Introduction to LTspice

Objectives

In this assignment, you will go through the process of constructing a schematic in LTspice, performing a DC sweep simulation, and creating a pdf file with figures showing the LTspice schematic and the simulation results with curve fits.

Background

Fig. 1a shows the schematic of an *inverting amplifier* circuit made from an op amp and two resistors. The circuit's input voltage couples into the op amp's inverting input through R_1, and the op amp's output voltage is fed back into the inverting input through a R_2. The op amp's noninverting input is held at a reference voltage, V_{ref}, somewhere within the power supply rails. The op amp adjusts V_{out} so that V becomes or remains equal to V_{ref}. A change in V_{in} has a tendancy to change V in the same direction. To compensate, the op amp changes its output in the opposite direction so that V remains constant ar or returns to V_{ref}. The amount by which V_{out} must change to compensate a given change in V_{in} is set by the ratio of the two resistors—the circuit can either amplify, invert (i.e., have a gain of -1), or attenuate, depending on the size of R_2 compared to R_1. Fig. 1b show the inverting amplifier's voltage transfer characteristic (VTC) for two values of V_{ref}. Until V_{out} saturates at one of the rails, the invering amplifier's VTC is given by

$$V_{\text{out}} = V_{\text{ref}} + A\left(V_{\text{in}} - V_{\text{ref}}\right),$$

where the gain is $A = -R_2/R_1$.

Experiment

Construct an inverting amplifier schematic in LTspice with a nominal gain of -2. Power your circuit from a single-ended $+5\,\text{V}$ power supply. Perform a DC sweep simulaton of your circuit's VTC for three values of V_{ref}. In your report, include a figure showing your LTspice schematic. Also include a single plot showing all three VTCs along with linear fits to the parts of the VTCs where the op amp's output is not saturated at one of the rails. For your plot, you should show the simulation results as discrete pointmarkers and you should show the fits as lines. You should adjust the axes limits so that the simulation results take up most of the plot. You should label your axes including appropriate units. Include the voltage gains that you obtain for each VTC from the slope of the best fit line. Please use vector-based graphics formats instead of raster-based ones.

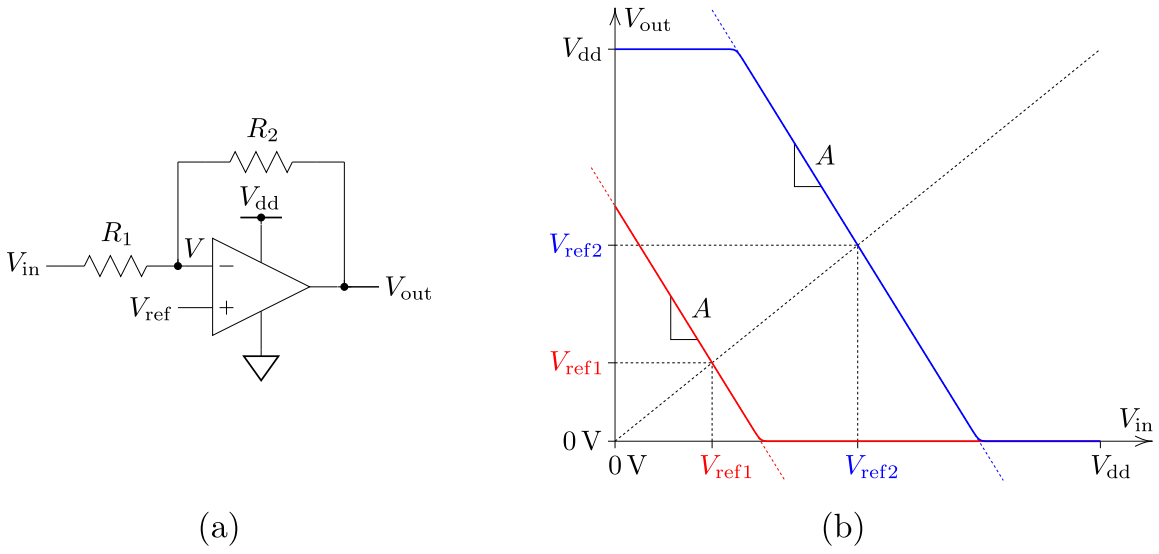

Figure 1: Inverting amplifier (a) circuit schematic and (b) voltage transfer characterisitc (VTC) for two values of V_{ref}.

Deliverable

A single pdf file containing your name and the two figures described uploaded to Canvas by noon on Wednesday, September 16, 2020.