

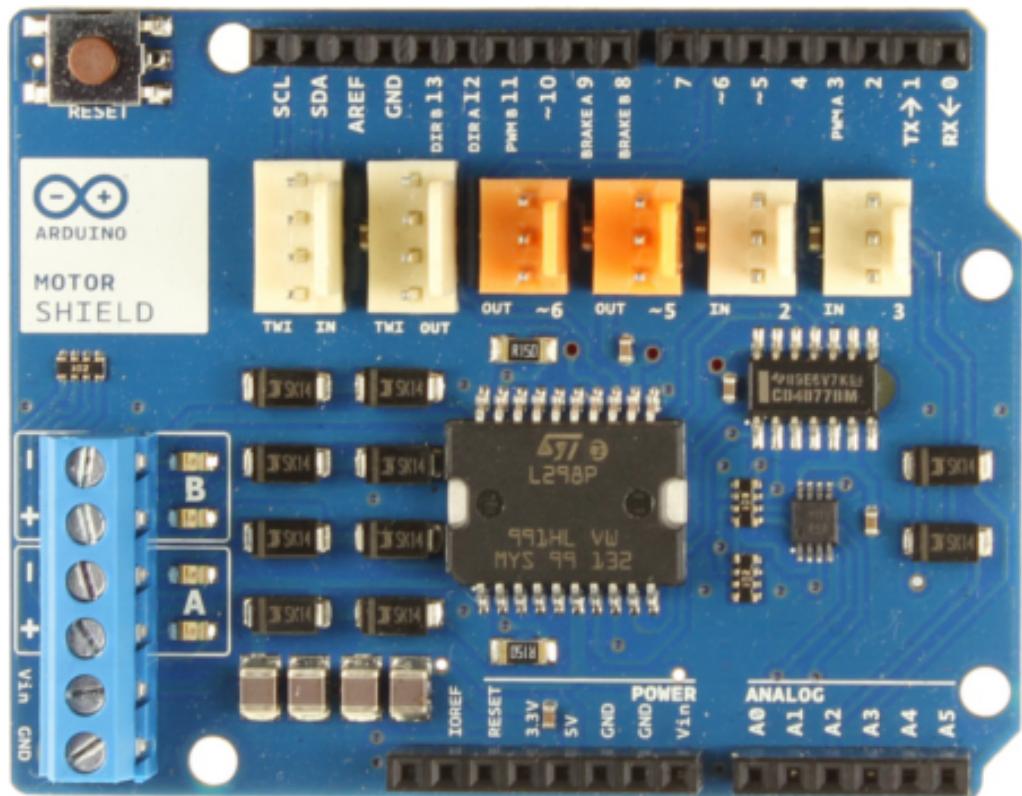
ROCO222: Intro to sensors and actuators

Lecture 4

Arduino motor shield

Arduino motor shield

- Based on the L298 dual full-bridge driver
- designed to drive inductive loads
- Relays
- Solenoids
- DC and stepping motors.
- Drives two DC motors
- Controlling speed
- Direction of each
- Can measure motor current



Arduino motor shield spec

- Motor controller L298P
- Operating Voltage 5V to 12V
- Max current 2A per channel
4A max (with external power supply)
- Current sensing 1.65V/A
- Drives 2 DC motors or 1 stepper motor
- Free running stop and brake function

