Name _____

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
6.091 Hands-On Introduction to EE Lab Skills
**Laboratory No. 3 Zeners, Power Supply, Timers**
IAP 2008

1 Objective

In this laboratory, you will become familiar with zener diodes, timers and other useful circuits. By now, you should be familiar with most of the instruments and construction techniques.

1.1 Zener Diode
Zener diodes are used to produce a fixed reference voltage. Many integrated circuits have zener diodes imbedded in the circuits. Within limits, the zener will maintain a fixed voltage. Of course, if you exceed the maximum allowable current, the diode will self-destruct.

1.1.1   Exercise – Zener Diode Characteristic

Build the circuit below using parts from the parts bin in the lab. Resistors, if needed are available from the drawers in center of the lab in 38-600.

4.7k

1N752A
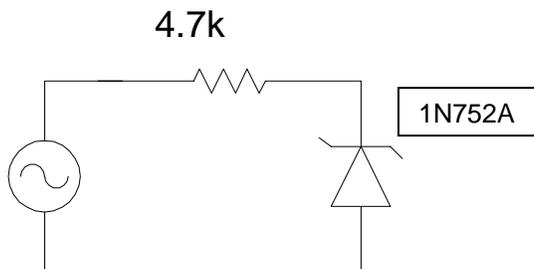
Turn on function generator and apply using a 0-10V ramp signal.

Display both the input voltage and the voltage across the zener diode on the scope.

How constant is the zener voltage as the input voltage increases?

1.2 Variable Power Supply – Voltage Source

Most circuits operate from a constant voltage power supply. Common voltages are +5, +12, +15, -12, and -15. 3.3V and lower voltages are now common place. In this exercise you will build a variable voltage power supply. Build the following circuit. The op-amp will attempt to keep $V_- = V_+$. V_+ is just the voltage from the potentiometer. V_- is the output voltage. What is the highest voltage possible for V_+?

What is the range of output voltage you able to achieve with a resistor load (not shown) of 10k at the output? Repeat for a 1K load. Now very carefully repeat with a 100 ohm load. Be very careful! The 2N2222 will most likely overheat and self destruct. The 100 ohm resistor may overheat too. Why?
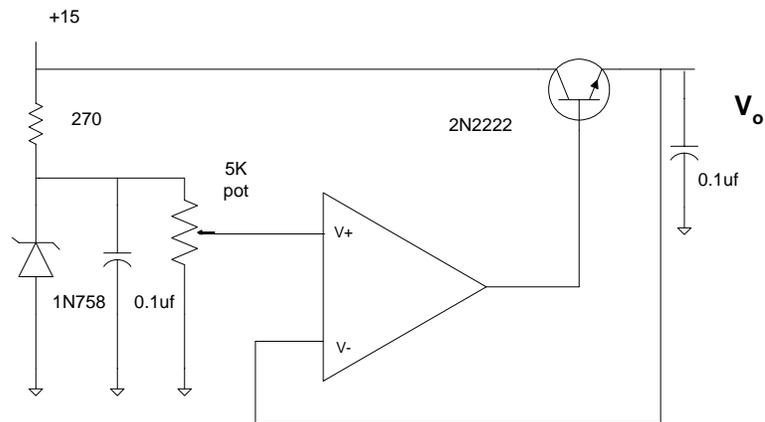
This is not a particularly good power supply design. The objective is to show the use of the zener diode as a reference, a voltage divider resistor, the use of negative feedback to achieve voltage regulation and the heat dissipation of a linear voltage regulator. In most applications, the above circuit can be replaced with a LM317 integrated circuit.
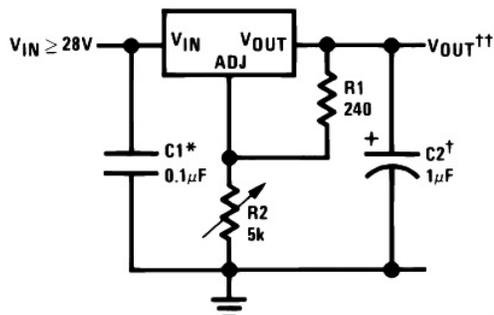
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1.3 Timers – 555

Introduction to Philips Application Note AN170, 555 Applications, removed due to copyright restrictions.

