OUTPUT STAGES

Goal:
Construct a source follower and find its incremental gain, $\chi$ and the output impedance.

Setup:

Assemble the above circuit. Now connect a 10k potentiometer.
Procedure:

1) Vary the voltage at the gate from \(-10\)V to \(+10\)V in steps of 1V, by sweeping the potentiometer from minimum to maximum position. i.e. take 21 readings in \([-10\,\text{V},+10\,\text{V}]\) range.

2) Now draw the following graph.

3) The slope of the curve near the point \(x\) gives the incremental gain.

4) \(\chi\) can now be calculated from, \(\text{slope} = \left[ \frac{1}{1 + \chi} \right]\)

5) Why is the output voltage always less than the input voltage?

6) Somebody claimed that the output voltage can be improved by connecting a 2k resistor between the gate and the source of the mosfet. He claimed that there is a feed forward through the 2k resistor and so the voltage at the output improves. Is he correct? Why? Why not? Verify. [You may notice that only the lower half of the waveform improves and not the upper half. Explain why.]

Now let us move to find the output impedance of this circuit.

So, let us construct the circuit as given in the next page
7) At the gate of the mosfet, input a sine wave – 4Vpp – 2KHz – zero DC offset.

8) You may need to adjust the DC offset to get a maximum sine wave at the source of the mosfet. Let us assume that you are getting a sine of Vpp = K volts, at source.

9) Now add a load of 1uF in series with a 1Meg potentiometer.

10) Now start sweeping the potentiometer from the minimum to maximum position [ By doing so, you are decreasing the potentiometer resistance and so consequently increasing the load current. So don’t short the potentiometer by sweeping it to a maximum position and burn the mosfet!] At the same time, keep an eye on the waveform at the source. Stop sweeping the potentiometer when the sine wave becomes half of its initial Vpp value i.e. \( \frac{k}{2} \).
At this point, your circuit is behaving as the following thevenin’s equivalent circuit,

\[ \begin{align*}
\text{Zout} & & V_{pp} = \frac{k}{2} \text{ Volts} \\
\text{Potentiometer resistance} & & \\
\end{align*} \]

Initially you were getting K volts. Now you are getting only k/2 volts, which means that the current potentiometer resistance is same as the Zout of the circuit.
But now you need to measure the current potentiometer resistance.
For this, remove the potentiometer from the circuit.
Now connect that end of the potentiometer which was connected to the negative end of the 10uF capacitor, to the positive end of a 5V supply. Connect the tapping point of the potentiometer to the negative end of the power supply. Switch on the power supply and note the current flowing through.

Now use the ohms law and get the value of the resistance. This value gives the current potentiometer resistance, which is same as the Zout of the circuit.

**RESULTS:**

1. The incremental gain of the given source follower is ____
2. The $\chi$ of the circuit is ______
3. The output impedance of the given source follower is____