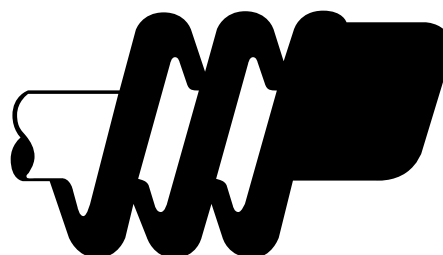
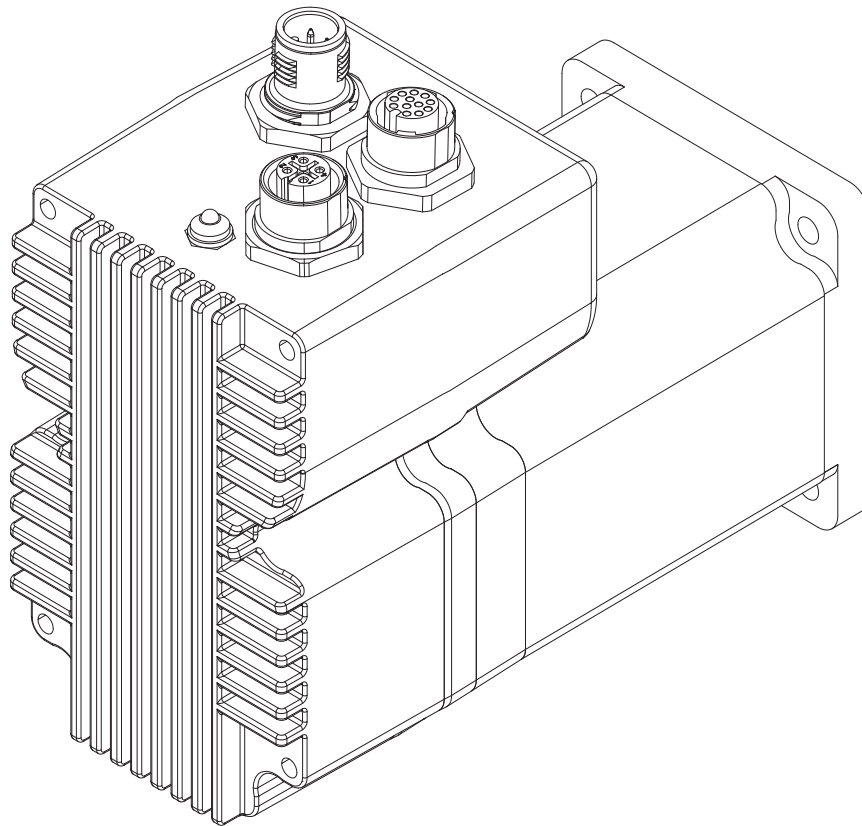


# **SWM24**

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## Hardware Manual



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## Introduction

Thank you for selecting the Applied Motion Products SWM24 Drive+Motor. We hope our dedication to performance, quality and economy will make your motion control project successful. If there's anything we can do to improve our products or help you use them better, please call or fax. We'd like to hear from you. Our phone number is (800) 525-1609, or you can reach us by fax at (831) 761-6544. You can also email [support@applied-motion.com](mailto:support@applied-motion.com).



## Features

- IP65 environmental protection
- Programmable, micro-stepping digital step Drive+Motor in an integrated package
- Operates from a 12 to 70 volt DC power supply
- Operates in velocity or position mode
- Mid-band anti-resonance
- Accepts analog signals, digital signals and streaming serial commands
- Step input signal smoothing
- Communication options: RS-232, Ethernet UDP/TCP, EtherNet/IP
- Encoder feedback
- Delivers up to 340 oz-in holding torque
- -SF & -QF: four optically isolated, 5 to 24 volt digital "flex I/O" points (each can be configured as an input or an output)
- -S, -Q, -IP: three optically isolated, 5 to 24 volt digital inputs, one optically isolated 30V, 100mA digital output
- Input filtering both hardware and software
- 0 to 5V analog input for speed and position control

## List of SWM24 Model Numbers

SWM24SF-3AE

SWM24QF-3AE

SWM24S-3EE

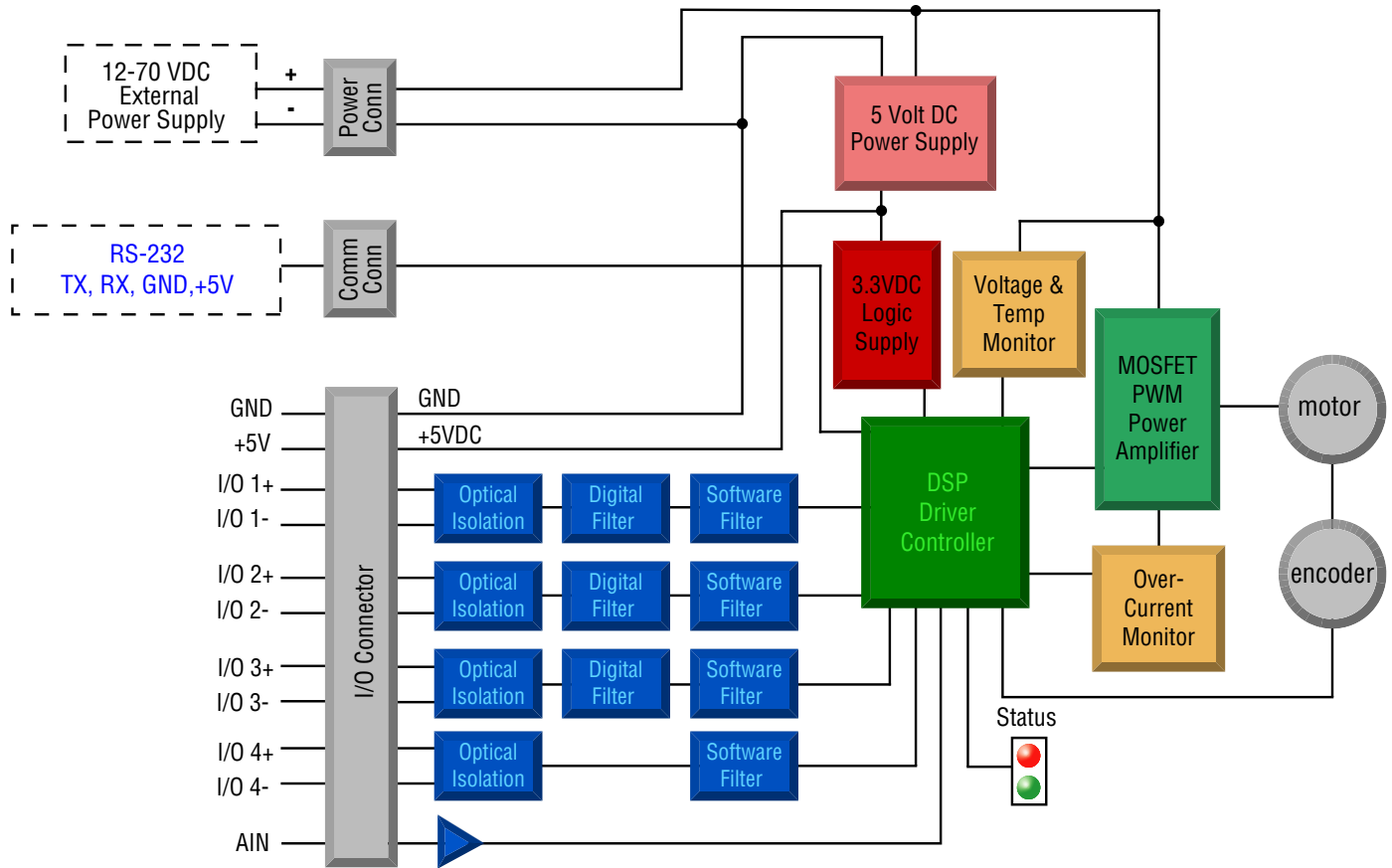
SWM24Q-3EE

SWM24IP-3EE

*Notes:*

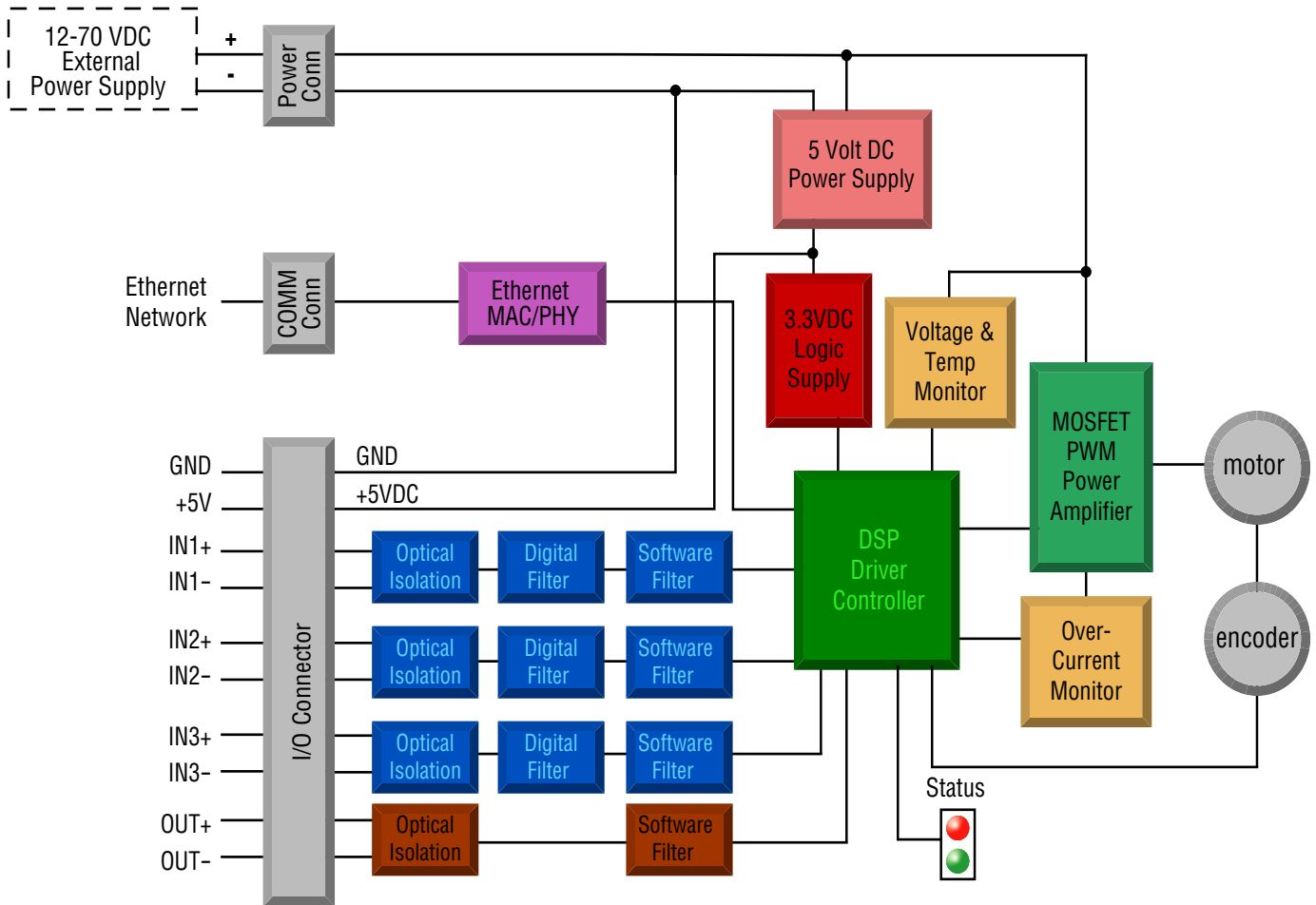
*Last digit indicates 1000 line internal encoder. E: encoder is included, N: no encoder*