L298 dual full-bridge driver



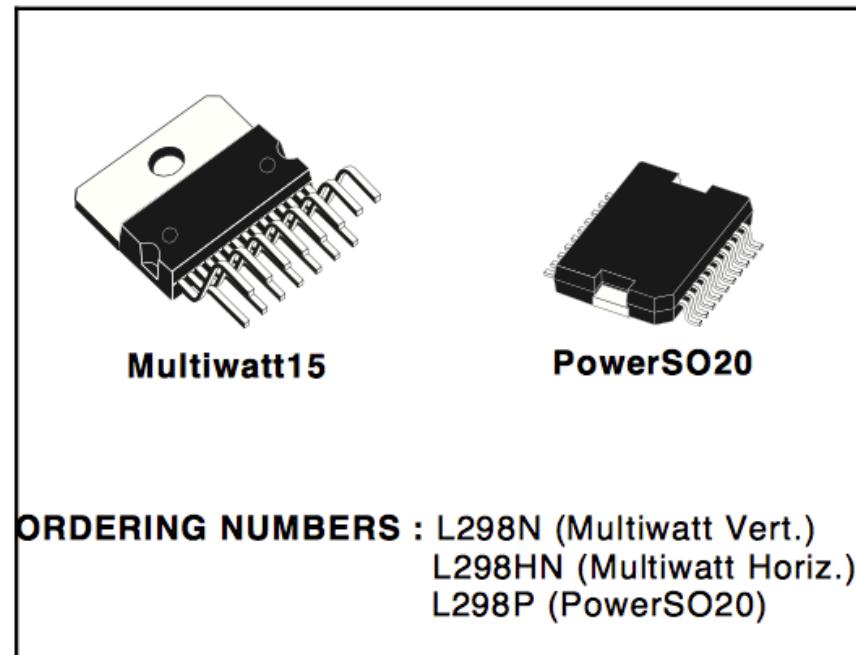
L298

DUAL FULL-BRIDGE DRIVER

- OPERATING SUPPLY VOLTAGE UP TO 46 V
- TOTAL DC CURRENT UP TO 4 A
- LOW SATURATION VOLTAGE
- OVERTEMPERRATURE PROTECTION
- LOGICAL "0" INPUT VOLTAGE UP TO 1.5 V
(HIGH NOISE IMMUNITY)

DESCRIPTION

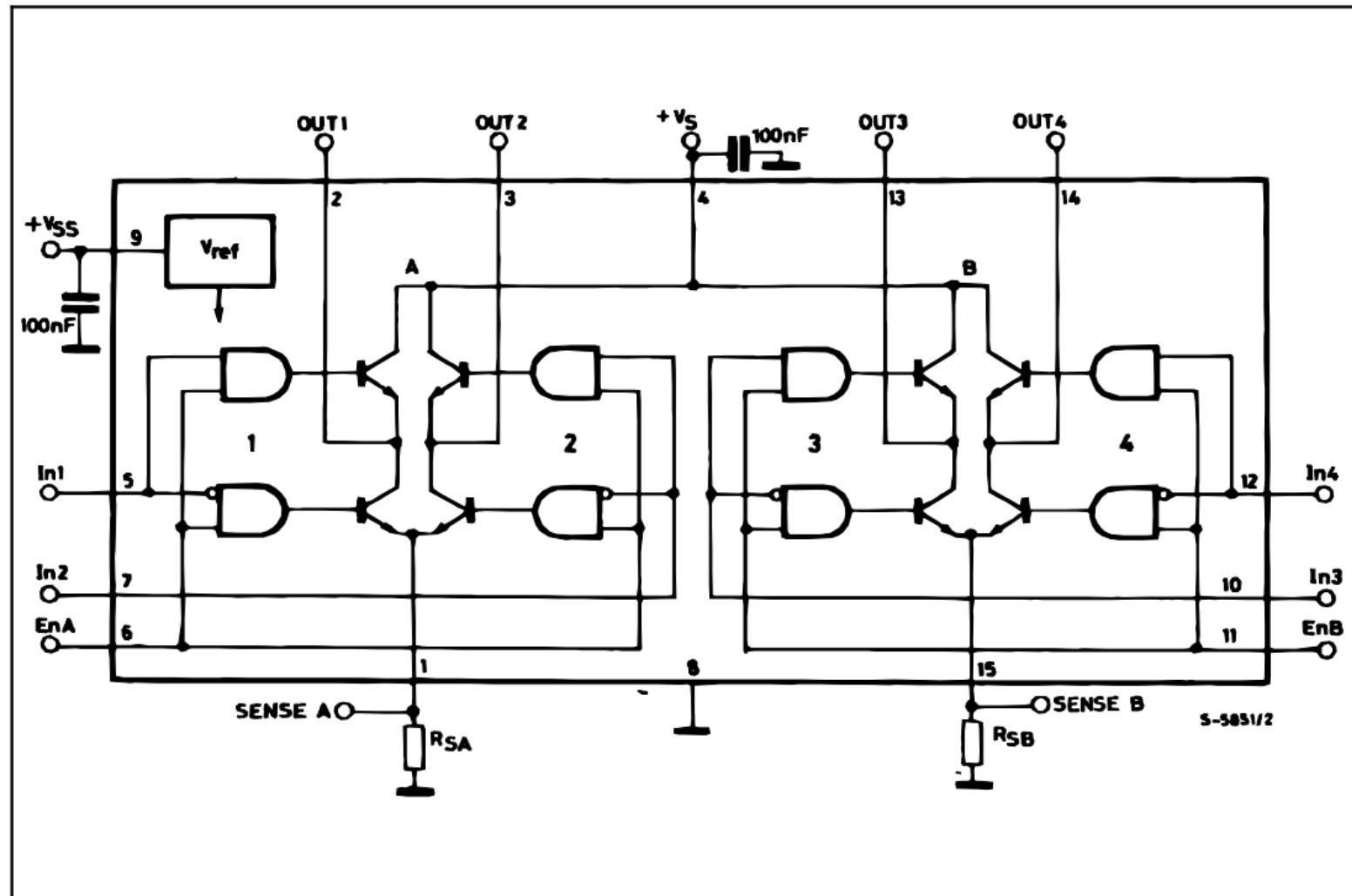
The L298 is an integrated monolithic circuit in a 15-lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the input signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional supply input is provided so that the logic works at a lower voltage.



