Lecture 8

Servomotors

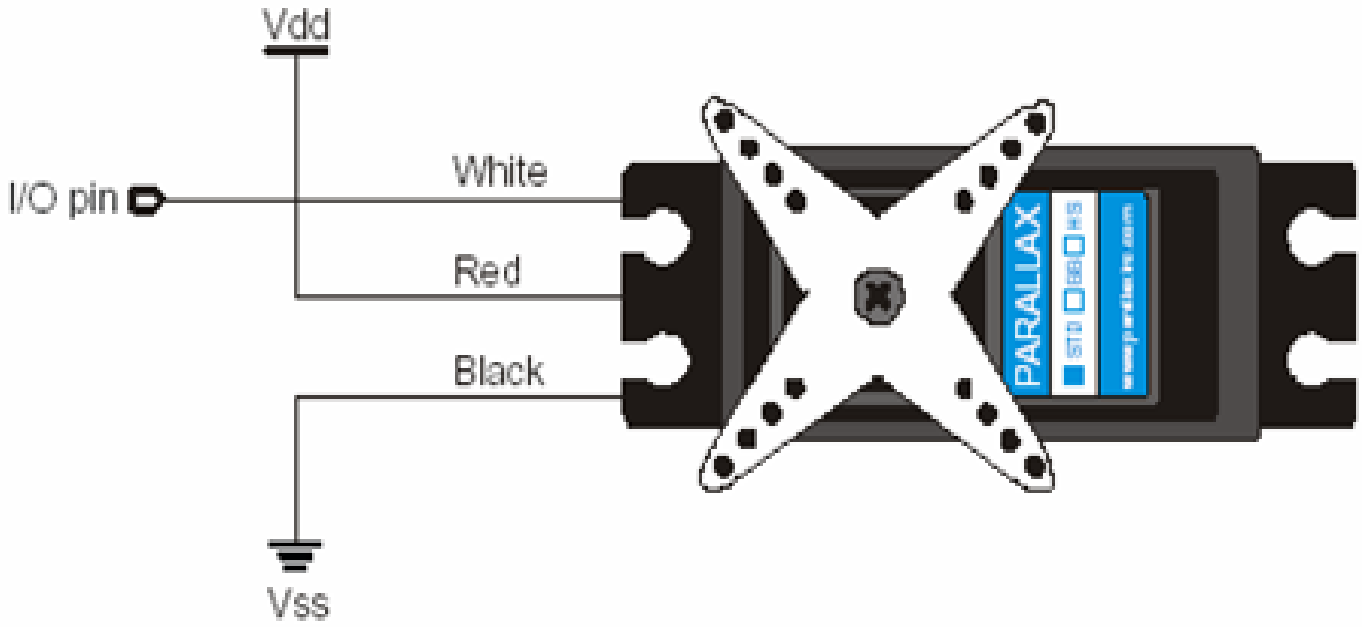
Servo Motor

- DC motors with feedback position control
- As long as the coded signal exists on the input line, the servo will maintain the angular position of the shaft
- As the coded signal changes, the angular position of the shaft changes

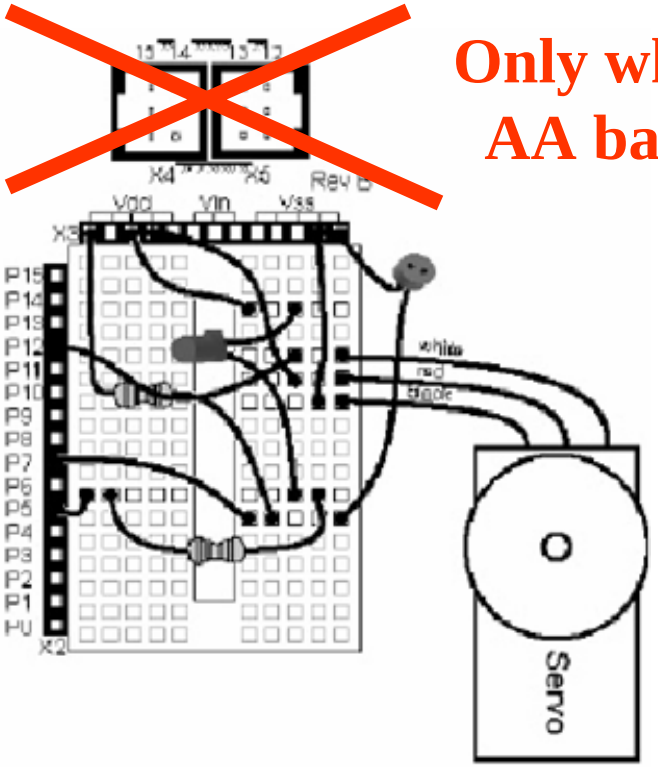
Servo Motor: How It Work?

- Consists of some control circuit and a potentiometer
- This potentiometer allows the control circuitry to monitor the current angle of the servo motor
- If the shaft is at the correct angle, then the motor shuts off
- If the circuit finds that the angle is not correct, it will turn the motor in the correct direction until the angle is corrected

Servo Motor Wiring



Servo Motor with BS2



Only when you use AA battery pack

2 servo motors only

Need another capacitor for additional servo motors

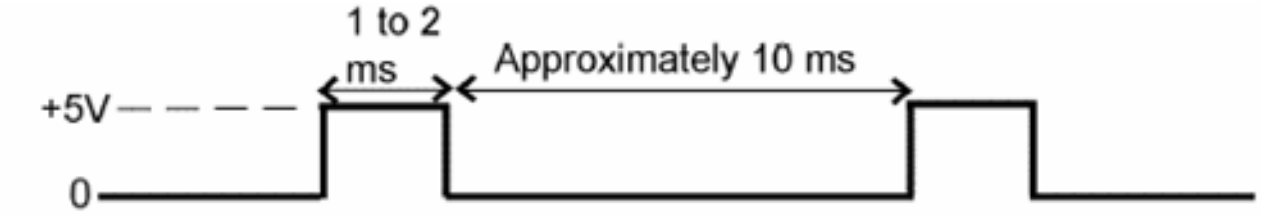
Sample Code

```
X var byte
Output 12

Here:
For X = 1 to 100
Pulsout 12, 500
Pause 10
Next
Pause 500

For X = 1 to 100
Pulsout 12, 1000
Pause 10
Next
Pause 500

Goto Here
```