1.3.1 Exercise – 555 Oscillator
One of the most common applications for the 555 is an oscillator. It is also commonly referred as an astable multivibrator. Wire up the circuit as shown below. Set V_{cc} to +5
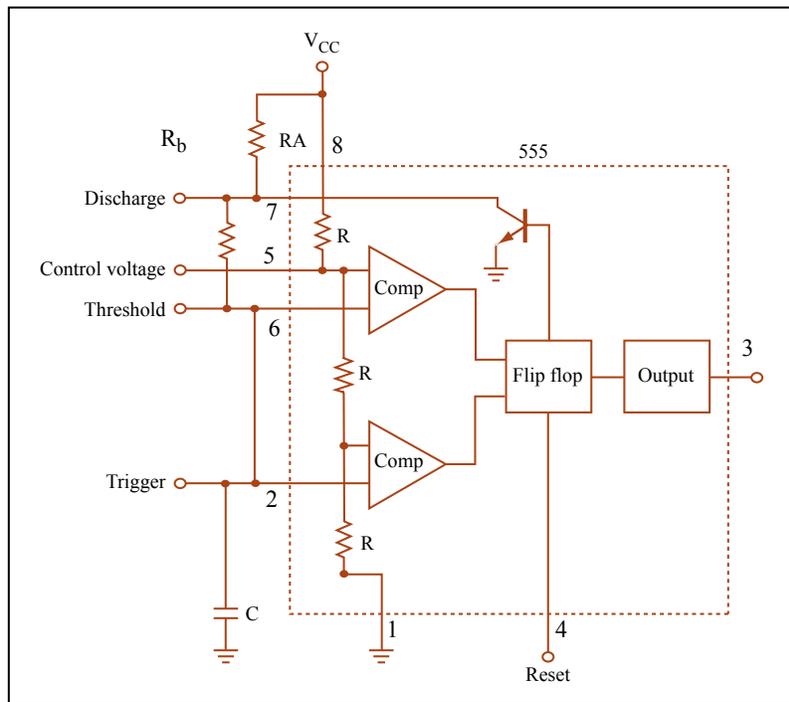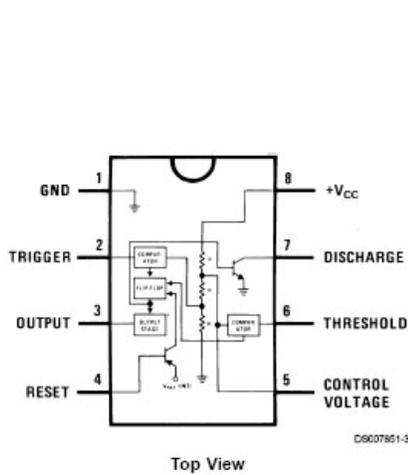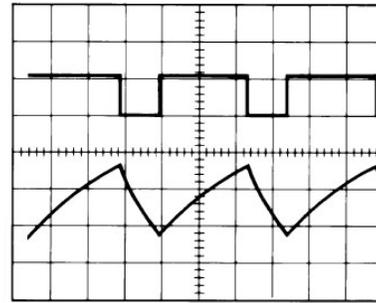

Figure by MIT OpenCourseWare, based on Philips Semiconductors datasheet.

Top View

DS007851-3

V_{CC} = 5V
TIME = 20μs/DIV.
R_A = 3.9kΩ
R_B = 3kΩ
C = 0.01μF

Top Trace: Output 5V/Div.
Bottom Trace: Capacitor Voltage 1V/Div.

DS007851-9

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Display the output and the voltage across the capacitor. Note the frequency. Now turn off the power supply and connect V_{cc} to +15. The output frequency should be the same. Notice that the reference voltages to the comparators are resistor dividers. As such, the frequency is relatively immune to voltage changes.

1.3.2   Exercise – Closet Light Timer

Many closets have lights controlled by the closet door. Unfortunately if the door is left open, the light remains on – wasting energy. This circuit turns on the light when the door opened but will turn off the light after a predetermined period. If the door is closed, the light will turn off.

Wire up the circuit and play around with the time. Use a wire for a switch.
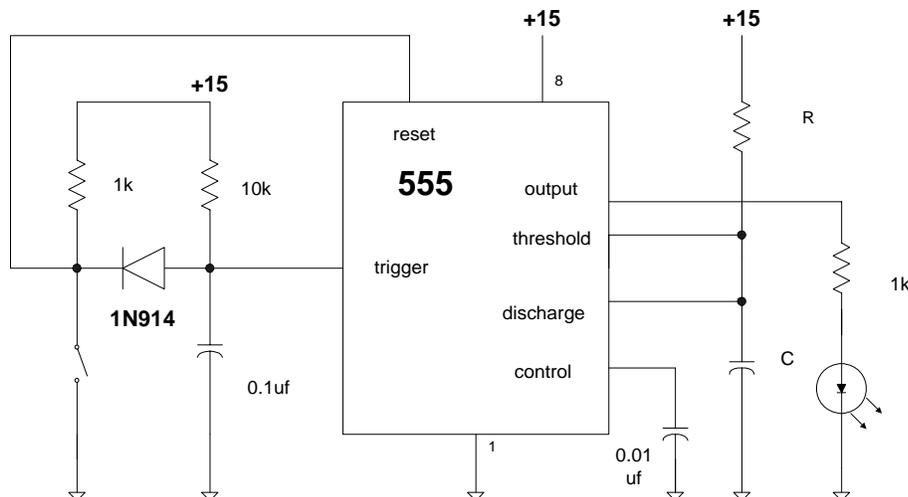
As explained in lecture, the on time is 1.1 RC. In this application, when the switch is closed, the door is closed.