

SURESTEP™
ADVANCED DC
MICROSTEPPING DRIVES



CHAPTER
4

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Features

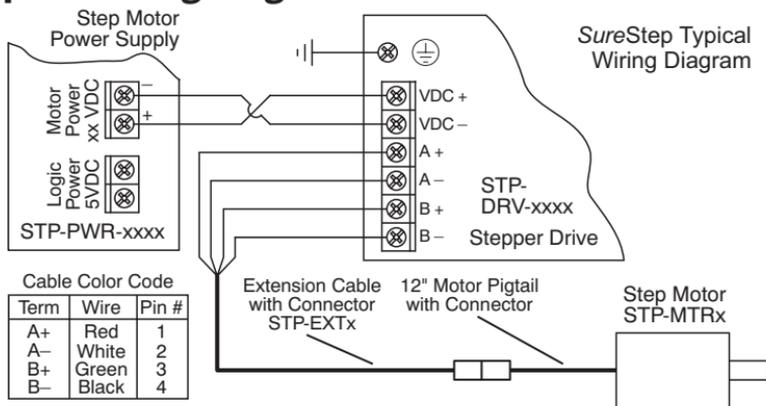
- Max 5A, 48V and max 10A, 80V models available
- Software configurable
- Programmable microsteps
- Internal indexer (via ASCII commands)
- Self test feature
- Idle current reduction
- Anti-resonance
- Torque ripple smoothing
- Step, analog, and serial communication inputs



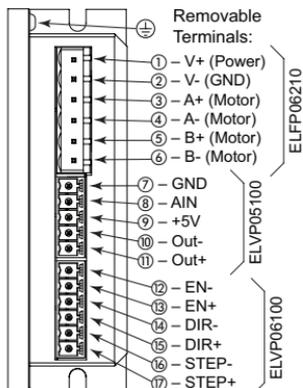
Specifications

SureStep™ Series Specifications – Microstepping Drives			
Microstepping Drive	STP-DRV-4850	STP-DRV-80100	
Drive Type	Advanced microstepping drive with pulse or analog input, serial communication, & indexing capability		
Output Current	0.1-5.0 A/phase (in 0.01A increments)	0.1-10.0 A/phase (in 0.01A increments)	
Input Voltage (external p/s required)	24-48 VDC (nominal) (range: 18-53 VDC)	24-80 VDC (nominal) (range: 18-88 VDC)	
Configuration Method	SureMotion Pro software		
Amplifier Type	MOSFET, dual H-bridge, 4-quadrant		
Current Control	4-state PWM @ 20 kHz		
Protection	Over-voltage, under-voltage, over-temperature, external output faults (phase-to-phase & phase-to-ground), inter-amplifier shorts		
Recommended Input Fusing	Fuse: 4A 3AG delay (ADC #MDL4) Fuse Holder: ADC #DN-F6L110	Fuse: 6.25A 3AG delay (ADC #MDL6-25) Fuse Holder: ADC #DN-F6L110	
Input Signals	Input Circuit	Opto-coupler input with 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 (see pages 4-8 and 4-9 for how to use input voltages higher than 5VDC)	
	Step/Pulse	Optically isolated, differential, 5V, 330Ω; Min pulse width = 250 ns, Max pulse frequency = 2MHz	
	Direction	Adjustable bandwidth digital noise rejection feature FUNCTIONS: step & direction, CW/CCW step, A/B quadrature, run/stop & direction, jog CW/CCW, CW/CCW limits	
	Enable	Optically isolated, 5-12V, 680Ω; min pulse width = 25μs, max pulse frequency = 20kHz FUNCTIONS: motor enable, alarm reset, speed select (oscillator mode)	
	Analog	Range: 0-5 VDC; Resolution: 12 bit; FUNCTION: speed control	
Output Signal	Optically isolated, 24V, 100mA max; FUNCTIONS: fault, motion, tach (3kHz max)		
Communication Interface	RS-232; RJ11 (6P4C) receptacle		
Non-volatile Memory Storage	Configurations are saved in FLASH memory on-board the DSP		
Features	Idle Current Reduction	Reduction range of 0-90% of running current after delay selectable in ms	
	Microstep Resolution	Software selectable from 200 to 51200 steps/rev in increments of 2 steps/rev	
	Modes of Operation	Pulse (step) & direction, CW/CCW, A/B quadrature, velocity (oscillator), SCL serial commands	
	Phase Current Setting	0.1-5.0 A/phase (in 0.01A increments)	0.1-10.0 A/phase (in 0.01A increments)
	Self Test	Checks internal & external power supply voltages, diagnoses open motor phases	
	Additional Features	Anti-resonance (Electronic Damping) Auto setup Serial Command Language (SCL) Host Control Step input signal smoothing (microstep emulation) Waveform (Torque Ripple) Smoothing	
Communication Port	RJ11 (6P4C)		
Removable Connectors	Motor & Power Supply: Screw term blocks Phoenix Contact 1757051 (30-12AWG) Signals: Screw terminal blocks Phoenix Contact 1803633 (30-14 AWG) AutomationDirect part number STP-CON-2 contains these replacement connectors.		
Maximum Humidity	90% non-condensing		
Storage Temperature	-20-80 °C [-4-176 °F] (mount to suitable heat sink)		
Operating Temperature	0-55 °C [32-158 °F] (mount to suitable heat sink)		
Drive Cooling Method	Natural convection (mount to suitable heat sink)		
Mounting	#6 mounting screws (mount to suitable heat sink)		
Dimensions	3.0 x 3.65 x 1.125 inches [76.2 x 92.7 x 28.6 mm]		
Weight	8 oz [227g] (approximate)		
Agency Approvals	CE		

