Page No. ______
Date 16 01 19

Experiment No. 1

AIM

Introduction to lab equipment & operational amplifier IC – $\mu A741C$

THEORY

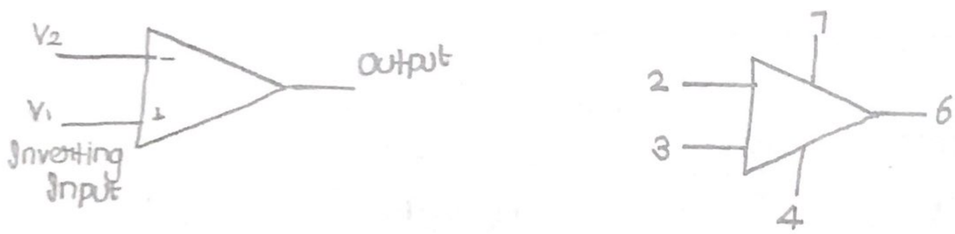
DSO or Digital Storage Oscilloscope is an instrument which stores a digital copy of the waveform in the digital memory which it analyses further using digital signal processing techniques. Signals are received, stored & then displayed.

Function Generator is usually a piece of electronic test equipment or software used to generate different types of electrical waveforms over a wide range of frequencies. Some of the most common waveforms produced by function generator are sine wave, square wave, triangular wave & sawtooth shapes.

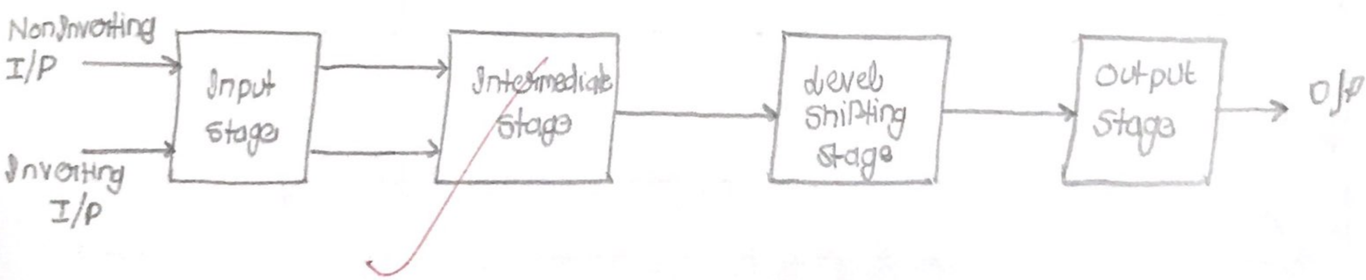
Dual Power Supply is a common equipment in electronics. The +ve polarity as well as –ve polarity & ground potential of op-amps need dual power sources

Operational Amplifier is a direct coupled high gain voltage amplifier with very high impedance.

Symbol of op-amp



Block Diagram of op-amp



Page No. ____
Date

Ideal Values of uA741C	Practical Values of uA741C
$A_v = \infty$	$A_v = 2 \times 10^5$
$R_i = \infty$	$R_i = 2M\Omega$
$R_o = 0$	$R_o = 75\Omega$
$BW = \infty$	$BW = 1MHz$
$CMRR = \infty$	$CMRR = 90\ dB$

- Different Types of Op-Amps

Each manufacturer uses a specific code & assigns a specific type number to the ICs. It produces-

1. Fairchild - uA, uAF
2. National Semiconductor - LM, LH, LF, TBA
3. Motorola - MC, MFA
4. Texas Instruments - SN
5. Signetics - N/S, NE/SE, SU

- 741 is a military grade op-amp (temp range -55°C to 125°C)

741C - Commercial grade op-amp (0°C to 70/75°C)

741A & 741E are improved versions of 741 & 741C

uA747 - Dual op-amp

LM32A
LF 351/353 } Quad op-amp

TL082 - JFET Dual op-amp

→ There are several different types of op-amps, some of which are -

Page No.
Date

- Voltage Follower
- Inverting op-amp
- Non-inverting op-amp
- Op-amp differentiator
- Differential amplifier
- Integrator

RESULT

We studied & learned about lab equipment and uA741C amplifier.

13/02/2020

14/15

General purpose operational amplifier

µA741/µA741C/SA741C

DESCRIPTION

The µA741 is a high performance operational amplifier with high open-loop gain, internal compensation, high common mode range and exceptional temperature stability. The µA741 is short-circuit-protected and allows for nulling of offset voltage.

FEATURES

- Internal frequency compensation
- Short circuit protection
- Excellent temperature stability
- High input voltage range

PIN CONFIGURATION

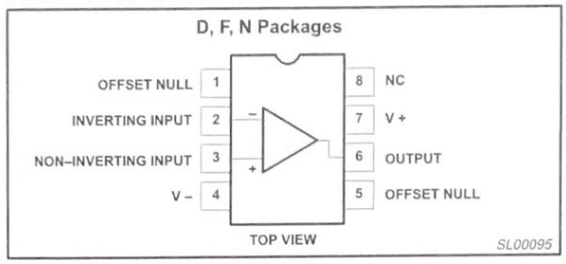


Figure 1. Pin Configuration

ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE	DWG #
8-Pin Plastic Dual In-Line Package (DIP)	-55°C to +125°C	µA741N	SOT97-1
8-Pin Plastic Dual In-Line Package (DIP)	0 to +70°C	µA741CN	SOT97-1
8-Pin Plastic Dual In-Line Package (DIP)	-40°C to +85°C	SA741CN	SOT97-1
8-Pin Ceramic Dual In-Line Package (CERDIP)	-55°C to +125°C	µA741F	0580A
8-Pin Ceramic Dual In-Line Package (CERDIP)	0 to +70°C	µA741CF	0580A
8-Pin Small Outline (SO) Package	0 to +70°C	µA741CD	SOT96-1

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNIT
V_S	Supply voltage		
	µA741C	±18	V
	µA741	±22	V
P_D	Internal power dissipation		
	D package	780	mW
	N package	1170	mW
	F package	800	mW
V_{IN}	Differential input voltage	±30	V
V_{IN}	Input voltage[1]	±15	V
I_{SC}	Output short-circuit duration	Continuous	
T_A	Operating temperature range		
	µA741C	0 to +70	°C
	SA741C	-40 to +85	°C
	µA741	-55 to +125	°C
T_{STG}	Storage temperature range	-65 to +150	°C
T_{SOLD}	Lead soldering temperature (10sec max)	300	°C

NOTES:

1. For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

DC ELECTRICAL CHARACTERISTICS

T_A = 25°C, V_S = ±15V, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	µA741			µA741C			UNIT
			Min	Typ	Max	Min	Typ	Max	
V_{OS}	Offset voltage	R_S=10kΩ		1.0	5.0		2.0	6.0	mV
		R_S=10kΩ, over temp.		1.0	6.0			7.5	mV
$\Delta V_{OS}/\Delta T$				10			10		µV/°C
I_{OS}	Offset current			20	200		20	200	nA
		Over temp.						300	nA
		T_A=+125°C		7.0	200				nA
		T_A=-55°C		20	500				nA
$\Delta I_{OS}/\Delta T$				200			200		pA/°C
I_{BIAS}	Input bias current			80	500		80	500	nA
		Over temp.						800	nA
		T_A=+125°C		30	500				nA
		T_A=-55°C		300	1500				nA
$\Delta I_B/\Delta T$				1			1		nA/°C
V_{OUT}	Output voltage swing	R_L=10kΩ	±12	±14		±12	±14		V
		R_L=2kΩ, over temp.	±10	±13		±10	±13		V
A_{VOL}	Large-signal voltage gain	R_L=2kΩ, V_O=±10V	50	200		20	200		V/mV
		R_L=2kΩ, V_O=±10V, over temp.	25			15			V/mV
	Offset voltage adjustment range			±30			±30		mV
PSRR	Supply voltage rejection ratio	R_S≤10kΩ					10	150	µV/V
		R_S≤10kΩ, over temp.		10	150				µV/V
CMRR	Common-mode rejection ratio					70	90		dB
		Over temp.	70	90					dB
I_{CC}	Supply current			1.4	2.8		1.4	2.8	mA
		T_A=+125°C		1.5	2.5				mA
		T_A=-55°C		2.0	3.3				mA
V_{IN}	Input voltage range	(µA741, over temp.)	±12	±13		±12	±13		V
R_{IN}	Input resistance		0.3	2.0		0.3	2.0		MΩ
P_D	Power consumption			50	85		50	85	mW
		T_A=+125°C		45	75				mW
		T_A=-55°C		45	100				mW
R_{OUT}	Output resistance			75			75		Ω
I_{SC}	Output short-circuit current		10	25	60	10	25	60	mA

DC ELECTRICAL CHARACTERISTICS

$T_A = 25°C$, $V_S = \pm15V$, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	SA741C			UNIT
			Min	Typ	Max	
V_{OS}	Offset voltage	R_S=10kΩ		2.0	6.0	mV
		R_S=10kΩ, over temp.			7.5	mV
$\Delta V_{OS}/\Delta T$				10		μV/°C
I_{OS}	Offset current			20	200	nA
		Over temp.			500	nA
$\Delta I_{OS}/\Delta T$				200		pA/°C
I_{BIAS}	Input bias current			80	500	nA
		Over temp.			1500	nA
$\Delta I_B/\Delta T$				1		nA/°C
V_{OUT}	Output voltage swing	R_L=10kΩ	±12	±14		V
		R_L=2kΩ, over temp.	±10	±13		V
A_{VOL}	Large-signal voltage gain	R_L=2kΩ, V_O=±10V	20	200		V/mV
		R_L=2kΩ, V_O=±10V, over temp.	15			V/mV
	Offset voltage adjustment range			±30		mV
PSRR	Supply voltage rejection ratio	R_S≤10kΩ		10	150	μV/V
CMRR	Common mode rejection ration		70	90		dB
V_{IN}	Input voltage range	Over temp.	±12	±13		V
R_{IN}	Input resistance		0.3	2.0		MΩ
P_d	Power consumption			50	85	mW
R_{OUT}	Output resistance			75		Ω
I_{SC}	Output short-circuit current			25		mA

AC ELECTRICAL CHARACTERISTICS

T_A=25°C, $V_S = \pm15V$, unless otherwise specified.

SYMBOL	PARAMETER	TEST CONDITIONS	μA741, μA741C			UNIT
			Min	Typ	Max	
R_{IN}	Parallel input resistance	Open-loop, f=20Hz	0.3			MΩ
C_{IN}	Parallel input capacitance	Open-loop, f=20Hz		1.4		pF
	Unity gain crossover frequency	Open-loop		1.0		MHz
	Transient response unity gain	V_{IN}=20mV, R_L=2kΩ, C_L≤100pF				
t_R	Rise time			0.3		μs
	Overshoot			5.0		%
SR	Slew rate	C≤100pF, R_L≥2kΩ, V_{IN}=±10V		0.5		V/μs

EQUIVALENT SCHEMATIC

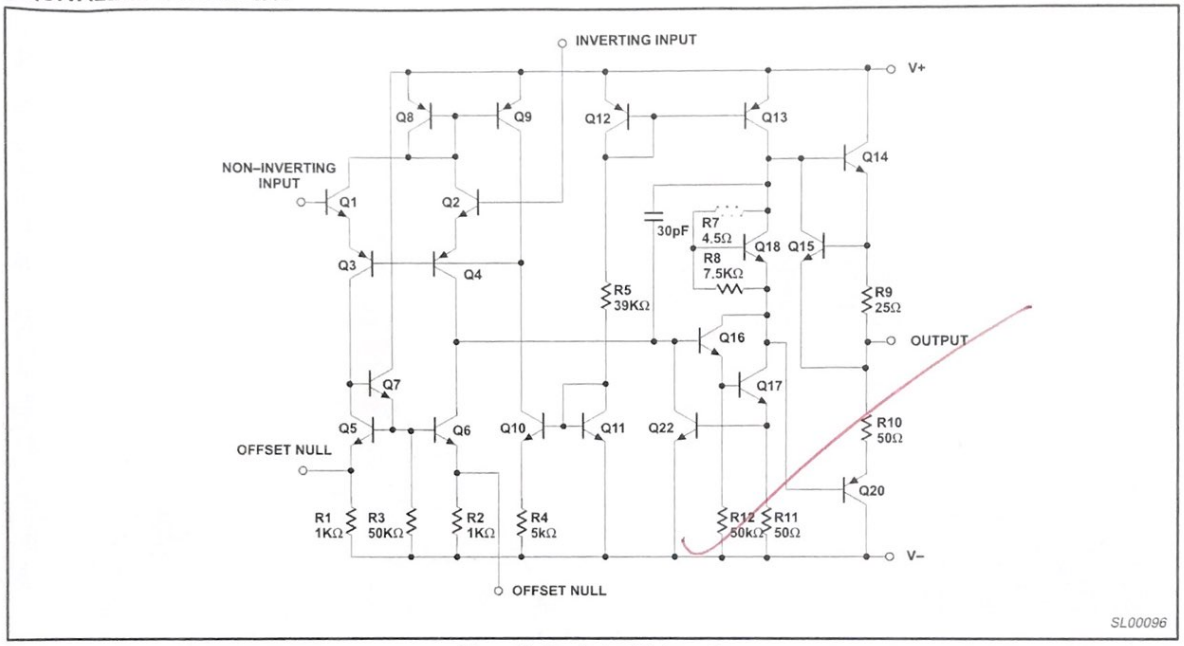


Figure 2. Equivalent Schematic

Page No.
Date 23/01/19

Experiment No. 2

AIM

To construct & test performance of op-amp in open loop configuration as ① Inverting Amplifier ② Non Inverting Amp. ③ Differential Amplifier using uA741C

APPARATUS REQUIRED

DSO tekhonic (40 MHz), Function Generator (25 MHz), op-amp uA741C, Dual power supply (Scientech 4075), Breadboard, connecting wires, probes

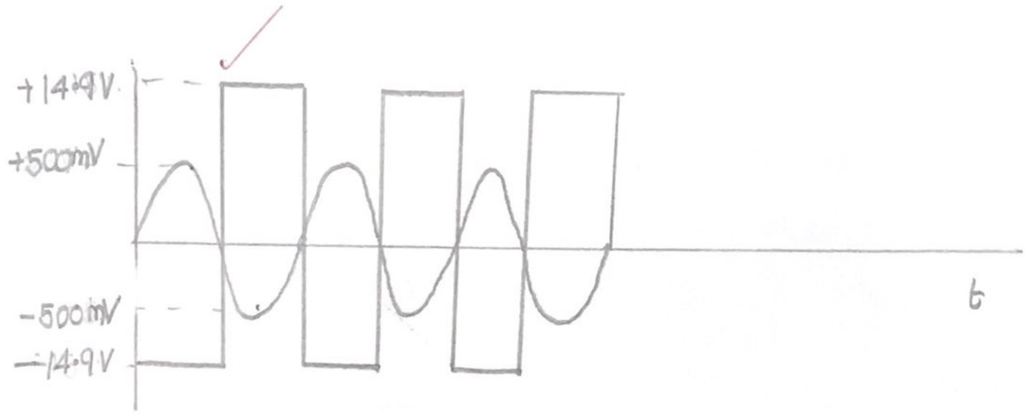
THEORY

In case of amplifier the term open loop gain indicates that no connection, either direct or via another network exists between the output & input terminals. That is, the output signal is not fed back in any form as part of input signal, and the loop that would have been formed with feedback is open.

