Lab 6.   555 timers

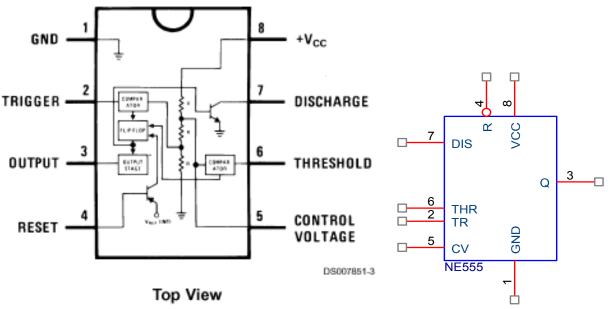**Overview of this Session**

In this laboratory, you will learn:
- To continue to use an oscilloscope
- How to generate a pulse train with a 555 timer

Introduction

- The TA will show you the 555 timer and the various passive components needed for this lab.

Background

The 555 timer can be used in a variety of forms. The *monostable mode* will create a single pulse of a specified width. A*stable mode* will create a repeating pulse train of specified frequency and duty cycle.
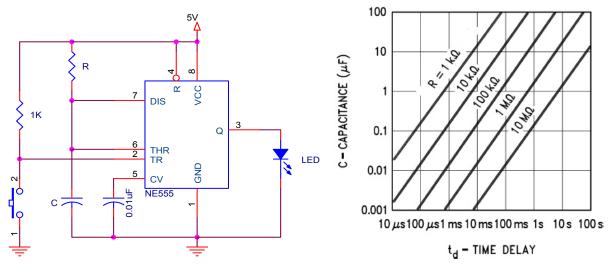
The chip is presented here:

Top View

Note: The pins are not presented in order in the diagram on the right. This is to keep schematics easier to read.

Oscilloscope Measurements

6.1   Connect the signal from the function generator to the oscilloscope and determine the type of signal present, the frequency, amplitude, and the DC offset.

Part I: Monostable Operation

Build this circuit

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

Use the chart at the right to determine values for R and C to get a pulse that is 0.5 seconds in length
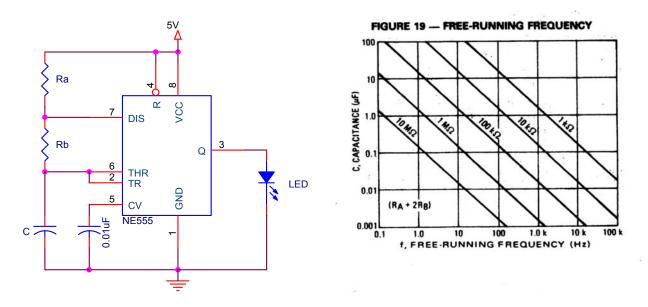
6.2   What values of R and C did you use?

6.3   Use the scope to measure to voltage on capacitor C. What voltage does the capacitor get to when the light turns off?

Increase the Vcc voltage to 9 volts.

6.4   What happens to the length of the output pulse? Why?

PART II: Astable Operation

Build this circuit

FIGURE 19 — FREE-RUNNING FREQUENCY

This 555 is set up in an astable mode. The 555 is triggered on its own. To figure out the values for R_a, R_b, and C you can use the chart on the right or the following equations:

The charge time (output high) is given by:

t1 = 0.693 (R_A +R_B)C

And the discharge time (output low) by:

t2 = 0.693 (R_B)C

Thus the total period is:

T =t1 +t2 = 0.693 (R_A +2R_B)C

The frequency of the waveform is given by:

$$f = \frac{1}{T} = \frac{1.44}{(R_A + 2 R_B)\, C}$$

The duty cycle (ratio of low time to entire period) may be determined from the following equation:
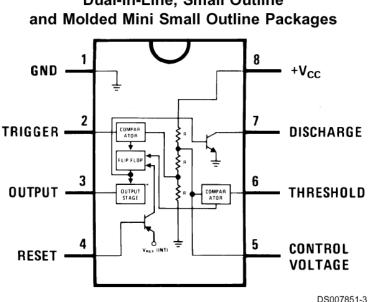
$$D = \frac{R_B}{R_A + 2R_B}$$

6.5　　Use these formulas and chart to design a circuit that will provide a waveform with a frequency of 1KHz with a duty cycle of 25%. You may have to arbitrarily choose some of the values based on availability.

6.6 Is it possible to create a symmetric squarewave with this circuit (50% duty cycle)?

6.7 What happens to the frequency of the waveform if Vcc is increased?

6.8 Find values for Ra, Rb, and C to create a waveform with a period of 1 second.

Lab 6 Data sheets

LM555
Timer

General Description

The LM555 is a highly stable device for generating accurate time delays or oscillation. Additional terminals are provided for triggering or resetting if desired. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For astable operation as an oscillator, the free running frequency and duty cycle are accurately controlled with two external resistors and one capacitor. The circuit may be triggered and reset on falling waveforms, and the output circuit can source or sink up to 200mA or drive TTL circuits.

Features

- Direct replacement for SE555/NE555
- Timing from microseconds through hours
- Operates in both astable and monostable modes
- Adjustable duty cycle
- Output can source or sink 200 mA
- Output and supply TTL compatible
- Temperature stability better than 0.005% per ˚C
- Normally on and normally off output
- Available in 8-pin MSOP package

Applications

- Precision timing
- Pulse generation
- Sequential timing
- Time delay generation
- Pulse width modulation
- Pulse position modulation
- Linear ramp generator

Dual-In-Line, Small Outline and Molded Mini Small Outline Packages

DS007851-3

Top View

Lab 6.   555 timers Answer Sheet

Name:_____   Section Number:_____
TA init:_____   Date_____

6.1   Draw the waveform shown on the oscilloscope. What is the name of this
        waveform? What is the amplitude, frequency, and DC offset? Show all
        your calculations.

6.2   R=   C=

6.3   Voltage on Cap when light turns off:

6.4   Describe change in output pulse length. Why is(n't) there a change?

6.5   Ra=   Rb=   C=

6.6   How can you make a symmetric (50%) duty cycle?

6.7   If Vcc affect frequency? If so, how? If not, why not?

6.8   Ra=   Rb=   C=