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A Compact DGS Based Multiband Reconfigurable Antenna for Wireless Applications

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Abstract

A reconfigurable microstrip patch antenna inspired by defected ground structure(DGS) is presented in the article, further to get frequency switching in three or more switchable frequency. A parasitic switch can operate as a reflector or a director by switching the diode ON or OFF. A presented structure is implemented with a defected slot on the ground plane to obtain filtering characteristics. The width of the DGS plays a major role in selecting attenuation poles of the filter. The distance between DGS affects the resonant frequency according to the dimensions of the structure. Both radiation and filtration can be performed to a single structure.

1. Introduction

In era of contemporary wireless communication, the frequencies higher than ten gigahertz area unit exploit larger attention, resulting in new wireless devices, products, and services. The essential and leading parts of transmission and reception system are antenna and filter. Generally, at higher frequencies the system exhibits larger scheme parts with freelance characteristics and performance. moreover, high insertion losses are found at interconnections leading to less polarized current being created within the divergent part. These portends for associate inefficient communication system. So in this article, we've got targeted on a smaller, compact, light-weight, low cost, multifunctional, and economical device rather than the sooner fictional devices for higher frequencies. A compact module that may perform each radiation and filtration simultaneously is named as filtenna. In different words, a microstrip patch antenna with integral filter is noted as filtenna. Etching or advisedly defecting is the best technique to improve or modification the performance of any structure, as etched cells are inherently resonant in nature and might be applied to the divergent component and ground plane. The defect within the ground plane disorders the protect current distribution, leading to modified values of capacitance and inductance of the transmission line and thus are often applied to the filter circuit and microstrip antenna.

2. Design of microstrip patch

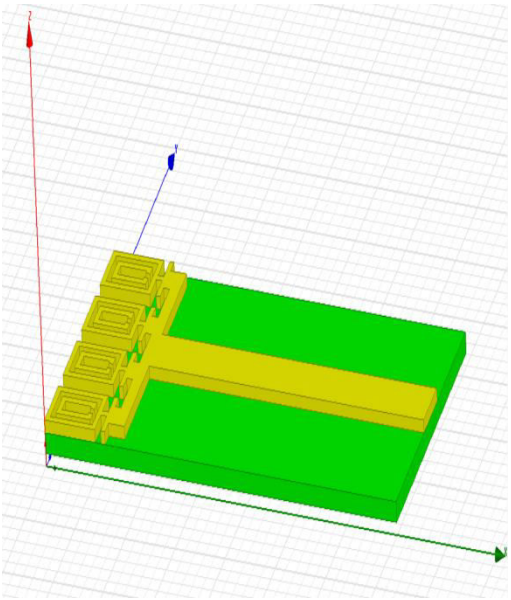


Figure 2.1

Radiating element is the split ring resonator and capacitance loaded

strip. The dimensions of the patch are Length=35 mm, breadth=16 mm, thickness=0.5 mm, patch consist of four unit cells and distance between each unit cell is 1.06 mm.Feedline of length=25 mm,breadth=3 mm is connected to the unit cell. Radiation element is omni-directional in both E-plane and H-plane.A patch is made up of copper material, Three strip lines are inside each unit cells. Antenna with conventional ground plane without DGS is called microstrip patch antenna.Figure 2.1 represents the design of patch or top layer.

