DEVICES AND CIRCUITS LAB REPORT – 9

EXPERIMENT NAME : Non-Linear Circuits - Multivibrators

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<u>HARDWARE EXERCISE:</u>

OBJECTIVES: To Construct and characterize a Schmitt Trigger, Mono-stable multivibrator and an Astable multivibrator.

EQUIPMENT USED:

1. Op-Amp µA 741
2. Resistors
3. Capacitors
4. Regulated Power Supply
5. Digital Storage Oscilloscope
6. Arbitrary Function Generator

OBSERVATIONS:

1.Schmitt trigger circuit:

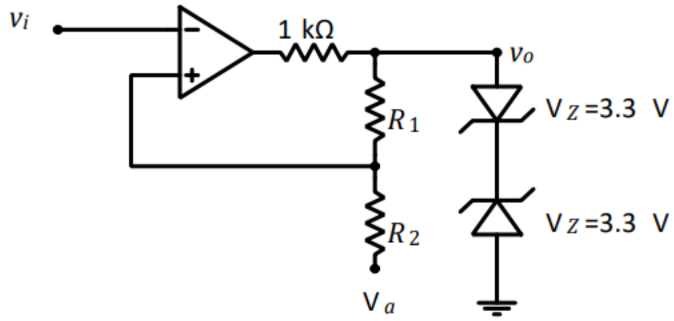


Figure 1: Circuit for Schmitt trigger.

1. We have made the hardware setup as shown in the above figure
2. Connect a sinusoidal input (7V peak, 100Hz) to input port
3. The calculated theoretical values are as follows:

Experiment - 9 :

Non- Linear Circuit - Multivibrators

1. Schmitt trigger Circuit :

$$V_t^+ = V_a\left(\frac{R_1}{R_1+R_2}\right) + V_o\left(\frac{R_2}{R_1+R_2}\right)$$

$$V_t^- = V_a\left(\frac{R_1}{R_1+R_2}\right) - V_o\left(\frac{R_2}{R_1+R_2}\right)$$

Case I :

$R_1 = R_2 = 10k\Omega$

$\boxed{V_a = 0}$ $\quad V_o = 7\left(\frac{10}{11}\right) = 6.36V.$

$\therefore V_t^+ = 6.36\left(\frac{1}{2}\right) = 3.18.$

$V_t^- = -6.36 \times \frac{1}{2} = -3.18$

Case II :

