SureStep™ STP-DRV-6575 Microstepping Drive

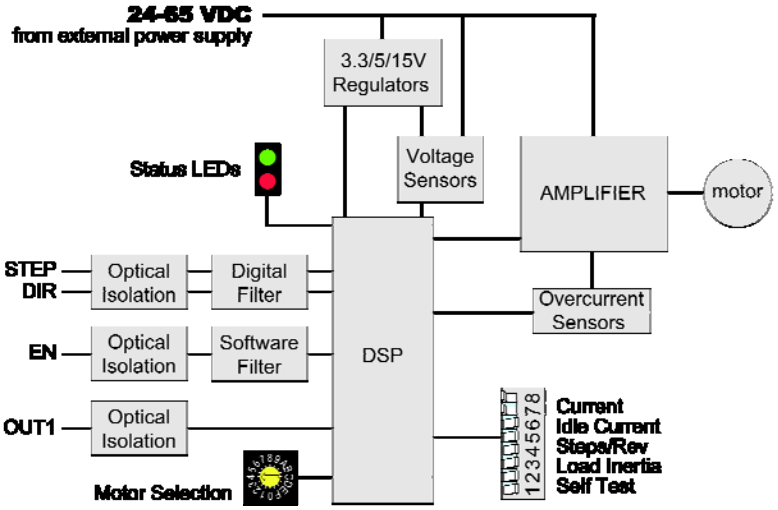
Chapter 2

In This Chapter...

Features

- Low cost, digital step motor driver in compact package
- Operates from Step & Direction signals, or Step CW & Step CCW (jumper selectable)
- Enable input & Fault output
- Optically isolated I/O
- Digital filters prevent position error from electrical noise on command signals; jumper selectable: 150 kHz or 2MHz
- Rotary switch easily selects from many popular motors
- Electronic damping and anti-resonance
- Automatic idle current reduction to reduce heat when motor is not moving; switch selectable: 50% or 90% of running current
- Switch selectable step resolution: 200 (full-step); 400 (half-step); 2,000; 5,000; 12,800; or 20,000 steps per revolution
- Switch selectable microstep emulation provides smoother, more reliable motion in full and half step modes
- Automatic self test (switch selectable)
- Operates from a 24 to 65 VDC power supply
- Running current from 0.5 to 7.5A