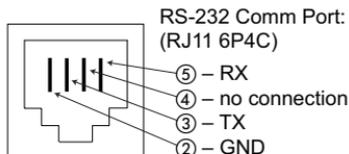
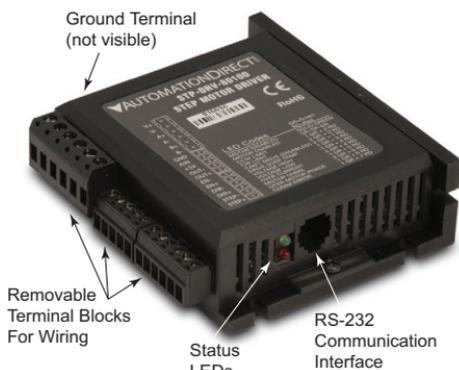
Typical Wiring Diagram



Connection Locations & Pin-out



Terminal block part #s (shown) are Amphenol PCD (www.amphenolpcd.com) Replacement connector kit STP-CON-2 contains all the above connectors



External wiring is connected using three separate pluggable screw terminal connectors. The power connections share a six position connector, the digital inputs share another six position connector, and the analog input and digital output share a five position connector.

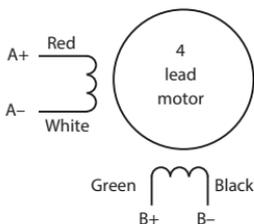
Connecting the Motor



Warning: When connecting a step motor to a SureStep™ advanced 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.



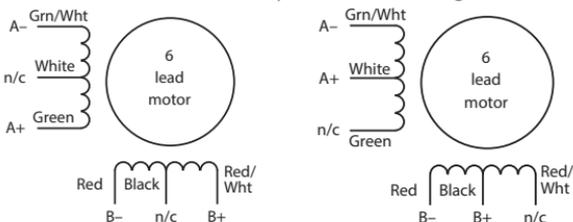
4 Leads



All AutomationDirect SureStep™ MTR and MTRL 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

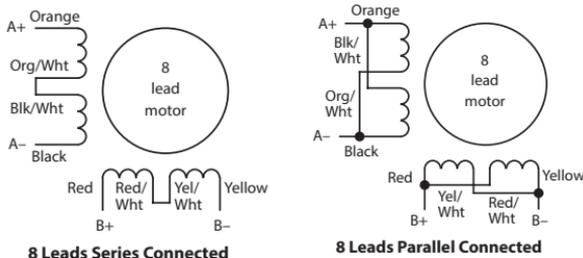
6 Leads Center Tap Connected



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 overheating. Parallel operation allows greater torque at high speeds. 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 does not overheat.