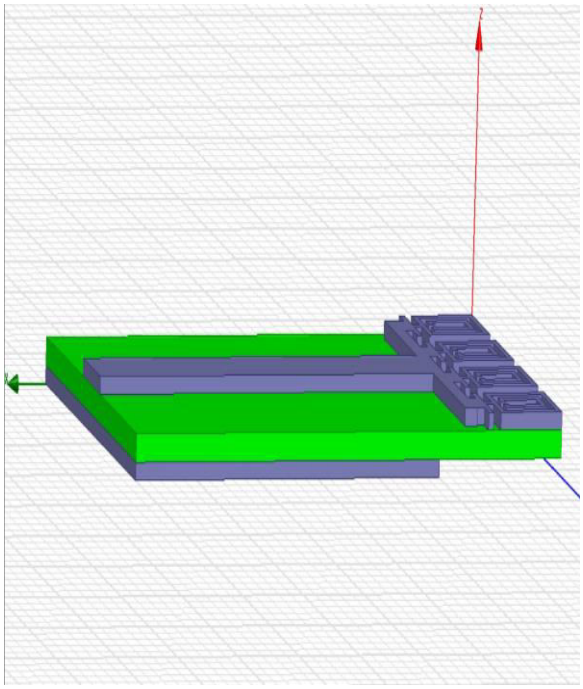


Figure 2.2

FR-4 substrate is used for a design FR-4 stands for flame retardant-4. This substrate has been used for our design because of performing good in non- resonating band thickness of the substrate is 0.8 mm, and length & breadth is 35 mm & 16 mm.Figure 2.2 represents the sandwiched layer of patch substrate and ground.

3. Design of DGS in ground plane

A DGS design is shown below. FR-4 substrate is used with following parameters εr=4.4, μr=1, σ=0.02. Double U-shaped slots are introduced in the bottom of ground plane. Length & breadth of ground is 27 mm & 16 mm. Distance between two double U-shaped slots is 10 mm. defected slots act as a filtering elements. By varying the dimensions of defected slots frequency changes. Each U-shape corresponds to larger and smaller attenuation.The ground plane is made up of copper material. Commonly DGS refers to implementation of slots in the ground plane.Figure 3.1 represents the design of defected slots in the ground.

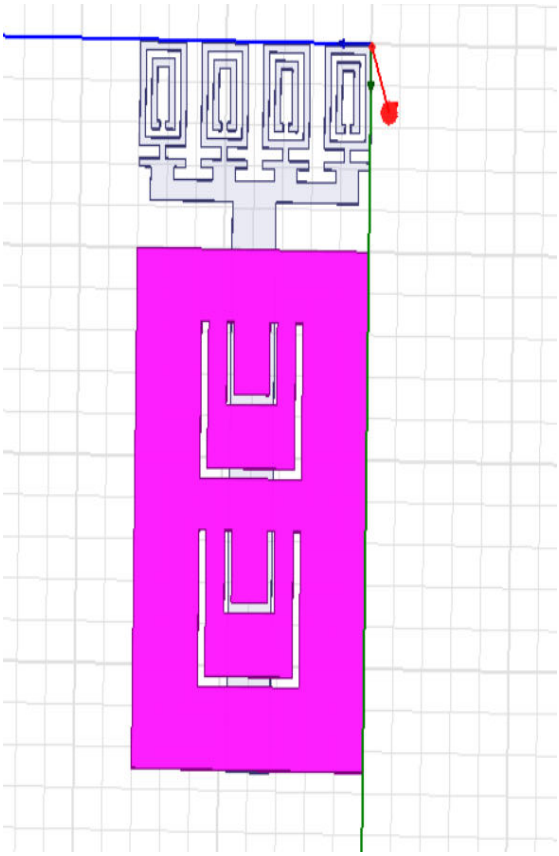


Figure 3.1

4. Reconfigurability using Diode

Switching to a particular frequency is done by using Pin-diode.

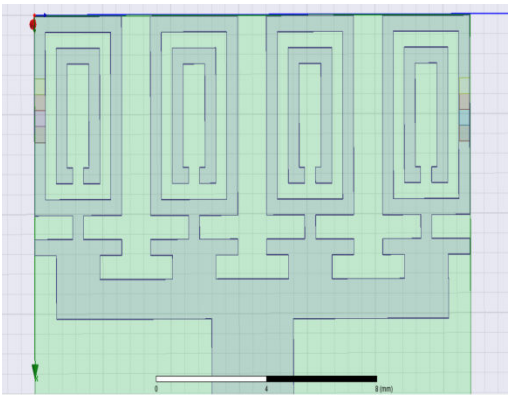
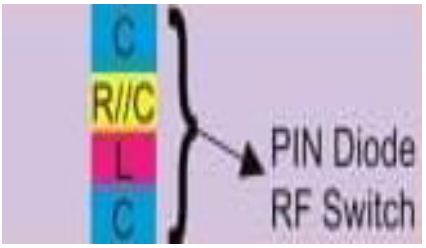


