International Journal of Engineering Applied Sciences and Technology, 2016
Vol. 1, Issue 6, ISSN No. 2455-2143, Pages 192-194
Published Online April - May 2016 in IJEAST (http://www.ijeast.com)

A CUSTOMIZED WIDEBAND BANDREJECT FILTER WITH MEANDER LINE AND CROSS COUPLING

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***Abstract*— A new customized Wideband Bandreject Filter with Meander line structure and cross coupling. Conventionally the size of Bandreject filter resonator should be in Quarter wave length. With the help of meander line, size of filter can be decreased up to 42%. To convert the long thin microstrip line into meander line, no need of extra calculation is necessary. An extra electric-coupling into two side by side Quarter wave length stubs is achieved, roll-off and sharp skirt successfully attain by introducing two transmissions zero in reject band. A Bandreject filter example is given with calculated attenuation of bandreject filter is 25.5 dB on fractional Bandwidth of 143 % with accessible tool HFSS-13.0, filter is analyzed with available reported result.**

Keywords— ***Bandstop filter (BSF); Meander line; Wideband; Cross coupling.***

I. INTRODUCTION

WIDEBAND Band reject filter widely employed in wireless and satellite communication system .Important role of Bandreject filter is to filter out unwanted and surplus signal and allow to pass only preferred signal. In oscillator and Mixer harmonics can be eliminated with the help of Bandreject filter. Sharp skirt and high roll of required in filter when frequency of operation change from passband to stopband. High attenuation in stop band and low insertion loss in passband is requirement of preferred communication system. Typically Microstrip bandreject filter [1] is made off open-circuited Shunt resonators that are λg/4 long with linking lines that also λg/4. This filter with more number of transmissions zero in stop band gives the excellent reject band. As large reject band output is required in band reject filter, the photonic band gap [2] structures and the defected ground plane structures [3] are different solutions. To advance the selectivity and reject band refusal, the introduction of electrical [4] or magnetic [5]–[6] cross couplings and the deployment of several signal transmission paths [9]–[11] have been verified to be two rather professional methods for introducing additional transmission zeros (TZs).

A 4th-order wideband Bandreject filter with stepped-impedance cross-coupled line is presented in this paper. A long thin microstrip cross coupled line is converted in Meander line structure. Meander line structure is useful in dimension attenuation so it is suggested in this proposed work .The projected scheme is very helpful in design of a BSF. By using this procedure we can do diminution in size up to 42%. Band reject filter characteristics can be controlled by Quarter wave length (λg/4) resonator. Dimension of the predicted filter operating frequency is 1.5 GHz and compact size is 0.60 λg x 0.05 λg. Projected filter has attenuation of 25.5 dB in stop band and fractional bandwidth is 143 %.projected filter getting good accord between mathematical result and simulated result.

II. ANALYSIS OF DESIGN

Band Stop filter [6] made known in Fig.1 as part 1. This band stop filter order is 3, after adding part 2 in part 1 order of filter will change from 3 to 4, Z_{3e}/Z_{3o} will represent the even/odd characteristics Impedance of transmission line The even/odd-mode characteristic Impedance for part 1 is Z_{3e}/Z_{3o} and part 2 is Z_{4e}/Z_{4o} s not similar. For this reason, the arrangement is a sort of coupled line stepped impedance with cross-coupling.

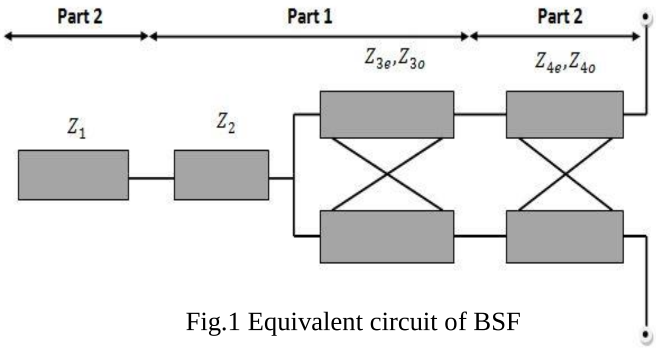

Fig.1 Equivalent circuit of BSF

At the Reject band central frequency f_0 , all transmission line are in proportion measurement lengthwise is λg/4. High order response is realized by introducing the further more introduced capacitances mutually with part 2. For improving the pass band range at upper cut off frequency open circuit shunt stub is converted into stepped impedance resonator, means conversion of UIR into SIR has done. We can carry out