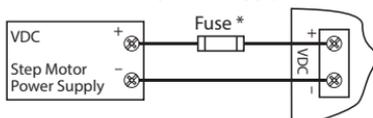


Step motor wire lead colors vary from one manufacturer to another. The example above only pertains to STP-MTRAC-34075(x) and 34115(x) SureStep Motors. For NEMA 42 wire colors, see "Connecting a STP-MTRAC(H)-42 Motor" in Chapter 7.

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 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 a fuse between the drive and the power supply. Install the fuse on the + power supply lead.



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

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



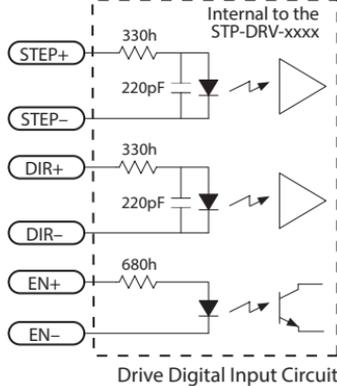
Warning: Connect the motor power supply "+" terminal to the drive "+ VDC" terminal, and connect the power supply "-" terminal to the drive "VDC-" terminal.

Use wire no smaller than 18 gauge, and be careful not to reverse the wires. Reverse connection will destroy your drive and void the warranty.

Connecting the I/O

SureStep™ Drive Digital Inputs

The SureStep advanced drives include two high speed 5V digital inputs (STEP and DIR), and one standard speed 5-12V input (EN).



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.

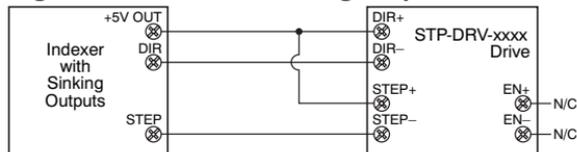
For bidirectional rotation, supply a source of step pulses to the drive at the STEP+ and STEP- terminals, and a directional signal at the DIR+ and DIR- terminals.

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.

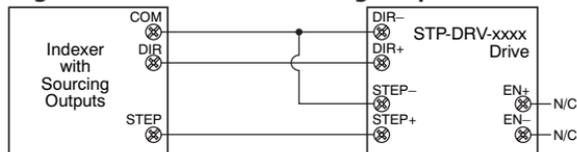
All logic inputs can be controlled by a DC output signal that is either sinking (NPN), sourcing (PNP), or differential.

Connecting STEP and DIR to 5V TTL Logic

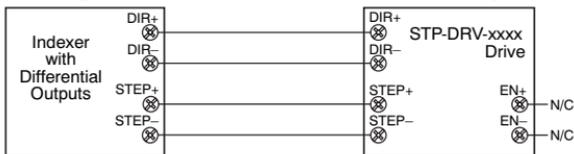
Connecting to an Indexer with Sinking Outputs



Connecting to an Indexer with Sourcing Outputs

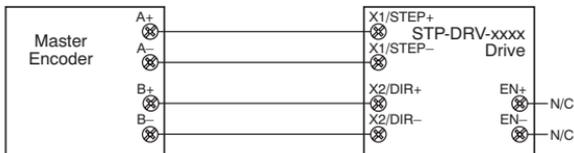


Connecting to an Indexer with Differential Outputs



Many high speed indexers have differential outputs.

Wiring for Encoder Following



Connecting STEP and DIR to Logic Other Than 5V 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 a SureStep advanced drive if you add external dropping resistors to the STEP, DIR and EN inputs.