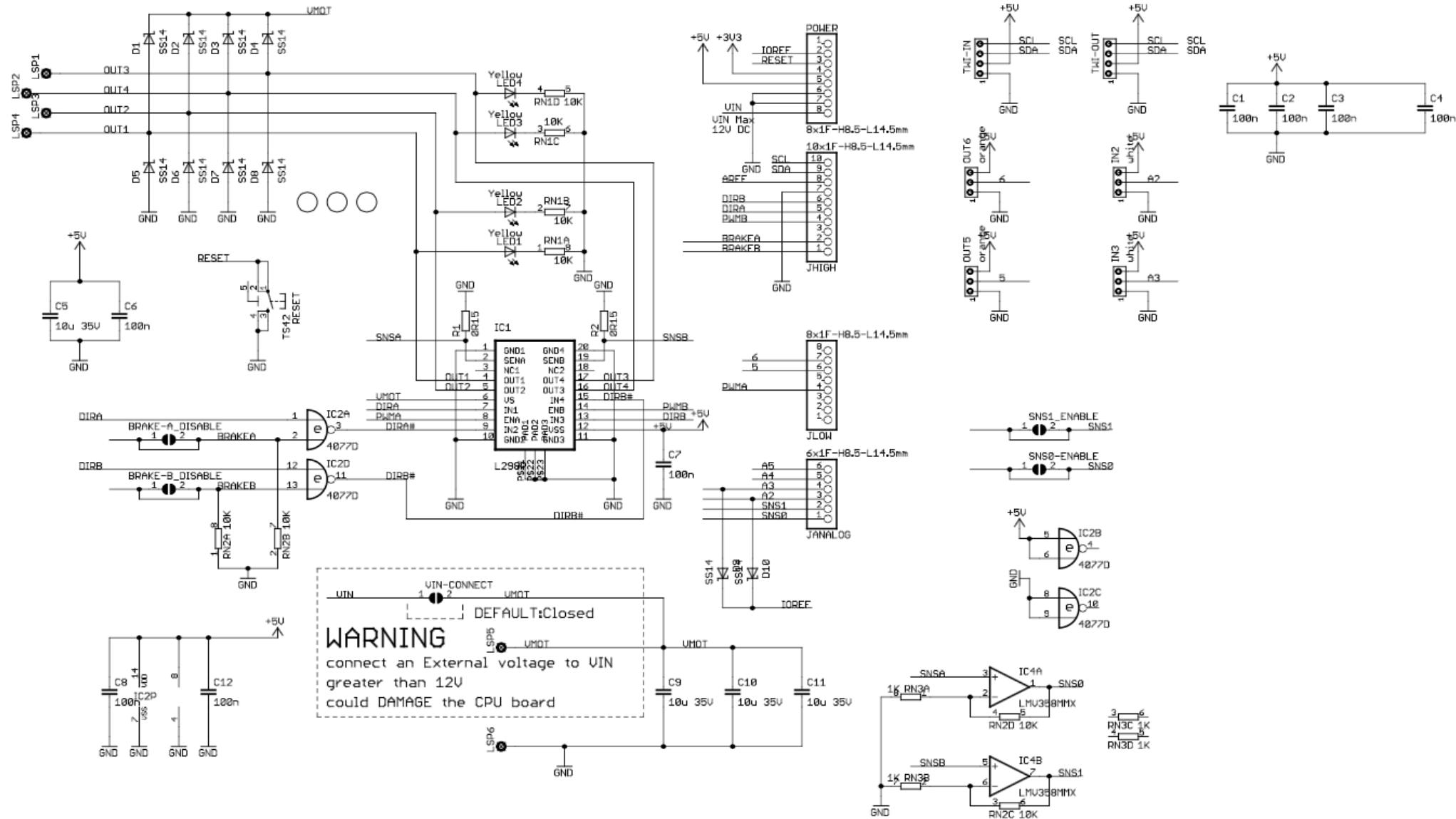
ORDERING NUMBERS : L298N (Multiwatt Vert.)
L298HN (Multiwatt Horiz.)
L298P (PowerSO20)

