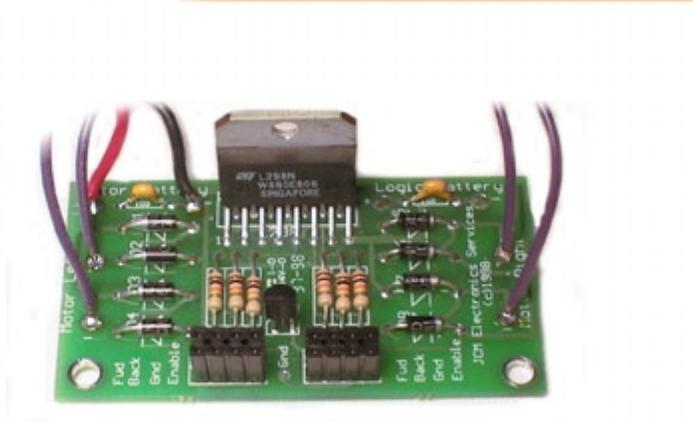




## L298 Motor Controller Kit



Controls 2 DC Motors up to 2 Amps each  
Forward, Reverse, Stop  
Runs on 6 to 35 Volts DC  
Fully Isolates Motor Electricals from Microcontroller  
Easy to Assemble



**Great for Robotics !**

Bi-Directional Motor Controller Interface

The L298 Motor Driver Kit allows the user to safely interface two DC motors to a host microcontroller using only 4 control lines. The motor driver isolates the host and controls continuous currents of up to 2 Amps per motor (4 Amps total). Short peaks (spikes) up to 3 Amps per motor can be tolerated without damage.

While ideally suited for use with a microcontroller, the kit may also be used with just about any form of 0-5 Volt signal (i.e. manual switches, TTL logic gates, relays etc).

### **Assembling the Board**

Assembly of the kit is straight forward; the silkscreen (white printing on the circuit board) shows where each component belongs and it's orientation. Make sure you install each diode so that the white ring on the diode is aligned with the white bar on the diode symbol on the silkscreen. The diodes are sometimes a tight fit in their holes and you might find a pair of small pliers useful in installing them.

This kit now comes with a 78L05 +5 Volt voltage regulator. The regulator takes power from the `Motor Battery` terminals and steps it down to +5 Volts for the logic circuits of the L298N chip (this assumes that your Motor Battery voltage is at least 6 Volts). If you are using a Motor Battery that is less than 6 Volts, the 78L05 will not be able to supply the necessary +5 volts to the L298. In this case, you will need to supply this voltage to the `Logic Battery` terminals yourself (if you do this, do not install the 78L05 and remove it if it is already installed). If you have doubts, measure the voltage across the `Logic Battery` terminals while both motors are running -there should be a minimum of +4.5 Volts. If there is less, the L298N may behave erratically.

The 0.01uF tantalum capacitors (marked "103") are used to suppress transients (spikes).

The kit includes 2 black terminal blocks. These terminal blocks provide an easy and convenient way to connect to the L298 kit; simply 'poke' a solid wire into the terminal holes to make a connection. If you want a more permanent connection, you can choose not to install the terminal blocks and solder your control lines directly to the board.

### **A Bit About Motor Current**

Motors are inductive devices; they draw much more current at startup than when they are running at a steady speed. Before connecting any

motor to the L298 you should know a few things about the motor:

- What voltage it is designed to work at
- How much current it draws when running (unloaded)
- How much current it draws at stall.

The “stall current” is the current the motor draws when you stop (stall) the output shaft (if you can). Stalling a motor is very hard on the motor and can burn open the motor windings and ruin the motor. If you want to test for stall current, grab the output shaft with your hand while measuring the current drawn. As the motor approaches stall, the current will climb.

The L298N can safely handle 2 Amps of continuous current for each motor. Short surges up to 3 Amps as the motor starts can be tolerated. A heatsink would be a good idea in situations that see the current surge above 2 Amps.

### **Connecting the Motors**

A DC motor has 2 terminals on it. If you take the positive and negative leads from a power source (battery, power supply etc.) and connect them to the terminals of the motor, the motor will spin in one direction. If you swap the connections, the motor will spin in the opposite direction.

You will want to wire your motors to the L298 board in such a way that the motor spins in the direction you call ‘forward’ when the `Fwd` line is activated and ‘reverse’ when the `Back` line activated.

When connecting the motors to the circuit board, use as thick a wire as is practical. The thicker the wire, the less the voltage drop and the more power is delivered to the motor. We recommend a minimum of 18 gauge stranded wire. Solid wire is fine, but will break if flexed too often.