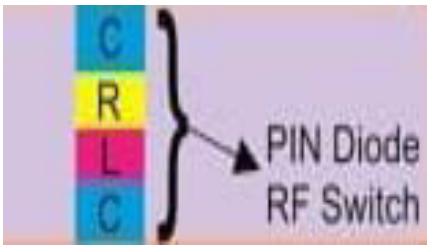
Figure 4.1

Pin diode is a lumped RLC circuit of R=1 ohms, L= 0.6 nH, C=0.6 µF. for ON state and R=2k ohms, L=0.6 nH, C=0.6 µF, 0.5 pF for OFF state. According to ON/OFF of pin diode appropriate switching to frequency occurs. Two pin diodes are use in the design.Figure 4.1 represents the introduction of diode in the unit cells of patch layer.The two pin diodes are placed in first and last unit cells.Normally the frequency responds according to the flow of current.When the diodes are placed in the strip lines, it acts as a barrier to the current flow and so the diode determines whether the current to flow or not based on the values of parameters of RLC circuit in each diode.Diode allows the current when it is in on state and blocks the current from flowing when it is in off state.



DIODE OFF

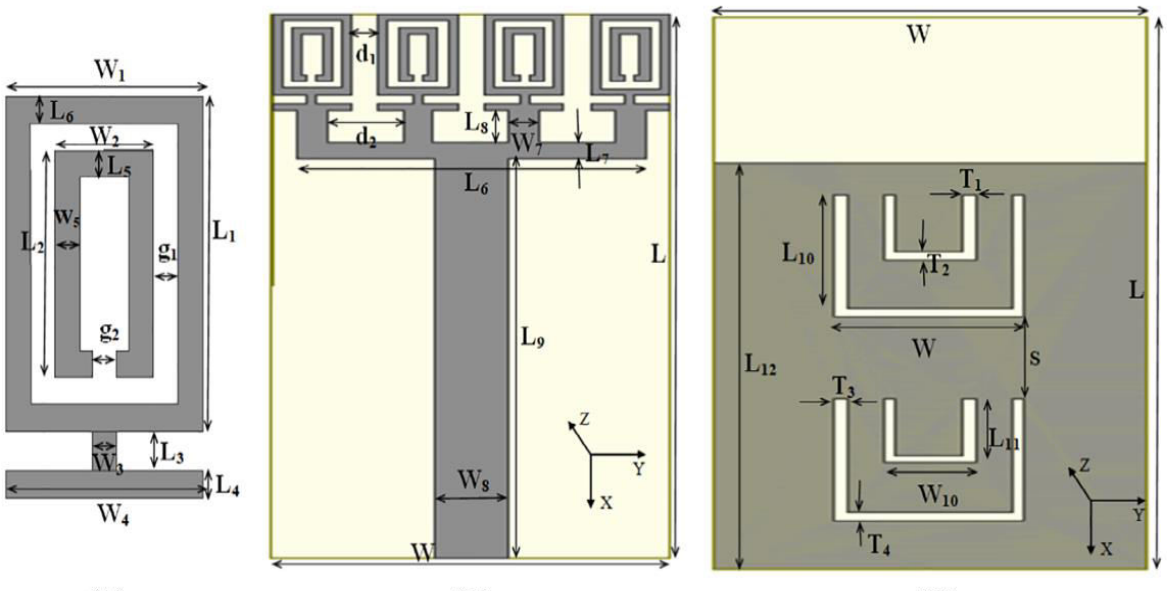
