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Design and Fabrication of Compact Low Pass and Band Pass Filters using DGS

D.Rajeswari[1], Dr. T. Jayanthy[2], Dr. S. Sathyamoorthy[3], Dr. S. Sathiyapriya[4]
[1, 2, 3, 4]Dept of ECE, Panimalar Institute of Technology, Chennai-600123

Abstract: This paper presents another smaller low pass and Band pass filter (LPF and BPF) utilizing a DGS structure etched in the ground plane. The filter response has enhancing exhibitions by utilizing coupling of two DGS structures. Moreover, the change to band pass channel (BPF) and Low pass channel is additionally examined. To investigate the outcomes in low pass channels (LPFs) and band pass channels (BPFs), DGS are outlined with the guide of ADS simulation. The filter design, a compact multilayer LPF, BPF is using compact defected ground structure for enhance filter performance. The BPF,LPF is designed with the desired frequency range of 1GHz-10GHz And have compact size, and adaptability in design. Measured S-parameters indicate high performance, with good agreement amongst simulation and measurements.
Keywords: Defected ground structure (DGS), low pass filter (LPF), band pass filter (BPF).

I. INTRODUCTION

Defected ground structure strategy is presently applied in the design of microstrip filters. This enhances the filters performances and causes a size decrease, which is viewed as a noteworthy advantage. This procedure is as of now utilized to take care of the expanding demand for compact structure high [1] filters. As needs be, various research has been done with a specific end goal to accomplish such objectives. Lowpass and bandpass filters are upgraded by the utilization of such systems [2-4] The openings presented at the supported ground plane layer (i.e, DGS) basically enhance the Performances of the filters. This is because of the way that the waves entering the structure are bothered, bringing on evening out in the model stage speed as for each other. This can likewise help in building up a more compact structure without the need to execute higher request filters with a similar execution. In this paper, a new r design for a LPF is explored. The filter performance has been improved by a defected ground structure in the ground plane. Moreover, we have concentrated the impact of changing a few parameters on the lowpass and bandpass filter performance such as the DGS.

DGS is currently broadly used to improve the performance of the filter. The different innovations of size diminishments are utilized by the researchers, for example, Electromagnetic band crevice structure (EBG). Moreover, DGS has broadly connected to the plan of microwave circuits, for example, filters, resonators, amplifiers, power dividers, so on. The defected ground structures exhibit points of interest that incorporate minimization and skilled and adaptable use of the ground plane structure for changing attributes of microwave components. In this paper, we present a new compact Lowpass and bandpass filter. The initial BPF and LPF overall size of 36mm × 30 mm and 34mm x 20mm is expressed. To make the size of the filter more compact size, an attempt is completed by applying DGS on the ground plane of the filter. In the design process, the performances of lowpass and bandpass channel and its physical dimensions are investigated to get the ideal plan for acknowledgment. Henceforth, the filter parameters, for example, insertion loss, return loss, and working bandwidth the performance is assessed, after hardware realization and experimental characterization the measured results are then compared to the design results for verification and analysis.

II. DESIGN AND FABRICATION OF FILTERS

A. Lowpass Filter

The structure of Lowpass filter is delineated in Fig.1. In this the ideal appropriated LPF is installed in the information impedance LPF with 50 Ohm.. This filter has general size of 34mm × 20mm with thickness of 1.5 mm and relative dielectric consistent 2.2. low pass channel (LPF) utilizing a Bottom shape structure etched in the ground plane.

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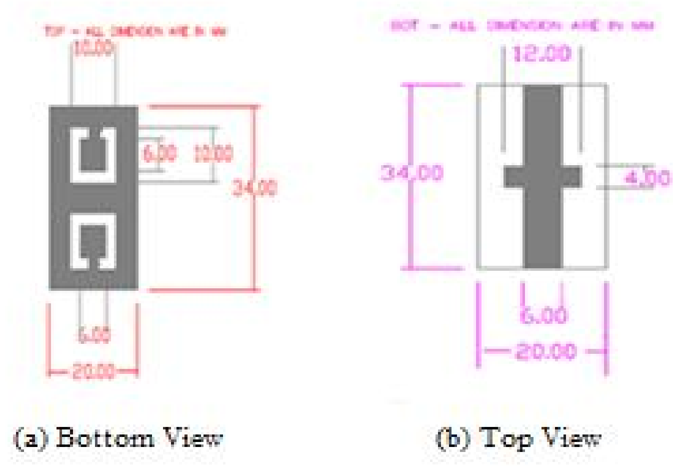

Fig 1. Low Pass Filter

Fig.2 demonstrates the photo of fabricated LPF filter. A compact LPF utilizing DGS is created on PTFE substrate with a relative dielectric constant of 2.2. with thickness of 1.5 mm and loss tangent of the filter is 0.02. The overall size of the channel is 34mm × 20mm. Fig.2(a) shows the images of bottom view of fabricated LPF channel and Fig.2(b) is a Top View of LPF, Bottom shape structure etched in the ground plane.

