

SURESTEP™
STP-DRV-4035
MICROSTEPPING DRIVE



In This Chapter...

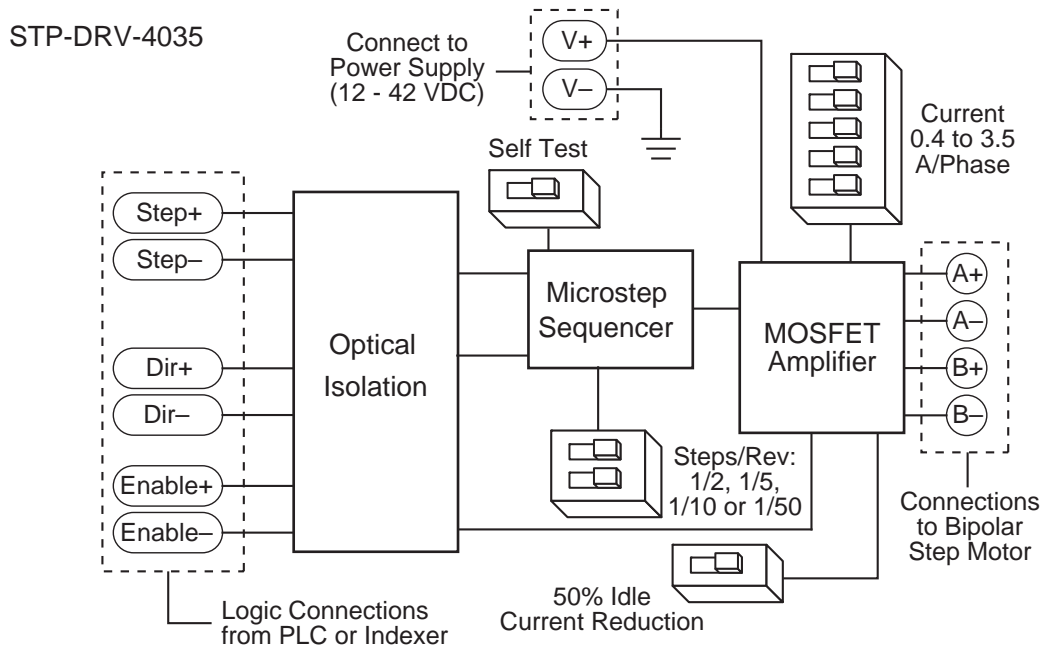
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Features

- Drives sizes 17 through 34 step motors
- Pulse width modulation, MOSFET 3 state switching amplifiers
- Phase current from 0.4 to 3.5 amps (switch selectable, 32 settings)
- Optically isolated step, direction and enable inputs
- Half, 1/5, 1/10, 1/50 step (switch selectable)
- Automatic 50% idle current reduction (can be switched off)



