



**University of Alexandria**  
**Faculty of Engineering**

*Division of Communications & Electronics*

Third Year– Semester 2

**Analog Integrated Circuits**  
**Lab**

---

*Experiment 3*

**Common Source Amplifier**

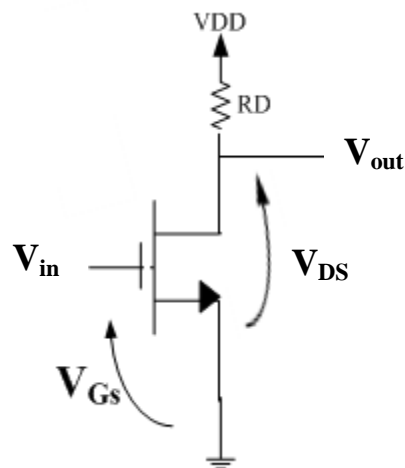
---

## I. Lab Work:

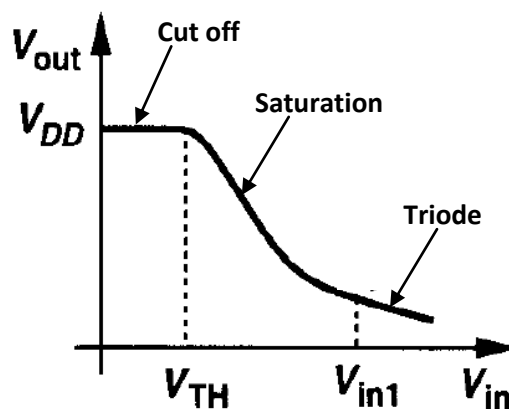
### ➤ Basic Idea

We can use a MOSFET transistor as a small signal amplifier. Since it mainly has 3 terminals (Drain, Source & Gate), we put the input signal on one terminal, take the output signal from another terminal and use the third one as a common between the input & output terminals.

In this experiment, we will put the input on the gate; take the output from the drain and use the source as the common. That's why this configuration is known as *Common Source Amplifier*.



Observe the large signal behavior of the amplifier



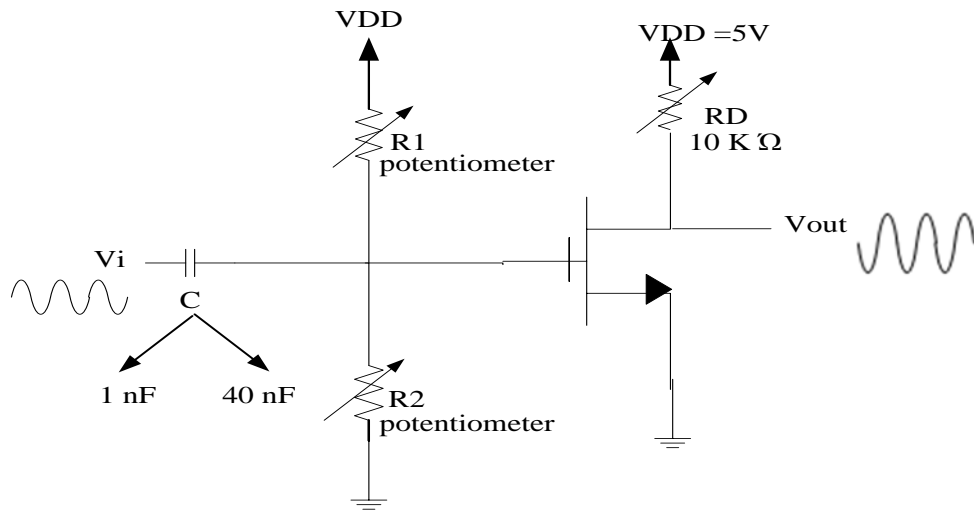
We can notice that the region that has the largest slope (i.e. the largest  $\frac{dV_{out}}{dV_{in}}$ ) is the saturation region.

So to have an amplifier with large gain (i.e. large  $\frac{dV_{out}}{dV_{in}}$ ), we will make our transistor work in saturation region.

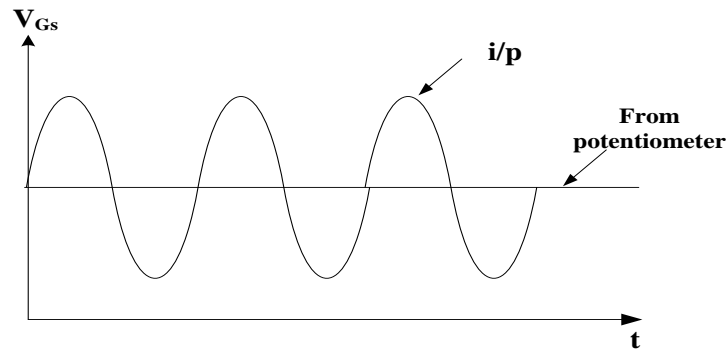
❖ Small signal Gain of common source amplifier:  $A_v = -g_m R_D$

- The  $-ve$  sign indicates that there is a phase shift  $180^\circ$  between input and output.
- If  $R_D$  increases, gain increases.
- If  $g_m$  increases, gain increases. To change the value of  $g_m$ , we will change  $V_{G_s\ dc}$ . Since  $g_m = \mu_n C_{ox} \left(\frac{W}{L}\right) (V_{G_s\ dc} - V_{th})$ , if  $V_{G_s\ dc}$  increases,  $g_m$  increases, gain increases.

### ➤ Lab Experiment



- Potentiometer ( $R_1$ ,  $R_2$ ) is used to put variable  $V_{G_s\ dc}$ .
- Capacitor ( $C$ ) to add  $V_{G_s\ ac}$  to  $V_{G_s\ dc}$ .



- Fix the input to sinusoidal wave of 0.5 V<sub>pp</sub> from the function generator and observe the output on the oscilloscope. You can use the second channel of the oscilloscope to show the input wave. Put the oscilloscope in the dual mode and observe the phase shift between output and input.
- First: We want to plot gain *vs* R<sub>D</sub>. Change R<sub>D</sub> & observe what happens to the output. Measure the value of R<sub>D</sub> and the output wave.
- Second: We want to plot gain *vs* V<sub>Gs dc</sub>. Change V<sub>Gs dc</sub> by changing potentiometer and observe the change in the output on the oscilloscope.
- Third: The input Capacitor and the potentiometer works as a HPF. We want to calculate the lower frequency f<sub>L</sub> below which the output signal starts to decrease. Measure f<sub>L</sub> for each of the two capacitors C<sub>1</sub> & C<sub>2</sub>. Try to deduce which is the bigger capacitor.
- Fourth: At high frequencies, the effect of the internal capacitances of the transistor begins to appear decreasing the amplifier gain. We want to calculate f<sub>H</sub> above which the output begins to decrease.