Experiment No. 9

Non-Linear Circuits - Multivibrators

Objectives:

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

Equipment/Components Required:

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

Steps:

1. Schmitt trigger circuit

- Analyze the Schmitt trigger circuit shown in the Figure 1 and calculate the threshold voltages V^{+}_{t} and V_{t}^{-} of the circuit.

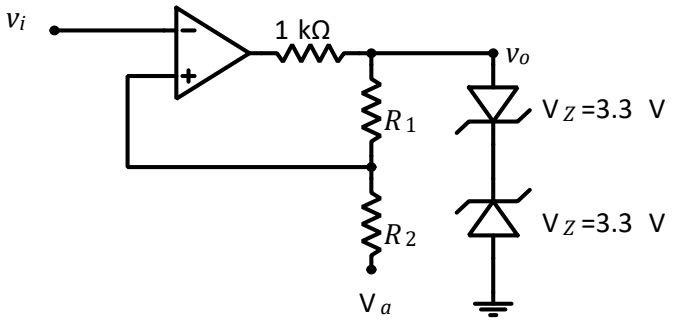

Figure 1: Circuit for Schmitt trigger.

- Wire up the Schmitt trigger circuit. Use ±15 V supply for the Op Amp. Connect a sinusoidal input (7V peak, 100Hz) and observe v_o. Also, display v_o versus v_i using the X-Y mode of the oscilloscope and measure the V_{t}^{+} and V_{t}^{-}. Compare the threshold voltages V_{th} and V_{tl} with the values you calculated theoretically.

	Theoretical			Practical		
(V_a,R_1,R_2)	V_{t}^{+}	V_{t}^{-}	$V_t^+ - V_t^-$	V_{t}^{+}	V_{t}^{-}	$V_t^+ - V_t^-$
(0 V, 10 kΩ, 10 kΩ)						
(0 V, 25 kΩ, 10 kΩ)						
(3 V, 10 kΩ, 10 kΩ)						
(3 V, 25 kΩ, 10 kΩ)						

- With R_1=R_2=10 kΩ and V_a=0 V, increase the input frequency from 100 Hz to 5 kHz and display v_o versus v_i again. Perform measurements for at least 10 frequencies. Comment on why the circuit behaviour changes with frequency.

Input frequency	v_i	v_o

2. Astable multivibrator

- For the Astable multivibrator shown in the Figure 2, calculate the minimum and maximum period of oscillation (as the 10 kΩ pot is changed). Use R_1=R_2=10 kΩ for your calculation.

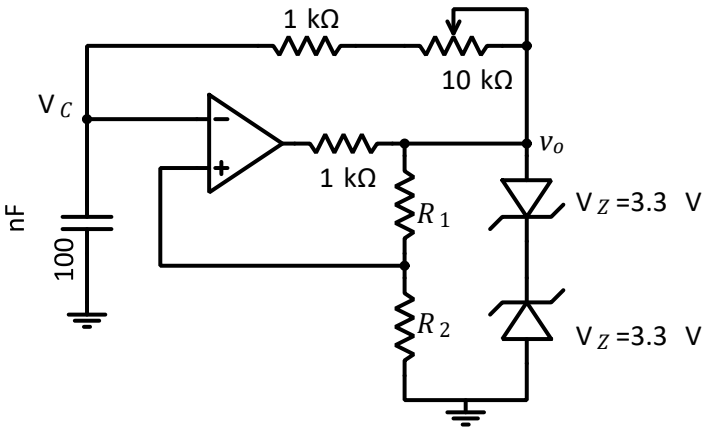

Figure 2: Circuit for Astable multivibrator.

- Wire up the circuit and observe the voltages V_C and v_o on the oscilloscope.
- Vary the 10 kΩ pot and see its effect on the waveforms (at least 10 data points). Compare the minimum and maximum period of oscillation with your calculation.

	Theoretical			Practical		
Resistance	V_c	v_o	Time period	V_c	v_o	Time period

3. Mono-stable multivibrator

- Calculate the output pulse width for the Monostable circuit shown in the Fig. 33 when the push button is closed and released.

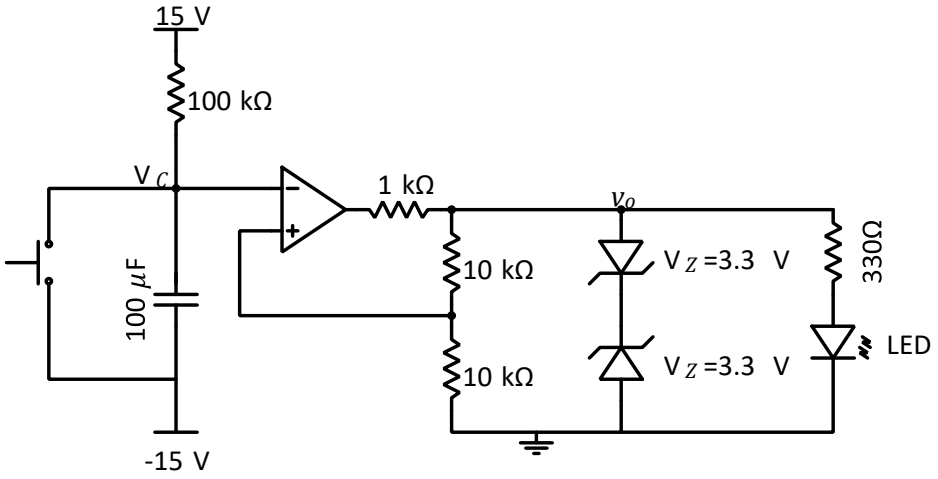

Figure 3: Circuit for Monostable multivibrator.

- Adjust the oscilloscope Volts/div setting so that both the high and low values of the output voltage can be seen on the display. Close and release the push button, and measure the duration of the output pulse using your wristwatch. Compare with your calculation.
- Using CH1 and CH2 of the oscilloscope, observe V_C and v_o simultaneously (use the same Volts/div setting for CH1 and CH2, and make their ground traces coincide).