Block Diagram



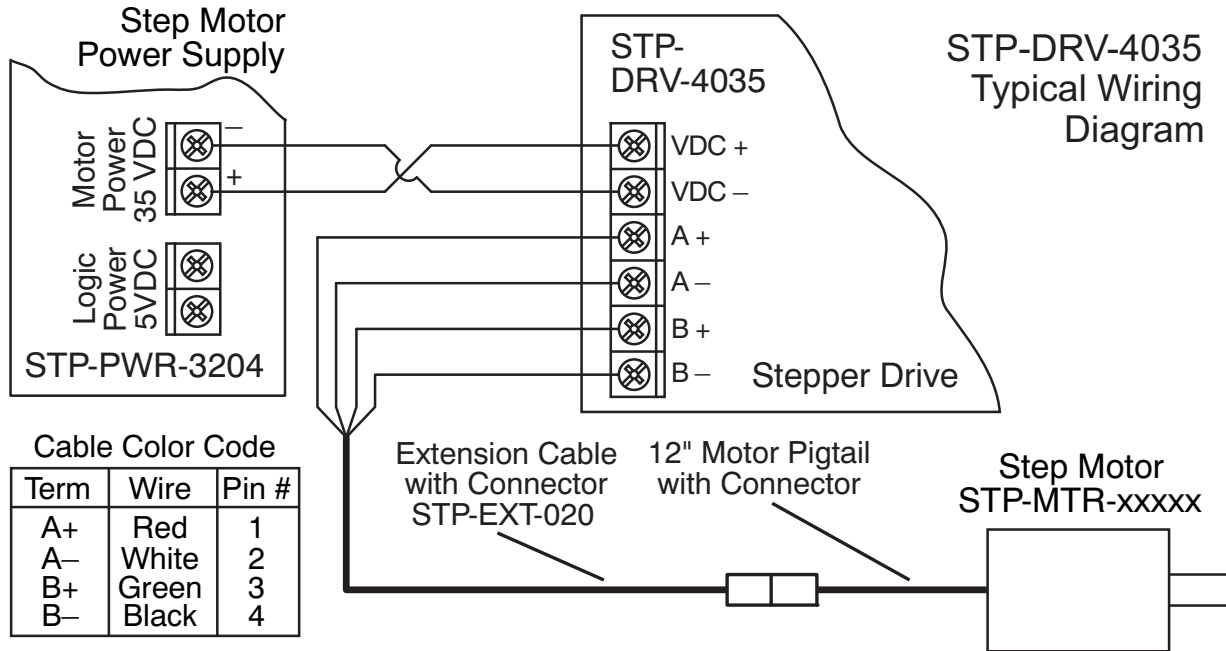
Specifications

SureStep™ Microstepping Drives Specifications		
Part Number	STP-DRV-4035	
Input Power (with red Power On LED)	12-42 VDC (including ripple voltage)	
Output Power	Output current selectable from 0.4 to 3.5 Amps/phase motor current (maximum output power is 140 W)	
Current Controller	Dual H-bridge Bipolar Chopper (3-state 20 kHz PWM with MOSFET switches)	
Input Signals	Input Signal Circuit	Opto-coupler input with 440 Ohm resistance (5 to 15 mA input current), Logic Low is input pulled to 0.8 VDC or less, Logic High is input 4 VDC or higher
	Pulse Signal	Motor steps on falling edge of pulse and minimum pulse width is 0.5 microseconds
	Direction Signal	Needs to change at least 2 microseconds before a step pulse is sent
	Enable Signal	Logic 1 will disable current to the motor (current is enabled with no hook-up or logic 0)
DIP Switch Selectable Functions	Self Test	Off or On (uses half-step to rotate 1/2 revolution in each direction at 100 steps/second)
	Microstepping	400 (200x2), 1,000 (200x5), 2,000 (200x10), or 10,000 (200x50) steps/rev
	Idle Current Reduction	0% or 50% reduction (idle current setting is active if motor is at rest for 1 second or more)
	Phase Current Setting	0.4 to 3.5 Amps/phase with 32 selectable levels
Drive Cooling Method	Natural convection (mount drive to metal surface if possible)	
Dimensions	3 x 4 x 1.5 inches [76.2 x 101.6 x 38.1 mm]	
Mounting	Use #4 screws to mount on wide side (4 screws) or narrow side (2 screws)	
Connectors	Screw terminal blocks with AWG 18 maximum wire size	
Weight	9.3 oz. [264g]	
Chassis Operating Temperature	0–55 °C [32–131 °F] recommended; 70 °C [158 °F] maximum (use fan cooling if necessary); 90% non-condensing maximum humidity	
Agency Approvals	CE (complies with EN55011A and EN50082-1 (1992))	



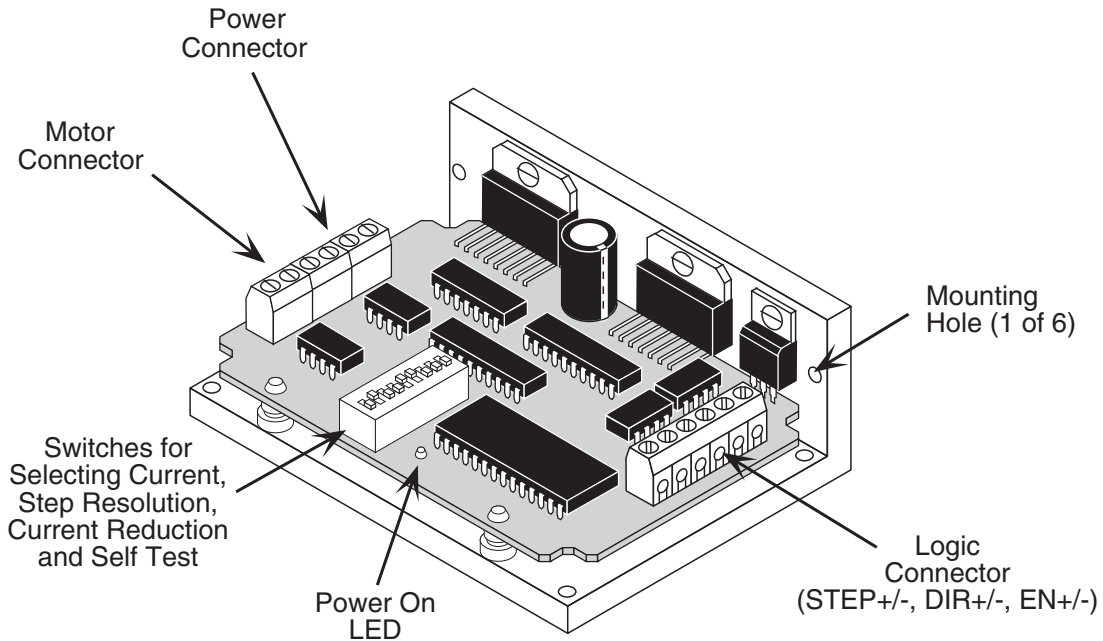
*Note: The STP-DRV-4035 Microstepping Drive works with 4, 6 and 8 lead bipolar step motors. All **AUTOMATIONDIRECT** SureStep™ motors are four lead bipolar step motors.*

