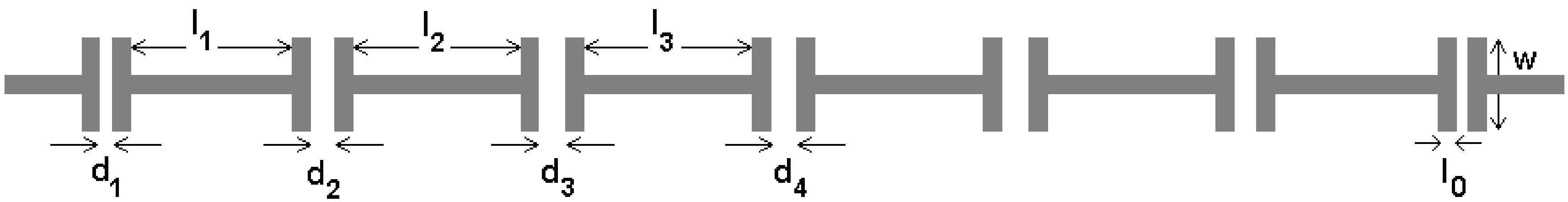
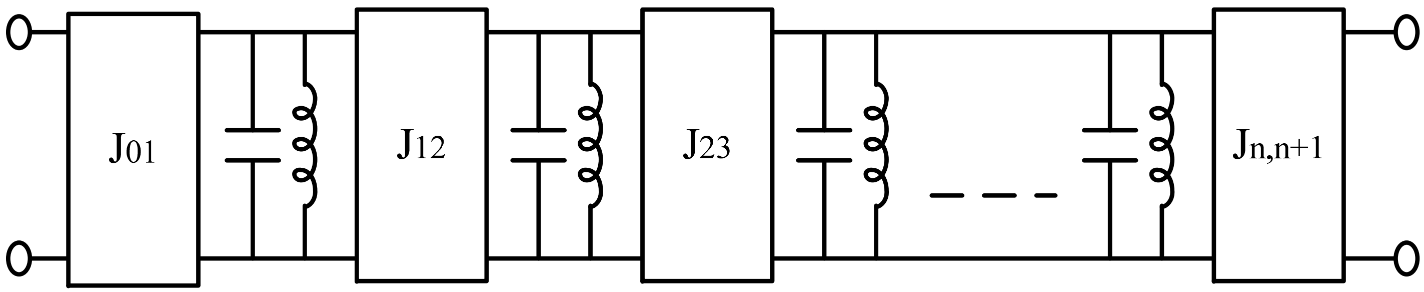
R. Mansour

Design Procedure for Capacitively- coupled Microstrip Filters



R. C. Cameron, C. M. Kudsia and R. R. Mansour, “Microwave Filters for Communication Systems - Fundamentals, Design and Applications, “ Wiley, 2007

J-Admittance Inverter Model for Bandpass Filters



$$\frac{J_{j,j+1}}{Y_o} = \frac{\pi\Delta}{2\sqrt{g_j g_{j+1}}}$$ j = 1,2……,N-1

$$\frac{J_{01}}{Y_o} = \sqrt{\frac{\pi\Delta}{2 g_o g_1}}$$

$$\frac{J_{N,N+1}}{Y_o} = \sqrt{\frac{\pi\Delta}{2 g_N g_{N+1}}}$$

where Δ is the percentage bandwidith

R. C. Cameron, C. M. Kudsia and R. R. Mansour, "Microwave Filters for Communication Systems - Fundamentals, Design and Applications, " Wiley, 2007

R. Mansour

Low Pass Filter Prototype

	g_1	g_2	g_3	g_4	g_5	g_6	g_7	g_8	g_9	g_{10}	g_{11}
					0.0138 dB ripple						
1	0.1128	1.0000									
2	0.4886	0.4365	1.1194								
3	0.6708	1.0030	0.6708	1.0000							
4	0.7537	1.2254	1.3717	0.6734	1.1194						
5	0.7965	1.3249	1.6211	1.3249	0.7965	1.0000					
6	0.8210	1.3770	1.7289	1.5445	1.5414	0.7334	1.1194				
7	0.8362	1.4075	1.7846	1.6368	1.7846	1.4075	0.8362	1.0000			
8	0.8463	1.4269	1.8172	1.6837	1.8847	1.6234	1.5973	0.7560	1.1194		
9	0.8533	1.4400	1.8380	1.7109	1.9348	1.7109	1.8380	1.4400	0.8533	1.0000	
10	0.8583	1.4493	1.8521	1.7281	1.9636	1.7542	1.9344	1.6546	1.6223	0.7668	1.1194

