Kathmandu University
Department of Electrical and Electronics Engineering
ANALOG ELECTRONICS LABORATORY WORK

EXPERIMENT 4: Controlled Sources

Objectives: To understand the operation of different controlled sources as applied to basic amplifier types

Software:
Multisim 8

Theory:
Amplifiers are basically dependent sources. Depending upon source and load effect, amplifiers are categorized into four types. When output voltage is a function of input voltage it is VCVS amplifier. When output voltage is a function of input current it is CCVS amplifier. When output current is a function of input current it is CCCS amplifier. When output current is a function of input voltage it is VCCS amplifier.

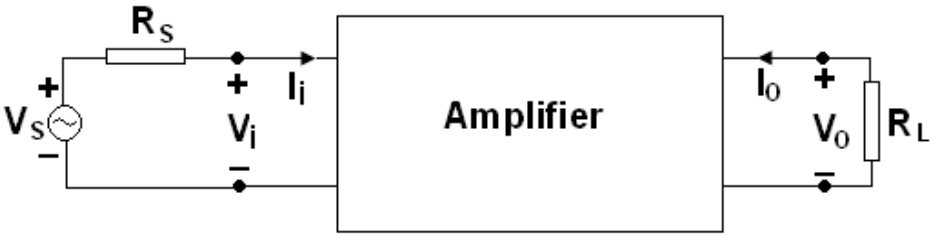

Fig 1

In this lab, we only consider unilateral amplifiers where reverse transmission factor is zero. In general, amplifiers are bilateral where it has finite reverse transmission factor. R_i is the input resistance of the amplifier and R_o is the output resistance of the amplifier. In general V_S can be another amplifier stage with source resistance R_s and R_L can be another amplifier stage totally drive by the amplifier shown in fig 1.

Voltage Controlled Voltage Sources (VCVS)

When $R_i >> R_S$, then the amplifier is VC and usually represented as Thevenin equivalent in the input terminal. When $R_o << R_L$, then the amplifier is VS. The important parameter of VCVS is $V_o = KV_i$, where K is the open circuit voltage gain of the amplifier. The amplifier are called voltage amplifier.

Current Controlled Current Sources (CCCS)

When $R_i << R_S$, then the amplifier is CC and usually represented as Norton's equivalent in the input terminal. When $R_o >> R_L$, then the amplifier is CS. The

important parameter of CCCS is $I_o = KI_i$, where K is the short circuit current gain of the amplifier. The amplifier are called current amplifier.

Voltage Controlled Current Sources (VCCS)

When $R_i >> R_S$, then the amplifier is VC. When $R_o >> R_L$, then the amplifier is CS. The important parameter of VCCS is $I_o = YV_i$. The amplifier are called trans-conductance amplifier.

Current Controlled Voltage Sources (CCVS)

When $R_i << R_S$, then the amplifier is CC. When $R_o << R_L$, then the amplifier is VS. The important parameter of CCVS is $V_o = ZI_i$. The amplifier are called trans-resistance amplifier.

VCVS

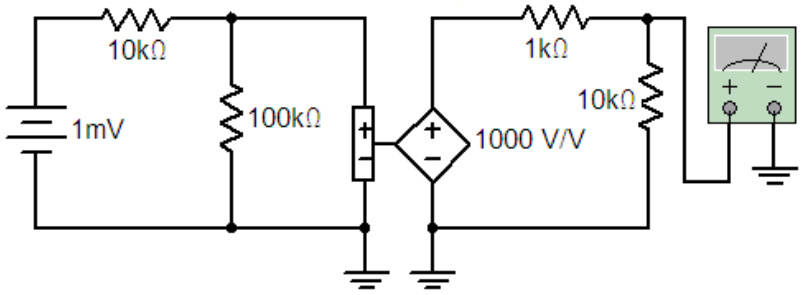

Fig 2

Procedure

1. Connect the circuit as shown in fig 2.
2. Find the voltage gain of the amplifier (V_o / V_s)
3. Find the current gain of the amplifier.

