Design of Microstrip Bandpass Coupled Lines Filter

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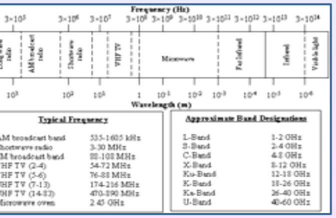
ABSTRACT

is is a project describes about the design and rication of microwave bandpass filter by using crostrip layout. A microwave filter is a two port twork used to control the frequency response thin a system by allowing the transmission of rtain frequencies in the passband while enuating frequencies in the stopband. The velopment of the microstrip filters are nulated by using (MWO) Microwave Office 03 (V6.01) simulator software. otolithographic process is used for fabrication. e final testing had done by using the RF twork Analyzer.

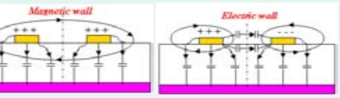
INTRODUCTION

e rapid growth in commercial microwave chnology, varies of microwave communication stem had been developed. Hence, Microstrip ers play important roles in many RF or crowave applications. Emerging applications ch as wireless communications continue to allenge RF/microwave filters with ever more ingent requirements higher performance, naller size, lighter weight, and lower cost.



COUPLED MICROSTRIP LINES

e couple microstrip lines are exhibiting a field tern with the quasi-TEM. A signal propagating a coupled line can be described by the perposition of an even mode and odd mode t exhibit different propagation factors and aracteristic impedance.



MICROSTRIP FILTER DESIGN STEP

1. Determine the number of sections from the specified attenuation characteristics for microstrip parameters.

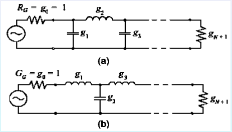
Frequency Range	Number of order	Equal Ripple Response	Impedance (Z_o)
1452 MHz to 1492 MHZ	3	0.5 dB	50 Ω

2. Determine the values of the prototype elements to realize the specifications. Example Chebyshev filter prototypes (g0=1, wc=1 and 3.0 dB ripple)

3.0 dB Ripple

N	g1	g2	g3	g4
1	1.9953	1.0000		
2	3.1013	0.5339	5.8095	
3	3.3487	0.7117	3.3487	1.0000

3. Determine the one-type resonator network (cascaded series resonators) and determine the inverter values for two equivalent realizations of the generic multi-section lowpass filter with normalized elements.



4. Obtain the even and odd mode coupled line characteristic impedances Z0e and Z0o.

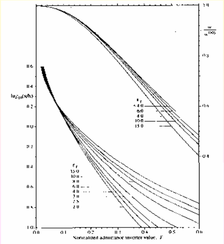
$$(Z_{0e})_{j,j+1} = Z_0\left[1 + \frac{J_{j,j+1}}{Y_0} + \left(\frac{J_{j,j+1}}{Y_0}\right)^2\right]$$

$$(Z_{0o})_{j,j+1} = Z_0\left[1 - \frac{J_{j,j+1}}{Y_0} + \left(\frac{J_{j,j+1}}{Y_0}\right)^2\right]$$

Where;

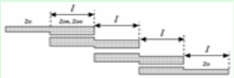
$$\frac{J_{01}}{Y_0} = \sqrt{\frac{\pi\, FBW}{2g_0g_1}};\quad \frac{J_{j,j+1}}{Y_0} = \frac{\pi\delta}{2\sqrt{g_jg_{j+1}}};\quad \frac{J_{n,n+1}}{Y_0} = \sqrt{\frac{\pi\, FBW}{2g_ng_{n+1}}}$$

5. Determine microstrip widths and separations (W,s) of the parallel coupled resonant lines from the Quasi-Static synthesis graphs.



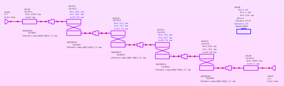
6. Calculate the coupled section length *lk* which is slightly less than quarter wavelength at centre frequency to account for the end fringing.

$$\lambda_g = \frac{300}{F\,(\text{GHz})\sqrt{\varepsilon_{eff}}}\,\text{mm};\quad l_n = \frac{\lambda_{gn}}{4}$$



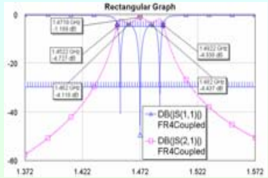
(MWO) SIMULATION DESIGN

Symbols are used for circuit representation of the filter. Behind each symbol there is a model, the input parameters for the model are specified under each symbol. In this case the filter is composed of microstrip coupled lines (MSCL).
Once the filter is specified we can generate the layout from the circuit representation. We can then perform electromagnetic (EM) analysis over the layout and compare the results.

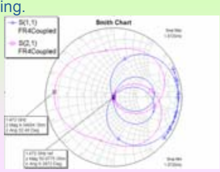


SIMULATION RESULT

Rectangular Graph showing S11 and S21 Parameters

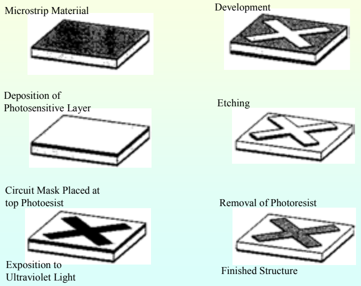


Smith Chart to define the Impedance Matching.



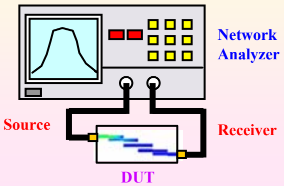
FABRICATION PROCESS

In the fabrication process, the circuit pattern is realized by the photolithographic process.



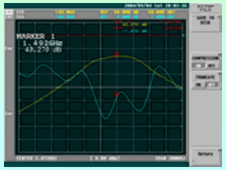
TESTING PROCESS

Network analyzer is used to measure the S-parameters (S11 Return Loss and S21 Insertion Loss) and impedance matching for the microwave filter.

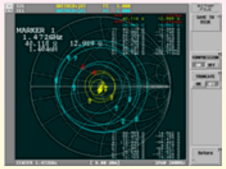


MEASUREMENT RESULT

The rectangular graph measurement for S11 (Return Loss) and S21 (Insertion Loss), the center frequency showed 1.492 GHz.



The Smith Chart measurement for impedar matching in frequency 1.472 GHz, S11=27.019 ohm and S21=40.118 ohm.



CONCLUSIONS

The result in between the simulation and physical layout design is difference. First, t dielectric constant of FR4 varies a lot from batch to batch. This means that the filter is likely to be too high or too low in frequency because the dielectric constant is out of ou expectation. Secondly, FR4 material has h factor of loss tangent, hence it produced hi losses for the design. Thirdly, the connecti of the cables and connectors to the device also affect the result.

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