Experiment 7
Adwait Naravane 19MS151

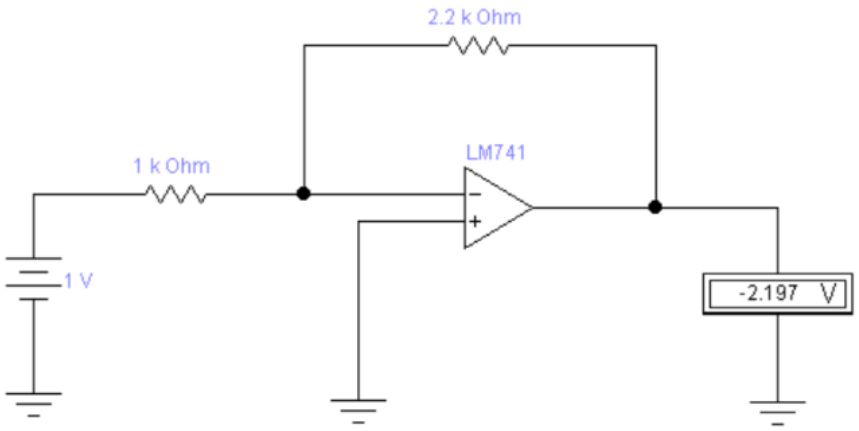
March 10, 2022

Aim

Study of operational Amplifier (OP-AMP) as inverting and non-inverting amplifier and its various applications.

Results

OP-AMP as an inverting amplifier

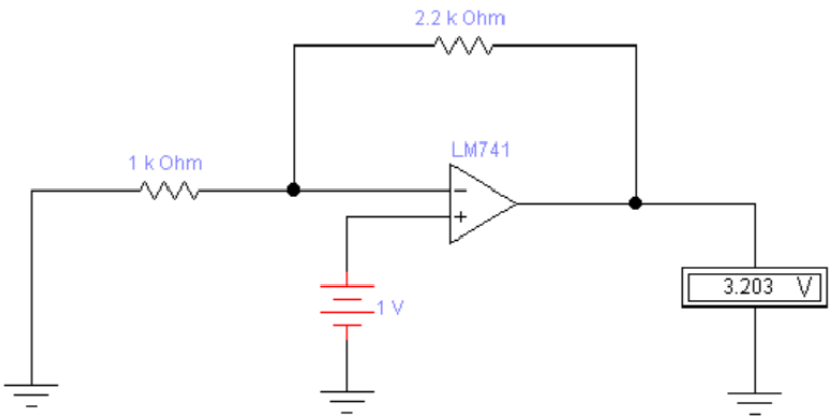


The inverting amplifier produces an output which is out of phase by 180. The output pulse therefore will have an opposite sign that of the input.

Input Voltage (V_{in})	0.5	1	1.5	1.75	2
Output Voltage (V_{out})	4.987	9.99	14.99	17.49	19.99
Measured Gain (V_o/V_{in})	9.974	9.99	9.993	9.994	9.995
Average gain			9.9893		
Theoretical gain (R_f/R_i) for $R_f = 22\Omega$ & $R_i = 2.2\Omega$			10		

Input Voltage (V_{in})	0.5	1	2	3	4
Output Voltage (V_{out})	1.097	2.197	4.397	6.597	8.797
Measured Gain (V_o/V_{in})	2.194	2.197	2.1985	2.199	2.19925
Average gain			2.1975		
Theoretical gain (R_f/R_i) for $R_f = 2.2\Omega$ & $R_i = 1\Omega$			2.2		
Output Voltage (V_{out})	0.547	1.098	2.198	3.298	4.398
Measured Gain (V_o/V_{in})	1.094	1.098	1.099	1.0993	1.0995
Average gain			1.09797		
Theoretical gain (R_f/R_i) for $R_f = 2.2\Omega$ & $R_i = 2\Omega$			1.1		
Output Voltage (V_{out})	2.266	4.539	9.084	13.63	18.18
Measured Gain (V_o/V_{in})	4.532	4.539	4.542	4.543	4.545
Average gain			4.543		
Theoretical gain (R_f/R_i) for $R_f = 10\Omega$ & $R_i = 2\Omega$			4.5454		