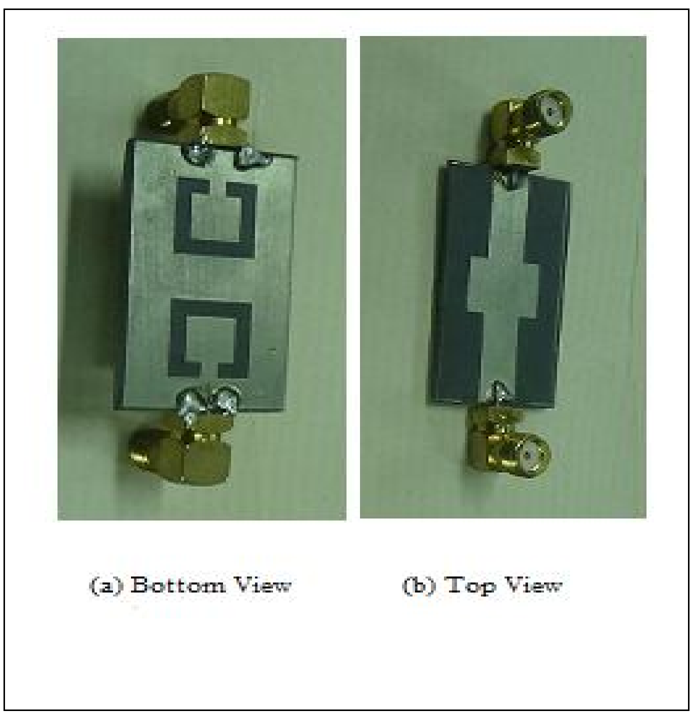

Fig 2. fabrication of LowPass Filter (a) Top View (b) Bottom View

B. Bandpass Filter

The structure of Bandpass filter is delineated in Fig 3. In this the optimum distributed BPF is inserted in the input impedance BPF with 50 Ohm. This filter has overall size of 36mm × 30mm with thickness of 1.5 mm and relative dielectric constant of 2.2. Band pass filter (BPF) utilizing a Bottom shape structure etched in the ground plane.

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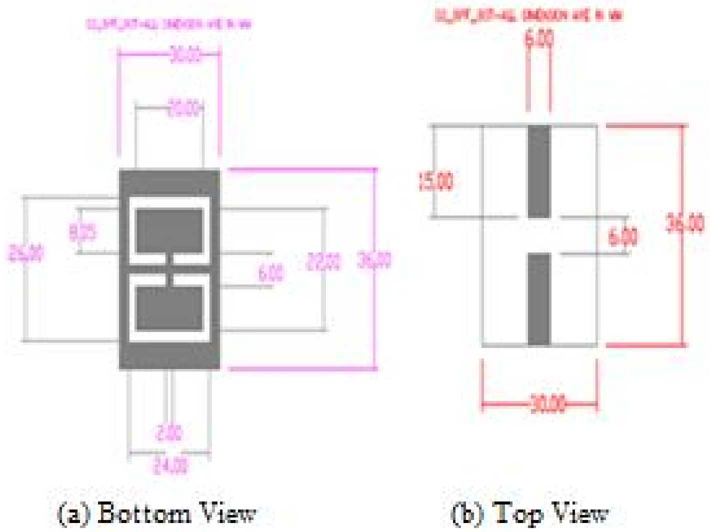

Fig 3. BandPass Filter

Figure 4 shows the picture of fabricated BPF filter. A compact BPF utilizing DGS is fabricated on PTFE substrate with a relative dielectric constant of 2.2. with thickness of 1.5 mm and loss tangent of the filter is 0.02. The overall size of the channel is 36mm × 30mm. Fig 4(a) shows the pictures of bottom view of fabricated BPF filter and Fig 4(b) is a Top View of BPF, Bottom shape structure carved in the ground plane.