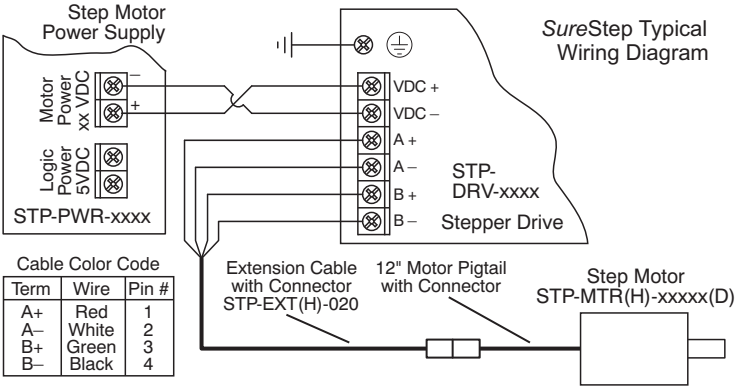
Block Diagram



Specifications

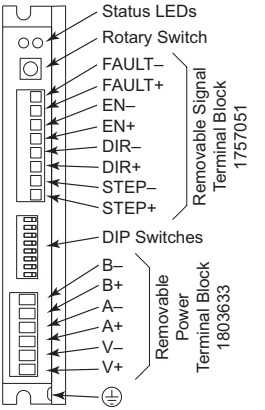
*Sure*Step™ Microstepping Drive Specifications		
Part Number		***STP-DRV-6575***
Input Power		24–65 VDC (external power supply required; fuse at 7A fast-acting)
Output Current		0.5–7.5 A/phase (peak of sine)
Current Controller		Dual H-bridge digital MOSFET, 4-quadrant PWM at 20 kHz
Input Signals	***Step***	5–24 VDC nominal (range: 4–30 VDC); (5mA @ 4V; 15 mA @ 30V); Optically isolated, differential. Minimum pulse width = 0.5µs. Maximum pulse frequency = 150 kHz or 2MHz (user selectable). Function = Step or Step CW pulse.
	Direction	5–24 VDC nominal (range: 4–30 VDC); (5mA @ 4V; 15 mA @ 30V); Optically isolated, differential. Minimum pulse width = 0.5µs. Maximum pulse frequency = 150 kHz or 2MHz (user selectable). Function = Direction or Step CCW pulse.
	Enable	5–24 VDC nominal (range: 4–30 VDC); (5mA @ 4V; 15 mA @ 30V); Optically isolated, differential. Function = disable motor when closed.
Output Signal	***Fault***	30 VDC / 80mA max, optically isolated photodarlington, sinking or sourcing. Function = closes on drive fault.
Rotary Switch Selectable Function		Select motor based on part number, or by motor current.
Jumper Selectable Functions	***Step Pulse Type***	Step and Direction: Step signal = step/pulse; Direction signal = direction. Step CW & CCW: Step signal = CW step; Direction signal = CCW step.
	Step Pulse Noise Filter	Select 150 kHz or 2MHz
DIP Switch Selectable Functions	***Current Reduction***	Reduce power consumption and heat generation by limiting motor running current to 100%, 90%, or 80% of maximum. Current should be increased to 120% if microstepping. (Torque is reduced/increased by the same %.)
	Idle Current Reduction	Reduce power consumption and heat generation by limiting motor idle current to 90% or 50% of running current. (Holding torque is reduced by the same %.)
	Load Inertia	Anti-resonance and damping feature improves motor performance. Set motor and load inertia range to 0–4x or 5–10x.
	Step Resolution	For smoother motion and more precise speed, set the pulse step resolution to 20000, 12800, 5000, 2000, 400 smooth, 400, 200 smooth, or 200 steps/rev.
	Self Test	Automatically rotate the motor back and forth two turns in each direction in order to confirm that the motor is operational.
Drive Cooling Method		Natural convection (mount drive to metal surface)
Mounting		Use (2) #6 screws to mount wide or narrow side to metal surface
Removable Connectors		Motor & Power Supply: Screw term blocks Phoenix Contact 1757051 (30–12AWG) Signals: Screw terminal blocks Phoenix Contact 1803633 (30–14 AWG)
Weight		10.8 oz [306g] – (including mating connectors)
Operating Temperature		0 to 85 °C [32 to 185 °F] – (interior of electronics section)
Ambient Temperature		0 to 50 °C [32 to 122 °F] – (drive must be mounted to suitable heat sink)
Humidity		Maximum 90% non-condensing
Agency Approvals		CE (EMC & LVD); RoHS

Typical Wiring Diagram



Wiring Connections and Configuration Switches

Terminals, Switches, Indicators



Terminal block part #s (shown) are
Phoenix Contact (www.phoenixcontact.com)

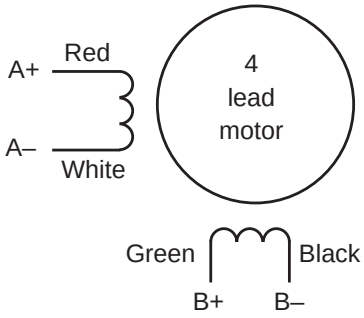
External wiring is connected using two separate pluggable screw terminal connectors. The power connections share a six-position connector, and the digital inputs and output share an eight-position connector.

Connecting the Motor

Warning: When connecting a step motor to a *Sure*Step™ STP-DRV-6575 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 in this chapter for the step motor lead color code of AutomationDirect supplied motors.)

Four lead motors

Four lead motors can only be connected one way, as shown below.