OP-AMP as a non-inverting amplifier

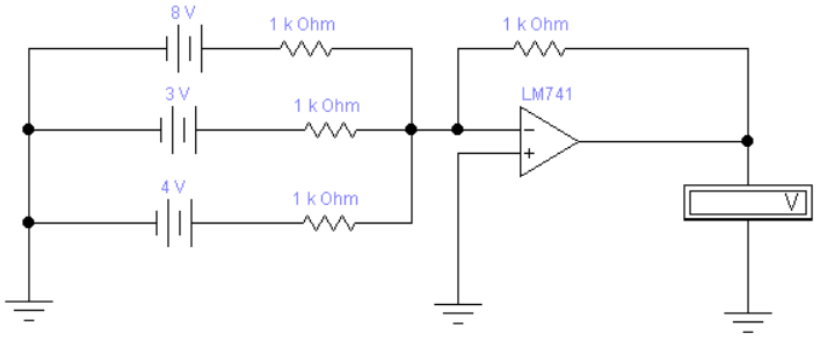


$V_{in}(V)$	1	1.5	3	6
$V_{out}(V)$	3.003	4.503	9.003	18
Measured Gain(V_0/V_i)	3.003	3.002	3.001	3
Average gain			3.0015	
Theo. Gain		3		
for $R_f = 2k\Omega$ & $R_i = 1k\Omega$				
$V_{out}(V)$	4.004	6.004	12	20.6
Measured Gain(V_0/V_i)	4.004	4.0027	4	3.435
Average gain			3.8604	
Theo. Gain		4		
for $R_f = 3k\Omega$ & $R_i = 1k\Omega$				
$V_{out}(V)$	2.503	3.753	7.503	15
Measured Gain(V_0/V_i)	2.503	2.502	2.501	2.5
Average gain			2.5015	
Theo. Gain		2.5		
for $R_f = 3k\Omega$ & $R_i = 2k\Omega$				

$V_{in}(V)$	0.5	1	1.5	1.8
$V_{out}(V)$	5.511	11.01	16.51	19.81
Measured Gain(V_0/V_i)	11.022	11.01	11.007	11.006
Average gain			11.012	
Theo. Gain		11		
for $R_f = 10k\Omega$ & $R_i = 1k\Omega$				

Inverting OP-Amp is an operational amplifier circuit, its output voltage is in phase with the input.

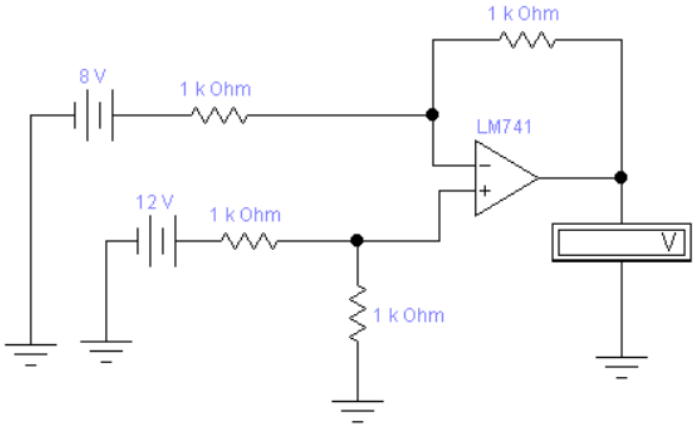
OP-AMP as an adder



$V_1(V)$	$V_2(V)$	$V_3(V)$	Measured V_{out}	Theo. $V_o(V_1 + V_2 + V_3)$
1	1	1	2.996	3
1	1	2	3.996	4
3	1	2	5.996	6
3	4	2	8.996	9
3	4	5	12	12
4	4	5	13	13
4	6	5	15	15
0.5	0.6	0.1	1.196	1.2
1.2	0.6	0.2	1.996	2
1	0.6	0.2	1.796	1.8

The output from this circuit is the sum of its input voltages applied at the inverting terminal.

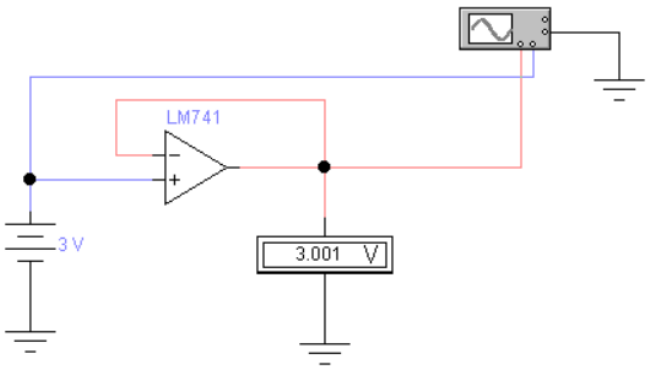
OP-AMP as a subtractor



$V_1(V)$	$V_2(V)$	Measured V_o	Theo $V_o = V_2 - V_1$
1	1	0.00198	0
1	2	1.002	1
3	1	1.998	2
3	4	1.002	1
2	4	2.002	2
1	6	5.002	5
0.5	0.6	0.102	0.1
20	10	10	10
1	10	9.002	9

This circuit gives an output which is equal to the difference in the input voltages applied at the non-inverting and inverting terminals respectively.

OP-AMP as a unit gain buffer



V_{in}	V_{out}	Measured gain	Average gain	Theo. Gain $(1 + R_f/R_i)$
1	1.001	1.001		
1.5	1.501	1.001	1.0006	
2	2.001	1.0005		1
5	5.001	1.0002		

A unit gain amplifier is an electronic amplifier circuit that does not amplify the input voltage. It has a gain of 1, therefore the output is same as the input signal.