*SURE*STEP™ STP-DRV-4035 BASIC DC MICROSTEPPING DRIVE

In This Chapter...

Features

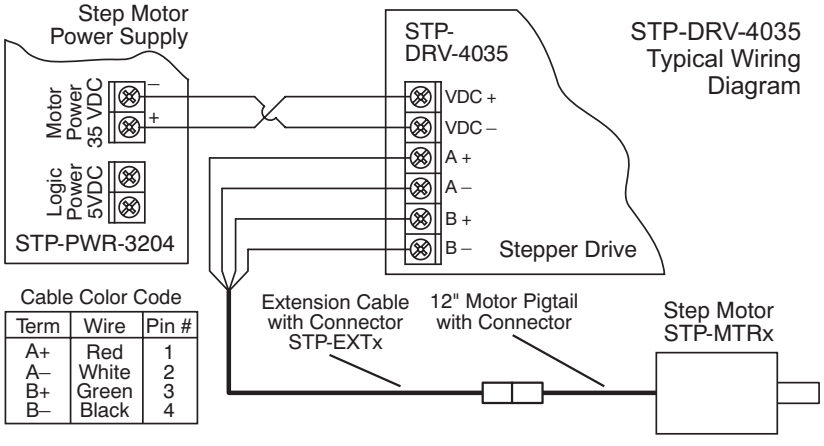
- Drives sizes 17 through 34 step motors
- Pulse width modulation, MOSFET 3 state switching amplifiers
- Phase current from 0.4 to 3.5 amps (switch selectable, 32 settings)
- Optically isolated step, direction and enable inputs
- Half, 1/5, 1/10, 1/50 step (switch selectable)
- Automatic 50% idle current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

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 (4-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 4VDC or higher (see page 3-9 for using input voltages higher than 5VDC)
	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. CW and CCW are viewed from the end opposite the drive end of the motor (looking out of the shaft).
	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]
Storage Temperature		-20–80 °C [-4–176 °F]
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

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

Typical Wiring Diagram

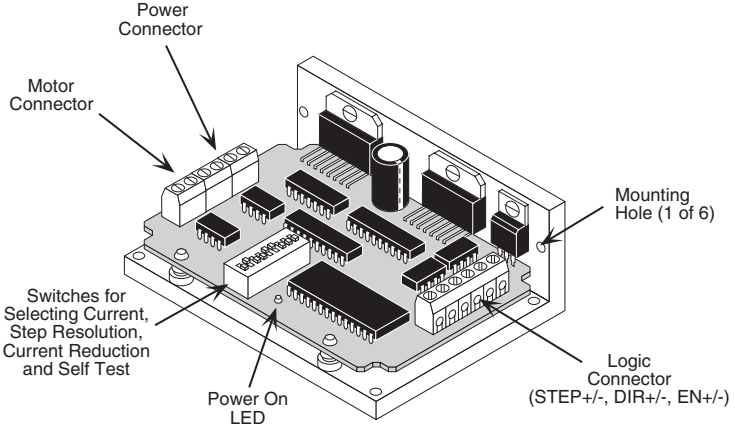


Cable Color Code

Term	Wire	Pin #
A+	Red	1
A–	White	2
B+	Green	3
B–	Black	4

Connection and Adjustment Locations

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



Connecting the Motor

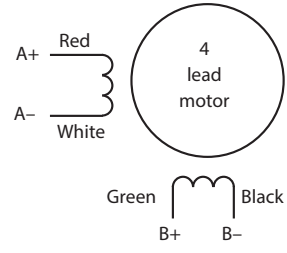
WARNING: ***When connecting a step motor to the SureStep™ STP-DRV-4035 microstepping drive, be sure that the motor power supply is switched off. When using a motor not supplied by AUTOMATIONDIRECT, secure any unused motor leads so that they can't short out to anything. Never disconnect the motor while 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.

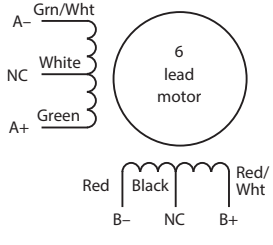
Note: All AUTOMATIONDIRECT SureStep™ motors are four lead bipolar step motors.



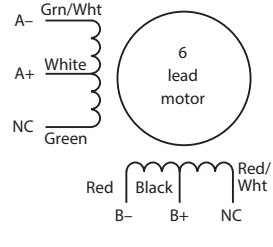
4 Leads

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.



