

ECE424F

MICROWAVE CIRCUITS

HOMEWORK #8

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Problem 1.

Suppose that you are faced with the problem of designing a receiver for PCS applications. In particular, you have to design a quadrature hybrid coupler at $f=1\text{GHz}$. Because of space constraints you soon realize that a microstrip branch-line coupler takes up a large surface on your substrate at 1GHz . Your task would be to convert the microstrip branch-line coupler to a lumped element form for saving up precious space. In the real world you would have to figure this out entirely on your own! However, because this is just an assignment you can follow the next steps:

Step #1: Derive the scattering matrix for a lossless quarter-wavelength section of a line with characteristic impedance Z_1 and a system impedance $Z_o = 50\Omega$.

Step#2: Convert the scattering matrix to an admittance matrix for the cases $Z_1 = Z_o$ and $Z_1 = Z_o/\sqrt{2}$.

Step#3: Find π -equivalent L,C networks for the quarter-wavelength lines of step#2.

Step#4: Based on the previous step and starting from the microstrip geometry of a branch-line coupler, derive the general layout of a lumped element L,C equivalent circuit.

Step#5: Give values to the L,C components of your lumped element hybrid at $f=1\text{GHz}$.

Problems 7.18, 7.21 and 7.28