Figure 4.2



DIODE ON

Figure 4.3

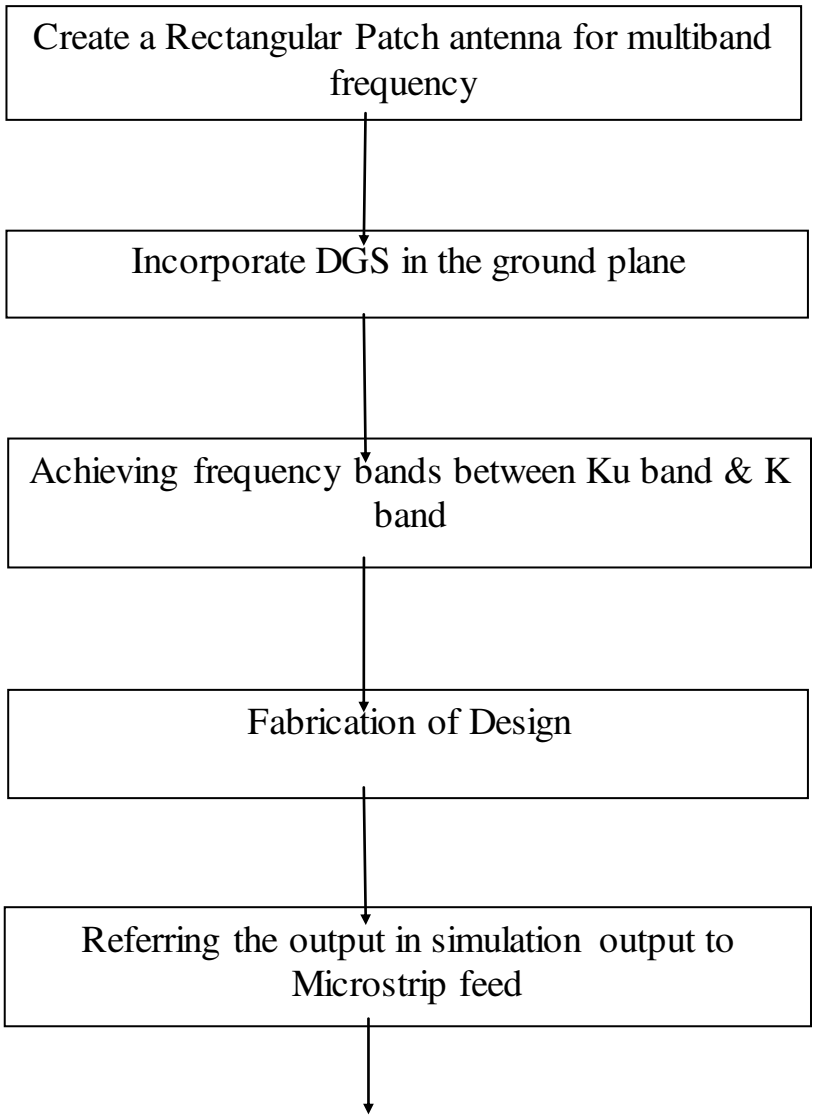
5. Dimensions Of Our Design:



(A) (B) (C)

Parameters	Values(mm)	Parameters	Values(mm)	Parameters	Values(mm)
L	35	L9	25	W6	14
L1	5	L10	7.02	T1,T2	0.5
L2	3.4	L11	3.47	T3,T4	0.5
L3,L8	0.6	L12	25	W8	3
L4	0.4	W	16	W9	7.02
L5	0.4	W1	3.2	W10	3.47
L6	0.4	W2	1.6	d1	1.06
L7	1	W3,W5,W7	0.4	d2	3.06
S	10	W4	3.4	g1,g2	0.4

6.Flow Diagram

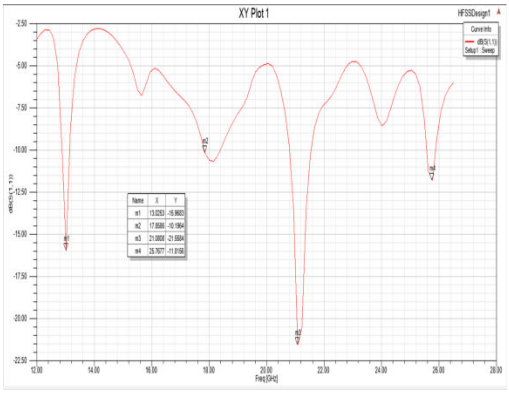


Achieving Reconfigurability through Switching elements

Ku band is neglected and K band obtained

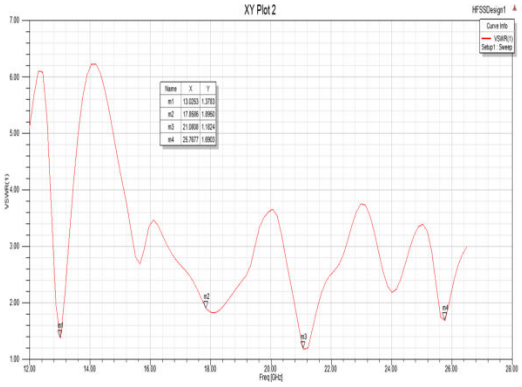
7.Obtained Results

Simulated S-parameter and VSWR result of Multiband antenna before placing diode are shown in Figure 5.1 and Figure 5.2. Result shows that the frequencies of 13 GHz and 17 GHz from Ku band and frequencies of 21 GHz and 25.7 GHz from K band is achieved as a output.



