**Lab– Oscillator Circuits - 555 Timers**

**Objectives:**

-To build and test a 555 timer circuit and to observe its different modes of operation: Astable and One-Shot

-To measure the frequency and duty cycle of this circuit when it is functioning as an Astable Oscillator

-To determine the difference between a 555 timer circuit in Astable mode to one in Monostable mode.

**Pre-Lab:**

1. What does a 555 timer do and what are some of the components of this IC? Describe how it is built.
2. Build the following circuit (Figure 1) in the Falstad simulator and determine its output. You will compare this simulated prediction with your observations from the experiment.

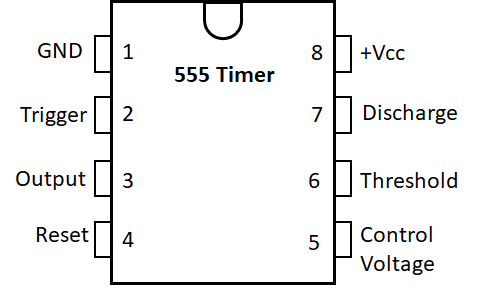
A picture containing clock

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*Figure 1: 555 timer circuit[[1]](#endnote-1)*

**Equipment:**

Two 555 timers; Two 1.0k Ohm resistor; One 10k Ohm resistor; One 470 Ohm resistor; One 330 Ohm resistor; One push button switch; Two .01µF capacitors; One 0.47 µF and One 10µF capacitor; Two 100k Potentiometers; 2 LED; Oscilloscope

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*Figure 2: 555 timer pin diagram*

**Activity 1 – 555 Timer – Astable Operation**

1.Use the pin diagram for the 555 timer above and wire up the circuit below (Figure 3). **Note:** R2 in the circuit is a 100k potentiometer not a resistor.

Diagram

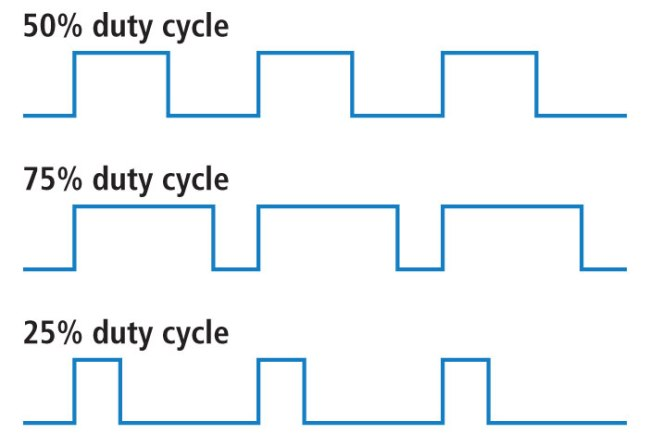
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*Figure 3: Astable Oscillator*

2.Be sure you are applying power (Vcc) and ground to the correct pins of each IC otherwise your circuit will not function. The value of Vcc should be 9 Volts.

3. Use an oscilloscope and place the scope probe from Channel 1 at the output. Sketch the output in the timing diagram below or in your notebook and determine the period(T), frequency(=1/T) and duty cycle of the signal. Record these values.

When the signal is high, we call this "on time". To describe the amount of "on time", we use the concept of duty cycle. Duty cycle is measured in percentage. The percentage duty cycle specifically describes the percentage of time a digital signal is on over an interval or period of time.



T

ton

Duty Cycle =

*Figure 4: Digital waveform and duty cycle*

4. Use Channel 2 on the scope and determine the signal waveform across capacitor C1. Make sure that when you sketch this signal that it is aligned with the signal from the output of the 555 timer.

**Q1:** What is happening to the LED as you vary the potentiometer?

5. While observing the signals from step 3 and 4, place a jumper wire across resistor R2 to short it out and record your observations.

**Q2:** What happened to signal when you placed a short across R2 and removed it? Be sure to look at the frequency and duty cycle and see how they change.

