

## Lesson 21 DC Motors

### Overview

In this lesson, you will learn how to control a small DC motor using an UNO R3 and a transistor.

### Component Required:

- (1) x Elegoo Uno R3
- (1) x 830 tie-points breadboard
- (1) x L293D IC
- (1) x Fan blade and 3-6v motor
- (5) x M-M wires (Male to Male jumperwires)
- (1) x Power Supply Module
- (1) x 9V1A adapter

### Component Introduction

#### Breadboard Power Supply

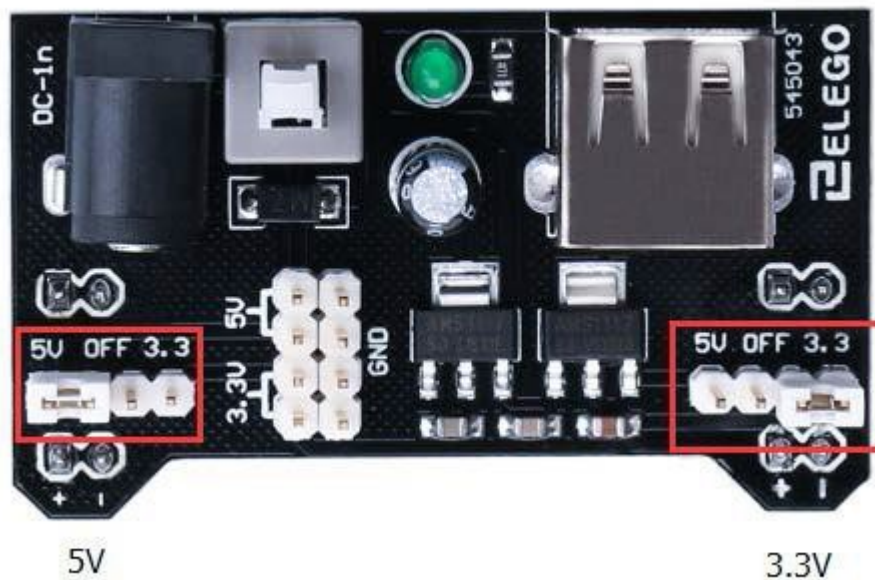
The small DC motor is likely to use more power than an UNO R3 board digital output can handle directly. If we tried to connect the motor straight to an UNO R3 board pin, there is a good chance that it could damage the UNO R3 board. So we use a power supply module provides power supply



