

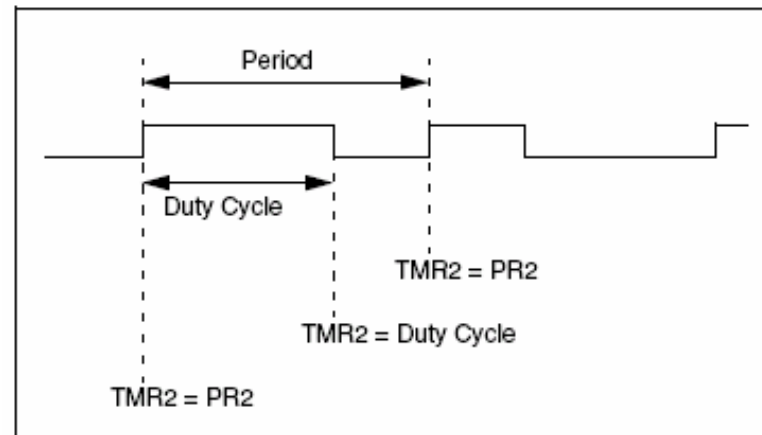
Questions?

- Show and Tell
 - Don't get behind!
- Project
 - Step #3 due this coming Thursday

Pulse Width Modulation (PWM)

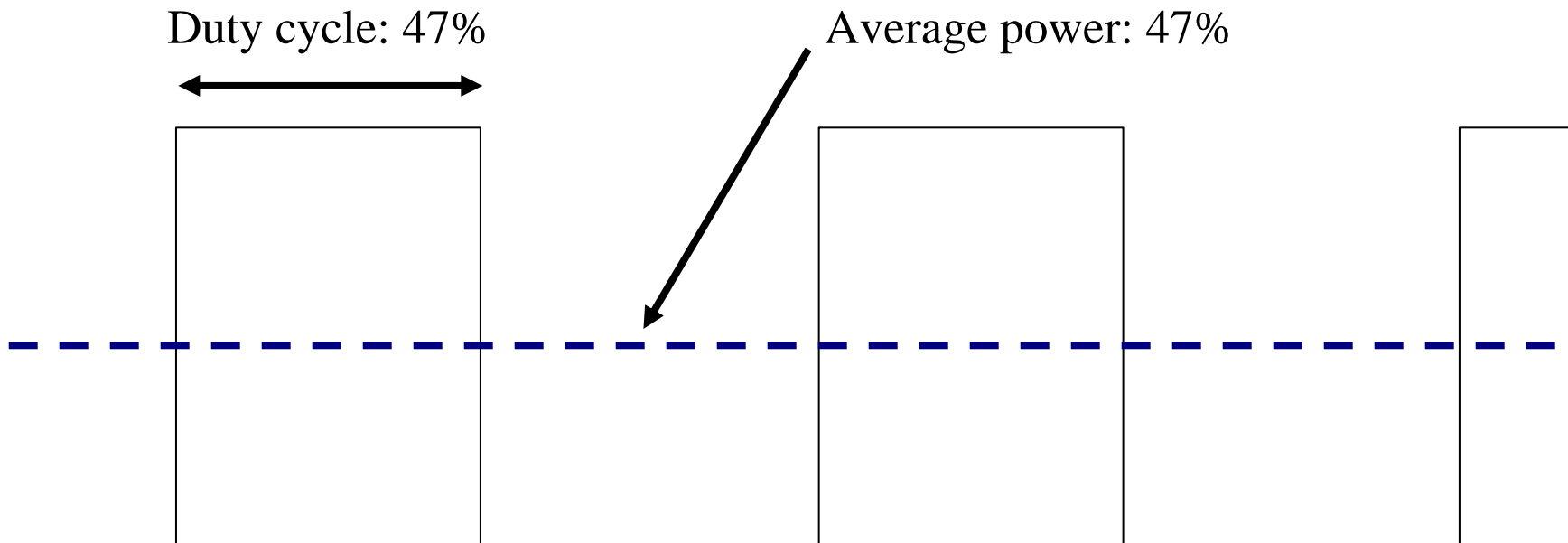
- Key points
 - Modulate power, by modulating the time a signal is on
 - PWM is a periodic signal (frequency controlled by Timer 2)
 - Programmable duty cycle (controlled by CCPR1)
 - *Duty cycle: percentage of time the signal is high*

FIGURE 14-4: PWM OUTPUT



Pulse Width Modulation (PWM)

