Miniaturized DMS based Microstrip Bandstop Filter with Large Attenuation

Ambika Chhabra
Student (M.E. ECE)
Thapar University
Patiala, Punjab

Rajesh Khanna
Professor (ECE)
Thapar University
Patiala, Punjab

ABSTRACT
The proposed EBG Structure consists of stepped impedance Microstrip line with slots etched on the ground plane. The T-shaped DMS (Defected microstrip structure) causes large attenuation in the stop-band. A comparison is made between the non-DMS Structure and a DMS Structure. The overall size is 35*20 mm^2. The structure is able to achieve a wide Stop band and a flat pass band with more than -30 dB attenuation in the stop band. A wide stop band from 4.4 GHz to 10.4 GHz is obtained. The CST Microwave Studio is used for Simulation.

General Terms
Band stop filter, large attenuation.

Keywords
Defected Microstrip Structure (DMS), Electromagnetic Band Gap (EBG).

1. INTRODUCTION
In recent years, there is an increasing interest to combine the microstrip structures and photonic bandgap structures (PBG), defected ground structure (DGS). As similar to DGS, defected microstrip structure (DMS) also disturbs current distribution and exhibits band stop properties. As similar to DGS, the DMS has also been applied to improve performances of microwave circuits like harmonic termination networks in power amplifier [1], filters [2] [3], antennas [4] etc. DGS defect in ground plane which disturbs the shield current distribution performs a band-gap behavior in some frequency band with only one or more unit patterns [5]. The DMS has been used to improve isolation between the two ports in patch antenna [6] and can also be used to achieve desirable coupling between the coupled microstrip lines [7] for size reduction in power dividers [8]. Moreover, DMS is employed with BPF to simultaneously produce band stop and bandpass response and to curtail ripples in the pass band response [9].

The stepped impedance is used to design filters but the limitation of Stepped impedance filters is low attenuation and the low selectivity. Unlike a spurline and an open stubs [10] used to combat the low attenuation and low selectivity, a combination of DGS and a T-shaped DMS structure with small size is proposed which is made by insertingimperfections or defects in the microstrip line, as slot in the microstrip line also causes resonant behavior in the frequency response.

In 2, the schematic of no, two and four DMS has been discussed separately. In 3, the effect of the three types and simulated results are shown separately.

2. DUAL PLANE EBG MICROSTRIP FILTER
The design comprises of modulated Stepped impedance Microstrip line with square patches whose area is taken as 5*5 mm^2. The overall size of the structure is 35*20 mm^2. The substrate is taken as FR-4 with dielectric constant of 4.3 and 1.6 mm thickness.

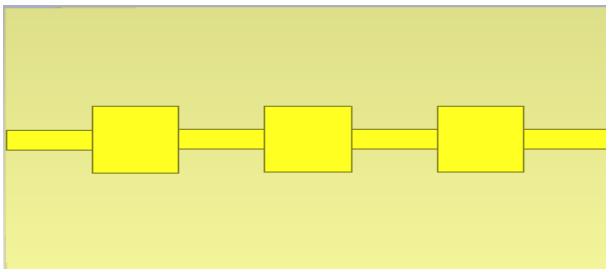
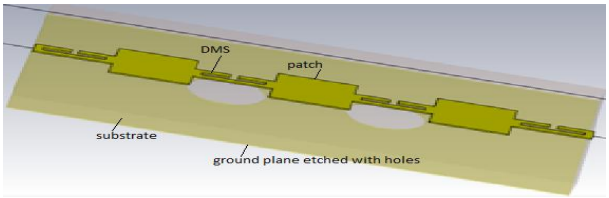


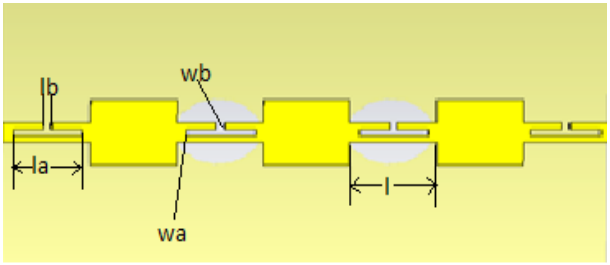
Fig 1: EBG structure without DGS

In order to improve bandwidth, the circular holes are etched on ground plane with radii of 5 mm.

The DMS comprises of Horizontal and a vertical slot with la = 4 mm, lb = 0.5 mm, wa = wb = 0.5 mm, l = 5 mm. The radii of slot in the ground plane are taken as 5 mm and the copper thickness is taken as 0.035 mm. The filling factor (length of patch/diameter of hole) is taken as 1. In this, the effective inductance and capacitance can be altered by horizontal slot and a vertical slot respectively.



