EE230: Analog Circuits Lab
Lab No.9

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Contents

1 Common Source (CS) Amplifier with Resistive Load

1.1 Aim of the experiment

The aim of this experiment is to design, simulate, and analyze a MOSFET based Common Source (CS) Amplifier with a resistive load to achieve a small signal gain (Av) greater than 18 dB.

1.2 Design

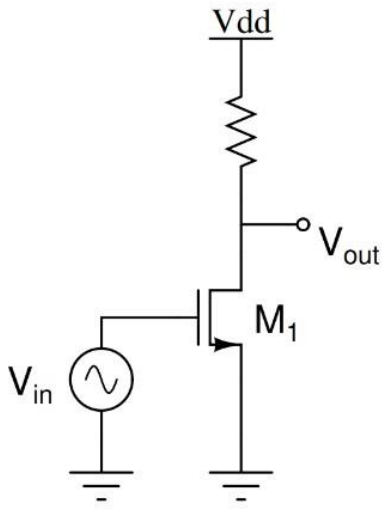

Figure 1: CS Amplifier with Resistive Load

Values taken are,

$$V_m = 1V$$

$$A_v = 20dB$$

By calculation, the values of R_D came out to be $23.678K\Omega$.

1.3 Experimental Results

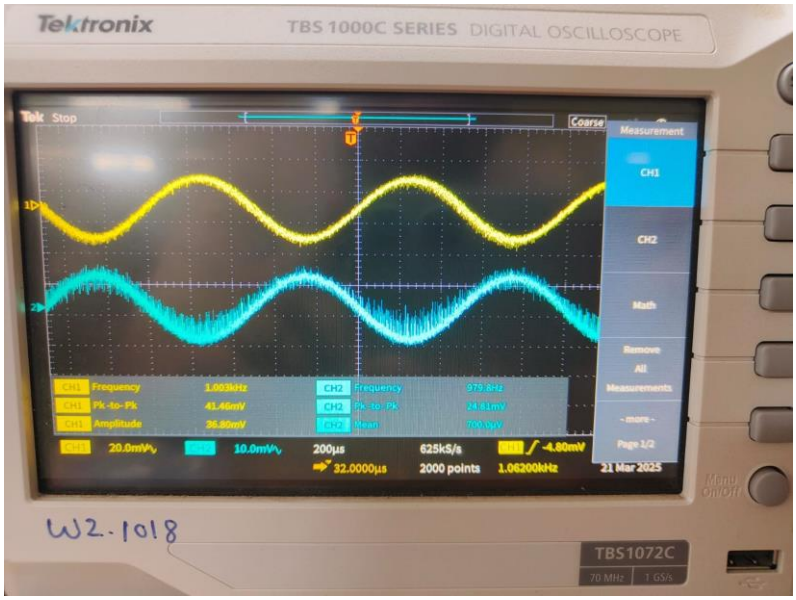

Figure 2: V_{out} before Adjusting

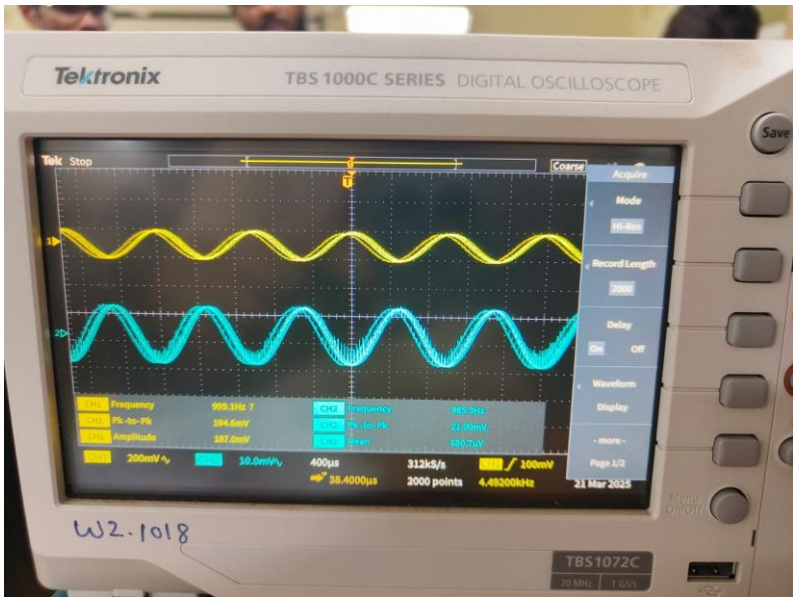

Figure 3: V_{out} after Adjusting

1.4 Conclusion and Inference

After adjusting values for R_D and V_{bias} the final values are:

- $R_D = 33.678K\Omega$
- $V_{bias} = 1.7V$
- $V_{outdc} = 3.4V$
- $A_{v(Experimental)} = 19.73dB$
- The MOSFET is operating in saturation region as $V_{GST} > 0$ & $V_{DS} > V_{GST}$.

1.5 Experiment completion status

I have completed all the parts for this section of the experiment.

2 Common Source (CS) Amplifier with Diode Connected Load

2.1 Aim of the experiment

The aim of this experiment is to design, simulate, and analyze a MOSFET based Common Source (CS) Amplifier with a diode load.

2.2 Design

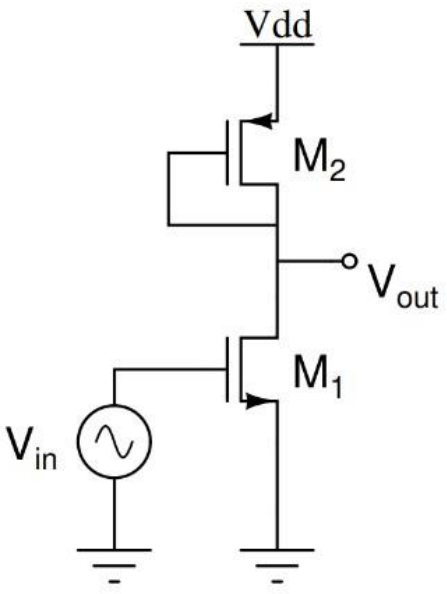

Figure 4: CS Amplifier with Resistive Load

Values taken are,

$$V_m = 1V$$

$$V_{in} = (\sqrt{\frac{K_{p_2}}{K_{n_1}}}(V_{dd} - (V_{in} - V_{th_1} + V_m) - V_{th_1})) + V_{th_1}$$

Solving this, $V_{in} = V_{bias} = 2.069V$.