When connected in open-loop configuration, the op-amp simply functions as a high gain amplifier. There are three open loop op-amp configurations

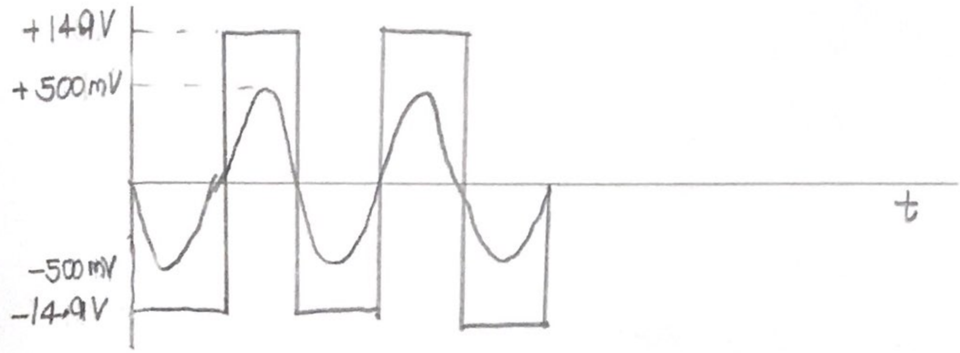
Inverting Amplifier

	Freq.	Pk-Pk (V)	Max (V)	Min (V)
I/P	1kHz	1V	+500mV	-500mV
O/P	1kHz	29.8V	+14.9V	-14.9V

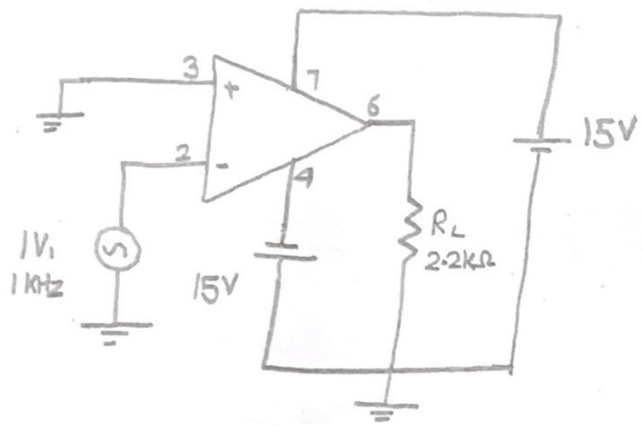


Non-Inverting Amplifier

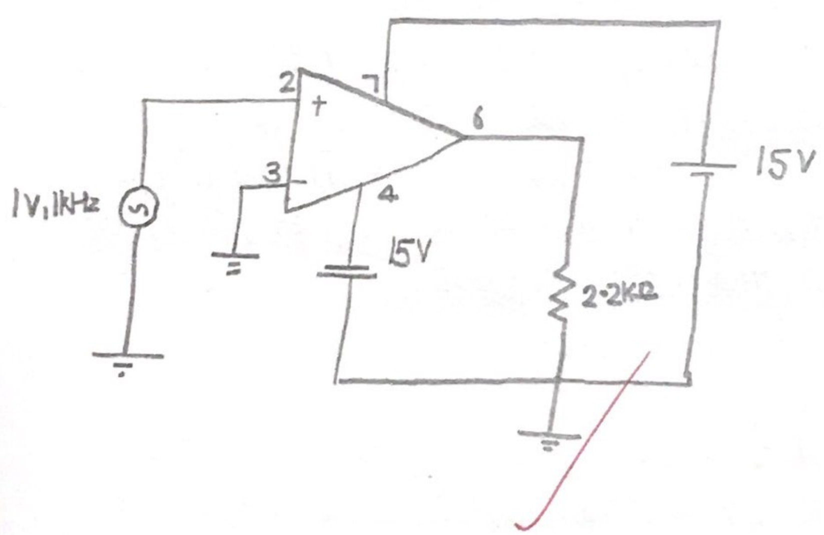
	Freq.	Pk-Pk (V)	Max (V)	Min (V)
I/P	1kHz	1V	+500mV	-500mV
O/P	1kHz	29.8V	+14.9V	-14.9V



Inverting Amplifier



Non-Inverting Amplifier



1. Inverting Amplifier :

In the inverting amplifier only one Input is applied & that is to the inverting input terminal. The non inverting input terminal is grounded.

$$\text{Sive } V_i = 0V \ \& \ V_2 = V_{in}$$

$$V_0 = -AV_{in}$$

The negative sign indicates that output voltage is out of phase with respect to input by 180° or is of opposite polarity. Thus in the inverting amplifier the input signal is amplified by gain A & is also inverted at the output.

2. Noninverting Amplifier :

In this configuration the input is applied to non inverting input terminal & the inverting terminal is connected to ground.

$$V_1 = V_{in} \text{ and } V_2 = 0V$$

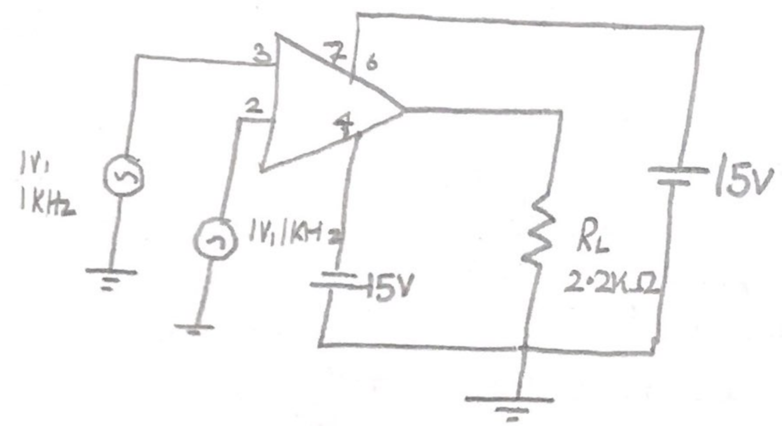
$$\text{So } V_0 = AV_{in}$$

Output voltage is larger than input voltage by gain A & is in phase with the input signal

3. Differential Amplifier:

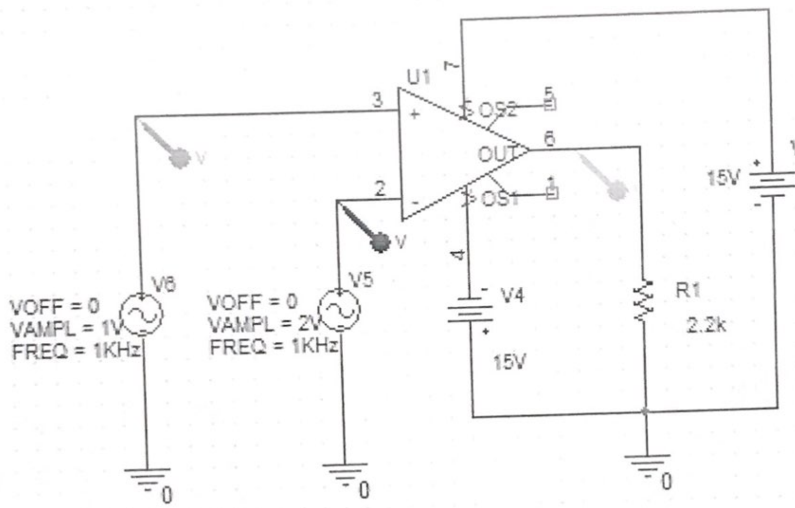
Since the op-amp amplifies the difference between the two input signals. This config. is called diff^n amplifier. The op-amp is a versatile device because it amplifies both ac & dc input signals. The source resistance R_{in_1} & R_{in_2} are normally negligible compared to input resistance R_i. So the voltage

Differential Amplifier

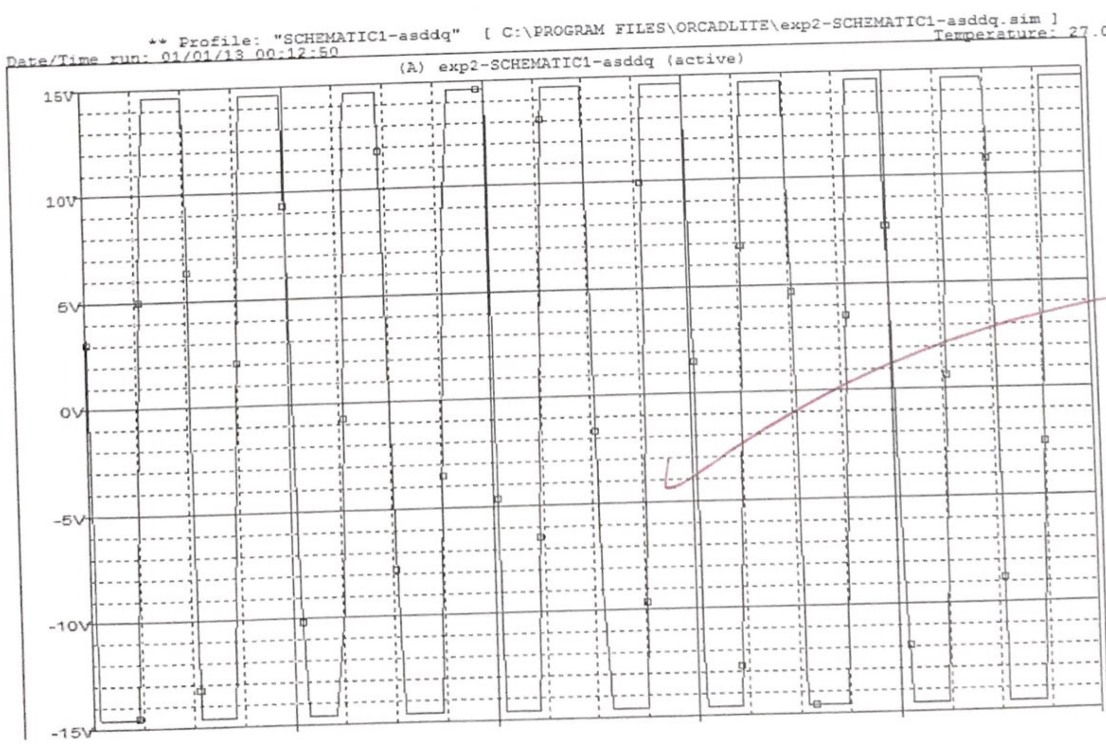


Experiment No. 2

Differential Amplifier



Output



drop across resistors can be assumed to be zero.

$V_1 = V_{in1}$ & $V_2 = V_{in2}$

$$V_0 = A(V_{in1} - V_{in2})$$

In open loop configurations, gain A is commonly reffered to as openloop gain

RESULT

Construction & test performance of op-amp in open loop configuration as ① Inverting Amp. ② Non Inverting Amp. & ③ Differential Amp. using μA 741C has been done.

13/02/2020

14/15

Page No.
Date 30 01 20

Experiment No. 3

AIM

To construct & test performance of closed loop op-amp in ① Inverting Configuration ② Non Inverting Amplifier & ③ Voltage Amplifier

APPARATUS

DSO Techtronic (40 MHz), Function Generator (25 MHz), opamp uA741C, Dual Power Supply (Scientech 4075), Breadboard, connecting wires & probes.

THEORY

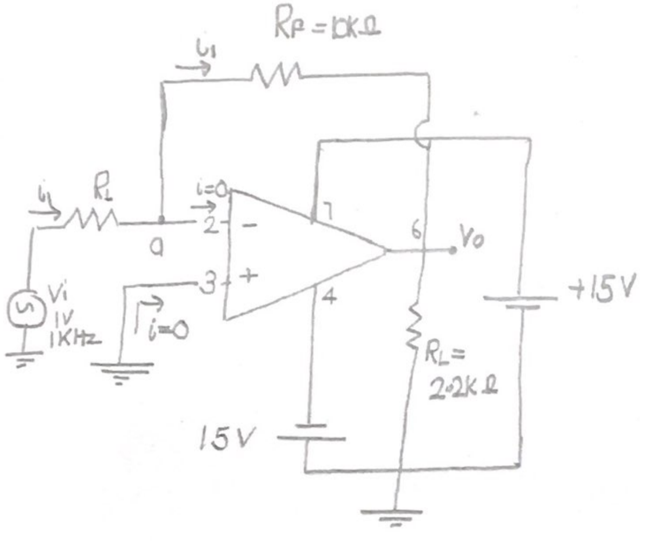
Gain of open loop opamp is very high as it makes the amplifier both unstable & hard to control as smallest of input signals would be enough to cause the output voltage to saturate & swing towards one or the other of voltage supply rails losing complete control of the output.

Feedback in Ideal Op-Amp.

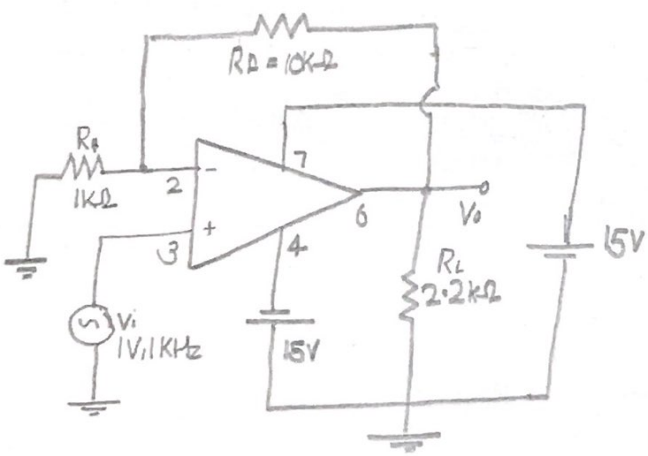
The utility of an op-amp can be greatly increased by providing negative feedback. The output in this case isn't driven into saturation & the circuit behaves in a linear manner.