**Block Diagram (-SF and -QF)**



I/O Functions (configure in software)			
I/O 1	I/O 2	I/O 3	I/O 4
Step Input	Direction Input		
Jog CW Input	Jog CCW Input	Limit CW Input	Limit CCW Input
Enable Input	Alarm Reset Input	Enable Input	Alarm Reset Input
Start/Stop Input		Change Speed Input	
General Purpose Input	General Purpose Input	General Purpose Input	General Purpose Input
Brake Output	Brake Output	Brake Output	Brake Output
Fault Output	Fault Output	Fault Output	Fault Output
Motion Output	Motion Output	Motion Output	Motion Output
Tach Output	Tach Output	Tach Output	Tach Output
General Purpose Output	General Purpose Output	General Purpose Output	General Purpose Output

## Block Diagram (-S, -Q and -IP)



### I/O Functions (configure in software)

IN1	IN2	IN3	OUT
Clockwise Limit	Counterclockwise Limit	Home Sensor	Fault
General Purpose Input	General Purpose Input	Enable Input	Brake
Master Encoder Ch.A	Master Encoder Ch.B	General Purpose Input	Motion
			Tach
			General Purpose Output

## Safety Instructions

Only qualified personnel are permitted to transport, assemble, commission, and maintain this equipment. Properly qualified personnel are persons who are familiar with the transport, assembly, installation, commissioning and operation of motors, and who have the appropriate qualifications for their jobs. The qualified personnel must know and observe the following standards and regulations:

IEC 364 resp. CENELEC HD 384 or DIN VDE 0100

IEC report 664 or DIN VDE 0110

National regulations for safety and accident prevention or VBG 4

To minimize the risk of potential safety problems, you should follow all applicable local and national codes that regulate the installation and operation of your equipment. These codes vary from area to area and it is your responsibility to determine which codes should be followed, and to verify that the equipment, installation, and operation are in compliance with the latest revision of these codes.

Equipment damage or serious injury to personnel can result from the failure to follow all applicable codes and standards. We do not guarantee the products described in this publication are suitable for your particular application, nor do we assume any responsibility for your product design, installation, or operation.

- Read all available documentation before assembly and commissioning. Incorrect handling of products in this manual can result in injury and damage to persons and machinery. Strictly adhere to the technical information on the installation requirements.
- It is vital to ensure that all system components are connected to earth ground. Electrical safety is impossible without a low-resistance earth connection.
- The SWM24 drives contain electrostatically sensitive components that can be damaged by incorrect handling. Discharge yourself before touching the product. Avoid contact with high insulating materials (artificial fabrics, plastic film, etc.). Place the product on a conductive surface.
- During operation keep all covers and cabinet doors shut. Otherwise, there are deadly hazards that could possibly cause severe damage to health or the product.
- In operation, depending on the degree of enclosure protection, the product can have bare components that are live or have hot surfaces. Control and power cables can carry a high voltage even when the motor is not rotating.
- Never pull out or plug in the product while the system is live. There is a danger of electric arcing and danger to persons and contacts.
- After powering down the product, wait until both LEDs are completely dark before touching live sections of the equipment or undoing connections (e.g., contacts, screwed connections). To be safe, measure the contact points with a meter before touching.

Be alert to the potential for personal injury. Follow the recommended precautions and safe operating practices included with the alert symbols. Safety notices in this manual provide important information. Read and be familiar with these instructions before attempting installation, operation, or maintenance. The purpose of this section is to alert users to possible safety hazards associated with this equipment and the precautions that need to be taken to reduce the risk of personal injury and damage to the equipment.

Failure to observe these precautions could result in serious bodily injury, damage to the equipment, or operational difficulty.

## Getting Started

This manual describes the use of four different drive models. What you need to know and what you must have depends on the drive model. For all models, you'll need the following:

- a 12 - 70 volt DC power supply. Please read the section entitled Choosing a Power Supply for help in choosing the right power supply.
- a small flat blade screwdriver for tightening the connectors (included).
- a personal computer running Microsoft Windows 98, 2000, NT, Me , XP, Vista or 7 (32 or 64 bit).
- *ST Configurator™* and *Q Programmer™* software applications, available at [www.applied-motion.com/products/software](http://www.applied-motion.com/products/software).
- Mating cables are available from Applied Motion, see the Accessories section for part numbers)

If you've never used an SWM24 drive you'll need to get familiar with the drive and the set up software before you try to deploy the system in your application. We strongly recommend the following:

1. For -Q drives, download and install the *ST Configurator™* software applications, available at [www.applied-motion.com/products/software](http://www.applied-motion.com/products/software).
2. Launch the software by clicking Start...Programs...Applied Motion...
3. Connect the drive to your PC using the programming cable.
4. Connect the drive to the power supply.
5. Apply power to the drive.
6. The software will recognize your drive, display the model and firmware version and be ready for action.

## Mounting the SWM24

As with any stepper motor the SWM24 must be mounted so as to provide maximum heat-sinking and air-flow. Keep space around the Drive+Motor to allow convected air-flow.

- ***Never use your Drive+Motor in a space where there is no air flow or where other devices cause the surrounding air to be more than 40°C.***
- ***Always provide airflow around the Drive+Motor.***

### Choosing a Power Supply

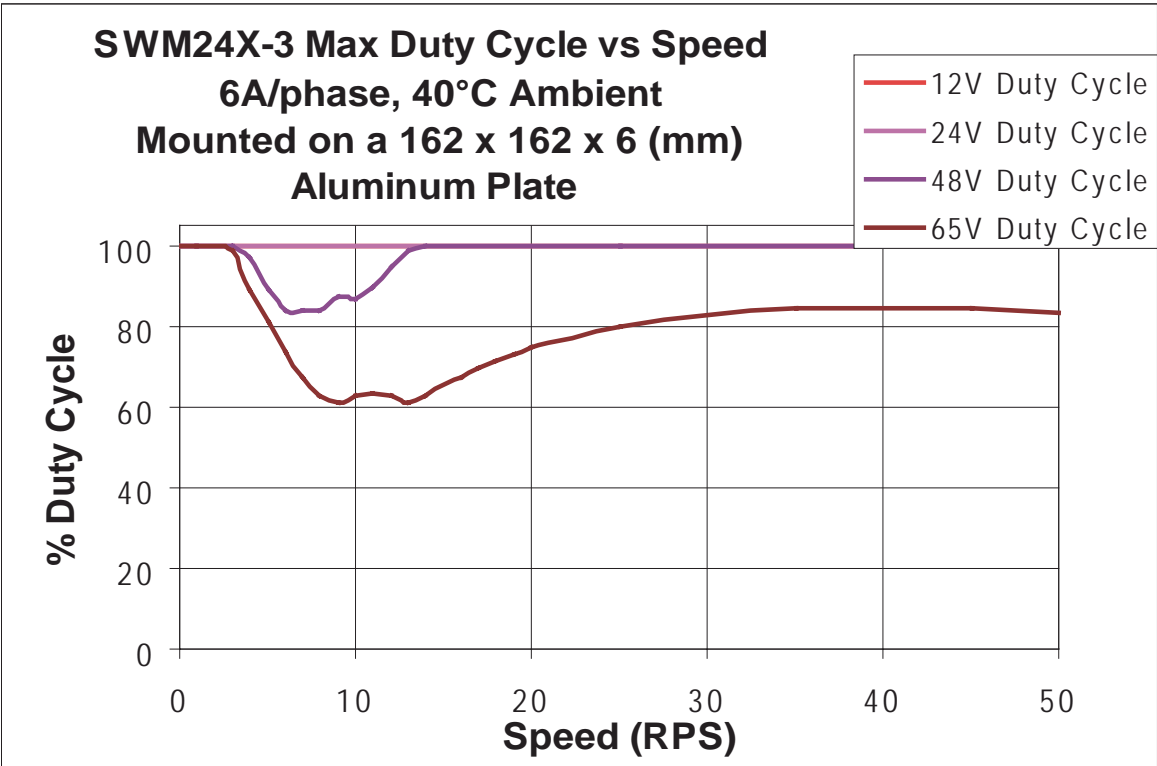
When choosing a power supply, there are many things to consider. If you are manufacturing equipment that will be sold to others, you probably want a supply with all the safety agency approvals. If size and weight are an issue use a switching supply.

You must also decide what size of power supply (in terms of voltage and current) is needed for your application.

### Voltage

The SWM24 is designed to give optimum performance between 24 and 70 volts DC. Choosing the voltage depends on the performance needed and Drive+Motor heating that is acceptable and/or does not cause a drive over-temperature. Higher voltages will give higher speed performance but will cause the Drive+Motor to operate at higher temperatures. Using power supplies with voltage outputs that are near the drive maximum may reduce the operational duty-cycle significantly. See the chart below to determine thermal performance at different power supply voltages

If you choose an unregulated power supply, make sure the no load voltage of the supply does not exceed the drive's maximum input voltage specification.