Typical Wiring Diagram



Connection and Adjustment Locations

The sketch below shows where to find the important connection and adjustment points.



Connecting the Motor

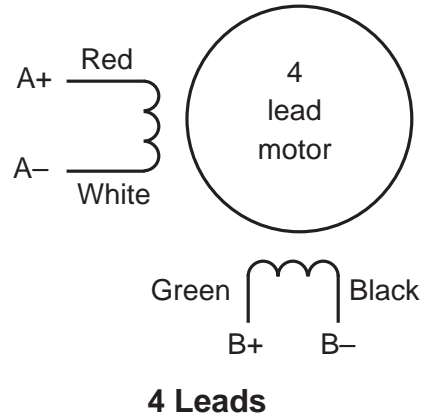


WARNING: When connecting a step motor to the SureStep™ STP-DRV-4035 microstepping drive, be sure that the motor power supply is switched off. When using a motor not supplied by AUTOMATIONDIRECT, secure any unused motor leads so that they can't short out to anything. Never disconnect the motor while the drive is powered up. Never connect motor leads to ground or to a power supply. (See the Typical Wiring Diagram shown on page 2-4 of this chapter for the step motor lead color code of AUTOMATIONDIRECT supplied motors.)

You must now decide how to connect your stepping motor to the SureStep™ STP-DRV-4035 microstepping drive.

Four lead motors

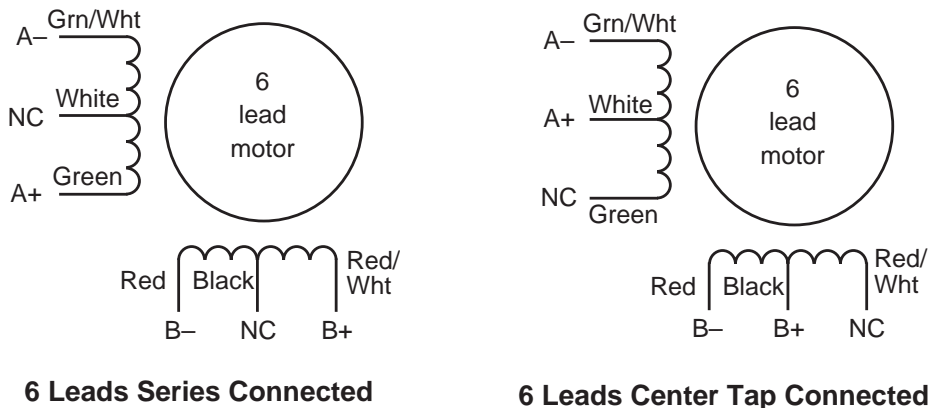
Four lead motors can only be connected one way. Please follow the wiring diagram shown to the right.



Note: All AUTOMATIONDIRECT SureStep™ motors are four lead bipolar step motors.

