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| Lab 2: Current Mirrors |

Student Name: Click or tap here to enter text.

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Preparation

1. **Current mirrors**

Consider ID1=1mA and VDD=5V and using the device parameters shown in Table 1 (ignore the transistor's output impedance):

1. Calculate RB and VB for current mirrors in Figure 1. Show your hand calculations.



Final answer: Click or tap here to enter text.

1. For the cascoded current mirror in Figure 1(b), calculate VB2 wisely to maximize the output swing while keeping the transistors in saturation. Show your hand calculations.



Final answer: Click or tap here to enter text.

1. Run a DC sweep to plot ID2 versus VO. You need to connect a DC voltage source to the output of the current mirror to provide VO and sweep it.
   1. DC sweep for fig. 1(a) - NMOS current mirror:



* 1. DC Sweep for fig. 1(b) - NMOS current mirror with a cascode transistor:



1. Label and comment on the plot as necessary to clearly show the output impedance and swing of the current mirrors and compare the output impedance of current mirrors.



Click or tap here to enter text.

1. **Common-source amplifier with an active load**
2. Run a DC sweep to plot VO and AV=dVO/dVi versus Vi. On your graph, show the input bias point for maximum signal swing.



1. Run a transient analysis for 10ms with a 10mVPP 1kHz sinusoidal input biased at the voltage found in the previous step. Plot VO and verify the small-signal gain found in the previous step.



Lab - Part II: Current Mirror Implementation

1. **Current mirrors**

Assemble the current mirror on a breadboard and connect a power supply to provide VDD.

1. Adjust the potentiometer (**RB**) to set **ID1 = 1 mA**. Record the value of **RB**.

Final answer: Click or tap here to enter text.

1. Connect a second power supply and a multimeter to the output side of the current mirror to provide **Vo** and measure **ID**. Use the correct multimeter port for current measurement and connect it in **series** with the circuit. Use another multimeter to measure **VD** accurately, as the power supply voltage reading may not be precise.
2. Vary **Vo** from **0 V to 5 V** and measure **ID** at each step to generate an **ID vs. VD** curve. Use enough points to guarantee an acceptable accuracy. Plot the resulting figure below while marking the measured points.



1. highlight the **output impedance** and **swing** of the current mirror. Provide comments on the observed behavior.

Final answer: Click or tap here to enter text.

1. **Common-source amplifier with a current-mirror load**

Do the following for the common-source amplifier with an active load shown in Figure 2. Use ID1=1mA and VDD=5V.

1. Adjust the potentiometer (**RB**) to set **ID1 = 1 mA**, following the same procedure as Step 1 in Lab - Part 1. Determine and record the value of **RB**.

Final answer: Click or tap here to enter text.

1. Use a potentiometer and capacitor, as in Lab 1, to bias the input for maximum output swing. Measure and record the input bias voltage.

Final answer: Click or tap here to enter text.

1. Apply a 1 kHz sinusoidal input signal with an amplitude of 10 mVpp. Measure the peak-to-peak voltage of the output signal and calculate the small-signal gain of the amplifier.



1. Adjust the amplitude of the input signal to determine the output swing of the amplifier. Identify the maximum output swing by gradually increasing the input amplitude until the output signal exhibits visible distortion (i.e. clipping). Record the corresponding input and output values on the same plot.



Output swing: Click or tap here to enter text.