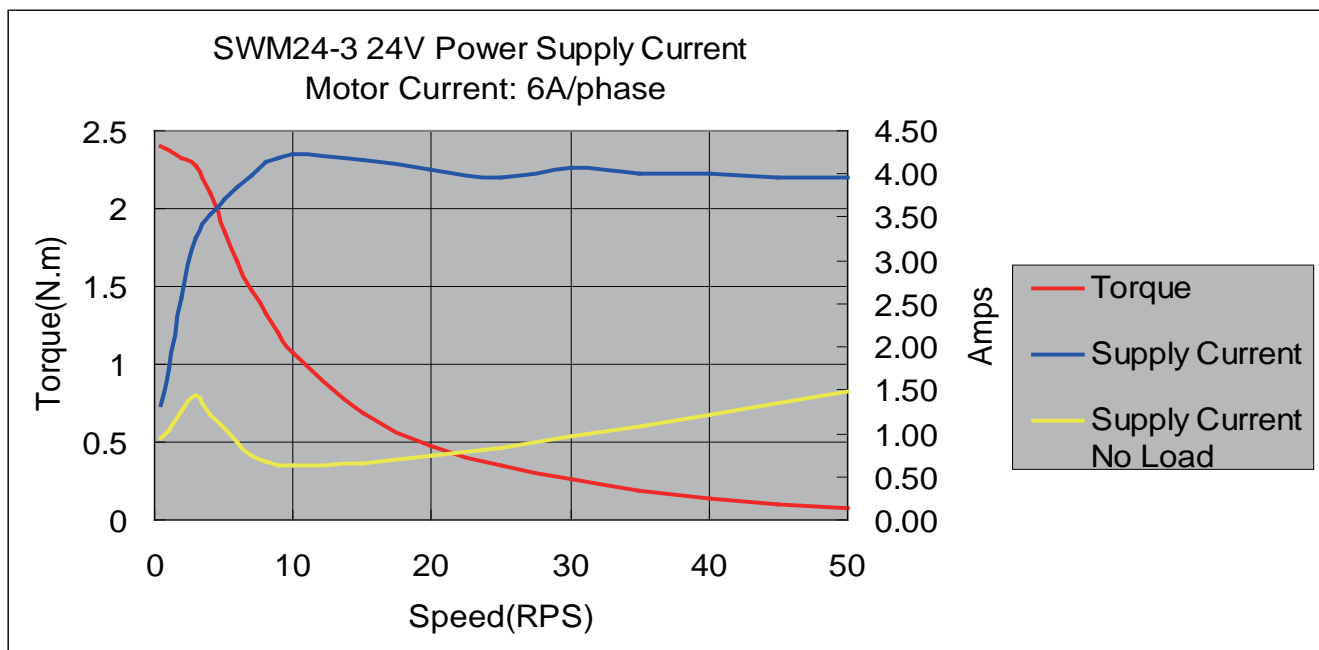
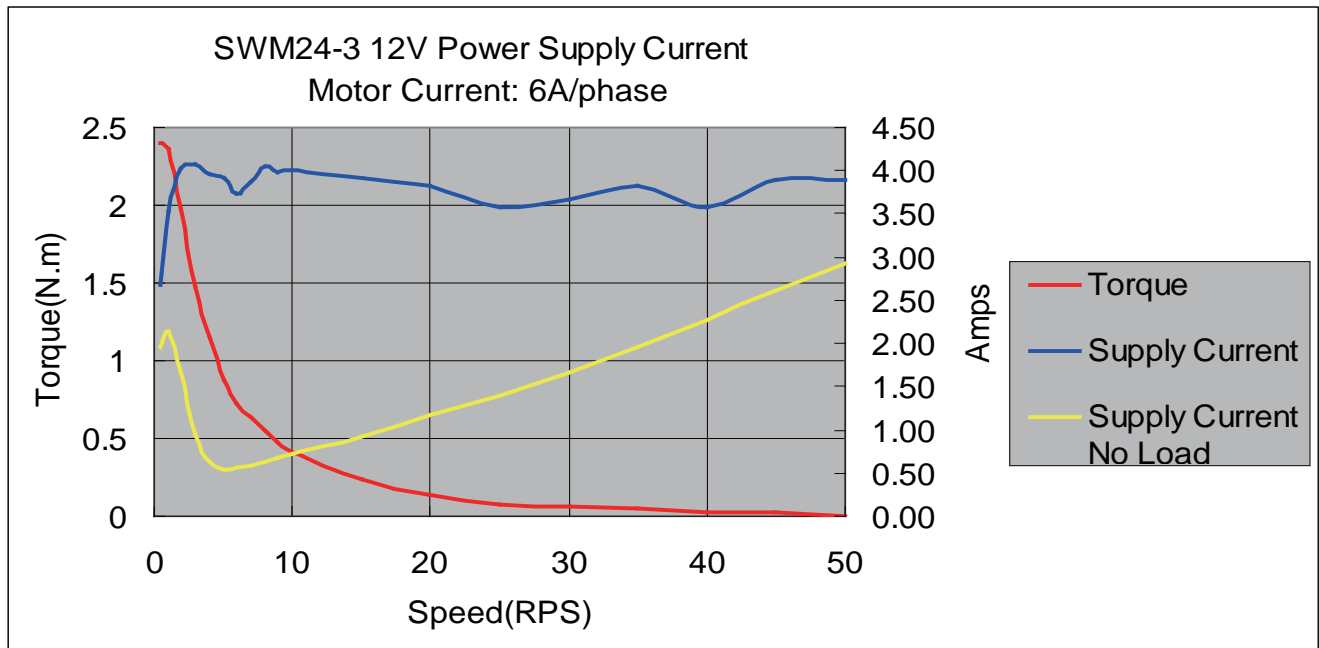


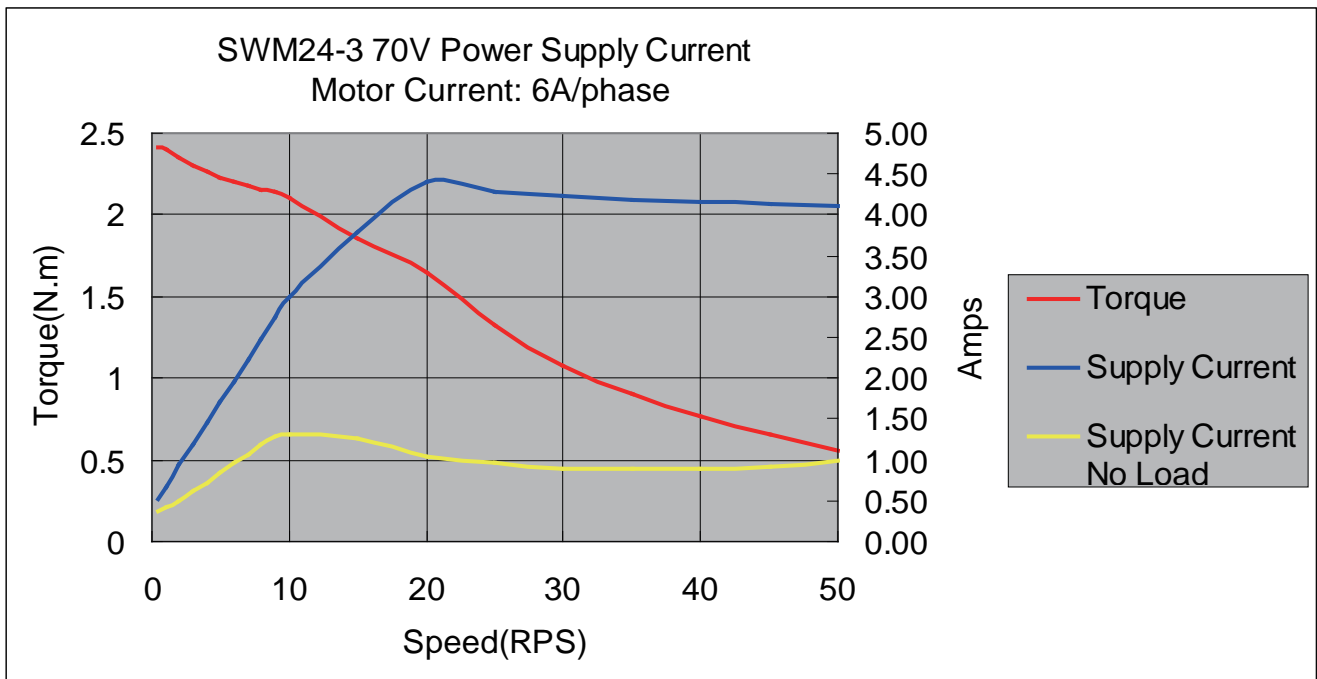
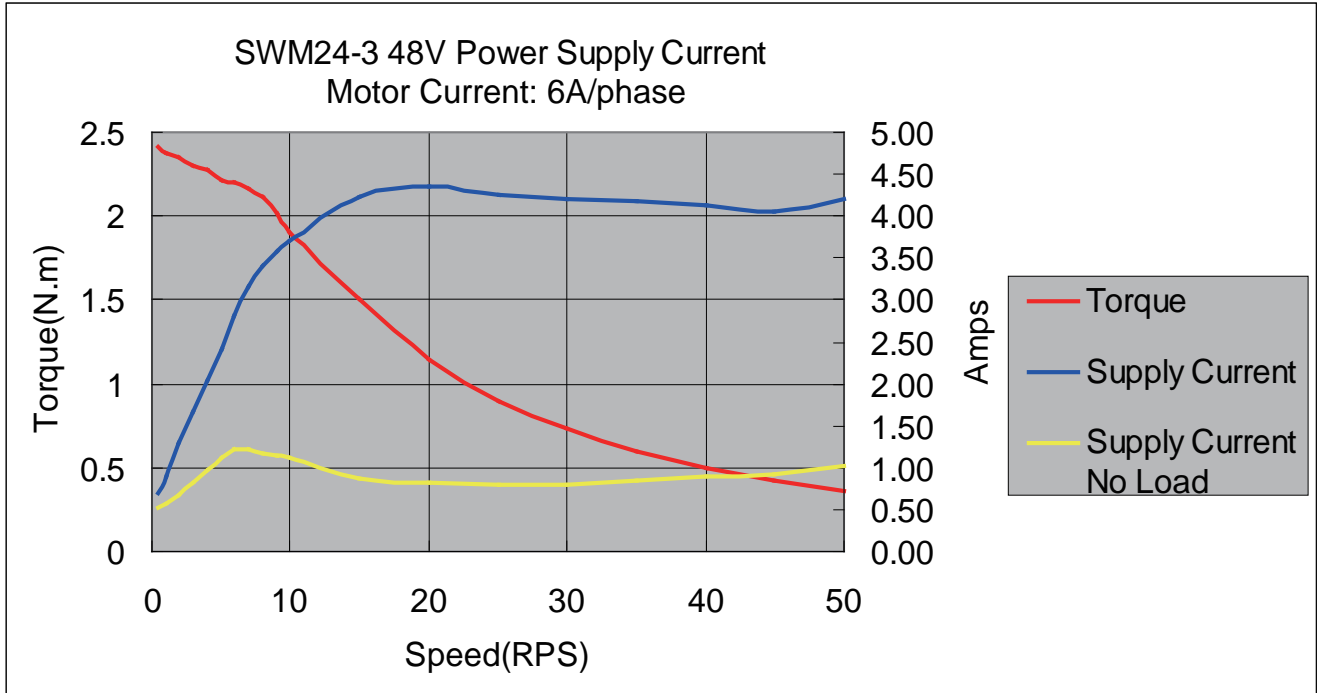


## Current

The maximum supply current required by the SWM24 is shown in the chart below with different power supply voltage inputs. You will note in the chart that the Drive+Motor does not draw as much current as the motor itself. That's because the SWM24 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.