Six lead motors

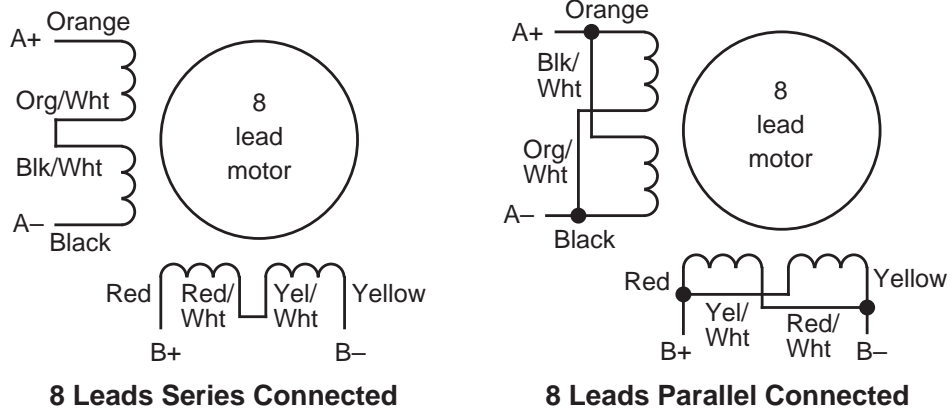
Six lead motors can be connected in series or center tap. In series mode, motors produce more torque at low speeds, but cannot run as fast as in the center tap configuration. In series operation, the motor should be operated at 30% less than rated current to prevent overheating. Wiring diagrams for both connection methods are shown below. **NC** means not connected to anything.



Note: Be aware that step motor wire lead colors vary from one manufacturer to another.

Eight lead motors

Eight lead motors can also be connected in two ways: series or parallel. Series operation gives you more torque at low speeds and less torque at high speeds. When using series connection, the motor should be operated at 30% less than the rated current to prevent over heating. Parallel operation allows a greater torque at high speed. When using parallel connection, the current can be increased by 30% above rated current. Care should be taken in either case to assure the motor is not being overheated. The wiring diagrams for eight lead motors are shown below.



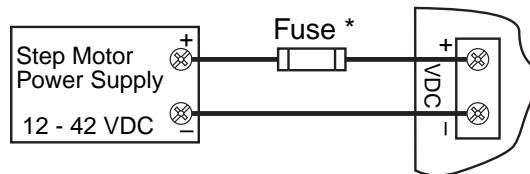
Note: Be aware that step motor wire lead colors vary from one manufacturer to another.

Connecting the Power Supply

The STP-PWR-3204 power supply from **AUTOMATIONDIRECT** is the best choice to power the step motor drive. If you need information about choosing a different power supply, please read the section titled "Choosing a Power Supply" in this manual.

If your power supply does not have a fuse on the output or some kind of short circuit current limiting feature you need to put a 4 amp fast acting fuse between the drive and power supply. Install the fuse on the + power supply lead.

Connect the motor power supply "+" terminal to the driver terminal labeled "+ VDC". Connect power supply "-" to the drive terminal labeled "VDC-". Use no smaller than 18 gauge wire. **Be careful not to reverse the wires.** Reverse connection will destroy your drive and void the warranty.



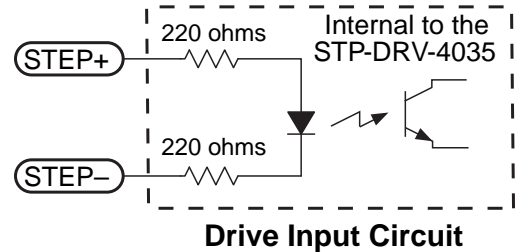
* External fuse not req'd when using an STP-PWR-3204 P/S; fuse is internal.



Do NOT use STP-PWR-48xx or -70xx power supplies with an STP-DRV-4035 drive, because those power supplies exceed the voltage limit of this drive.

Connecting the Logic

The *SureStep* drive contains optical isolation circuitry to prevent the electrical noise inherent in switching amplifiers from interfering with your circuits. Optical isolation is accomplished by powering the motor driver from a different supply source than your control circuits. There is no electrical connection between the two; signal communication is achieved by infrared light. When your circuit turns on or turns off, an infrared LED (built into the drive), signals a logic state to the phototransistors that are wired to the brains of the drive. A schematic diagram input circuit is shown to the right.

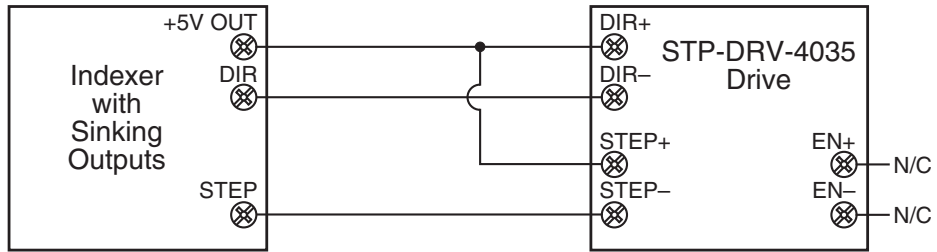


You will need to supply a source of step pulses to the drive at the STEP+ and STEP- terminals and a direction signal at the DIR+ and DIR- terminals, if bidirectional rotation is required. You will also need to determine if the **ENABLE** input terminals will be used in your application. Operation, voltage levels and wiring on the **ENABLE** terminals is the same as the **STEP** and **DIRECTION** terminals. The EN+ and EN- terminal can be left not connected if the enable function is not required.