$$I.L = 0.0138 = -10\log|S_{21}|^2$$

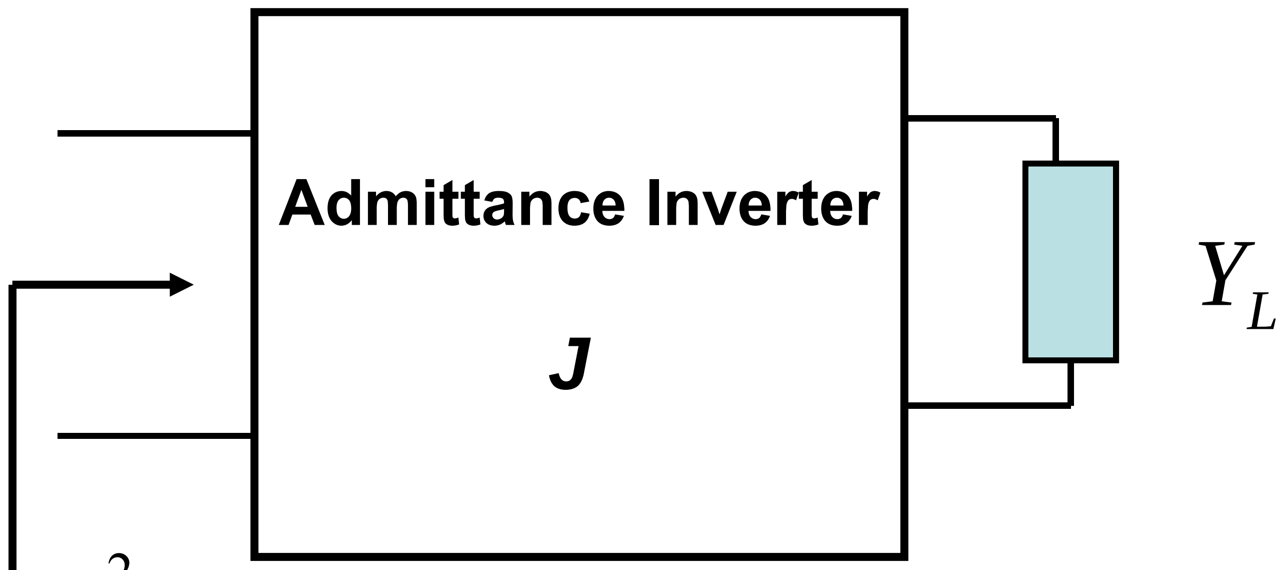
$$R.L = -10\log[1-|S_{21}|^2]$$

I.L (insertion loss)

R.L (return loss)

R. C. Cameron, C. M. Kudsia and R. R. Mansour, "Microwave Filters for Communication Systems - Fundamentals, Design and Applications, " Wiley, 2007

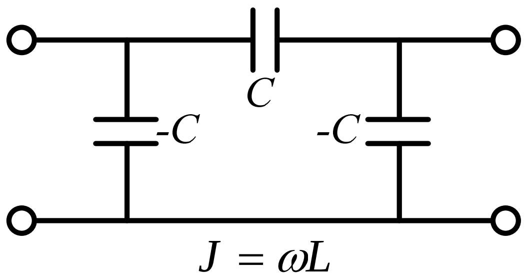
Admittance Inverters



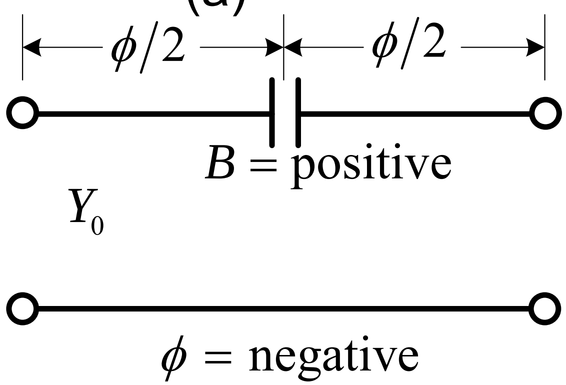
$$Y_{in} = \frac{J^2}{Y_L}$$

R. C. Cameron, C. M. Kudsia and R. R. Mansour, "Microwave Filters for Communication Systems - Fundamentals, Design and Applications, " Wiley, 2007

