University of Washington

BEE331 Lab 2

2301991 *Jason Truong*

2130474 *Henry Haight*

supervised by
Prof. Joseph Decuir

July 31, 2024

MOSFET Bias Circuit

Design Objective

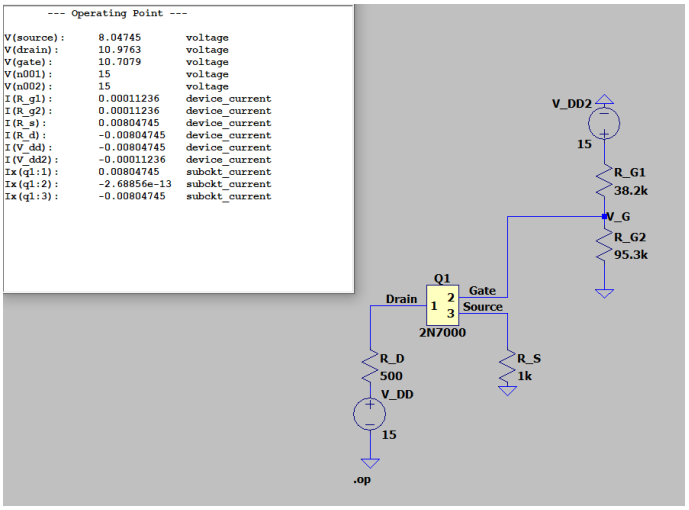
In this lab we bias a MOSFET for use in both saturation and triode regions. This allows us to maintain a stable DC operating point.

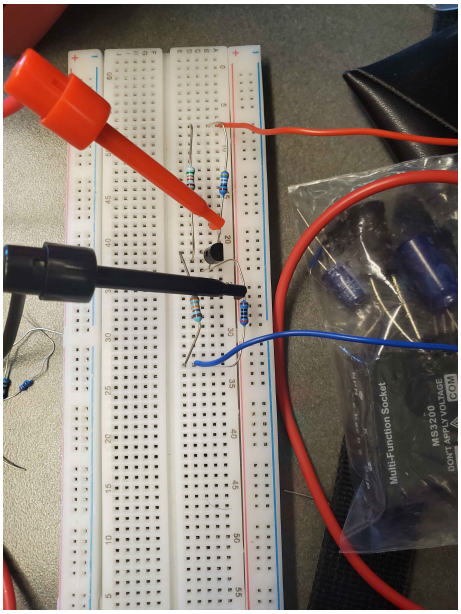
Circuit Design Outline

Using our calculated resistors of 38.2$k\Omega$ and 95.3$k\Omega$ combined with our given resistance values of 500Ω and 200Ω and connecting them to our NMOS transistor in the configureation shown below we can bias our circuit so that the current across the 500Ω and 200Ω (I_D) is 10mA. By inputting a voltage of 15V at the leg of the 500Ω resistor we can achive 10mA across the resistors.

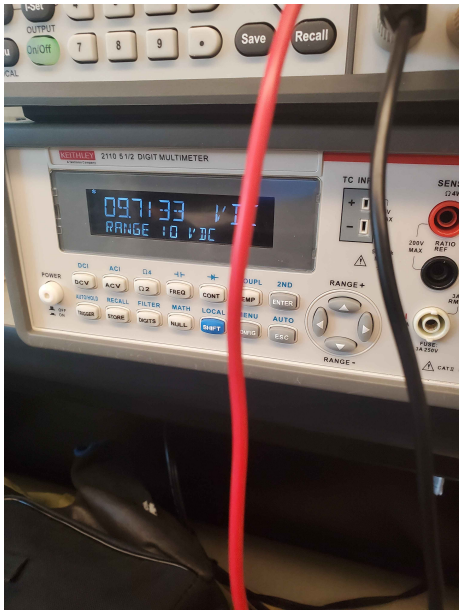
Figure 1: Bias Circuit

(a) Bias Circuit Sim





(b) Bias Circuit Image



(c) Bias Circuit Measurement

Measurement and Simulation Results

Analysis

- **1. Calculate expected V_G, I_D and V_{DS}**

  Using $V_{GS} = V_G$ - V_S and a voltage divider accross the $38.2k\Omega$ and $95.3k\Omega$ resistors we find that $V_G = 10.708$V.

  Using the equation $I_D = k_n(V_{GS} - V_T)^2$ we can solve for I_D obtaining $I_D = 10.84mA$ using $k_n = 0.0011$ and $V_T = 1.6$

  V_{DS} is therefore found using $V_{DS} = V_D$ - V_S where V_D is found using I_D, V_{DD}, and the 500Ω resistor. This gives us $V_{DS} = 7.411V$

- **2. Compare to simulated results for V_G, I_D and V_{DS}**

  The simulated results for V_G, I_D and V_{DS} all line up with what we observed during our measurements. The % difference between the calculated and simulated values are found at a 2% difference (10.84mA vs 11.04mA).

- **3. Comment on discrepancies**

  Discrepancies appear from the natural impedance of the NMOS transistor; and the transience of the Gate-Voltage causing a natural and slow rise. As Semiconducting Materials in real life are difficult to keep at a consistent voltage due to them being VERY sensitive and dependent on temperature.

Summary & Conclusions

In this lab, we analysed; characterised; and designed with an NMOSFET transistor for the I_D over both the V_{GS} and V_{DS} region, but also the biasing effects of voltage-dividing over V_G