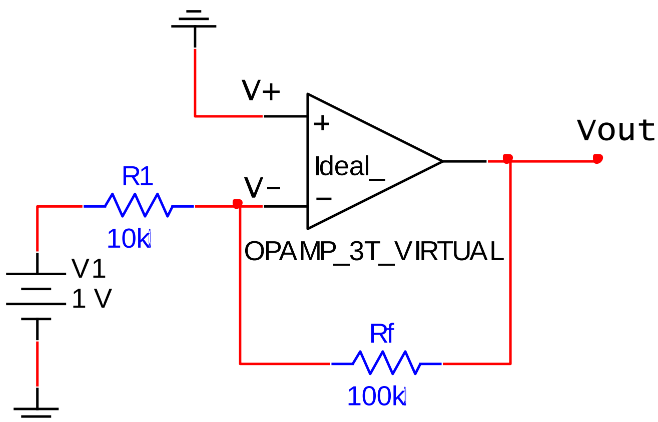
Component Level Laboratory

Analog Power Source Fundamentals (VCCS, CCVS,)

Exercise 1: Inverting Op Amp Circuit

A. Model the circuit shown below using Multisim (choose Ideal OpAmp chip). Energize the model, and use the analysis tools provided in Multisim, measure and record the following circuit parameters:



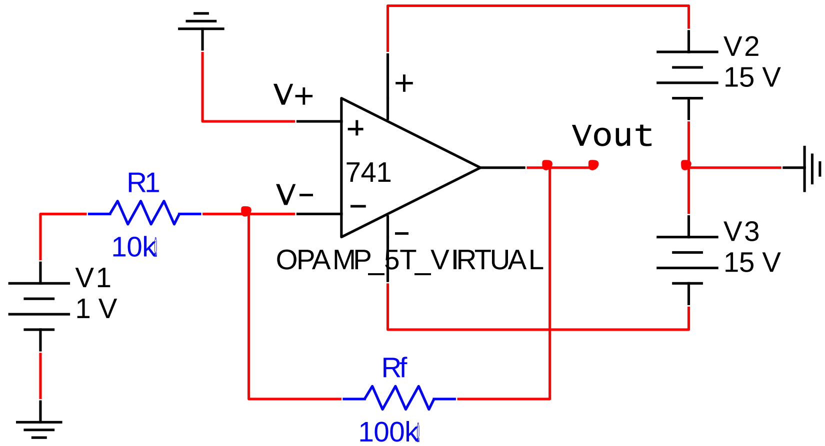
a. V_{R1}: ___________________ b. V_{RF}: ___________________

c. V_{+}: ___________________ d.V-: ___________________

e. I-: ___________________ f. V_{out}: ___________________

g. I_{RF}: ___________________ h. Gain: ___________________

B. Using Multisim, model the circuit shown below (choose 741 OpAmp chip). Energize the model and use the Multisim analysis tools to measure the following circuit parameters:



a. V_{R1}: ____________________ b. V_{RF}: ____________________

c. V_{+}: ____________________ d.V-: ____________________

e. I-: ____________________ f. V_{out}: ____________________

g. I_{RF}: ____________________ h. Gain: ____________________

C. Construct the same circuit on a breadboard. Measure and record the circuit parameters:

a. V_{R1}: ____________________ b. V_{RF}: ____________________

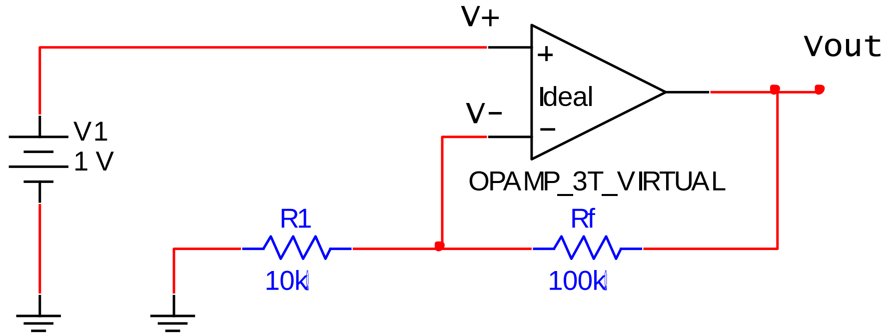
c. V_{+}: ____________________ d.V-: ____________________

