INTRODUCTION to ELECTRONICS and ANALOG ELECTRONICS CIRCUITS LABORATORY

EXPERIMENT REPORT

Experiment Name	Linear Applications of Operational Amplifiers
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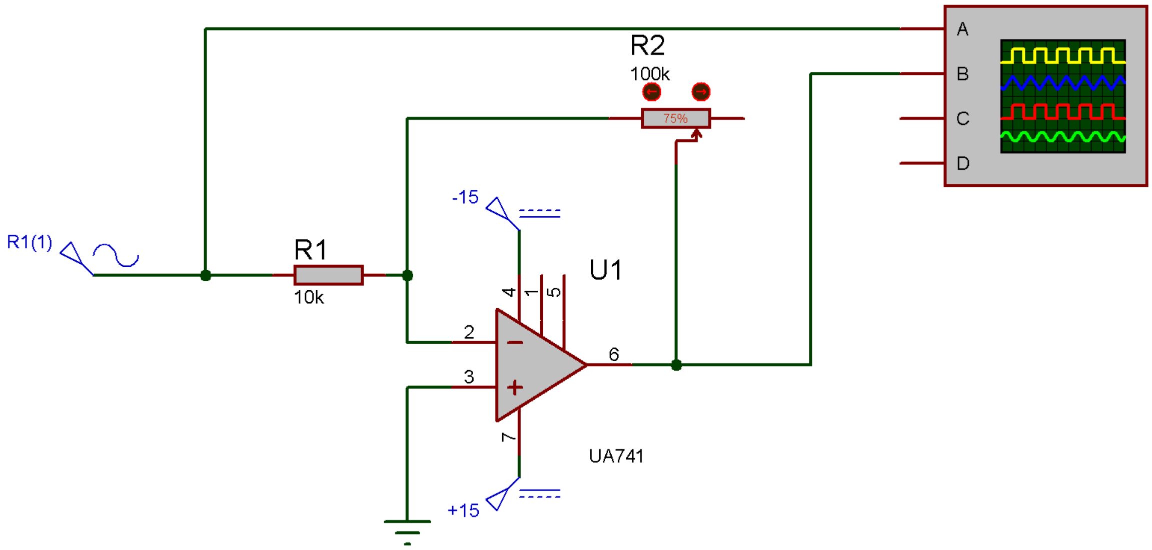
Aim of the Experiment

In this experiment session, we investigate basic understanding of operational amplifiers (op-amps) for performing linear applications such as inverting amplifiers, non-inverting amplifiers and some mathematical functions.

Exp #1 Inverting OP-AMP

We provide 2V peak to peak sinusoidal wave signal to input. R1 is 10k Ω resistor and R2 is a 100k Ω linear potentiometer. Since R2 is potentiometer, we can set various values for R2 and measure the peak to peak voltage of output signal from oscilloscope.

