MICROSTRIP END COUPLED BANDPASS FILTER WITH KOCH FRACTAL SHAPED

Ms Gurpreet Kaur Kohli[1], Ms. Pravesh Singh[2]

[1]Department of ECE, MTU Noida , (India)
[2]Faculty, Department of ECE, KIET, Ghaziabad, (India)

ABSTRACT

Filters are an important part of telecommunications and radar systems which effects the performance and cost of such systems . The advancement of the frequency bands in microwave filter, plays an important role in different application like RF or microwave. Through an investigation into and a subsequent implementation of filter theory, the RF filter design of End Half-wavelength Resonators Bandpass Filter is simulate in this paper . The proposed filter having an center frequency of 2.02 GHz with the return loss and insertion loss the amplitude response using the IE3D simulation software .

Keywords - Fractal Shaped Micro strip Band pass Filter, End Coupled Filter, RF Filters, Wavelength Resonators and Centre Frequency

I INTRODUCTION

This filter is particularly suitable for planar formats and are easily implemented with printed circuit technology and has the advantage is that of taking up no more space than a plain transmission line would. The basic limitation of this topology is that performance (particularly insertion loss) deteriorates with increasing fractional bandwidth, and acceptable results are not obtained . With the further difficulty with producing low-*Q* designs is that the gap width is required to be smaller for wider fractional bandwidths. The minimum width of gaps, like the minimum width of tracks, is limited by the resolution of the printing technology. To reduce insertion loss in the pass-band, the gaps are usually much smaller than the substrate height to enable tight coupling. The resonator lengths depend on the guide wavelength, coupling reactance and the gap capacitance. This configuration provides relatively narrow bandwidth. Since this structure is large, it is not a much preferred configuration.

II END COUPLED FILTER

Figure 1 illustrates the end-coupled half-wavelength bandpass filters, where each open-end microstrip resonators is almost half-wavelength ($\lambda/2$) long at the midband frequency f_o of the bandpass filter. The resonators are coupled by means of gap capacitances between the resonator sections. The resonator length θ and the coupling gaps S between successive resonators are important design parameters. The gap could be imagined as a J-inverter in this case, these J-inverters tend to reflect high impedance levels to the end of the $\lambda/2$ resonators.

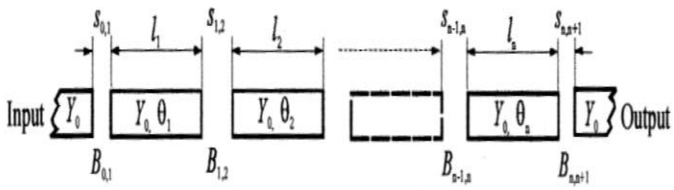

Fig1 : General Structure Of End Coupled Microstrip Bandpass Filter.

Hence, the filter operates like the shunt-resonators type and the design equations are [2]:

$$\frac{J_{01}}{Y_0} = \sqrt{\frac{\pi}{2}\frac{FBW}{g_0 g_1}} \quad \textbf{(1)}$$

$$\frac{J_{j,j+1}}{Y_0} = \frac{\pi FBW}{2}\frac{1}{\sqrt{g_j g_{j+1}}} \quad \text{for j=1 to n-1} \quad \textbf{(2)}$$

$$\frac{J_{n,n+1}}{Y_0} = \sqrt{\frac{\pi}{2}\frac{FBW}{g_n g_{n+1}}} \quad \textbf{(3)}$$

where g_o, g_1 ... g_n are the element of a ladder-type lowpass prototype with a normalized cutoff $\Omega_c = 1$ and FBW is the fractional bandwidth of bandpass filter. The $J_{j,\, j+1}$ are the characteristic admittances of J-inverters and Y_o is the characteristic admittance of the microstrip line. Assuming the capacitive gaps act as perfect, series-capacitance discontinuities of susceptance $B_{j,\, j+1}$ are: [2]

$$\frac{B_{j,j+1}}{Y_0} = \frac{\frac{J_{j,j+1}}{Y_0}}{1-(\frac{J_{j,j+1}}{Y_0})^2} \quad (4)$$

$$\theta_j = \pi - \frac{1}{2}\left[\tan^{-1}(\frac{2B_{j-1,j}}{Y_0}) + \tan^{-1}(\frac{2B_{j,j+1}}{Y_0})\right] radians \quad (5)$$

where the $B_{j,j+1}$ and are evaluated at f_0. The second term on the right-hand side of (1,2,3) indicates the absorption of the negative electrical lengths of the J-Inverters associated with the jth half-wavelength resonator.