Also note that the current draw is significantly different at higher speeds depending on the torque load to the motor. Estimating your current needs may require a good analysis of the load the motor will encounter.





## Connecting the Power Supply

If you need information about choosing a power supply, please read “Choosing a Power Supply” located above in this manual.

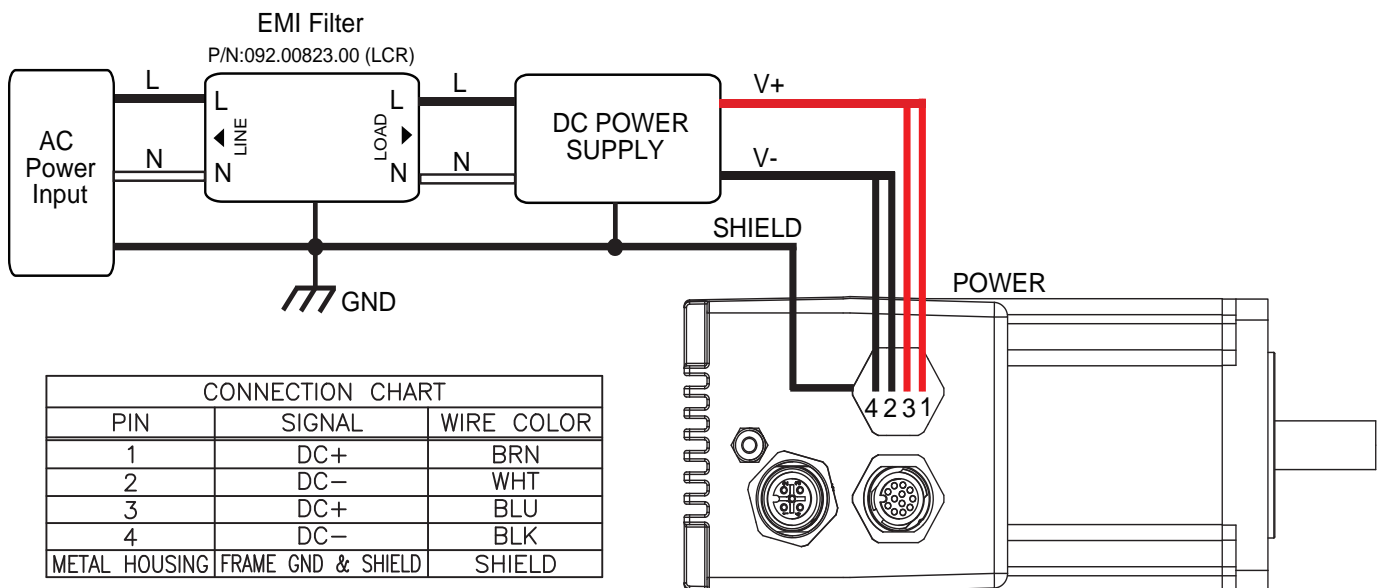
The SWM24 contains an internal fuse that connects to the power supply + terminal. This fuse is not user replaceable. If you want to install a user serviceable fuse in your system install a 5 amp fast acting fuse in line with the + power supply lead.

***Be careful not to reverse the wires. Reverse connection may open the internal fuse on your driver and void your warranty.***

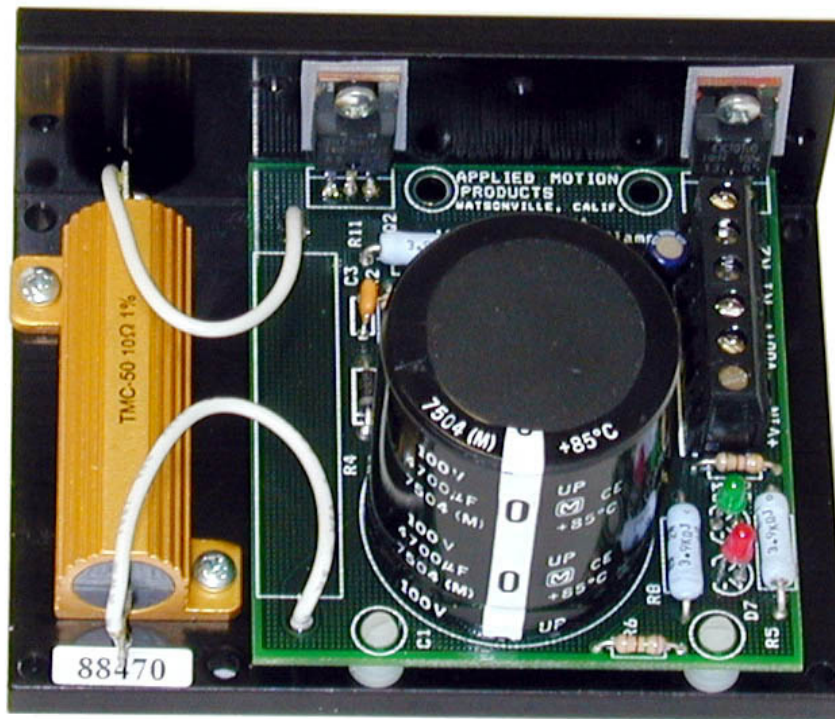


## Installation Requirements for CE Compliance

In order to meet the EMC Directive of CE, a line filter must be installed between AC power and the DC power supply as shown below.



If you plan to use a regulated power supply you may encounter a problem with regeneration. If you rapidly decelerate a load from a high speed, much of the kinetic energy of that load is transferred back to the power supply. This can trip the over-voltage protection of a switching power supply, causing it to shut down. We offer the RC-050 "regeneration clamp" to solve this problem. If in doubt, buy an RC-050 for your first installation. If the "regen" LED on the RC-050 never flashes, you don't need the clamp.



**RC-050 Regen Clamp**

### **+5V Keep-Alive Feature:**

+5Volts can be fed to the +5V terminal to keep the logic alive when the DC bus voltage is removed. This is very useful when an encoder is present, as the position of the system is then known when the DC bus is re-applied. An internal voltage fault will have to be cleared and the motor re-enabled when the DC bus is re-applied. A .4 Amp or larger supply is required for the keep-alive supply.

## Connecting the SWM24 Communications

The SWM24 is available with two types of serial communication: RS-232 (SWM24x-xAx) or Ethernet. Each type requires a different hardware connection for interface to a PC or other host system. Below are descriptions of how to interface the SWM24 to a PC.

### Connecting to a PC Using RS-232

- Locate your computer within 8 feet of the Drive+Motor.
- Your drive was shipped with a communication cable. Plug the large end into the serial port of your PC and the small end into the RS-232 jack (M12 connector) on your drive. Secure the cable to the PC with the screws on the sides.

NOTE: If the PC does not have an RS-232 serial port, a USB Serial Converter will be needed.

The RS-232 circuitry does not have any extra electrical "hardening" and care should be taken when connecting to the RS-232 port as hot plugging could result in circuit failure.

***Do not plug or unplug the RS-232 connection while power is applied to the drive. This is known as "hot plugging" and should be avoided.***

## Connecting to a Host Using Ethernet

This process requires three steps

- Physically connect the drive to your network (or directly to the PC)
- Set the drive's IP address
- Set the appropriate networking properties on your PC.

*Note: the following pages are an excerpt from the "eSCL Communication Reference Guide". For more information, please read the rest of the guide.*

### Addresses, Subnets, and Ports

Every device on an Ethernet network must have a unique IP address. In order for two devices to communicate with each other, they must both be connected to the network and they must have IP addresses that are on the same subnet. A subnet is a logical division of a larger network. Members of one subnet are generally not able to communicate with members of another unless they are connected through special network equipment (e.g. router). Subnets are defined by the choices of IP addresses and subnet masks.

If you want to know the IP address and subnet mask of your PC, select Start...All Programs...Accessories...Command Prompt. Then type "ipconfig" and press Enter. You should see something like this:

```
Windows IP Configuration

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix . : 
    IP Address. . . . . : 192.168.0.22
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.0.254
```

If your PC's subnet mask is set to 255.255.255.0, a common setting known as a Class C subnet mask, then your machine can only talk to another network device whose IP address matches yours in the first three octets. (The numbers between the dots in an IP address are called octets.) For example, if your PC is on a Class C subnet and has an IP address of 192.168.0.20, it can talk to a device at 192.168.0.40, but not one at 192.168.1.40. If you change your subnet mask to 255.255.0.0 (Class B) you can talk to any device whose first two octets match yours. Be sure to ask your system administrator before doing this. Your network may be segmented for a reason.

Your drive's IP Address is stored internally in nonvolatile memory. The factory default address is 10.10.10.10. This address can be changed using our ST Configurator software. See Edit IP Address Table under the Drive menu.

If someone were to change the setting and not write it down or tell anyone (I'm not naming names here, but you know who I'm talking about) then you will not be able to communicate with your drive. The only way to "recover" it is to apply power to the SWM24 with the network cable unplugged. The SWM24 will detect this condition and revert to a recovery address of 10.10.10.10. You may then connect your cable to the network and use ST Configurator to upload and change the stored address (using Edit IP Address Table under the Drive menu).