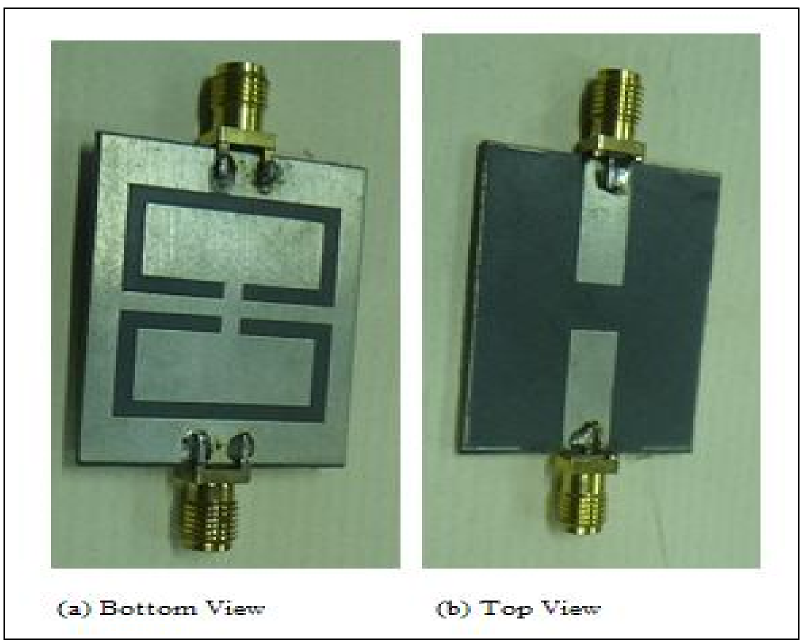

Fig 4. fabrication of BandPass Filter (a) Top View (b) Bottom View

III. SIMULATION AND MEASURED RESULTS

A. Lowpass filter

Simulation is carried out using ADS, which is a full wave electromagnetic simulator. The simulation S parameters of the proposed bandpass filter are transmission band ranges from 1 GHz to 10GHz and has insertion loss of -1 dB and return loss of -30 dB.

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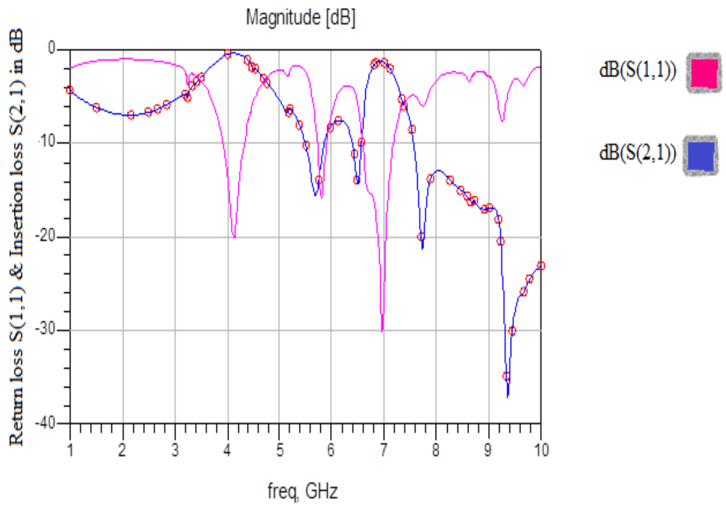

Fig 5 LPF simulation Return loss and Insertion Loss

The developed filter is compact and shows better performance in terms of functional parameters than filters reported in Table 1. This filter could be integrated with RF systems and efficiently enhance the performance of the system. Figure 5 shows the phase simulation of S_{21} for Low pass filter that is acceptably linear for microwave applications.