- For 12V logic, use 820Ω, 1/4W resistors
- For 24V logic, use 2200Ω, 1/4W resistors

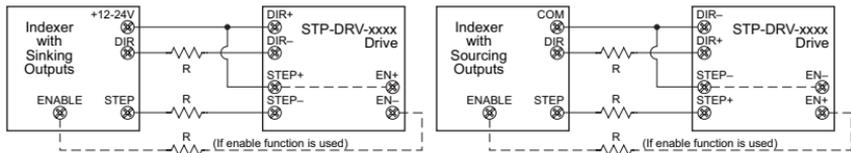


Most PLCs can use 24 VDC Logic.

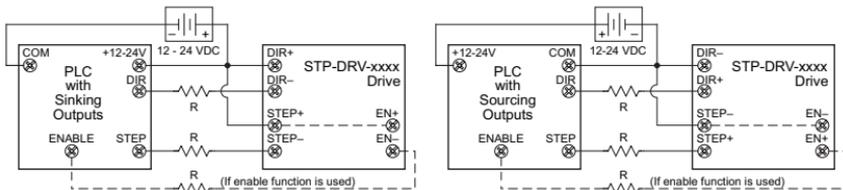
Connecting to an Indexer with Sink or Source 12-24 VDC Outputs



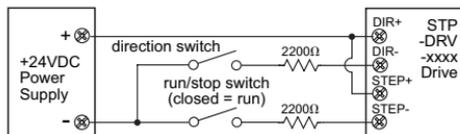
Warning: 5VDC is the maximum voltage that can be applied directly to a high speed input (STEP and DIR). If using a higher voltage power source, install resistors to reduce the voltage at the inputs. Do NOT apply an AC voltage to an input terminal.



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



Connecting to Mechanical Switches at 24 VDC



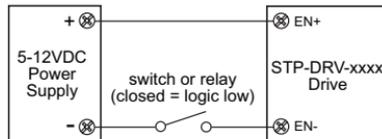
Connections to the EN Input

The ENABLE input allows the user to turn off the current to the motor by providing a 5-12 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.

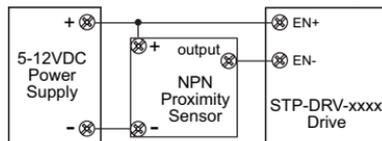


Warning: 12VDC is the maximum voltage that can be applied directly to the standard speed EN input. If using a higher voltage power source, install resistors to reduce the voltage at the input. Do NOT apply an AC voltage to an input terminal.

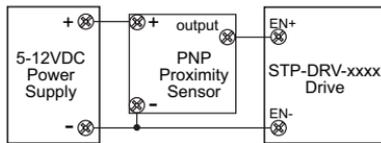
Connecting ENABLE Input to Relay or Switch



Connecting ENABLE Input to NPN Proximity Sensor



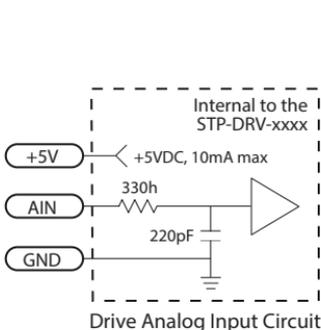
Connecting ENABLE Input to PNP Proximity Sensor



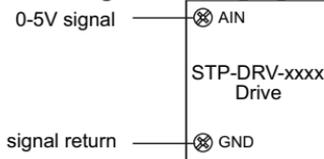
Leave the ENABLE input unconnected if you do not need to disable the amplifiers.

Connecting the Analog Input

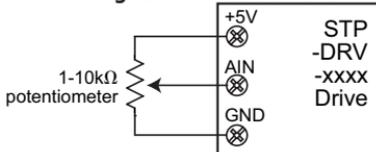
The SureStep advanced drives have one 0-5 VDC analog input.



Connecting AI to Analog Signal



Connecting AI to Potentiometer

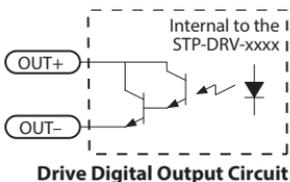


Warning: The analog input is NOT optically isolated, and must be used with care.

