The PBG Filter Design

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Abstract— The performances of the periodic surface structures of defected shapes on the ground plane for low-pass filter (LPF) co-design are studied. Simulated results with full wave electromagnetic analyses are in good agreement with those experimental data. The optimal structure of double periodic structure bringing about the perturbation electromagnetic waves will be determined. The proposed LPF has defect ground surface with the characteristics of band-gap characteristics.

1. INTRODUCTION

The periodic surface structure is like photonic band-gap (PBG) [1, 2] structures are effective in RF and microwave application that provides an effective control of electromagnetic (EM) waves along specific direction and performance. Controlling the periodic distance of PBG that exist band reject characteristic. Periodic and defected ground structure (DGS) have some excellent performance applied microwave transmission line guide such as the microstrip PBG [3], coplanar waveguide PBG [4], coplanar-stripline PBG [5], uniplanar compact PBG [6] and multiplayer PBG [7]. The perforation patterns of PBG on the ground surface with band-stop and slow wave characteristics are studied. The DGS show great promise in improving the power added efficiency and radiation pattern in high power amplifiers [8], increase the Q value of planar inductor [9] or high efficiency planar antenna [10] application to suppress unwanted sub-harmonic compared to conventional harmonic turning techniques. Some papers also report a new tunable technique on traditional planar filter [11] or DR filter [12] to reject undesired resonator modes.

2. DESIGN & RESULTS

In this paper, a traditional LPF (Figure 1) placed at center the DGS with various PBG structures (Figure 2 and Figure 3) are studied, then proposed high harmonic reject low pass characteristic on PBG microstrip line. By the way of measurement and simulation (Figure 4) to detect this structure exist obvious passband, stopband and leaky wave band region then compare with interrelate research papers [13–17]. Via measurement to calculate EM structures [18, 19] on band-gap region, then find DGS structure can apply high reject band characteristic as a perfect low-pass filter circuit. FR4 substrate (dielectric constant 4.4, loss $\tan\delta = 0.015$ and height 1.6 mm) was used for this design and implement, as shown in Figure 5 and Figure 6.

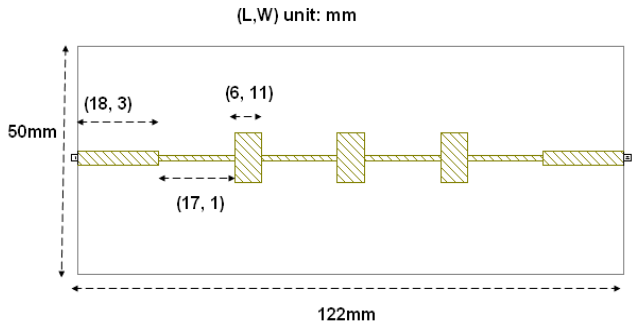

Figure 1: Traditional LPF design with perfect ground plane.

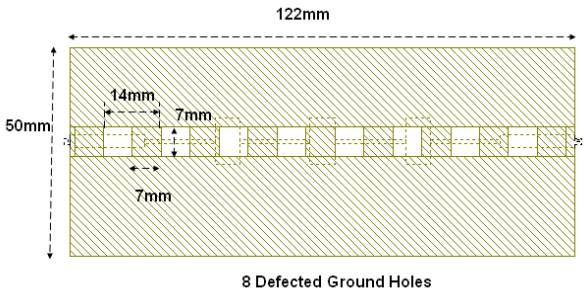

Figure 2: LPF design with periodic and defected ground plane.

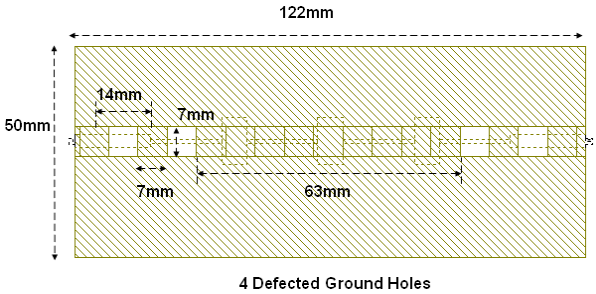

Figure 3: LPF design with non-periodic and defected ground plane.

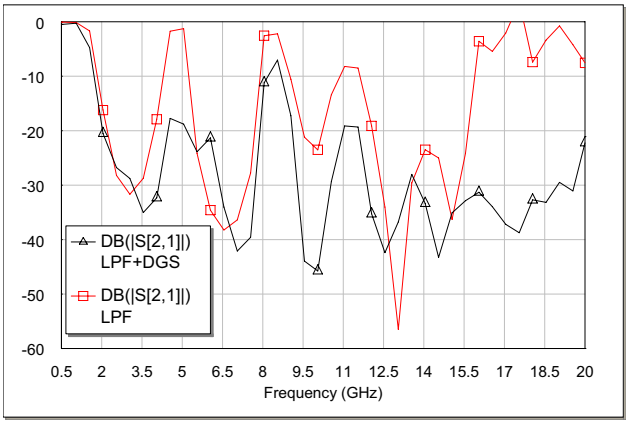

Figure 4: The simulated data of LPF embedded DGS (Fig. 3) and traditional LPF (Fig. 1).

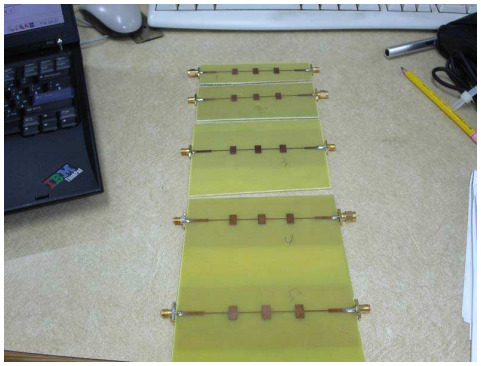

Figure 5: The practical LPF with DGS design (top-plane).

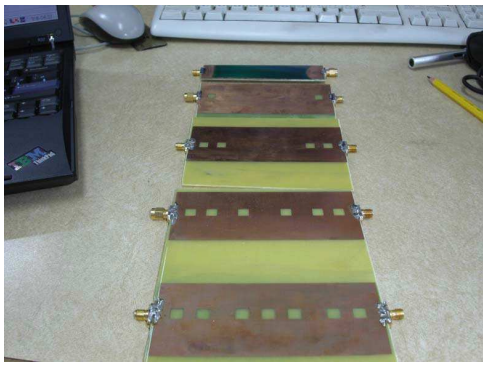

Figure 6: The practical LPF with DGS design (bottom-plane).

3. CONCLUSIONS

This paper describes a harmonic tuning for embedded defected ground plane. EM modeling for a LPF embedded defected ground plane structure co-design is determined. The structure with stop-band characteristic for broadband harmonic rejection tuning has been experimentally verified. Method of moment is applied to simulate the fields and currents distribution of the design. The results of full wave electromagnetic analyses are in good agreement with those experimental data. An optimal structure of the LPF and defected ground plane structure is determined.

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