L298 dual full-bridge driver

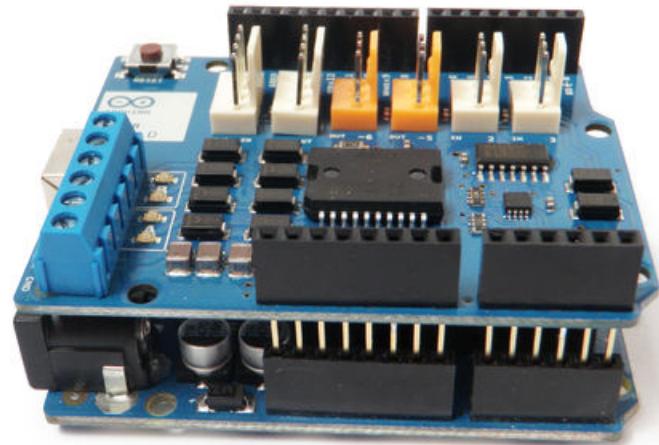
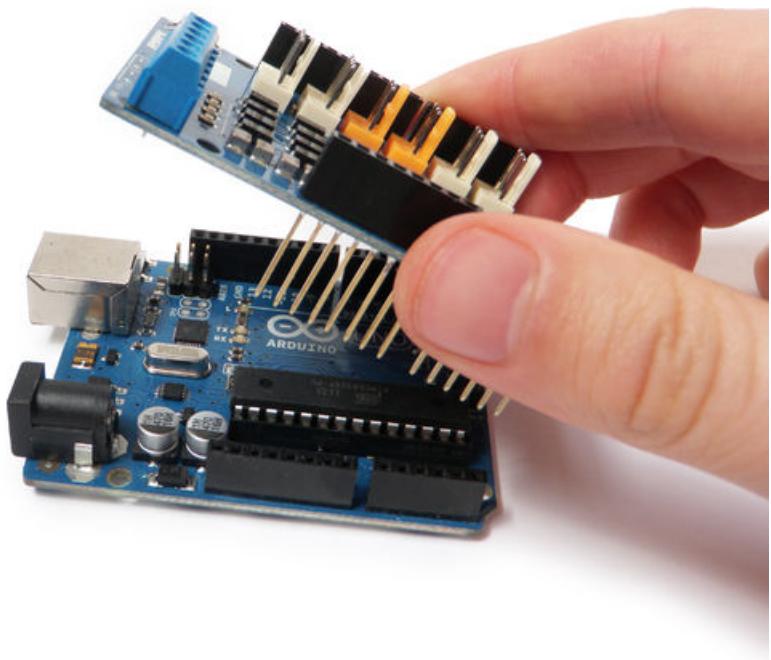
BLOCK DIAGRAM



