

O-PWM DC MOTOR

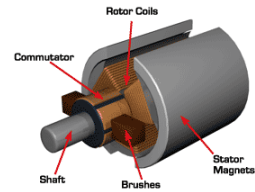
Required knowledge DC motor principle, Transistor, H-bridge

DC motor – How DC motors work

Transistor

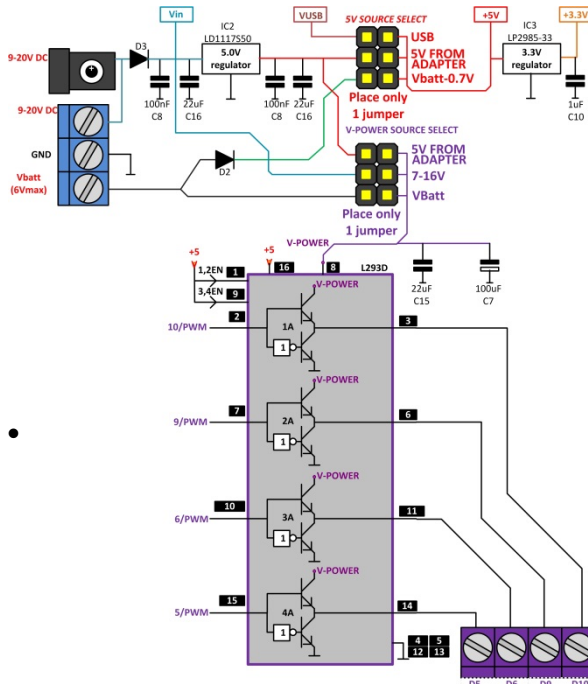
H-brug – H-bridge – PWM – Pulse Width modulation

DC motors can convert electrical power into a mechanical turning movement. They are available with or without a gearbox. DC motors will draw too much current for our 20mA output pins. That is why we need to use the 4 power output pins that are available on the Brainbox Arduino. These 4 pins can deliver 600mA per pin and this is sufficient for most of the small DC motors we like to use. O-Power covers a few solutions if the current rises above 600mA. Use the PWM mode to regulate the power to the DC motor.



DC motor	DC motor from CD-ROM from PC.... (Farnell, DX.com, Conrad, Opittec)
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1. Brainbox L293D H-Bridge:



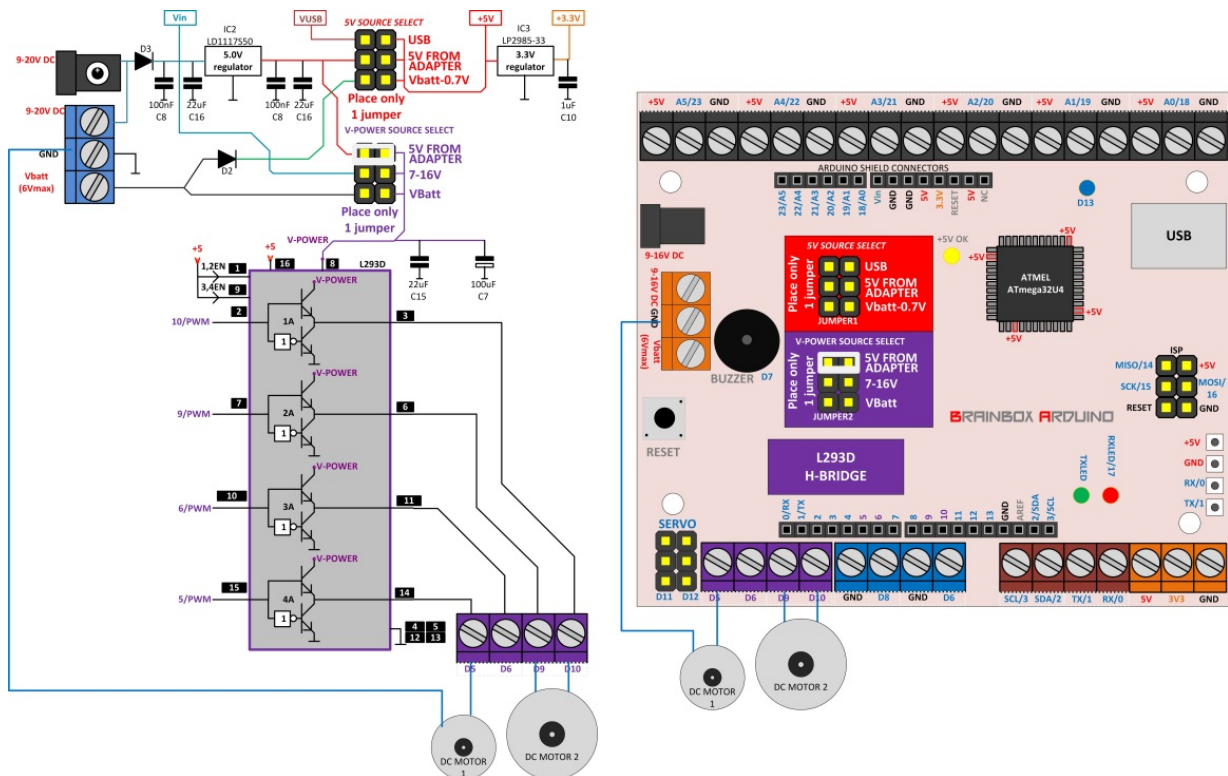
- The L293D IC can be used as a double H-bridge or as 4 separate high current output pins.
- With this IC the power of four 20mA output pins is boosted up to 600mA/pin.
- These 4 boosted output pins (D5, D6, D9, D10) are available at a 4-pin screw connector.
- The working voltage of the L293D can be selected by placing the jumper at 'V-POWER source select'. In Theory the L293 can operate from 4.5 to 36Volt.