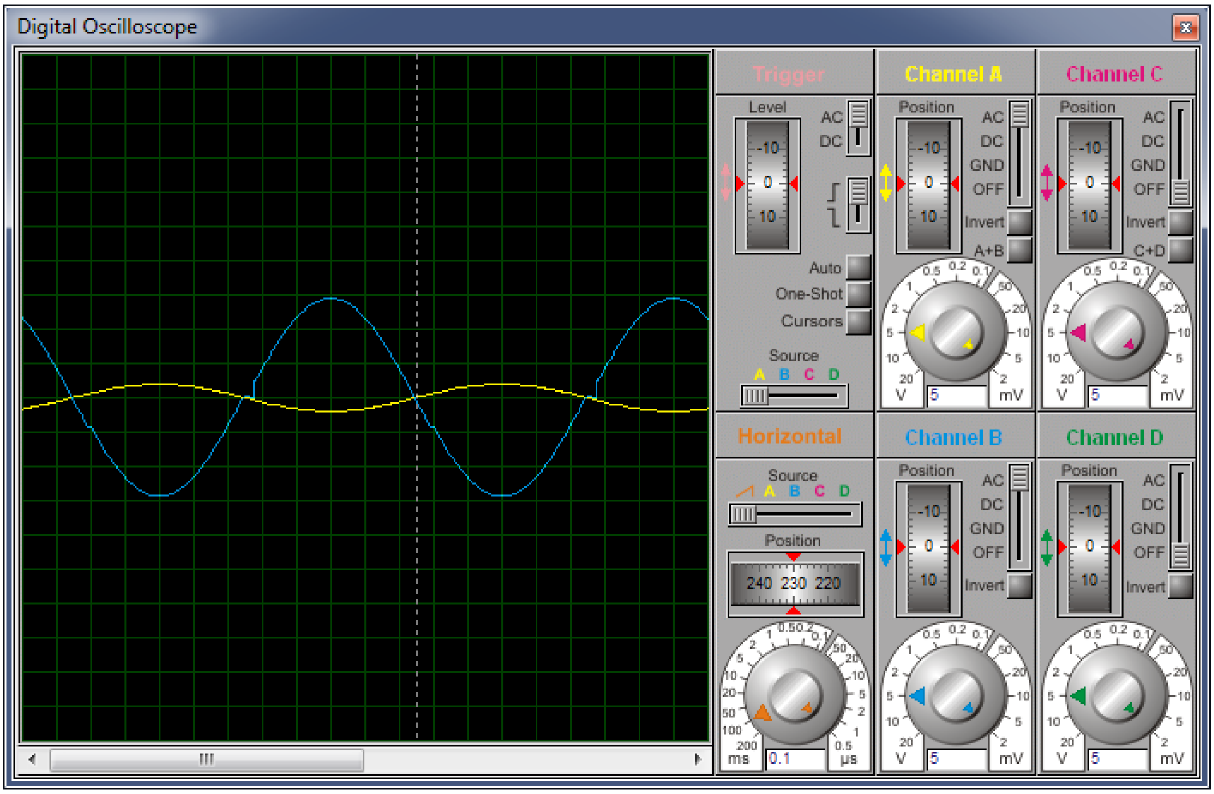


V_{in} = 2V (V_{pp})

R_2(Ω)	**Measured V_{out} (V_{pp})**	**Theoretical V_{out} (V_{pp})**
100k	18.4 V	20 V
75k	14.4 V	15 V
50k	9.46 V	10 V
25k	2.54 V	5 V
10k	2 V	2 V

Theoretical V_{out} calculated from the voltage gain equation of the inverting amplifier circuit is:

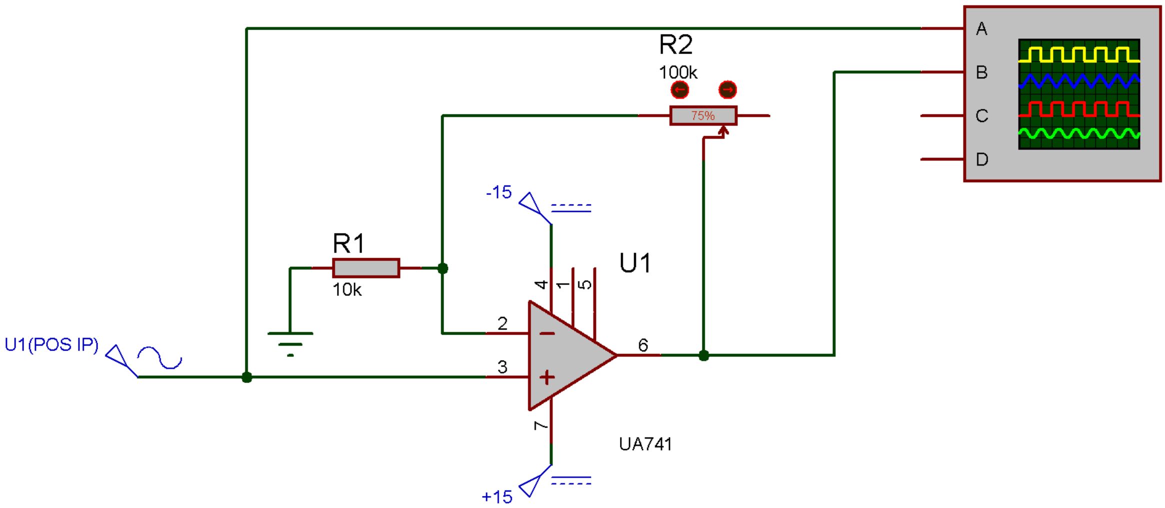
$$\frac{V_{out}}{V_{in}} = -\frac{R_2}{R_1}$$



As can be seen in simulation oscilloscope screen, input signal (yellow line) is amplified and inverted to output signal (blue line).