- Principle



PWM settings

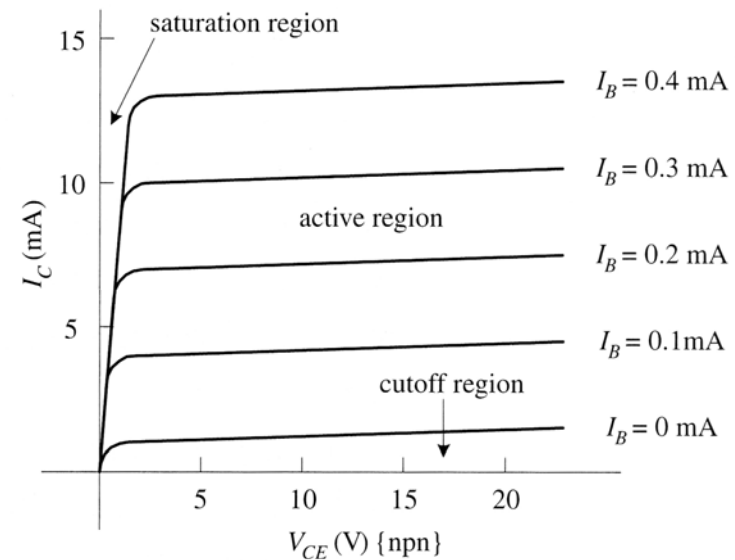
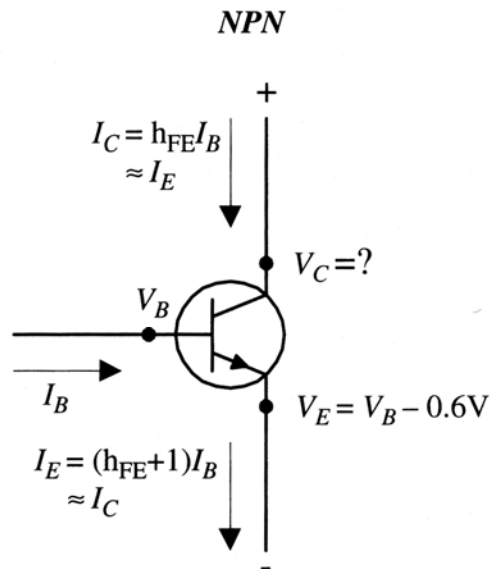
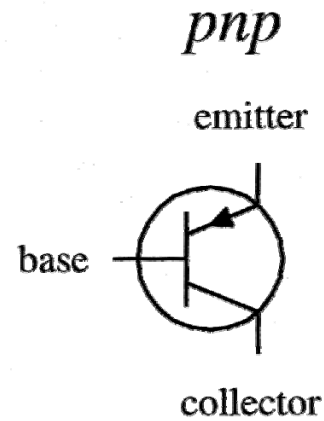
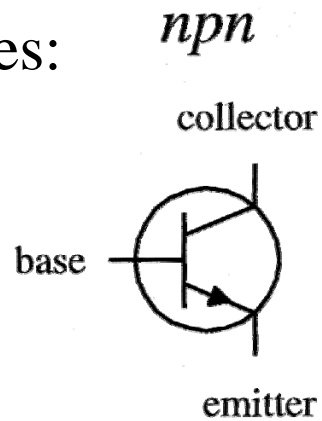
- To do
 - Set CCP1 pin (PORTC2) as an output
 - Set the CCP setting to PWM (CCP1CONbits.CCP1M3:0)
 - Set Timer 2 pre-scaler (T2CONbits.T2CKPS1:0)
 - Set period value (PR2)
 - *Target value is: 2KHz*
 - Set duty cycle CCPR1L and CCP1CONbits.DC1B1:0
 - Start Timer2

Assignment

- Build a light (LED) dimmer
 - Adjusted with the potentiometer
 - Sample the potentiometer every 10ms

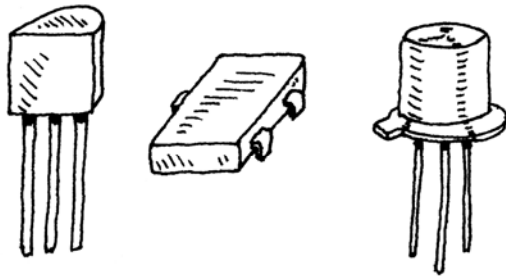
Bipolar transistor: key facts

- Two varieties:

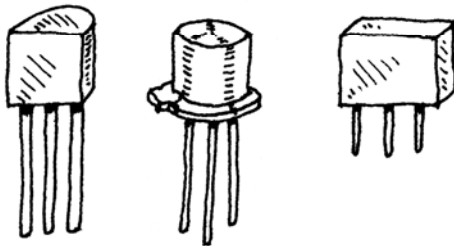


Bipolar transistor: Examples

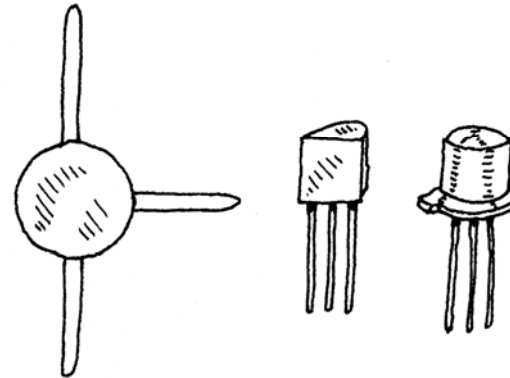
SMALL SIGNAL



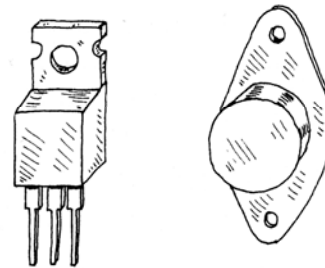
SMALL SWITCHING



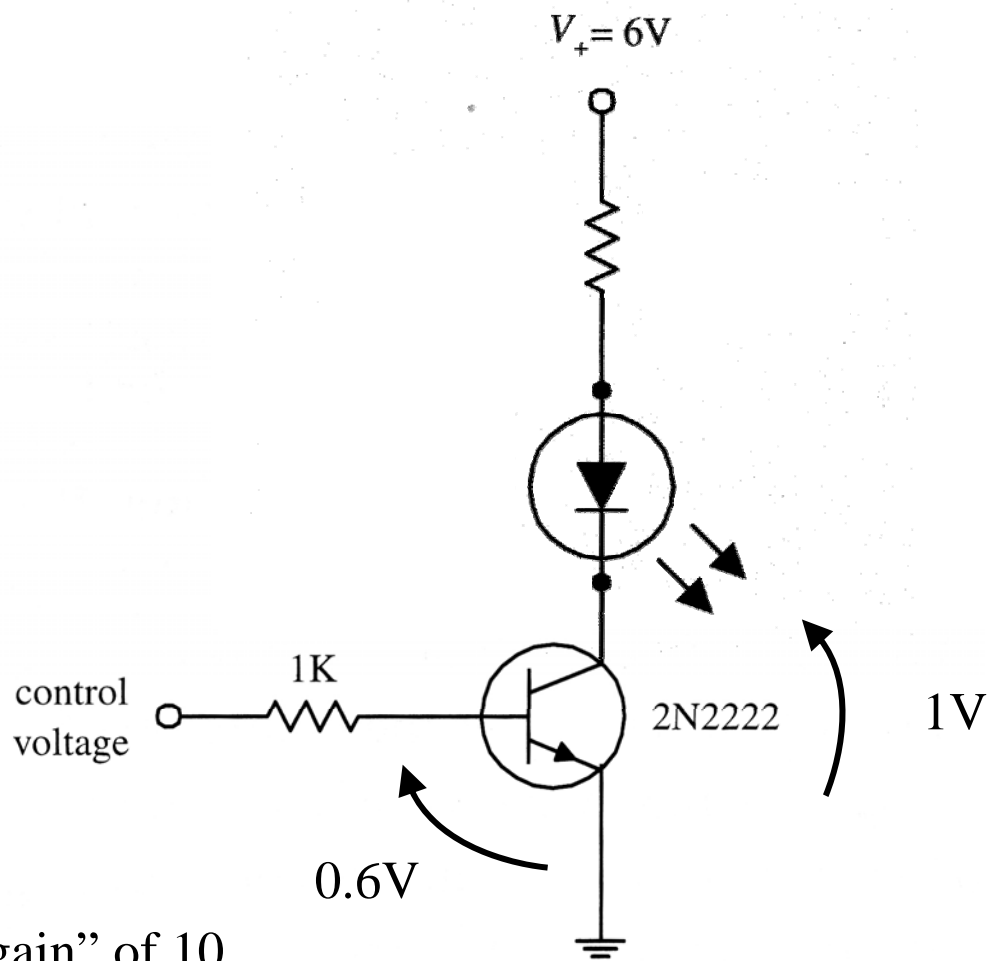
HIGH FREQUENCY (RF)