Pulsout Pin #, Duration

12 is pin number of BS2

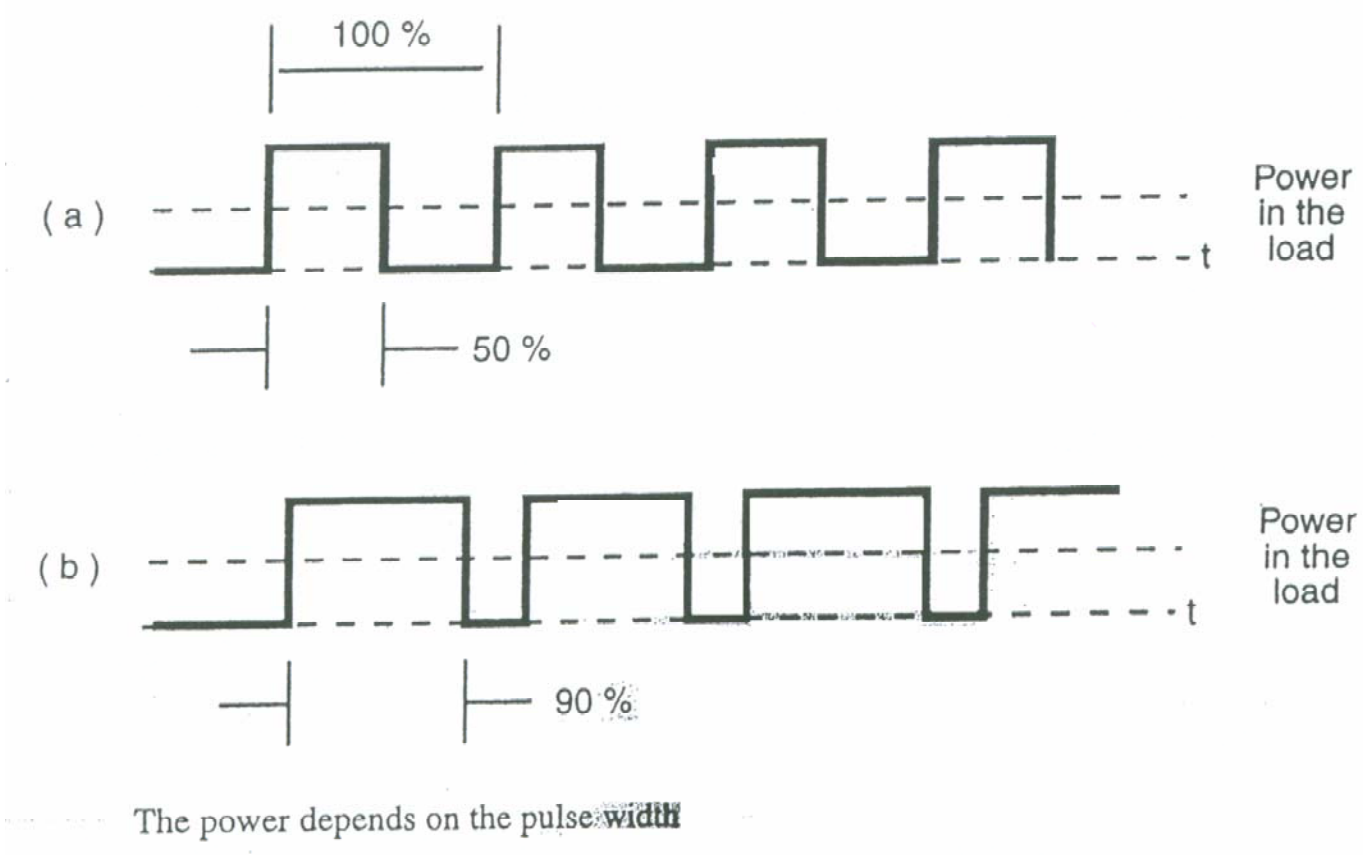
500 means 1millisecond



PWM

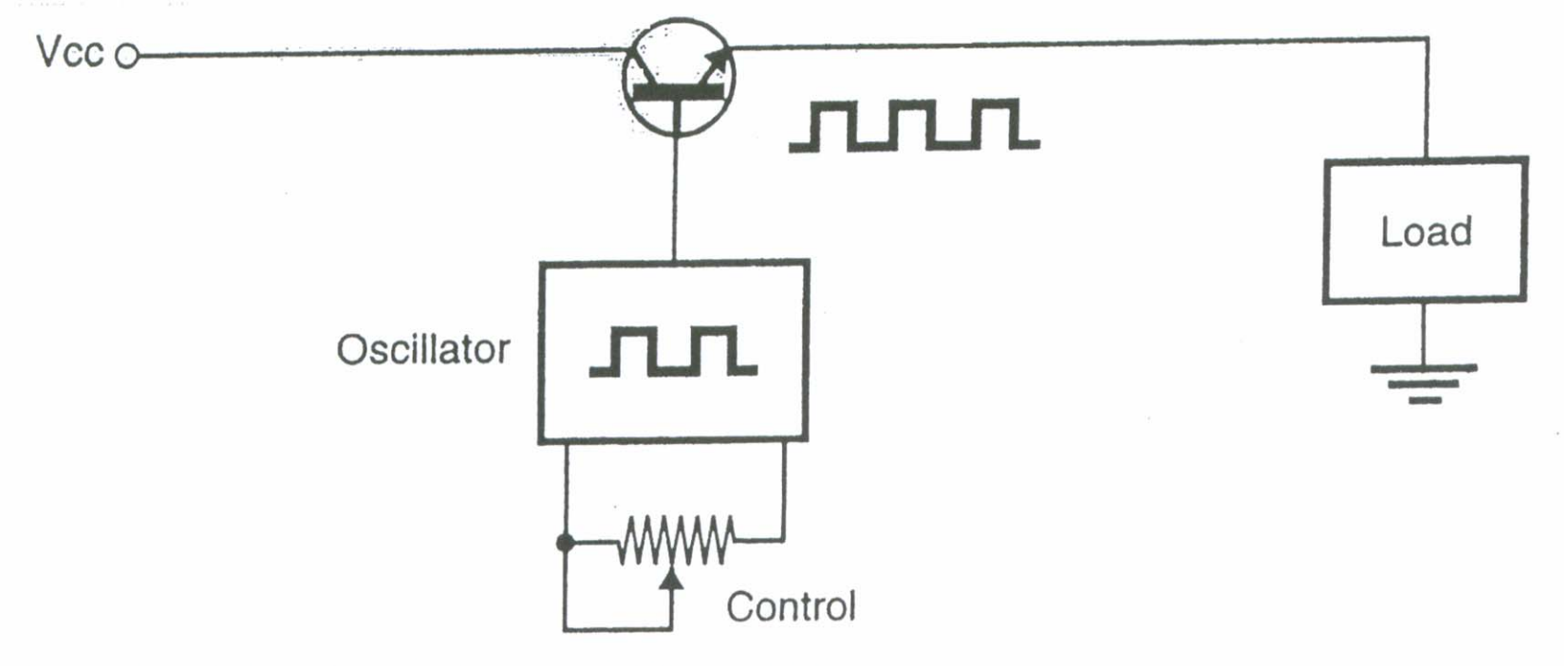
- Pulse-Width-Modulation
- An efficient method to deliver controlled amount of power to loads such as motors
- Use square voltage pulses
- Modulation
  - Process of controlling the duty cycle of square wave
- Pulse-width-modulator
  - The circuit used to achieve modulation tasks