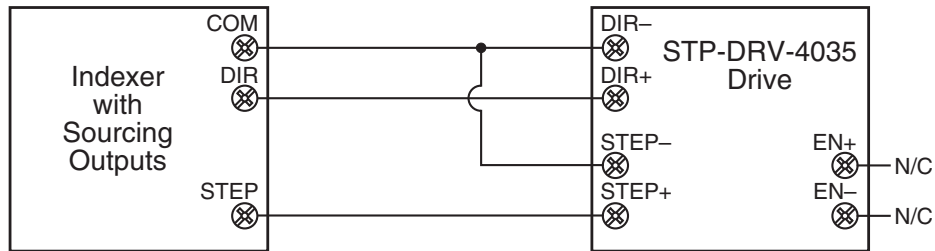
All logic inputs can be controlled by a DC output signal that is either sinking (NPN), sourcing (PNP), or differential.

On the next couple of pages are examples for connecting various forms of outputs from both indexers and PLCs.

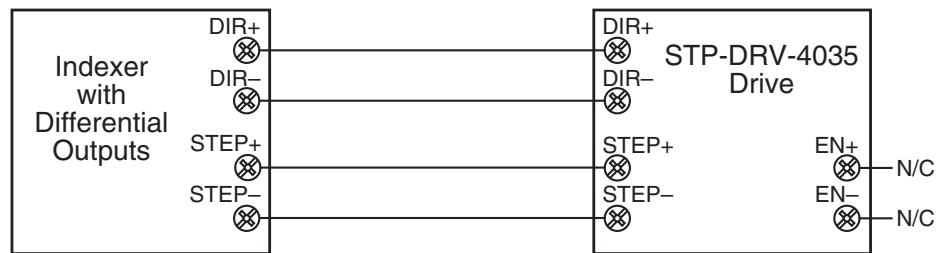
Connecting to an Indexer with Sinking Outputs



Connecting to an Indexer with Sourcing Outputs



Connecting to an Indexer with Differential Outputs



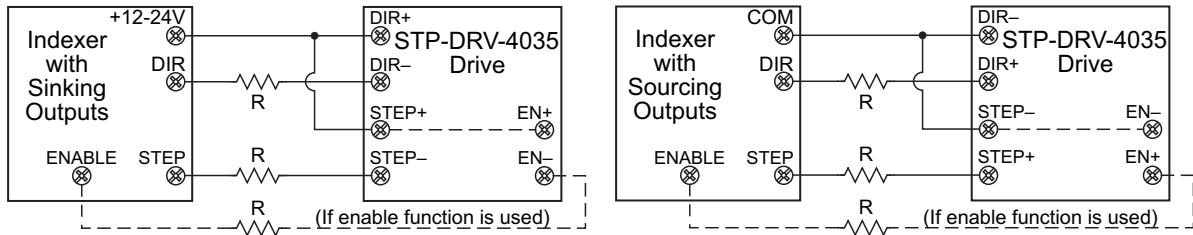
Note: Many high speed indexers have differential outputs.

Using Logic That is Not 5 volt TTL Level

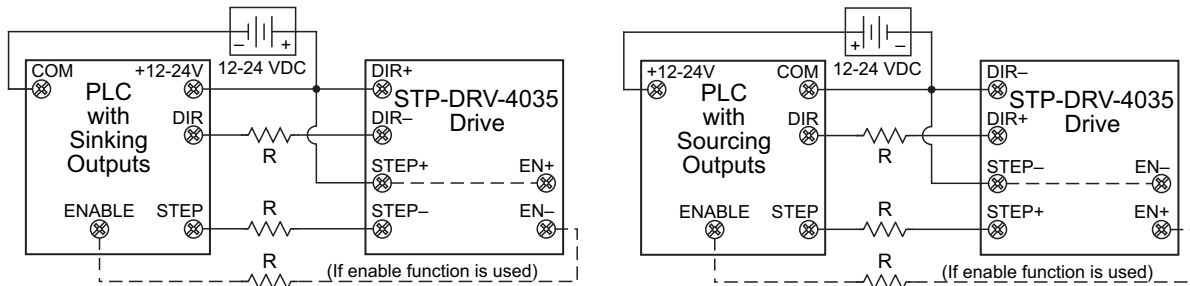
Some step and direction signals, especially those of PLCs, don't use 5 volt logic. You can connect signal levels as high as 24 volts to the *SureStep* drive if you add external dropping resistors to the STEP, DIR and EN inputs, as shown below.