The coupling gaps $s_{j,\, j+1}$ of the microstrip end coupled resonator filter are;

$$C_g^{j,j+1} = \frac{B_{j,j+1}}{\omega_0} \quad (6)$$

Where $\omega_0 = 2\pi f_0$ is the angular frequency at the midband. The physical lengths of resonators are given by

$$\ell_j = \frac{\lambda_{g0}}{2\pi}\theta_j - \Delta\ell_j^{e1} - \Delta\ell_j^{e2} \quad (7)$$

Table1

Parameters of End Coupled Half- wavelength Resonators Band pass Filter

S.No	Parameters	Section1	Section2	Section3	Section4
1	g_n	1.5963	1.0967	1.5963	1.0967
2	Z_0J_n	0.3137	0.1187	0.1187	0.3137
3	B_n	$6.96\text{x}10^{-3}$	$2.41\text{x}10^{-3}$	$2.41\text{x}10^{-3}$	$6.96\text{x}10^{-3}$
4	C_n	0.4520pF	0.1564pF	0.1564pF	0.4520pF
5	θ_n	2.72 rad	2.91 rad	2.72 rad	-

The effective lengths can then be found by

$$\Delta\ell_j^{e1} = \frac{\omega_0 C_p^{j-1,j}}{Y_0} \frac{\lambda_{g0}}{2\pi} \quad (8)$$

$$\Delta\ell_j^{e2} = \frac{\omega_0 C_p^{j,j+1}}{Y_0} \frac{\lambda_{g0}}{2\pi} \quad (9)$$

III FILTER DESIGN

End coupled Fractal shaped microstrip bandpass filter , with a 0.5dB equal-ripple passband characteristic for Ist order for the center frequency of 2.45 GHz, bandwidth of 10% and equal ripple in the pass-band of 0.5dB , the FR4 substrate of dielectric constant 4.2 with thickness of 1.58mm for a third order Chebyshev filter.

$g_0 = 1.0000$
$g_1 = 1.5963$
$g_2 = 1.0967$
$g_3 = 1.5963$
$g_4 = 1.0000$

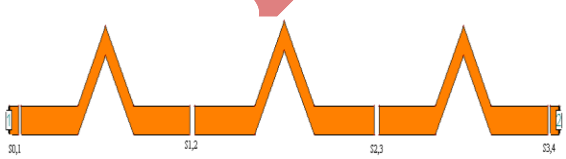

Fig 2

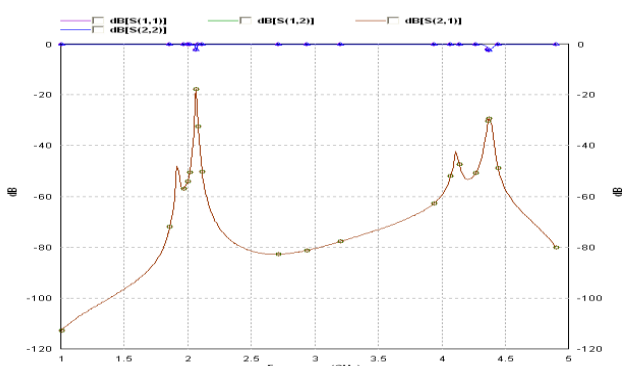

Fig 3

Fig 2 : Layout of 1st order with $S_{0,1} = S_{3,4} = 0.437$mm and $S_{1,2} = S_{2,3} = 0.801$ mm

Fig 3: Response of the Layout of 1st order with $S_{0,1} = S_{3,4} = 0.437$mm and $S_{1,2} = S_{2,3} = 0.801$ mm

IV RESULT AND ANALYSIS

The above responses using IE3D for the end-coupled line band-pass filter of 1st order the Return Loss is 2.434db and Insertion loss is 18.83 and $S_{1,2} = S_{2,3}$= 0.801 mm with centre frequency of 2.02GHz .

V CONCLUSION

This is observed from this analysis that the further symmetrical approach i.e. iterations tends to produce a more compact filter with less coupling effect in its realization when frequency increases and also this minimizes required space for realization and is suitable for integration within wireless system.

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