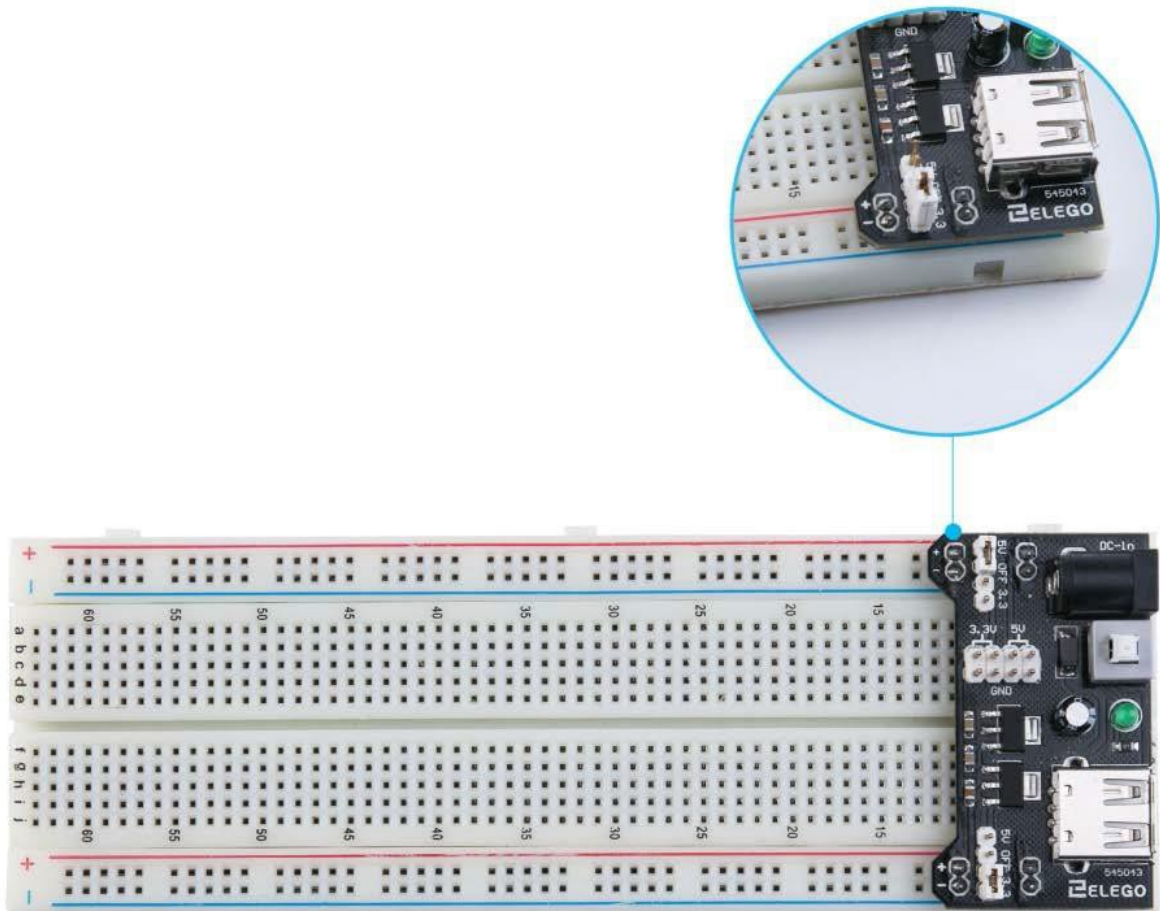
**Product Specifications:**

- Locking On/Off Switch
- LED Power Indicator
- Input voltage: 6.5-9v (DC) via 5.5mm x 2.1mm plug
- Output voltage: 3.3V/5v
- Maximum output current: 700mA
- Independent control rail output. 0v, 3.3v, 5v to breadboard
- Output header pins for convenient external use
- Size: 2.1 in x 1.4 in
- USB device connector onboard to power external device

**Setting up output voltage:**



The left and right voltage output can be configured independently. To select the output voltage, move jumper to the corresponding pins. Note: power indicator LED and the breadboard power rails will not power on if both jumpers are in the “OFF” position.

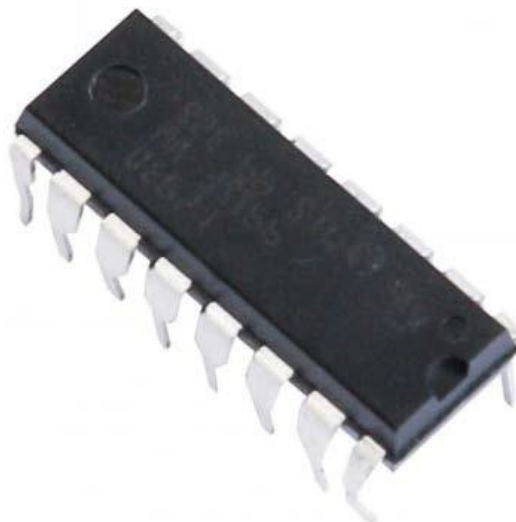


### Important note:

Make sure that you align the module correctly on the breadboard. The negative pin(-) on module lines up with the blue line(-) on breadboard and that the positive pin(+) lines up with the red line(+). Failure to do so could result in you accidentally reversing the power to your project

### L293D

This is a very useful chip. It can actually control two motors independently. We are just using half the chip in this lesson, most of the pins on the right hand side of the chip are for controlling a second motor.



