DESIGNING OF LOW PASS MICROSTRIP FILTER USING RECTANGULAR PHOTONIC BAND GAP

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Abstract—**Transmitted and received signals have to be filtered at a certain frequency with a specific bandwidth.Filters play an significant role in radio frequency communication techniques. Techniques are wide enough, from entertainment through television, to civil and military radar system. In this paper the design of filter is done in the without rectangular photonic band gap (PGB) and with rectangular photonic band gap (PGB) The development of the Micro strip low pass filters are simulated by using IE3D simulator software.**

.**Keywords**: -**Low pass filter (LPF), Photonic band gap (PBG), Strip line and micro strip line and Loss tangent.**

I. INTRODUCTION

The EM waves with frequencies above 30 GHz to 300 GHz are also called millimeter waves because their wavelengths are in the millimeter range (1–10 mm).The term microwaves may be used to describe electromagnetic (EM) waves with frequencies ranging from 300 MHz to 300 GHz, which correspond to wavelengths (in free space) from 1 m to 1 mm.
Medicalinstrumentation and others that explore the usage of frequency spectrums in the range of, say, 300 kHz up to 300 GHz [1]. Conventional filter structures like equal ripple and butter worth low pass filters are requirement of special fabrication methods. Periodic structures that can change the propagation of EM waveshas been used to obtain structures with the specific response.
PBG application to antenna improves directivity it suppress the harmonics. The suppression of harmonics with PBG acts like a filter for higher radiation frequencies.

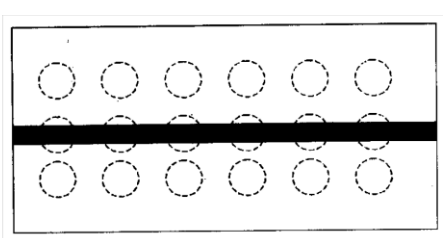

Figure.1: Microstrip with etched periodic pattern in ground plane

Etching in the ground plane is eliminating the need of holes and vias because these structures have a very big problem, they must be suspended.
In the present work optimum distributed low pass filter has been designed. This modified filter with PBG has improved performance in comparison with the quasi-lumped low pass filter. The designed filter has been analyzed using IE3D simulation software [2].

II. MICROSTRIP FILTER DESIGN

The element values of the low pass prototype filters, which are usually used to make source impedance $g_0 = 1$ and a cutoff frequency $\Omega_C = 1.0$, are then transformed to the L-C elements for the desired cutoff frequency and the desired source impedance, which is normally 50 ohms for micro strip filters. The element values for the low pass prototype with Chebyshev response at pass band ripple factor L_{AR}= 0.1 dB, characteristicimpedance source/load $Z_0 = 50 ohms$, are taken from normalized values g_i i.e. $g_{1,} g_{2,} g_{3,} ....g_n$. The filter is assumed to be fabricated on a substrate of dielectric constant $\varepsilon_r = 4.4$ and of thickness $t = 1.6mm$ .For Angular cutofffrequency $\Omega_C = 1.0$

- Filter Specification

Stepped-Impedance, L-C Ladder Type low-passes Filter for $n = 3$,
In order to illustrate the design procedure for this type of filter, the design of a three-pole low-pass filter is described in follows –The specifications for the filter under consideration are Cutoff frequency

$$f_C = 1.8GHz \quad (1)$$

Pass band ripple 0.1 dB (or return loss = –12.0 dB) Source/load impedance

$$Z_0 = 50 ohms \quad (2)$$

A low-pass prototype with Chebyshev response is chosen, whose element values are:-Microstrip filters for RF/Microwave applications by (Jia-Sheng Hong *et al.* [1], 2001).

For $n = 3$

$$g_0 = g_4 = 1.0; g_1 = g_3 = 1.0316; g_2 = 1.1474 \quad (3)$$

Here g_1, g_3 is inductive element& g_2 is capacitive element.

In these design we have following parameter-

Cut-off frequency,

$$f_C = 1.8 GHz \quad (4)$$

The substrate used –

Relative Dielectric Constant,

$$\varepsilon_r = 4.4 \quad (5)$$

Height of substrate,

$$h = 1.6 mm \quad (6)$$

The loss tangent

$$\tan\delta = 0.02 \quad (7)$$

$$Z_0 = 50; Z_{0C} = 20; Z_{0L} = 85 \quad (8)$$

And

$$\Omega_C = 1.0 \quad (9)$$

Determine the values of the prototype elements to realize the specifications. Also we have taken the element value for low pass from Table 1

For capacitor

$$W = 8.8247 mm \quad (10)$$

For inductor

$$W = 0.8 mm \quad (11)$$

$$L_1 = L_3 = \left(\frac{Z_0}{g_0}\right)\left(\frac{\Omega_C}{2\pi f_C}\right) g_1 = 8.2134 \times 10^{-9} H \quad (12)$$

$$C_2 = \left(\frac{g_0}{Z_0}\right)\left(\frac{\Omega_C}{2\Pi f_c}\right) g_2 = 3.64 \times 10^{-12} F \quad (13)$$

$$l_1 = l_3 = \frac{\lambda_{gl}}{2\pi} \sin^{-1}(w_c L_1 Z_{oL}) = 17.126 mm \quad (14)$$

$$l_2 = \frac{\lambda_{gc}}{2\pi} \sin^{-1}(w_c c_2 Z_{oc}) = 8.1072 mm \quad (15)$$

Initially, photonic band gap(PBG) devices were proposed in optical applications, which have a property of preventing light from propagating in certain frequency bands.PBG are periodic structures, it has the ability to control the propagation of electromagnetic waves.