Motor shield schematic

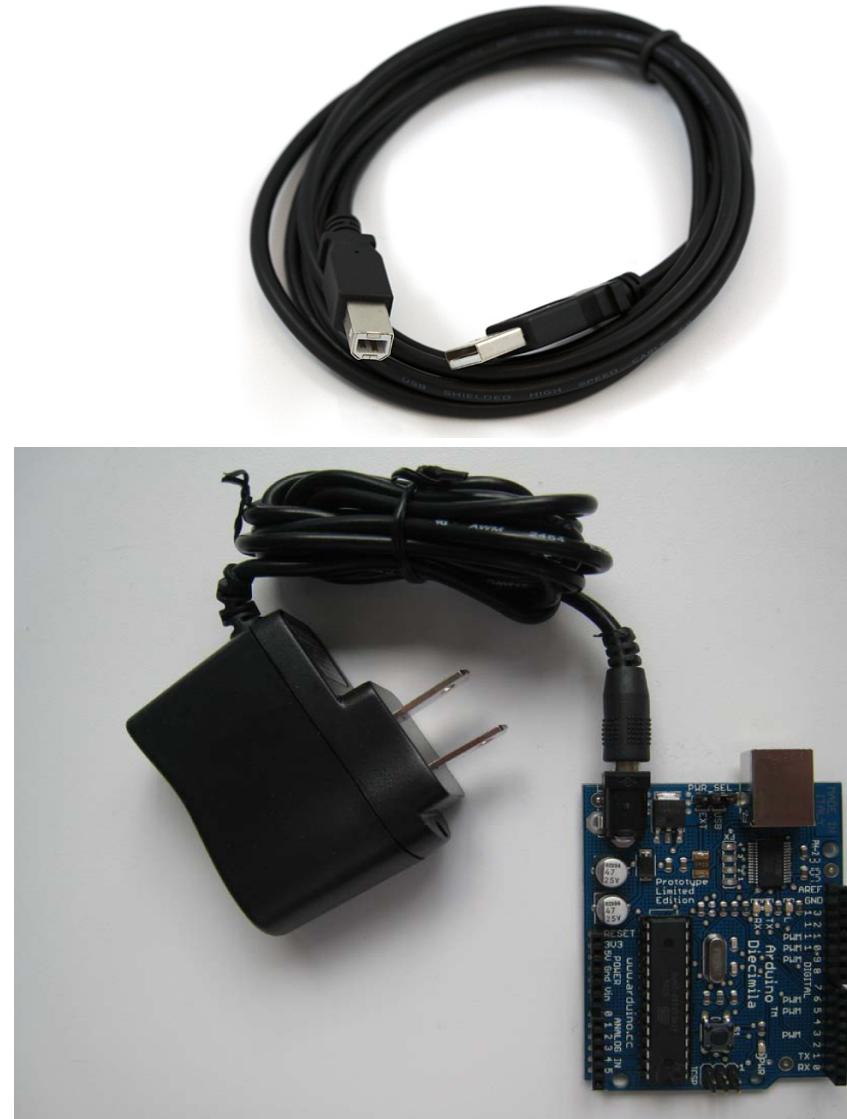


Install the Arduino motor shield



Arduino motor shield power supply

- Required motor current **almost always** exceeds the maximum USB current rating!
- Must be powered only by an external power supply
- Adapter can be connected by plugging a 2.1mm center-positive plug into the Arduino's board power jack
- Use an external power supply between 7 and 12V



Arduino motor shield output channels

- The motor shield has 2 separate channels: A and B
- Each use 4 of the Arduino pins to drive or sense the motor
- Use each channel separately to drive two DC motors
- Combine them to drive one stepper motor
- Has 6 headers for the attachment of Tinkerkit inputs, outputs, and communication lines.
- With an external power supply, the motor shield can safely supply up to 12V and 2A per motor channel (or 4A to a single channel).

Pins on the Arduino always in use by the motor shield

- By addressing these pins you can
- Select a motor channel to initiate
- Specify the motor direction (polarity)
- Set motor speed (PWM)
- Stop and start the motor
- Monitor the current absorption of each channel

Motor shield pin usage

Function	<u>Channel A</u>	<u>Channel B</u>
<i>Direction</i>	Digital 12	Digital 13
<i>Speed (PWM)</i>	Digital 3	Digital 11
<i>Brake</i>	Digital 9	Digital 8
<i>Current Sensing</i>	Analog 0	Analog 1

ROCO222: Intro to sensors and actuators

Lecture 4

Arduino DC motor control

DC Motors connections

- Drive two Brushed DC motors by connecting the two wires of each one in the (+) and (-) screw terminals for each channel A and B
- Control direction by setting HIGH or LOW the DIR A and DIR B pins
- Control the speed by varying the PWM A and PWM B duty cycle values
- Brake A and Brake B pins set HIGH will brake the DC motors
- Measure DC motor current reading the SNS0 and SNS1 pins
- voltage proportional to the measured current, which can be read as a normal analog input, through the function `analogRead()` on the analog input A0 and A1.

Motor shield 1-channel DC motor demo

Plug the motor's positive (red) wire into Channel A's + terminal on the motor shield