Solder the Positive and negative motor leads for the ‘left’ motor to `Motor Left +` and `-` solder pads. Repeat for the ‘right’ motor.

Connect the `+` and `-` leads from your motor battery to the `Motor Battery +` and `-` solder pads -again, use as thick a wire as it practical.

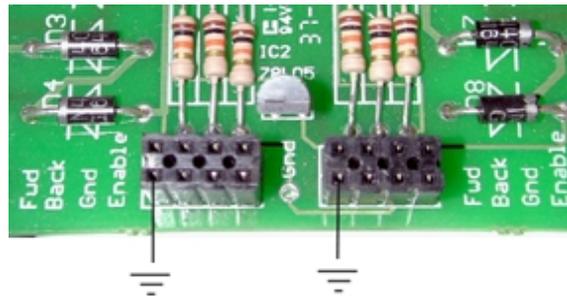
**A Note on ‘Motor Battery’ Voltages:** There is a 1.4V drop associated with the L298. This means that if your motor runs on 12 VDC, you should use a 13.4 VDC supply in order to get full power to the motor.

## Operation

Control is accomplished by grounding the control pin(s) for the desired function/motor. This is usually done by putting a logic LOW (i.e. 0V or ground) on an output pin of your host microcontroller, which is in turn connected to the appropriate control connection (Fwd, Back, Enable).

### Fwd

To make a motor move forward, ground the 'Fwd' connection on the appropriate connector (left / right). To stop, un-ground the connection. The photo below shows how both motors would be made to go 'forward'.



### Back (Reverse)

To drive the motor in reverse, ground the appropriate Back connection. To stop, un-ground the connection.

### Gnd

Gnd is a ground connection. The L298 Controller board and your control circuit must share the same ground.

### Enable

The Enable connection is an active LOW connection that is pulled HIGH for you on the circuit board. Ground this connection to disable a motor. Note: While disabled, commands from the host microcontroller (grounding/un-grounding the control connections) will have no effect on that motor. Disabling a motor shuts-down the L298's internal circuits, putting it into a low current consumption mode (for that channel). When both channels are disabled, the motor controller will consume approx. 10 mA.

## Pulse-Width Modulation (PWM)

Pulse-Width Modulation is a method of controlling the speed of a motor by turning the power on and off at varying speeds. If you have a 12 Volt motor and turn it on 50% of the time and turn it off 50% of the time (switching it at several KHz) then the effective voltage you are applying to the motor is 6 Volts. As the voltage to the motor varies, so does its' speed.

It should be noted that the L298 Kit was not intended for high-speed PWM operation. The diodes in the kits are general purpose rectifier diodes intended for 60 Hz operation. If you want to experiment with PWM and you don't get the kind of results you want, try exchanging the diodes for 'fast recovery Schottky' models.

## Heat Sinks

The L298 has internal thermal protection circuitry that shuts down the chip if it becomes too hot (when you try to draw too much current). If you find this happening, you should add some kind of heat sink to the L298. A simple heat sink can be made from a piece of scrap aluminum by cutting as big a piece as you have room for and drilling a 1/8" hole into it (for a bolt to hold it to the L298). If available, a thin smear of thermal compound (white, greasy stuff, available at Radio Shack) on the back of the L298's metal tab (i.e. between it and the heat sink) will maximize heat dissipation. Of course, you should always make sure that air can circulate freely around the L298 and it's heatsink.

NOTE: If a motor behaves erratically i.e. turning on and off rapidly, it is likely the L298 senses that it is being overloaded. This usually means that you are drawing too much current. Either add a heat sink to the L298 and/or reduce the current being drawn.

**Caution:** The L298's heat sink (the metal tab) is at ground potential. Do not allow any ground-referenced voltage source to touch it or any heat sink connected to it, or you will cause a short.

## H-Bridge Theory

Figure 1 shows the basic schematic for a typical H-Bridge along with it's truth table. In order to make a motor turn, we need to apply a voltage to it. We do this by turning certain NPN transistors on. By looking at the truth table, we can see that in order to make a motor go forward

(NOTE: 'Forward and 'Reverse' are arbitrary directions for purposes of illustration. In your application, forward and reverse will be determined by how the motors are mounted with respect to each other and the polarity of the voltage) we must turn on Q1 and Q4. This puts the Motor Battery Positive on the left side of the motor (through Q1) and grounds the other side of the motor (through Q4).