POWER



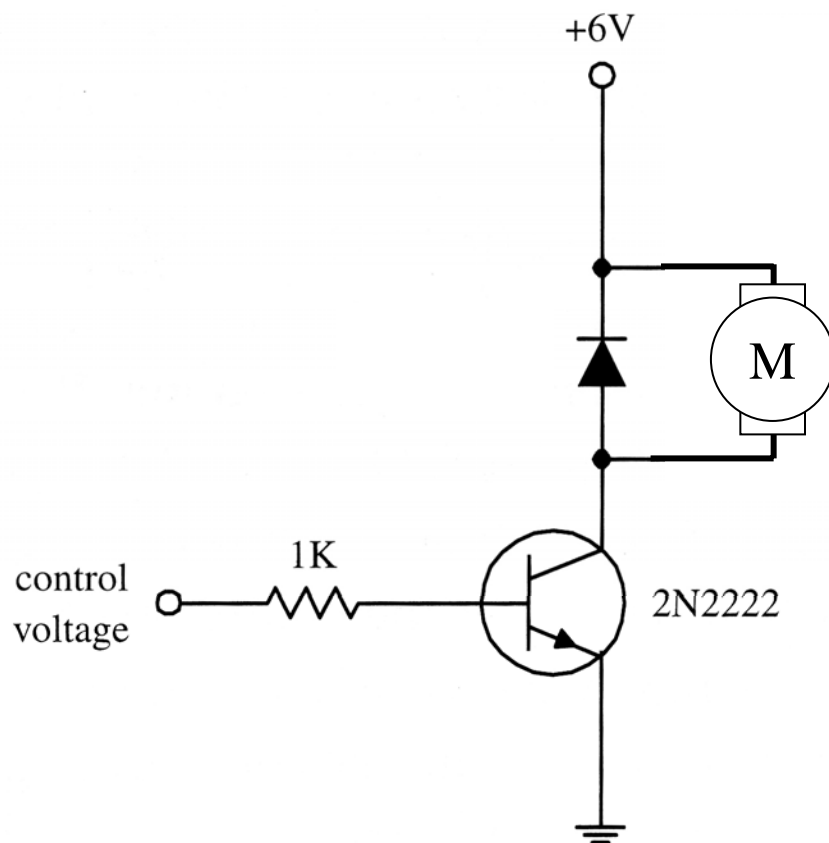
Bipolar Transistor: LED driver



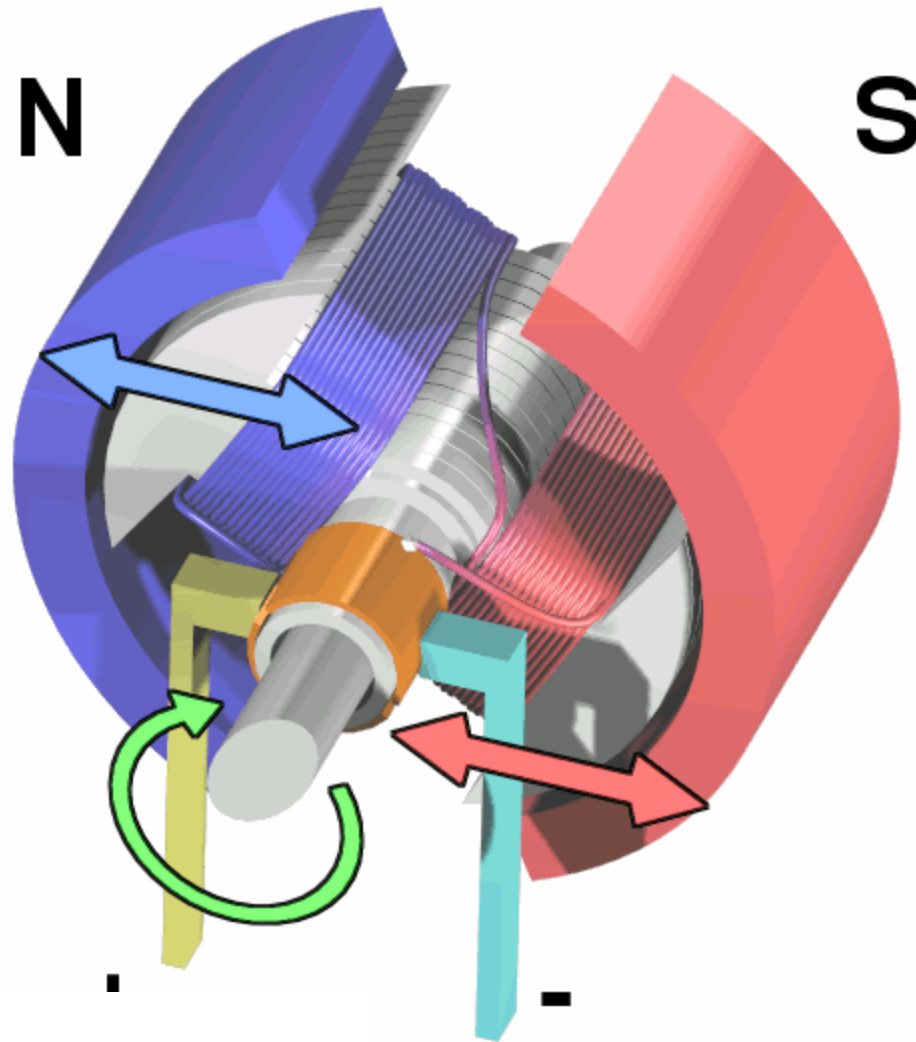
Assume a "gain" of 10

Bipolar Transistor: motor driver (small load)

- Be careful about the noise generated by the motor!



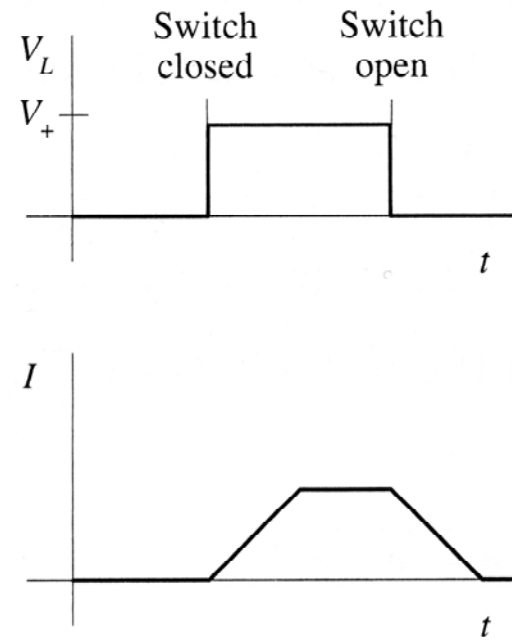
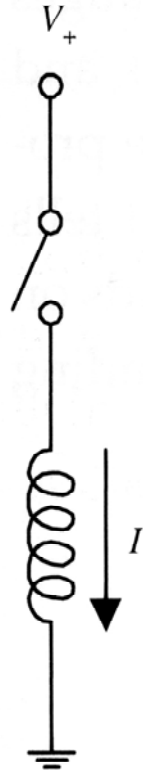
Inside of a motor



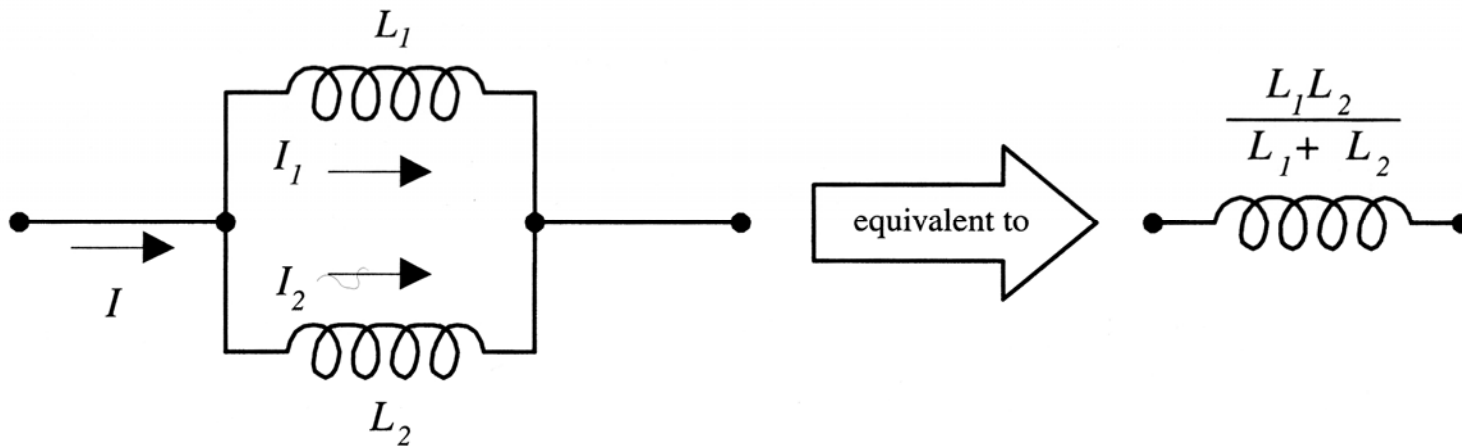
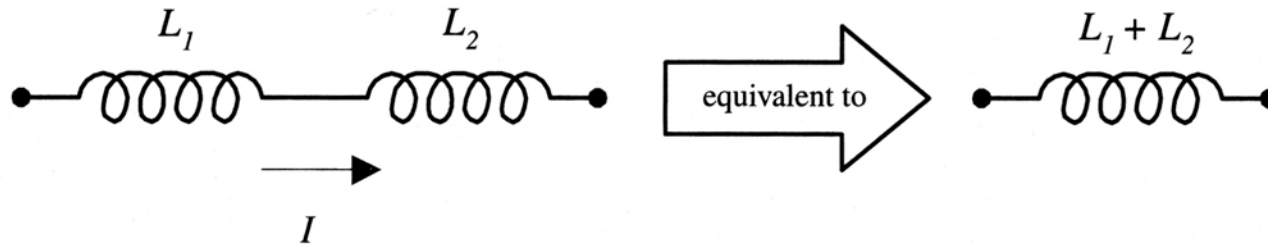
Inductor: key facts