$R_1 = 25k\Omega \quad R_2 = 10k\Omega$

$V_a = 0, \quad V_o = 6.36V$

$V_t^+ = 6.36\left(\frac{10}{35}\right) = 1.81V$

$V_t^- = -6.36\left(\frac{10}{35}\right) = -1.81V$

Case-III : $R_1 = R_2 = 10k\Omega.$, $V_a = 3V.$

$V_t^+ = 6.36\left(\frac{1}{2}\right) + 3\left(\frac{1}{2}\right)$

$= 4.68V$

$V_t^- = -6.36\left(\frac{1}{2}\right) + 3\left(\frac{1}{2}\right) = -1.68$

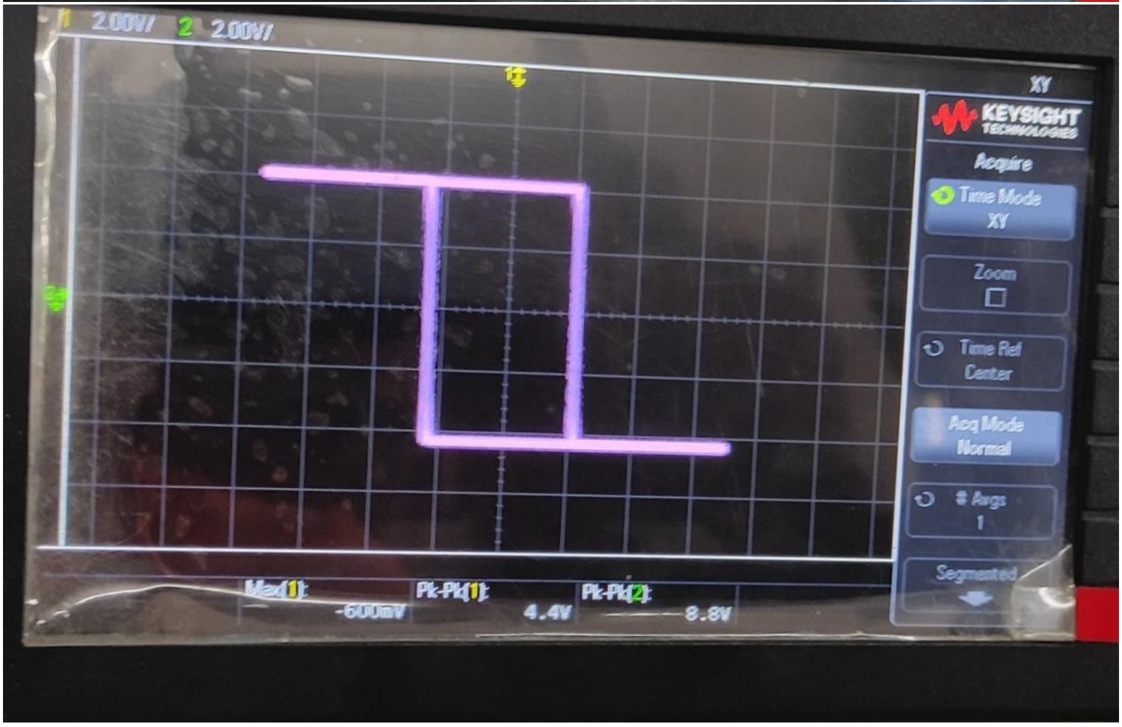
Case-IV : $R_1 = 25k\Omega$, $R_2 = 10k\Omega$, $V_a = 3V$

$V_t^+ = 6.36\left(\frac{10}{35}\right) + 3\left(\frac{25}{35}\right) = 3.95$; $V_t^- = -6.36\left(\frac{10}{35}\right) + 3\left(\frac{25}{35}\right)$

4. The practical observed values are:

	Theoretical(inV)			Practical(inV)		
(Va,R1,R2)	Vt+	Vt-	Vt+ - Vt-	Vt+	Vt-	Vt+ - Vt-
(0 V, 10 kΩ, 10 kΩ)	3.18	-3.18		2.25	-2.25	4.5
(0 V, 25 kΩ, 10 kΩ)	1.81	-1.81		1.46	-1.46	2.92
(3 V, 10 kΩ, 10 kΩ)	4.68	-1.68		3.73	-0.73	4.46
(3 V, 25 kΩ, 10 kΩ)	3.95	0.32		3.42	0.51	2.91

5. With R1=R2=10 kΩ and Va=0 V, we increased the input frequency from 100 Hz to 5kHz and we found that the input peak voltage and output peak voltage are same but the threshold voltage is changed when the frequency is increased and the hysteresis width will increase.