**Observations:**

A picture containing bird

Description automatically generated

*Figure 5: Timing diagram*

**Activity 2: 555 timer** -**Monostable Operation (‘One Shot’)**

Grab a second 555 timer and build the following circuit (Figure 6.) in a separate area on the breadboard. **Note:** R3 in the circuit is a 100k potentiometer not a resistor. Also, make sure pin 6 & 7 are connected to each other.

Diagram, schematic

Description automatically generated

*Figure 6 – Monostable Mode “One-Shot” 555 timer Circuit*

In the circuit above (Figure 6), the button (SW1) is used to create a negative pulse to trigger the circuit. Once this button is pressed the 555 will start to charge the capacitor (C2) and the LED should turn on. Once the capacitor reaches a threshold level (2/3 of Vcc), the 555 discharges the capacitor (through its discharge pin (7)) and the light turns off.

1.Use the oscilloscope to measure the time length of the output pulse. You will need to turn the TIME/DIV knob to about 500ms to see the signal.

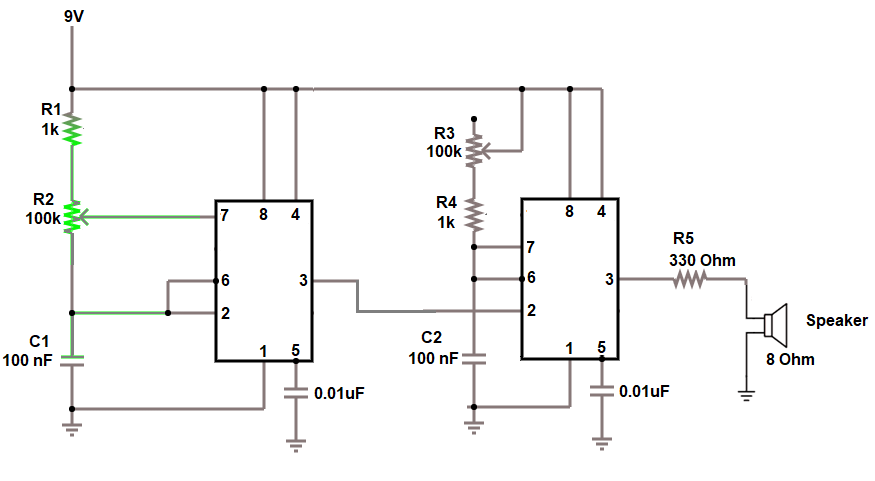
2.Vary the potentiometer R3 and describe what happens to square wave pulse. Sketch or take a picture of this pulse. Also describe what happens to the LED and compare your observations to what you saw in Activity 1 with the Astable circuit.

**Observations:**

**Mini-Project – The Atari Punk**

The Atari punk is a primitive synthesizer created out of two 555 timers. The sounds made by the circuit remind people of some of the sounds made by the Atari 2600 video game console that was popular in the early 1980s hence the name.

The circuit below is basically the two circuits in activities 1 and 2 (Astable and Monostable) connected to each other with the output of the monostable circuit connected to a speaker. The potentiometers allow you change the frequencies of the sounds created. **Note:** 10nF capacitor is the same as a 0.01 mF capacitor and that 100nF cap is the same as a 0.1 mF capacitor. R2 and R3 are potentiometers.

1. Remove the 330 Ohm resistor and LED from pin 3 in figure 3. Replace capacitors C1 and C2 from the previous two circuits with 10 nF and 100 nF capacitors, respectively.
2. Remove the 10k Ohm resistor and switch SW1 and the LED from the circuit in figure 6.
3. Replace the LED in the circuit in Figure 3 with an 8 Ohm speaker. Powered speakers work best! Connect a wire from pin 3 (figure 3 circuit) to pin 2 (figure 6 circuit). Your circuit should look like the one below. **Note:** Don’t forget to connect pin 7 and 6 together on the 555 timer (U2) pictured on right below.

*Figure 7 – Atari Punk Circuit*

1. All schematic diagrams were created with Falstad circuit simulator (https://falstad.com/circuit/)  [↑](#endnote-ref-1)