CCCS

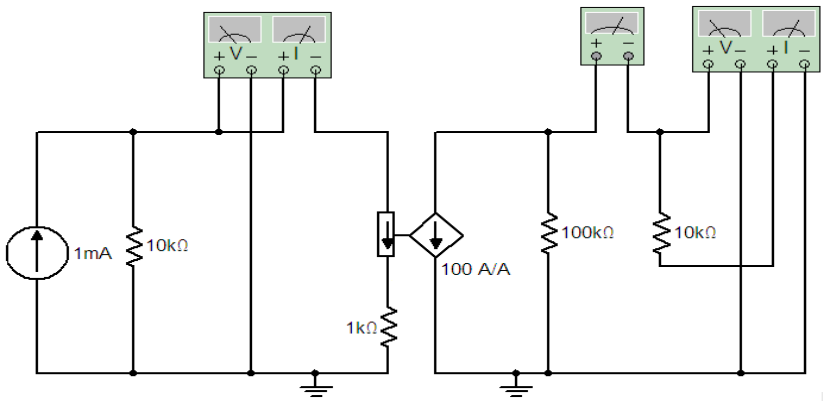

Fig 3

Procedure

1. Connect the circuit as shown in fig 3 without the wattmeters.

2. First find the current gain of the amplifier (I_o / I_s).
3. Find the power gain of amplifier from the reading of wattmeters.
4. Remove the wattmeter and measure the output voltage and input voltage by using multi-meter across 10K resistors (V_o /V_i).
5. By using the multi-meter in current mode, measure the current through 1K resistor and 10K load resistor. (I_o / I_i).
6. Verify that power gain of amplifier is equal to product of voltage gain and current gain.

Multistage Amplifier

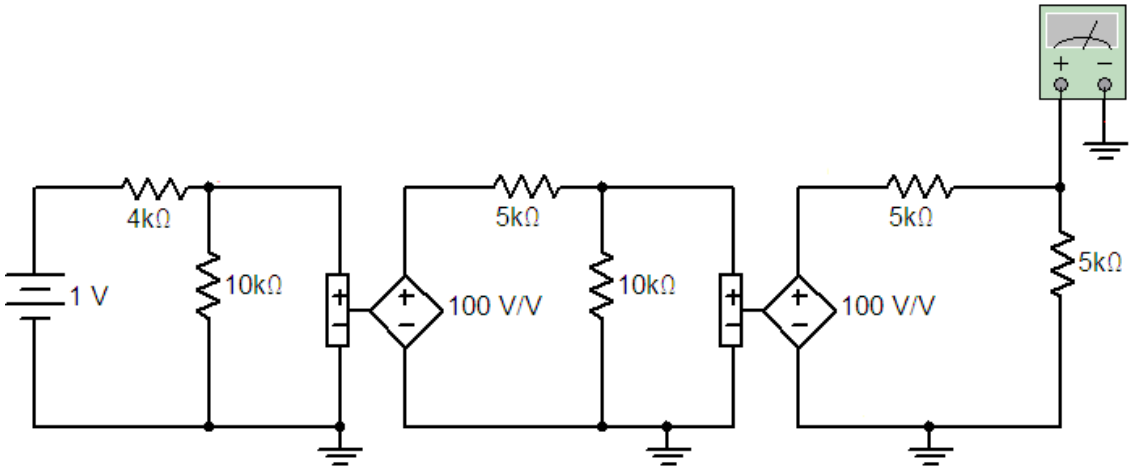

Fig 4

Procedure

1. Measure the voltage gain (V_{o2} / V_s).
2. Measure the voltage across 10K resistor of first amplifier and find (V_{o2}/V_{i1}).
3. Measure the current through 10K resistor of first amplifier (I_{i1}) and current through 5K resistor of second amplifier (I_{o2}). Find the current gain.
4. Connect the wattmeters and find output power and input power.
5. Find the power gain in dB.
6. Measure output current of first amplifier and its input current. Find the current gain.
7. Measure output voltage of first amplifier and its input voltage. Find the voltage gain.
8. Verify that when the identical amplifiers are cascaded, voltage gain is equal to the current gain of each stage.

Amplifier Conversion From VCVS to VCCS

Procedure

1. Connect the circuit as shown in fig 5.

2. Find the voltage gain and compare with that of fig 2.
3. Find the current gain and compare with that of fig 2.

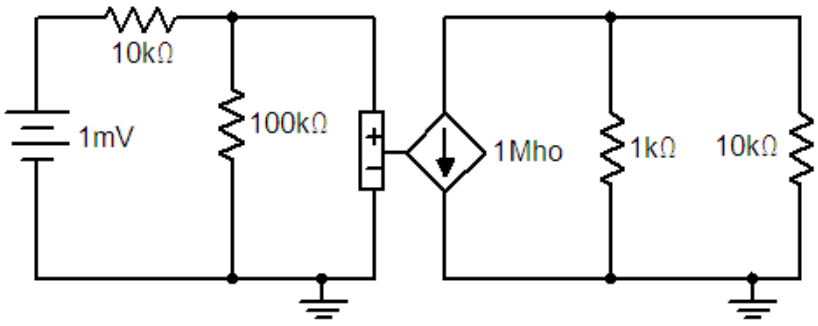

Fig 5: Equivalent VCCS representation of VCVS of fig 2