2. Astable multivibrator:

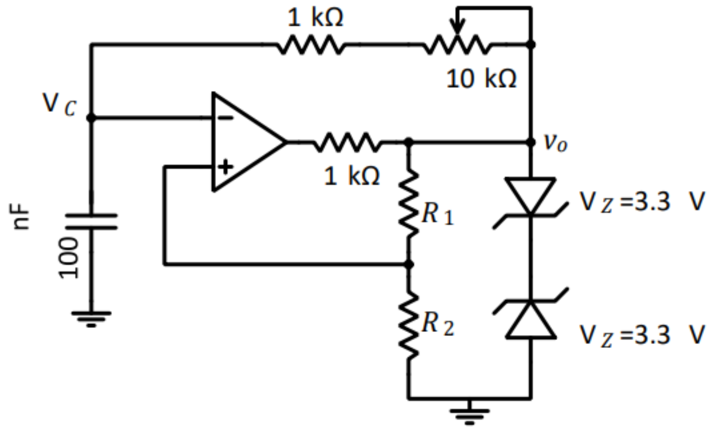
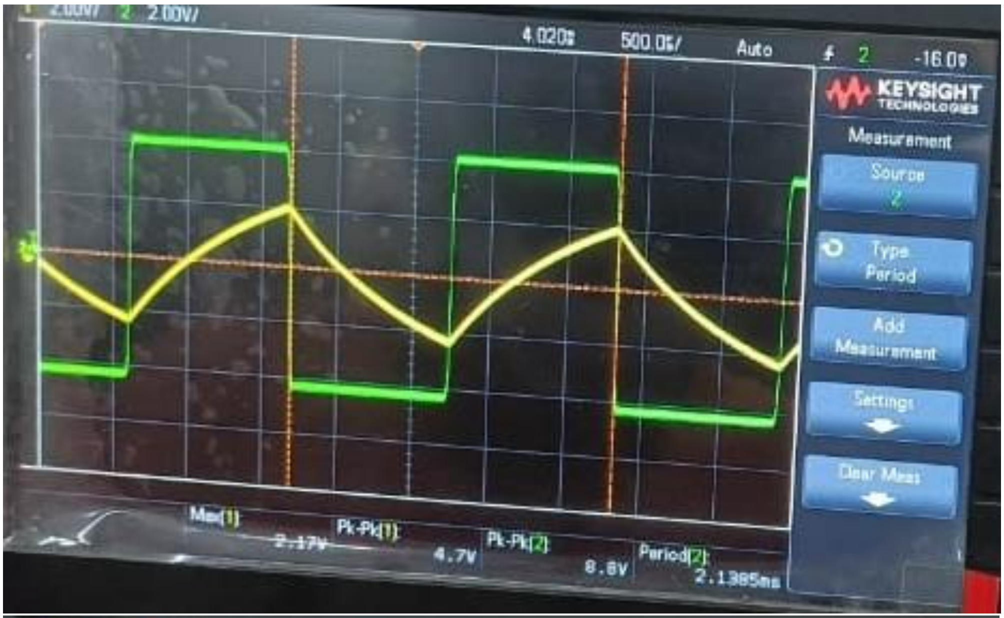


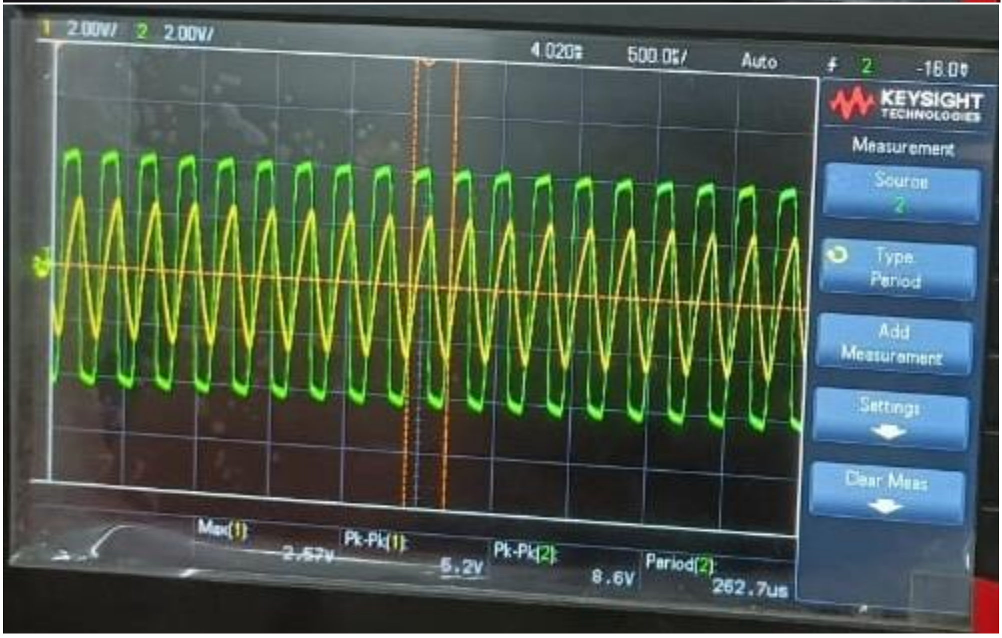
Figure 2: Circuit for Astable multivibrator.

1. We have made the hardware setup as shown in the above figure
2. We used R1 = R2 = 10k ohm and rotated the pot with 5 equal rotations and observed the Vc and Vo of the circuit.