PWM - Duty Cycle



Amount of power delivered to load depending on duration of each pulse

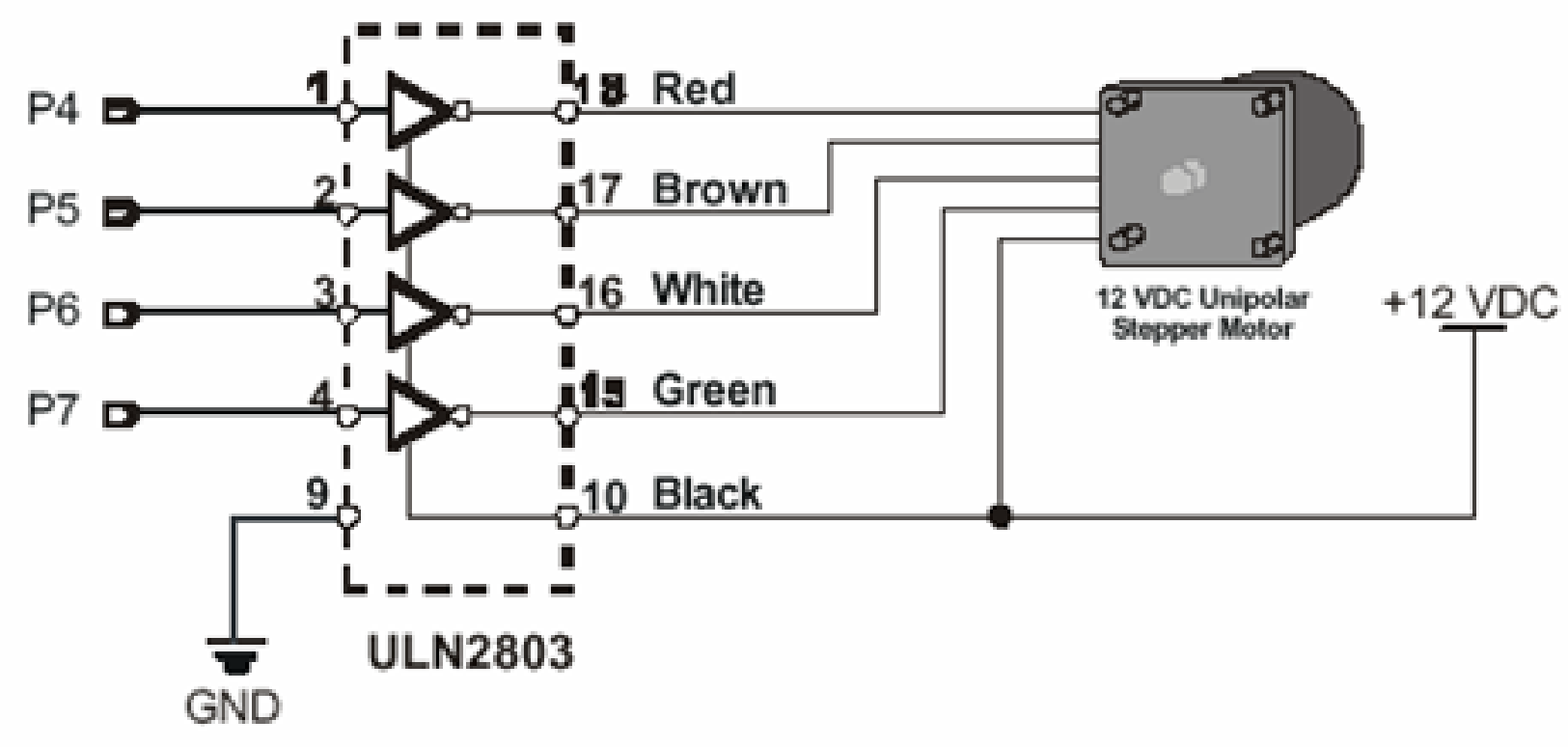
The Basic PWM Control



Stepper Motor

- Do not spin freely with just power
- Driven by the interaction (attraction and repulsion) of magnetic fields
- With proper sequence of the on-off pattern of the magnetic fields, the stepper turns (when it's not, the stepper sits and quivers).

Stepper Motor with BS2



ULN 2803 high-current transistor driver

Motor Experiments

Experiments	Chapters
What's micro controller	4
Basic A and D	
Process Control	
Boe Bot Robotics	2
Smart Sensors	
Others	