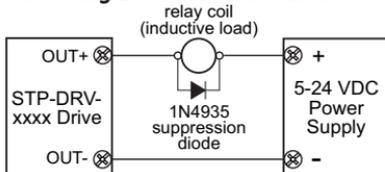
It may operate improperly and it can be damaged if the system grounds are not compatible.

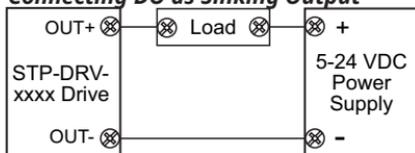
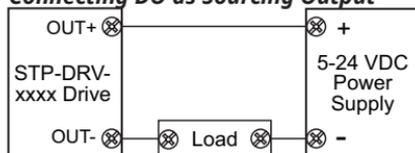
Connecting the Digital Output

The SureStep advanced drives have one digital output (DO) that has separate positive (+) and negative (-) terminals, and can be used to sink or source current.



Connecting DO to Inductive Load



Connecting DO as Sinking Output**Connecting DO as Sourcing Output**

Warning: Do NOT connect the digital output to a voltage greater than 30VDC. The current through each DO terminal must not exceed 100mA.

LED Display Codes

The LEDs on the Surestep advanced drives flash in the sequences shown in the table below to denote various alarm states.

STP-DRV-4850 and 80100 Alarm Codes		
Alarm Code	LED Sequence	Alarm Description
SG	 Solid green	No alarm, motor disabled
FG	 Fast green	Factory use
01	 Flashing green	No alarm, motor enabled
10	 Flashing red	Configuration or memory error ¹
11	 1 red, 1 green	Motor stall (optional encoder only) ⁴
12	 1 red, 2 green	Move attempted while drive disabled
21	 2 red, 1 green	CCW limit
22	 2 red, 2 green	CW limit
31	 3 red, 1 green	Drive overheating
32	 3 red, 2 green	Internal voltage out of range ²
33	 3 red, 3 green	Factory use
41	 4 red, 1 green	Power supply overvoltage ²
42	 4 red, 2 green	Power supply undervoltage
43	 4 red, 3 green	Flash memory backup error
51	 5 red, 1 green	Over current / short circuit ^{2, 3}
61	 6 red, 1 green	Open motor winding ²
62	 6 red, 2 green	Bad encoder signal (optional encoder only) ⁴
71	 7 red, 1 green	Serial communication error ⁵
72	 7 red, 2 green	Flash memory error

1 - Does not disable the motor.

The alarm will clear about 30 seconds after the fault is corrected.

2 - Disables the motor. Cannot be cleared until power is cycled.

3 - 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.

4 - This alarm only occurs on STP-MTRD advanced integrated motor/drives

5 - This alarm does not occur on STP-DRV-6575 or standard integrated motor/drives

Alarm Code Definitions

Alarm Code	Error	Description	Corrective Action
SG	No alarm, motor disabled	No faults active, Circuit is closed between EN+ and EN-.	N/A
01	No alarm, motor enabled	No faults active, Circuit is open between EN+ and EN-.	N/A
10	Configuration or memory error	Memory error detected when trying to load config from flash on powerup.	Restart device. No fix if restart doesn't work. Return to manufacturer for correction.
11	Motor stall (optional encoder only)	Motor torque demand exceeded capability and the motor skipped steps. This is configured in SureMotion Pro.	Increase torque utilization if it's not already maxed out, otherwise decrease the torque demand by modifying the move profile, or put in a larger motor.
12	Move attempted while drive disabled	Drive is disabled and move attempted.	Reset alarm, enable motor, and move again.
21	CCW limit	CCW limit is reached. The digital input that has been assigned CCW limit has been activated.	Unblock the CCW sensor (open the circuit) or redefine the input with SureMotion Pro.
22	CW limit	CW limit is reached. The digital input that has been assigned CW limit has been activated.	Unblock the CCW sensor (open the circuit) or redefine the input with SureMotion Pro.
31	Drive overheating	The drive's internal temperature is too high.	If the drive is operating within its standard range (input voltage and output current are OK), more heat must be removed from the drive during operation. For Advanced drives (see "Mounting the Drive" on page 4-14), ensure the drive is mounted to a metal surface that can dissipate the drive's heat. For Integrated motor/drives, see "Mounting" on page 5-13. For both types of drives: If the mounting surface cannot pull enough heat away from the drive, forced airflow (from a fan) may be required to cool the drive.
32	Internal voltage out of range	Gate voltage, 5V rail, or 3V rail are out of spec.	Ensure adequate supply voltage (in very rare cases, low input voltages combined with fast accelerations can draw down the gate voltage) and try again. If persistent, RMA is required.