## Product Specifications:

- Featuring Unitrode L293 and L293D Products Now From Texas Instruments
- Wide Supply-Voltage Range: 4.5 V to 36 V
- Separate Input-Logic Supply
- Internal ESD Protection
- Thermal Shutdown
- High-Noise-Immunity Inputs
- Functionally Similar to SGS L293 and SGS L293D
- Output Current 1 A Per Channel (600 mA for L293D)
- Peak Output Current 2 A Per Channel (1.2 A for L293D)
- Output Clamp Diodes for Inductive Transient Suppression (L293D)

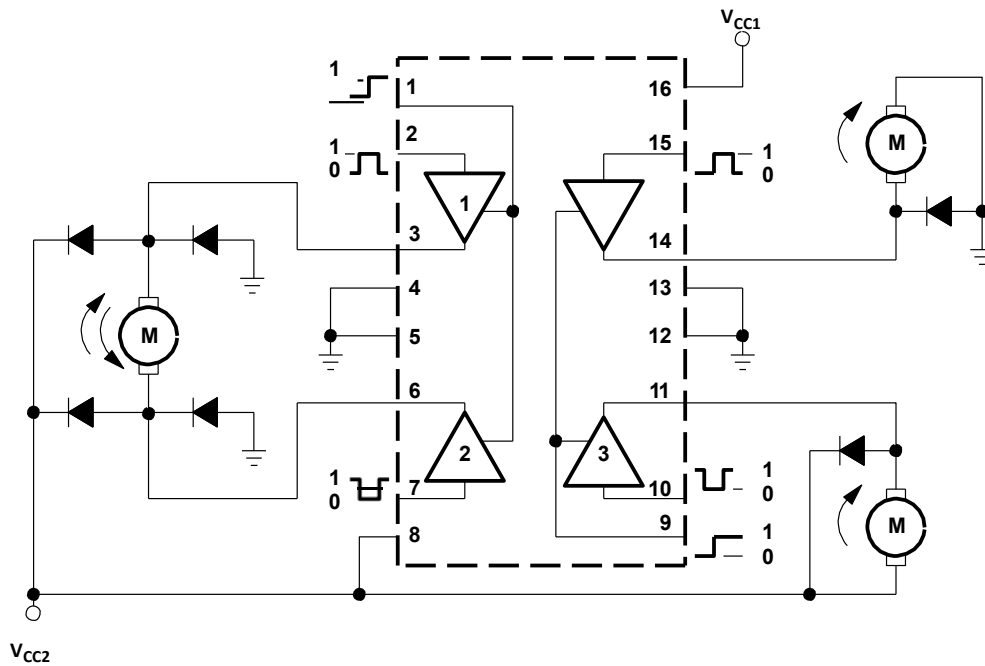


## Description/ordering information

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.

All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

## Block diagram



I got fed up with indecipherable pinout diagrams within datasheets, so have designed my own that I think gives more pertinent information.

There are 3 wires connected to the Arduino, 2 wires connected to the motor, and 1 wire connected to a battery.

**Note: Pin 16 must be supplied with current, the L293D can work normally.**

L293D			
M1 PWM	1	16	Battery +ve
M1 direction 0/1	2	15	M2 direction 0/1
M1 +ve	3	14	M2 +ve
GND	4	13	GND
GND	5	12	GND
M1 -ve	6	11	M2 -ve
M1 direction 1/0	7	10	M2 direction 1/0
Battery +ve	8	9	M2 PWM
Motor 1		Motor 2	

To use this pinout:

The left hand side deals with the first motor, the right hand side deals with a second motor.

Yes, you can run it with only one motor connected.

