

6-Wire Unipolar Stepper Motor Control Using The Big Easy Driver

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Abstract

This application note covers the minimal setup needed to control a 6-wire stepper motor with the Big Easy Driver (BED). This will cover the needed board and power connections as well as additional components necessary for the proper operation of the stepper motors. Additionally, this application note describes the optional use of pull-down resistors to modify the stepping behavior of an attached motor, and the different functionalities that the BED can perform.

What is the Big Easy Driver (BED)?

The Big Easy Driver is an open source stepper motor driver board that is based upon the Allegro A4988 driver chip. More about the A4988 can be found here <http://www.allegromicro.com/Products/Motor-Driver-And-Interface-ICs/Bipolar-Stepper-Motor-Drivers/A4988.aspx>. This board is designed to be able to drive up to 2A per phase of a bi-polar stepper motor, at 35V. This design is robust enough to handle most medium-sized stepper motors. A reference board can be seen below in Figure 1.



Figure 1 The Big Easy Driver board.

Setting up the BED to drive a 6-wire stepper motor

The BED controls stepper motors by cycling power between the four half-coils in sequence to rotate the magnet in the motor. This connection is made slightly more complicated due to the need for a 6-wire unipolar stepper motor to have its center tap wires connected to the positive voltage source. **Caution:** Due to the low resistance windings used in stepper motors, care must be taken to make sure that the current delivered to the board does not exceed 2A. The basic wiring diagram is shown below in Figure 2.

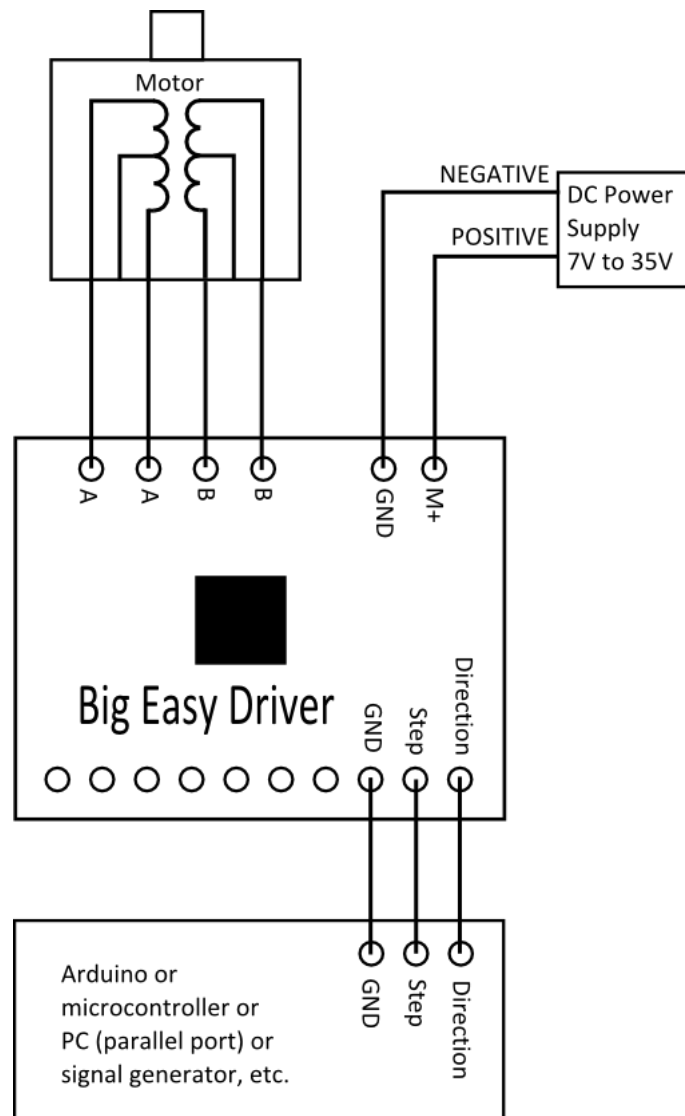


Figure 2 Diagram for Minimal Wiring Configuration

The Coils of the stepper motor are labeled A and B respectively. These connections are made as shown to the board. These connections are what are used to step the magnet inside of the stepper motor. The positive and negative power connections to the board can

be seen at in the upper right hand corner of it. This takes a 7V to 35V power supply (ideally between 8V and 30V) at up to 2A. At the bottom we see connections to a microcontroller or signal generator. These connections are what controls the motions of the motor. For each rising-edge pulse received by the step pin the controller cycles the A and B connections to make a step of the motor. This step must be greater than 3Vpp and must have a frequency that is compatible with the stepper motor attached to the board.

Optional board connections

Though the 7-wire configuration of the board is the minimum configuration necessary to drive a 6-wire stepper motor, we can utilize additional pins on the BED to gain greater step accuracy or speed, change the direction of rotation, and power our Microcontrollers.

As seen in Figure 2, there is also a Direction pin on the bottom of the board. This direction pin is internally tied high, and results in a counter clock-wise rotation of the motor. If this pin is driven low, the direction of the steps immediately reverses and it begins to turn clockwise.

Figure 3 shows the other pins that will be explored in these application notes.

