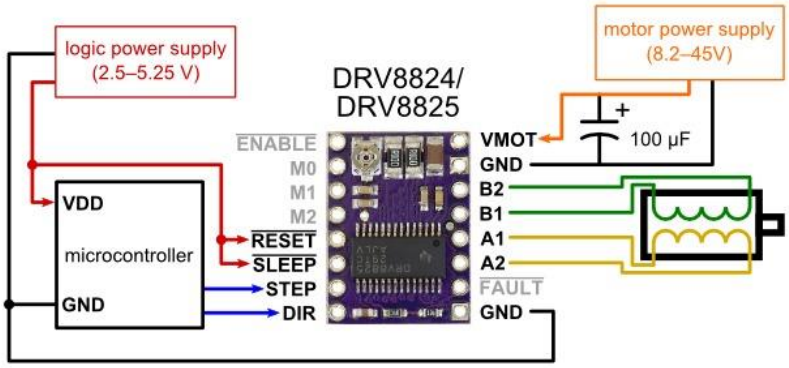
Stepper Motor Driver DRV8825

Using the Driver DRV8824



Minimal wiring diagram for connecting a microcontroller to a DRV8824/DRV8825 stepper motor driver carrier (full-step mode).

Power connections

The driver requires a motor supply voltage of 8.2 – 45 V to be connected across VMOT and GND. This supply should have appropriate decoupling capacitors close to the board, and it should be capable of delivering the expected stepper motor current.

Warning: This carrier board uses low-ESR ceramic capacitors, which makes it susceptible to destructive LC voltage spikes, especially when using power leads longer than a few inches. Under the right conditions, these spikes can exceed the 45 V maximum voltage rating for the DRV8825 and permanently damage the board, even when the motor supply voltage is as low as 12 V. One way to protect the driver from such spikes is to put a large (at least 47 µF) electrolytic capacitor across motor power (VMOT) and ground somewhere close to the board.

Motor connections

Four, six, and eight-wire stepper motors can be driven by the DRV8825 if they are properly connected; a FAQ answer explains the proper wirings in detail.

Warning: Connecting or disconnecting a stepper motor while the driver is powered can destroy the driver. (More generally, rewiring anything while it is powered is asking for trouble.)

Step (and microstep) size

Stepper motors typically have a step size specification (e.g. 1.8° or 200 steps per revolution), which applies to full steps. A microstepping driver such as the DRV8825 allows higher resolutions by allowing intermediate step locations, which are achieved by energizing the coils with intermediate current levels. For instance, driving a motor in quarter-step mode will give the 200-step-per-revolution motor 800 microsteps per revolution by using four different current levels.

The resolution (step size) selector inputs (MODE0, MODE1, and MODE2) enable selection from the six-step resolutions according to the table below. All three selector inputs have internal 100kΩ pull-down resistors, so leaving these three microstep selection pins disconnected results in full-step mode. For the microstep modes to function correctly, the current limit must be set low enough (see below) so that current limiting gets engaged. Otherwise, the intermediate current levels will not be correctly maintained, and the motor will skip microsteps.

MODE0	MODE1	MODE2	Microstep Resolution
Low	Low	Low	Full step
High	Low	Low	Half step
Low	High	Low	1/4 step
High	High	Low	1/8 step
Low	Low	High	1/16 step
High	Low	High	1/32 step
Low	High	High	1/32 step
High	High	High	1/32 step

Control inputs

Each pulse to the STEP input corresponds to one microstep of the stepper motor in the direction selected by the DIR pin. These inputs are both pulled low by default through internal 100kΩ pull-down resistors. If you just want rotation in a single direction, you can leave DIR disconnected.

The chip has three different inputs for controlling its power states: RESET, SLEEP, and ENBL. For details about these power states, see the datasheet. Please note that the driver pulls the SLEEP pin low through an internal 1MΩ pull-down resistor, and it pulls the RESET and ENBL pins low through internal 100kΩ pull-down resistors. These default RESET and SLEEP states are ones that prevent the driver from operating; both of these pins must be high to enable the driver (they can connect directly to a logic “high” voltage between 2.2 and 5.25 V, or they can dynamically control via connections to digital outputs of an MCU). The default state of the ENBL pin is to enable the driver, so this pin can be left disconnect.

The DRV8825 also features a FAULT output that drives low whenever the H-bridge FETs are disabling as the result of over-current protection or thermal shutdown. The carrier board connects this pin to the SLEEP pin through a 10k resistor that acts as a FAULT pull-up whenever SLEEP is externally held high, so no external pull-up is necessary on the FAULT pin.

Note that the carrier includes a 1.5k protection resistor in series with the FAULT pin that makes it is safe to connect this pin directly to a logic voltage supply, as might happen if you use this board in a system designed for the pin-compatible A4988 carrier. In such a system, the 10k resistor between SLEEP and FAULT would then act as a pull-up for SLEEP, making the DRV8825 carrier more of a direct replacement for the A4988 in such systems (the A4988 has an internal pull-up on its SLEEP pin). To keep faults from pulling down the SLEEP pin, any external pull-up resistor you add to the SLEEP pin input should not exceed 4.7k.

Current limiting

To achieve high step rates, the motor supply is typically much higher than would be permissible without active current limiting. For instance, a typical stepper motor might have a maximum current rating of 1 A with a 5Ω coil resistance, which would indicate a maximum motor supply of 5 V. Using such a motor with 12 V would allow higher step rates, but the current must actively be limite to under 1 A to prevent damage to the motor.

The DRV8825 supports such active current limiting, and the trimmer potentiometer on the board can use to set the current limit. You will typically want to set the driver’s current limit to be at or below the current rating of your stepper motor. One way to set the current limit is to put the driver into the full-step mode and to measure the current running through a single motor coil without clocking the STEP input. The measure current will be 0.7 times the current limit (since both coils are always on and limit to approximately 70% of the current limit setting in full-step mode).

Another way to set the current limit is to measure the voltage on the “ref” pin and to calculate the resulting current limit (the current sense resistors are **0.100Ω**). The ref pin voltage is accessible on a via that is the circle on the bottom silkscreen of the circuit board. The current limit relates to the reference voltage as follows:

Current Limit = VREF × 2

So, for example, if you have a stepper motor rated for 1 A, you can set the current limit to 1 A by setting the reference voltage to 0.5 V.

Note: The coil current can be very different from the power supply current, so you should not use the current measure at the power supply to set the current limit. The appropriate place to put your current meter is in series with one of your stepper motor coils.