Jmpr pos	Voltage L293D
5V from adapter	The 4 outputs now switch between 0V and 5V. The 5V is delivered by the adapter – not by USB. The maximum current that the 5.0V regulator can have is 1A, but it will go into temperature protection mode if it heats up over 160°C. It is recommended to limit the current to 500mA in this mode.
7-16V	The power is now taken from the circuit between the diode and the 5.0V voltage regulator. The outputs of the L293D will now switch between 0V and the voltage that the adapter delivers (minus the 0.7V over the protection diode). Feel free to draw up to 600mA/pin in this mode if your adapter can handle this.

VBatt	This mode is developed to power the whole Brainbox from 4xAA battery or one 6V lead battery. The 4 power output pins will now switch between 0V and 6V. The maximum current is 4x600mA. You could use this mode for robotics and cars.
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2. First you need to determine what the working voltage of your DC motor is. If you are not sure, start at 5.0V. Put the jumper at 'V-POWER source select' in the correct position. Connect your DC motor to a separate power supply, measure and make sure that the current in your application does not exceed 600mA. If it does exceed 600mA, no problem, but then you need to use a Mosfet or a Relais and follow these instructions: **"O-POWER – MOSFET"**
3. Notice that the DC motor can be connected in different ways. Motor 1 uses only one of the 4 power outputs but in this case it can only turn in 1 direction. Motor 2 is connected between 2 power outputs but this makes it possible to make the motor drive forwards and backwards. *The L293D has internal back-emf diodes on all 4 outputs.*



CODE EXAMPLE: 'O-600'

4. ON-OFF mode >> Follow programming instructions: 'O-600'

- D5 High : Motor 1 turns at full speed
- D5 Low : Motor 1 does not turn

- D9 High - D10 Low : motor 2 turns at full speed forward
- D9 Low - D10 High : motor 2 turns at full speed reverse
- D9 Low - D10 Low : motor 2 does not turn

TIP: Be aware that sudden changes in direction may cause large inductive current flows in the L293D. It is good practice to first stop the motor and wait until it is fully stopped before you reverse the direction.

CODE EXAMPLE: 'O-PWM'

5. Speed control with PWM >> Follow programming instructions: O-PWM

- These 4 power outputs are also capable of generating PWM signals. With PWM you can control the power and so also the RPM of the DC motor between 0 and 100%.

CODE EXAMPLE: 'O-POWER'

6. For higher power DC motors – with currents exceeding 600mA - there are other solutions with Mosfets and Relais. To learn more about this – refer to these lessons: O-POWER