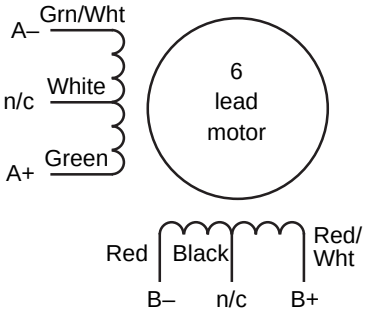


4 Leads

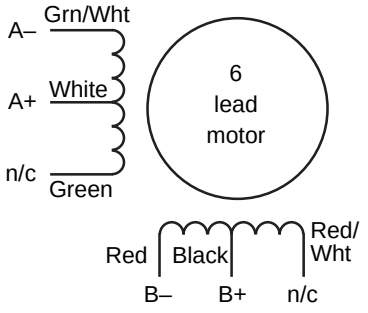
All AutomationDirect SureStep™ motors are four lead bipolar step motors.

Six lead motors

Six lead motors can be connected in series or center tap. Motors produce more torque at low speeds in series configuration, 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.



6 Leads Series Connected

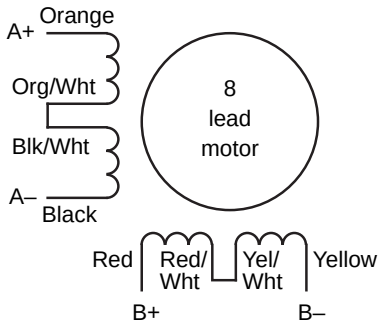


6 Leads Center Tap Connected

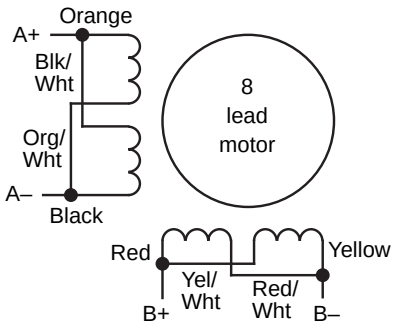
Step motor wire lead colors vary from one manufacturer to another.

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, but 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 greater torque at high speeds. When using parallel connection, the current can be increased by 40% above rated current. Care should be taken in either case to assure that the motor does not overheat.



8 Leads Series Connected



8 Leads Parallel Connected

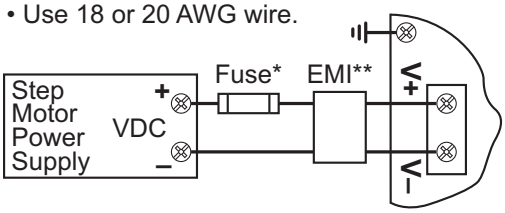
Step motor wire lead colors vary from one manufacturer to another.

Connecting the Power Supply

An STP-PWR-xxxx power supply from AutomationDirect is the best choice to power the step motor drive. If you need information about choosing a different power supply, refer to the section entitled "Choosing a Power Supply" in this chapter.

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

- Connect the green ground screw to earth ground
- Use 18 or 20 AWG wire.



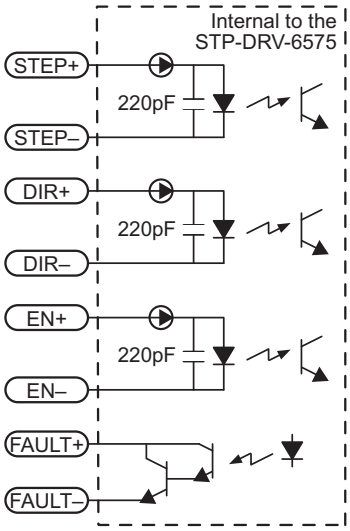
* External fuse not req'd when using an STP-PWR-xxxx P/S; fuse is internal.
** CE use requires an EMI line filter.

Do NOT use STP-PWR-70xx power supplies with an STP-DRV-6575 drive, because those power supplies exceed the voltage limit of this drive.

Connecting the I/O

*Sure*Step™ Drive Digital Inputs and Outputs

The *Sure*Step STP-DRV-6575 drive includes two high-speed 5–24 VDC digital inputs (STEP & DIR), one standard-speed 5–24 VDC digital input (EN), and one 30 VDC digital output (Fault).



Drive Digital Input Circuit

The digital inputs are optically isolated to reduce electrical noise problems. There is no electrical connection between the control and power circuits within the drive, and input signal communication between the two circuits is achieved by infrared light. Externally, the drive's motor power and control circuits should be supplied from separate sources, such as from a step motor power supply with separate power and logic outputs.