Inverting Amplifier

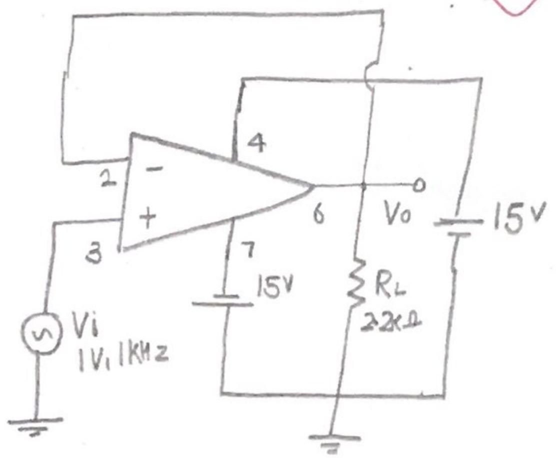
This is perhaps most widely used of all the op-amp



Inverting Amplifier



Non Inverting Amplifier



Voltage Follower

Page No.
Date

circuits. The output voltage V_o is feedback to the inverting input terminal through the $R_f - R_i$ network where R_f is the feedback resistor. Input signal V_i is applied to the inverting input terminal through R_L & non inverting input terminal op-amp is grounded.

Gain of an inverting Amplifier is $A_{CL} = \frac{-R_f}{R_L}$

Non Inverting Amplifier

If a signal is applied to non-inverting input terminal and feedback, the circuit amplifies without inverting the input signal. Such a circuit is called non inverting amplifier. As the differential voltage V_d at the input terminal of op-amp is zero, the voltage at node 'a' is V_i, same as the input voltage applied to non inverting input terminals.

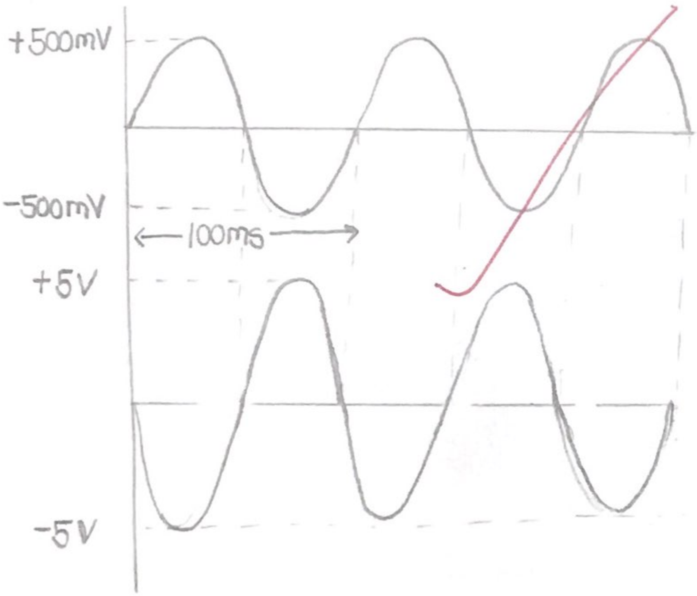
Gain $A_{CL} = \frac{V_o}{V_i} = 1 + \frac{R_f}{R_L}$

Voltage Follower:

In the non inverting amplifier if $R_f = 0$ and $R_1 = \infty$, we get modified circuit & $V_o = V_i$.

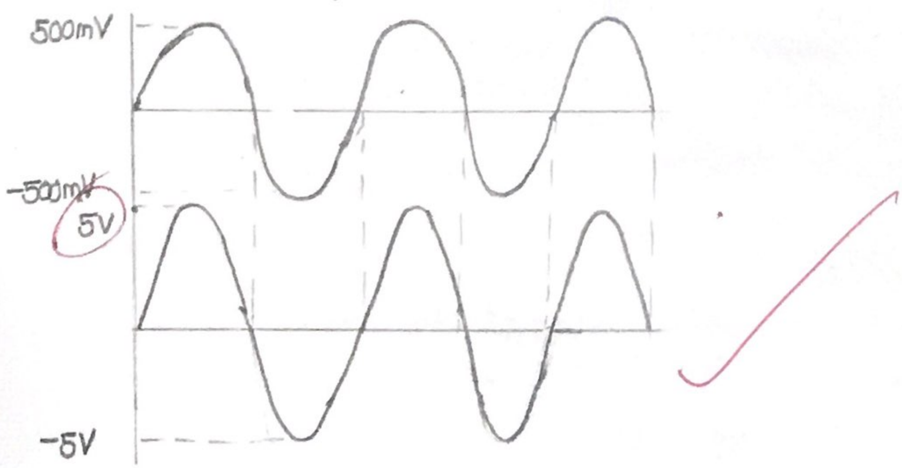
That is, the output voltage is equal to input voltage, both in magnitude & phase. In other words we can also say that the output voltage follows the input voltage exactly. Hence, the circuit is voltage follower.

Inverting Amplifier



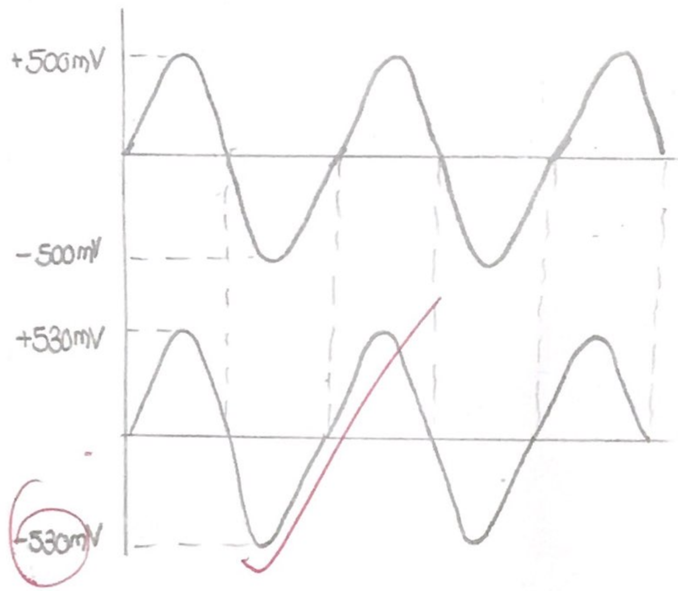
	Frequency	Pk-Pk (V)	Max	Min
Input	1KHz	1V	+500mV	-500mV
Output	998.0Hz	10V	+5V	-5V

Non Inverting Amplifier



	Frequency	Pk-Pk(V)	Max	Min
Input	1KHz	1V	+500mV	-500mV
output	1KHz	11V	+5.5V	-5.5V

Voltage Follower:



	Frequency	Pk-Pk (V)	Max	Min
Input	1KHz	1V	+500mV	-500mV
Output	998.0Hz	1.06V	+530mV	-530mV

Page No.
Date

RESULT

Construction & test performance of closed loop op-amp in Inverting configuration, Non Inverting Amplifier & voltage Follower using uA741C has been done.

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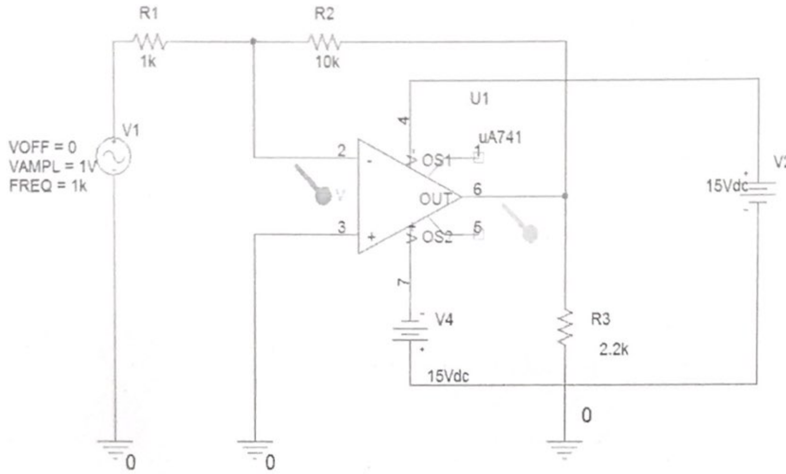
14/15

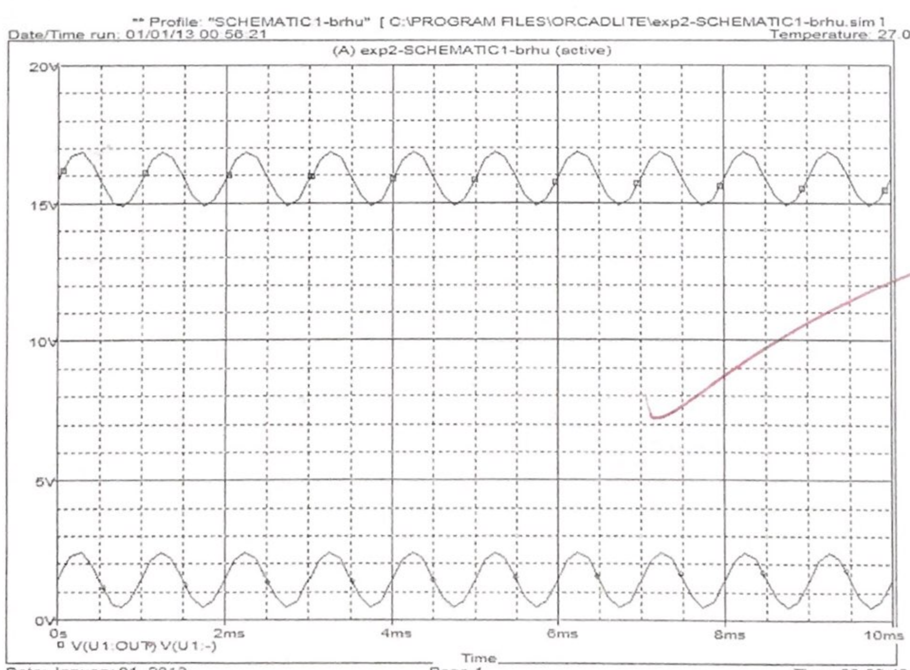
EXPERIMENT-3

Closed Loop Inverting

Circuit Diagram



Output



Page No. ______
Date 6 | 02 | 20

Experiment No. 4

AIM

To construct & test the performance of an Integrator using IC uA741C

APPARATUS & SPECIFICATIONS

DSO Tektronic (40 MHz); Function Generator (25 MHz), op-amp uA741C, Dual Power Supply (scientech 4075), Breadboard, Connecting Wires, probes

THEORY

A circuit in which the output voltage waveform is integral of input voltage waveform is the integrator or the integration amplifier

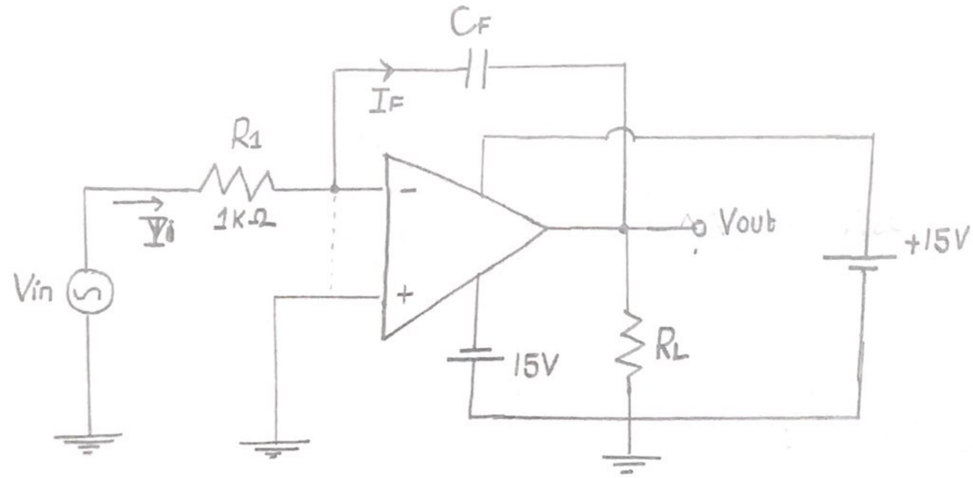
$$I_1 \approx I_C \quad \text{(due to presence of virtual ground)}$$

We know that $I_C = C\frac{dV_C}{dt}$

$$\therefore \quad \frac{V_{in} - 0}{R_1} = C_F \frac{d}{dt}(0 - V_{out})$$

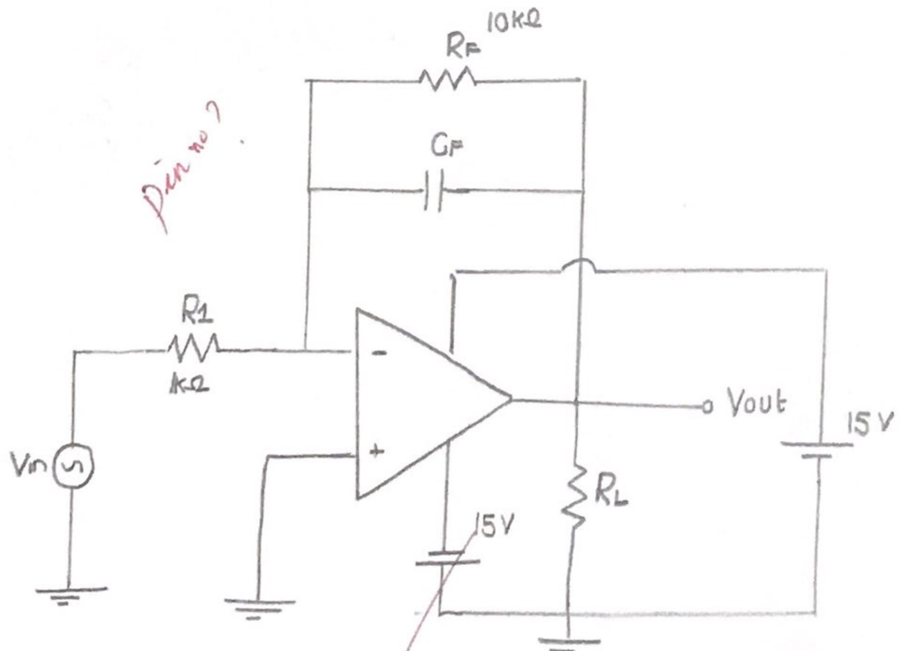
$$\frac{d}{dt} V_{out} = \frac{-1}{R_1 C_F} V_{in}$$

$$\boxed{V_{out} = \frac{-1}{R_1 C_F} \int V_{in}(t)\, dt + C}$$



Ideal Integrator

pin no ?