- For 12 volt logic, add 820 ohm, 1/4 watt resistors
- For 24 volt logic, use 2200 ohm, 1/4 watt resistors

Connecting to an Indexer with Sink or Source 12-24 VDC Outputs



Connecting to a PLC with Sink or Source 12-24 VDC Outputs



Note: Most PLCs can use 24 VDC Logic.

The Enable Input

The **ENABLE** input allows the user to turn off the current to the motor by providing a positive voltage between EN+ and EN-. The logic circuitry continues to operate, so the drive "remembers" the step position even when the amplifiers are disabled. However, the motor may move slightly when the current is removed depending on the exact motor and load characteristics.



*Note: If you have no need to disable the amplifiers, you don't need to connect anything to the **ENABLE** input.*

**Step Table
(half stepping)**

Step	A+	A-	B+	B-
0	open	open	+	-
1	+	-	+	-
2	+	-	open	open
3	+	-	-	+
4	open	open	-	+
5	-	+	-	+
6	-	+	open	open
7	-	+	+	-
8	open	open	+	-

DIR=1
cw

DIR=0
ccw

Step 0 is the Power Up State

Setting Phase Current

Before you turn on the power supply the first time, you need to set the drive for the proper motor phase current. The rated current is usually printed on the motor label. The *SureStep* drive current is easy to set. If you wish, you can learn a simple formula for setting current and never need the manual again. Or you can skip to the table on the next page, find the current setting you want, and set the DIP switches according to the picture.

Current Setting Formula

Locate the bank of tiny switches near the motor connector. Five of the switches, DIP switch positions 5-9, have a value of current printed next to them, such as 0.1, 0.2, 0.4, 0.8 and 1.6. Each switch controls the amount of current, in amperes (A), that its label indicates in addition to the minimum current value of 0.4 Amps. **There is always a base current of 0.4 Amps, even with all five DIP switches set to the "off" position (away from their labels).** To add to that, slide the appropriate switches toward their labels on the PC board. You may need a small screwdriver for this.

**DIP switch current total settings =
step motor required phase current – 0.4 Amps always present base current**

Example

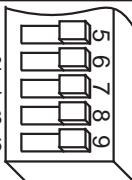
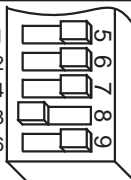
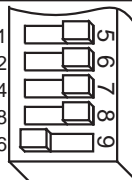
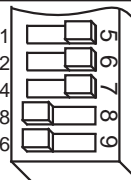
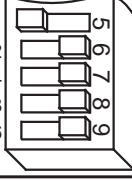
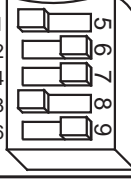
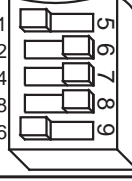
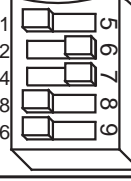
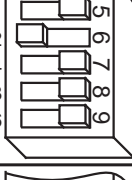
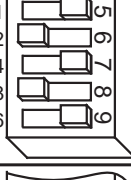
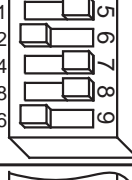
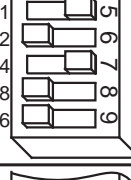
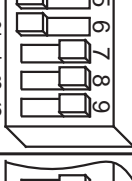
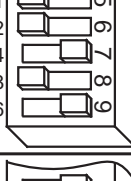
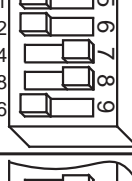
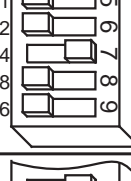
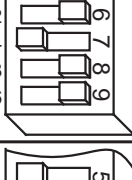
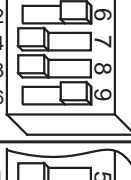
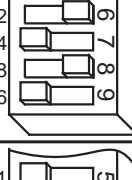
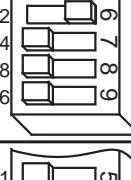

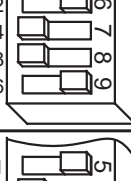
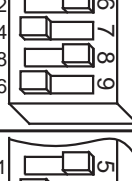
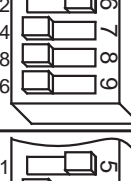
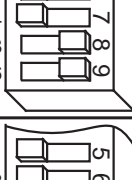
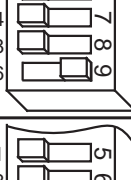
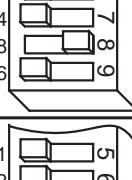
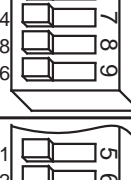