Your PC, or any other device that you use to communicate with the drive, will also have a unique address.

Use the standard class B subnet mask (i.e. "255.255.0.0"). The mask for the recovery address is the standard class A (i.e. "255.0.0.0").

One of the great features of Ethernet is the ability for many applications to share the network at the same time.

Ports are used to direct traffic to the right application once it gets to the right IP address. The UDP eSCL port in our drives is 7775. To send and receive commands using TCP, use port number 7776. You'll need to know this when you begin to write your own application. You will also need to choose an open (unused) port number for your application. Our drive doesn't care what that is; when the first command is sent to the drive, the drive will make note of the IP address and port number from which it originated and direct any responses there. The drive will also refuse any traffic from other IP addresses that is headed for the eSCL port. The first application to talk to a drive "owns" the drive. This lock is only reset when the drive powers down.

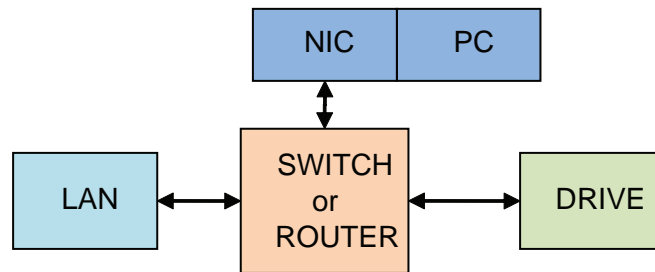
If you need help choosing a port number for your application, you can find a list of commonly used port numbers at <http://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xhtml>.

One final note: Ethernet communication can use one or both of two "transport protocols": UDP and TCP. eSCL commands can be sent and received using either protocol. UDP is simpler and more efficient than TCP, but TCP is more reliable on large or very busy networks where UDP packets might occasionally be dropped.

### Option 1: Connect a Drive to Your Local Area Network

If you have a spare port on a switch or router and if you are able to set your drive to an IP address that is compatible with your network, and not used by anything else, this is a simple way to get connected. This technique also allows you to connect multiple drives to your PC. If you are on a corporate network, please check with your system administrator before connecting anything new to the network. He or she should be able assign you a suitable address and help you get going.

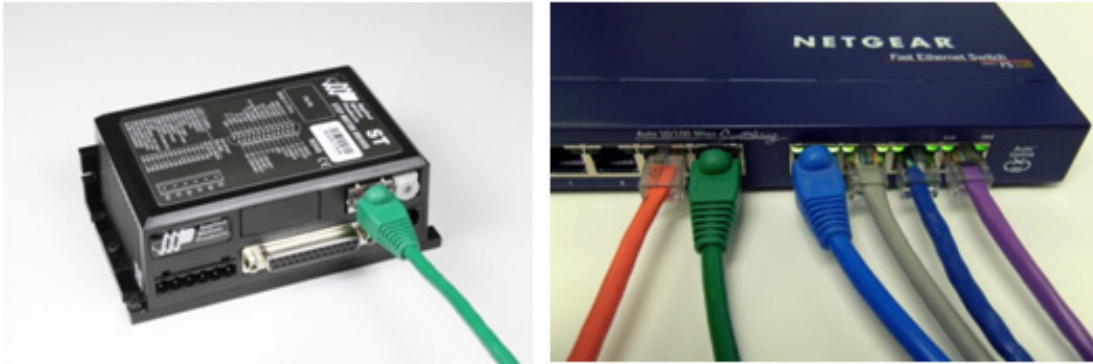
If you are not sure which addresses are already used on your network, you can find out using "Angry IP scanner", which can be downloaded free from <http://www.angryip.org/w/Download>. But be careful: an address might



appear to be unused because a computer or other device is currently turned off. And many networks use dynamic addressing where a DHCP server assigns addresses "on demand". The address you choose for your drive might get assigned to something else by the DHCP server at another time.

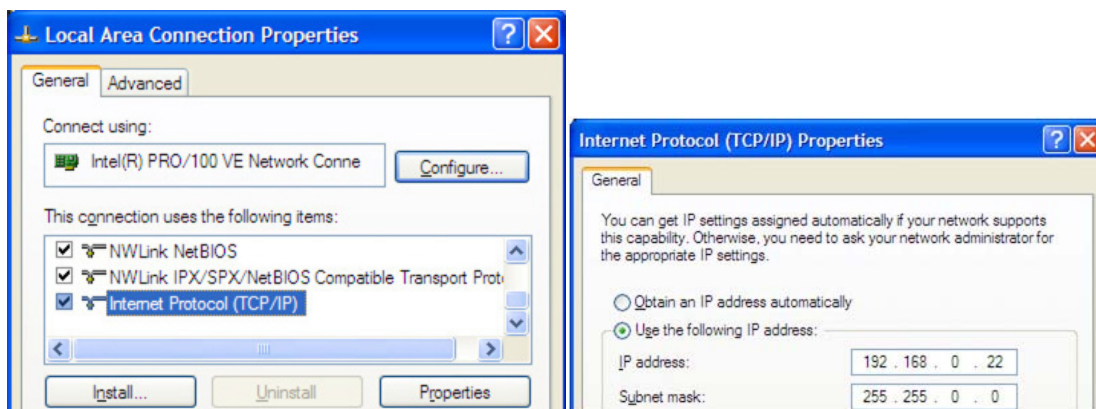


Enter the desired IP address in ST Configurator by using the Edit IP Address Table under the Drive menu. If your network uses addresses starting with 192.168.0, the most common subnet, you will want to assign an address beginning with 192.168.0.



To change your PC's subnet mask:

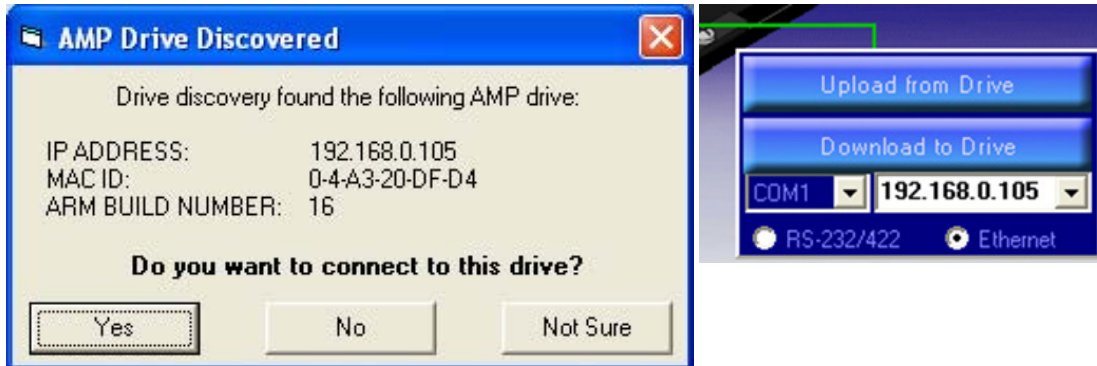
1. On Windows XP, right click on "My Network Places" and select properties. On Windows 7, click Computer. Scroll down the left pane until you see "Network". Right click and select properties. Select "Change adapter settings"
2. You should see an icon for your network interface card (NIC). Right click and select properties.
3. Scroll down until you see "Internet Properties (TCP/IP)". Select this item and click the Properties button. On Windows 7 and Vista, look for "(TCP/IPv4)"
4. If the option "Obtain an IP address automatically" is selected, your PC is getting an IP address and a subnet mask from the DHCP server. Please cancel this dialog and proceed to the next section of this manual: "Using DHCP".
5. If the option "Use the following IP address" is selected, life is good. Change the subnet mask to "255.255.0.0" and click OK.



## Option 2: Connect a Drive Directly to Your PC

When you first receive your SWM24 from the factory, you will need to do this:

1. Connect one end of a CAT5 Ethernet cable into the LAN card (NIC) on your PC and the other into the drive.



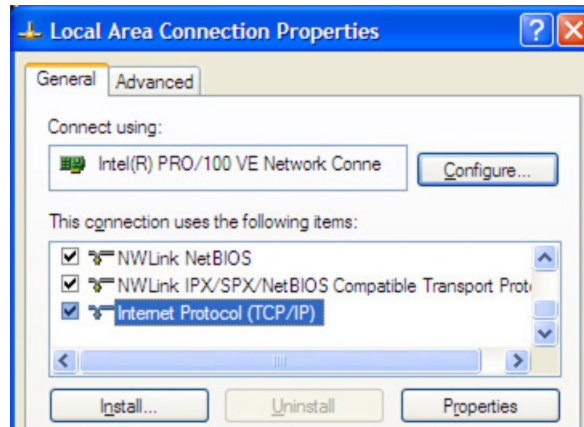
You don't need a special "crossover cable"; the drive will automatically detect the direct connection and make



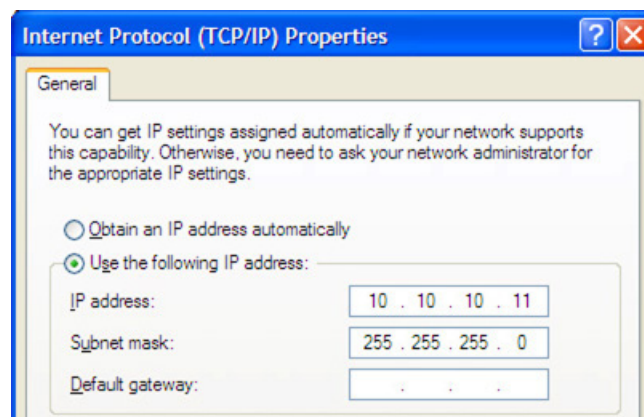
the necessary physical layer changes.

2. Set the IP address on the drive to "10.10.10.10".
3. To set the IP address of your PC:
  - a. On Windows XP, right click on "My Network Places" and select properties.
  - b. On Windows 7, click Computer. Scroll down the left pane until you see "Network". Right click and

- select properties. Select “Change adapter settings”
4. You should see an icon for your network interface card (NIC). Right click and select properties.
    - a. Scroll down until you see “Internet Properties (TCP/IP)”. Select this item and click the Properties button.
    - b. On Windows 7 and Vista, look for “(TCP/IPv4)”
  5. Select the option “Use the following IP address”. Then enter the address “10.10.10.11”. This will give your PC an IP address that is on the same subnet as the drive. Windows will know to direct any traffic intended for the drive’s IP address to this interface card.