① Input : Sine Wave   Output : Cosine Wave

S.No.		Freq.	PK-PK	Max	Min
1	I/P	1KHz	1V	+500mV	-500mV
	O/P	1KHz	4.20V	+2.10V	-2.10V
2	I/P	10KHz	1 V	+500mV	-500mV
	O/P	10.20 KHz	580mV	+290mV	-290mV
3	I/P	50KHz	1V	+500mV	-500mV
	O/P	50.25KHz	660mV	+330mV	-330mV
4	I/P	100KHz	1V	+500mV	-500mV
	O/P	100KHz	680mV	+340mV	-340mV

② Input : Square Wave   Output : Triangular Wave

	Frequency	PK-PK	Max	Min
I/P	1 KHz	1V	+500mV	-500mV
O/P	994.7 Hz	6.40V	+ 3.20V	-3.20V

③ Input : Triangular Wave   Output : Parabolic Wave

	Frequency	PK-PK	Max	Min
I/P	1 KHz	1V	+500mV	-500mV
O/P	1 KHz	3.36 V	+ 1.18V	-1.18V

Page No. ______
Date

The output voltage is directly proportional to negative integral of input voltage & inversely proportional to time constant R_1C_F. For sine input the integrator gives consine output.
When $V_{in}=0$, integrator works in open loop config. C_F acts as an open circuit to the input offset voltage V_{io}. The Input off V_{io} & the part of input current charging capacitor C_F produces an error voltage at the output.
∴ In practical integrator we use a resistor R_F connected across feedback capacitor C_F. Thus R_F limits low frequency gain & hence minimizes the variations in the output voltages. Both stability & roll off problems can be corrected by addition of resistor R_F.

Applications:
Waveshaping Circuits
Analog Computers
Analog to Digital Converter

RESULT
Construction & test performance of an integrator using IC uA741C has been done

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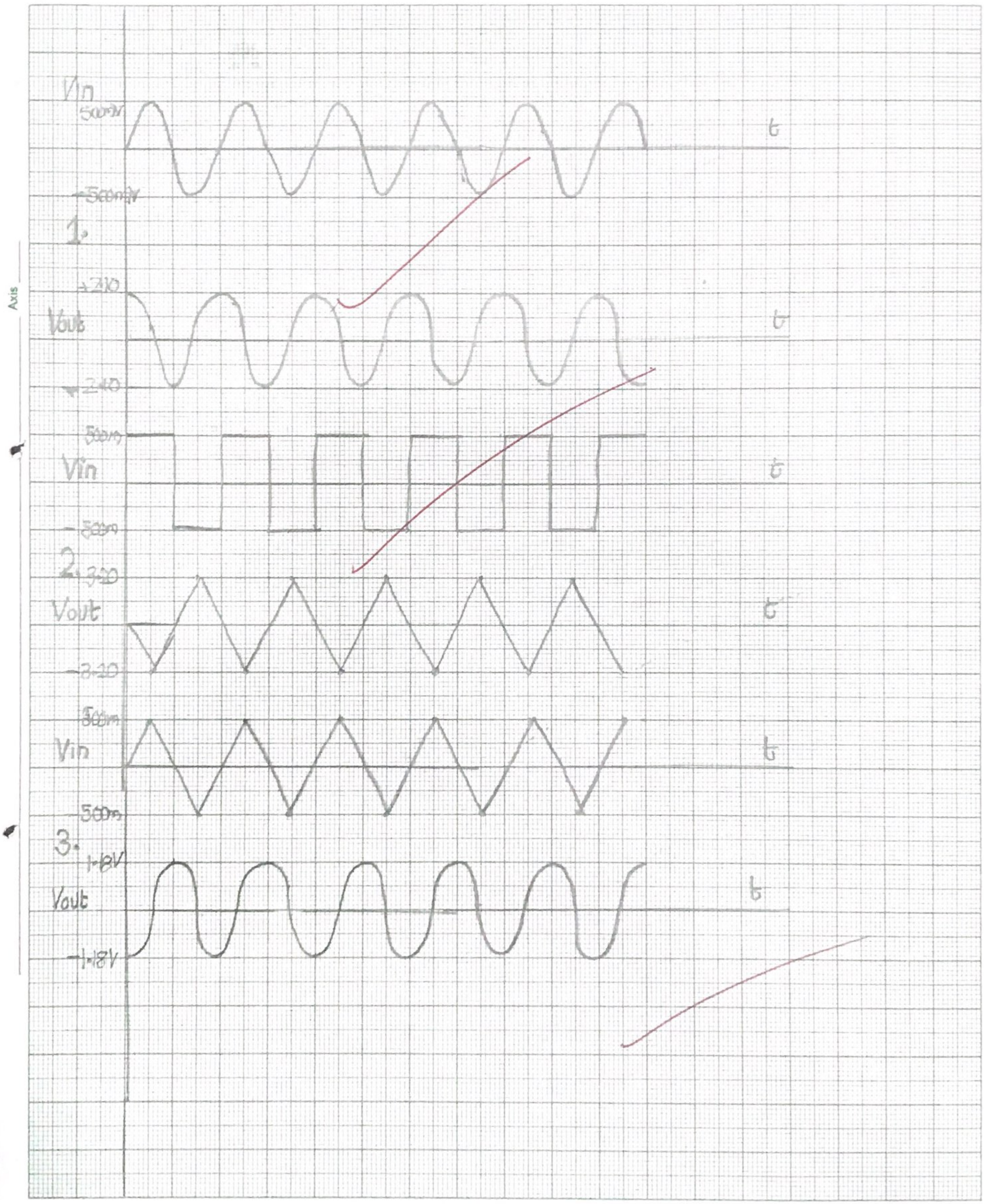
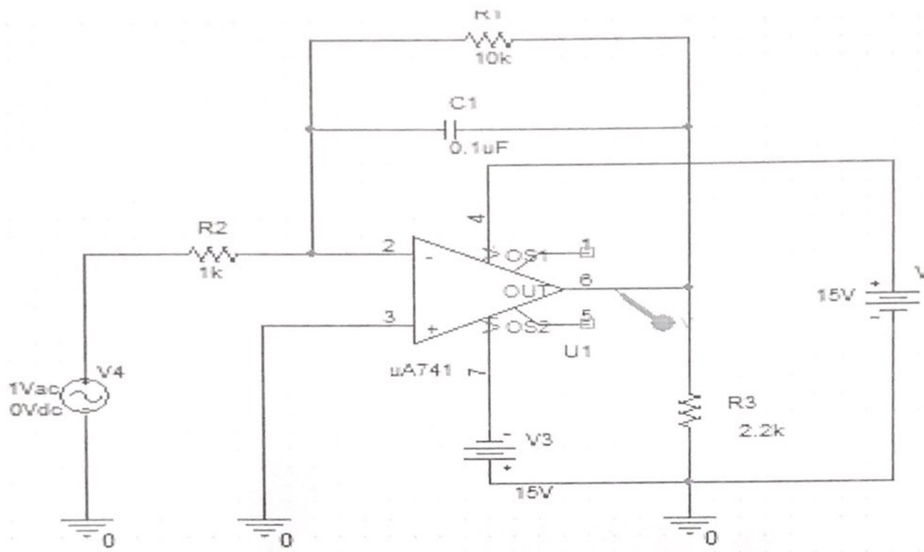


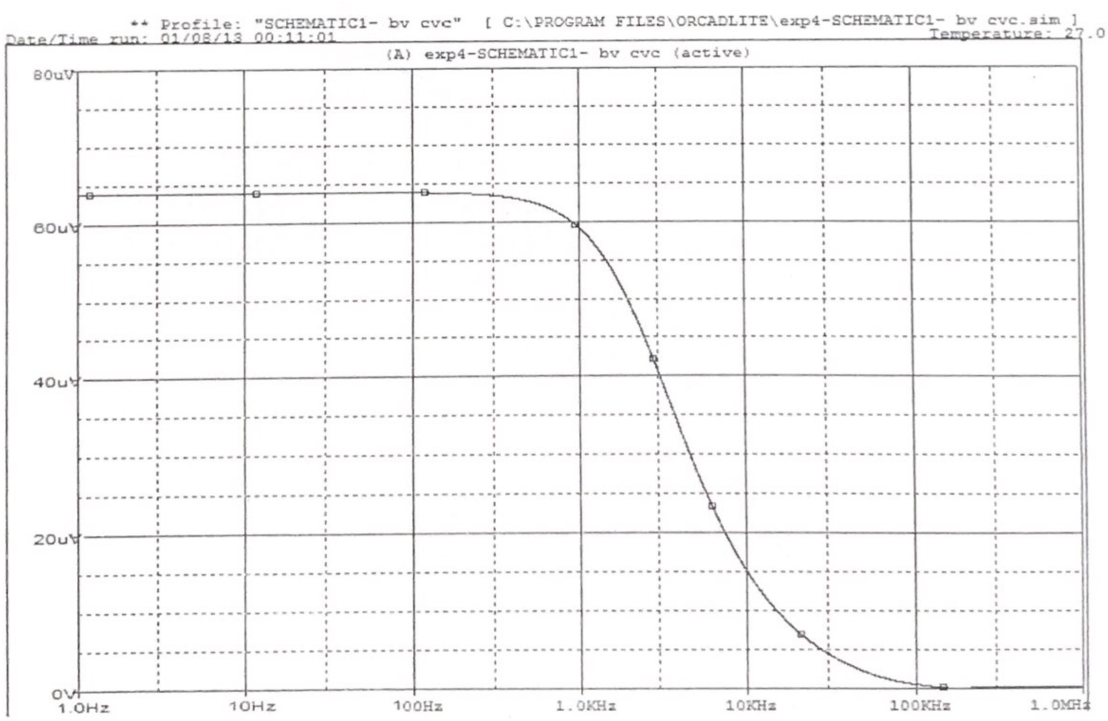
Vin
500mV
-500mV
t
1.
+2.10
Vout
-2.10
t
500m
Vin
-500m
t
2.
3.20
Vout
-3.20
t
500m
Vin
-500m
t
3.
1.18V
Vout
-1.18V
t
Axis
Axis

Experiment No. 4

Integrator using μA741c



Output



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Experiment No. 5

Aim:

To construct & test the performance of the differentiator using IC μA741C.

APPARATUS & SPECIFICATIONS:

DSO Tektronic (40 MHz), Function Generator (25 MHz), opamp μA741C, Dual Power Supply (Scientech 4075), breadboard, connecting wires, probes

Theory:

The circuit performs the mathematical operation of differentiation, that is output waveform is derivative of the input waveform. The differentiator may be constructed from a basic inverting amplifier if an input resistor R_1 is replaced by a Capacitor.

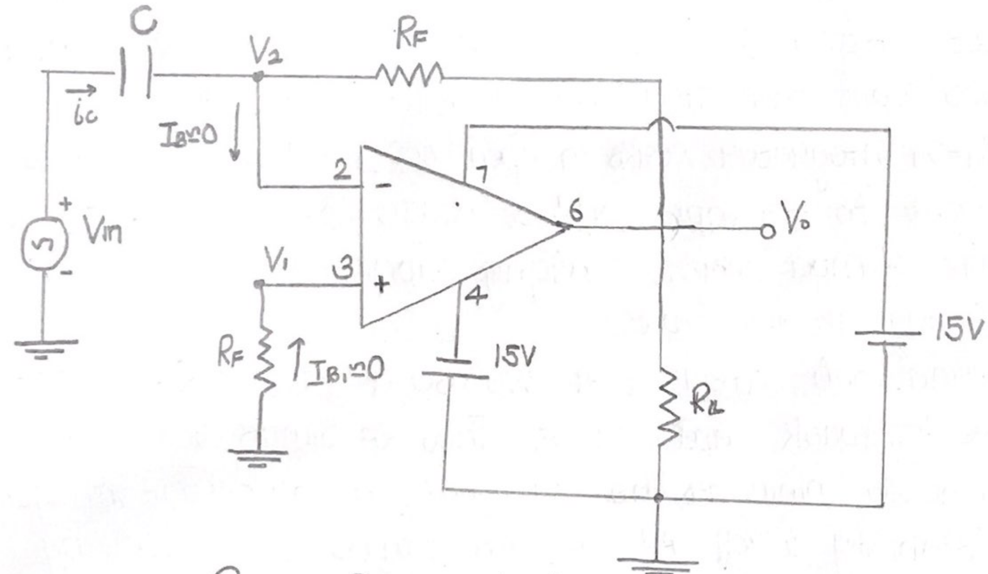
The expression for the output voltage can be obtained from Kirchoff's Current Equation written at node V_2 as follows -

$$i_C = I_B + i_F \quad , \quad \because I_B \simeq 0$$

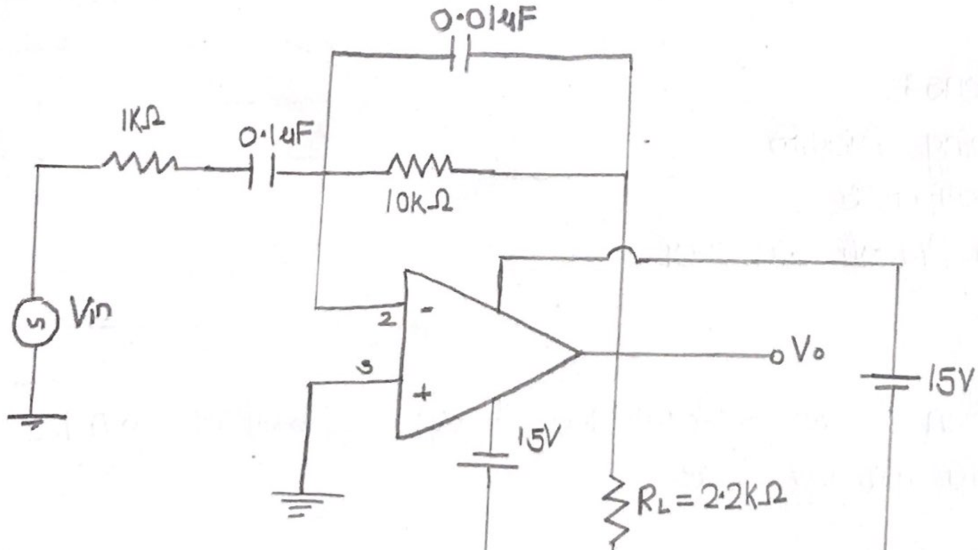
$$i_C = i_F$$

$$C_1 \frac{d}{dt}(V_{in} - V_2) = \frac{V_2 - V_o}{R_F}$$

But $V_1 = V_2 \simeq 0V$ because A is very large. Therefore, Circuit Diagram :