Examples of Admittance Inverters

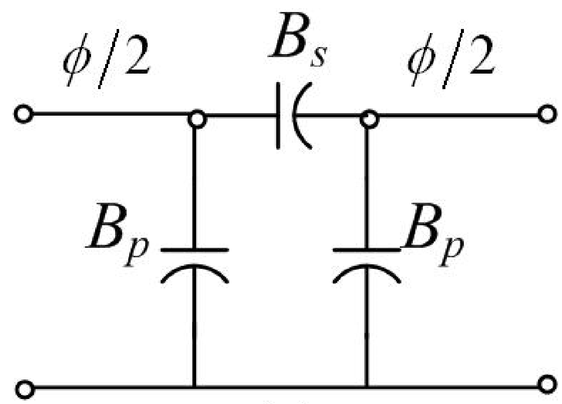


(a)



(d)

$$\left|\frac{B}{Y_0}\right| = \frac{\frac{J}{Y_0}}{1-\left(\frac{J}{Y_0}\right)^2} \qquad \phi = -\tan^{-1}\frac{2B}{Y_0}$$



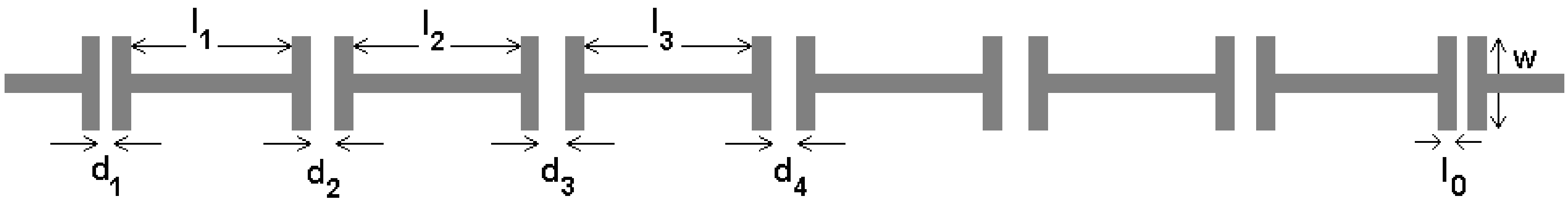
(e)

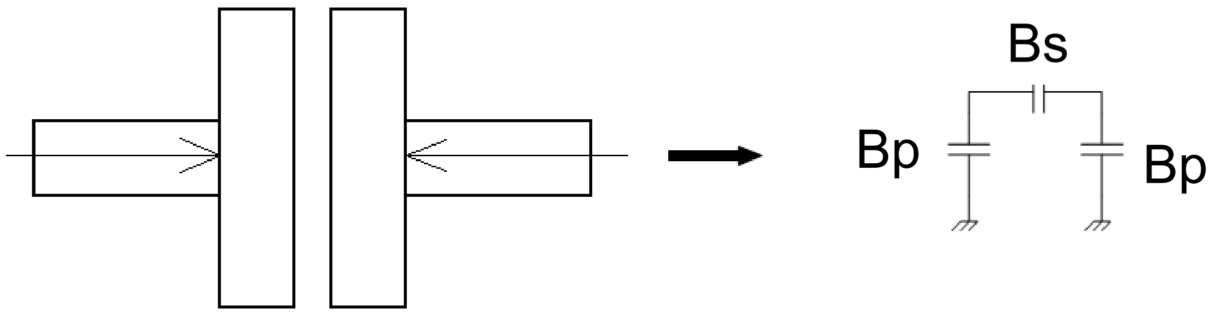
$$\frac{J}{Y_0} = \left|\tan\left(\frac{\phi}{2} + \arctan\frac{B_p}{Y_0}\right)\right|$$

$$\phi = -\arctan\left(2\frac{B_s}{Y_0} + \frac{B_p}{Y_0}\right) - \arctan\frac{B_p}{Y_0}$$

R. C. Cameron, C. M. Kudsia and R. R. Mansour, “Microwave Filters for Communication Systems - Fundamentals, Design and Applications, “ Wiley, 2007

Design of a Microstrip Filter Cont.