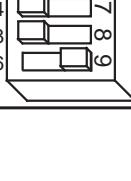
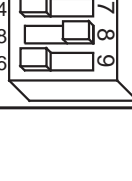
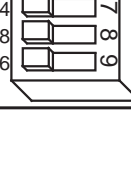
Suppose you want to set the drive for 2.2 Amps per phase based on the step motor showing a phase current of 2.2 Amps. You need the base current of 0.4 Amps plus another 1.6 and 0.2 Amps.

$$2.2 = 0.4 + 1.6 + 0.2$$

Slide the 1.6 and 0.2 Amp DIP switches toward the labels as shown in the figure to the right.



Current Setting Table

<p>0.4 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>1.2 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>2.0 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>2.8 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>Factory Default</p>
<p>0.5 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>1.3 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>2.1 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>2.9 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	
<p>0.6 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>1.4 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>2.2 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>3.0 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	
<p>0.7 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>1.5 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>2.3 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>3.1 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	
<p>0.8 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>1.6 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>2.4 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>3.2 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	
<p>0.9 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>1.7 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>2.5 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>3.3 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	
<p>1.0 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>1.8 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>2.6 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>3.4 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	
<p>1.1 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>1.9 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>2.7 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	<p>3.5 0.1 0.2 AMPS/ 0.4 PHASE 0.8 1.6</p> 	

Microstepping

Most step motor drives offer a choice between full step and half step resolutions. In most full step drives, both motor phases are used all the time. Half stepping divides each step into two smaller steps by alternating between both phases on and one phase on. Microstepping drives like the *SureStep* drive precisely control the amount of current in each phase at each step position as a means of electronically subdividing the steps even further. The *SureStep* drive offers a choice of half step and three microstep resolutions. The highest setting divides each full step into 50 microsteps, providing 10,000 steps per revolution when using a 1.8° motor.

In addition to providing precise positioning and smooth motion, microstep drives can be used to provide motion in convenient units. When the drive is set to 2,000 steps/rev (1/10 step) and used with a 5 pitch lead screw, you get .0001 inches/step.

Setting the step resolution is easy. Look at the dip switch on the *SureStep* drive. Next to switches 2 and 3, there are labels on the printed circuit board. Each switch has two markings on each end. Switch 2 is marked 1/5, 1/10 at one end and 1/5, 1/50 at the other. Switch 3 is labeled 1/2, 1/5 and 1/10, 1/50. To set the drive for a resolution, push both switches toward the proper label. For example, if you want 1/10 step, push switch 2 toward the 1/10 label (to the left) and push switch 3 toward 1/10 (on the right).

Please refer to the table below and set the switches for the resolution you want.

	<p>400 STEPS/REV (HALF)</p>	<p>2,000 STEPS/REV (1/10)</p>
Factory Default	<p>1,000 STEPS/REV (1/5)</p>	<p>10,000 STEPS/REV (1/50)</p>

Idle Current Reduction

Your drive is equipped with a feature that automatically reduces the motor current by 50% anytime the motor is not moving. This reduces drive heating by about 50% and lowers motor heating by 75%. This feature can be disabled if desired so that full current is maintained at all times. This is useful when a high holding torque is required. To minimize motor and drive heating we highly recommend that you enable the idle current reduction feature unless your application strictly forbids it.

Idle current reduction is enabled by sliding switch #4 toward the **50% IDLE** label, as shown in the sketch below. Sliding the switch away from the **50% IDLE** label disables the reduction feature.



**Idle Current Reduction
Selected
(Factory Default)**

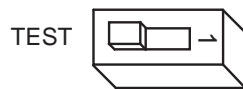


No Current Reduction

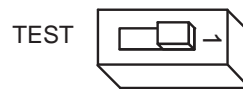
Self Test

The *SureStep* drive includes a self test feature. This is used for trouble shooting. If you are unsure about the motor or signal connections to the drive, or if the *SureStep* drive isn't responding to your step pulses, you can turn on the self test.

To activate the self test, slide switch #1 toward the **TEST** label. The drive will slowly rotate the motor, 1/2 revolution forward, then 1/2 rev backward. The pattern repeats until you slide the switch away from the **TEST** label. The *SureStep* drive always uses half step mode during the self test, no matter how you set switches 2 and 3. The self test ignores the **STEP** and **DIRECTION** inputs while operating. The **ENABLE** input continues to function normally.