$$V = L \frac{\partial I}{\partial t}$$

$$\partial I = \frac{V}{L} \partial t$$

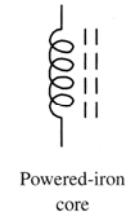
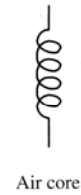
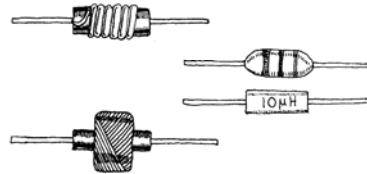


Inductor: key facts

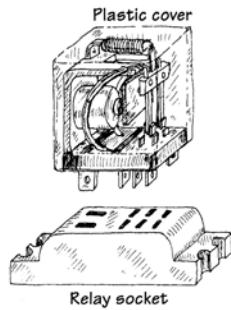


Inductor: Examples

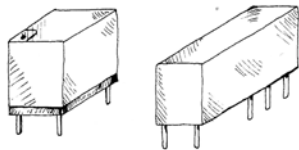
Chokes



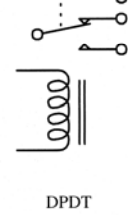
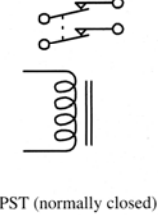
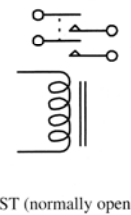
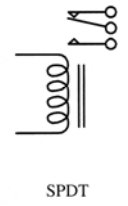
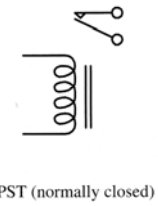
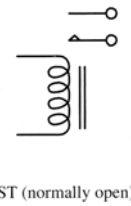
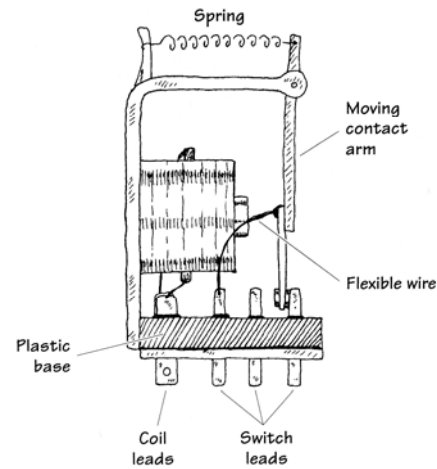
Subminiature Relays



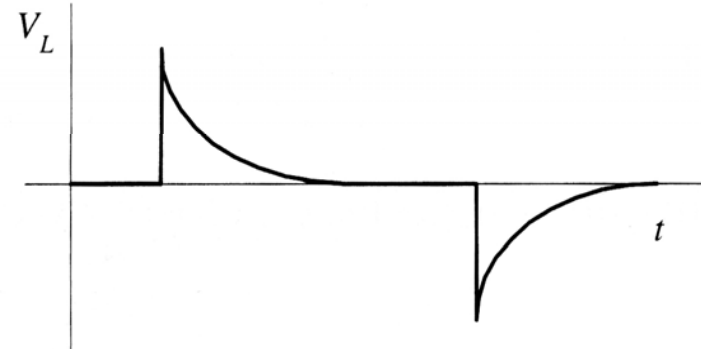
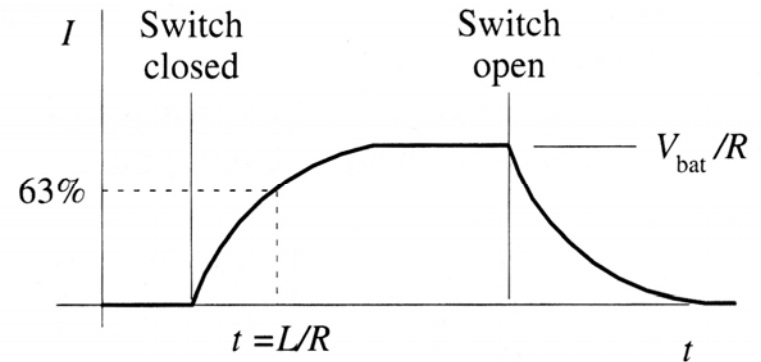
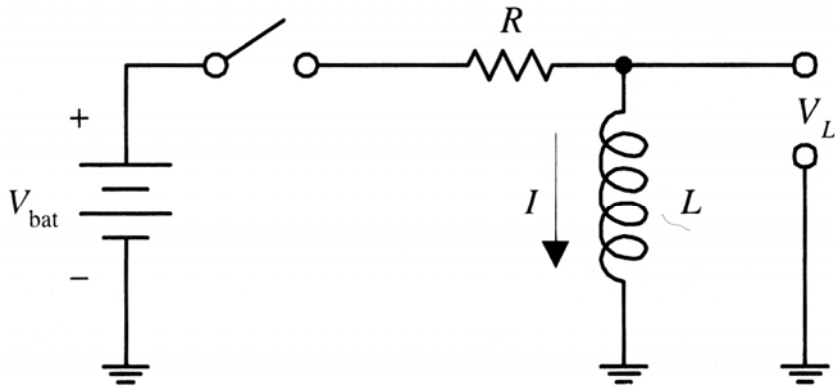
Miniature Relays