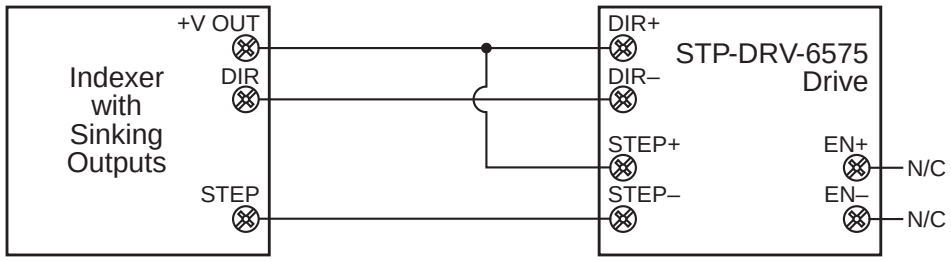
For bidirectional rotation, supply a source of step pulses to the drive at the STEP+ and STEP– terminals, and a directional signal at the DIR+ and DIR– terminals.

The ENABLE input allows the logic to turn off the current to the step motor by providing a signal to the EN+ and EN– terminals. The EN+ and EN– terminal can be left unconnected if the enable function is not required.

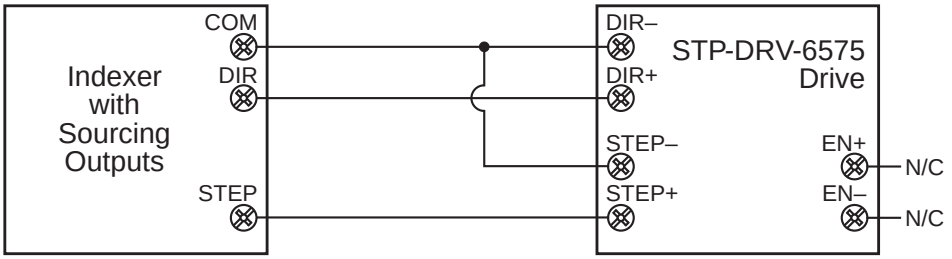
All logic inputs can be controlled by a DC output signal that is either sinking (NPN), sourcing (PNP), or differential.

Connecting the Input Signals – STEP and DIR

Connecting Inputs to an Indexer with Sinking Outputs

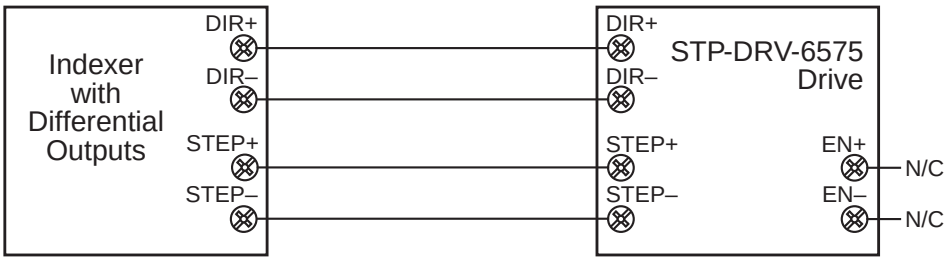


Connecting Inputs to an Indexer with Sourcing Outputs



Connecting the Input Signals – STEP and DIR (continued)

Connecting Inputs to an Indexer with Differential Outputs



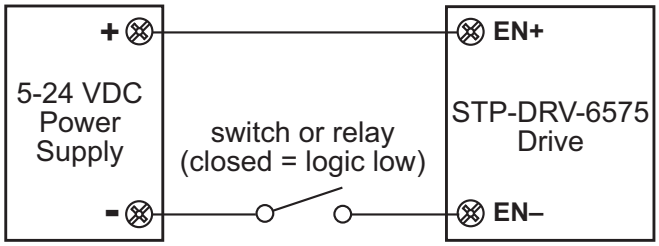
Many high speed indexers have differential (also known as line-driver) outputs.