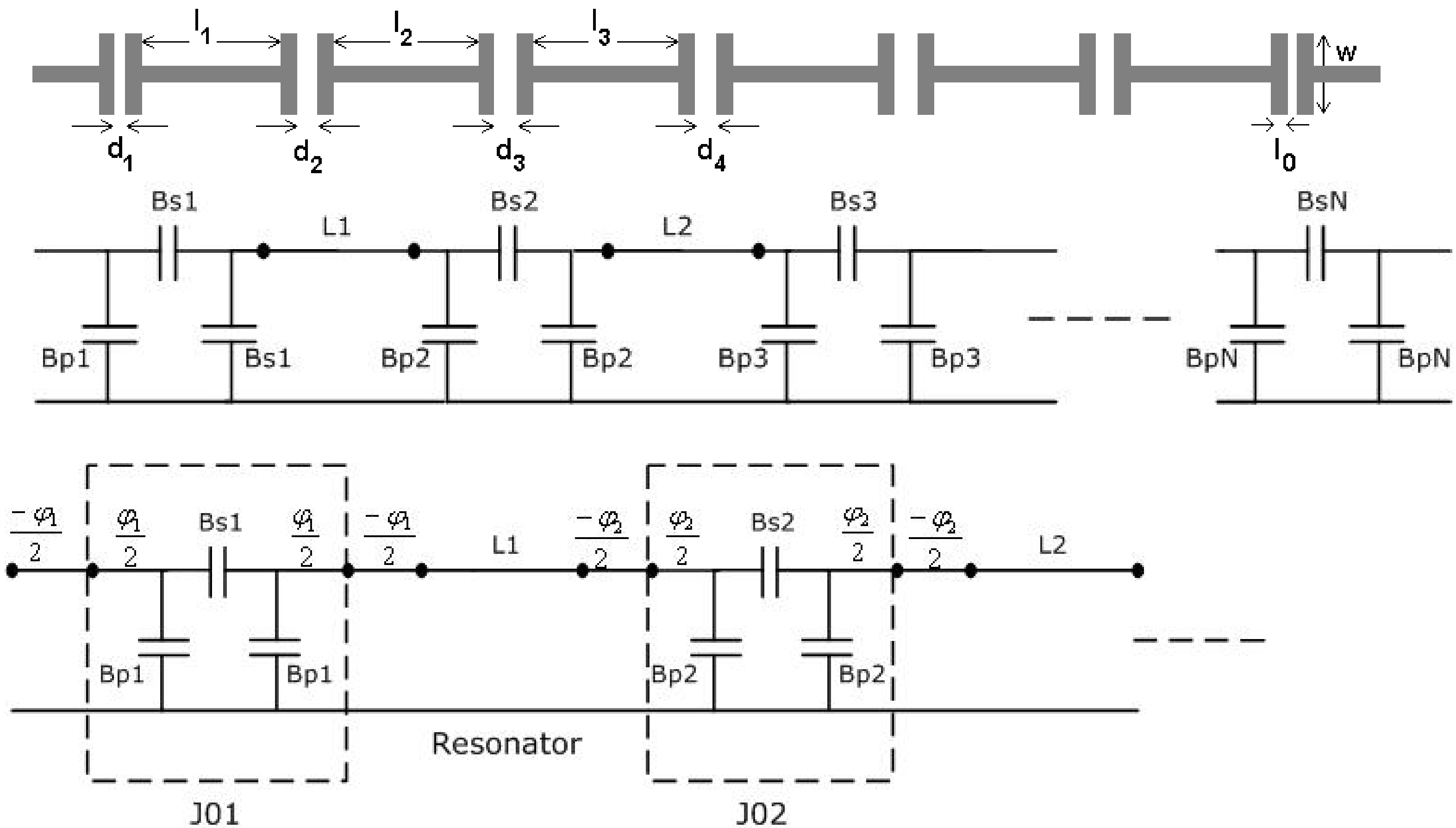


Using an EM Simulator, calculate scattering parameters from which you can calculate Y-parameters. of the capacitive discontinuity.

