EE6314, Fall 2009
Homework 1
Noise Figure Analysis and Simulation

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- Clearly explain the methods/ procedures. Most of the credit is for such explanations.
- You can make any reasonable assumptions. However, state them clearly.
- Use 300K for temperature unless otherwise mentioned.
- A library containing the schematics needed for this assignment is posted on website.

1 Resistive Divider

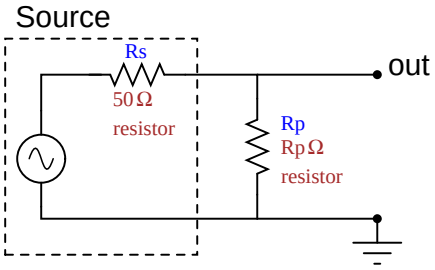

Figure 1: Resistive Divider

Objective of the problem is to simulate the noise figure of a resistive divider in the Fig (1) and compare it with the theoretical estimate.

Noise figure could be simulated in Cadence by using the ".noise" analysis.

- Initially set R_s and R_p to 50Ω. Sweep the frequency from 1kHz to 100kHz for noise analysis.
- Report the integrated noise due to R_s and R_p at the output.
- Calculate the Noise Factor and Noise Figure. Explain the procedure used in simulating the Noise Figure and Noise Factor.
- Sweep the value of R_p from 50Ω to $50k\Omega$ and plot the Noise Factor as function of R_p.

2 Equivalent Noise Parameters

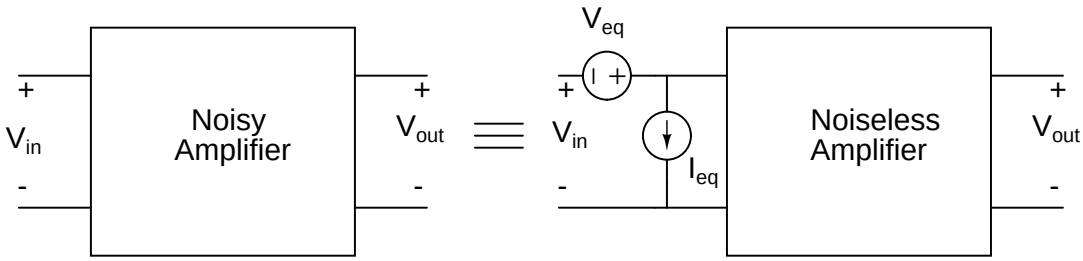

Figure 2: Equivalent representation of an amplifier

Objective of this problem is to derive the equivalent noise parameters of a given amplifier block and theoretically calculate the noise figure of an amplifier based on the derived equivalent models. Use Amplifier 1 (from the library posted on the website) for this problem.

- Perform noise analysis with input of the amplifier left open. Measure the noise at the output at 1GHz and calculate I_{eq} based on this information. Report the value of I_{eq}.
- Perform noise analysis with input shorted. Measure the noise at the output at 1GHz and calculate V_{eq} based on this information. Report the value of V_{eq}.
- Include the circuit diagrams used for above simulations.
- Based on the discussion in the class, calculate the value of Noise Figure using the calculated values of V_{eq}, I_{eq}. Use $R_s = 50\Omega$.
- Simulate the noise figure of the given amplifier block for frequencies from 900MHz to 1GHz using Cadence. Plot the Noise Figure and compare the result with theoretically calculated value.

3 Friis Equation

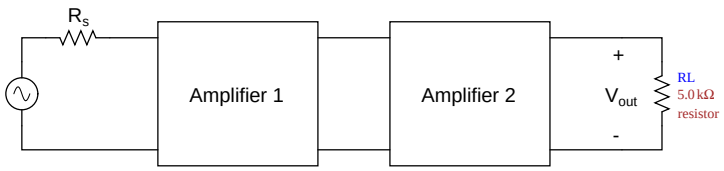

Figure 3: System to verify Friis Equation

Objective of this problem is to verify Friis Equation.

- Simulate the Noise Figure and available power gain of Amplifier 1 and 2. For noise analysis, sweep the frequency from 900MHz to 1GHz.

- Report the available power gains and plot the Noise figures.
- Using Friis Equation, calculate the Noise Figure (at 1GHz) of the cascaded system shown in the Fig (3).
- Simulate the Noise Figure (900MHz to 1GHz) of the cascaded system using cadence. Plot the Noise Figure.
- Do the simulated result and calculated result match?