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Frequency Reconfigurable Patch Antenna

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ABSTRACT:

It is proposed to design a RF patch antenna of a compact size and can be used in mobile communication. The operating frequency of the antenna can be reconfigured to different predetermined frequencies between 2GHz-5GHz. Frequency reconfiguration can be obtained by switching ON/OFF with opening and closing of copper (CU) strips.

KEY WORDS: Patch antenna, Re-configurability, Copper strips.

INTRODUCTION:

Reconfigurable antennas are playing a critical role in designing present /future wireless communication systems. Low cost, compact design, multipurpose functions made them superior and be adapted to mobile wireless systems. The properties of antenna like frequency, polarization, radiation pattern can be reconfigured. RF switching is done by using varactor diodes orpin diodes arenormally used for achieving re-configurability of the frequency. Here we are using copper metal strips toON/OFF switching for frequency re-configurability.

With this switching we achieve the change in effective length of the radiator of the antenna and thus provide frequency reconfigurable characteristic of antenna. Reconfigurable pattern antenna provide a steerable main beam between several directions. The angle diversity is achieved by changing the capacitance of varactor diode or parasitic element angle manipulation using switches. The reconfigurable polarization antenna is capable to radiate either in linear, right hand or left hand circular polarization. Few works have been done to achieve frequency re-configurability of patch antenna by using RF varactor diodes, pin diodes to switch the frequency bands. But design of biasing circuits is complicated where the bias lines required for pin diode activation.

The biasing lines also degrade the performance of the antenna. This letter proposes copper metal strips (Cu) in place of pin diodes and use humanly close /open the coppermetal strips as manual switching. Therefore we can avoid costly pin diodes and biasing circuits.

In this letter a narrow band patch antenna is capable of frequency switching in the wide frequency range of 2-5GHz. It is capable of switching to 3 different frequencies. Details of proposed design are described the simulated and measured results were presented.

DESIGN AND CONFIGURATION:

In this section the structure of proposed antenna is described. Fig 1 shows the basic structure of the design. The structure is printed on a 1.6mm thick FR4 dielectric substrate with a dielectric constant of 4.4 and tangential loss of 0.0018. ADS 2009 (Advanced Design System) software is used to design and simulate the antenna.

The dimensions of the ground plane are Wg (width) 37mm and Lg (length) 28mm. The dimensions of patch are W=27mm & L=18.6mm. The patch is shown in figure 1. A feed point is given by micro strip feed line technique of 1mm thick at the center point along the width of the patch. At a distance of 13mm from both edges of the patch.The structure is simulated and S11 parameters were plotted.

As shown in figure 2 a slot of 1.8mm width is cut on the entire patch at a distance of 1.5mm from both ends as shown in figure 2 this is the second structure.This is alsosimulated and results are plotted.By introducing copper metal strips as shown in figure 3 which can open and close to realize both structures of fig 1&2.

S1----------S9 are 9 copper strips placed as ON/OFF switches.
If all switches S1-S9 are closed Fig 1 is realized.
If all switches S1-S9 are open Fig 2 is realized.