Mechanical Relay

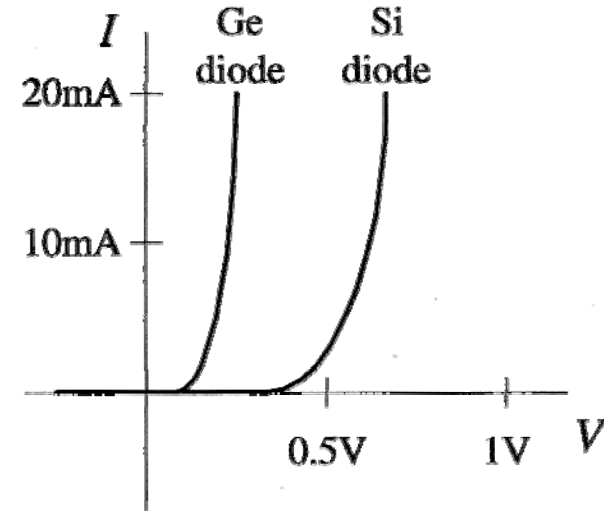
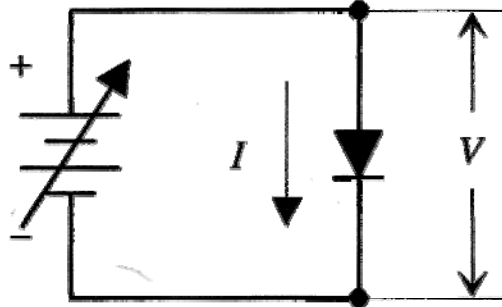


Inductor generate spikes



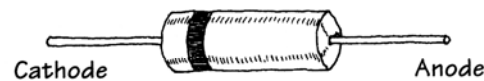
Diode: key facts

- Unidirectional conduction



- Examples

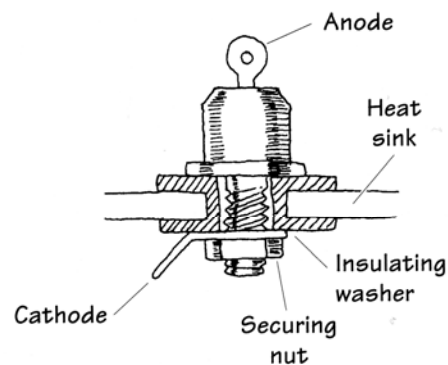
Glass-encapsulated signal diode



Plastic-encapsulated diode

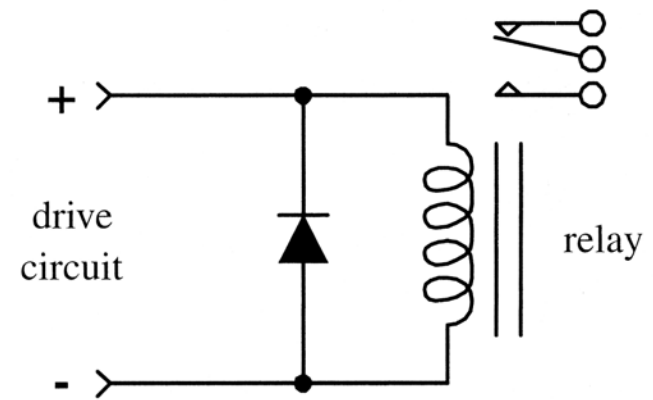
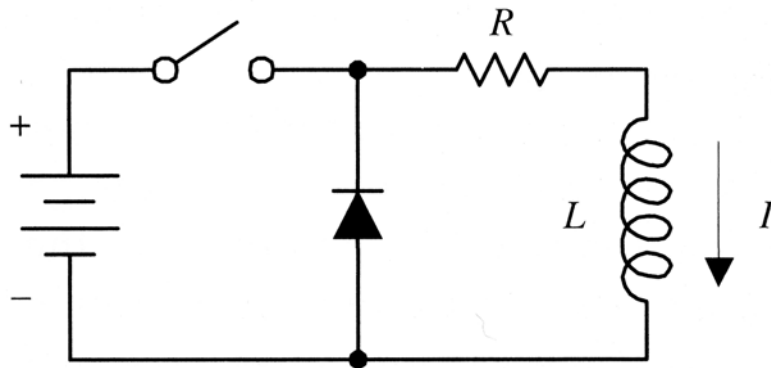


Power rectifier



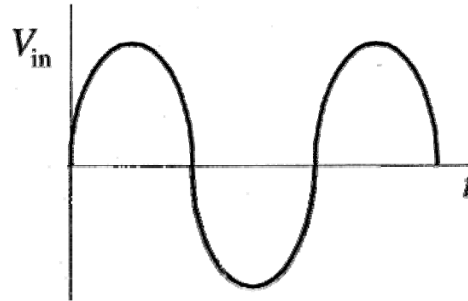
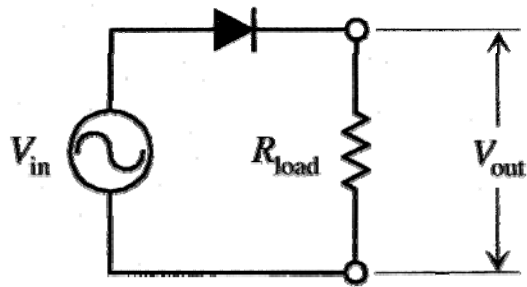
Diode as spike suppressor