6 Leads Series Connected

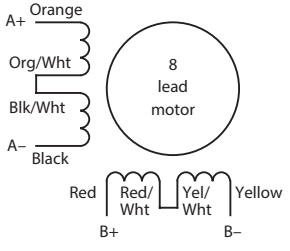


6 Leads Center Tap Connected

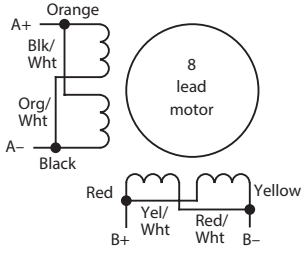
Note: Be aware that step motor wire lead colors vary from one manufacturer to another.

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.



8 Leads Series Connected



8 Leads Parallel Connected

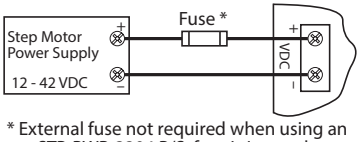
Note: Be aware that step motor wire lead colors vary from one manufacturer to another. The example above only pertains to STP-MTRAC-34075(x) and 34115(x) SureStep Motors.

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 Chapter 7: "SureStep System Power Supplies".

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.



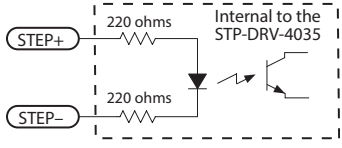
* External fuse not required when using an STP-PWR-3204 P/S; fuse is internal.

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.

Further information about braking accessories and regeneration clamping can be found in Appendix A and the STP-DRVA-RC-050 REGENERATION CLAMP datasheet.

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.



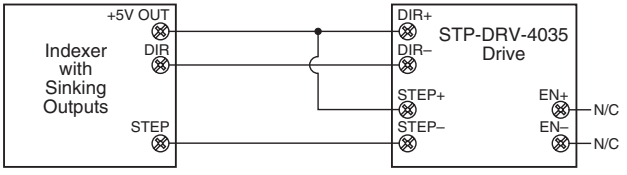
Drive Input Circuit

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.

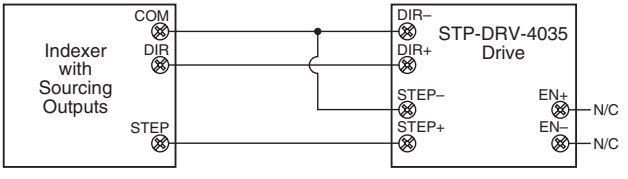
All logic inputs can be controlled by a DC output signal that is either sinking (NPN), sourcing (PNP), or differential.

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

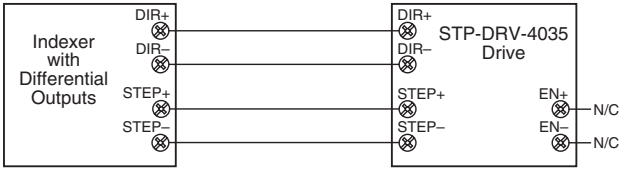
Connecting to an Indexer with Sinking Outputs



Connecting to an Indexer with Sourcing Outputs



Connecting to an Indexer with Differential Outputs



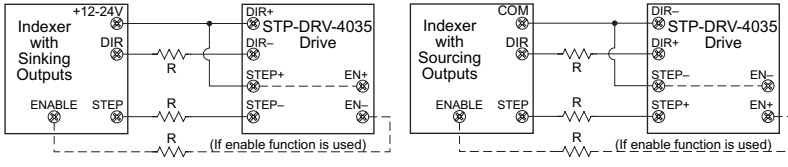
Note: Many high speed indexers have differential outputs.

Using Logic That is Not 5 volt TTL Level

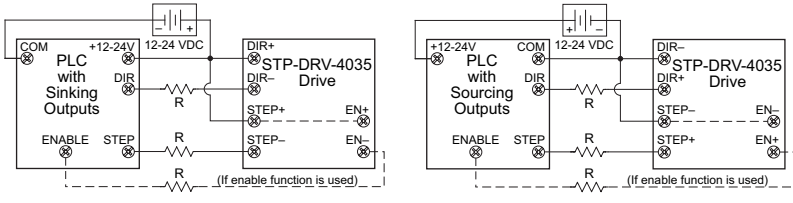
Some step and direction signals, especially those of PLCs, don't use 5 volt logic. You can connect signal levels as high as 24 volts to the SureStep drive if you add external dropping resistors to the STEP, DIR and EN inputs, as shown below.