Connecting the Input Signals – EN Input

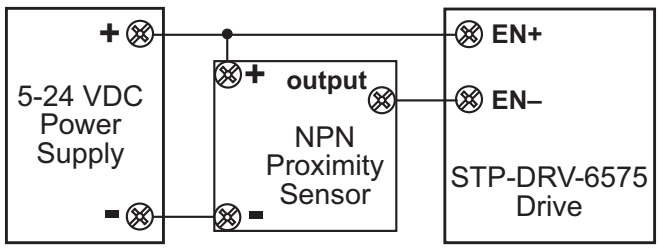
The ENABLE input allows the user to turn off the current to the motor by providing a 5–24 VDC positive voltage between EN+ and EN-. The logic circuitry continues to operate, so the drive "remembers" the step position even when the amplifiers are disabled. However, the motor may move slightly when the current is removed depending on the exact motor and load characteristics.

Warning: 24VDC is the maximum voltage that can be applied directly to the standard speed EN input. If using a higher voltage power source, install resistors to reduce the voltage at the input. Do NOT apply an AC voltage to an input terminal.

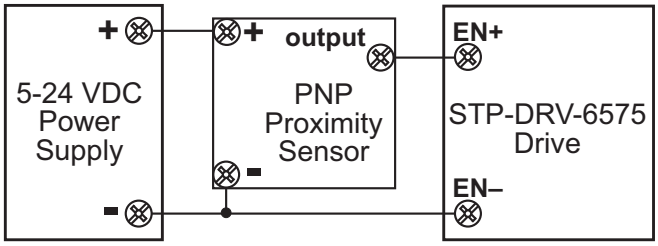
Connecting ENABLE Input to Relay or Switch



Connecting ENABLE Input to NPN Proximity Sensor



Connecting ENABLE Input to PNP Proximity Sensor

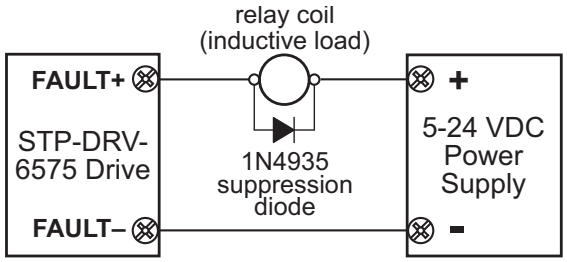


Leave the ENABLE input unconnected if you do not need to disable the amplifiers.

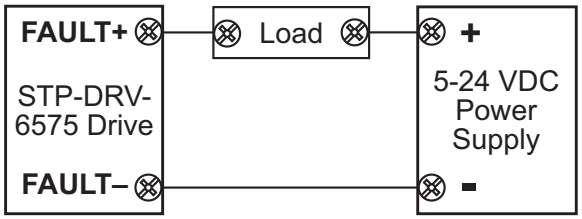
Connecting the Fault Output

The *Sure*Step advanced drives have one digital output that has separate + and - terminals, and can be used to sink or source current.

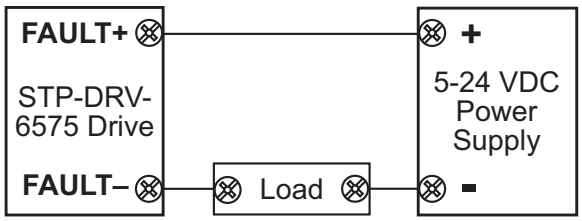
Connecting FAULT Output to Inductive Relay



Connecting FAULT Output as Sinking Output



Connecting FAULT Output as Sourcing Output



Do not connect more than 30 VDC. Current must not exceed 80 mA.