Exp #2 Non-Inverting OP-AMP

We provide 2V peak to peak sinusoidal wave signal to input like first experiment. R1 is 10k Ω resistor and R2 is a 100k Ω linear potentiometer. Since R2 is potentiometer, we can set various values for R2 and measure the peak to peak voltage of output signal from oscilloscope.

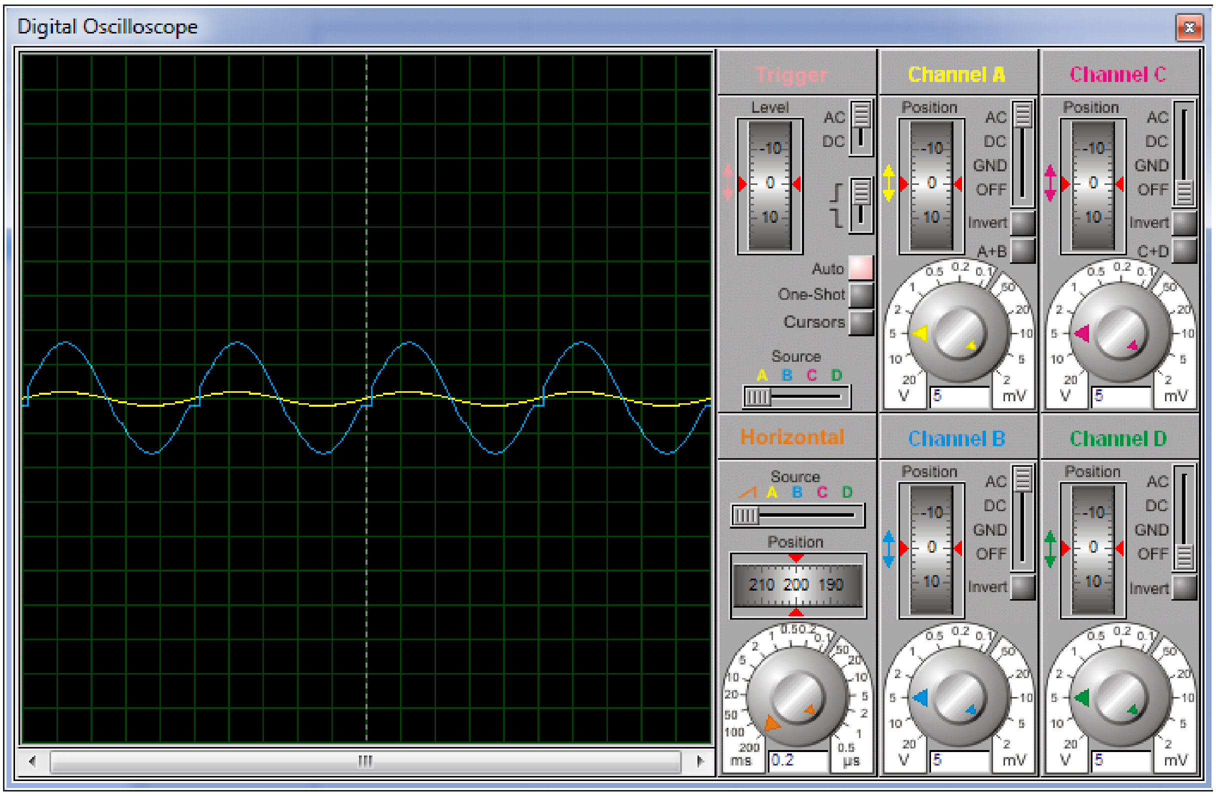


V_{in} = 2V (V_{pp})

$R_2(\Omega)$	Measured V_{out} (V_{pp})	Theoretical V_{out} (V_{pp})
100k	20.2 V	22 V
75k	16.6 V	17 V
50k	11.9 V	12 V
25k	6.91 V	7 V
10k	3.95 V	4 V

Theoretical V_{out} calculated from the voltage gain equation of the non-inverting amplifier circuit is:

$$\frac{V_{out}}{V_{in}} = 1 + \frac{R_2}{R_1}$$



As can be seen in simulation oscilloscope screen, input signal (yellow line) is amplified and to output signal (blue line).