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Fig1

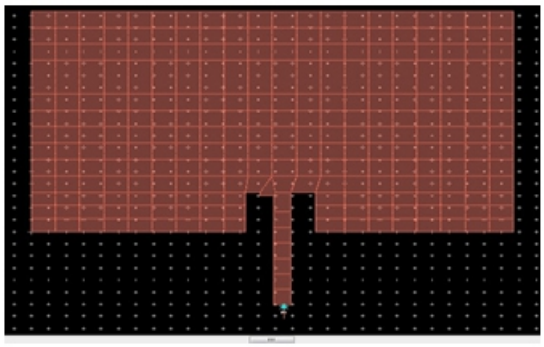


Fig2

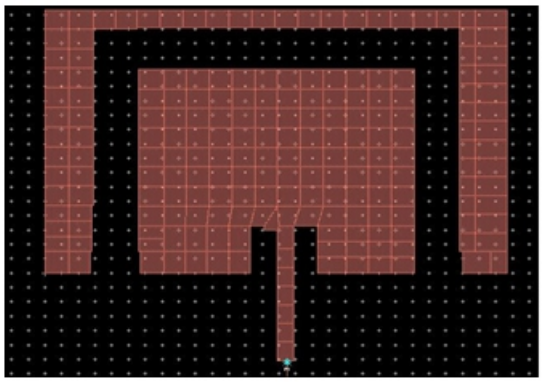
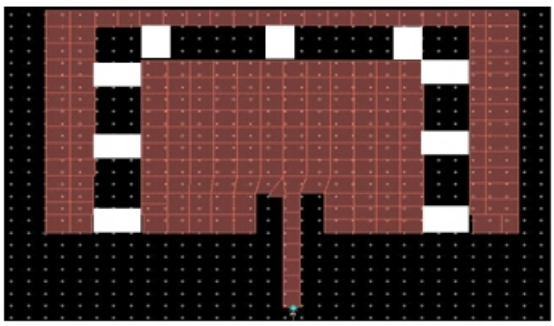


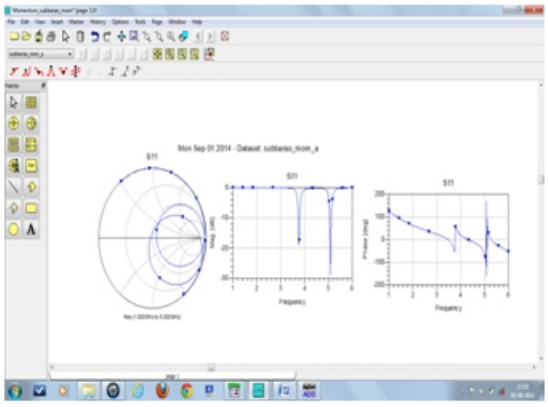
Fig3



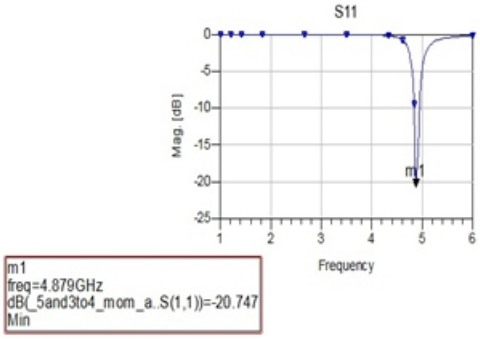
strips (S1 to S9)

RESULTS AND DISSCUSSION:

Simulated results of structure 1
Fr=5.091Ghz at28.039db
Fr=3.760Ghz at 18.520db
Fig 4



Simulated results of structure 2
Fr==4.879Ghz at20.747db.
Fig 5



Measured results:
Fr=5.0332Ghz at25.342db
Fr=4.8032at16.346db
Fr=3.6932Ghz at15.567db
Fig 5

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Fig 6

By simulating ADS 2009 software we can get the following results.

By opening all the copper strips and simulating we find return loss 4.879Ghz at20.747db.

By closing all the copper strips and simulating we find return loss 18.520 DB at 3.760GHz and 28.039DB at 5.091GHz.Now the re-configurability between the 3 frequencies are 3.760GHz, 4.87GHz, 5.091GHz can be achieved.

CONCLUSION:

A compact re configurable patch antenna has been designed simulated and measured. It has been demonstrated frequency re configurability can be achieved by changing length of the patch by on /off copper strips. The size of antenna is compact and good return loss has been obtained. In the measured results the frequency is less by few 100MHz. It is easier to fabricate this antenna as it does not need bias circuits. These antennas have wider applications in mobile communications, GPS, radar applications etc. Disadvantages are low efficiency, low gain and low power handling capacity.

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