFF.

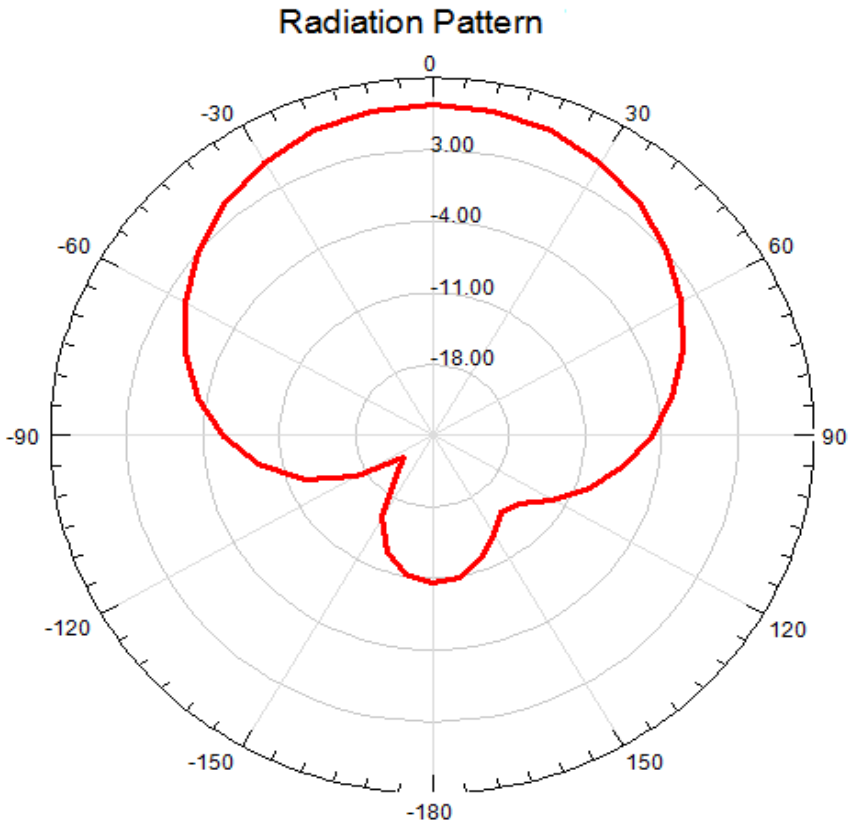

Figure 4: Radiation Pattern of slotted Patch antenna when all switches are OFF.

When all the switches are ON, i.e. small patches are connected to main patch so whole structure is operating. In this case the slotted patch antenna resonates at frequency 1.45 GHz with a gain of 6.74 dB and 10dB beamwidth of 84.90^0 (as shown in figure 5, 6, and 7).

