

S-26.3120 Spring 2014 – Lab 4 Design of microwave transistor amplifier (LNA)

Pre-study instructions

The pre-study comprises of basic calculations required to design a single stage LNA. The goal is to use the S-Parameters for the given specifications of each group and design matching networks at the input and output and draw the schematic of the amplifier. The pre-study comprises of the following two tasks:

Task 1: Answer the following questions briefly:

1. Describe the procedure to design a low-noise microwave transistor amplifier.
2. Describe the various methods by which the amplifier can be stabilized. What are the tradeoffs when using different methods to stabilize the transistor?
3. What is the difference between the unilateral and bilateral scenario in designing transistor amplifiers and how does it impact the design? What is the unilateral figure of merit?
4. What is the difference between the operating and available power gain circles? Which of these should be considered for designing an LNA?
5. What are the different types of matching networks that can be used for matching the source and load? Enumerate the advantages/ disadvantages of the different methods.
6. How is the reflection coefficient of the designed amplifier calculated? What is the compromise when designing an amplifier for low-noise and maximum gain operation?
7. Briefly discuss the impact of grounding using plated-through holes (PTH) via.

Task 2:

1. For the given specifications of operation, calculate the stability factor and draw the input and output stability circles. Is the transistor unconditionally stable? If not, propose methods by which the stability can be improved.
2. Can you use the unilateral or bilateral scenario for the design of the transistor amplifier? Justify your selection.
3. Draw the gain and noise circles. Calculate the input and output reflection coefficients and design the matching networks. Does the input reflection coefficient satisfy the requirement? If not, what can be done?
4. Draw the final schematic of the amplifier including the matching circuits.

Note: You can use the RF toolbox in MATLAB to draw various circles and compute the reflection coefficients.

References:

1. David M Pozar, "Microwave engineering", John Wiley and sons.
2. Guillermo Gonzalez, "Microwave transistor amplifiers", 2nd edition, Prentice hall.

Return date: 17.03.2014 at 16:00 hours. (Send the pre-study to sathya.venkatasubramanian@aalto.fi)