6. Next, enter the subnet mask as “255.255.255.0”.
7. Be sure to leave “Default gateway” blank. This will prevent your PC from looking for a router on this subnet.
8. Because you are connected directly to the drive, anytime the drive is not powered on, your PC will annoy you with a small message bubble in the corner of your screen saying “The network cable is unplugged.”



### Option 3: Use Two Network Interface Cards (NICs)

This technique allows you to keep your PC connected to your LAN, but keeps the drive off the LAN, preventing possible IP conflicts or excessive traffic.

1. If you use a desktop PC and have a spare card slot, install a second NIC and connect it directly to the



drive using a CAT5 cable. You don't need a special "crossover cable"; the drive will automatically detect the direct connection and make the necessary physical layer changes.

2. If you use a laptop and only connect to your LAN using wireless networking, you can use the built-in RJ45 Ethernet connection as your second NIC.
3. Set the IP address on the drive to "10.10.10.10".
4. To set the IP address of the second NIC:
  - a. On Windows XP, right click on "My Network Places" and select properties.
  - b. On Windows 7, click Computer. Scroll down the left pane until you see "Network". Right click and select properties. Select "Change adapter settings"
5. You should see an icon for your newly instated NIC. Right click again and select properties.
  - a. Scroll down until you see "Internet Properties (TCP/IP)". Select this item and click the Properties button.
  - b. On Windows 7 and Vista, look for "(TCP/IPv4)"
6. Select the option "Use the following IP address". Then enter the address "10.10.10.11". This will give your PC an IP address that is on the same subnet as the drive. Windows will know to direct any traffic intended for the drive's IP address to this interface card.
7. Next, enter the subnet mask as "255.255.255.0". Be sure to leave "Default gateway" blank. This will prevent your PC from looking for a router on this subnet.
8. Because you are connected directly to the drive, anytime the drive is not powered on your PC will annoy you with a small message bubble in the corner of your screen saying "The network cable is unplugged."

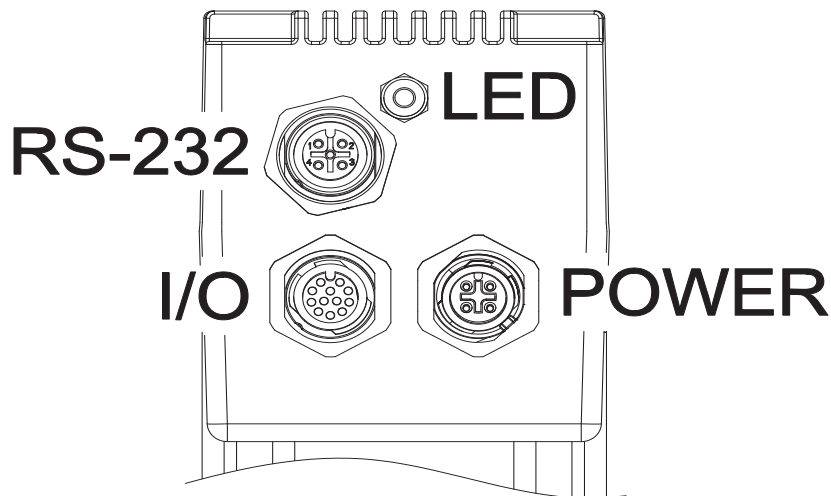
## Inputs and Outputs (-SF and -QF)

The SWM24SF and SWM24QF have four “flex I/O” points. Each can be configured as a digital input or a digital output. In addition, pre-defined functions such as motor enable or fault output can be assigned, providing the flexibility to handle a diverse range of applications.

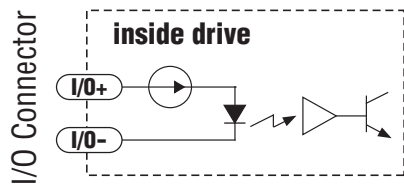
*ST Configurator™* is used to set each flex I/O point as an input or output. *ST Configurator™* can also be used to assign functions to each I/O point, or functions can be assigned “on the fly” from SCL streaming commands or stored Q\_programs. Example connection diagrams can be found on the following pages.

I/O Functions (configure in software)			
I/O 1	I/O 2	I/O 3	I/O 4
Step Input	Direction Input		
Jog CW Input	Jog CCW Input	Limit CW Input	Limit CCW Input
Enable Input	Alarm Reset Input	Enable Input	Alarm Reset Input
Start/Stop Input		Change Speed Input	
General Purpose Input	General Purpose Input	General Purpose Input	General Purpose Input
Brake Output	Brake Output	Brake Output	Brake Output
Fault Output	Fault Output	Fault Output	Fault Output
Motion Output	Motion Output	Motion Output	Motion Output
Tach Output	Tach Output	Tach Output	Tach Output
General Purpose Output	General Purpose Output	General Purpose Output	General Purpose Output

SWM24 Connectors

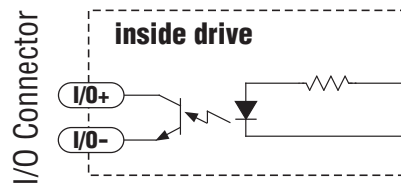


*Refer to connection charts at the end of this manual for wire colors on mating cables.*

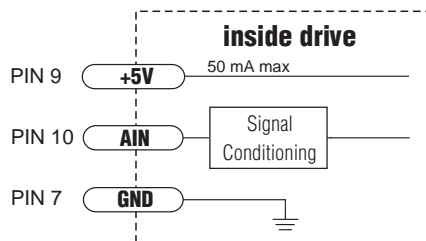


**Equivalent Circuit: Flex I/O Point Set as Input**

I/O	PIN
1+	1
1-	3
2+	5
2-	8
3+	6
3-	4
4+	11
4-	12



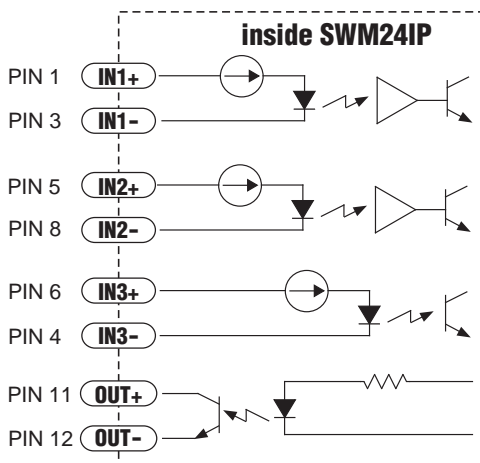
**Equivalent Circuit: Flex I/O Point Set as Output**



**Equivalent Circuit: Analog Input (page 35 for details)**

## Inputs and Outputs (-S, -Q, -IP)

The SWM24S, SWM24Q, and SWM24IP have three digital inputs and one digital output. IN1 and IN2 are high speed inputs that can be configured for a number of different functions. Typically these inputs connect to an external controller that provides step & direction command signals. You can also connect a master encoder to the high-speed inputs for “following” applications. IN3 may be configured as an Enable/Disable input or a general purpose input. All 3 inputs can be configured in ST Configurator for use with Wait Input, If Input, Feed to Sensor, Seek Home and other SCL or Q commands. The output (OUT) can be configured for different functions also. See table below. Example connection diagrams can be found on the following pages.



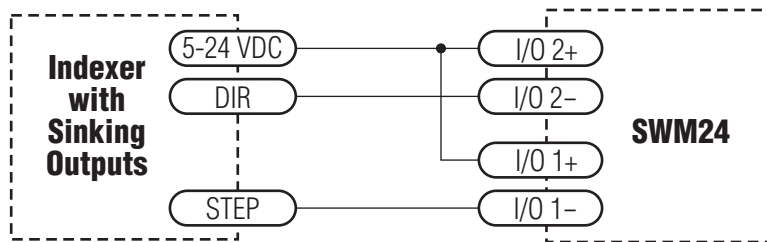
**Equivalent Circuit (page 35 for details)**

I/O Functions (configure in software)			
IN1	IN2	IN3	OUT
Clockwise Limit	Counterclockwise Limit	Home Sensor	Fault
General Purpose Input	General Purpose Input	Enable Input	Brake
Step Input	Direction Input	General Purpose Input	Motion
Jog CW Input	Jog CCW Input		Tach
Enable Input	Alarm Reset Input		General Purpose Output
Start/Stop Input			

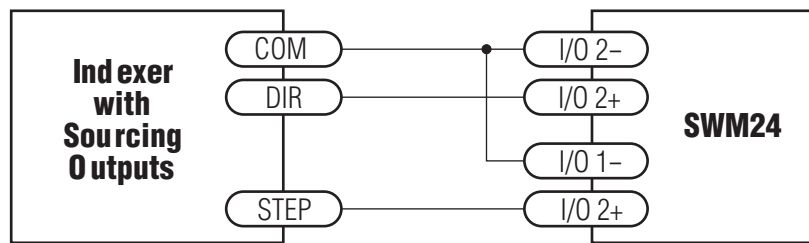
## Connecting Step and Direction Signals

All SWM24 drives include two high-speed inputs that can accept 5 to 24 volt single-ended or differential signals, up to 3 MHz. These inputs can be connected to an external controller that provides step & direction (or step CW and step CCW) command signals. You can also connect a master encoder to the high-speed inputs for "following" applications. Or you can use these inputs with Wait Input, If Input, Feed to Sensor, Seek Home and other SCL or Q commands.

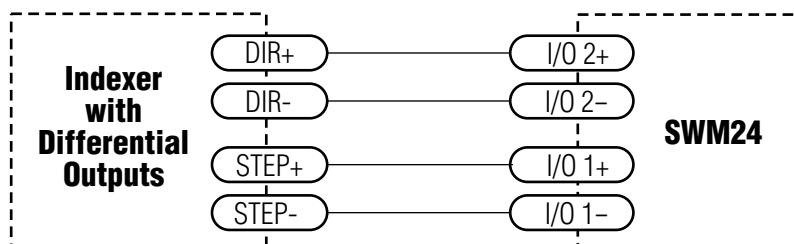
Connection diagrams follow.