### Arduino Connections

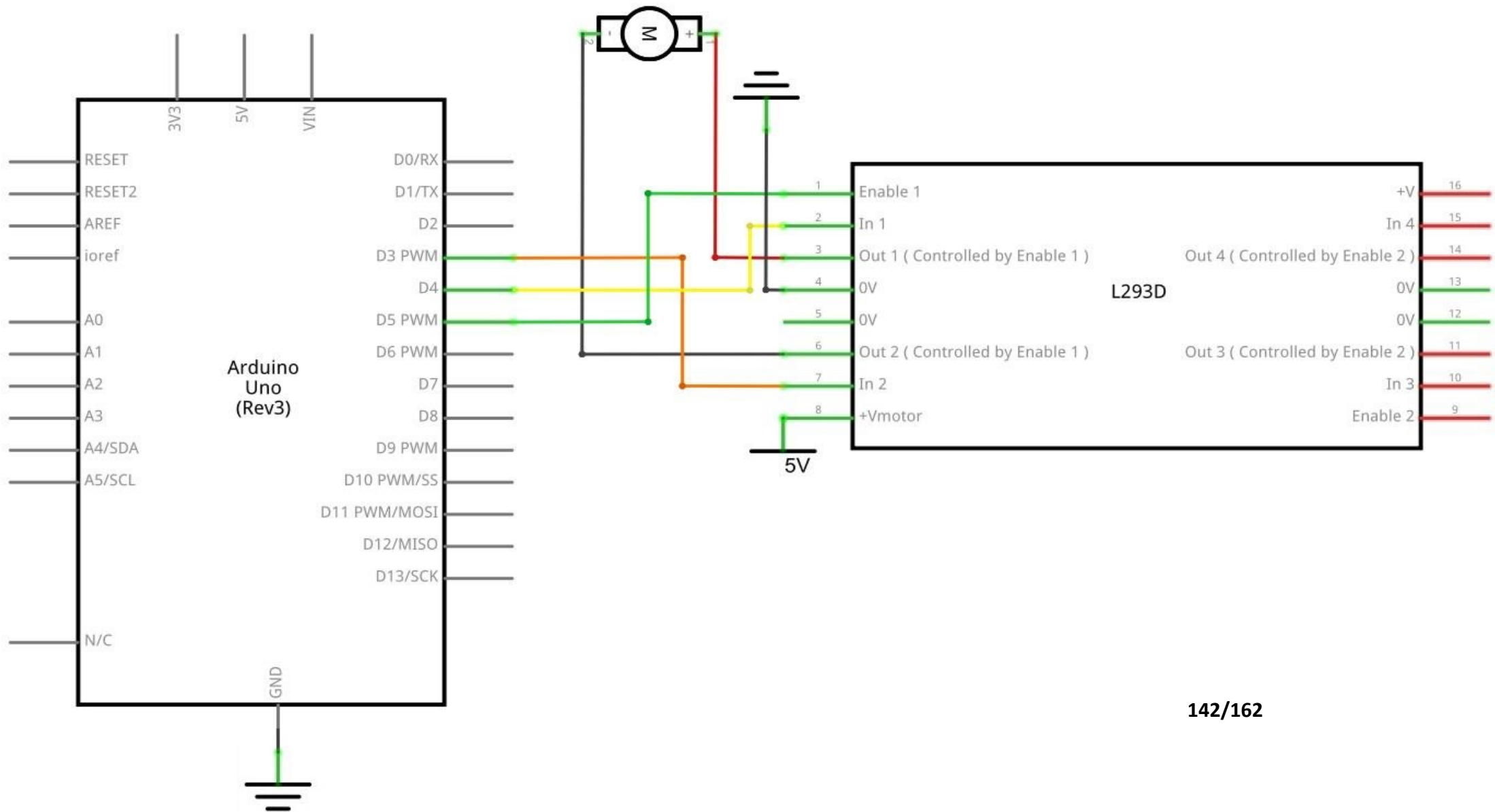
M1 PWM - connect this to a PWM pin on the Arduino. They're labelled on the Uno, pin 5 is an example. Output any integer between 0 and 255, where 0 will be off, 128 is half speed and 255 is

max speed.

M1 direction 0/1 and M1 direction 1/0 - Connect these two to two digital Arduino pins. Output one pin as HIGH and the other pin as LOW, and the motor will spin in one direction.

