Lab 6: Bistable Multivibrator Oscillator Design and Implementation

1. Task:

Many applications require the use of a periodic trigger or a clock for their function. An oscillator is a circuit that can create this periodic waveform output. There are two main types of oscillator, a) harmonic and b) relaxation that are used in a variety of electronic applications, mostly involving radio transmitters and radar technology.

In this task you will be designing a bistable multivibrator oscillator and implementing it using an operational amplifier. This lab involves: a) How to design a bistable multivibrator oscillator; b) How to modify the frequency of oscillation.

2. Pre-Lab:

Bistable Multivibrator Oscillator:

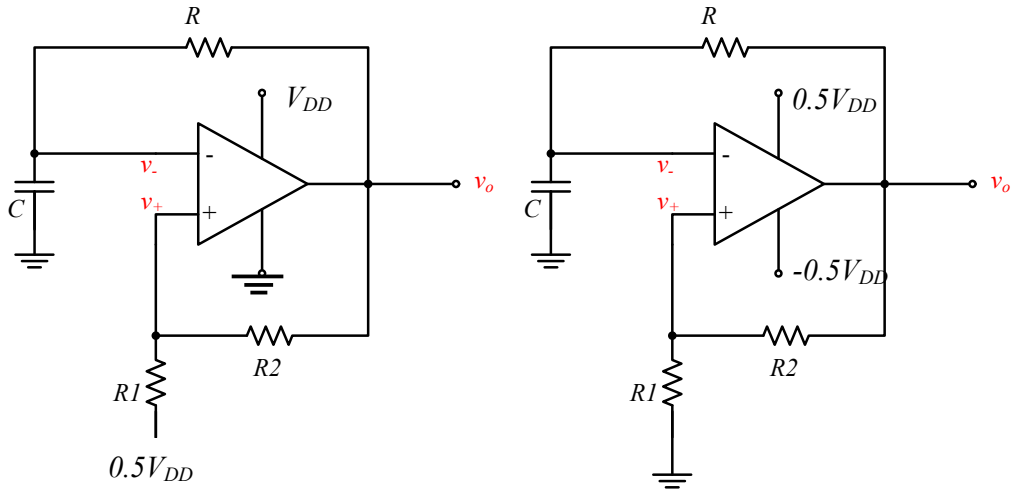

Figure 1: Square Wave Generator

Figure 1(a) shows a square wave generator using an operational amplifier. To simplify the analysis, it is common practice to map the original circuit to opamp circuit with dual supplies as shown in Figure 1(b). The values of the resistors and

capacitor determine the rate of discharge and therefore the period of the square wave. The voltage at 'v_+' is given by:

$$v_+ = \frac{R1}{R1+R2} \times V_{DD} = \lambda \times V_{DD} \quad (1)$$

When the voltage 'v_-' is greater than '$+\lambda V$' the output 'v_o' is switched to 'V-'. The capacitor which charged to '$+\lambda CV$' now begins to discharge. When the capacitor voltage gets to '$-\lambda CV$' another switch occurs to bring the output to 'V+'.

As shown in EE2021, Devices and Circuits, if R1=R2, the following time period of the oscillator can be obtained:

$$T = 2CR\ln(3) \quad (2)$$

In this lab, you will learn how to find out these parameters from the components given and to verify it experimentally.

3. Resources:

Table 1: List of Hardware

Name	Qty	Description
Multimeter	1	To measure different parameters of the circuit
Oscilloscope	1	To view the output and input waveforms
NI Elvis	1	Hardware test platform
DC Power Supply	1	Provide a constant voltage supply

Table 2: Component List

Name	Qty	Description
LM358	1	Operational Amplifier
1/4W Resistor	-	Use resistors as mentioned in lab procedure
Trimmer	1	1M trimmer
Capacitor	2	1 μF Ceramic Capacitor
LED	2	Red

4. Lab procedure and analysis:

4.1 Square Wave Generator

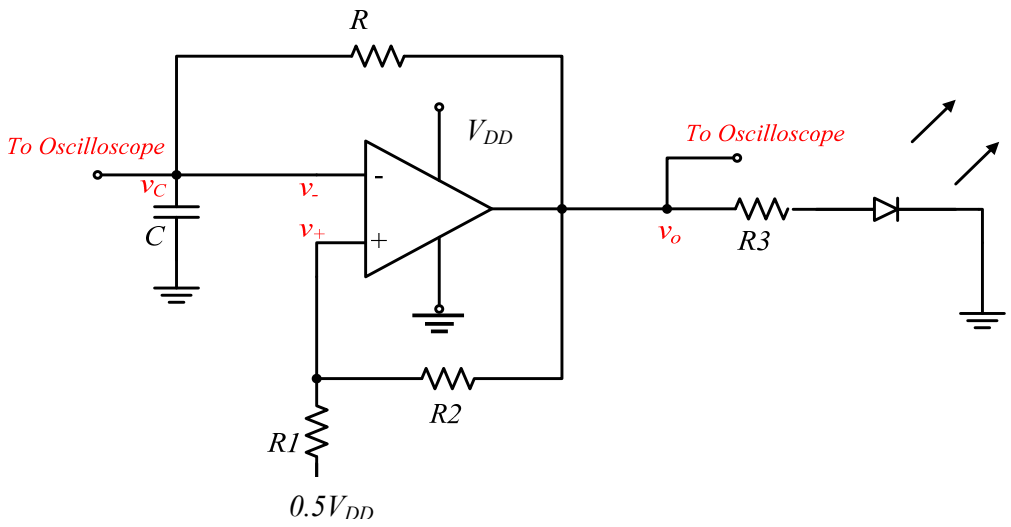

Figure 2: Circuit Diagram for the experiment

1. Build the circuit on breadboard as shown in Figure.2 with R1 = 100kΩ, R2=100kΩ.
2. Select R3 such that the current flow through diode is 10mA.
3. Use oscilloscope to measure and record the peak to peak magnitude, period and frequency of v_o. Also connect the oscilloscope probe to '*Vc*' and observe the waveform.
4. Replace R with a trimmer. Adjust the trimmer so that the oscillator is oscillating at 1Hz. You can perform the adjustment by observing the output waveform at the oscilloscope. You should now observe the LED blinked at a rate of 1s.
5. Now adjust the trimmer until you no longer observe the LED blinking. You should perform the adjustment carefully such that the LED is at the edge of blinking.
6. Based on the circuit shown in Figure 2, proposed a slight modification that allows two LEDs to blink alternatively.