The design of the filter is completed; the layout of the without rectangular photonic band gap (PBG) and with rectangular photonic band gap low filter is given in Figure 2 &3 with all the determined dimensions.

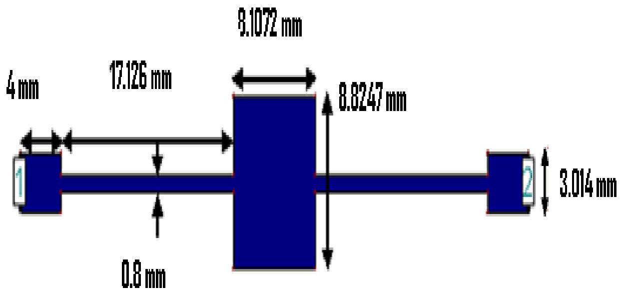

Figure 2: Dimensions of Stepped Impedance, L-C Ladder Type LPF (without Photonic Band Gap (PBG)

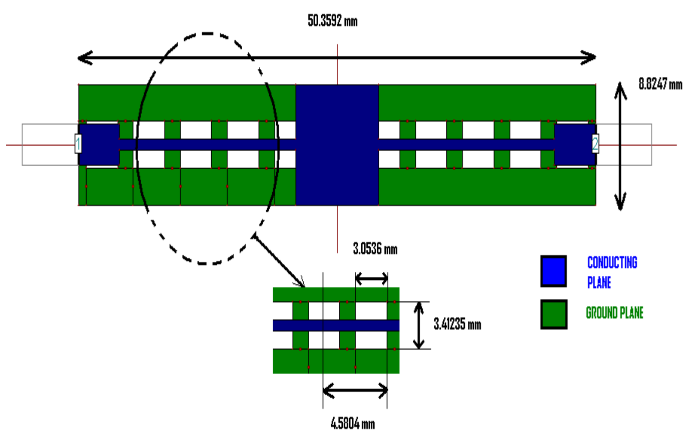

Figure 3: Dimensions of Stepped Impedance, L-C Ladder Type LPF (n=3) with PBG

III. RESULTS & ANALYSIS

The Simulated without rectangular photonic band gap (PBG), with rectangular photonic band gap (PBG) filter as shown in Figure 4 and 5 shows the geometry & response of low pass filters for n=3.

IV. CONCLUSION

Application of microstrip filters, for better responses, are increasingly used in science and engineering. In this paper microwave photonic band gap (PBG) were used in the designing of microstrip low pass filter. Microwave PBG is broad and a new field, a lot of things could be possible in all research areas for design and implementation of microstrip filters.

TABLE I

Dimensions For A Stepped-Impedance Low Pass Filters (For n=3)

Parameter	**Matching Section**	**Inductor section**	**Capacitor section**
Characteristic Impedance (Ω)	$Z_0 = 50$	$Z_{0L} = 85$	$Z_{0C} = 20$
Effective Dielectric Constant	$\varepsilon_{reo} = 3.3$	$\varepsilon_{rel} = 3.08$	$\varepsilon_{reC} = 3.7$
Width of Micro strip Line (mm)	W_{Z0}= 3.014	W_L = 0.8	W_C=8.8247
Length of Micro strip Line (mm)	L_{Z0}= 4	L_L= 17.126	L_C= 8.1072

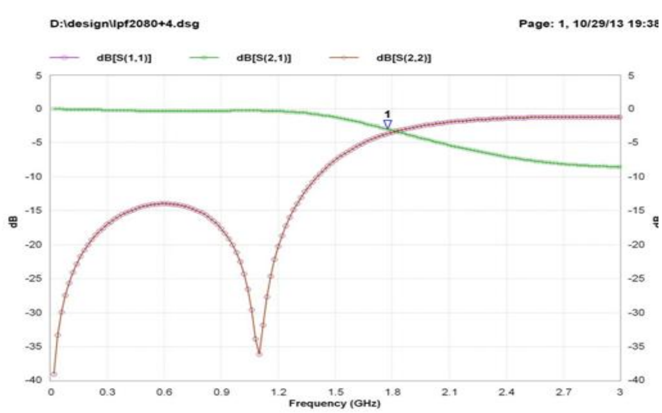

Figure 4: Simulated performance of stepped impedance, L-C ladder type without rectangular photonic band gap (PBG) LPF

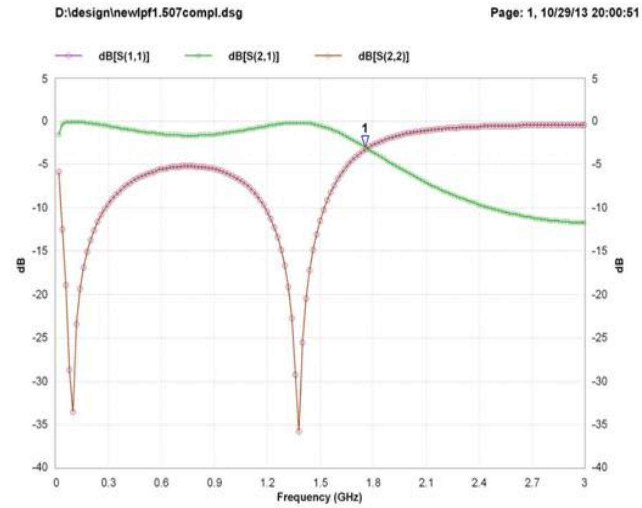

Figure 5: Simulated performance of stepped impedance, L-C ladder type with rectangular photonic band gap (PBG) LPF

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