Alarm Code	Error	Description	Corrective Action
41	Power supply overvoltage	The DC voltage feeding the drive is above the allowable level.	<p>Decrease the input voltage. Linear power supplies do not output a fixed voltage: the lighter the output current, the higher the output voltage will float. If a linear supply's voltage floats above the drive's max voltage, you can install a small power resistor across the linear power supply's output to provide some load that will help pull down the floating voltage. Consider using a switching power supply such as the Rhino PSB power supply series.</p> <p>Overvoltage can also be fed back into a system by regeneration (when an overhauling load pushes energy back into the motor). In an application with regen problems, install an STP-DRVA-RC-050 regen clamp to help dissipate the extra energy. (The regen clamp will not help with the floating linear power supply that floats too high, but it will help with excess voltage generated from an overhauling load.)</p>
42	Power supply undervoltage	The DC voltage feeding the drive is below the allowable level.	Correct the power supply. If this error occurs during operation, the power supply is most likely undersized. A sudden high current demand can cause an undersized power supply to dip in output voltage.
43	Flash memory backup error	Memory error detected when trying to load config from flash on powerup.	Restart device. No fix if restart doesn't work. Return to manufacturer for correction.
51	Over current / short circuit	Motor leads shorted - only checked on powerup.	Check and fix motor wiring.
61	Open motor winding	Motor leads not connected - only checked on powerup.	Check and fix motor wiring.
62	Bad encoder signal (optional encoder only)	Noisy or otherwise incorrectly formatted encoder signal (lack of A or B, lack of differential signal).	Check encoder wiring, always use differential encoders (or use checkbox in SureMotion Pro to disable this error when using single ended).
71	Serial communication error	Catch-all error for something wrong with serial communications. See CE command in HCR for details.	If drive can communicate, CE can give a precise diagnosis. If not, refer to the Serial Communications part of the HCR for troubleshooting.
72	Flash memory error	Memory error detected when trying to load config from flash on powerup.	Restart device. No fix if restart doesn't work. Return to manufacturer for correction.

Drive Configuration

You need to configure your drive for your particular application before using the drive for the first time. The SureStep advanced microstepping drives require SureMotion Pro (part number SM-PRO, free download at Automationdirect.com) drive configuration software for this purpose. Please refer to “Chapter 10: SureMotion Pro Configuration Software” or the software’s help file for more detailed information on configuring the drive. The software contains instructions for installation on a PC, and instructions for configuring the drives. Configuration settings include:

- drive model
- motor characteristics
- motion control mode
- I/O configuration

Anti-Resonance / Electronic Damping

Step motor systems have a tendency to resonate at certain speeds. SureStep advanced drives automatically calculate the system’s natural resonate frequency, and apply damping to the control algorithm. This greatly improves midrange stability, allows higher speeds and greater torque utilization, and improves settling times.

This feature is on by default, but it can be turned off using the “Motor...” icon of the SureMotion Pro software.

Idle Current Reduction

This feature reduces current consumption while the system is idle, and subsequently reduces drive and motor heating. However, reducing the idle current also reduces the holding torque.

The percent and delay time of the idle current reduction can be adjusted using the “Motor...” icon of the SureMotion Pro software.