S-Parameter Result for Multiband Antenna

FIGURE 5.1



VSWR Result for Multiband Antenna

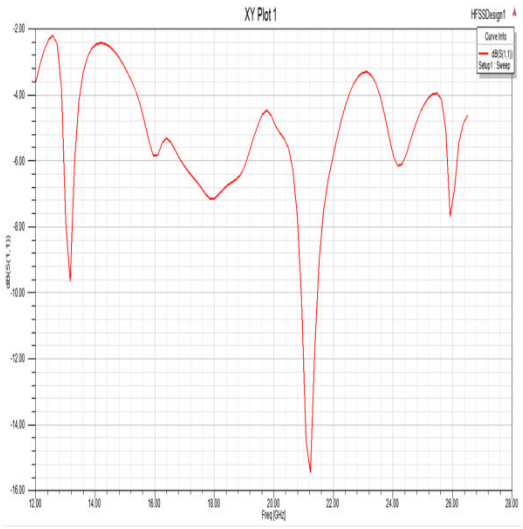
FIGURE 5.2

VSWR gets the better improvement that is VSWR $\leq$ 2 at frequencies 13.0253 GHz, 17.8586 GHz, 21.0808 GHz, 25.7677 GHz.

8.Results Of Reconfigurability

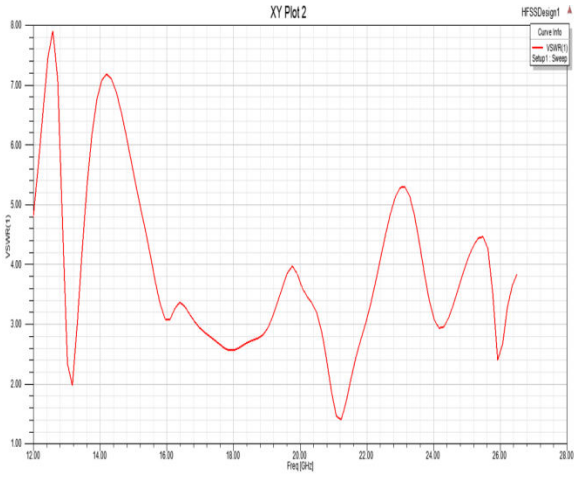
The results of S-Parameter and VSWR for Reconfigurable Antenna

after placing diode are shown in figure 6.1 and figure 6.2.



S-Parameter Result for Reconfigurable Antenna

FIGURE 6.1



VSWR Result for Reconfigurable Antenna

FIGURE 6.2

Reconfigurability is obtained by implementing PIN diodes in design. By turning diodes ON and OFF switching between these bands occurs. In previous design that is at Figure 5.1 and 5.2 Ku-band and K-band is obtained but by using diodes Ku-band has been eliminated and K-band is obtained from figure 6.1 and 6.2.

9.Advantages Of Multiband

Following are the some of the advantages of multiband antenna

- Have a multiband antenna in a single terminal for various applications.
- Low complexity and cost.
- Small in size.
- Easy to integrate with switching devices and control circuit.
- Planar reconfigurable antenna has a good ability of reconfiguration.
- Used in various applications like satellite communication radar,navigation,mobile communication,wifi etc.,

10.Conclusion

Thus the Design of MULTIBAND antenna with DGS incorporated frequency in the range of 12-18 GHz of Ku Band and 18-26.5 GHz of K band was simulated with improved frequency selectivity was done and the result was verified using Ansoft's HFSS software. Switching to a particular band of frequency (K band) through reconfigurability technique using pin diode. Results show that the selectivity was improved and return loss was reduced. Frequency was varied by varying the length of the slot and width of the slots. The proposed antenna was very compact in size and simple to use in portable Multiband systems.

In future our work is to obtain switching between various bands of frequency .

8.References

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