- Spike suppressor



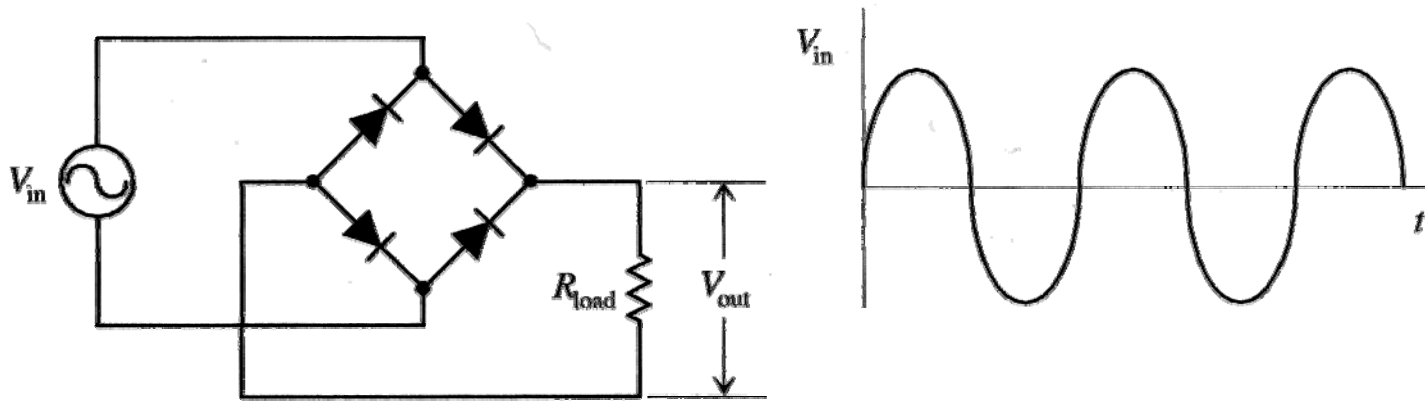
Diode as rectifier (I)

Half-Wave Rectifier

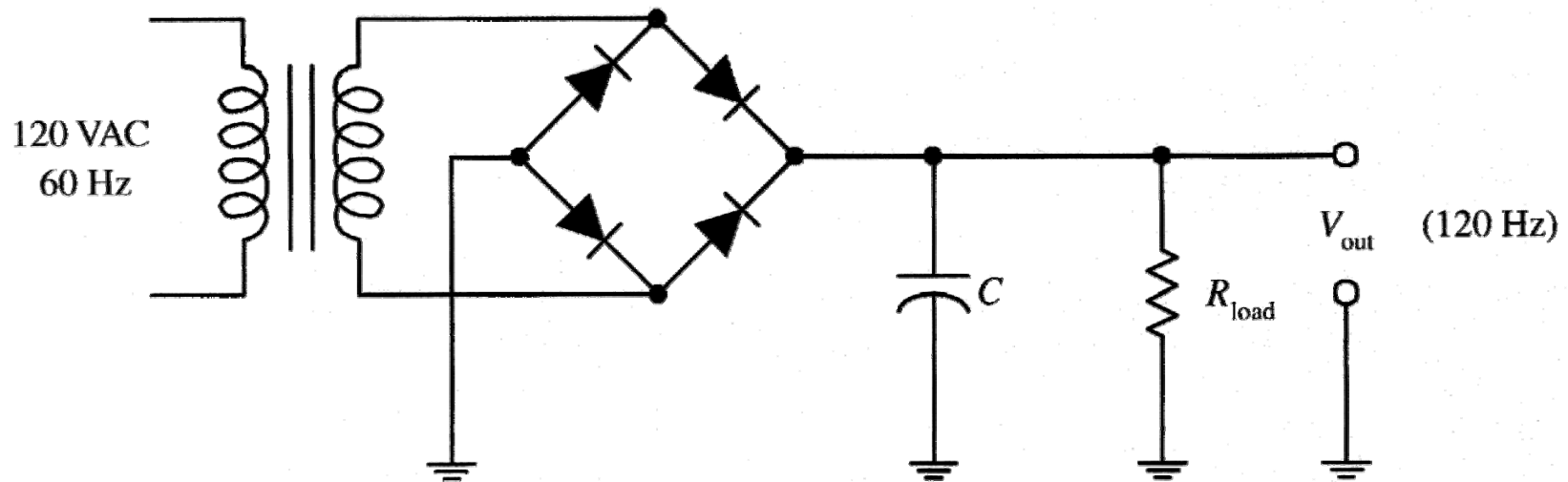


Diode as rectifier (II)

