Pre-Lab 5

Michael Brodskiy
Professor: M. Onabajo

November 11, 2024

1. We may begin by performing a DC analysis of the circuit. As a result, we may see that I_D and V_{DS} need to be calculated. Assuming performance in the saturation region (since this is preferred for amplification), we may write:

$$I_D = \frac{1}{2}\mu_n \cos\left(\frac{w}{L}\right)(V_{GS} - V_t)^2$$

We can substitute in known values to obtain:

$$I_D = \frac{1}{2}\left(.25 \cdot 10^{-3}\right)(2-1)^2$$
$$\boxed{I_D = .125[\text{mA}]}$$

From this, we may write:

$$-V_{DD} + R_D I_D + V_D = 0$$
$$V_D = V_{DD} - R_D I_D$$

We now substitute known values to get:

$$V_D = (10) - (10k)(.125m)$$
$$\boxed{V_D = 8.75[\text{V}]}$$

To confirm saturation conditions, we get:

$$V_{DS} \geq V_{GS} - V_t$$

$$V_{DS} = V_{DD} - V_D$$
$$V_{DS} = 10 - 8.75$$

$$\boxed{V_{DS} = 1.25[\text{V}]}$$

Since $1.25 \geq 1$, we may conclude that we are, as a matter of fact, operating in saturation. We may proceed to calculation of a Thévenin equivalent:

$$V_{th} = V_{DD}\left(\frac{R_{G2}}{R_{G1} + R_{G2}}\right)$$
$$R_{th} = \left(\frac{R_{G1}R_{G2}}{R_{G1} + R_{G2}}\right)$$
$$R_{th} = \left(\frac{R_{G1}R_{G2}}{R_{G1} + R_{G2}}\right)$$

To find the correct values, we use KVL to write:

$$-V_{DD} + I_D R_D + V_{DS} + V_S = 0$$

This lets us find V_S:

$$V_S = 10 - 8.75 - 1.25$$
$$V_S = 0[\text{V}]$$

Since we know the value of V_{GS}, we write:

$$V_{GS} = V_G - V_S$$
$$2 = V_G - V_S$$

Thus, we find that $V_G = V_{th} = 2[\text{V}]$. We may then write:

$$2 = \frac{10R_{G2}}{R_{G1} + R_{G2}}$$
$$R_{G1} + R_{G2} = 5R_{G2}$$
$$R_{G1} = 4R_{G2}$$

We can take any values for which the above statement is true. As such, let us use:

$$\boxed{R_{G1} = 4[\text{M}\Omega] \quad \text{and } R_{G2} = 1[\text{M}\Omega]}$$

2. Read through, no questions ✓

3. We may combine some CD4007s to obtain (Note A, B, and C are the push-button inputs):

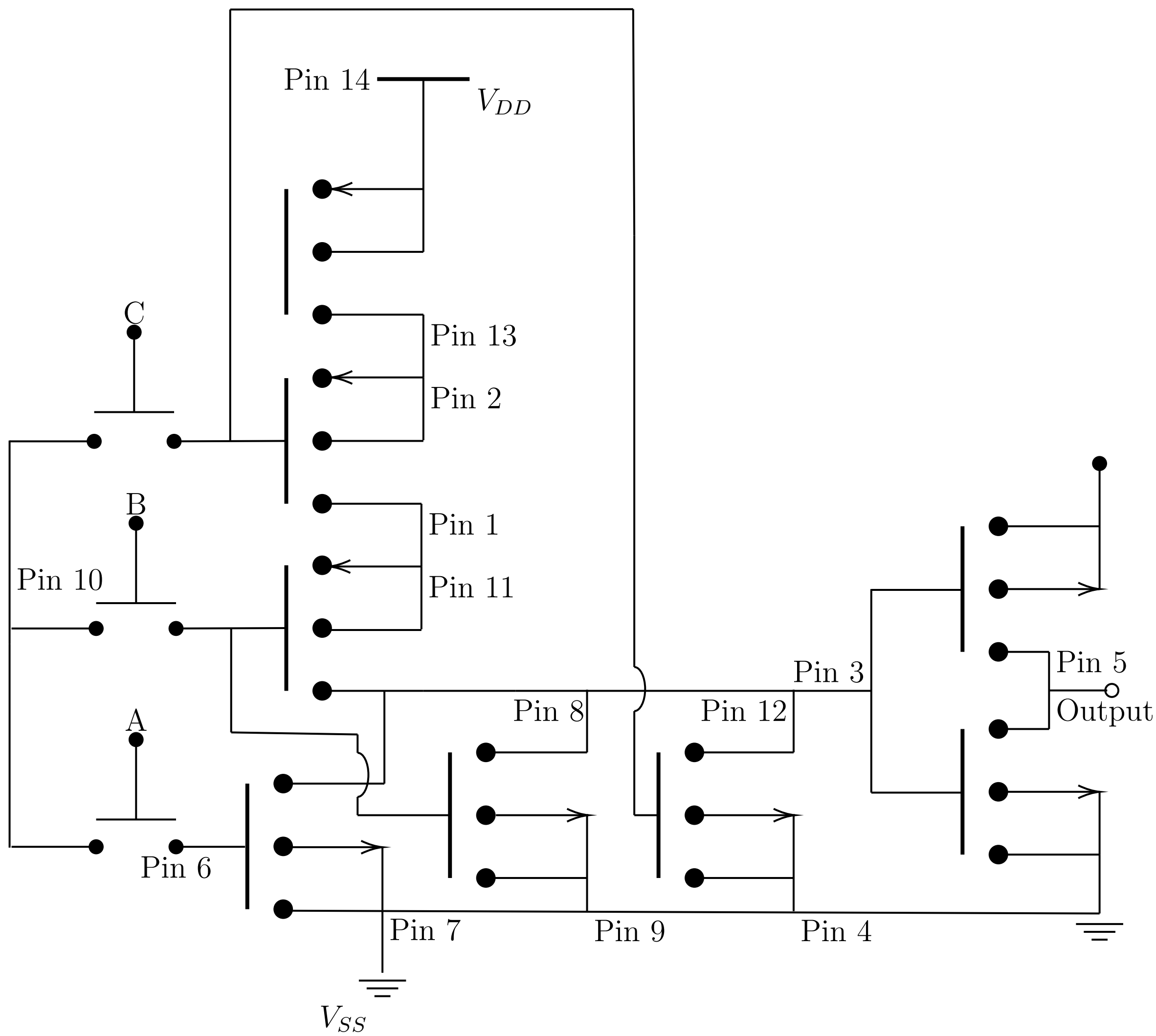

Figure 1: CD4007 Combination