Lecture 9

555 Timer

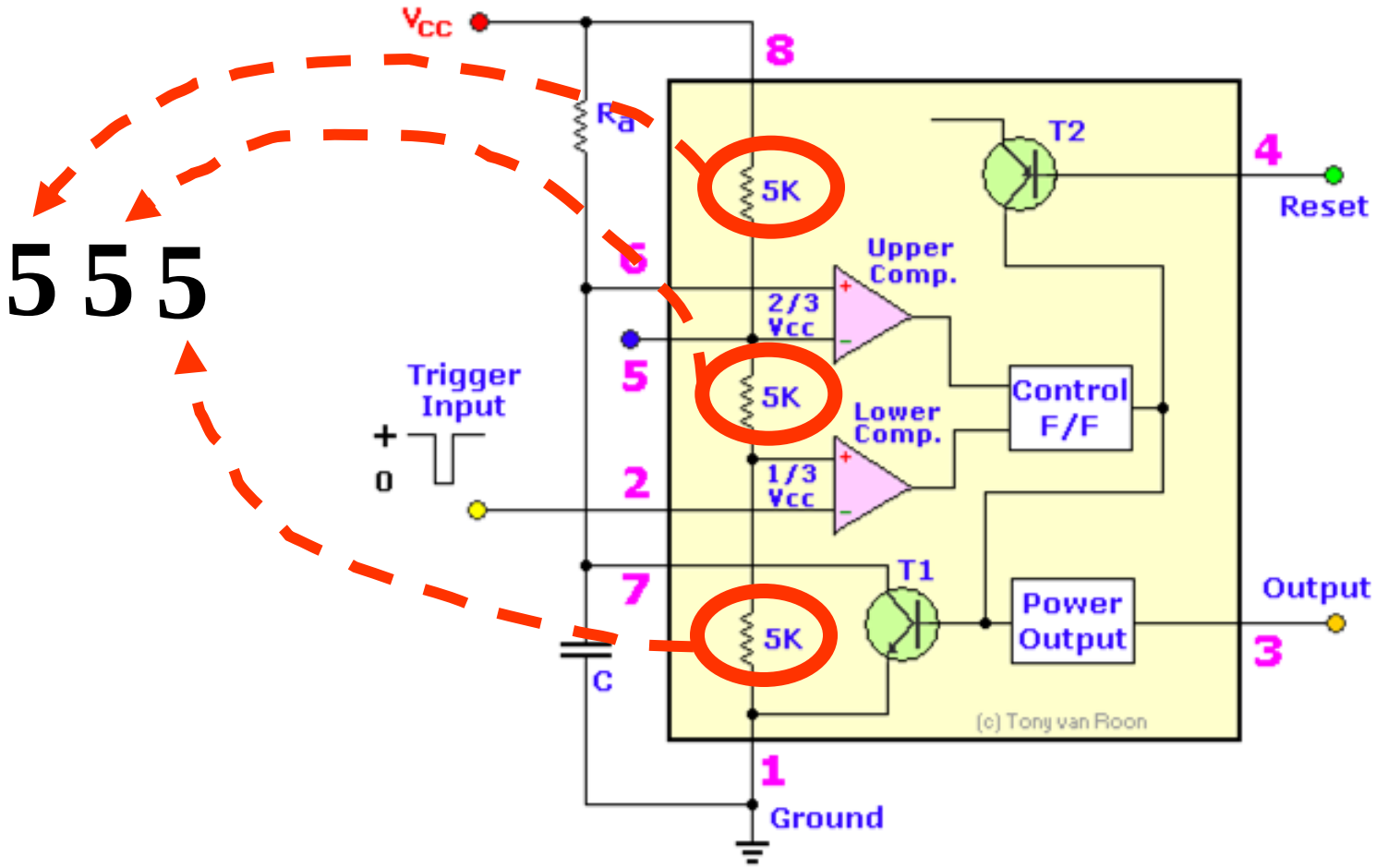
Pulse Generation

- Pulsout
  - Software version of pulse generation
  - Pulsout pin, Period
    - Pin: specified I/O pin from 0 to 15
    - Period: 2 μsec per each unit
- 555 Timer
  - Hardware version of pulse generation
  - BS2 can do other works
  - Microcontroller is not necessary

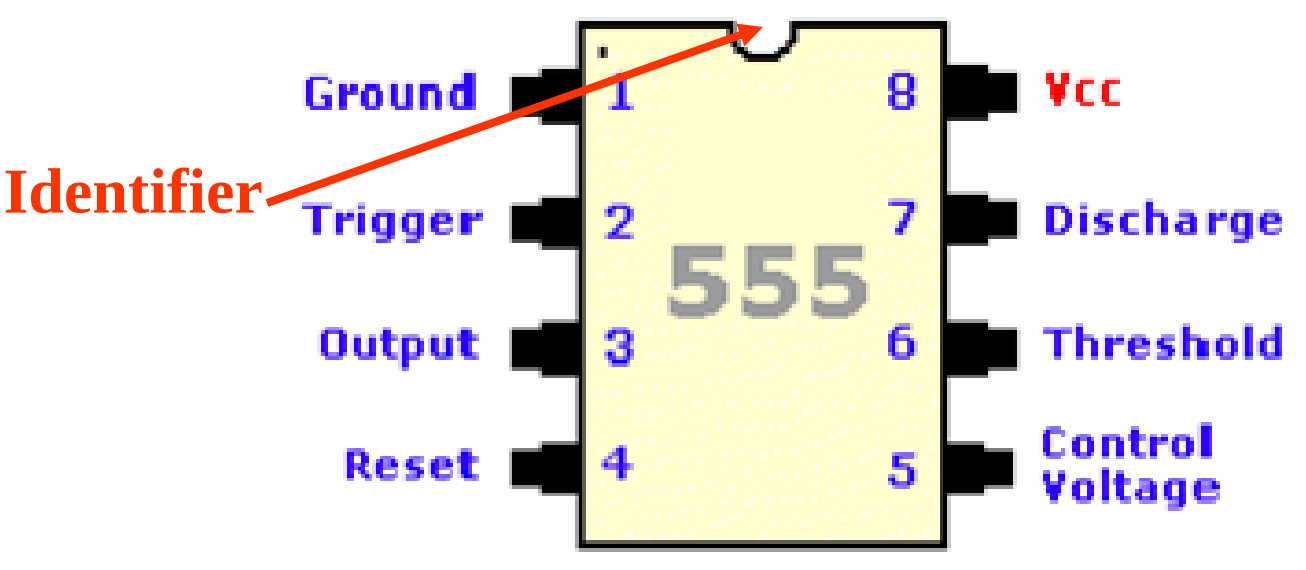
555 Timer

- Highly stable devices for generating accurate time delay or oscillation
- Not programmable
- Controlled by resistors and capacitors
- Applications
  - Pulse generation
  - PWM
  - Time delay generation

