A Navel Frequency Reconfigurable Slotted Patch Antenna

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Abstract - A navel frequency reconfigurable antenna structures is presented. The slots made on the aperture of antenna are made to orient by making its axis as reference either in clock or anti clock wise direction. This orientation distributes the surface currents in different fashions results change in its resonance frequency. Present proposal is designed to operate in L band region. The proposal is designed and simulated in software. Obtained results are proving the change in operating frequency without effecting radiation pattern.

Keywords - *Patch, Slots, Revolving motion, Reconfigurable frequency*

I. INTRODUCTION

In literature wide variety of reconfigurable frequency models were existed, but most popular once are designed by incorporating active electronic components in it's structure. All these are suffering with some draw backs such as non linear characteristics of active electronic components incorporated in its structure. Mounting of active electronic components at high frequencies is another complicates issue etc., This proposal of work is showing solution to above problems. It is simple in design doesn't require any electronic components to be mounted over to its surface. It is a more compact in structure and doesn't require any external circuitry. Hence cost is less.

II. DESIGN CONSIDERATIONS

This navel structure consists of three layers. The bottom layer is a metal conductor called as ground plane, this covers complete structure. It's dimensions can be given as

Lg = 6h+L

Wg = 6h+W

The middle layer consists of dielectric substrate having relative permittivity --, and dielectric loss tangent of --. It's dimensions can be derived as

$$\varepsilon_{ref} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{\frac{-1}{2}}$$

The height of substrate is 62mil. Top of substrate also consists of metal patch whose dimensions can be given as

$$W = \frac{c}{2f_0\sqrt{\frac{\varepsilon_r + 1}{2}}}$$

$$L_{eff} = \frac{c}{2f_0\sqrt{\varepsilon_{ref}}}$$

$$\Delta L = 0.412h\frac{\left(\varepsilon_{ref} + 0.3\right)\left(\frac{W}{h} + 0.264\right)}{\left(\varepsilon_{ref} - 0.258\right)\left(\frac{W}{h} + 0.8\right)}$$

$$L = L_{eff} - 2\Delta L$$

This top rectangular patch is provided with a slot cuts. The arrangement following the binomial distribution from center to outward on either side. The radiating top metal patch is feed with a strip line of 50 ohm matched impedance to its one of edge.

III. DESIGN VALUES

The patch antenna is initially designed to operate at 2.2425GHz. To achieve this the antenna dimensions are is as follows. The ground plane and substrate are of size 8.1cm, 16.56cm in two dimensional plane. The patch antenna have 4.74cm, 3.97cm at a height of 62mil from ground plane. The slots are made on patch shown in figure 1.

IV. FREQUENCY RECONFIGURABLE PRINCIPLE

The slots shown in figure 1 are made to move either in clock wise or anti-clock wise around its axis. Present paper we made slots to be positioned in its rest position i.e zero degree. Latter they are made to rotate from zero degree position up to 90 degrees with a step size of 45 degree, in counter clock wise direction. At each step the return loss and radiation pattern curves are observed which clearly indicating the changes in center frequencies without altering the radiation pattern. If same process is repeated in clock wise direction we got similar results that indicating the design similarity on other direction.