e. I-: ____________________ f. V_{out}: ____________________

g. I_{RF}: ____________________ h. Gain: ____________________

Exercise 2: Non-Inverting Op Amp Circuit

A. Model the circuit shown below using Multisim (choosing Ideal OpAmp chip). Energize the model. Measure and record the following circuit parameters using the analysis tools provided in Multisim.



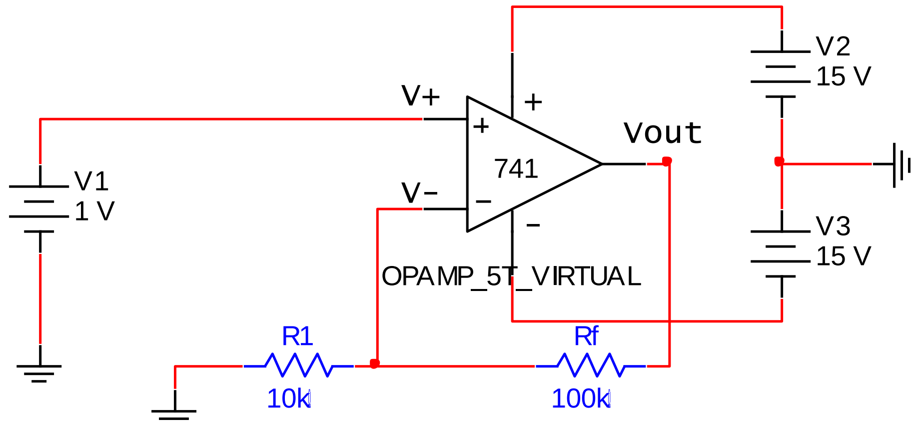
a. V_{R1}: ____________________ b. V_{RF}: ____________________

c. V_{+}: ____________________ d.V-: ____________________

e. I+: ____________________ f. V_{out}: ____________________

g. I_{RF}: ____________________ h. Gain: ____________________

B. Using Multisim, model the circuit shown below (choose 741 OpAmp chip). Energize the model and use the Multisim analysis tools to measure the following circuit parameters:



a. V_{R1}: ___________________ b. V_{RF}: ___________________

c. V_{+}: ___________________ d. V_{-}: ___________________

e. I+: ___________________ f. V_{out}: ___________________

g. I_{RF}: ___________________ h. Gain: __________________

C. Construct the same circuit on a breadboard (use the +/-12V breadboard power supply to replace the +/-15V power supply shown in the figure). Measure and record the circuit parameters

a. V_{R1}: ___________________ b. V_{RF}: ___________________

c. V_{+}: ___________________ d. V_{-}: ___________________

e. I+: ___________________ f. V_{out}: ___________________

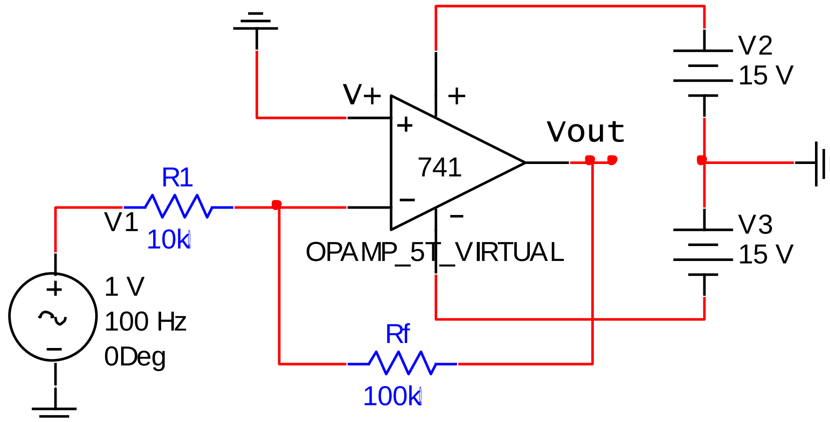
g. I_{RF}: ___________________ h. Gain: __________________