Basic Differentiator Circuit



Practical differentiator Circuit

Observations -

(1) Input : Sine Wave

		Frequency	Pk - Pk	Max	Min
1.	Input	1KHz	1V	+500mV	-500mV
	Output	1KHz	6·28 V	+3·14V	-3·14V
2.	Input	10KHz	1V	+500mV	-500mV
	Output	10.01KHz	3·18V	+1·59V	-1·59V
3.	Input	50KHz	1V	+500mV	-500mV
	Output	50KHz	780mV	+390mV	-390mV
4.	Input	100KHz	1V	+500mV	-500mV
	Output	100KHz	540mV	+270mV	-270mV

(2) Input : Square Wave

		Frequency	Pk - Pk	Max	Min
(1)	Input	500 Hz	1V	+500mV	-500mV
	Output	500 Hz	6·88V	+3·44V	-3·44V
(2)	Input	1kHz	1V	+500mV	-500mV
	Output	1KHz	6·24V	+3·12V	-3·12V
(3)	Input	10KHz	1V	+500mV	-500mV
	Output	10KHz	2V	+1V	-1V
(4)	Input	50KHz	1V	+500mV	-500mV
	Output	50KHz	880mV	+440mV	-440mV

(3) Input : Ramp Wave

		Frequency	Pk-Pk	Max	Min
1.	Input	1KHz	1V	+500mV	-500mV
	Output	1KHz	3.92V	+1.91V	-1.91V
2.	Input	10KHz	1V	+500mV	-500mV
	Output	10KHz	968mV	+484mV	-484mV
3.	Input	100KHz	1V	+500mV	-500mV
	Output	100KHz	672mV	+336mV	-336mV
4.	Input	150KHz	1V	+500mV	-500mV
	Output	150KHz	640mV	+320mV	-320mV

Topic________________ Date________

$$C_1 \frac{dV_{in}}{dt} = \frac{-V_o}{R_F}$$

$$\boxed{V_o = -R_F C_1 \frac{dV_{in}}{dt}}$$

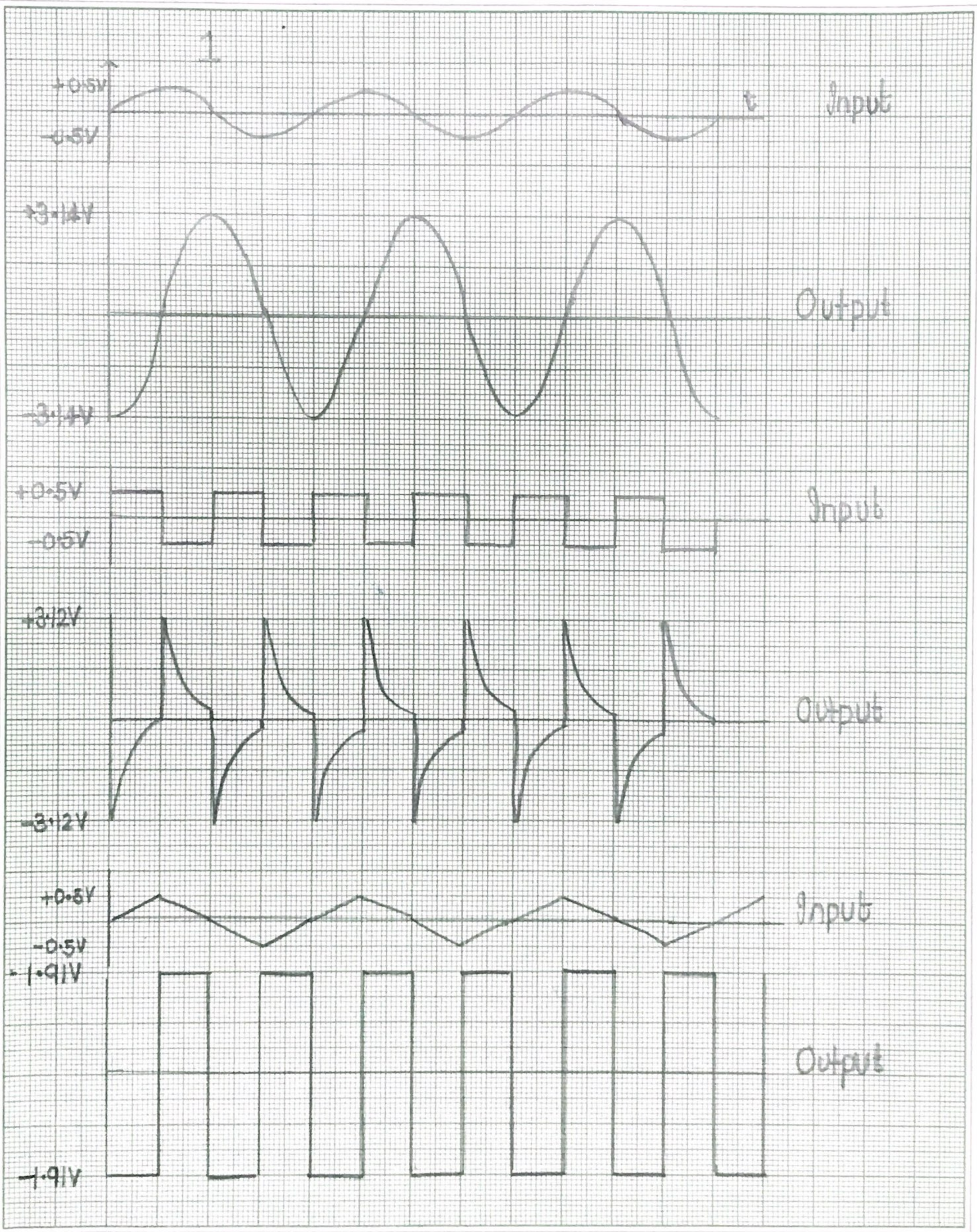
The output V_o is equal to $R_F C_1$ times the negative instantaneous rate of change of the input voltage Vin with time. Since the diff. performs the reverse of integrator function. However, this differentiator will have some practical problems. The gain of the circuit (R_F/X_{C_1}) increases with increase in frequency at a rate of 20dB/decade. It makes circuit unstable. Also the input impedance X_{C_1} decreases with increase in frequency, which makes the circuit very suseptible to high frequency noise. Both the stability & high frequency noise problems can be constructed by addition of two components R_1 & C_F. This circuit is practical differentiator.

Some of its applications are -

(1) Waveshaping Circuits
(2) Rate of change detector in FM Modulator

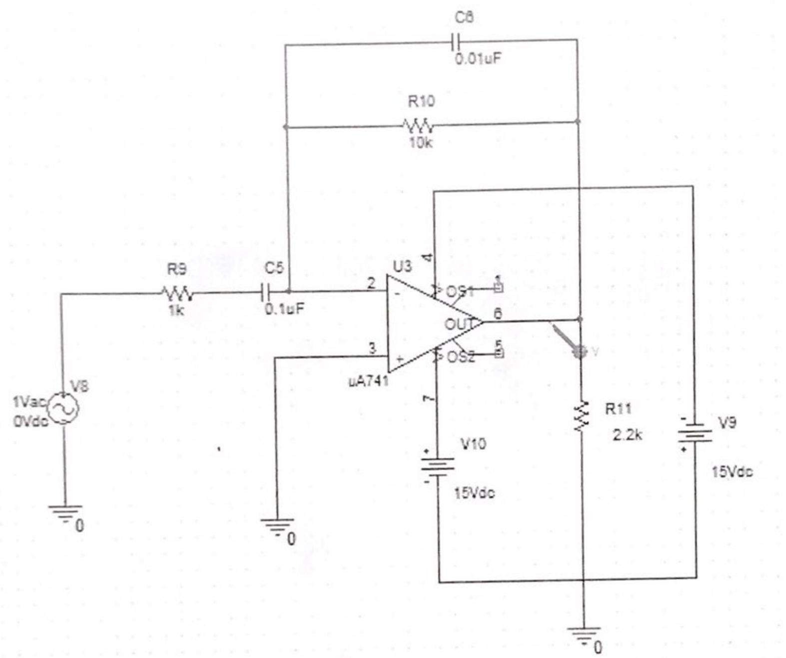
Result:

Construction & test performance of the differentiator using IC μA741C has been done.

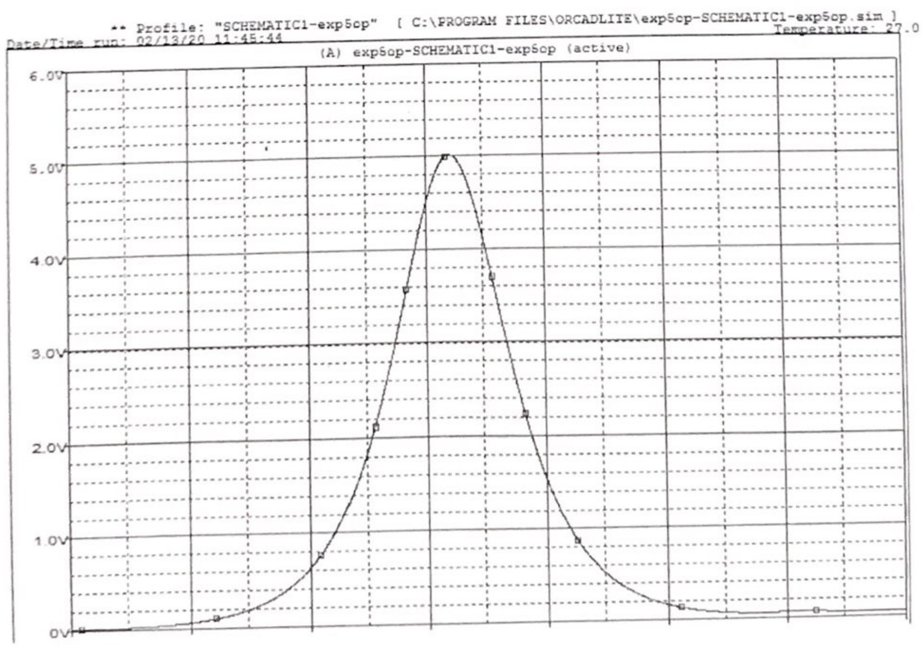

1
+0·5V
-0·5V
t
Input
+3·14V
-3·14V
Output
+0·5V
-0·5V
Input
+3·12V
-3·12V
Output
+0·5V
-0·5V
Input
+1·91V
-1·91V
Output

Experiment No. 5

Differentiator using $\mu A741c$



Output



Topic ______ Date ______

Experiment No. 6

Aim :

To design & verify operation of active low pass filter using IC uA741C

Software Used :

PSpice

Theory :

A low pass filter is a filter which only allows frequencies with lower magnitude as compared to ~~specific~~ frequency to pass through and block the higher frequencies. The limit of the frequencies up to which the circuit allows is known as critical frequency.

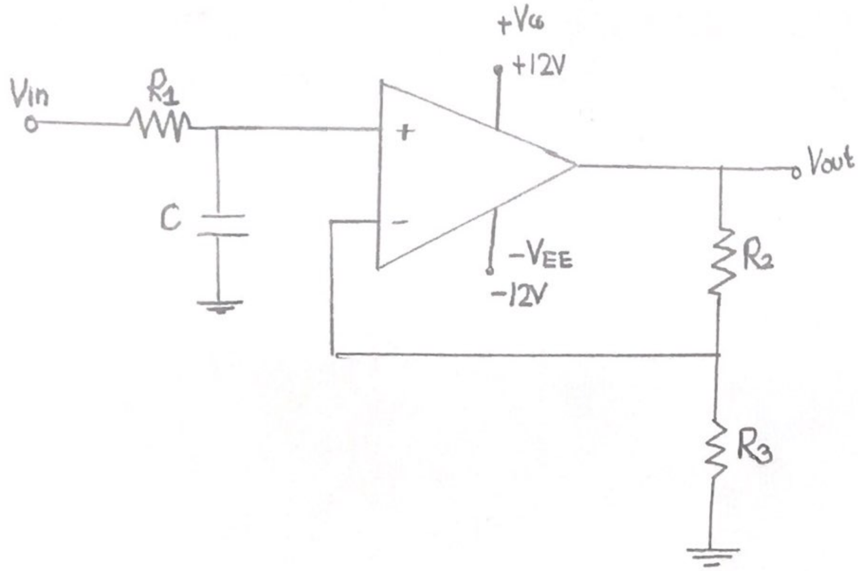
The frequency is present at -3dB of the maximum magnitude or 0.707 or 70.7% the maximum magnitude.