R. C. Cameron, C. M. Kudsia and R. R. Mansour, “Microwave Filters for Communication Systems - Fundamentals, Design and Applications, “ Wiley, 2007

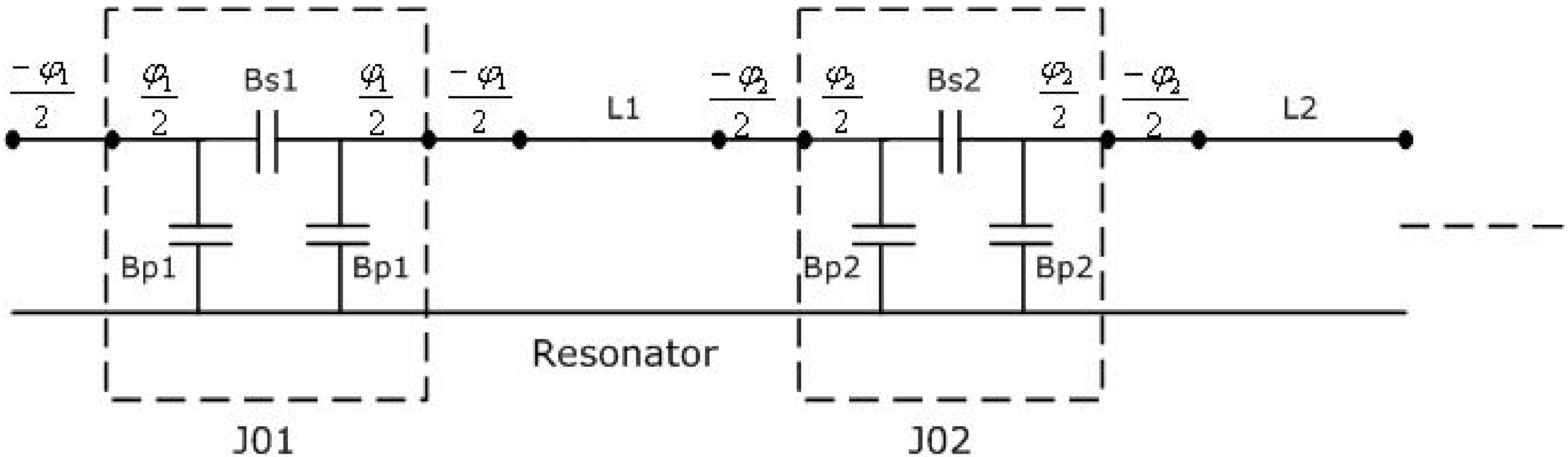
Design of a Microstrip Filter Cont.

Step 2: Calculation of Inter-resonator Coupling



R. C. Cameron, C. M. Kudsia and R. R. Mansour, “Microwave Filters for Communication Systems - Fundamentals, Design and Applications, “ Wiley, 2007

Design of a Microstrip Filter Cont.



$$\frac{J}{Y_0} = \left| \tan\left(\frac{\phi}{2} + \arctan\frac{B_p}{Y_0}\right) \right|$$

$$\phi = -\arctan\left(2\frac{B_s}{Y_0} + \frac{B_p}{Y_0}\right) - \arctan\frac{B_p}{Y_0}$$

$$l_r = \frac{\lambda_{g0}}{2\pi}\left[\pi + \frac{1}{2}(\phi_{r-1} + \phi_r)\right], \qquad r = 1,\ldots, N$$

[1] R. C. Cameron, C. M. Kudsia and R. R. Mansour, “Microwave Filters for Communication Systems - Fundamentals, Design and Applications, “ Wiley, 2007

Design of a Microstrip Filter Cont.

