

Workshop Week 8  
**Alternate Output: Motors and Actuation**

**Preparation:**

In *Programming Interactivity* Read:

- A. [Motors](#) (p. 380 -391)  
[Solenoids](#) (p. 417 – 420)
  
- B. Read installation and usage instructions for the Servo Library here:  
<http://www.arduino.cc/playground/ComponentLib/Servo>

**Resources**

**Servo Library:**

<http://www.arduino.cc/playground/ComponentLib/Servo>

**Transistor Basics:**

<http://www.kpsec.freeuk.com/trancirc.htm>

**Working with Transistors:**

<http://www.kpsec.freeuk.com/components/tran.htm>

**Controlling High Current Loads with a Transistor:**

<http://itp.nyu.edu/physcomp/Tutorials/HighCurrentLoads>

**H-Bridge Basics:**

[http://www.modularcircuits.com/h-bridge\\_secrets1.htm](http://www.modularcircuits.com/h-bridge_secrets1.htm)

**Servo Motor Resources**

<http://itp.nyu.edu/physcomp/Labs/Servo>

<http://www.arduino.cc/playground/ComponentLib/Servo>

<http://www.seattlerobotics.org/guide/servos.html>

## Workshop Week 8

### Motors and Actuation

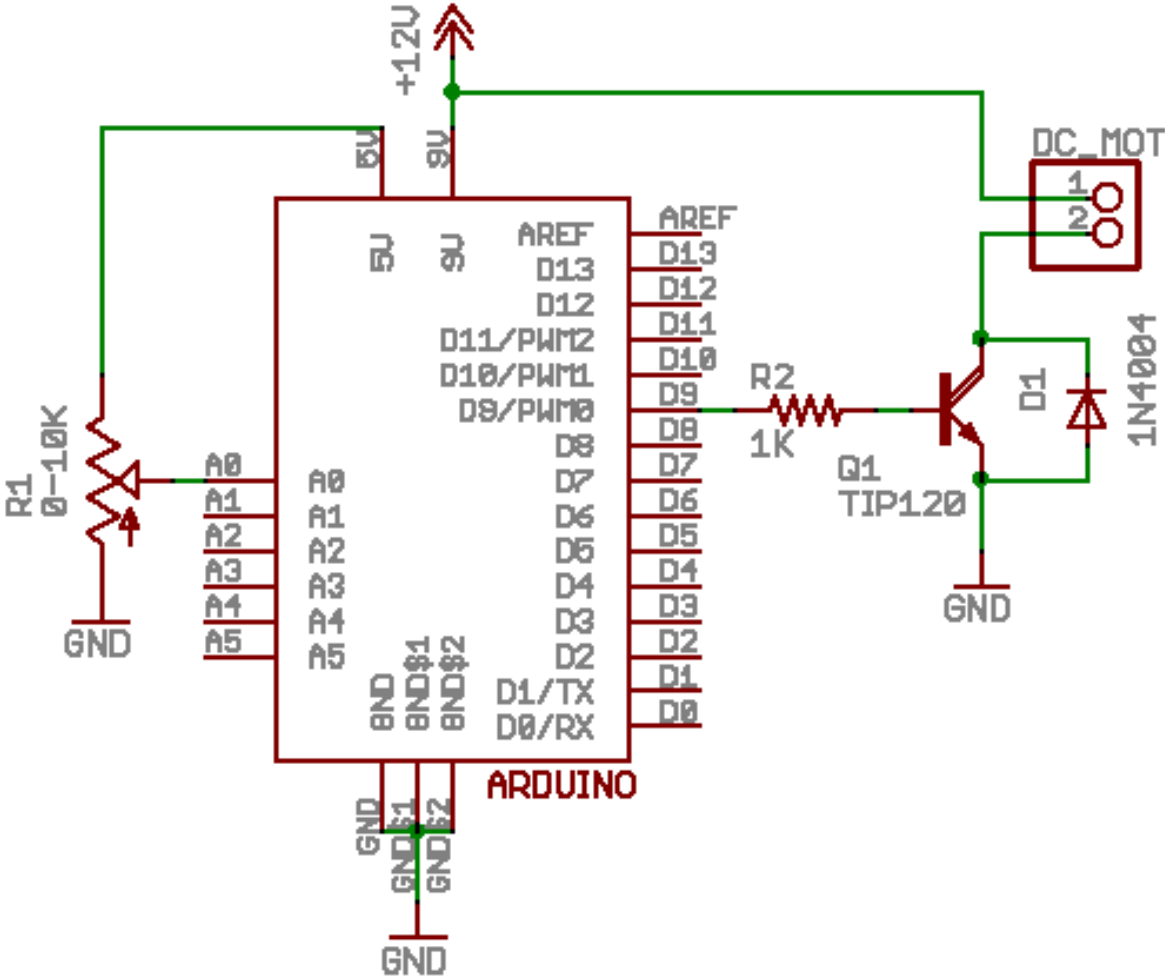
#### In Class Activities:

##### Equipment:

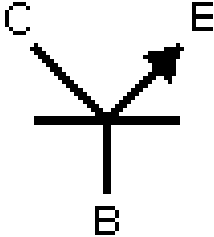
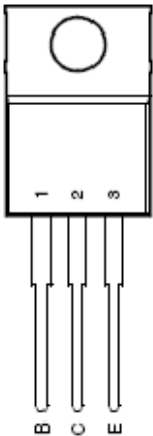
Arduino  
Servo Motor  
DC Motor  
12V AC Adapter  
Power Plug  
Voltage Regulator (5v)  
Potentiometer  
NPN Transistors (TIP 120)  
Capacitors (1mf or 10mf)  
Diode  
Resistors (1k)  
Wires  
Breadboard

- A. Warning:** Make sure that all your components share a common ground!!!! This is extremely important when using two power sources. You will blow a transistor or possibly the Arduino Board if you do not do this.
- B.** Design a circuit that uses a potentiometer to control a DC Motor. You should use a 12 volt adapter as a separate power source for the motor and an NPN transistor to switch the current. You will need to use a voltage regulator to bring the voltage supplied to the motor down to 5v and a diode to prevent back current.
- *Step 1: Attach Potentiometer (and test functionality using serial window)*
  - *Step 2: Build Voltage Regulator circuit to power motor (test with multi-meter)*
  - *Step 3: Finish circuit by adding transistor, Diode, and motor elements.*
- C.** Design a circuit to control a servo motor. Use the potentiometer from your previous circuit to control the position of the servo. Use the AC adapter to power the Arduino board to ensure that you have enough power for the system and to make it more portable. You can use the software servo library included with the Arduino software.
- *Step 1: Attach AC adapter to Arduino Board and adjust pin for external power.*
  - *Step 2: Make sure potentiometer is working and check output range.*
  - *Step 3: Convert incoming value from the potentiometer to a value between 0 – 180 to correspond to the angle of the servo [Map() function]*
  - *Step 4: Attach servo*

### Schematic: Controlling DC motor speed using a potentiometer



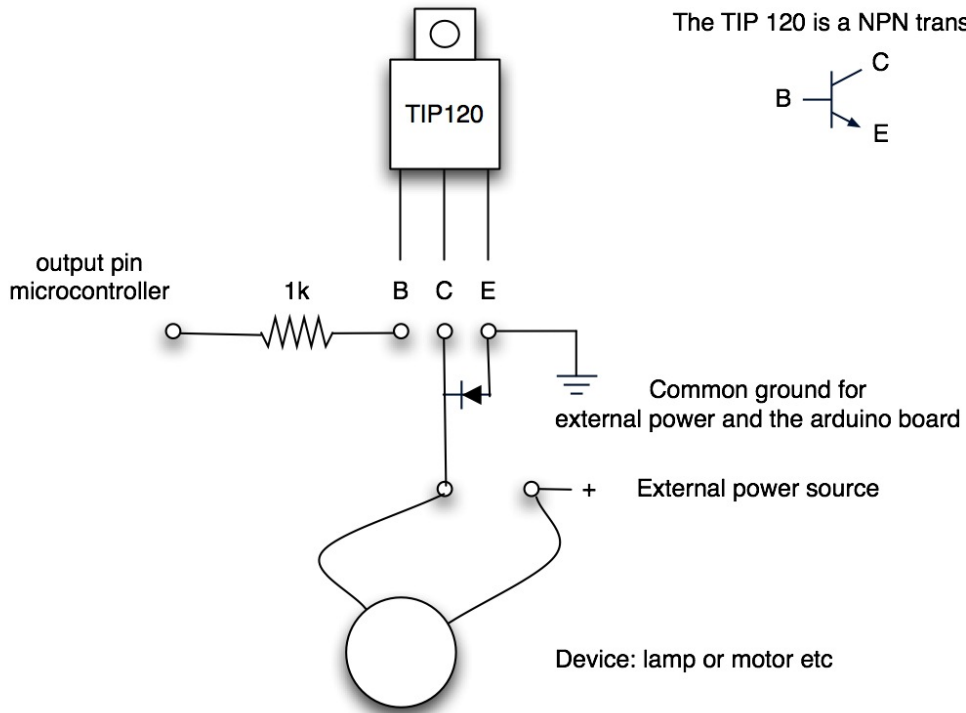
### NPN Transistor Usage



**Terminal Connections:**

- Base is connected to a control voltage (e.g. Microcontroller output)
- The Collector is attached to the negative terminal of the load (e.g. motor or light)
- The Emitter is connected to the common ground

# Illustrated DC Motor Circuit



**Base to microcontroller**  
**Emitter to ground**  
**Collector to device**

Diode from E to C when connected to inductive load like a DC motor

## DC Motor Circuit Attached to an Arduino