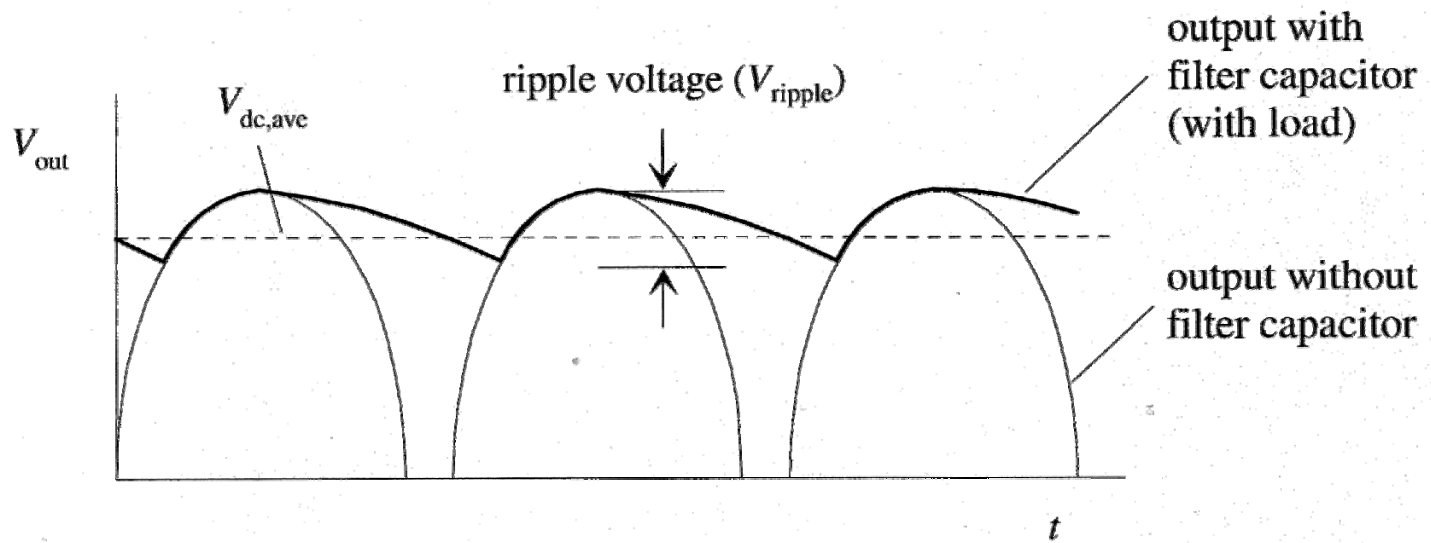
Full-Wave Bridge Rectifier



Basic power supply

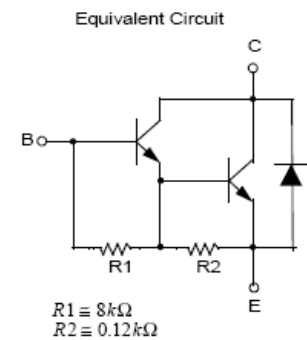
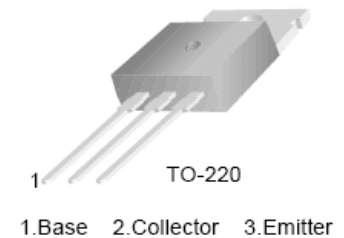
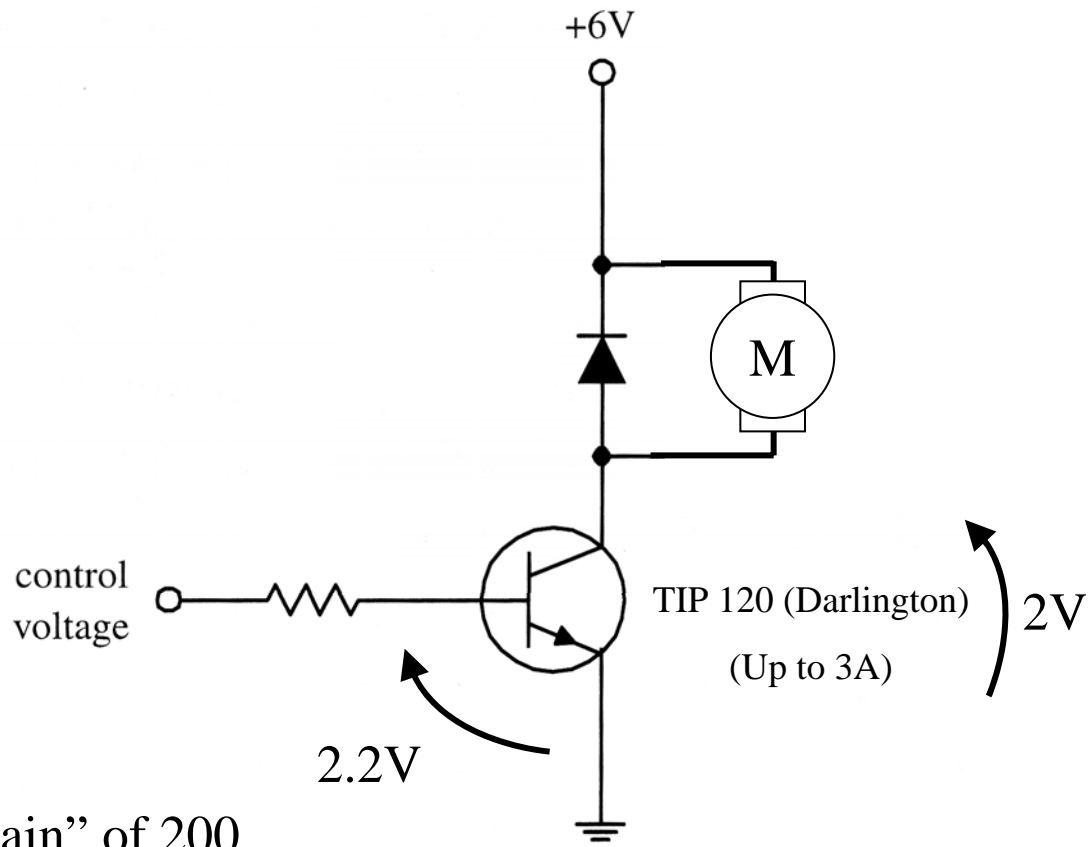


Basic power supply wave form



Bipolar Transistor: motor driver (larger load)

- Be careful about the noise generated by the motor!



Assume a “gain” of 200

MOSFET: motor driver (larger load)

- Be careful about the noise generated by the motor!