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the even and odd mode study because circuit is unique with their geometry. In S-plane, if I/O admittance is equal for even and odd mode then by means of Richard's Transformation-

$$S = j\Omega = j\tan\frac{\pi f}{2 f_0} \quad (1)$$

Where Richards, lumped and scattered element frequency variables, will be given as S, Ω and f are the correspondingly.

(A). Meander Structure design by means of Kotch Curve

The Kotch curve [9] understanding is obtained in notice for predictable new pattern. Up to two iteration of curve is provided in Fig.[2] with the help of Basic Kotch curve style. Basic Kotch curve is used where very thin microstrip line structure is used.

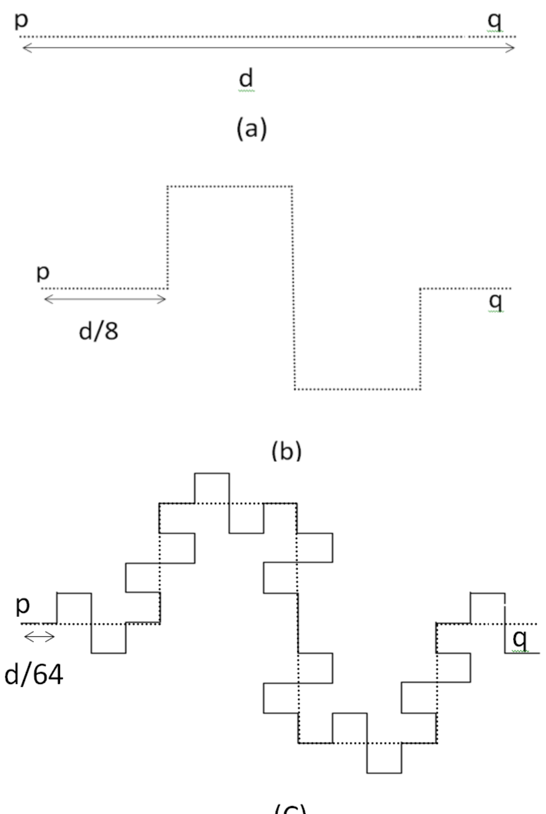

Figure2. Basic Kotch curve arrangement: (a) Zero iteration; (b) 1st iteration; (c) 2nd iteration

The Fig.[a] is given for zero iteration , where the initial length of thin microstrip line (p to q) is d. Fig.[b] is given for first iteration , where the length of microstrip line will get reduced by d/2 and Fig.[c] is given for second iteration , where the length of microstrip line will reduce by d/4. In first iteration the gap between the point p and q is reduced by d/2 and length of unit section line will L/8. In second iteration the distance between p and q is reduced by d/4 and the length of unit section line will d/64. By using this procedure the length of thin microstrip line can be reduced up to ¼ times. This procedure can be appropriate for Band stop filter (BSF) and Low pass filter (LPF). In this proposed work, after performing 2nd iteration length of unit section line will very small that will create problem in filter fabrication so we are doing only 1st iteration in this work.

III. Experiment and Result

A Customized wide bandreject filter with meander line and cross coupling is intended with substrate thickness of 0.73mm, dielectric constant of 2.65 and loss tangent of material will 0.003. The BSF is made up of stepped-impedance coupled line be involve with an open-circuited shunt Stepped impedance resonator (SIR). Proportionate electrical span of λg/4, stepped impedance coupled line are used in filter design. Frequency of reject band can be determined with the help of typical impedance ratio and SICL span. Coupling gap between the λg/4 resonators is main deciding factor for bandwidth of reject band. Utilize of simulator ANSYS HFSS-13 has done for simulation of anticipated customized Wideband Bandreject Filter with Meander line structure and cross coupling.