(a)



. (b)

Fig 2: Proposed EBG structure. (a) 3-D view (b) Top view

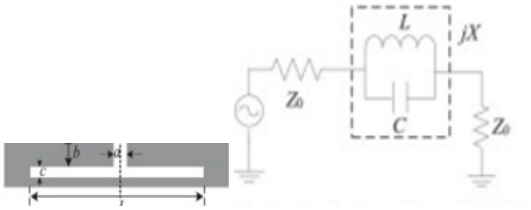
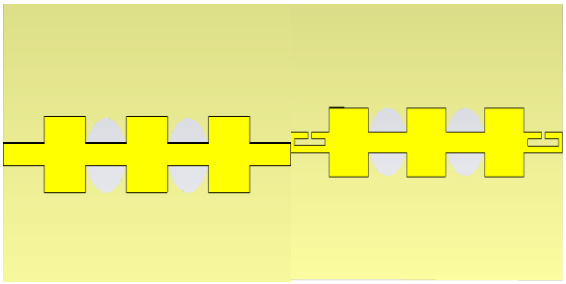


Fig 3: (a) T shaped DMS (b) Equivalent circuit



(a) (b)

Fig 4: (a) A simple Band stop filter

(b) A Band stopfilter withtwo DMS

Firstly, a simple band stop filter without DGS and with two circular holes is simulated, and then a band stop filter with DMS is simulated. Fig 3 shows a T-shaped defected microstrip structure and its equivalent circuit and Fig 4 shows the simple stepped impedance Band stop filter with two slots etched on the ground plane and a Band stop filter with two defected microstrip structures respectively. Fig 5 shows a Band stop filter integrated with four DMS.