Lookup table to find the desired gap sizes using Momentum EM Simulator

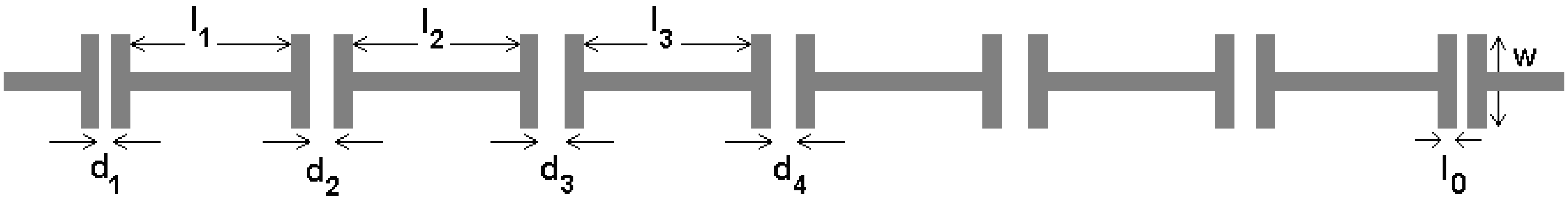
d(mm)	Y_{11}	Y_{12}	J	ϕ
0.10	-	-	0.0039	-
0.11	-	-	0.0038	-
0.133	j0.0165340	-j0.0059586	0.00361	-1.3304
0.138	-	-	0.00357	-
0.14	-	-	0.00356	-
0.15	-	-	0.0035	-
1.56	-	-	5.3439e-004	-
1.565	j0.0137929	-j0.0007837	5.3128e-004	-1.2065
1.58	-	-	5.2217e-004	-
1.80	-	-	4.0571e-004	-
1.82	-	-	3.9664e-004	-
1.83	-	-	3.9210e-004	-
1.85	j0.0137662	-j0.0005648	3.8330e-004	-1.2052
1.89	j0.0137637	-j0.0005397	3.6630e-004	-1.2050
1.90	-	-	3.6224e-004	-

Step 1 - Knowing the g-values we van get required J.
Step 2- Fix W and lo Use EM simulation for the capacitive discontinuity to find the S-parameters and the Y-parameters (Bp and Bs).
Step 3 -Generate a look-up Table for d versus J and ϕ. Then find d_n and l_n that correspond to the required J values

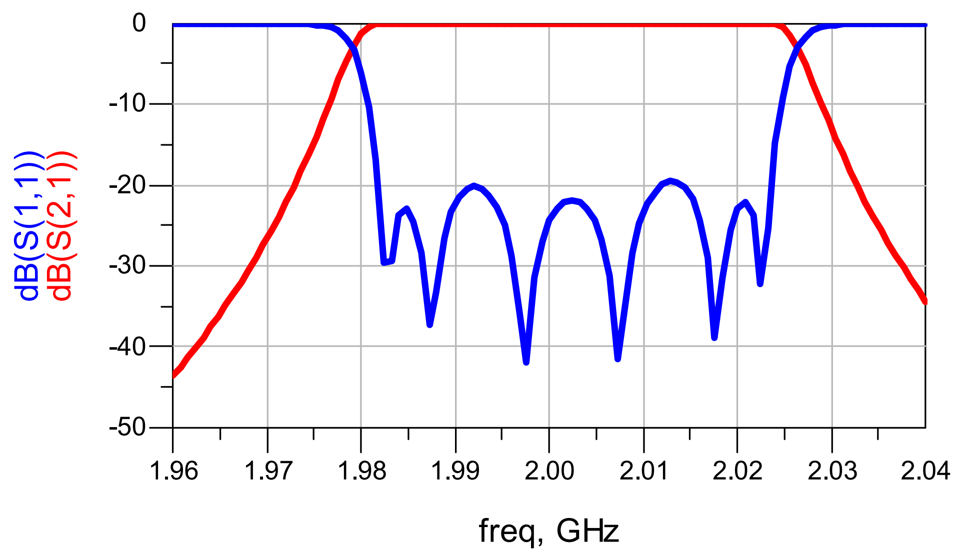
R. C. Cameron, C. M. Kudsia and R. R. Mansour, “Microwave Filters for Communication Systems - Fundamentals, Design and Applications, “ Wiley, 2007

R. Mansour

Design of a Microstrip Filter Cont.



Final Design



R. C. Cameron, C. M. Kudsia and R. R. Mansour, "Microwave Filters for Communication Systems - Fundamentals, Design and Applications, " Wiley, 2007