

Lab #3
Branch Line Coupler (Quadrature Hybrid)
ECEn 464

Introduction: Branch line couplers find a wide variety of applications in microwave circuits. This lab is designed to give you experience in designing such structures and aid you in witnessing the importance of such structures in current use. **Be sure to provide screen shots of the pertinent information and describe what you are doing in a systematic fashion.**

Laboratory objective: Become more familiar with the branch line coupler and its uses.

Laboratory exercises:

1. Internet search and discussion of branch line couplers.

Give a short (one paragraph) synopsis of a scholarly paper that uses branch line couplers (IEEE Xplore at <http://www.lib.byu.edu> is a good database). The paper must have been published in 2002 or later. Include a copy of the first page of the paper in the lab report.

2. ADS Simulation of a branch line coupler:

Design a branch line coupler using a system impedance of $Z_0 = 50$ ohms at 6 GHz. Use the microstrip T-line palette and choose the same substrate parameters as in Lab #2. Be sure to terminate all ports. Make plots of the important behavior of the coupler over ranges of 1 GHz to 10 GHz and 5 GHz to 7 GHz.

Simulate the design and plot the relevant S-parameters to verify the functionality of the coupler. Because the transmission line Tees contribute a small amount of electrical length to the coupler, the lengths of the branches must be reduced slightly to tune the design to a 6 GHz center frequency. Use the Tuning function to adjust the branch lengths to ensure minimum reflection at 6 GHz and 3 dB output coupling. Verify that the outputs have a 90 degree phase difference. Be sure to note and explain the pertinent behaviors in the lab report.

Conclusion: Make some general observations about what you learned from ADS simulations of branch line couplers.

Below is a design for a coupler with a different substrate and for a different frequency (1 GHz). It will help you understand how to lay the circuit out. To tune, make sure you have the S-Parameter simulation item on the schematic set up as you want. Press the tuning fork in the toolbox (just to the right of the simulation “gear”). When the simulation finishes and the plot comes up, add S11, S21, S31, and S41 (in dB is usually best). Then, click on the length parameters (L = ...) for each of the four branches. The tuning window will show these parameters and allow you to tune them until your circuit is matched at the specified center frequency.