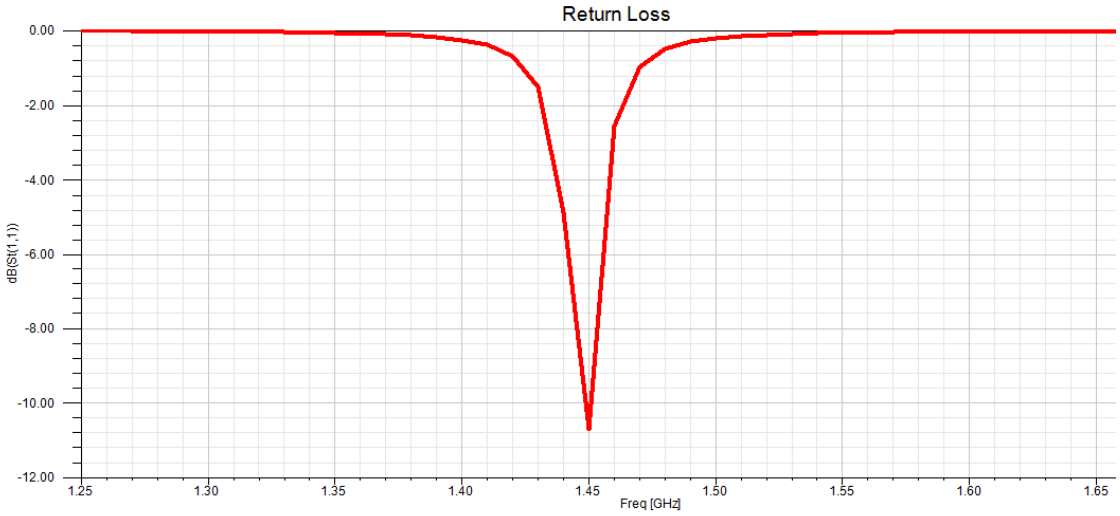

Figure 5: Return loss of slotted Patch antenna when all switches are ON.

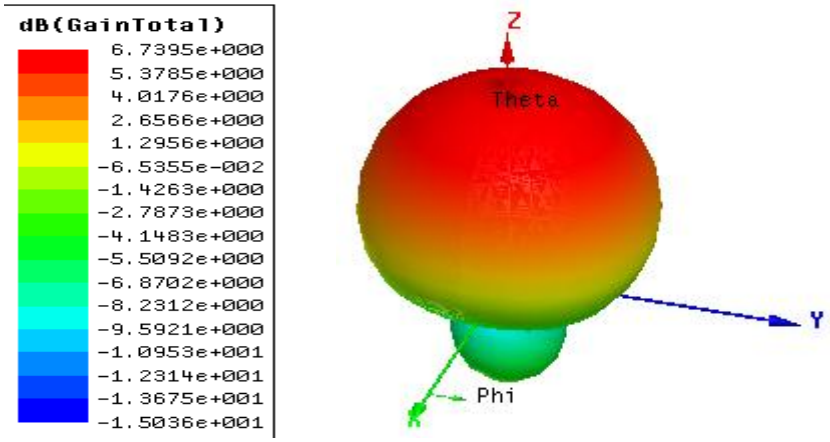

Figure 6: Gain of slotted Patch antenna when all switches are ON.

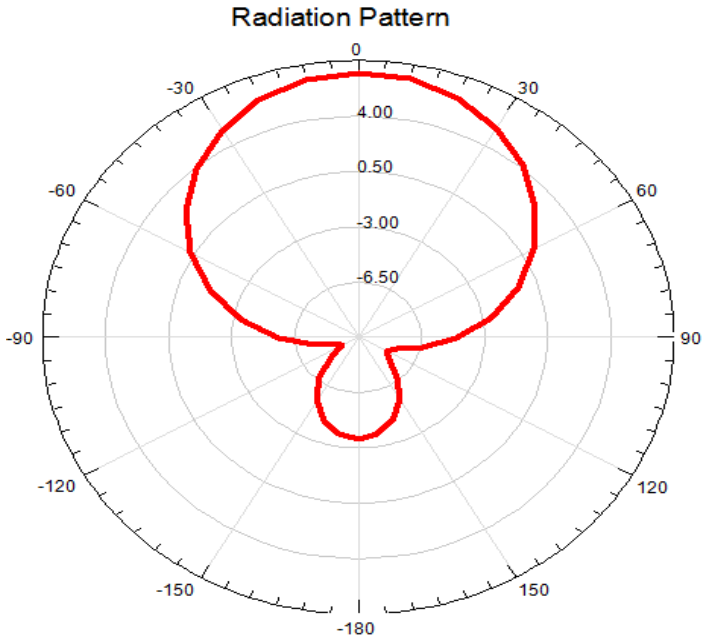

Figure 7: Radiation pattern of slotted Patch antenna when all switches are ON.

CONCLUSION

A design of reconfigurable slotted 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 1.78 GHz with a gain of 7.5 dB and switched to 1.45 GHz with a gain of 6.74 dB when all switches are ON.

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