Connecting to indexer with Sinking Outputs

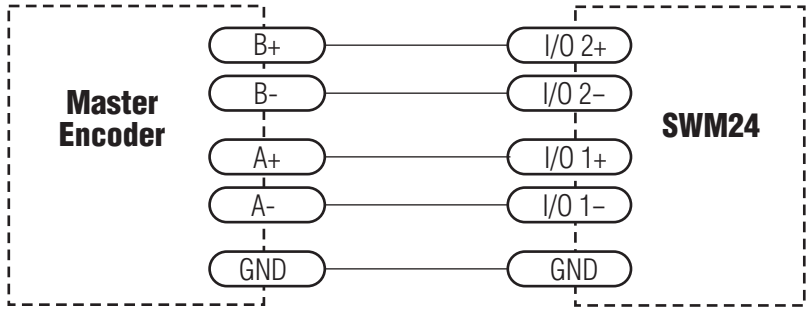


Connecting to indexer with Sourcing Outputs



Connecting to Indexer with Differential Outputs

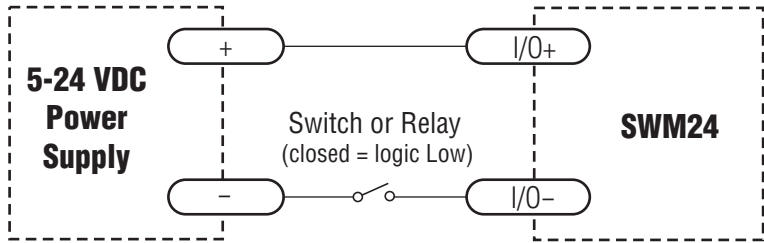




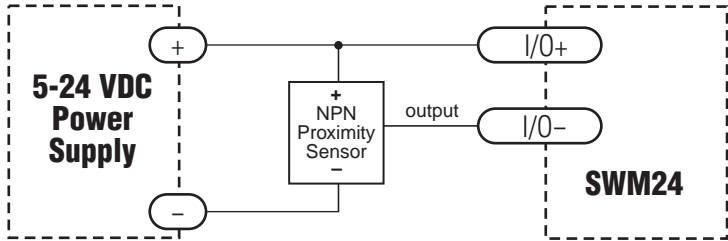
### Wiring for Encoder Following

#### Connecting Other Signals

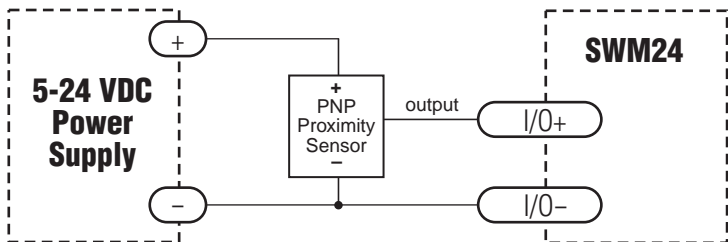
*Note: If current is flowing into or out of an input, the logic state of that input is low or closed. If no current is flowing, or the input is not connected, the logic state is high or open.*



### Using Mechanical Switches



Connecting an NPN Type Proximity Sensor to an Input  
(When prox sensor activates, input goes low).

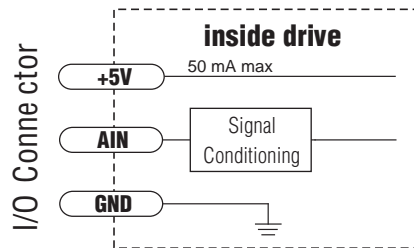


Connecting a PNP Type Proximity Sensor to an Input  
(When prox sensor activates, input goes low).

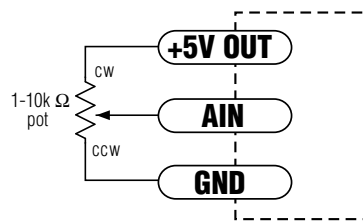


## Analog Input

All SWM24 drives feature an analog input. The input can accept a signal range of 0 to 5 VDC. The drive can be configured to operate at a speed or position that is proportional to the incoming analog signal. Use the *ST Configurator™* software to set the signal range, offset, dead-band and filter frequency. The SWM24 provides a +5VDC 50ma output that can be used to power external devices such as potentiometers. It is not the most accurate supply for reference; for more precise readings use an external supply that can provide the desired accuracy.



### Analog Input Circuit



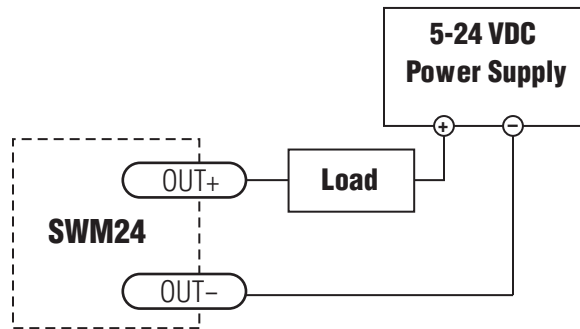
### Connecting a Potentiometer to the Analog Input

## Programmable Output

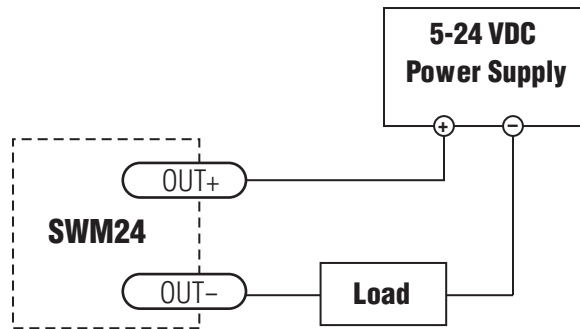
The SWM24SF and SWM24QF include four “flex I/O” points which can be individually configured to act as digital outputs. The SWM24Q, SWM24S and SWM24IP includes one dedicated digital output. Each output can be set to automatically control a motor brake, to signal a fault condition, to indicate when the motor is moving or to provide an output frequency proportional to motor speed (tach signal). An output can also be turned on and off by program instructions like Set Output. An output can be used to drive LEDs, relays and the inputs of other electronic devices like PLCs and counters. The “OUT+” (collector) and “OUT-” (emitter) terminals of the transistor are available at the connector. This allows you to configure the output for current sourcing or sinking.

Diagrams of various connection types follow.

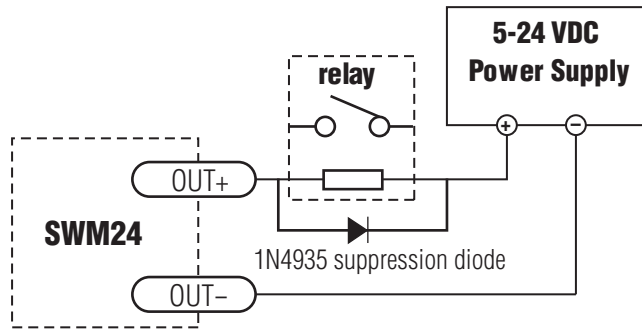
**Do not connect the output to more than 30VDC.**  
**The current through the output terminal must not exceed 40ma.**



Connecting a Sinking Output



Connecting a Sourcing Output

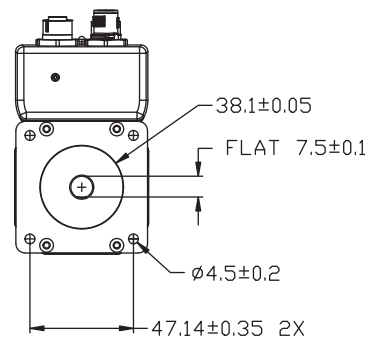
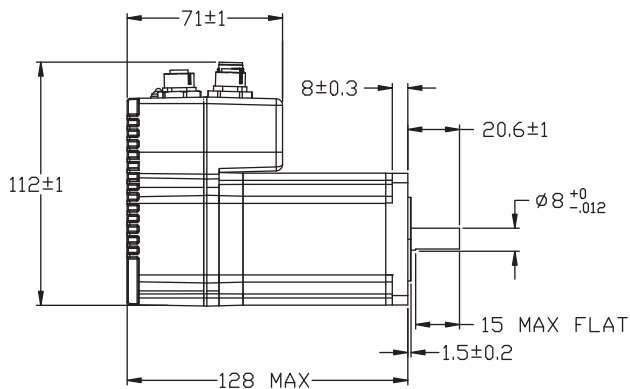
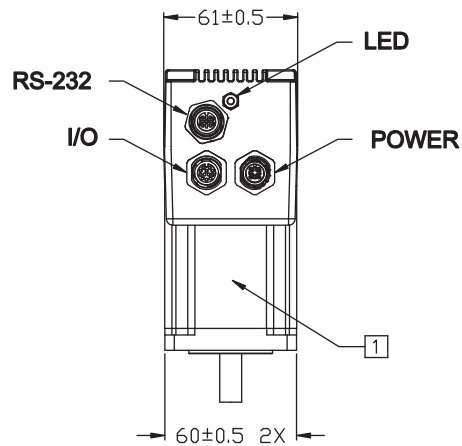
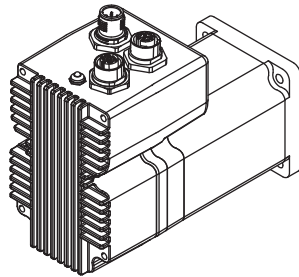


### Connecting to a load with a coil

*Note - A suppression diode should be placed in parallel with the coil when driving any inductive load such as a relay coil, a valve coil, a solenoid coil, etc*

## Reference Materials

## Mechanical Outline



## Technical Specifications

<b>POWER AMPLIFIER: All Models</b>	
AMPLIFIER TYPE	Dual H-Bridge, 4 quadrant
CURRENT CONTROL	4 state PWM at 20 kHz
OUTPUT TORQUE	340 oz-in with suitable power supply
POWER SUPPLY	External 12 - 70 VDC power supply required
INPUT VOLTAGE RANGE	10 - 75 min/max (nominal 12 - 70 VDC)
PROTECTION	Over-voltage, under-voltage, over-temp, motor/wiring shorts (phase-to-phase, phase-to-ground)
IDLE CURRENT REDUCTION	Reduction range of 0 - 90% of running current after delay selectable in milliseconds

<b>PHYSICAL AND ENVIRONMENTAL</b>	
MASS	1.58 kg (56 oz)
ROTOR INERTIA	900 g-cm <sup>2</sup> (1.27 x 10 <sup>-2</sup> oz-in-sec <sup>2</sup> )
AMBIENT TEMPERATURE	0 to 40°C (32 - 104°F) when mounted to suitable heatsink
HUMIDITY	90% non-condensing
AXIAL BEARING LOAD RATING	3.37 Lbs
RADIAL BEARING LOAD RATING	15.96 Lbs