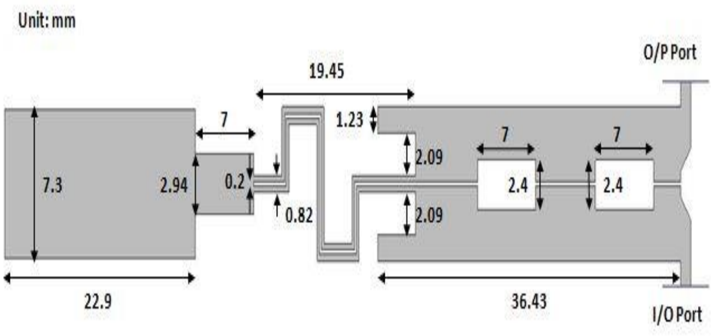

Figure 3 estimated design of filter with Meander lines and Stepped Impedance resonator.

Figure 3 illustrate the design of predicted filter. The design of figure (II) is applied to reference [7]. After applying Kotch structure in reference [7] length of Patch reduced by 19%. New structure is again modified by changing the open circuit shunt UIR stub into open circuit shunt SIR stub and two slots have been etched at the surface of substrate. New modified structure is portrayed in figure3. New modified structure length of meander line is 19.45mm. Coupling is increase by reducing gap between the Stepped impedance coupled lines.

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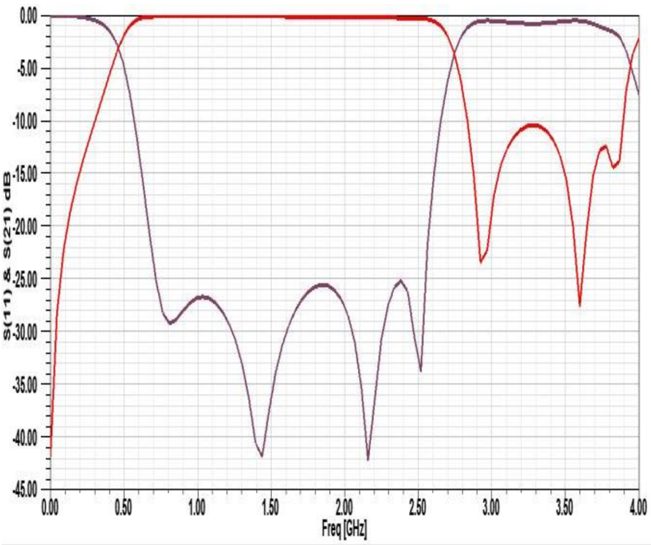

Fig.4 Simulated result of the experimental filter.

TABLE I

COMPARISON OF DIFFERENT WIDE BAND BSF

Ref.	Ope. Fre. (GHz)	order	no. of zero	fbw %	attenuation(db)	size (λg×λg)
[10]	4	≥5	3	47	23	0.181
[7]	2	-	4	100	20	0.109
[8]	1	7	5	140	20	0.056
[5]	1.5	5	5	113.4	34.4	0.040
[this work]	1.5	4	4	143	25.5	0.033

The result of simulated filter is given in Fig.4. Achieved maximum attenuation in reject band is 25.5 dB. Measured insertion loss in lower pass band from (0.01-0.234 GHz) less than 0.28dB and Insertion loss in upper pass band (2.73-3.8 GHz) less than 1.50 dB. The packed size of anticipated filter is 0.601. ×0.051. ,where 1. is denotes the guided wavelength of a 50 Ω transmission line on the centre-stopband. Table(I) uncovered the evaluation of the performance of unlike BSF with unlike previous designe.The anticipated BSF show immense FBW and a reduced amount of packing in size.

IV. CONCLUSION

The projected method is a doing well and capable of size diminution technique with simplicity. This method of dimension diminution (Meander line structure) can be imposed on almost every of the long thin transmission line. Projected work diminished the excess of 19% of the dimension with several modifications in the reference diagram of BSF. Converting open circuit shunt Uniform impedance response (UIR) into stepped impedance resonator (SIR) was helpful in the increment of upper pass band filter, some small stubs are used for impedance matching has done to get desired attenuation. Reduction in size has achieved from 0.040 λg × λg to 0.033 λg × λg. A BSF example is given with measured attenuation of stop reject filter is 25.5dB on a fractional bandwidth of 143%

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