Drive Configuration

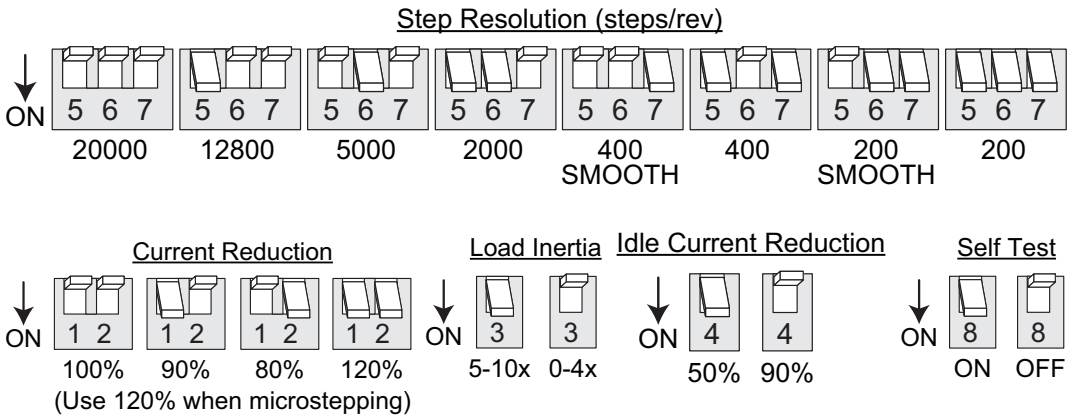
You need to configure your drive for your particular application before using the drive for the first time. The *Sure*Step STP-DRV-6575 microstepping drive offers several features and configuration settings, including:

Drive Configurations Settings

STP-DRV-6575 Configuration Settings		
Feature	***Description***	***Configuration Method***
Motor Phase Current	Select motor based on part number, or set by motor current.	Rotary Switch
Mode of Operation (Step Pulse Type)	Step and Direction (default): Step signal = step/pulse; Direction signal = direction. Step CW & CCW: Step signal = CW step; Direction signal = CCW step.	Jumper S3
Step Pulse Noise Filter	Select 150 kHz, or 2MHz (default)	Jumper S4
Current Reduction	Reduce power consumption and heat generation by limiting motor running current to 100%, 90%, or 80% of maximum. Current should be increased to 120% if microstepping. (Torque is reduced/increased by the same %.)	DIP Switches
Idle Current Reduction	Reduce power consumption and heat generation by limiting motor idle current to 90% or 50% of running current. (Holding torque is reduced by the same %.)	
Load Inertia	Anti-resonance and damping feature improve motor performance. Set motor and load inertia range to 0–4x or 5–10x.	
Step Resolution	For smoother motion and more precise speed, set the pulse step resolution to 20000, 12800, 5000, 2000, 400 smooth, 400, 200 smooth, or 200 steps/rev.	
Self Test	Automatically rotates the motor back and forth two turns in each direction in order to confirm that the motor is operational.	

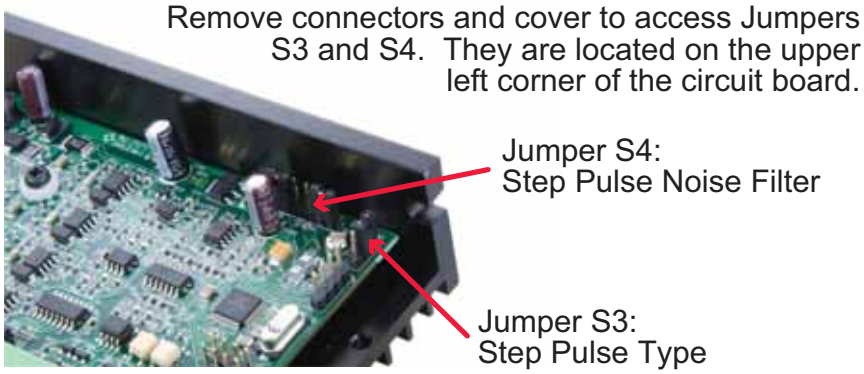
DIP Switch Settings

(Factory default = all switches OFF)



Jumper Settings

Jumpers S3 and S4 are located on the internal circuit board, and they can be accessed by removing the drive's front cover.