To go in the opposite direction, we must turn off these transistors and turn on Q2 and Q3. Now, the Motor Battery Positive will be on the right side of the motor (through Q3) and ground is on the left (through Q2). You have now reversed the polarity of the motor's supply voltage and the motor will spin in the opposite direction.

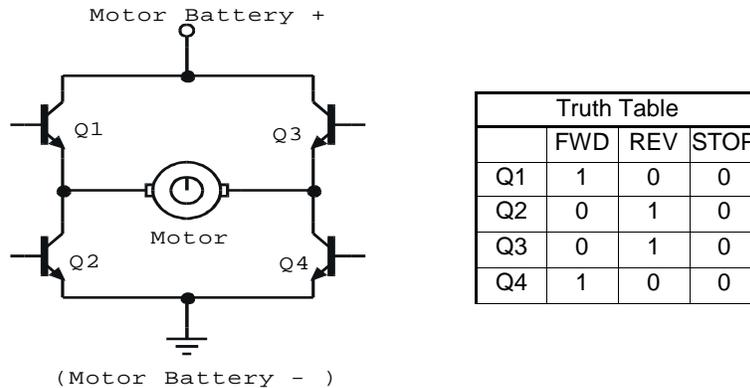


Figure 1.

You will notice that each time a motor is turned on, current passes through 2 NPN transistors. Each transistor has (approximately) 0.7 Volt drop across it, so the motor will see about 1.4 Volts LESS than the Motor Battery Voltage across it's terminals. This means that if you have a 12 Volt motor, and you want it to receive maximum power, you should use a 13.4 Volt battery.

Also notice that if transistors Q1 and Q2 (or Q3 and Q4) were turned on, that you would make a short circuit across the battery. For this reason, the L298N has internal logic that prevents this from happening.

### Further Information

A complete datasheet for the L298N can be found on the HVW Technologies web site, on the L298 product page

## Specifications

Max supply voltage: 46 V  
 Max current (per channel): 2 A (DC); Non-repetitive (t=100 uS): 3A;  
 Repetitive (80% on, 20% off, t<sub>on</sub>=10 ms): 2.5 A  
 Total Power Dissipation: 25W

## Troubleshooting

Symptom	Probable Cause(s) / Solution(s)
Motor does not move when control line is grounded	-Ground of controller is not connected to ground of L298 board. Ensure a common ground. -Voltage at "Logic Battery" terminals is less then 4.5 Volts. Increase voltage. -"Motor Battery" is not connected or needs charging. Connect suitable battery.
Motor shuts on and off on its' own	-Too much current is being drawn and the L298 is going in and out of thermal shutdown. Reduce current to 2A per motor and/or add a heatsink. -Ground of controller is not connected to ground of L298 board. Ensure a common ground.

L298 Motor Controller Kit Parts List	
(Qty)	Description (Part #) [PCB Silkscreen description]
(1)	L298N IC (L298N) [IC1]
(2)	0.01 µF Capacitors (103) [103]
(8)	1N4001 Diode (1N4001) [D1 - D8]
(6)	10K Resistors (Brown-Black-Orange) [10k]
(1)	78L05 +5 Volt Voltage Regulator (78L05ACP) [78L05]
(2)	2x4 Row Terminal Blocks
(1)	Printed Circuit Board

## Technical Support

Technical support is available if you are having problems. If you need help, please provide as much detailed information as possible.

E-mail: [support@HVWTech.com](mailto:support@HVWTech.com)

Phone: (403) 730.8603 (Monday - Friday 9am – 5pm Mountain time)

## **Motor Control Made Easy**

Completely Isolates Motors From Control Circuit

**This Package Contains an L298 H-Bridge Motor Controller Kit**  
(PCB, all parts, and detailed instructions)

Build Time:

Beginner:20-35 min. Intermediate:15-20 min. Expert:10-15 min.

## **Other Products from HVW Technologies**

**Stamp Stack II:** The Ultimate BASIC Stamp II prototyping tool. A complete BASIC Stamp II on a board that mounts onto a solderless breadboard. Includes a serial connector, reset switch and a "bullet-proof" power supply. Easy to build, simple to use.

**Also:** Microcontrollers ⇄ IR Sensors ⇄ Compilers ⇄ PIC Programmers and Proto Boards ⇄ Schematic/PCB Software ⇄ Robotics Kits/Parts....

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HVW Technologies Inc.  
3907 - 3A St. N.E. Unit 218  
Calgary, Alberta T2E 6S7  
CANADA

☎ 403.730.8603

☎ 403.730.8903

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