Calculations :

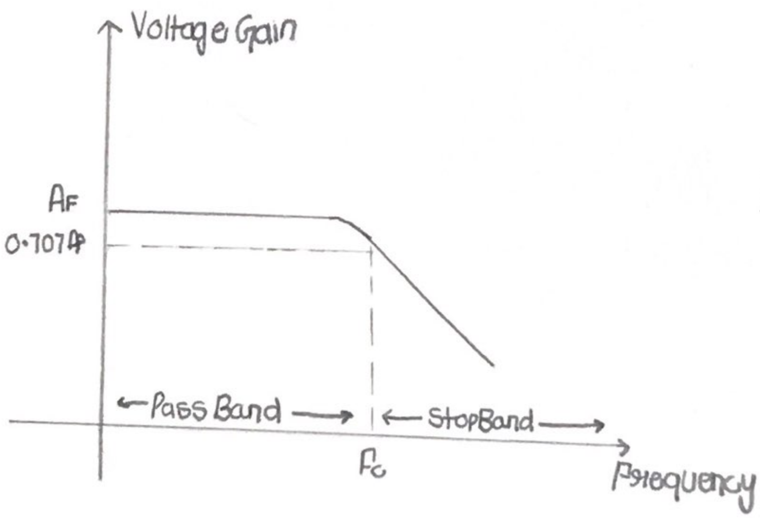
Voltage gain of Low Pass Filter

$$A_V = \frac{V_{out}}{V_{in}} = \frac{A_F}{\sqrt{1 + \left(\frac{f}{f_c}\right)^2}}$$

Cutoff frequency $f_c = \frac{1}{2\pi RC}$



First Order
Low Pass Circuit



Frequency Response

Topic ____ Date ____

Let us design a Low Pass Filter with $F_c = 10KHz$

Let $C = 1\mu F$, R is found using equation $F_c = 1/2\pi RC$

To find R_1 and R_2

$$Gain = 1 + \left(\frac{R_1}{R_2}\right)$$

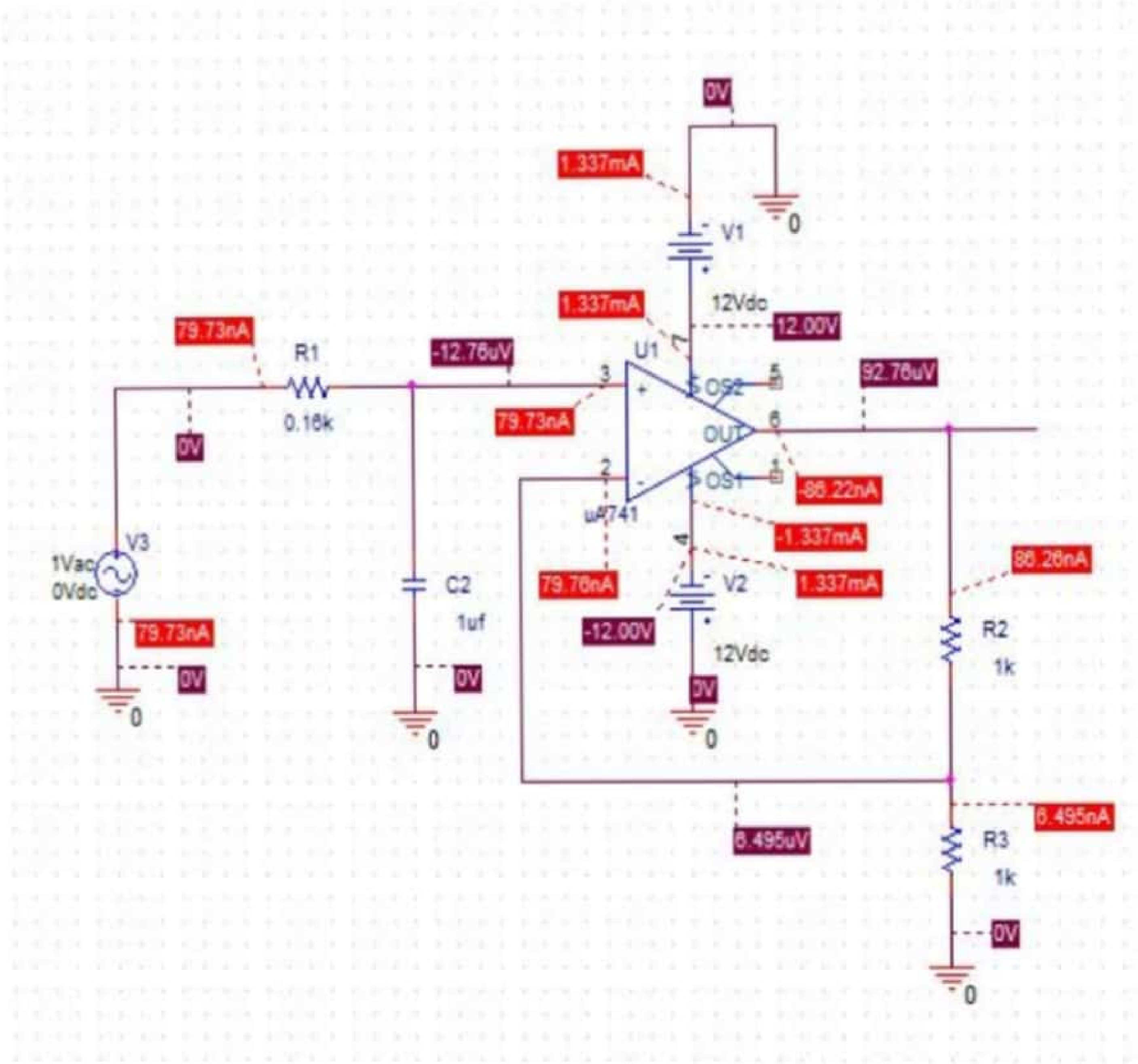
For $A_V = 2$

$$\frac{R_1}{R_2} = 1$$

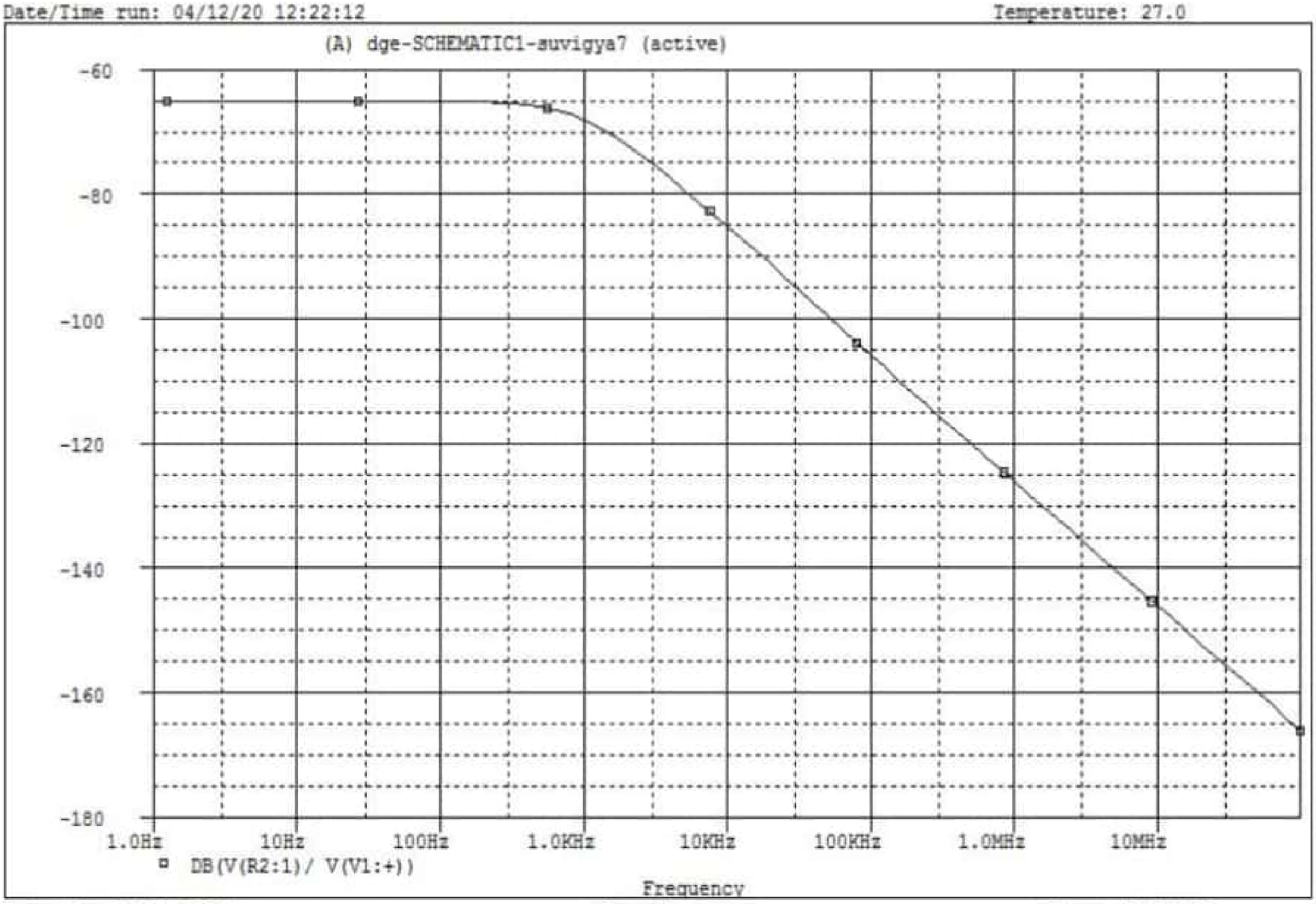
If $R_1 = 1K\Omega$ then $R_2 = 1K\Omega$

Results

Design & verification of active low pass filter using IC UA741 has been done


0V
1.337mA
V1
0
1.337mA
12Vdc
12.00V
79.73nA
R1
-12.76uV
U1
3
7
5
OS2
92.76uV
0.16k
79.73nA
6
OUT
0V
2
1
OS1
-86.22nA
uA741
-1.337mA
V3
4
86.26nA
1Vac
0Vdc
C2
79.76nA
V2
1.337mA
1uf
-12.00V
R2
79.73nA
1k
12Vdc
0V
0V
0V
0
0
0
6.495nA
6.495uV
R3
1k
0V
0

Date/Time run: 04/12/20 12:22:12 Temperature: 27.0



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Experiment No. 7

Aim:
To design & construct a Schmitt trigger using IC uA741C

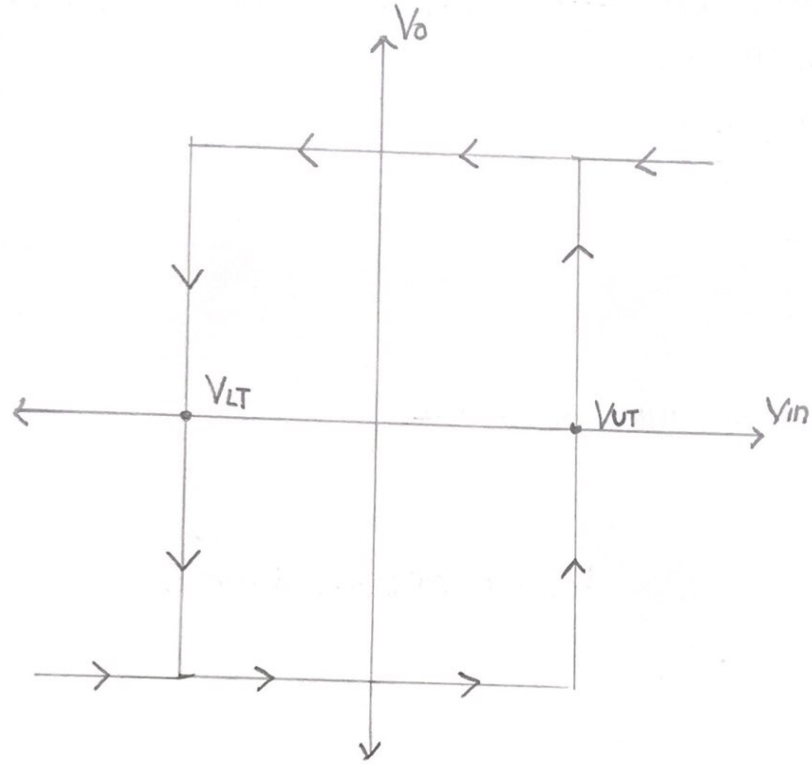
Tool:
Orcad Pspice

Theory:
Schmitt Trigger converts an irregular shaped waveform to a square wave or pulse. Here, the input voltage triggers the output voltage every time it exceeds certain voltage levels called the upper threshold voltage V_{UTP} and lower threshold voltage V_{LTP}. The input voltage is applied to inverting input. Because the feedback voltage is aiding the input voltage, the feedback is positive. A comparator using positive feedback is usually called Schmitt Trigger. Schmitt Trigger is used as a squaring circuit, amplitude comparator etc.

From circuit diagram using voltage divider circuit rule,

$$V_{UT} = \frac{R_2}{R_1 + R_2} (+V_{sat})$$

$$V_{LT} = \frac{R_2}{R_1 + R_2} (-V_{sat})$$



Hysteresis Curve

Topic ______ Date ______

If the threshold voltages V_{UT} & V_{LT} are made larger than input noise voltages, the positive feedback will eliminate the false output transcitions. Also the positive feedback, because of regenerative reaction, will make V_o switch faster between $+V_{sat}$ & $-V_{sat}$.