$$V_{outdc} = V_{in} - V_{th1} + V_m = 2.259V$$

$$A_{v(calculated)} = \sqrt{\frac{K_{n_1}}{K_{p_2}}} = 1.78$$

2.3 Experimental Results

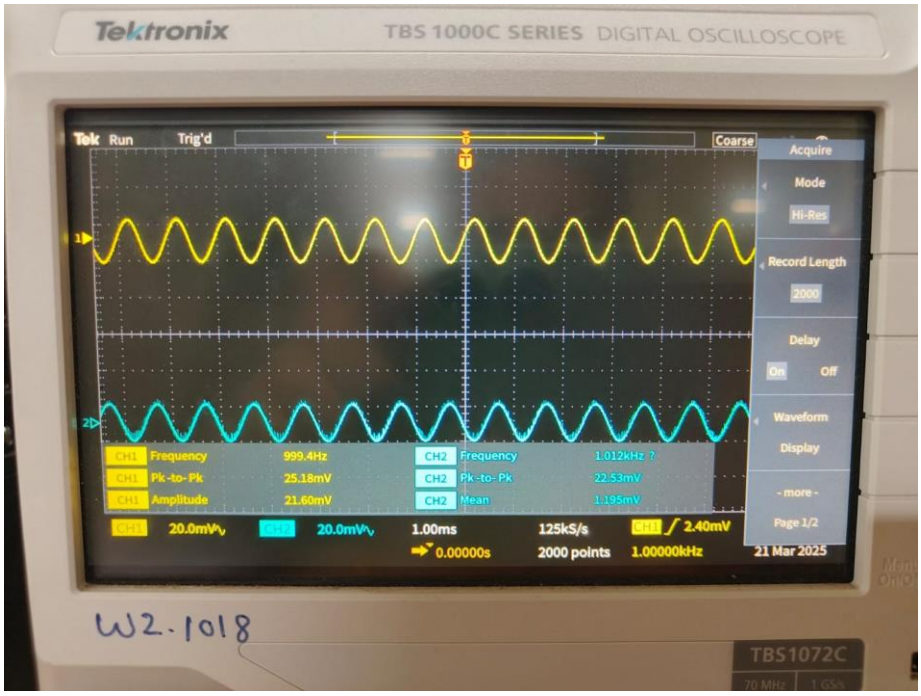

Figure 5: Vout and Vin

2.4 Conclusion and Inference

After adjusting values for V_{bias} the final values are:

- $V_{bias} = 2.069V$
- $V_{outdc} = 2.9V$
- $A_{v(simulation)} = 2.2dB$
- The MOSFET is operating in saturation region as $V_{GST} > 0$ & $V_{DS} > V_{GST}$.

2.5 Experiment completion status

I have completed all the parts for this section of the experiment.

3 Current Mirror (CM) Design

3.1 Aim of the experiment

The aim of this experiment is to study the Current Mirror circuit & analyze the value of V_{DS2} for which the current derived becomes equal to the current in primary side.

3.2 Design

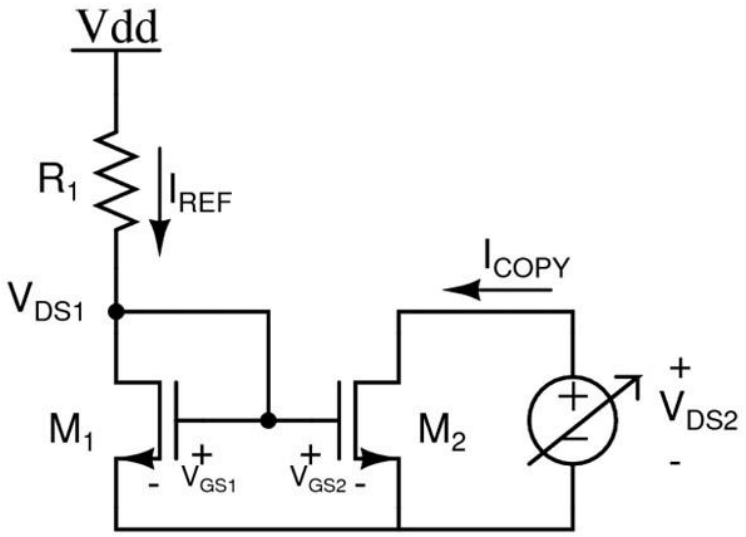

Figure 6: CS Amplifier with Resistive Load

$$I_{REF} = \frac{K_n}{2}(V_{GS_1} - V_{TH_1})^2$$

Solving this, $V_{GS1} = V_{DS1} = 3.323V$ Thus, $R_1 = 2338.5\Omega$.

3.3 Experimental Results

V_{DS2} (in V)	I_{COPY} (in mA)
0 V	0 mA
0.5 V	0.9 mA
1 V	1.47 mA
1.5 V	1.64 mA

2 V	1.67 mA
2.5 V	1.69 mA
3 V	1.70 mA
3.5 V	1.71 mA
4 V	1.71 mA
4.5 V	1.72 mA
5 V	1.72 mA
5.5 V	1.72 mA
6 V	1.73 mA
6.5 V	1.73 mA
7 V	1.74 mA
7.5 V	1.75 mA
8 V	1.75 mA

3.4 Conclusion and Inference

- $V_{GS1} = V_{DS1} = 3.4V$.
- $I_{REF} = 1.9mA$
- We should've observed minimum mrror between I_{REF} & I_{COPY} when $V_{DS1} = V_{DS_2}$
- To design the current mirror for $I_{COPY} = NI_{REF}$, where N is a positive integer, adjustments in the sizing of current source MOSFETs are required. This involves connecting multiple MOSFETs in parallel with appropriate sizing to achieve the desired multiplication factor.

3.5 Experiment completion status

I have completed all the parts for this section of the experiment.