Reconfigurable Printed Cactus Antenna

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Abstract - A new printed antenna model, the "cactus-antenna" is presented and discussed. The antenna consists of a printed monopole with one or two sleeves attached to each side. Switches are used to control the lengths of the monopole and the length of each sleeve to tune the first and the second resonant frequency of the antenna respectively. In the case of the double-sleeved antenna the switches are used to connect and disconnect a second sleeve to the monopole. Simulation data are compared against measurements to verify the performance of this antenna.

Introduction

Monopole antennas have found widespread applications, especially in wireless communications. Designs of dual-frequency monopole antennas have been reported [1-2]. Nowadays, the coplanar waveguide approach is proposed as a feeding transmission line medium for antennas. It is well known that coplanar waveguide (CPW) feed lines are uniplanar structures, which are compatible with monolithic microwave integrated circuits (MMICs), have less radiation losses and less dispersion than microstrip lines [3]. Reconfigurability, is another desired antenna characteristic that has been the focus of several research groups working on multi-functional antennas.

In this work a modified monopole antenna with additional side sleeves is designed to obtain frequency agility and performance versatility. To achieve this goal switches are introduced in order to control both, the length of the monopole and the length of the sleeves. This switching can be accomplished using PIN or RF MEMS switches.

Antenna Design

Figure 1 depicts the proposed cactus-antenna with one sleeve on each side of the monopole (all dimensions are in mm). The antenna consists of a monopole printed on a Rogers RO 3203 substrate with a relative permittivity of 3.02 (ε_r) and dielectric thickness 1.524 mm. Two sleeves are attached to the monopole. Switches are used to connect additional patches to the monopole and the sleeves. Tiny copper strips of area 0.4 x 0.12 mm^2 model the switches. PIN or RF MEMS

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switches can also be used. The switches are being used to change the length of both the monopole and that of the sleeves producing a reconfigurable antenna structure that offers more frequency agility.

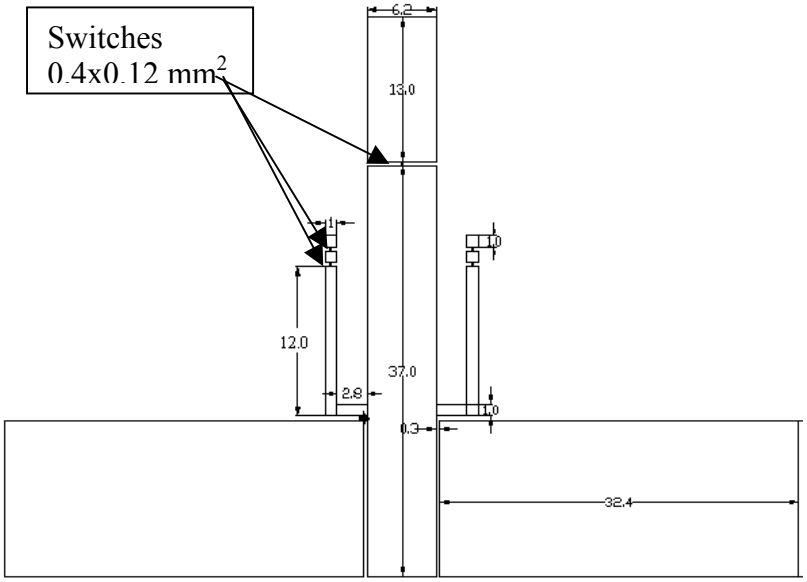

Fig.1. Cactus-antenna configuration

The analysis is carried out using the method of moment simulator IE3D 9.0. The results of the return loss versus the frequency are given in Figures 2 and 3. When the monopole switch being ON the resonance frequency is 1.85 GHz and when the switch is OFF then the first resonance shifts to 2.4 GHz. The second resonance takes the values 3.2 GHz, 3.4 GHz and 3.6 GHz depending on the sleeve switch states.

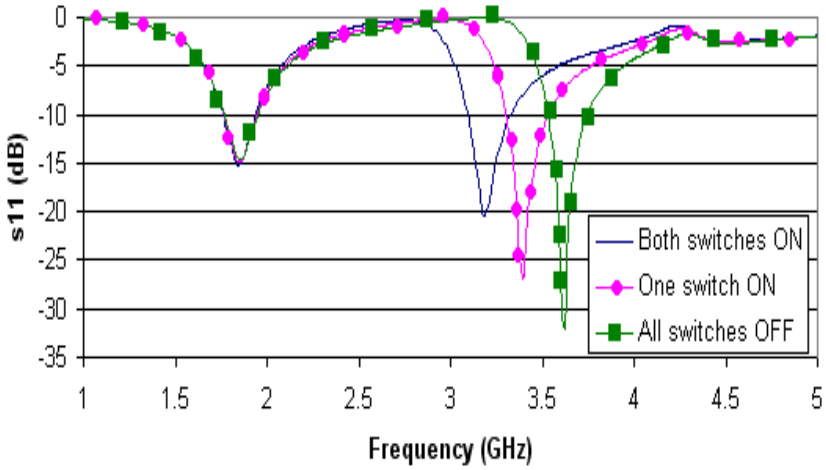

Fig.2. S_{11} vs. frequency for different sleeve switch states when monopole switch ON