Jumper S3 – Step Pulse Type

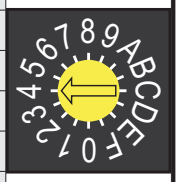
- Jumper in "1-2" position – Step & Direction (factory default)
- Jumper in "1-3" position – Step CW / Step CCW

Jumper S4 – Step Pulse Noise Filter

- Jumper in "1-2" position – 2MHz
- Jumper in "1-3" position – 150 kHz (factory default)

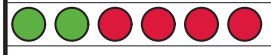
Rotary Switch Settings – Motor/Current Settings

STP-DRV-6575 Motor Selection Table									
Motor Data						*Drive Configuration Data*			*Rotary Switch Position*
Motor STP-MTR -xxxx(D)	*Motor Current (A_{rms}/phase)*	*Holding Torque (oz·in)*	*Roter Inertia (oz·in²)*	*Inductance (mH)*	*Resistance (Ω)*	*Torque (mN·m)*	*Inertia (g·cm²)*	*Drive Current (peak sine A)*	
n/a	reserved								***0–2***
n/a	1.3	custom NEMA 17							***3***
n/a	4.0	custom NEMA 23							***4***
n/a	4.0	custom NEMA 34							***5***
-17040	1.7	61	0.28	3.03	1.60	434	51	2.04	***6***
-17048	2.0	83	0.37	2.65	1.40	586	82	2.40	***7***
-17060	2.0	125	0.56	3.30	2.00	883	37	2.40	***8***
-23055	2.8	166	1.46	2.36	0.08	1172	271	3.36	***9***
-23079	2.8	276	2.60	3.82	1.10	1949	475	3.36	***A***
-34066	2.8	434	7.66	7.70	1.11	3065	1402	3.36	***B***
H-23079	5.6	287	2.60	1.18	0.40	2025	371	6.72	***C***
H-34066	6.3	428	7.66	1.52	0.25	3021	1402	7.56	***D***
H-34097	6.3	803	14.80	2.07	0.03	5668	2708	7.56	***E***
H-34127	6.3	1292	21.90	4.14	0.49	9123	4008	7.56	***F***



Alarm Codes

In the event of a drive fault or alarm, the green LED will flash one or two times, followed by a series of red flashes. The pattern repeats until the alarm is cleared.

STP-DRV-6575 Alarm Codes		
Status LED Alarm Code		***Error***
	solid green	no alarm; motor disabled
	flashing green	no alarm; motor enabled
	flashing red	configuration or memory error *
	1 green, 4 red	power supply voltage too high **
	1 green, 5 red	over current / short circuit ** †
	1 green, 6 red	open motor winding **
	2 green, 3 red	internal voltage out of range **
	2 green, 4 red	power supply voltage too low *

* *Does not disable the motor.*
The alarm will clear about 30 seconds after the fault is corrected.

** *Disables the motor. Cannot be cleared until power is cycled.*

† *The over-current/short-circuit alarm typically indicates that an electrical fault exists somewhere in the system external to the drive. This alarm does not serve as motor overload protection.*

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. Generally, more is better; the upper limit being the maximum voltage rating of the drive itself.

If you choose an unregulated power supply, do not allow the “no load” voltage to exceed the maximum voltage rating of the drive. Unregulated supplies are rated at full load current. At lesser loads, such as 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-xxxx power supplies are designed to provide maximum voltage while under load, without exceeding the drive’s upper voltage limit when unloaded.

Use the “...Recommended Component Compatibilty” chart in the “Chapter 1: Getting Started” to select the appropriate *Sure*Step power supplies for use with *Sure*Step drives.

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 *Sure*Step drives use 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, choose 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 test 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.

SureStep™ STP-PWR-xxxx power supplies from AutomationDirect are the best choices of DC power supply to use with SureStep™ STP-DRV-xxxx(D) microstepping drives.

Mounting the Drive

You can mount your drive on the wide or the narrow side of the chassis using (2) #6 screws. Since the drive amplifiers generate heat, the drive should be securely fastened to a smooth, flat metal surface that will help conduct heat away from the chassis. If this is not possible, then forced airflow from a fan may be required to prevent the drive from overheating.

- Never use your drive in a space where there is no air flow or where the ambient temperature exceeds 50 °C (122 °F).
- When mouting multiple STP-DRV-xxxx drives near each other, maintain at least one half inch of space between drives.
- Never put the drive where it can get wet.
- Never allow metal or other conductive particles near the drive.

Dimensions and Mounting Slot Locations

Dimensions = in [mm]