

EE6320 Project 1: LNA Design – due Sunday 01/03/2026 (11:59pm)

In this project, you are asked to design a differential cascoded common source Low-Noise Amplifier (CS-LNA) for the specifications given below. The basic circuit topology should be that discussed in class. However, you can modify it with circuit techniques to improve its performance, as long as you support it with analytical and simulation results. Use the IBM 130 nm CMOS process parameters supplied to you through the class website ($V_{dd} = 1.2$ V, $W_{min} = 0.16$ μm , $L_{min} = 0.12$ μm). Design for the following specs:

- Frequency of operation $f_0 = 3.45$ to 3.55 GHz.
- Differential $R_{in} = 100$ Ω ; $S_{11} < -10$ dB between 3.45 GHz to 3.55 GHz.
- Capacitive load = 200 fF (minimum) at each output node.
- Differential voltage gain ≥ 20 dB over the complete band (from balun output to LNA output).
- Gain flatness over the above band should be ≤ 1 dB.
- $NF \leq 2$ dB.
- $IIP_3 \geq -10$ dBm {Use two tones separated by 1 MHz; choose the extrapolation point carefully}
- Minimise power consumption (i.e. total DC current drawn from supply); $V_{DD} = 1.2$ V

Notes:

- 1) For all your simulations, place an ideal balun from ahdLib library between single-ended input port with impedance of 50 Ω and differential output ports each with 50 Ω impedance to drive the LNA input. Alternatively, you can use an ideal $1:\sqrt{2}$ transformer to accomplish the same.
- 2) The minimum load capacitance of 200 fF represents the expected mixer input capacitance.
- 3) No ideal inductors are allowed! Add a resistor in parallel with each of the inductors in your circuit so that it has a Q of 20 at 3.5 GHz). All capacitors can be assumed to be ideal.
- 4) If the gate inductor becomes too large (>7 nH), its Q will limit your noise figure. For this project, assume that the gate inductor (whichever value you design for) will be implemented using an high-Q off-chip inductor. Add a resistance in parallel with the gate inductor such that its Q = 50 at 3.5 GHz.