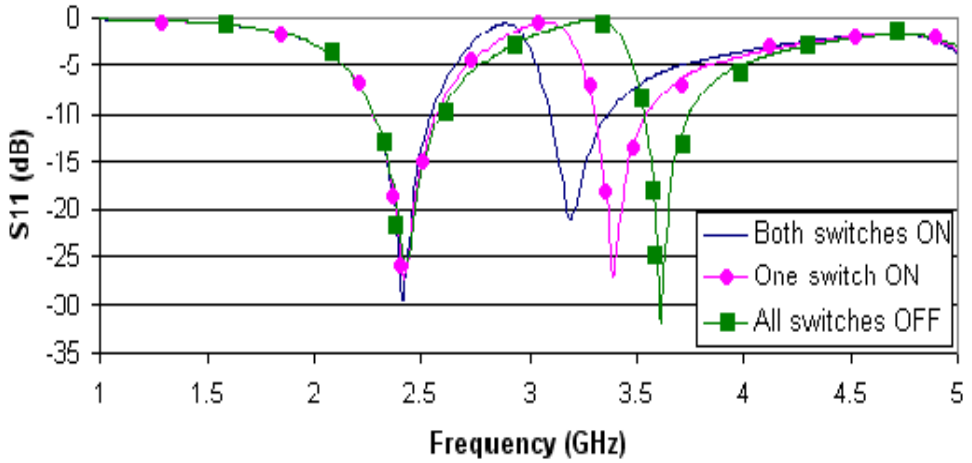

Fig.3. S_{11} vs. frequency for different sleeve switch states when monopole switch OFF

Next, a second sleeve is added to the monopole. In this case, a switch is used to connect or disconnect the second (upper) sleeve. The configuration of the antenna is given in Figure 4. The same CPW line is used to feed the antenna.

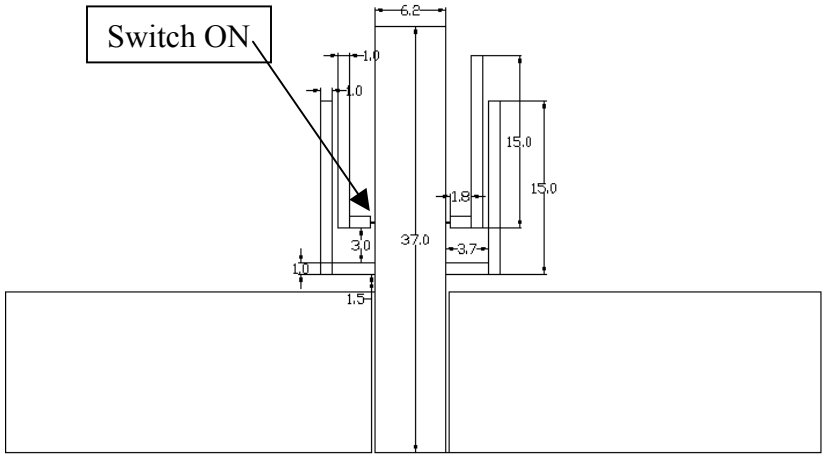

Fig.4. Double-sleeved antenna configuration

In this case when the switch is ON three resonant frequencies are obtained, at 2.4 GHz, 2.92 GHz and 3.15 GHz. When the switch is OFF we have two resonant frequencies at 2.65 GHz and 3.17 GHz.

Measurements

Some measured results from these antennas are shown in Figures 5 and 6. Measured S_{11} vs. frequency for different sleeve switch states when monopole switch OFF and for the double sleeved-antenna.

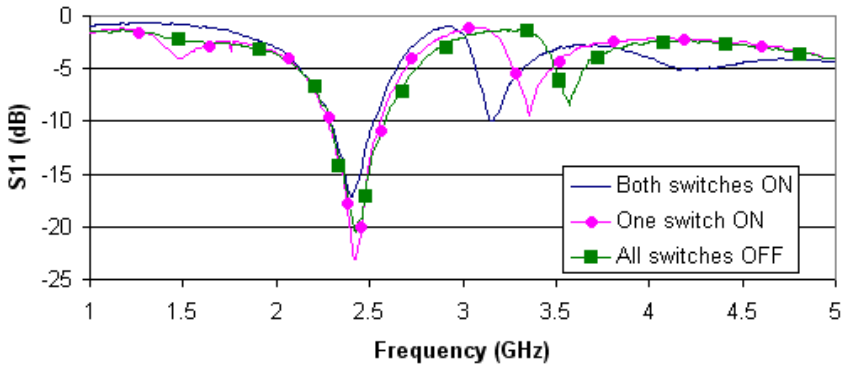

Fig.5. Measured S_{11} vs. frequency when monopole switch OFF

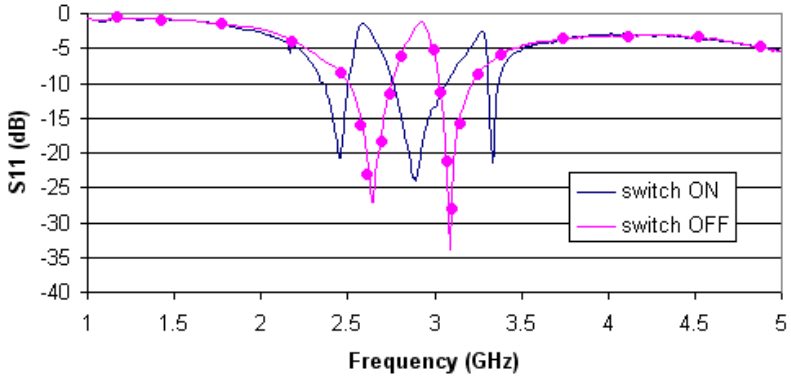

Fig.6 Measured S_{11} vs. frequency for the double-sleeved antenna

The radiation patterns of the antennas are "dipole-like" shape for all the different switch states.

Conclusions. A new printed reconfigurable monopole antenna with one and two sleeves is presented and discussed. Switches are used to control the different resonant frequencies of the antenna. The agreement between theoretical and measured data is very good.

References

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