Exp #3 Summing Amplifier

We provide 5V DC signal as V_1 and 6V peak to peak sinusoidal wave signal as V_2 to input. R1 is 8.2kΩ resistor, R2 is 2.7kΩ resistor and R3 is 8.2kΩ resistor for adjusting a = 1 and b = 3 in output equation;

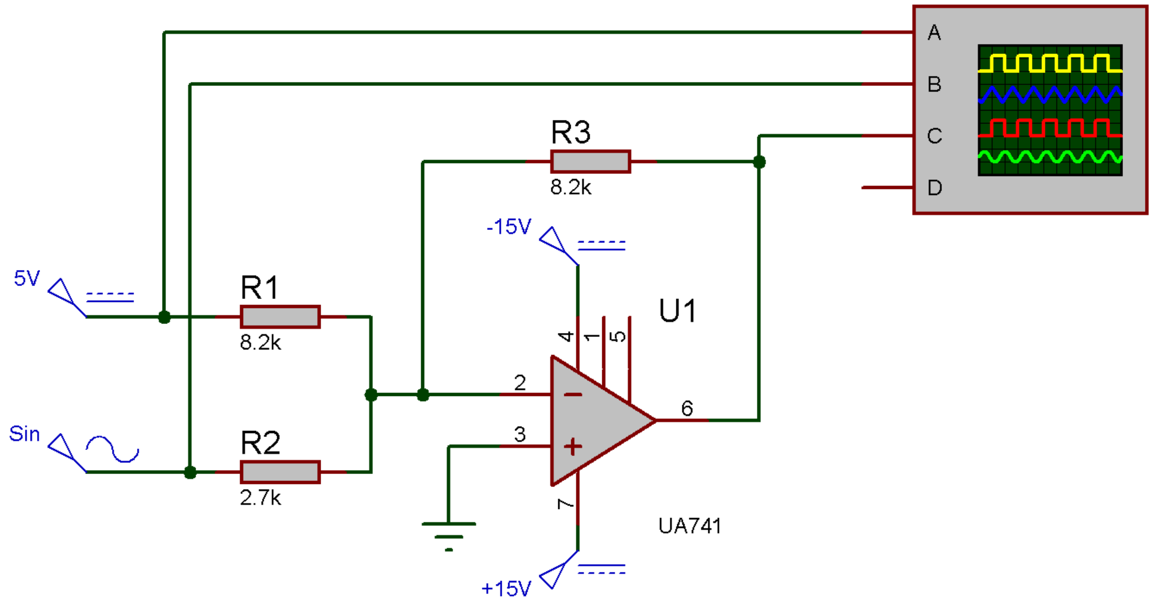
$V_o \; = \; -(aV_1 + bV_2)$ so;