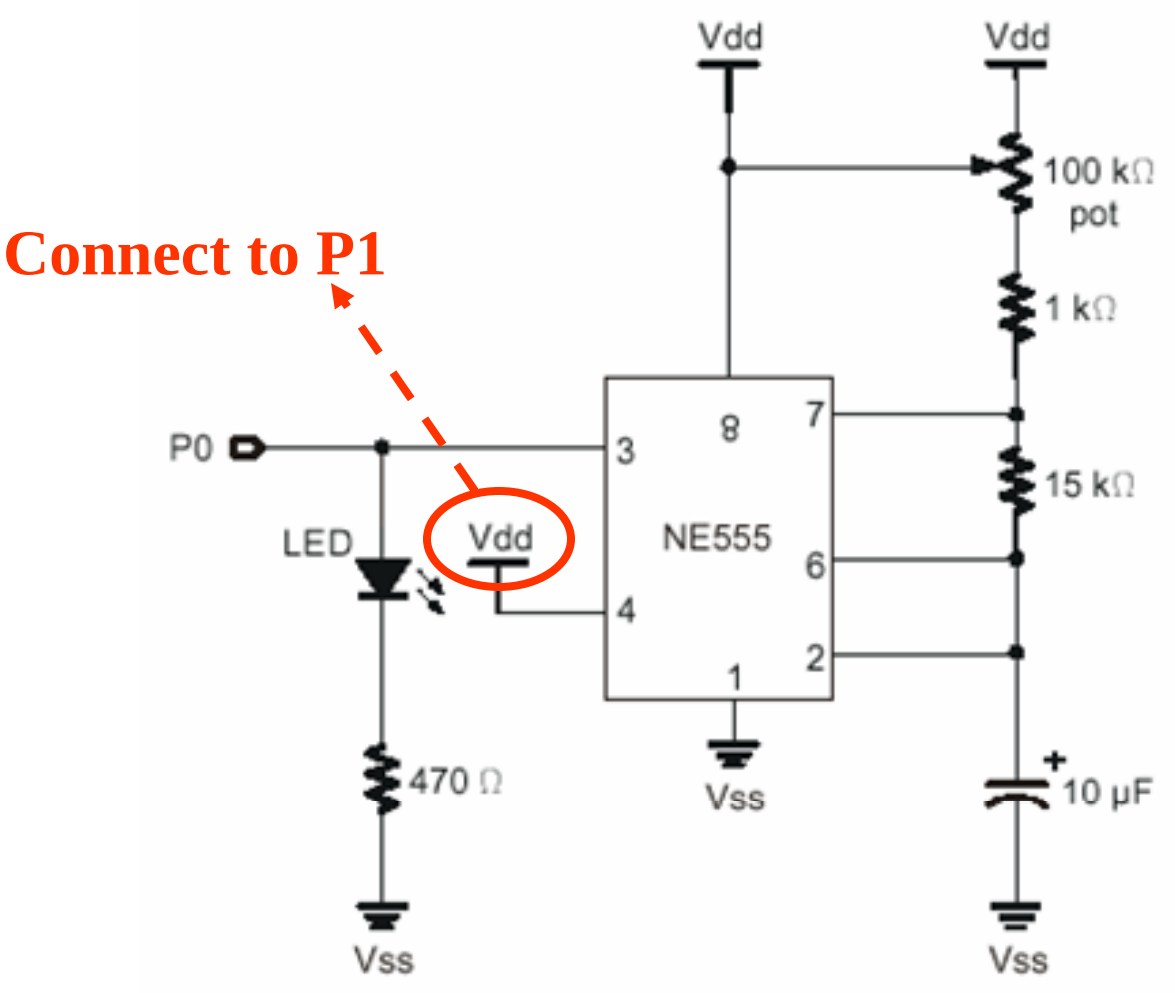
555 Timer Block Diagram



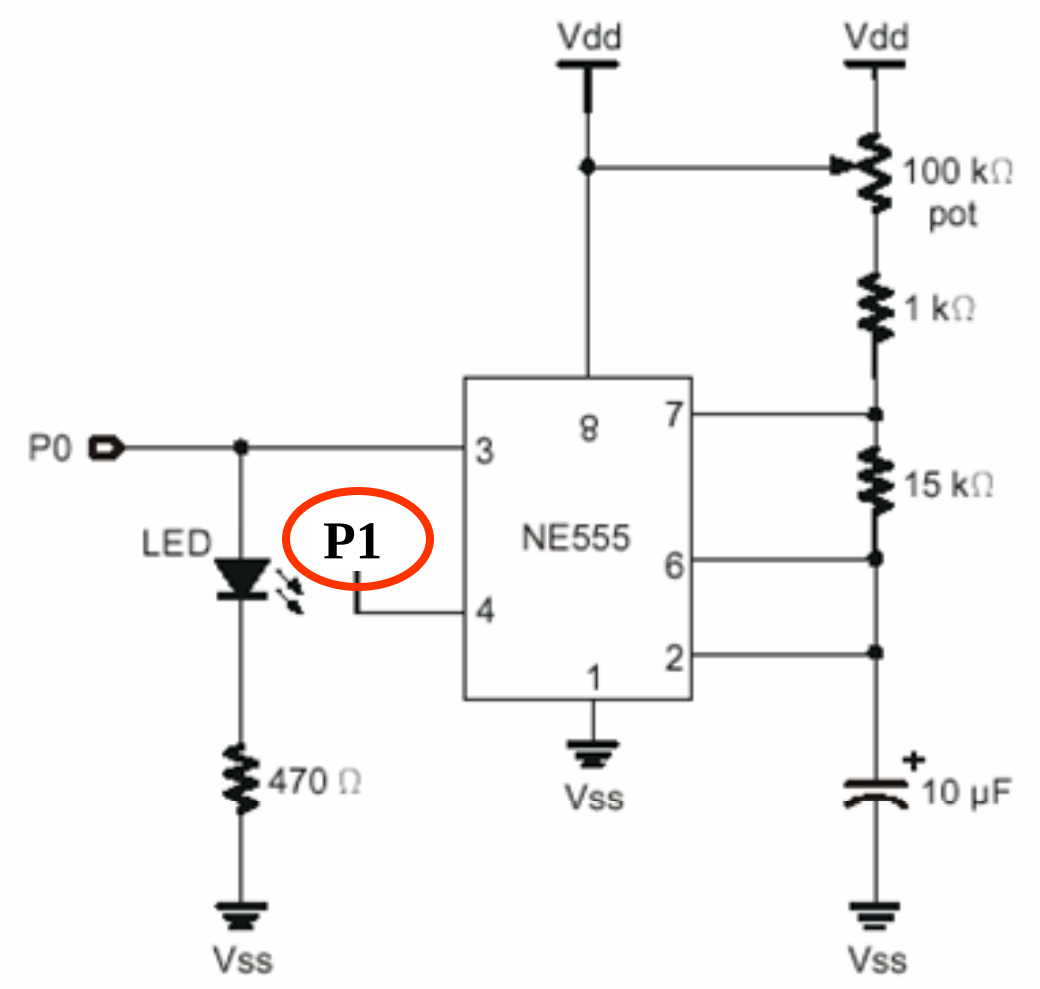
Connection Diagram



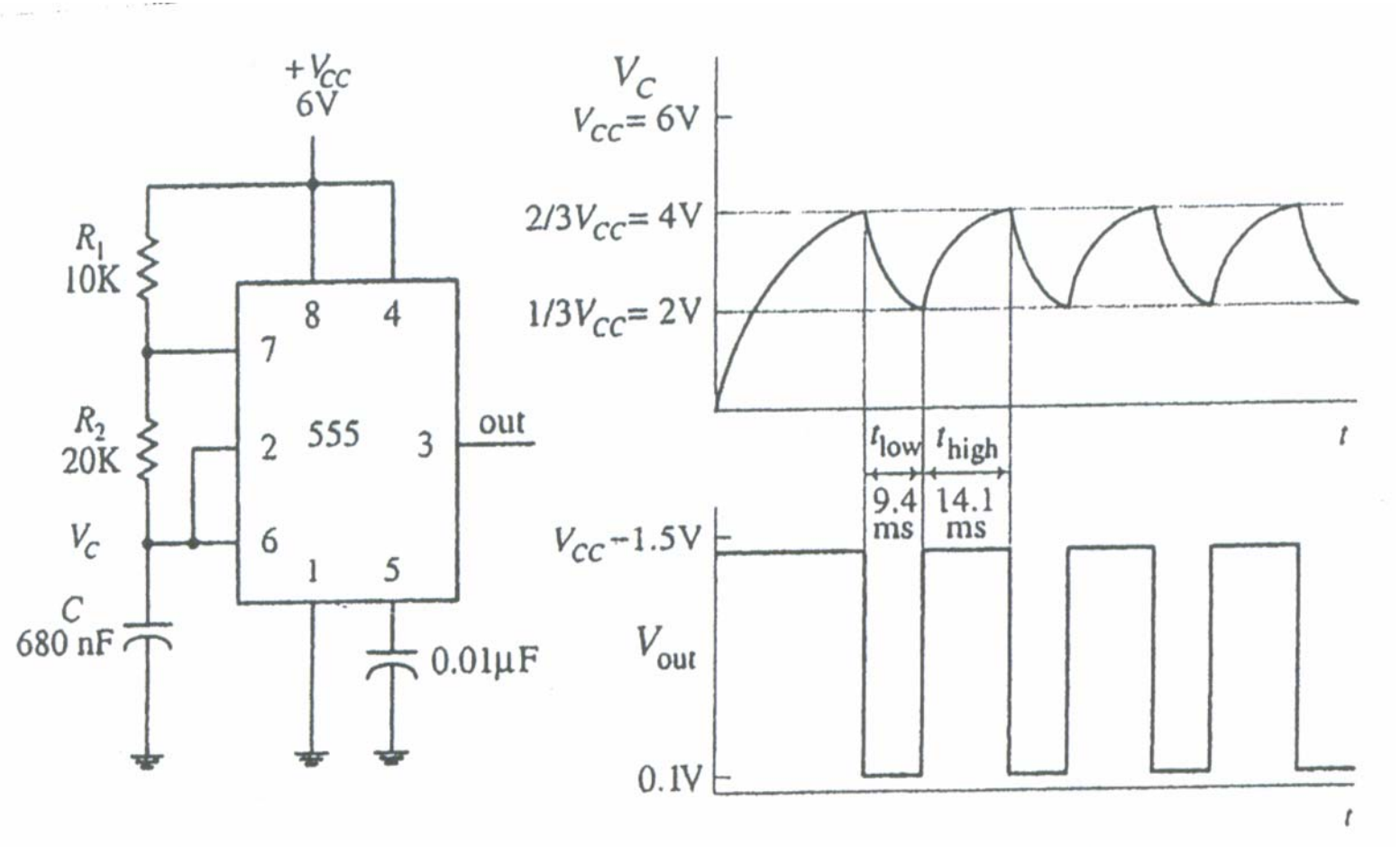
555 Timer without BS2



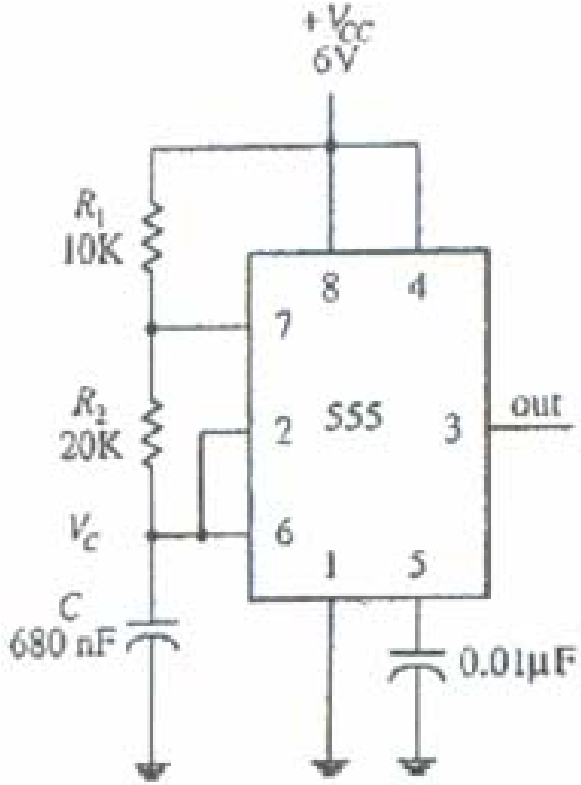
555 Timer with BS2



Astable Operation 1



Calculation of Duty Cycle

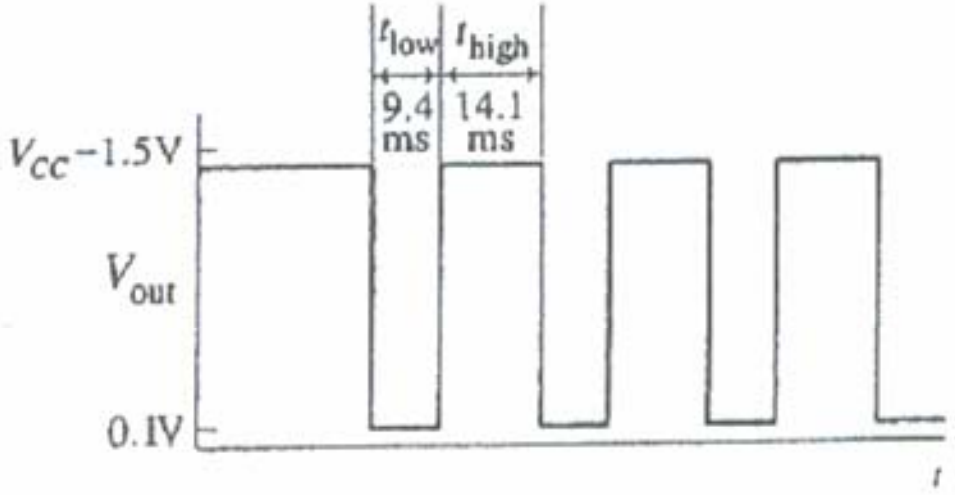