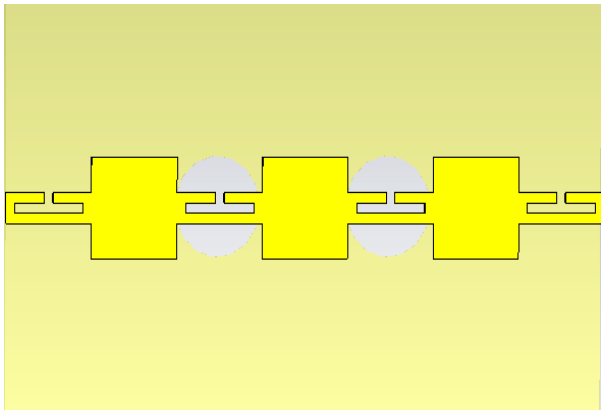


Fig 5. A simple Band stop filter with four DMS

3. SIMULATED RESULTS

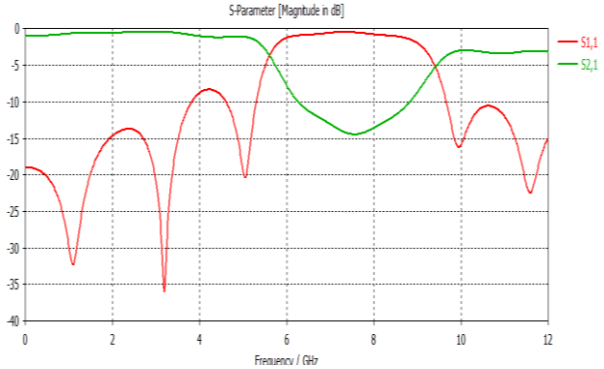


Fig 6: S parameters without DGS

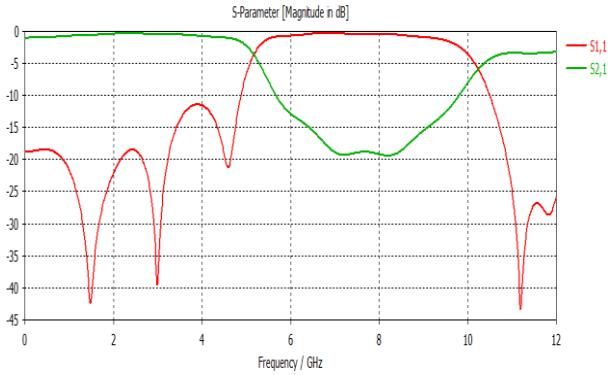


Fig 7: S parameters of a simple Band stop Filter

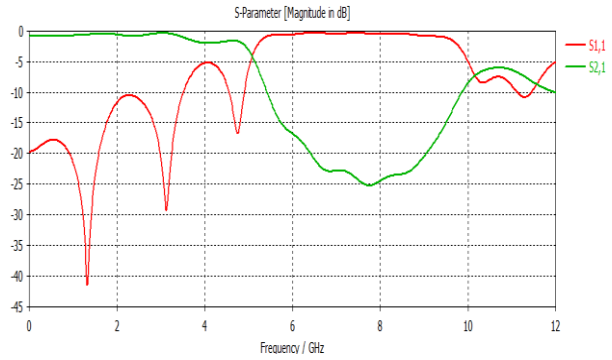


Fig 8: S parameters of a Band stop filter with two DMS

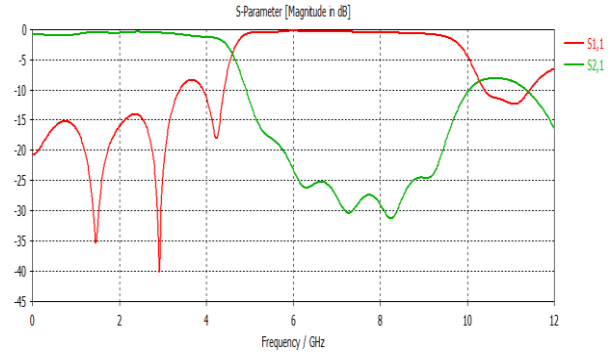


Fig 9: S parameters of a Band stop filter with four DMS

As it can be seen from Fig 6 that a simple Band stop filter without DGS has stop band from 6 GHz to 9 GHz and Fig 7 shows that band stop filter with defects on the ground plane is having broader bandwidth from 4.8 GHz - 10.4 GHz. The attenuation in the stop band is increased on increasing the number of DMS structure. There is aslight increase in stop bandwidth (in MHz) of Fig. 9 from 4.41 GHz - 10.4 GHz.

Table 1. Comparison of results

Configuration	Attenuation
Without DGS	-15 dB
No DMS	-20 dB
Two symmetric DMS	-25 dB
Four symmetric DMS	-30 dB

4. CONCLUSION

A wide stop band with large attenuation greater than -30 dB is achieved by using Defected Microstrip Structure whereas the bandwidth can be enhanced by making Defects in the ground plane. But the pass band performance gets degraded as it can be seen in the higher pass band. So, in future work can be done to improve the pass band response.

5. REFERENCES

[1] Chaudhary,G., Jeong,Y., Lim,J., Kim,C. D., Kim,D., Kim, J. C. and Park,J. C.2010. DMS harmonic termination load network for high efficiency power amplifier applications. In Proceedingsof the IEEE European Conference on Microwaves.

[2] M. Naser-Moghadasi, M. Alamolhoda, and B. Rahamti, "Harmonic blocking in hairpin filter using defected microstrip structure", IEICE,2011, inElectronics Express.

[3] M. Naser-Moghadasi, M. Alamolhoda, and B. Rahamti, "Spurious-response suppression in microstrip parallel-coupled bandpass filters using defected microstrip structures", IEICE, 2011, in Electronics Express.

[4] J. A. T. Mendez, H. J. Aguilar, F. I. Sanchez, I. G. Ruiz, V. M. Lopez, and R. A. Herrera, "A proposed defected microstrip (DMS) behavior for reduced rectangular antenna size",in Microwave Optical Tech. Letters, 2004.

[5] Amar B. Kachare, Mahesh S. Mathpati, "Effect of DGS on characteristics of Rectangular Microstrip Patch Antenna", International Journal of Research in Engineering and Technology, 2015.

[6] Arabinda Roy, Chandan Ghosh, Susanta Kumar Parui, "Highly Isolated Dual-Polarized Microstrip Patch Antenna Using Defected Microstrip Structure", International Journal of Soft Computing and Engineering, 2012.

[7] Jongsik Lim, "Design of Power Dividers using Defected Microstrip Structure and an Analytically Calculated Characteristic Line Impedance", International Journal of Control and Automation, 2014.

[8] Kazerooni, M. and Aghalari, M., "Coupling Control in Coupled Microstrip lines using Defected Microstrip Structure", The Second Iranian Conference on Engineering Electromagnetics, 2014.

[9] ZahriladhaZakaria, MohamadAriffinMutalib, MohdSa'ariMohamad Isa, NurAishahZainuddin, Sam WengYik and Abdul Rani Othman, "Design of MicrostripBandpass Filter with Defected Microstrip Structure (DMS)", Australian Journal of Basic and Applied Sciences, 2013.

[10] Haoran Zhu, Junfa Mao, "Miniaturized Tapered EBG Structure with wide stop band and Flat passband",inIEEE Antennas and Wireless Propagation Letters, 2012.