	Theoretical(inV)			Practical(inV)		
Resistance(in ohm)	Vc	Vo	Time period(in ms)	Vc	V0	Time period(in ms)
0	1.65	3.3	0.219	2.2	4.4	0.263
2	1.65	3.3	0.659	2.2	4.4	0.69
4	1.65	3.3	1.098	2.2	4.4	1.47
6	1.65	3.3	1.538	2.2	4.4	1.83
8	1.65	3.3	1.977	2.2	4.4	1.91
10	1.65	3.3	2.41	2.2	4.4	2.13



2.00V/
2.00V/
4.020s
500.0s/
Auto
-16.0s
KEYSIGHT TECHNOLOGIES
Measurement
Source
Type Period
Add Measurement
Settings
Clear Meas
Max(1):
2.17V
Pk-Pk(1):
4.7V
Pk-Pk(2):
8.6V
Period(2):
2.1385ms



2.00V/
2.00V/
4.020s
500.0s/
Auto
-16.0s
KEYSIGHT TECHNOLOGIES
Measurement
Source
Type Period
Add Measurement
Settings
Clear Meas
Max(1):
2.57V
Pk-Pk(1):
5.2V
Pk-Pk(2):
8.6V
Period(2):
262.7us

2) Astable Multivibrator.

$\beta = \frac{R_2}{R_1+R_2} = \frac{1}{2}$ $T = 2RC\ln\left(\frac{1+\beta}{1-\beta}\right)$

$\therefore T = 2(1+x)\,10^{-7}\ln(3)$

x: resistance of potentiom

For $\boxed{x=0}$

$T = 2\times10^{-7}\times\ln 3\times10^{3} = 2.19\times10^{-4}$

For $x = 2$

$T = 6.59\times10^{-4}$

For $x = 4$

$T = 10.98\times10^{-4}$

For $x = 6$

$T = 15.38\times10^{-4}$

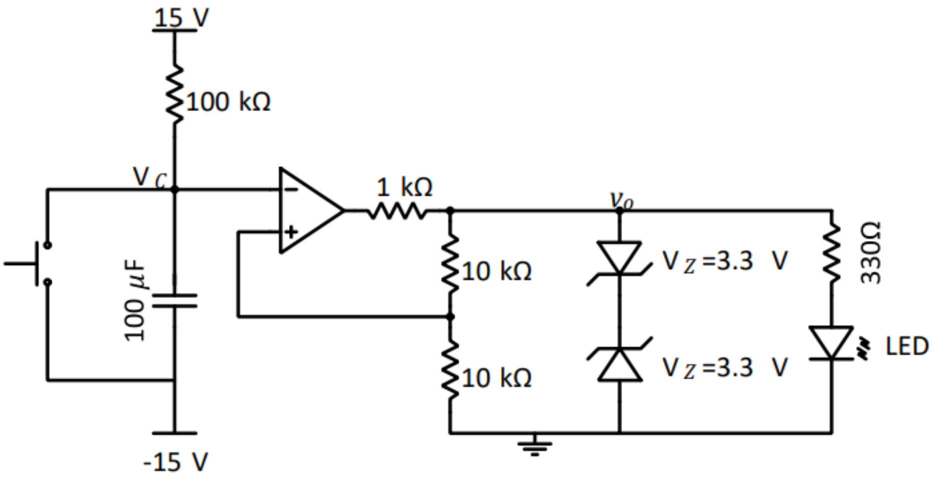
For $x = 8$

$T = 19.77\times10^{-4}$

For $x = 10$

$T = 24.1\times10^{-4}$.

3.Mono-stable multivibrator:



1.We have made the hardware setup as shown in the above figure.

2.We calculated the output pulse width and it turns out to be 9.6 sec by using the below formula

T = RC*ln(2V'/V'-Vth);

3.We used the led and wrist watch to find the output pulse width we we gave the impulse signal at input and it turns out to be that the output is 9.8 sec.

Discussion:

200020051: In lab 9 we did practical's on operational amplifiers and Zener diode, we learnt the characteristics of all the circuits and it is very interesting too learn the new topics in lab. In this lab to calculate theoretical values it took some time more than the previous labs.

200020010: Today in lab 9 we have done hardware excercise of operational Amplifiers and Zener diode. We understood how to build and characterize a Schmitt Trigger, Mono-stable multivibrator and an Astable multivibrator using Op-Amps. In hardware excercise we learnt the daily uses of these circuits in such as bits conversion in communications.