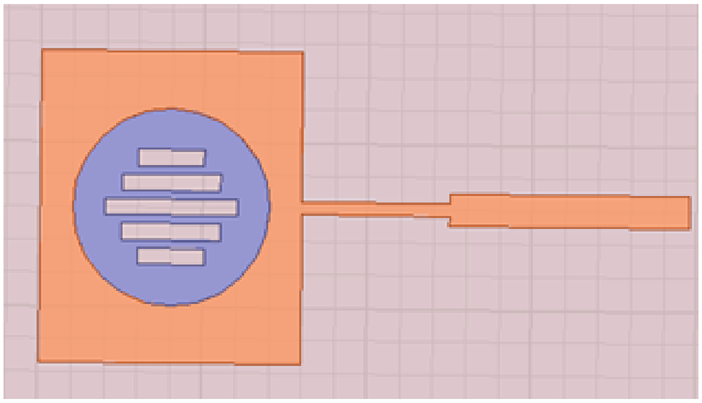

Figure 1: Slot cuts are at zero degree

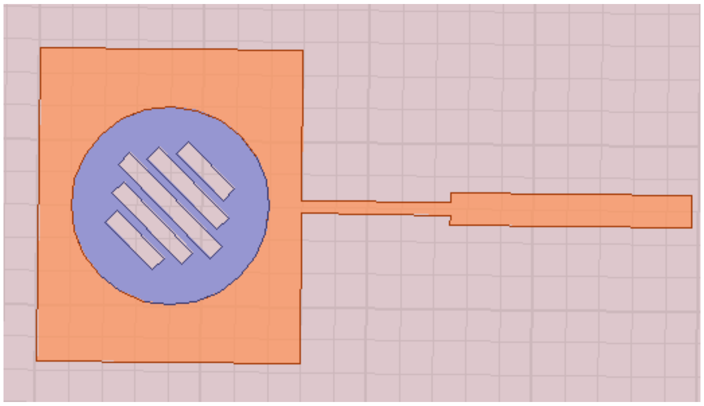

Figure 2: Slot cuts are at -45 degree

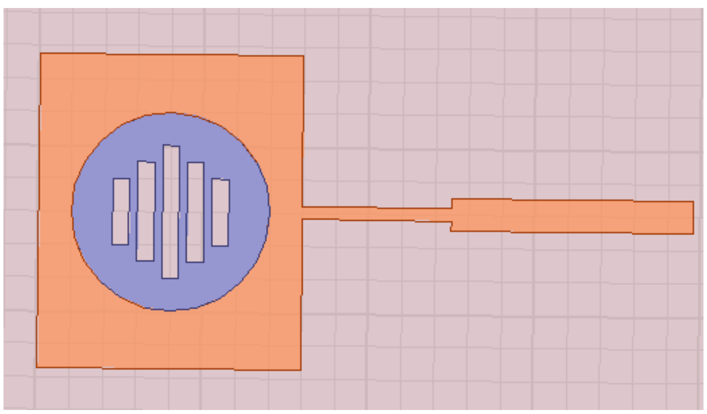

Figure 3: Slot cuts are at -90 degree

V. RESULTS AND DISCUSSIONS

The plot of magnitude of S11 verses frequency clearly showing the operating frequency values of the navel structure. When slot cuts are at reference zero position the structure is producing the center frequency of 2.3304GHz. The magnitude of return loss is at -22.9638dB indicates maximum amount of power is delivered to radiating patch antenna from source with minimum losses. When slot cuts are oriented in counter clock wise direction with a step size of -45 degrees, then this structure is producing another resonance frequency, which is at 2.2425GHz. The magnitude of return loss is at -15.1936dB. When orientation of slots reaches to -90 degrees, the resonance frequency reaches to 2.054GHz and magnitude of return loss is at -24.0307dB.

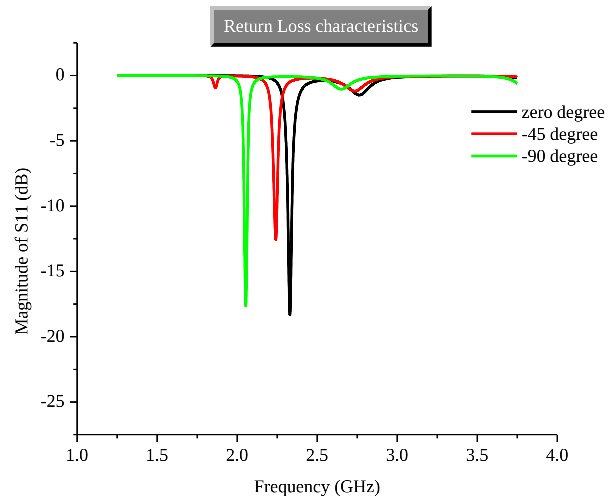

Figure 4: Resonating frequencies at different rotation angles

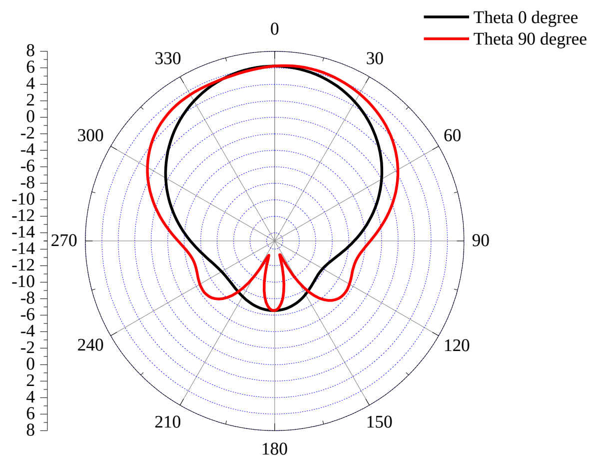

Figure 5: Radiation Pattern at different rotation angles

Comparison of antenna parameters at three stages of operation.

Quantity	Zero degree	-45 degree	-90 degree
Max U	0.00152815 (w/Sr)	0.00153038(w/Sr)	0.00070472(w/sr)
Peak Directivity	4.21682	4.6134	4.53565
Peak Gain	4.00058	4.31647	4.10461
Peak realized gain	1.92082	1.92318	0.885598
Radiated power	0.00455514(watts)	0.00416869(watts)	0.00195253(watts)
Accepted power	0.00480136 (watts)	0.00445545(watts)	0.00215757(watts)
Incident Power	0.01(watts)	0.01(watts)	0.01(watts)
Radiation Efficiency	94.872	93.5637	90.4966
FBR	119.934	27.9271	25.6146

The table shown above is clearly showing that the antenna prime parameters like gain, directivity and efficiency are almost remain constant during the slots orientation process. That means this navel technique of reconfigurable frequency giving identical results at all the intervals of rotation of slots. This technique is more suitable when the operating frequencies are at high. Where conventional frequency reconfigurable techniques are not suitable.

VI. CONCLUSION

This navel frequency reconfigurable antenna presented above is more suitable for high frequencies of operation. It does not require any additional power feed elements as like in active phase shifters available in literature.

VII. REFERENCES

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