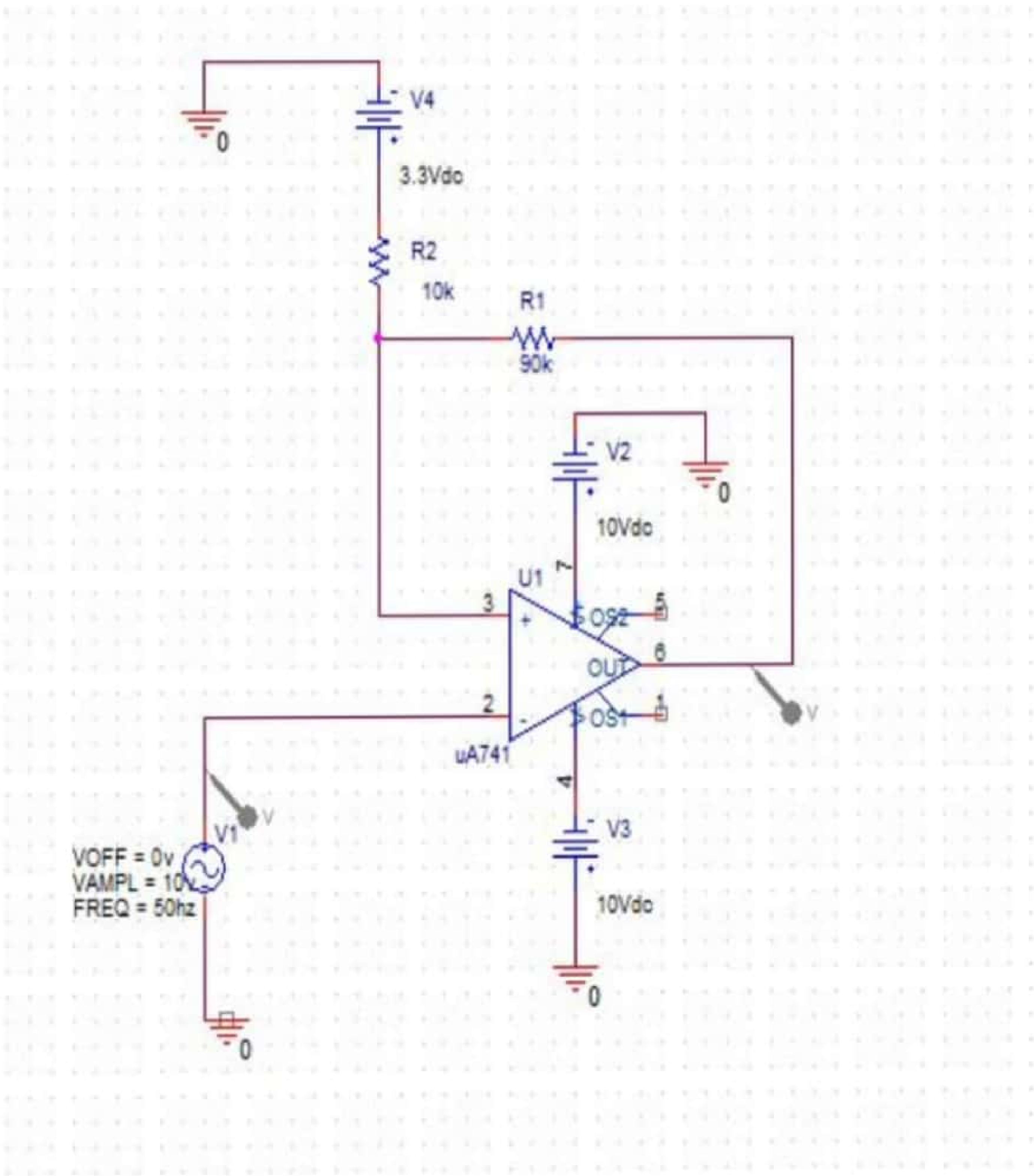
Calculations:

$$V_{UT} = \frac{R_2}{R_1+R_2}(+V_{sat}) = \frac{10}{10+90} \times 10 = +1V$$

$$V_{LT} = \frac{R_2}{R_1+R_2}(-V_{sat}) = \frac{10}{10+90}(-10) = -1V$$

Result:

Design & Construction of Schmitt trigger using IC $\mu A741$ has been done.



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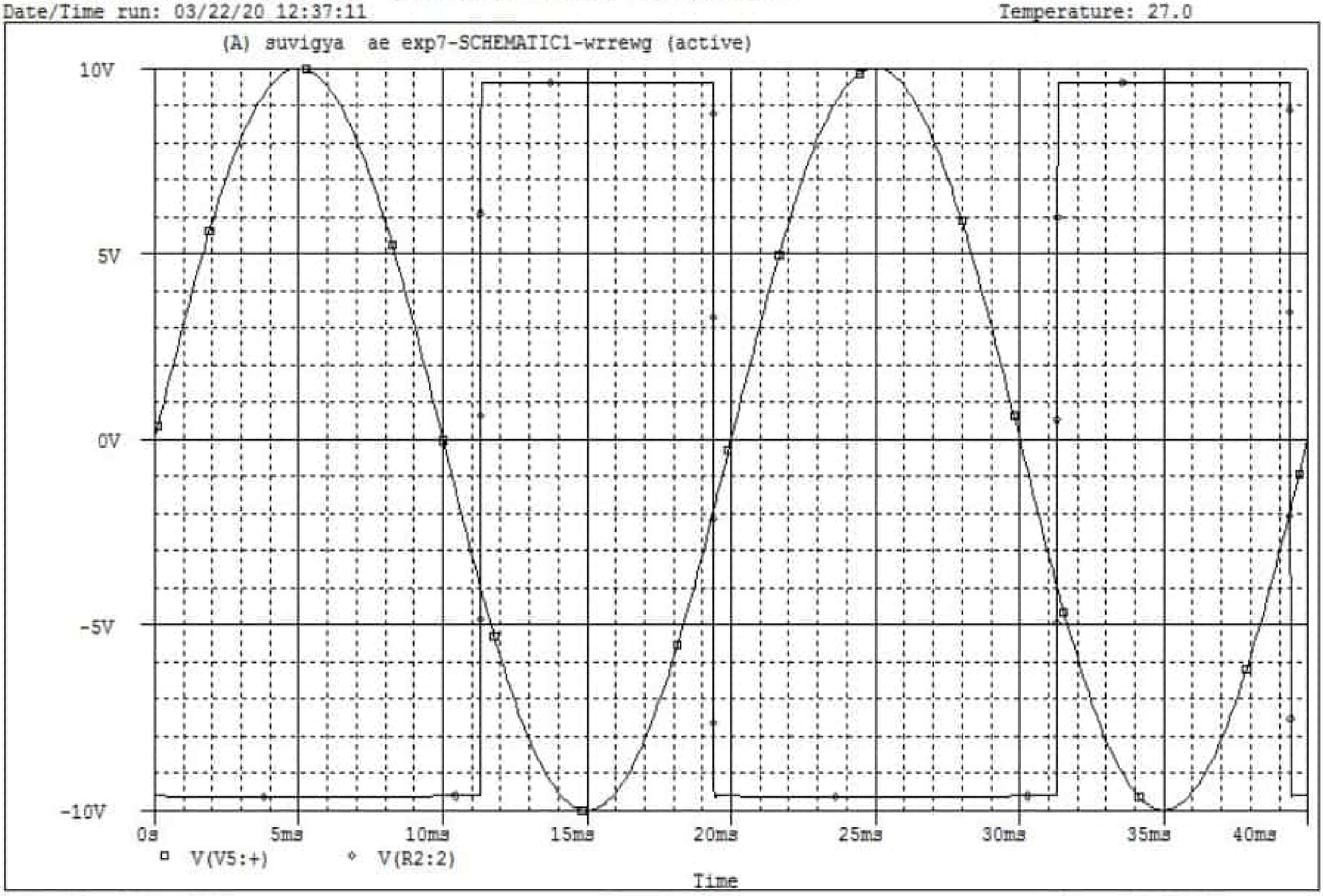


Topic _____ Date _____

Experiment No. 8

Aim:

To design & test Wein Bridge Oscillator using IC uA741C

Tool:

PSpice

Theory:

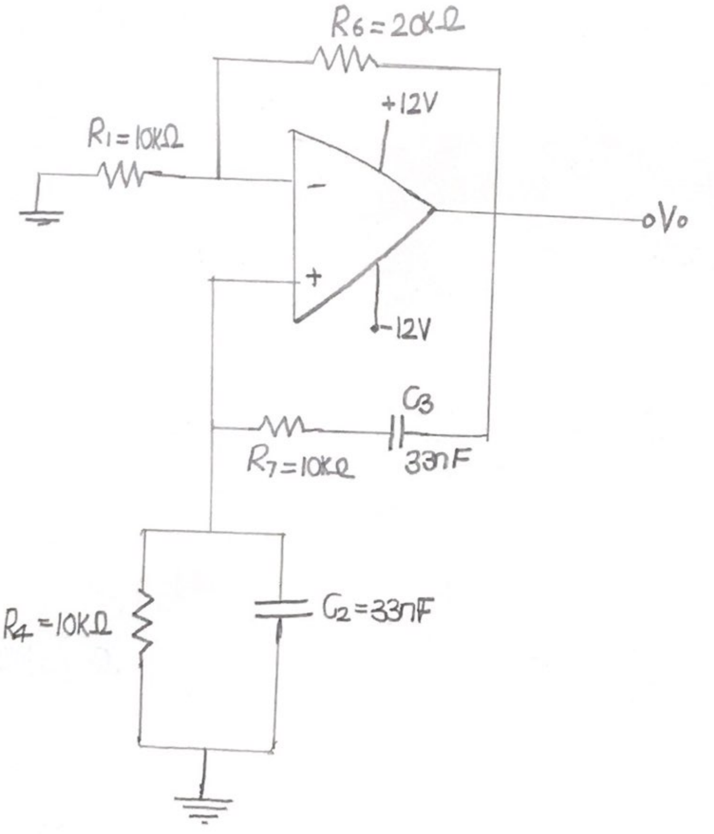
In Wein bridge oscillator, wein bridge circuit is connected between the amplifier input terminals & output terminals. The bridge has a series rc network in one arm & parallel network in adjoining arm. In the remaining 2 arms of the bridge resistors R_1 & R_F are connected.

To maintain oscillations total phase shift around the circuit must be zero & loop gain unity. First condition occurs only when the bridge is balanced. Assuming that the resistors & capacitors are equal in value, the resonant frequency of balanced bridge is given by,

$$F_0 = \frac{1}{2\pi RC}$$

Conditions For Oscillation:

1. The gain required for sustained oscillations is given by



From the waveform the value of Time period (T) is 2 ms

Topic ____________ Date ______

$A_F = 1 + \frac{R_6}{R_1}$

hence, $3 = 1 + \frac{R_6}{R_1} \Rightarrow R_6 = 2R_1$

Let $R_1 = 10K\Omega$ then $R_6 = 20K\Omega$

2. Oscillating Frequency, $F_0 = 1/2\pi RC$

Assuming the values of some of the resistors and capacitors the value of frequency is calculated

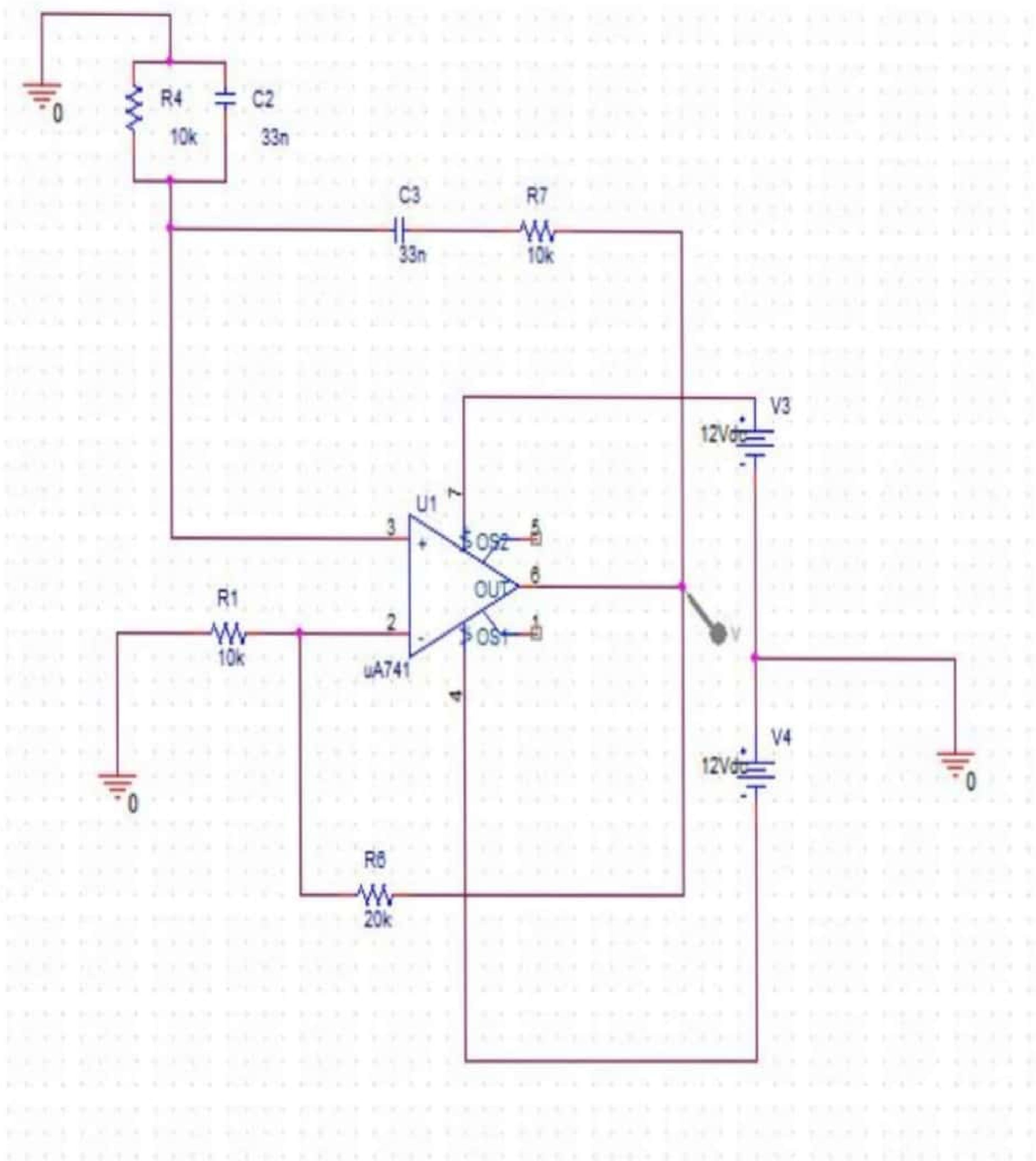
Theoretical Value: $F = 1/(2 \times 3.14 \times 10 \times 10^3 \times 33 \times 10^{-9})$

$F = 482.5Hz$

$T = \frac{1}{F} = 2.07\ ms$

Result:

Wein Bridge Oscillator has been studied, the output waveform traced & theoretical time period & time period from output waveform were approximately equal.