Microstep Resolution

The microstep resolution (steps/rev) can be selected using the “Motion & I/O...” icon of the SureMotion Pro software, and selecting “Pulse and Direction Mode”.

Modes of Operation

Modes of operation are selectable via the SureMotion Pro software “Motion & I/O...” icon.

- Pulse & Direction Mode
 - Pulse & Direction
 - CW & CCW Pulse
 - A/B Quadrature
- Velocity (Oscillator) Mode
- Serial Command Language (SCL)

Phase Current Setting

Motor phase current settings are available through the SureMotion Pro software “Motor...” icon and the “Running Current” settings.

Serial Command Language (SCL) Host Control

SureStep advanced drives can accept serial commands from a host PC or PLC.

This feature can be selected using the “Motion & I/O...” icon of the SureMotion Pro software, and selecting Serial Command Language.

Step Smoothing Filter (Command Signal Smoothing & Microstep Emulation)

The Step Smoothing Filter setting is effective only in the Step (Pulse) & Direction mode. It includes command signal smoothing and microstep emulation to soften the effect of immediate changes in velocity and direction, therefore making the motion of the motor less jerky. An added advantage is that it can reduce the wear on mechanical components.

This feature can be modified by using the “Motion & I/O...” icon of the SureMotion Pro software, and selecting “Pulse and Direction Mode”.

Waveform (Torque Ripple) Smoothing

All step motors have an inherent low speed torque ripple that can affect the motion of the motor. SureStep advanced drives can analyze this torque ripple and apply a negative harmonic to negate this effect. This feature gives the motor much smoother motion at low speeds.

This feature is on by default, and is factory preset for standard motors. It can be turned off or on using the “Motor...” icon of the SureMotion Pro software. To set Waveform Smoothing for custom motors, select “Define Custom Motor...” and the “Waveform Smoothing” “Wizard...”.



CAUTION: Power down the SureStep drive before plugging a communication cable into the comm port of the drive. Failure to do so may result in damage to the drive comm port!

Mounting the Drive

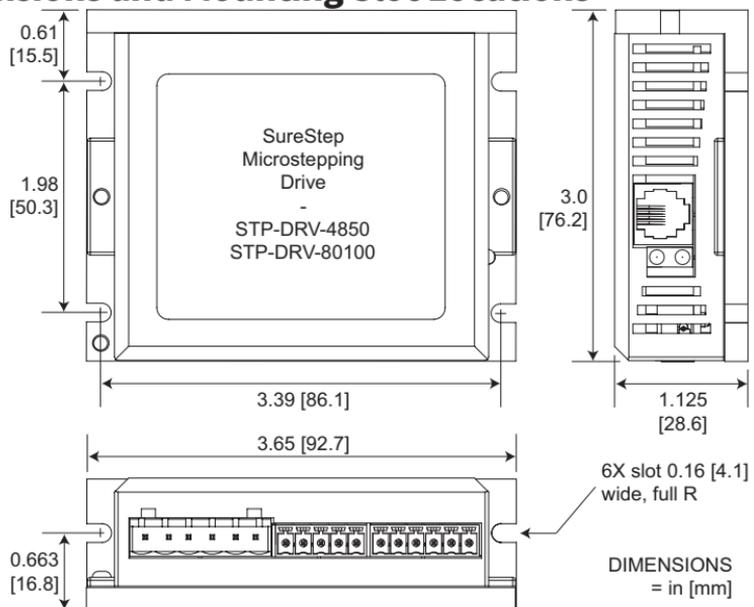
You can mount your drive on the wide or the narrow side of the chassis using #6 screws. Since the drive amplifiers generate heat, the drive should be securely fastened to a smooth, flat metal surface that will help conduct heat away from the chassis. If this is not possible, then forced airflow from 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 40 °C (104 °F).
- When mounting 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.

Drive Heating

For information on drive heating, please see Chapter 8: SureStep System Power Supplies.

Dimensions and Mounting Slot Locations



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