- 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)

DIR=1 cw

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=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.

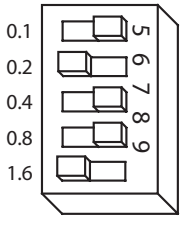
DIP switch current total settings =
step motor required phase current – 0.4 Amps always present base current

Example

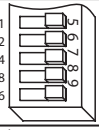
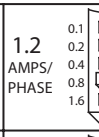
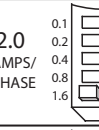
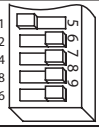
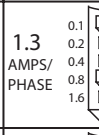
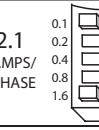
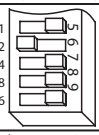
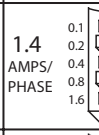
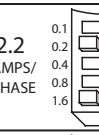
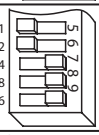
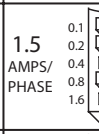
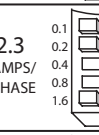
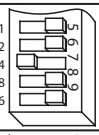
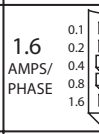
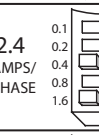
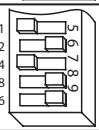
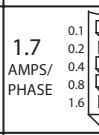
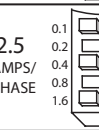
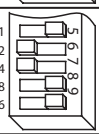
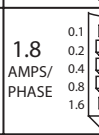
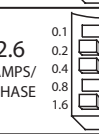
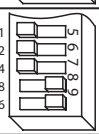
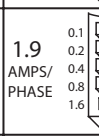
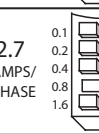
Suppose you want to set the drive for 2.2 Amps per phase based on the step motor showing a phase current of 2.2 Amps. You need the base current of 0.4 Amps plus another 1.6 and 0.2 Amps.

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

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

Factory Default

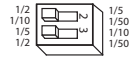
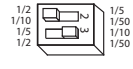
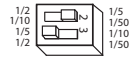
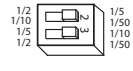
Microstepping

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.

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

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

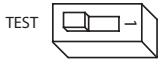
(Factory Default)

No Current Reduction

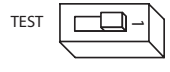
Self Test

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

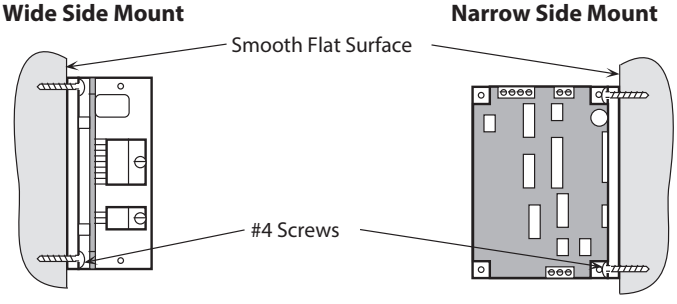


Self Test OFF

(Factory Default)

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.

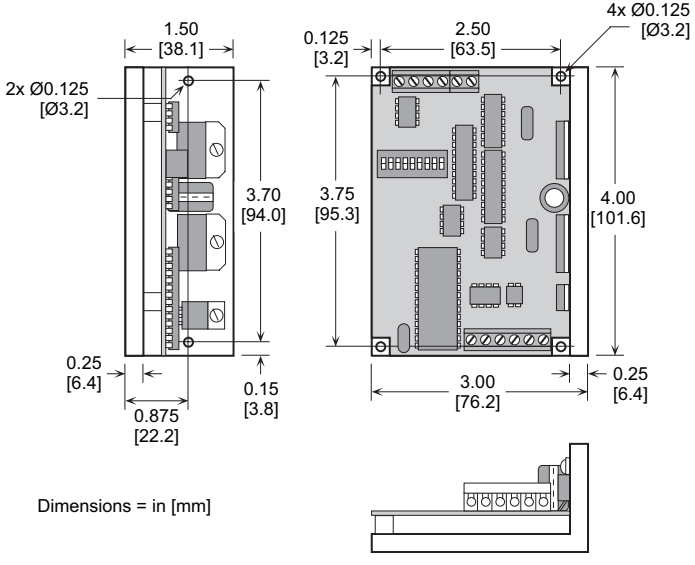


Unless you are running at 1 Amp/phase motor current or below, you may need a heat sink. Often, the metal subpanel being used for the control system will make an effective heat sink.

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



Dimensions = in [mm]

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