$$t_{low} = 0.693\ R_2 C$$

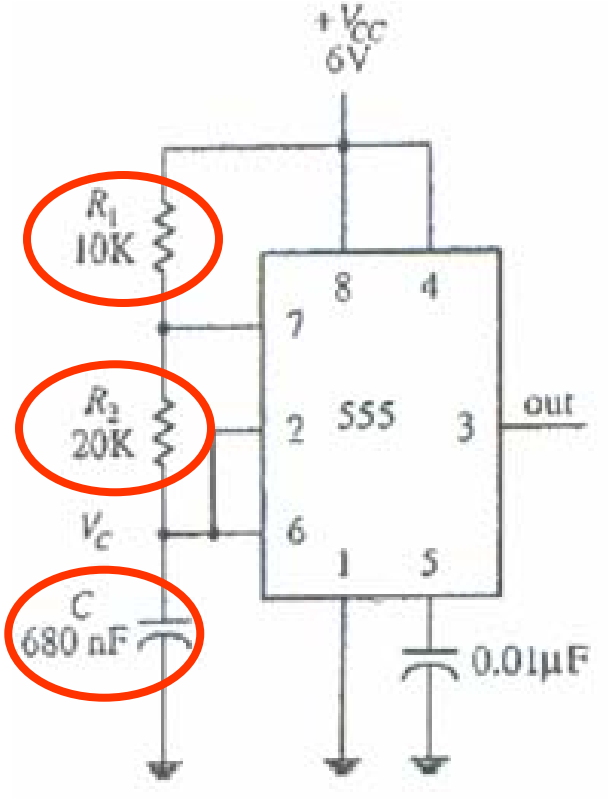
$$t_{high} = 0.693\ (R_1 + R_2) C$$

$$Duty\ \ cycle = \frac{t_{high}}{t_{high} + t_{low}}$$

$$f = \frac{1}{t_{high} + t_{low}}$$



Calculation of Duty Cycle



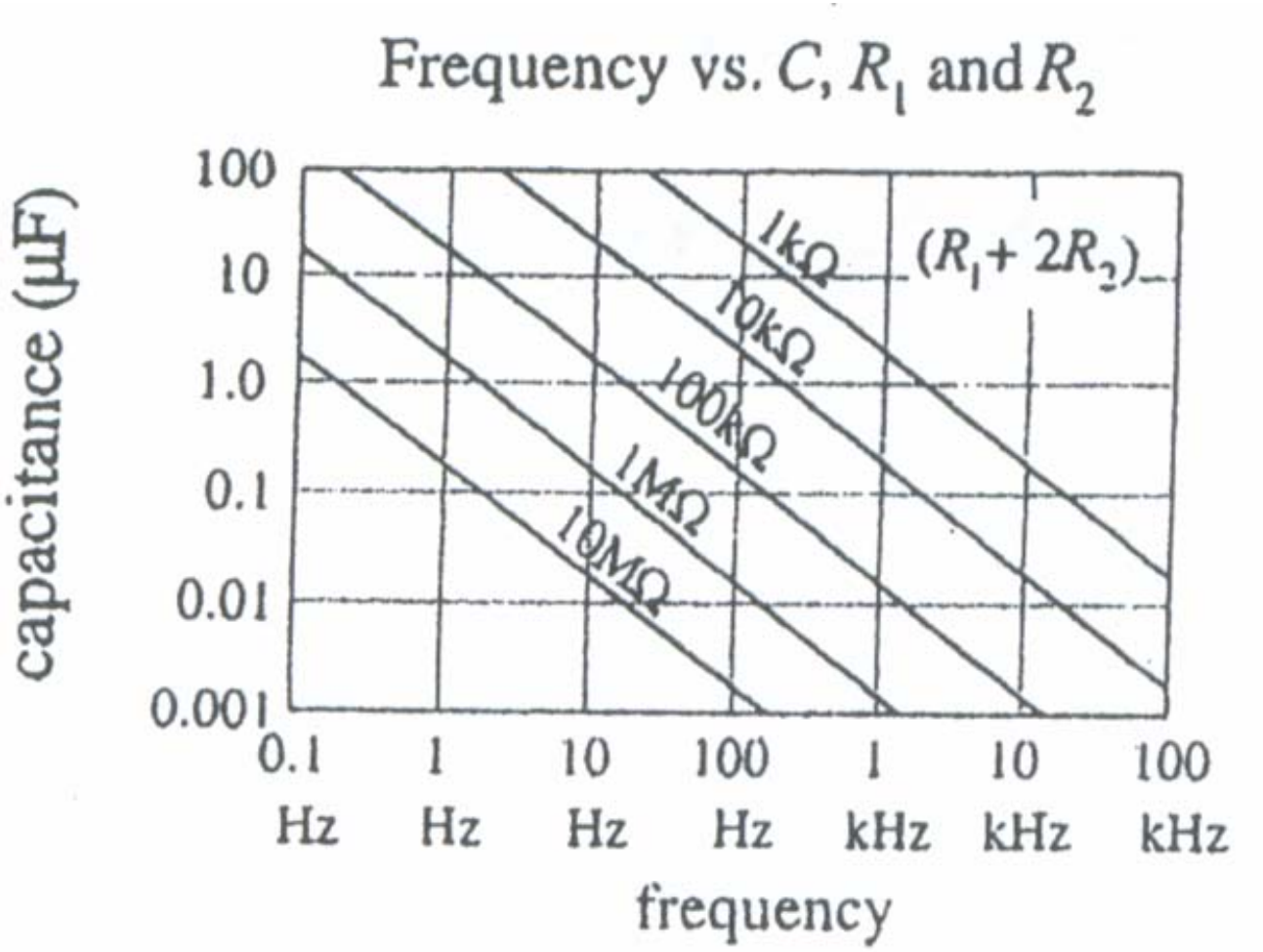
$$t_{low} = 0.693(20K)(680nF) = 9.6ms$$