Self Test ON



**Self Test OFF
(Factory Default)**

Choosing a Power Supply

Voltage

Chopper drives work by switching the voltage to the motor terminals on and off while monitoring current to achieve a precise level of phase current. To do this efficiently and silently, you'll want to have a power supply with a voltage rating at least five times that of the motor. Depending on how fast you want to run the motor, you may need even more voltage. More is better, the only upper limit being the maximum voltage rating of the drive itself: 42 volts (including ripple).

If you choose an unregulated power supply, do not exceed 30 volts DC. This is because unregulated supplies are rated at full load current. At lesser loads, like when the motor is not moving, the actual voltage can be up to 1.4 times the voltage list on the power supply label. The STP-PWR-3204 power supply is designed to provide maximum voltage, approximately 32 VDC, while under load without exceeding the upper limit of 42 VDC when unloaded.

Current

The maximum supply current you will need is the sum of the two phase currents. However, you will generally need a lot less than that, depending on the motor type, voltage, speed and load conditions. That's because the SureStep drive uses switching amplifiers, converting a high voltage and low current into lower voltage and higher current. The more the power supply voltage exceeds the motor voltage, the less current you'll need from the power supply.

We recommend the following selection procedure:

1. If you plan to use only a few drives, get a power supply with at least twice the rated phase current of the motor.
2. If you are designing for mass production and must minimize cost, get one power supply with more than twice the rated current of the motor. Install the motor in the application and monitor the current coming out of the power supply and into the drive at various motor loads. This will tell you how much current you really need so you can design in a lower cost power supply.

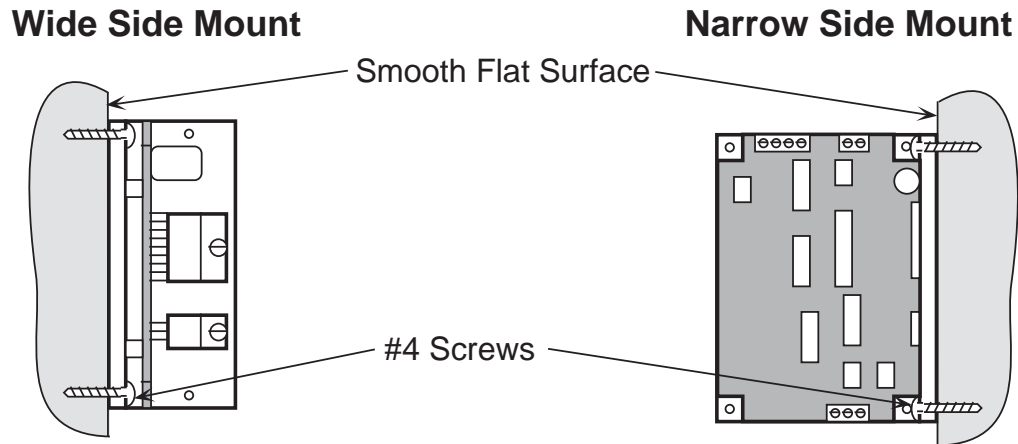
If you plan to use a regulated power supply you may encounter a problem with current foldback. When you first power up your drive, the full current of both motor phases will be drawn for a few milliseconds while the stator field is being established. After that the amplifiers start chopping and much less current is drawn from the power supply. If your power supply thinks this initial surge is a short circuit it may "foldback" to a lower voltage. With many foldback schemes the voltage returns to normal only after the first motor step and is fine thereafter. In that sense, unregulated power supplies are better. They are also less expensive.



The SureStep™ STP-PWR-3204 power supply from AutomationDirect is the best choice of DC power supply to use with the SureStep™ STP-DRV-4035 microstepping drive.

Mounting the Drive

You can mount your drive on the wide or the narrow side of the chassis. If you mount the drive on the wide side, use #4 screws through the four corner holes. For narrow side mounting applications, you can use #4 screws in the two side holes.



Unless you are running at 1 Amp/phase motor current or below, you may need a heat sink. Often, the metal subpanel being used for the control system will make an effective heat sink.

The amplifiers in the drive generate heat. Unless you are running at 1 amp or below, you may need a heat sink. To operate the drive continuously at maximum power you must properly mount it on a heat sinking surface with a thermal constant of no more than 4°C/Watt. Often, the metal enclosure of your system will make an effective heat sink.

Never use your drive in a space where there is no air flow or where other devices cause the surrounding air to be more than 70 °C. Never put the drive where it can get wet or where metal particles can get on it.

Dimensions

