SideStep

Bi-polar Microstepping Chopper Driver

Model: SideStep

Stepper Motor Microstepping Driver Specs:

- Chopper Current Driver
- 0.5 - 2.5 Amp Current Limiting
- Dual H-Bridge Configuration
- Full, Half, Quarter, & Eighth Microstepping
- Buffered Step & Direction Lines
- 8V - 32V Supply

Description:

The SideStep is a complete microstepping motor driver and control system with a built-in translator. It is designed to operate bipolar stepper motors in full-, half-, quarter-, and eighth-step modes, with output drive capability of 32 V and up to 2.5 A. This driver utilizes the Allegro A3977 chip which includes a fixed off-time current regulator that has the ability to operate in slow-, fast-, or mixed-decay modes. This current-decay control scheme results in reduced audible motor noise, increased step accuracy, and reduced power dissipation. The SideStep is one of the smallest stepper driver boards in its class, making it ideal for incorporating into robots and other industrial control equipment.

Features:

- Hardware or software selectable step and direction signals
- Current limit adjustable by potentiometer
- Wide range of motor power (5-35 V)
- Power (for logic) indicator LED
- 2.5 A, 35 V Output Rating
- Automatic Current Decay Mode Detection/Selection Mixed-, Fast-, and Slo- Decay Modes
- 3.0-5.5 V Logic Supply Voltage Range
- Synchronous Rectification for Low Power Dissipation
- Internal UVLO and Thermal-Shutdown Circuitry
- Crossover Current Protection

Flexible Design:

The SideStep was designed with flexibility in mind with features including:

- Internal synchronous-rectification control circuitry is provided to improve power dissipation during PWM operation.
- Internal circuit protection includes thermal shutdown with hysteresis, under-voltage lockout (UVLO), and crossover-current protection. Special power-up sequencing is not required.
- The logic signals are brought out to a .1" pin header on one side, allowing for use of an IDC cable to connect your boards. Every other pin on the IDC header is connected to ground, which acts to shield the control signals from noise. Noise in a stepper control system can cause miss stepping, which can damage your equipment, cause injury, and ruin your work piece.
- A schmitt trigger IC buffers the high voltage driver from your sensitive parallel port, and filters noise.
- A large ground plane exists for heat dissipation however, the layout of the components of this driver board allows for the use of a standard 1" square BGA heatsink. The board's large ground plane makes a heat sink unnecessary in many applications; however, use of a heat sink is recommended, especially when driving motors at higher than 1.5 amps per phase.
- An under-voltage lockout circuit protects the A3977 from potential shoot-through currents when the motor supply voltage is applied before the logic supply voltage. All outputs are disabled until the logic supply voltage is above 2.7V; the control logic is then able to correctly control the state of the outputs. Thermal protection circuitry turns off all the power outputs if the junction temperature exceeds 165°C. As with most integrated thermal shutdown circuits, this is intended only to protect the A3977 from failure due to excessive junction temperature and will not necessarily protect the IC from output short circuits. Normal operation is resumed when the junction temperature has decreased by about 15°C.
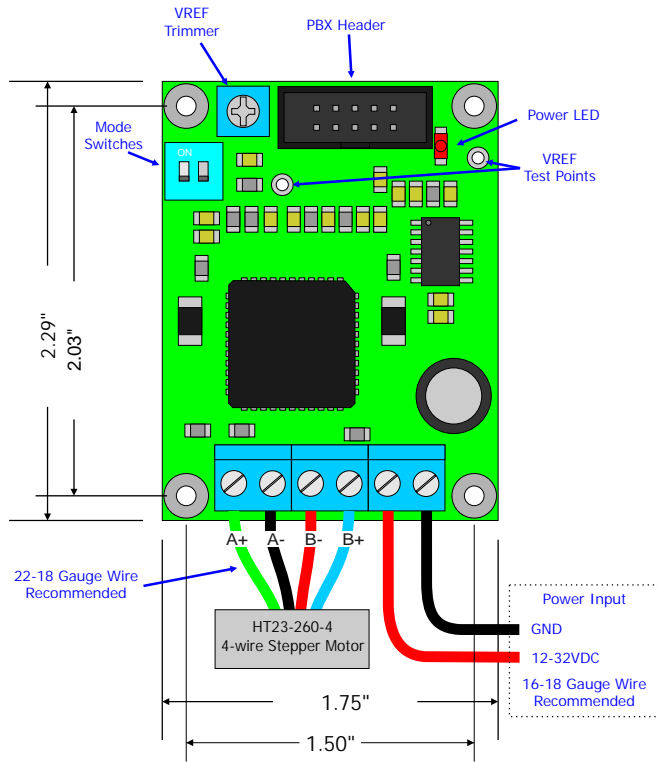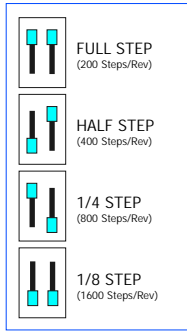
Bipolar Chopper Drivers:

Bipolar chopper drivers are by far the most widely used drivers for industrial applications. Although they are typically more expensive to design, they offer more performance and increased efficiency. Bipolar chopper drivers use an extra set of switching transistors to eliminate the need for two power sources. Additionally, these drivers use a four transistor bridge with recirculating diodes and a sense resistor that maintains a feedback voltage proportional to the motor current. Motor windings, using a bipolar chopper driver, are energized to the full supply level by turning on one set (top and bottom) of the switching transistors. The sense resistor monitors the linear rise in current until the required level is reached. At this point the top switch opens and the current in the motor coil is maintained via the bottom switch and the diode. Current "decay" (loss over time) occurs until a preset position is reached and the process starts over. This "chopping" effect of the supply is what maintains the correct current voltage to the motor at all times.

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VREF Trimmer

PBX Header

Power LED

VREF Test Points

Mode Switches

FULL STEP
(200 Steps/Rev)

HALF STEP
(400 Steps/Rev)

1/4 STEP
(800 Steps/Rev)

1/8 STEP
(1600 Steps/Rev)

2.29"
2.03"

A+ A- B- B+

22-18 Gauge Wire Recommended

HT23-260-4
4-wire Stepper Motor

Power Input
GND
12-32VDC
16-18 Gauge Wire Recommended

1.75"

1.50"

Vref = 1.6 * desired motor current.

2.5 A = Vref 4.0 V
2.0 A = Vref 3.2 V
1.5 A = Vref 2.4 V
1.0 A = Vref 1.6 V
0.5 A = Vref 0.8 V

WARNING: Do not exceed 4 V unless using Full-Step mode!

Figure 1: PBX Header Pin Diagram

GND GND GND GND GND

| 2 | 4 | 6 | 8 | 10 |

| 1 | 3 | 5 | 7 | 9 |

DIRECTION STEP GND +5VDC NC

Note About The Silkscreen on th PCB:

The silkscreen on the PCB uses a deprecated phase naming convention 1A, 1B, 2A, 2B. Please disregard and use the phase naming convention on this diagram. The phases will map to:

2B = A+
2A = A-
1A = B-
1B = B+

Setting Current Limit

Measure the DC voltage between the Ref Pin and GND, and adjust the trimmer as follows: Vref = 1.6 * desired motor current.

2.5 A = Vref 4.0 V
2.0 A = Vref 3.2 V
1.5 A = Vref 2.4 V
1.0 A = Vref 1.6 V
0.5 A = Vref 0.8 V

WARNING: Do not exceed 4.0 V unless full stepping!

1. Determine the step resolution you wish to use, and set the dip switches according to Figure 2.

2. If driving your motors at more than 1.5Amp, install a BGA heat sink over the driver chip. Contact us if you need heat sinks.

3. Apply power.

4. Connect a voltmeter between the VREF signal and GND and adjust the current trimmer to the desired voltage determined above.

WARNING: If the motor is connected during this adjustment, excessive heating may occur. Most motors can NOT experience temperatures above 100°C. At these temperatures internal melting and seizure may occur. Short-term current overdrive will, in general, not harm most motors.
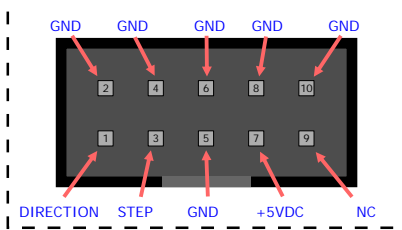
WARNING: Never remove a connection to the stepper motor with power applied. There is a HIGH probability the A3977 IC will be damaged. The A3977 is rated for 35V DC max. The power supply voltage should be limited to ~32V DC to allow for back EMF generated by the stepper.

Control Software Setup

The SideStep is negative logic. The STEP and DIRECTION lines should be inverted in your software. Please contact us if you need help configuring your software.

Minimum pulse width for the step pulse is 5 uS. Maximum step frequency is 40 kHz. Most steppers torque really drop above 1 kHz at full step, or 8 kHz if you're using the eighth-step mode.