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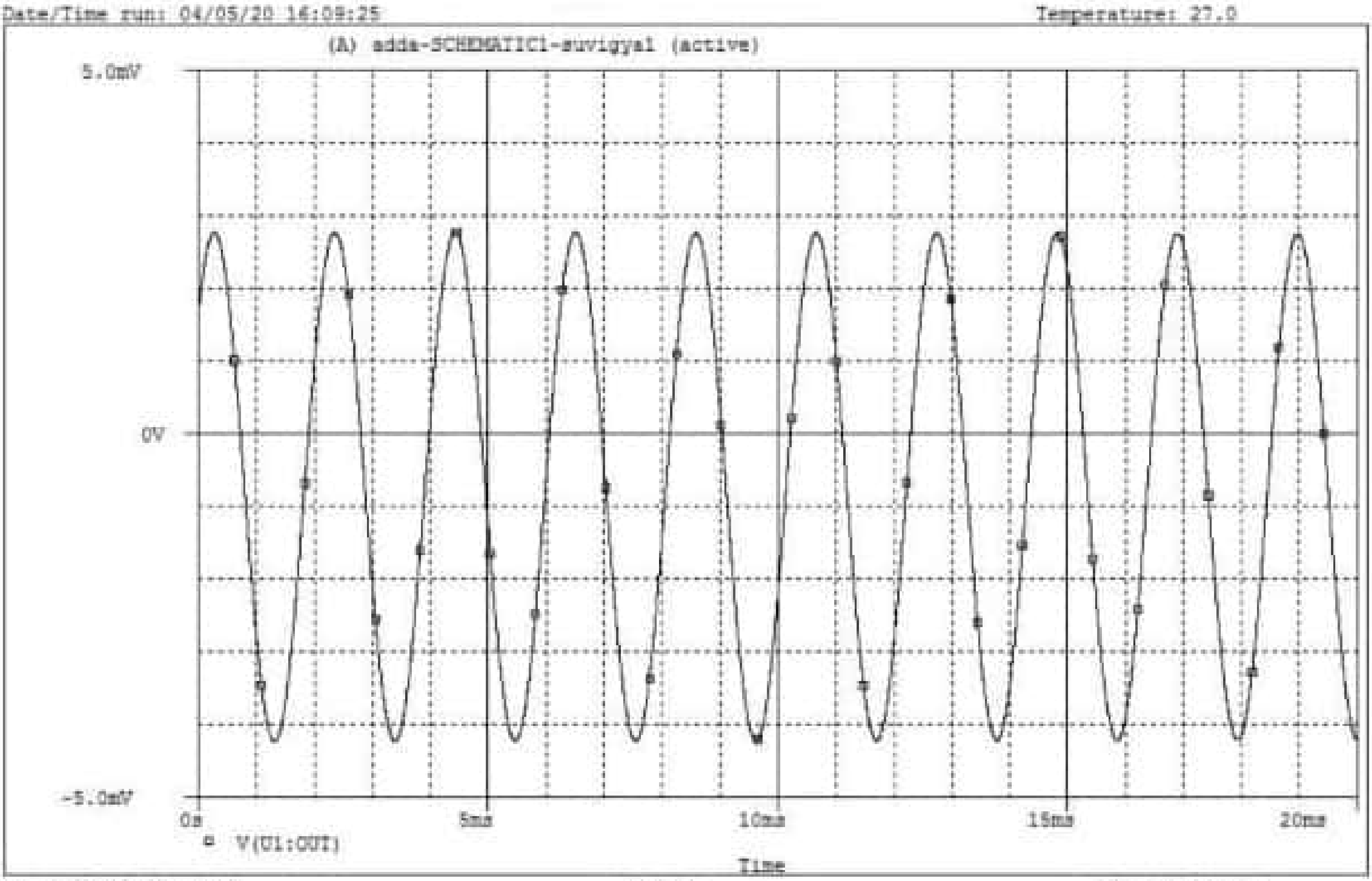

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Experiment No. 9

Aim:

To design & test astable multivibrator using IC 555

Tool:

Pspice

Theory:

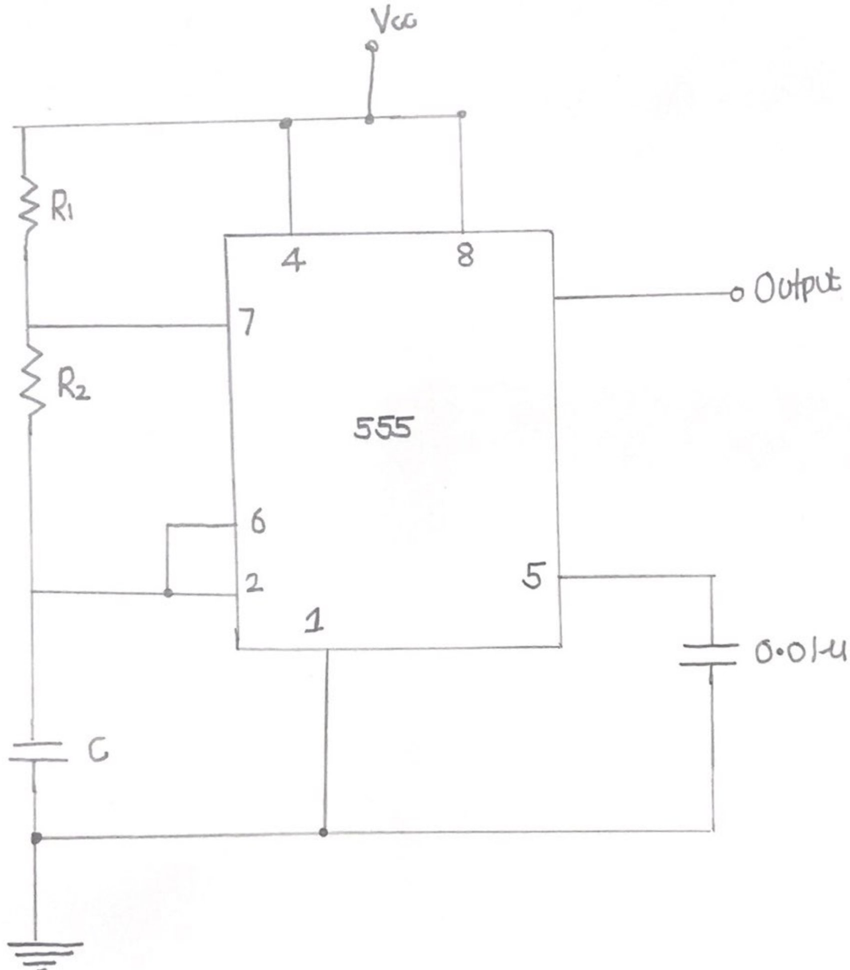
The 555 timer IC can be connected either in its monostable mode thereby producing a presision timer of a fixed time duration or its bistable mode to produce a flip flop type switching action. But we can also connect the 555 timer IC in an Astable mode to produce a very stable 555 Oscillator Circuit for generating highly accurate free running waveforms whose output frequency can be adjusted by means of an Externally connected RC tank circuit consisting of just two resistors & a capacitor

The individual times reaquired completing one charge & discharge cycle of output is given as:

$t_1 = 0.693(R_1+R_2)C$

$t_2 = 0.693R_2C$

$T = t_1 + t_2$


Vcc
R1
R2
4
8
7
555
6
2
1
5
Output
0.01uF
C

Topic______ Date______

Calculations :

Let $t_2 = 0.693s$

$t_1 = 0.699s$

$C = 10\mu F$

$t_2 = 0.693R_2C$

$0.693 = 0.693R_2C$

$R_2 = 100k\Omega$

$t_1 = 0.693(R_1+100)C$

$0.699 = 0.693(R_1+100)10\times10^{-6}$

$R_1 = 1k\Omega$

$T = t_1+t_2$

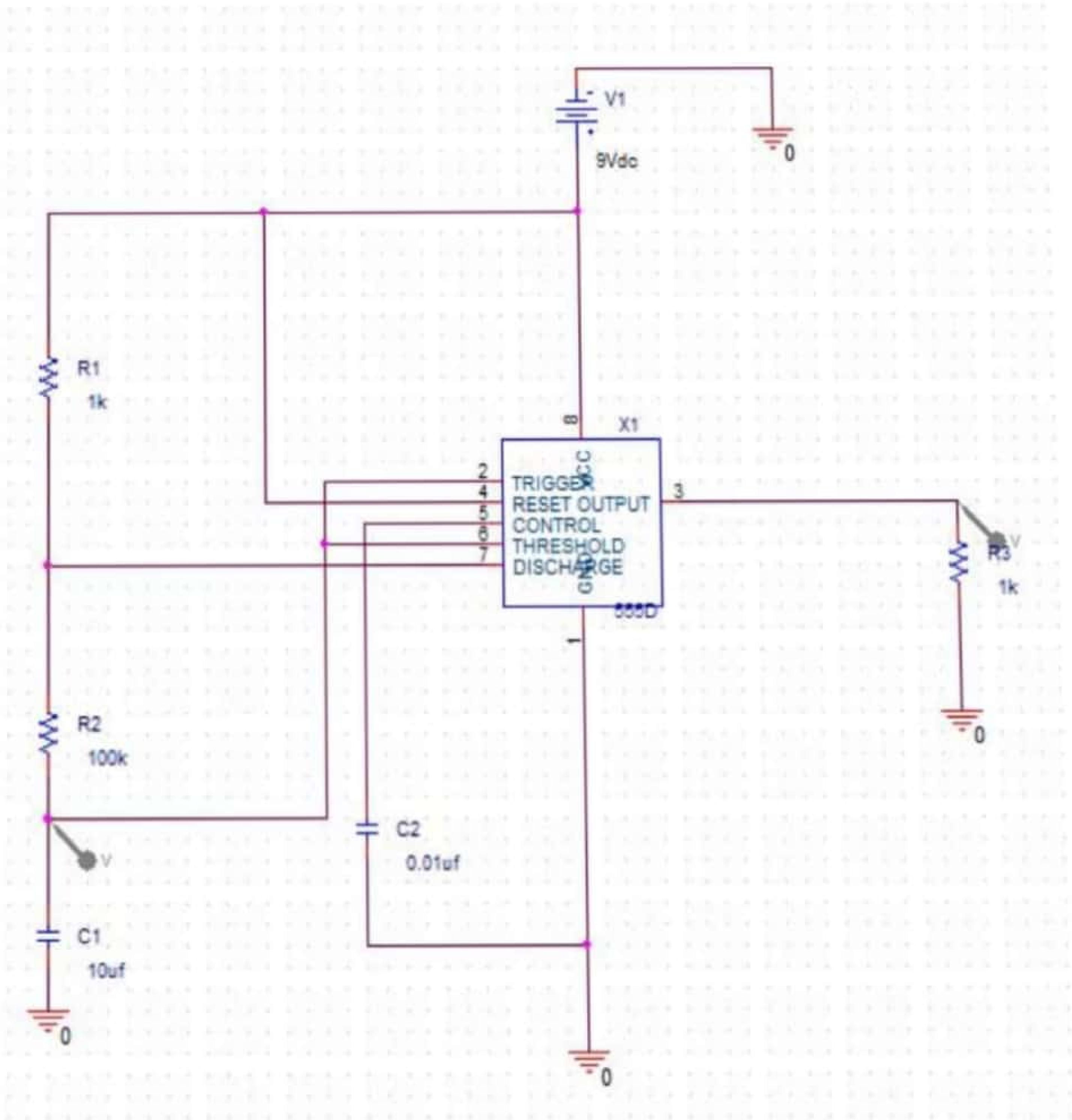
$= (0.699+0.693)$

$= 1.392s$

From the waveform time period obtaned is approximately equal to the theoretical value of time period.

Result:

Hence Astable vibrator using 555 is studied & its output waveform is traced.



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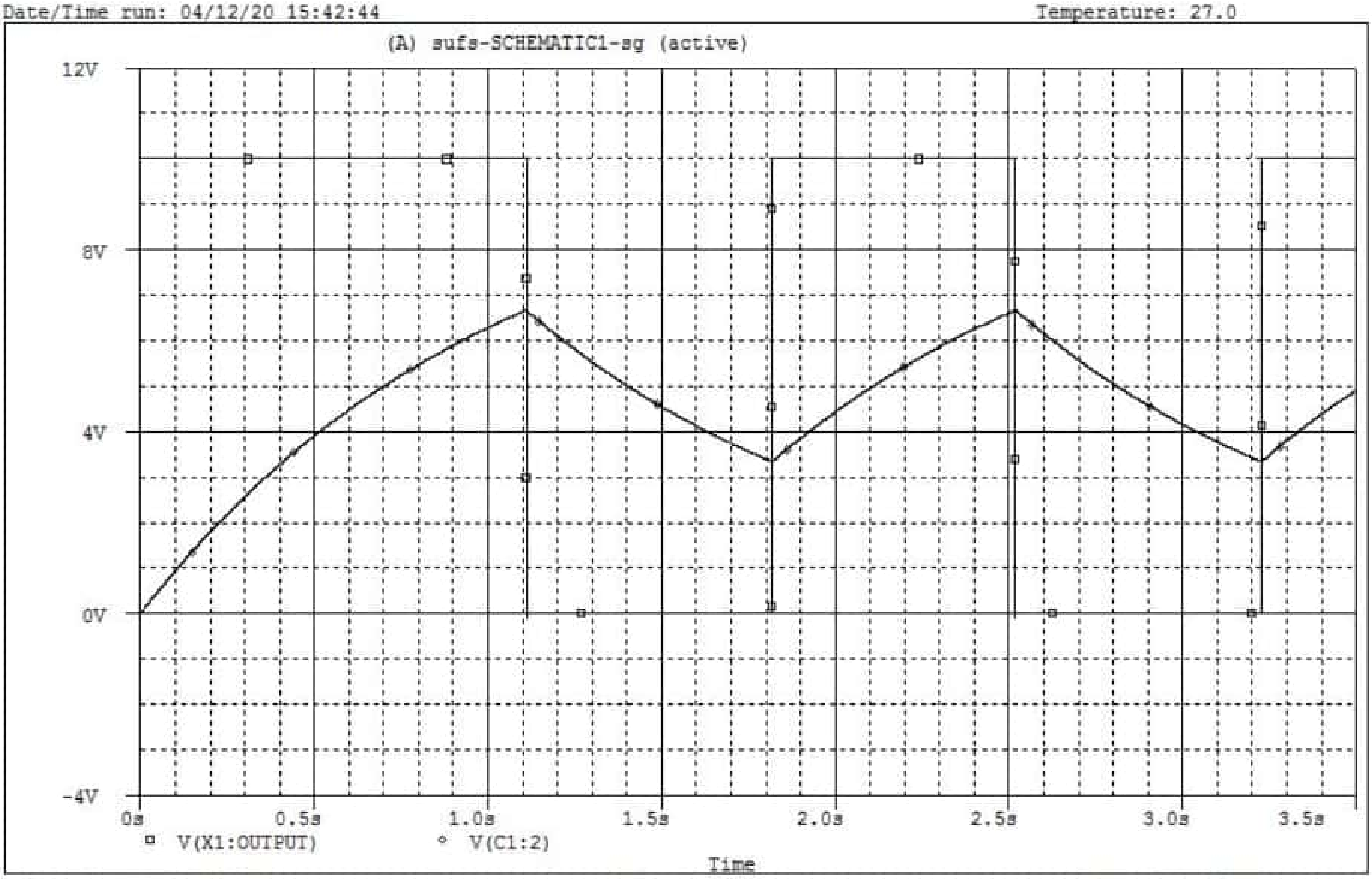

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