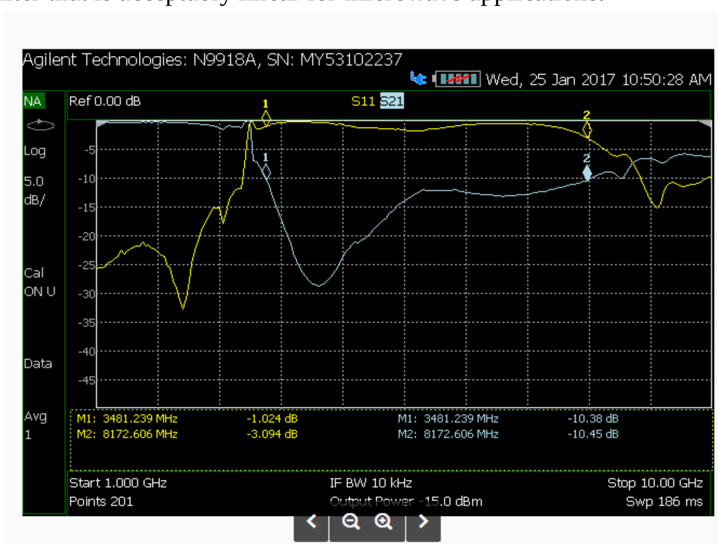

Fig 6. LPF Measured Return loss and Insertion Loss

The snapshot of fabricated LPF is shown in Fig.3, where two 50 Ω transmission lines are extended to accommodate the SMA connectors to connect to the Network Analyzer for measurement. The measured results of insertion loss and return loss for the developed filters are compared with the simulated insertion and return loss characteristics of the filter which is shown in Fig.5and 6.The measured insertion loss less than -1 dB within the passband is depicted in Figure 6. On comparison with simulation, the measured results are -1dB and -32 dB more in ripples and edges, the small discrepancy between them might be due to fabrication tolerance, loss tangent of the substrate and parasitic effect of the SMA connectors. Simulation results of proposed LPF is compared with the developed one in terms of prime parameters of the filter namely, insertion loss and return loss, which is tabulated in Table 1.

B. Bandpass filter

Simulation is carried out using ADS, which is a full wave electromagnetic simulator. The simulation S parameters of the proposed bandpass filter are transmission band ranges from 1 GHz to 10GHz and has insertion loss of -1dB and return loss of -38 dB.

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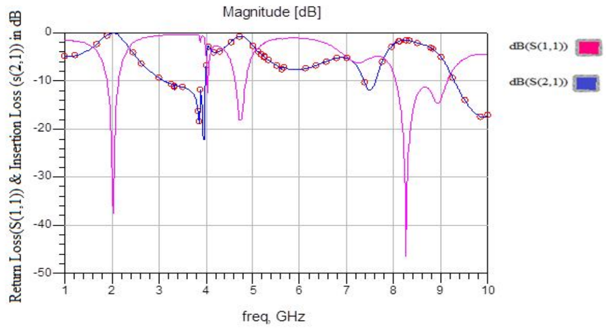

Fig 7 BPF simulation Return loss and Insertion Loss

The snapshot of fabricated BPF is shown in Fig.3, where two 50 Ω transmission lines are extended to accommodate the SMA connectors to connect to the Scalar Network Analyzer for measurement. The measured results of insertion loss and return loss for the developed filters are compared with the simulated insertion and return loss characteristics of the filter which is shown in Fig 6 and 7.The measured insertion loss less than -1 dB within the passband is depicted in Fig 8. On comparison with simulation, the measured results are -6 dB and -22 dB more in ripples and edges, the small discrepancy between them might be due to fabrication tolerance, loss tangent of the substrate and parasitic effect of the SMA connectors. Simulation results of proposed BPF is compared with the developed one in terms of prime parameters of the filter namely, insertion loss and return loss, which is tabulated in Table 1.

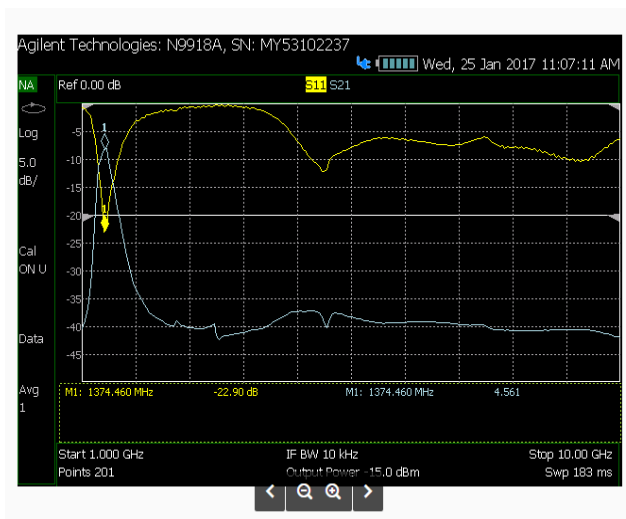

Fig 8. BPF Measured Return loss and Insertion Loss

TABLE 1
COMPARISON OF FILTERS PARAMETERS

Filter	S Parameter	Simulated Output	Measured Output
LPF	Insertion	-1dB	-1dB
LPF	Loss	-30dB	-32dB
BPF	Return Loss	-1dB	-6dB
BPF	Insertion	-38dB	-22dB
	Loss		
	Return Loss		

The above mentioned Table 1 Compares the results of Lowpass Filter and BandPass Filter performs better in terms of insertion loss, return loss, fractional bandwidth and compact in size.

IV. CONCLUSION

A compact LPF and BPF using defected ground structure is proposed, developed and presented in this paper. The functional parameters, particularly, insertion loss and return loss of the filter obtained by simulation are experimentally verified. The measured results are in good agreement with simulated one.

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