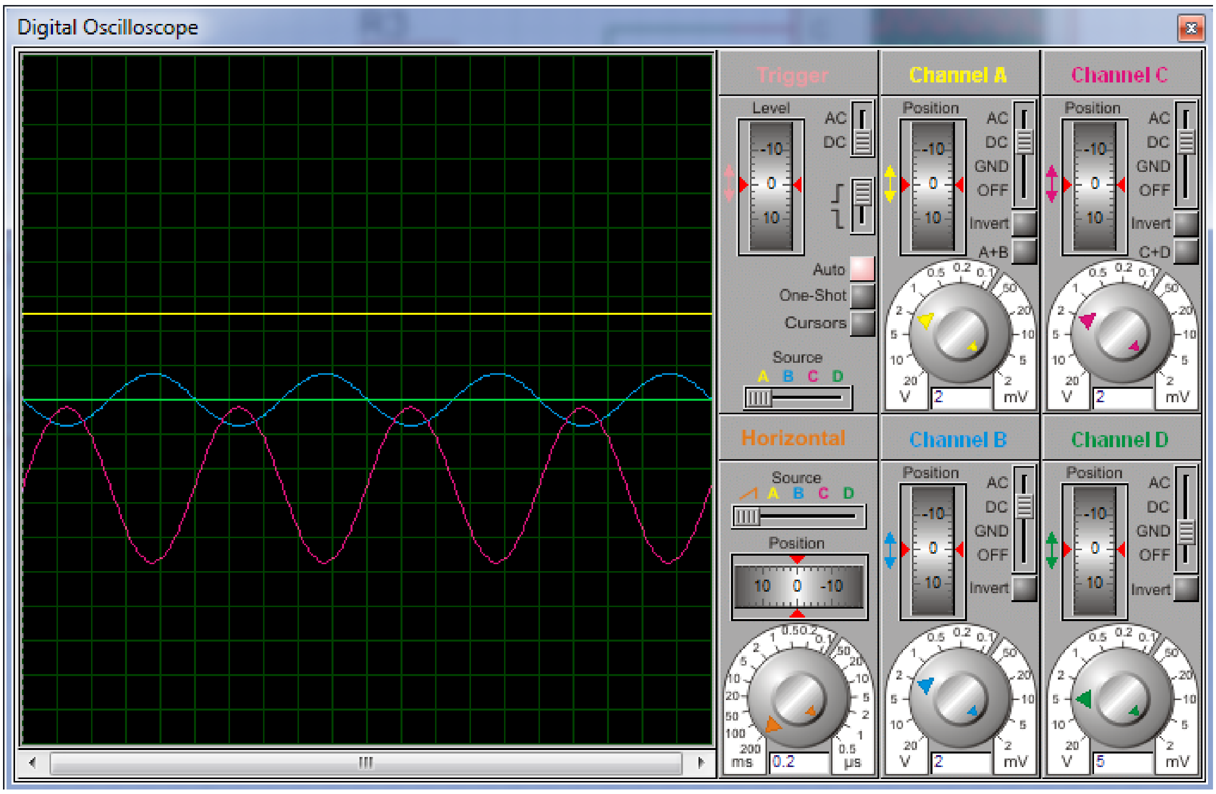
$V_o \; = \; -(V_1 + 3V_2)$

Which is actually; the voltage gain equation of the summing amplifier:

$$V_o = -\left(\frac{R_3}{R_1}V_1 + \frac{R_3}{R_2}V_2\right)$$

Then we measure the peak to peak voltage of output signal from oscilloscope.



