# DC Motor Control and PWM

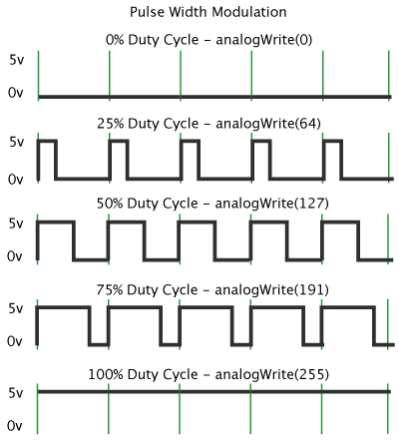
In this assignment you will learn to control a DC motor using an H-bridge integrated circuit.

## Necessary Hardware

Arduino Board – with USB or battery power
DC Motor
Hook-up wire
Breadboard

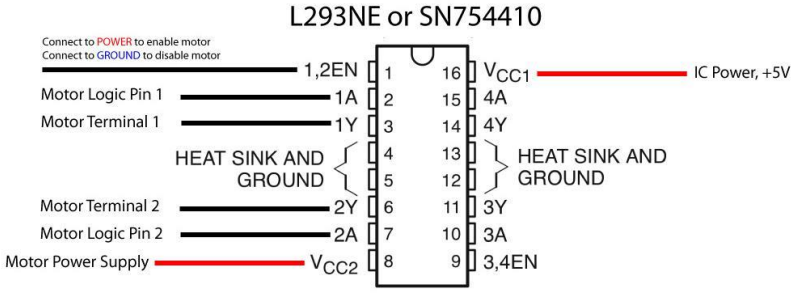
## The Circuit

The Arduino does not have analog output capability, however analog output can be approximated with Pulse Width Modulation (PWM). PWM is achieved with the analogWrite() command. This command has two arguments: first is the write pin, and second is the duty cycle. The duty cycle argument is between 0 and 255 and creates a PWM with the proportional duty cycle as shown in the figure. In this manner the speed of a motor can be controlled by only supplying current a fraction of the time.




You will be controlling a motor using the Texas Instruments L293D H- bridge. You will need to connect the chip to the appropriate power supplies and command pins in order to control the motor speed and direction.

The pin-outs and truth table are shown in the following figure. Be very careful when connecting the power supply. $V_{CC1}$ (or pin 16 on the L293) is the power supply for the Integrated Circuit. This should come from the 5V power pin on your Arduino. $V_{CC2}$ is the motor power supply. This will be a much higher voltage/current source depending on the needs of your motor. In this assignment you can connect $V_{CC2}$ to the $V_{in}$ connection on your Arduino. This will provide the motor with the same power source as connected to the Arduino (9 volt battery or USB in this case).




| EN | 1A | 2A | FUNCTION |
|---|---|---|---|
| H | L | H | Turn right |
| H | H | L | Turn left |
| H | L | L | Fast motor stop |
| H | H | H | Fast motor stop |
| L | X | X | Fast motor stop |

L = low, H = high, X = don't care

Motor Logic pins (2 and 7 on the L293) should be connected to Arduino digital outputs capable of PWM. These pins will be set according to the truth table and will dictate the direction of motor operation. For example, suppose L293 pin 1A is given a PWM signal with zero duty cycle {e.g.

`analogWrite(pin1,0)` } and L293 pin 2A is given a non-zero PWM { e.g. `analogWrite(pin2,127)`}. The result of this pair of commands is that the motor will rotate to the right (as per row 1 of truth table) at about half its maximum speed (50% duty cycle PWM).

## The Code

Below is an example sketch that will drive the motor as outlined above.

```
// Define pin inputs and outputs

// Motor logic pins
int motorlogic1Pin = 10;  //connect to L293 pin 1A
int motorlogic2Pin = 11;  //connect to L293 pin 2A

void setup() {

  // Set pins as input or output
  pinMode(motorlogic1Pin, OUTPUT);
  pinMode(motorlogic2Pin, OUTPUT);

}


void loop() {

  // Control speed of motor with analogWrite
  analogWrite(motorlogic1Pin, 0);
  analogWrite(motorlogic2Pin, 127);

}
```