Reverse the outputs to LOW and HIGH, and the motor will spin in the other direction.

# Connection Schematic

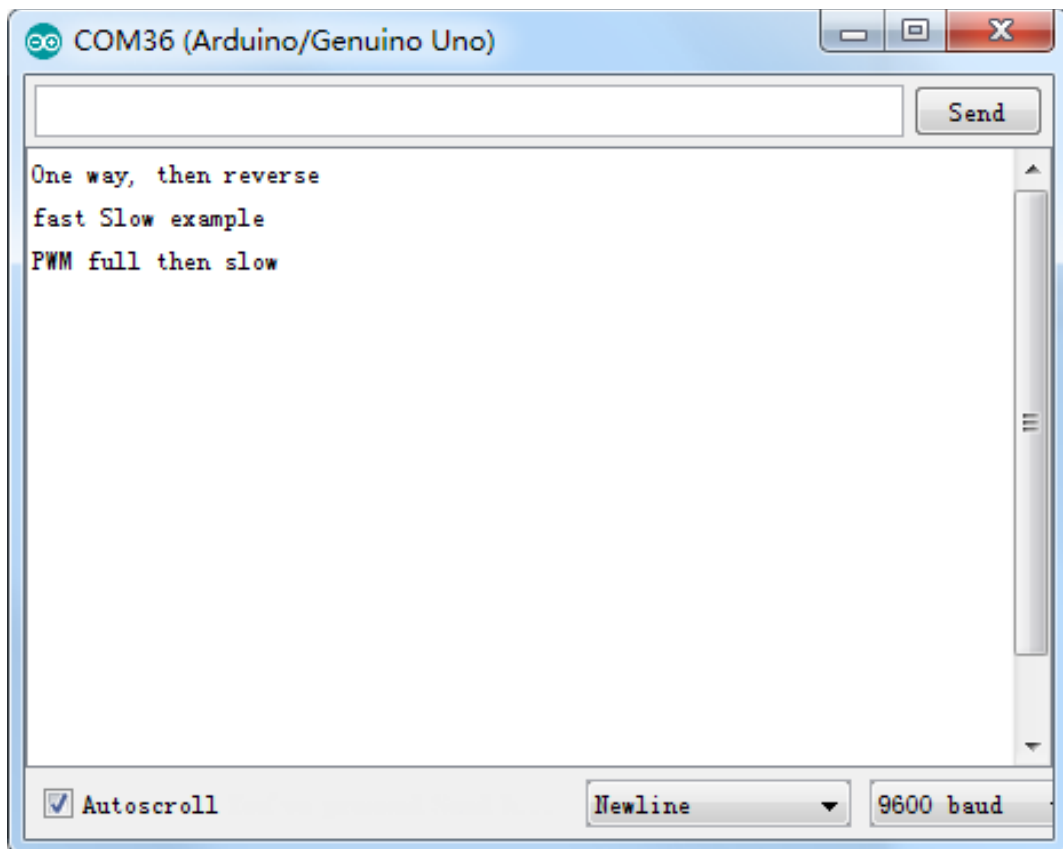






The code below does not use a separate power supply (ie a battery), it uses instead the 5v power from the Arduino. Note that this would be risky without the L293D controlling it.

You should never connect a motor directly to the Arduino, because when you switch a motor off you get an electrical feedback. With a small motor, this will damage your Arduino, and with a large motor, you can watch an interesting flame and sparks effect.



## Code

After wiring, please open the program in the code folder- Lesson 21 DC Motors and click **UPLOAD** to upload the program. See Lesson 2 for details about program uploading if there are any errors.

After program loading, turn on all the power switches. The motor will slightly rotate clockwise and anticlockwise for 5 times. Then, it will continue to dramatically rotate clockwise. After a short pause, it will dramatically rotate anticlockwise. Then the controller board will send PWM signal to drive the motor, the motor will slowly reduce its maximum RPM to the minimum and increase to the maximum again. Finally, it comes to a stop for 10s until the next cycle begins.

Example picture