Plug the motor's ground (black) wire into Channel A's - terminal on the shield

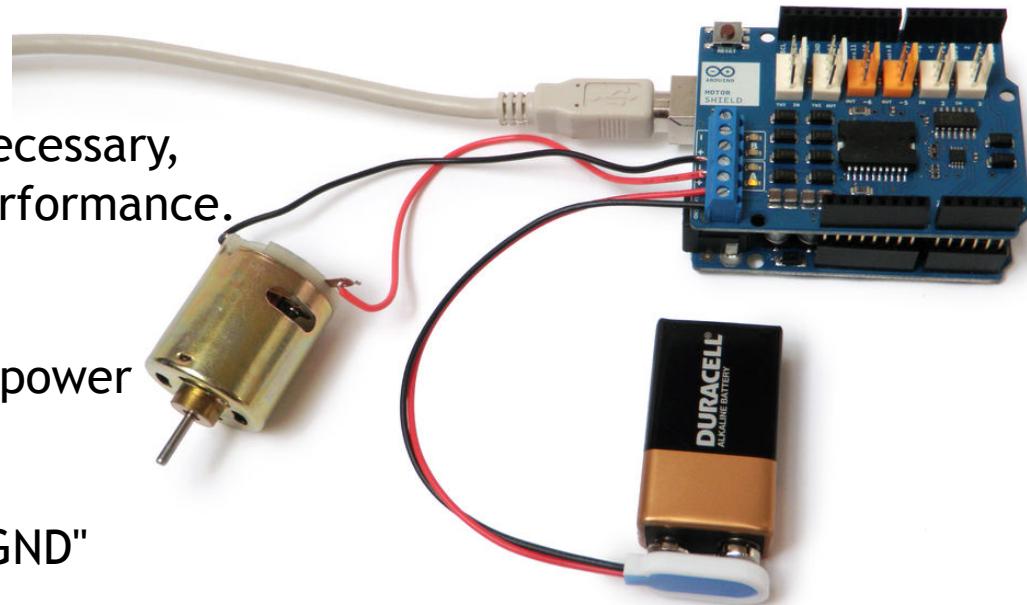
An external power supply is not always necessary, but it drastically improves the motor's performance.

To connect your external power supply:

Connect the positive (red) wire from the power supply to the "Vin" terminal

Connect the ground (black) wire to the "GND" terminal.

Upload the code to control the Motor Shield from Arduino.



Motor shield 1-channel DC motor demo

Function	Channel A	Channel B
<i>Direction</i>	Digital 12	Digital 13
<i>Speed (PWM)</i>	Digital 3	Digital 11
<i>Brake</i>	Digital 9	Digital 8
<i>Current Sensing</i>	Analog 0	Analog 1

```
*****
```

Motor Shield 1-Channel DC Motor Demo

by Randy Sarafan

For more information see:

<http://www.instructables.com/id/Arduino-Motor-Shield-Tutorial>

```
***** /
```

```
void setup() {
```

```
  //Setup Channel A
```

```
  pinMode(12, OUTPUT); //Initiates Motor Channel A pin
```

```
  pinMode(9, OUTPUT); //Initiates Brake Channel A pin
```

```
}
```

Motor shield 1-channel DC motor demo

```
void loop(){
```

```
    //forward @ full speed
```

```
    digitalWrite(12, HIGH); //Establishes forward direction of Channel A
```

```
    digitalWrite(9, LOW); //Disengage the Brake for Channel A
```

```
    analogWrite(3, 255); //Spins the motor on Channel A at full speed
```

```
    delay(3000);
```

```
    digitalWrite(9, HIGH); //Engage the Brake for Channel A
```

```
    delay(1000);
```

```
    //backward @ half speed
```

```
    digitalWrite(12, LOW); //Establishes backward direction of Channel A
```

```
    digitalWrite(9, LOW); //Disengage the Brake for Channel A
```

```
    analogWrite(3, 123); //Spins the motor on Channel A at half speed
```

```
    delay(3000);
```