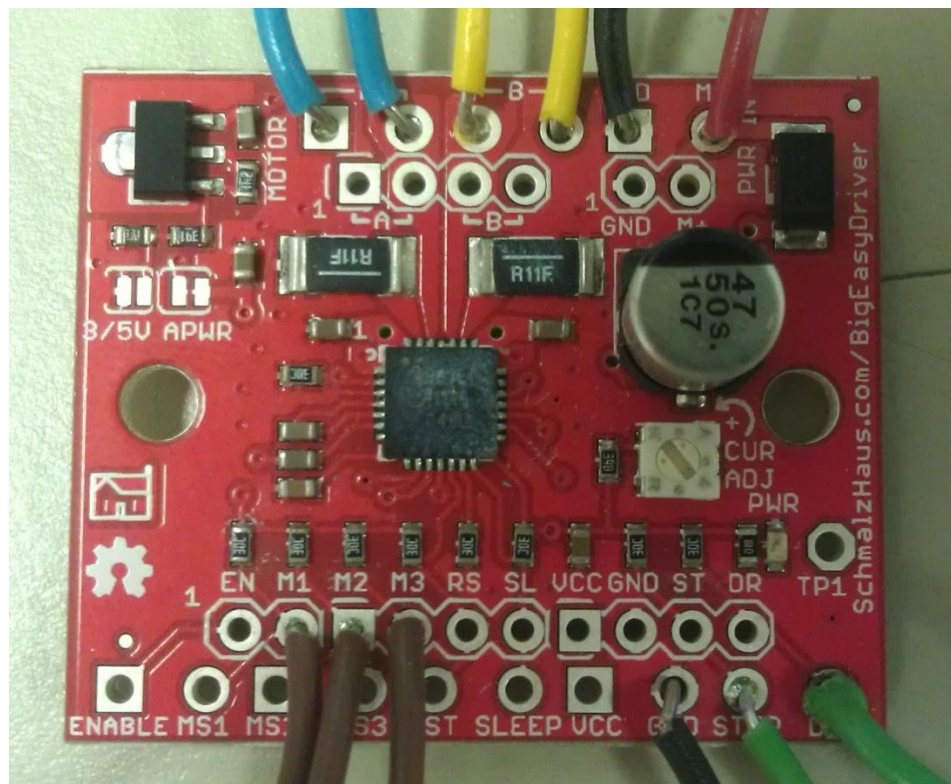


Figure 3 Pins on the BED

Pins M1, M2, and M3 are all used to control the size of the steps that the motors will take. These pins are all internally tied to VDD so must be driven low to modify the stepping behavior. Figure 4 shows the effects of the different configurations of these pins.

MS1	MS2	MS3	Microstep Resolution	Excitation Mode
L	L	L	Full Step	2 Phase
H	L	L	Half Step	1-2 Phase
L	H	L	Quarter Step	W 1-2 Phase
H	H	L	Eighth Step	2W 1-2 Phase
H	H	H	Sixteenth Step	4W 1-2 Phase

Figure 4 Microstep Resolution Table

Figure 3 also shows the VCC pin, which can be used to output a 3.3V or 5V signal designed to power the microcontroller providing the step inputs to the board.

Additionally visible are the Enable and Sleep pins. The sleep pin can put the driver in a low power state for cases where efficiency is key, and the enable pin can turn on or off the attached motors.

Since the internal pull up resistors are in the range of 100kOhms, to drive any of these signals low, a pull down resistor of 20kOhms can be used with great success.

Fully connected example

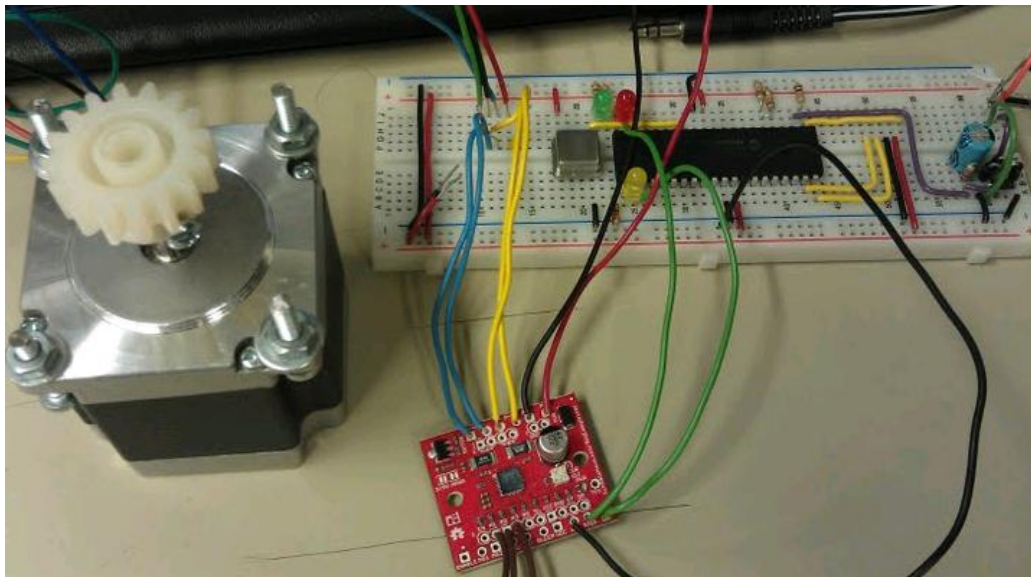


Figure 5 Complete control circuit for an externally powered microcontroller

In this example, the center-tap power lines for the motor are connected to the power supply. The other coil-leads are connected to the breadboard and then again to the BED.

The power and ground wires to the BED are connected to a power supply as well. The BED is not powering the microcontroller in this figure, but that would certainly be possible (by connecting the vcc pin to the positive power rail on the breadboard). Also disconnected are the MS1, MS2, and MS3 pins, the enable and the sleep. The step and direction inputs are connected to two of the outputs of the PIC microcontroller, which is controlling the motor's motion.

References

<http://dlnmh9ip6v2uc.cloudfront.net/datasheets/Robotics/4983.pdf>

<http://www.piclist.com/techref/io/stepper/wires.htm>

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