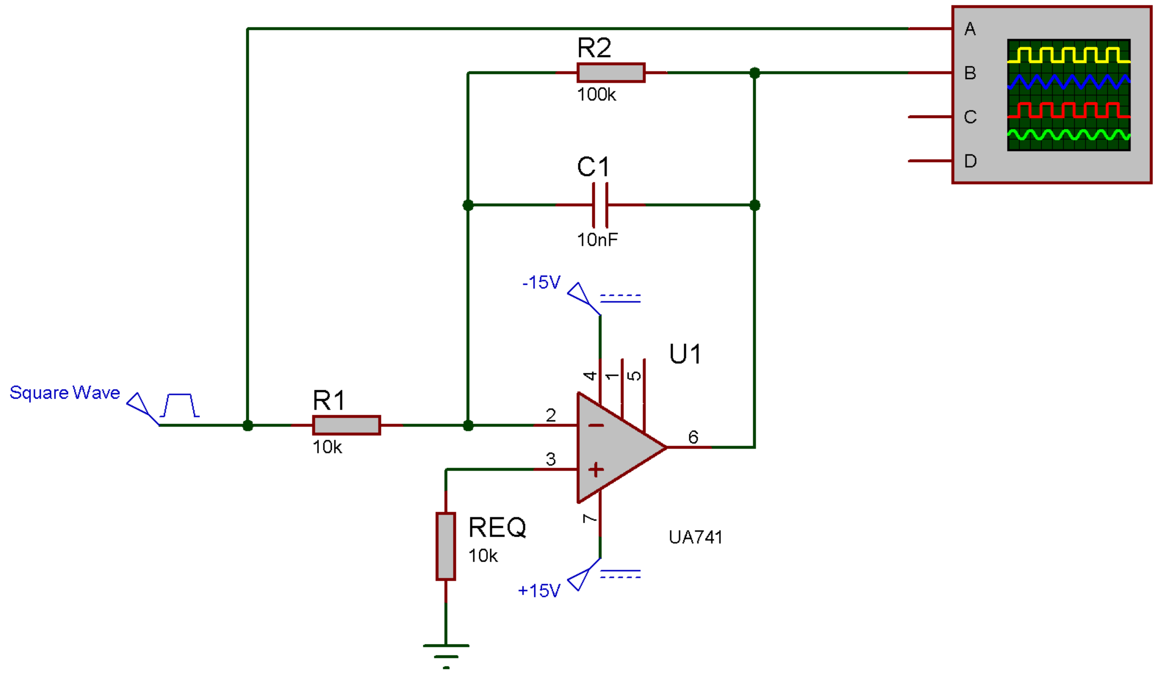


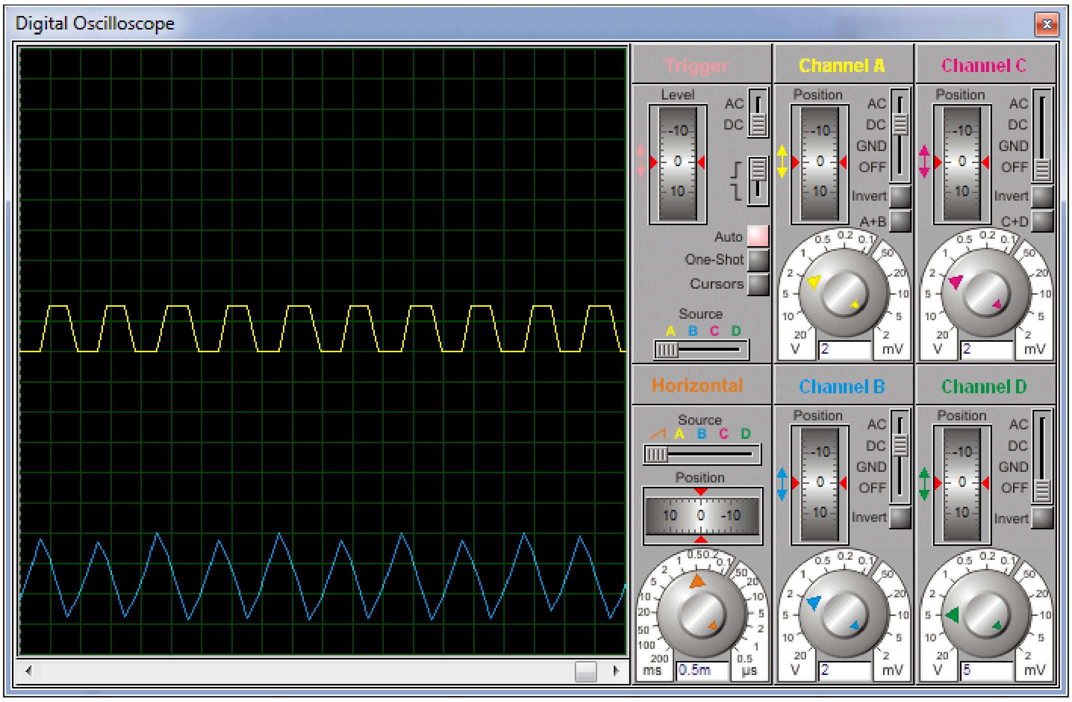
As can be seen in simulation oscilloscope screen; input signal 5V DC as V_1 (yellow line), input signal 6V sinusoidal as V_2 (blue line), ground (green line) and the output signal (purple line). Output is like inverted and amplified sinusoidal wave with 5V offset bellow the ground.

Exp #4 OP-AMP Integrator

We provide 5V peak to peak square wave signal as V_{in}, R1 is 10kΩ resistor, R2 is 100kΩ resistor and R_{eq} is 10kΩ resistor for adjusting voltage equation of the op-amp integrator.

$$V_o = -\frac{1}{RC}\int V_1 dt + V_{o(t=0)}$$





As can be seen in simulation oscilloscope screen; input signal 5V square wave as V_{in} (yellow line) and the output signal (blue line). Output is integral form of input signal, so integral form of square wave signal is rectangle wave signal.