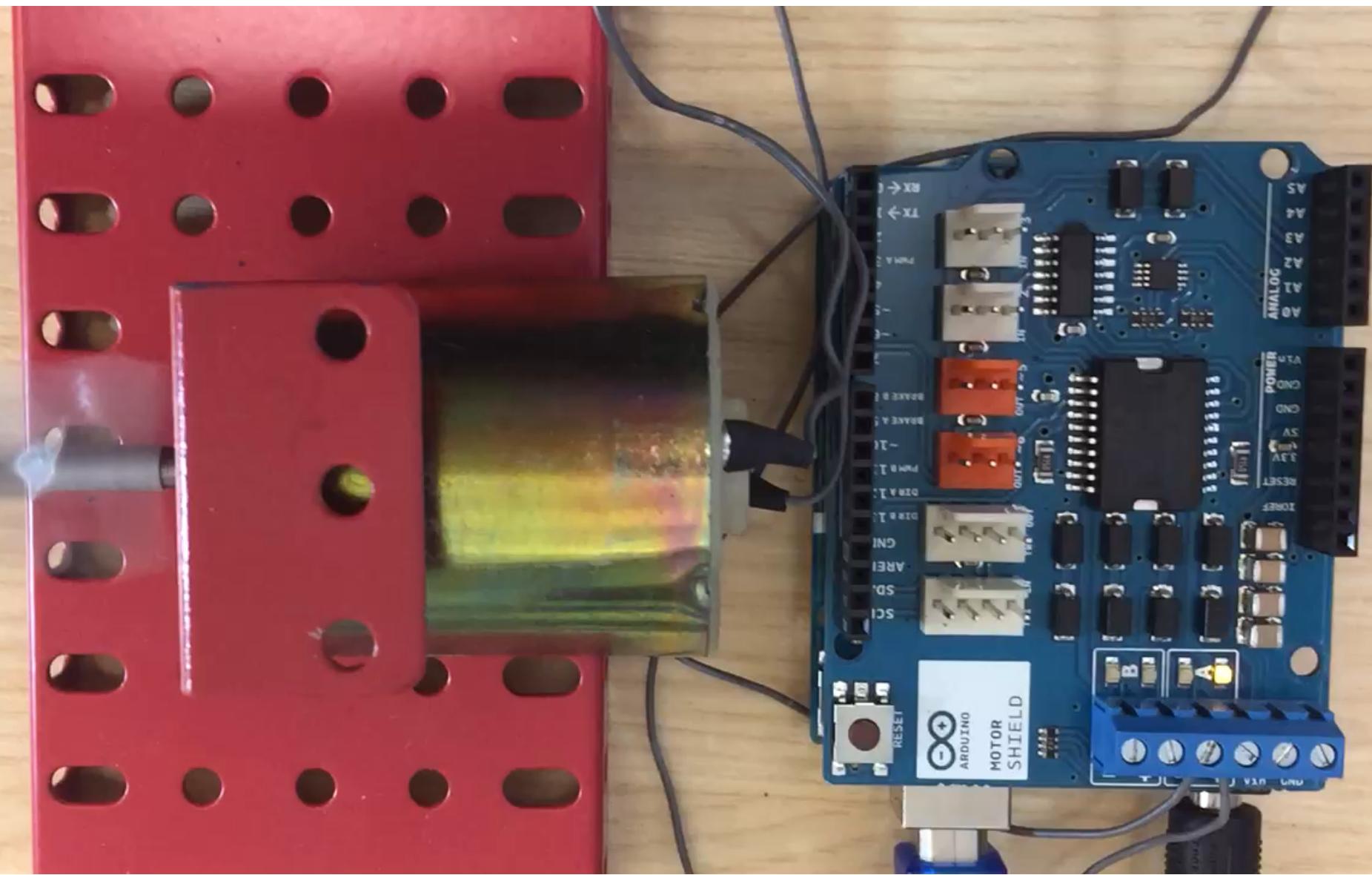
```
    digitalWrite(9, HIGH); //Engage the Brake for Channel A
```

```
    delay(1000);
```

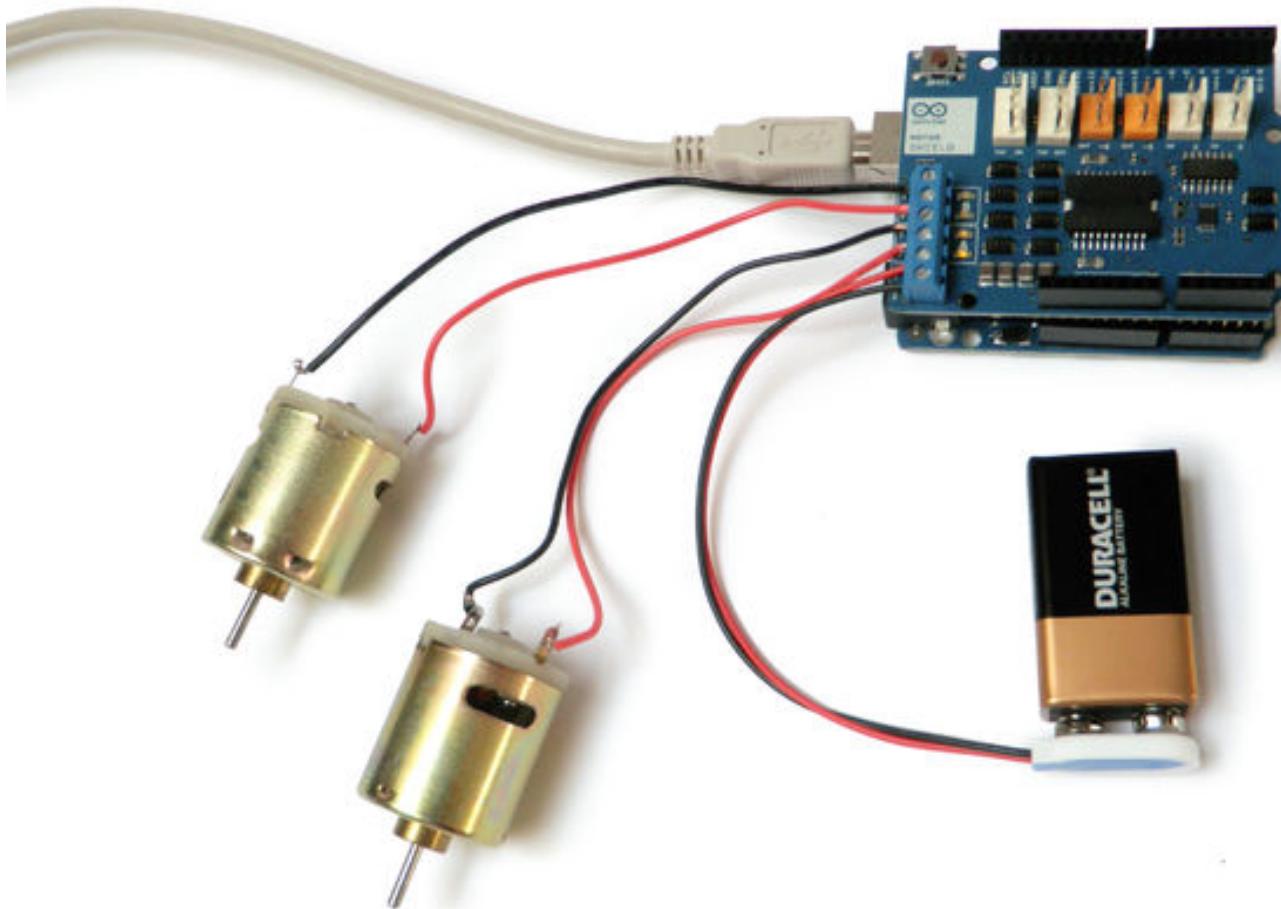
Function	Channel A	Channel B
<i>Direction</i>	Digital 12	Digital 13
<i>Speed (PWM)</i>	Digital 3	Digital 11
<i>Brake</i>	Digital 9	Digital 8
<i>Current Sensing</i>	Analog 0	Analog 1

```
}
```