Exercise 3. Non-inverting Voltage Controlled Voltage Source (VCVS)

A. Use Multisim, model the circuit shown below. Energize the model and measure the following circuit parameters:

a. Close Loop Gain: ___________________ b. Z_{in}: ___________________

c. V_{out}: ____________________ d.V-: ____________________



(1) Apply an input voltage of 1 VDC (as shown) to the circuit. Energize the model and use the analysis tools provided in Multisim to measure the output voltage Vout. Calculate the voltage gain using the measured values of Vin and Vout and compare with the Close Loop Gain calculated in the Prelab:

Close Loop Gain (Measured): __________________

Difference ((Measured – Calculated) / Calculated): _________________%

(2) Apply a sinusoidal input voltage of 1V peak (f =100Hz). Energize the model and using the oscilloscope to measure the input (V-) and output voltage (V_{out}). Determine the phase relationship of V- and Vout. Calculate the gain from these measurements and compare with the expected values calculated in the Prelab.

Vin (peak): ____________________ Vout (peak): ____________________

Phase angle: ____________________ Gain: ____________________

(3) Increase the AC input voltage until saturation occurs on both peaks of the output signal. Record positive and negative saturation voltage levels.

Vsat+ ____________________ Vsat-______________________

B. Construct the same circuit on a breadboard and repeat the three steps as described above. Record measured values.

(1) 1VDC: Close Loop Gain (Measured): _______ Difference: ________________%

(2) Sinusoidal input voltage of 1V peak (f =100Hz).

Vin (peak): ____________________ Vout (peak): ____________________

Phase angle: ____________________ Gain: ____________________

(3) Increase AC excitation until Saturation:

Vsat+ ____________________ Vsat-______________________

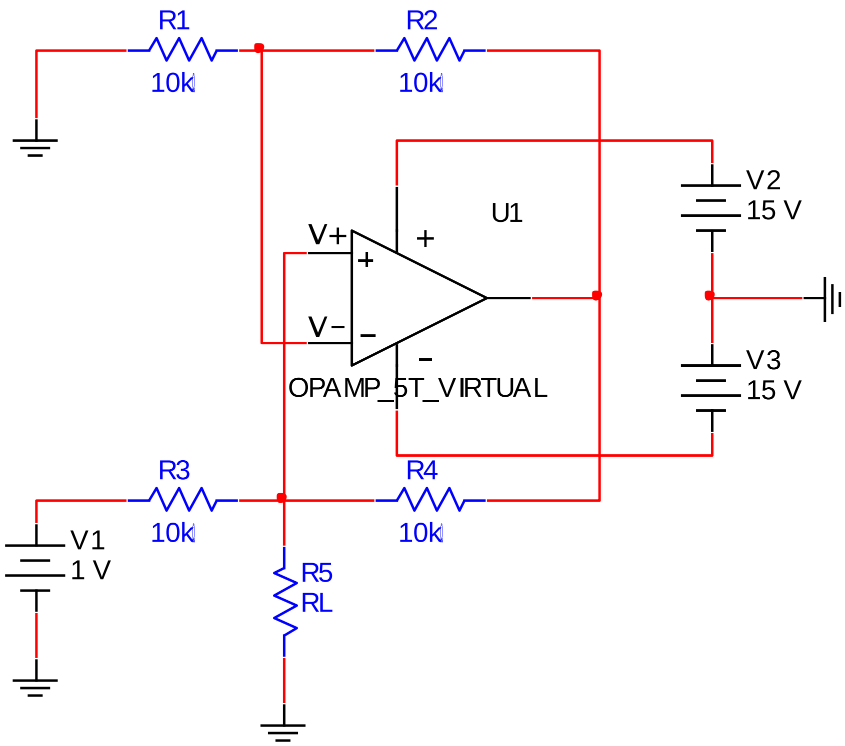
Exercise 4. Voltage Controlled Current Source (VCIS)

A. Use Multisim to model the circuit shown below.

(1) Set the value of R_L to mid-range value from Prelab $(RL_{min}+RL_{max})/2$, energize the model and measure the current through R_L. Compare the result with the calculated value

I_{RL} (Measured): ___________________ Difference: ___________________%

(2) Use the measure value of I_{RL} to calculate the trans-conductance of the circuit and compare it with the calculated value from the Prelab.