$$t_{high} = 0.693(10K + 20K)(680nF) = 14.1ms$$

$$Duty\,cycle = \frac{14.1ms}{14.1ms + 9.6ms} = 0.6$$

$$f = \frac{1}{14.1ms + 9.6ms} = 42Hz$$

Astable Operation 2



Applications 1

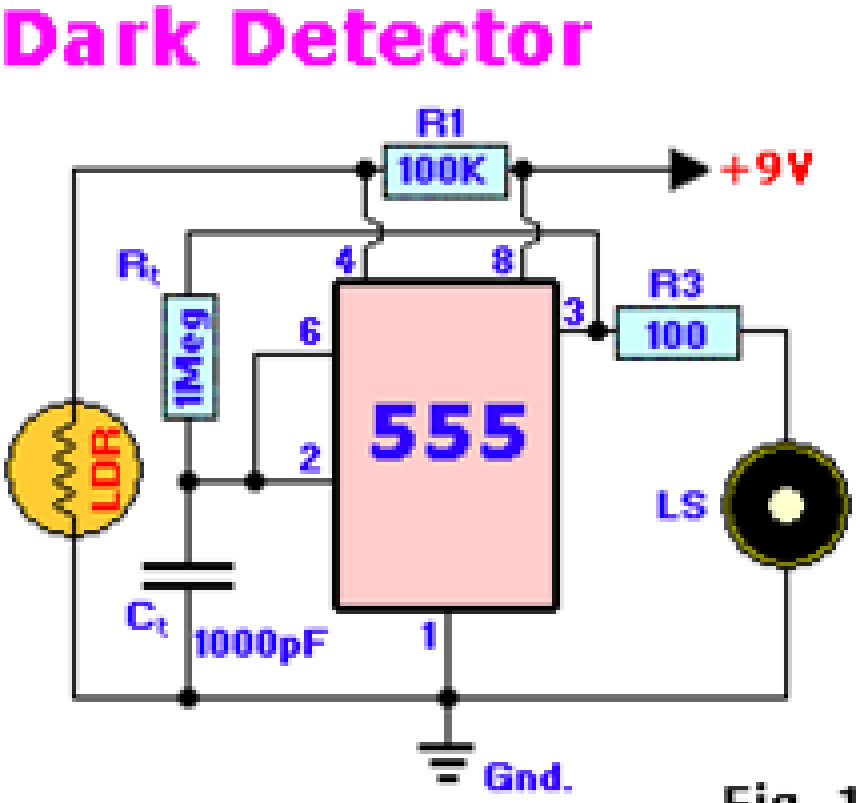


Fig. 1

- It will sound an alarm if it gets too dark all over sudden
- The LDR enables the alarm when light falls below a certain level