DC motor running



Motor shield 2-channel DC motor demo



Motor shield 2-channel DC motor demo

Motor Shield 2-Channel DC Motor Demo

by Randy Sarafan

For more information see:

<http://www.instructables.com/id/Arduino-Motor-Shield-Tutorial/>

******/

```
void setup() {  
  //Setup Channel A  
  pinMode(12, OUTPUT); //Initiates Motor Channel A pin  
  pinMode(9, OUTPUT); //Initiates Brake Channel A pin  
  
  //Setup Channel B  
  pinMode(13, OUTPUT); //Initiates Motor Channel A pin  
  pinMode(8, OUTPUT); //Initiates Brake Channel A pin  
}
```

Function	Channel A	Channel B
<i>Direction</i>	Digital 12	Digital 13
<i>Speed (PWM)</i>	Digital 3	Digital 11
<i>Brake</i>	Digital 9	Digital 8
<i>Current Sensing</i>	Analog 0	Analog 1

Motor shield 2-channel DC motor demo

```
void loop(){

    //Motor A forward @ full speed
    digitalWrite(12, HIGH); //Establishes forward direction of Channel A
    digitalWrite(9, LOW); //Disengage the Brake for Channel A
    analogWrite(3, 255); //Spins the motor on Channel A at full speed

    //Motor B backward @ half speed
    digitalWrite(13, LOW); //Establishes backward direction of Channel B
    digitalWrite(8, LOW); //Disengage the Brake for Channel B
    analogWrite(11, 123); //Spins the motor on Channel B at half speed
    delay(3000);

    digitalWrite(9, HIGH); //Engage the Brake for Channel A
    digitalWrite(9, HIGH); //Engage the Brake for Channel B
    delay(1000);

    //Motor A forward @ full speed
    digitalWrite(12, LOW); //Establishes backward direction of Channel A
    digitalWrite(9, LOW); //Disengage the Brake for Channel A
    analogWrite(3, 123); //Spins the motor on Channel A at half speed

    //Motor B forward @ full speed
    digitalWrite(13, HIGH); //Establishes forward direction of Channel B
    digitalWrite(8, LOW); //Disengage the Brake for Channel B
    analogWrite(11, 255); //Spins the motor on Channel B at full speed
    delay(3000);

    digitalWrite(9, HIGH); //Engage the Brake for Channel A
    digitalWrite(9, HIGH); //Engage the Brake for Channel B
    delay(1000);
}
```

Function	Channel A	Channel B
Direction	Digital 12	Digital 13
Speed (PWM)	Digital 3	Digital 11
Brake	Digital 9	Digital 8
Current Sensing	Analog 0	Analog 1