$g_m' =$ ___________________ Difference: ___________________%

(3) Vary the value of R_L within the range determined in Prelab and measure the current through it, I_{RL}.

RL = __________ $I_{RL} =$ ______

RL = __________ $I_{RL} =$ ______

(4) Set R_L to a value EXCEEDING the RL_{max} and measure the current I_{RL}

$R_L =$ __________ $I_{RL} =$ ______

(5) Determine the maximum value of R_L at which the circuit ceases to operate properly.

$R_L =$ __________

B. Construct the same circuit on a breadboard and repeat the steps described above. Record measured values and calculate the differences.

(1) Set the value of R_L to mid-range value from Pre lab: $(RL_{min}+RL_{max})/2$

I_{RL} (Measured): _______________ Difference from calculated result: ____________%

(2) Use measured I_{RL} to calculate g_m

g_m' = ____________________ Difference: ____________________%

(3) Vary the value of R_L within the range determined in Pre lab and measure the current through it, I_{RL}.

RL = __________ I_{RL} = ______

RL = __________ I_{RL} = ______

(4) Set R_L to a value EXCEEDING the RL_{max} and measure the current I_{RL}

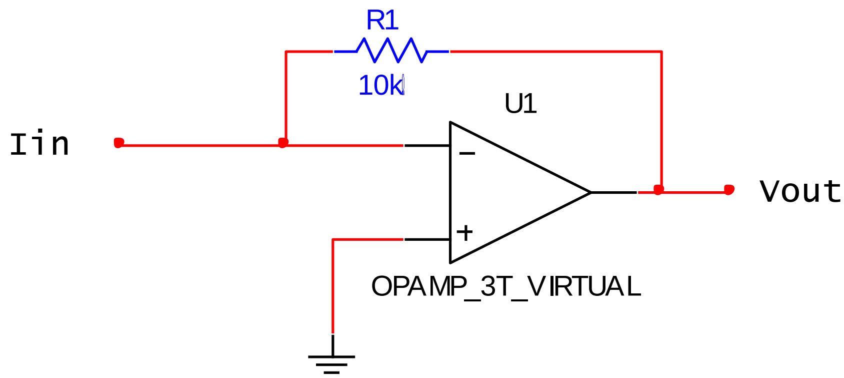
R_L = __________ I_{RL} = ______

(5) Determine the maximum value of R_L at which the circuit ceases to operate properly.

R_L = __________

Exercise 5. Current Controlled Voltage Source (ICVS)

A. Using Multisim, model the circuit shown below



(1) Use the current source from **Experiment 4 (VCIS)** to supply a DC input current of 0.1mA. Measure the output voltage and compare with the calculated value from the Pre lab.

Vout (measured) = ________ Difference: __________________%

(2) Using the measured Vout, calculate the trans-resistance of the circuit and compare it with the calculated value from Prelab 3.

Rm' = ________ Difference: __________________%

B. Construct the same circuit on a breadboard and repeat the steps described above. Record measured values and calculate the differences.

Vout (measured) = ________ Difference: __________________%

Rm' = ________ Difference: __________________%

Post lab Exercise:

(1) Explain any variations from the expected and measured values.

(2) Explain any differences in the results of A, B, and C part of Experiment 1 and 2. Use the properties of the ideal op amp model to explain the differences.

(3) Is the ideal Op Amp model a good approximation of the behavior of a real Op Amp?

(4) Why current remains stable in the Voltage Controlled Current Source (VCIS) circuit?

(5) The summing circuit is often designed as an inverting circuit. Why?