Applications 2

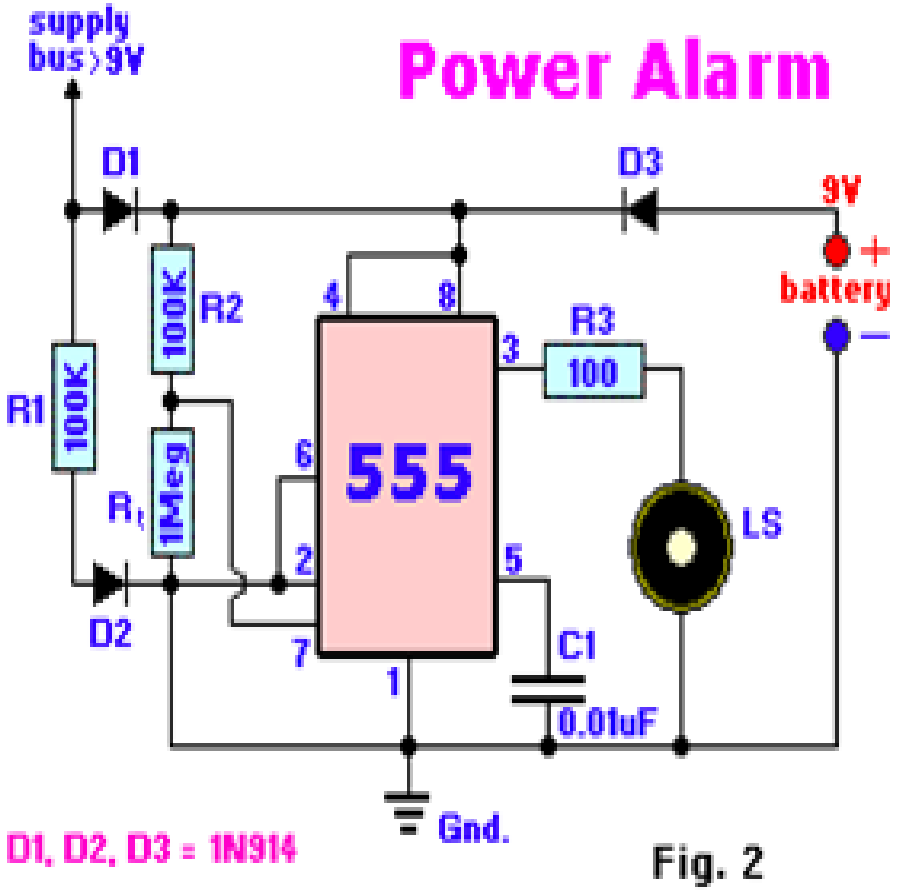


Fig. 2

- This circuit can be used as a audible 'Power-out Alarm'
- When the line voltage fails, the tone will be heard in the speaker

Applications 3

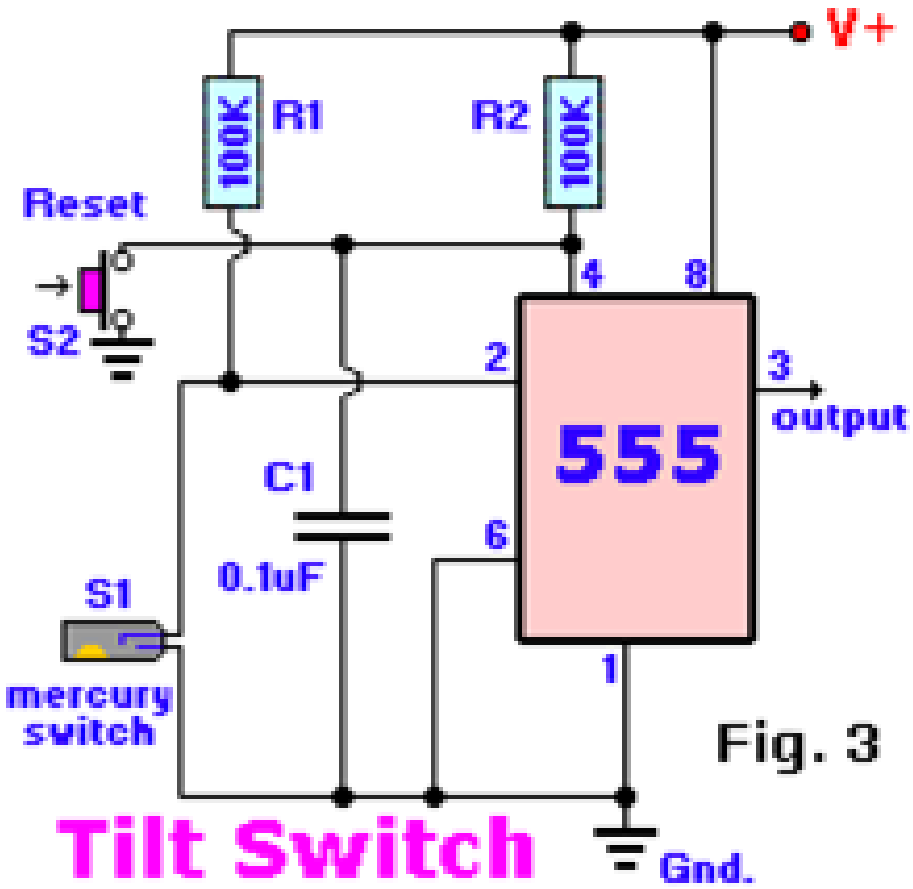


Fig. 3

- **Actually really a alarm circuit, it shows how to use a 555 timer and a small glass-encapsulated mercury switch to indicate 'tilt'.**

Applications 4

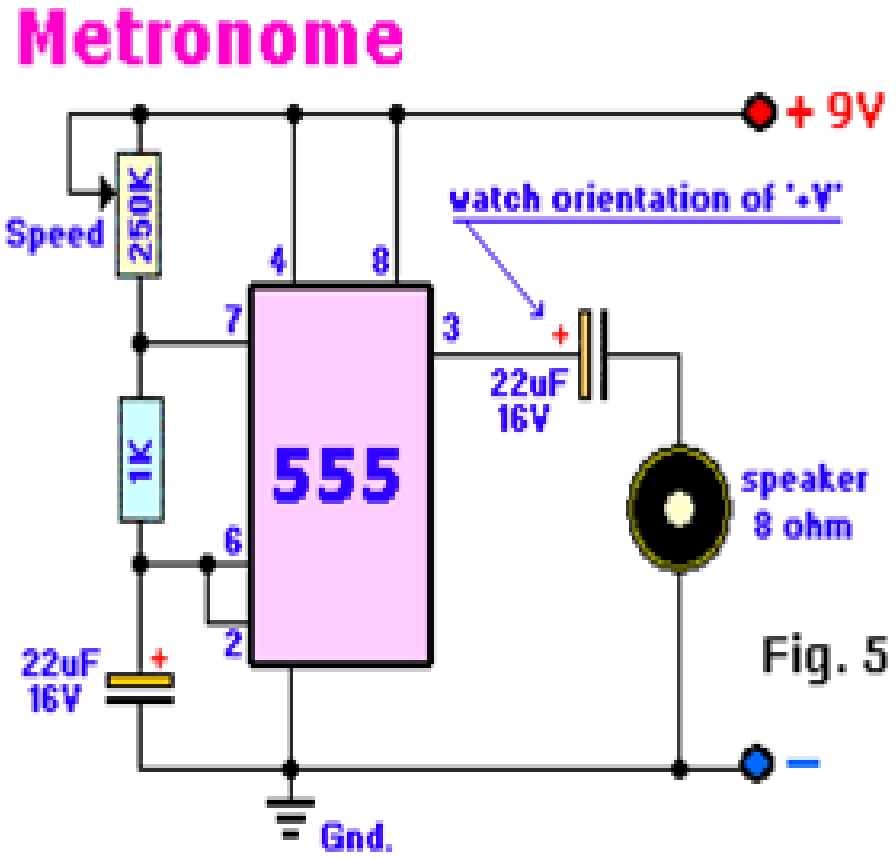


Fig. 5

- **A Metronome is a device used in the music industry**
- **It indicates the rhythm by a 'tic-toc' sound which speed can be adjusted with the 250K potentiometer**

555 Timer Experiments

Experiments	Chapters
What's micro controller	5
Basic A and D	6
Process Control	
Boe Bot Robotics	
Smart Sensors	
Others	