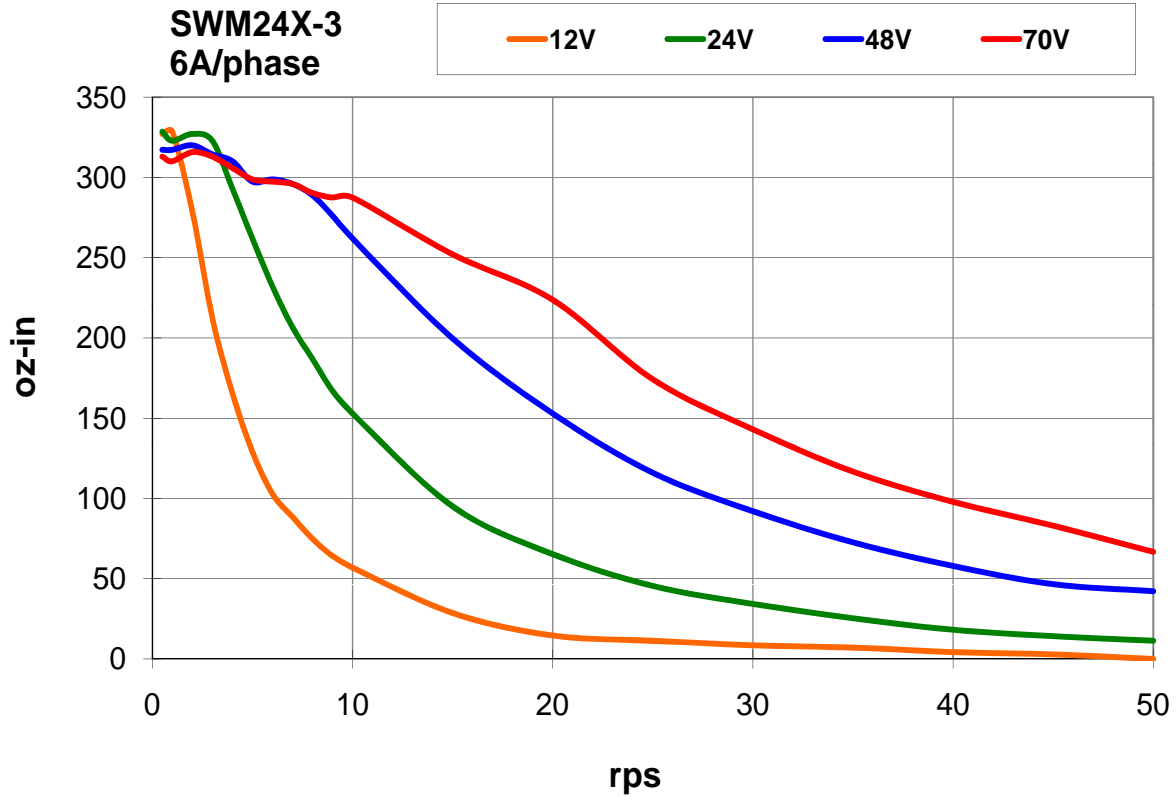
<b>CONTROLLER: All Models</b>	
MICROSTEP RESOLUTION	Software selectable from 200 to 51200 steps/rev in increments of 2 steps/rev
SPEED RANGE	0.00416 to 50 revolutions/second
DISTANCE RANGE	Up to 10,000,000 revolutions (at 200 steps/rev)
ANTI-RESONANCE (Electronic Damping)	Raises the system damping ratio to eliminate midrange instability and allow stable operation throughout the speed range and improves settling time.
TORQUE RIPPLE SMOOTHING	Allows for fine adjustment of phase current waveform harmonic content to reduce low-speed torque ripple in the range 0.25 to 1.5 rps
AUTO SETUP	Measures motor parameters and configures motor current control and anti-resonance gain settings
SELF TEST	Checks internal & external power supply voltages. Diagnoses open motor phases and motor resistance changes >40%.
MICROSTEP EMULATION	Performs high resolution stepping by synthesizing fine microsteps from coarse steps (Step & Direction mode only)
COMMAND SIGNAL SMOOTHING	Software configurable filtering reduces jerk and excitation of extraneous system resonances (Step & Direction mode only).
ENCODER	1000 lines (4000 counts/revolution). Index pulse mapped to input "0". See Host Command Reference for more information.

<b>CONTROLLER: SF &amp; QF Models</b>	
MODES OF OPERATION	Step & direction, CW/CCW pulse, A/B quadrature, oscillator, joystick, SCL streaming commands, stored programs (Q only).
I/O 1 (STEP)	<p>INPUT: Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter.</p> <p>Function: Step, CW Step, A quadrature, CW jog, Start/stop (oscillator mode), motor enable, general purpose Input.</p> <p>OUTPUT: Optically isolated, open emitter/collector, 30V, 40 mA max. 10 kHz max. Function: fault, motion, tach, brake, general purpose</p>
I/O 2 (DIR)	<p>INPUT: Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter. Function: direction (step &amp; direction or oscillator modes), CCW step, B quadrature, alarm reset, CCW jog, sensor, general purpose input.</p> <p>OUTPUT: Optically isolated, open emitter/collector, 30V, 40 mA max. 10 kHz max. Function: fault, motion, tach, brake, general purpose</p>
I/O 3	<p>INPUT: Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter. Function: speed change (oscillator mode), CW limit, sensor, motor enable, general purpose input.</p> <p>OUTPUT: Optically isolated, open emitter/collector, 30V, 40 mA max. 10 kHz max. Function: fault, motion, tach, brake, general purpose</p>
I/O 4	<p>INPUT: Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter.</p> <p>Function: Alarm reset, CCW limit, sensor, general purpose input.</p> <p>OUTPUT: Optically isolated, open emitter/collector, 30V, 40 mA max. 10 kHz max. Function: fault, motion, tach, brake, general purpose</p>
ANALOG INPUT RANGE (AIN)	0 to 5VDC
ANALOG INPUT RESOLUTION	12 bits
COMMUNICATION	RS-232
5 VOLT USER OUTPUT	4.8 to 5.0 VDC, 50 mA maximum

<b>CONTROLLER: -S, -Q, -IP Models</b>	
IN1	Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter Function: CW limit, general purpose input.
IN2	Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter Function: CCW limit, general purpose input.
IN3	Optically isolated, 5-24 V, 8-12 mA. Function: home sensor, general purpose input.
OUT	Optically isolated, 30V, 40mA MAX. open emitter/collector. Function: fault, motion, alarm, tach or general purpose

## Torque-Speed Curves

Note: all torque curves were measured at 20,000 steps/rev.



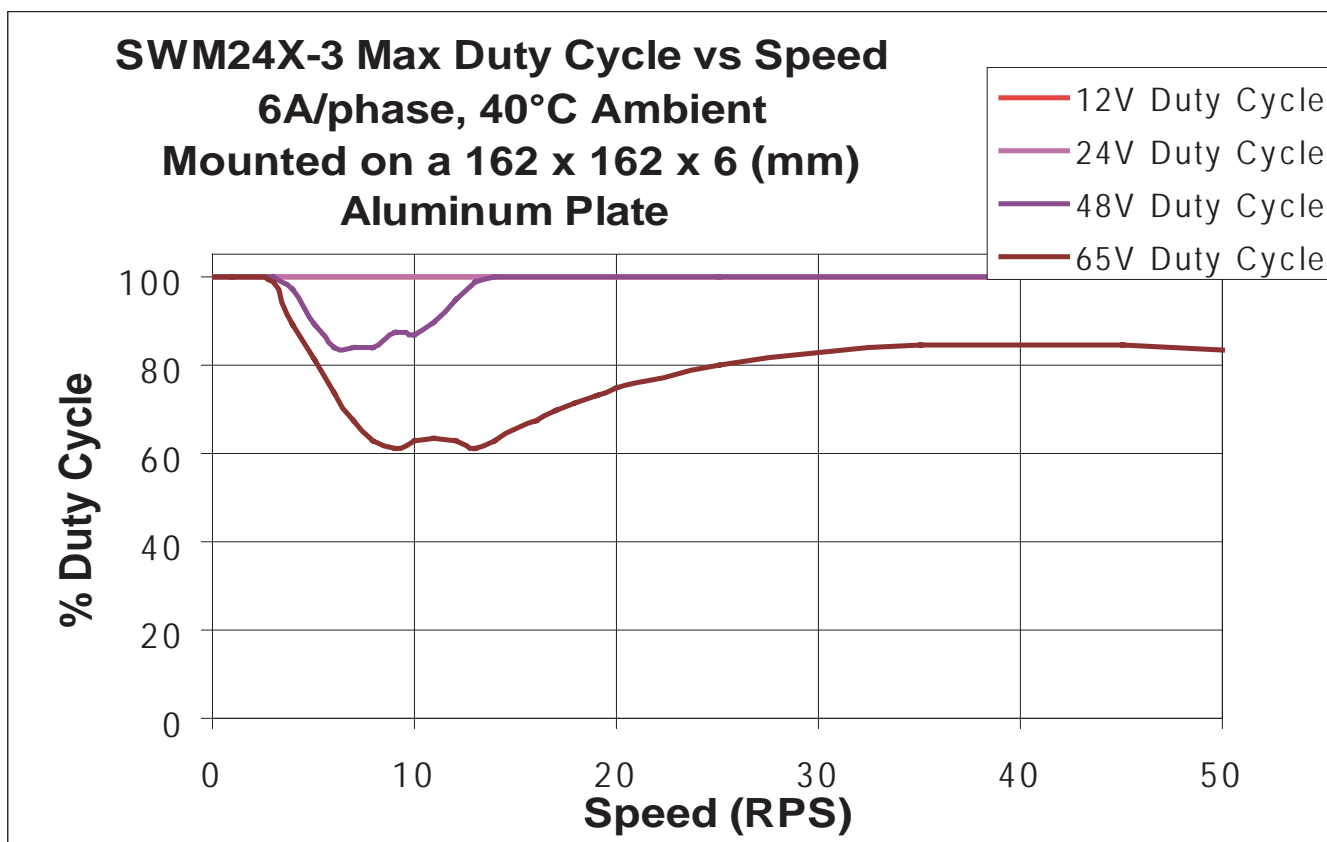
## Drive/Motor Heating

Step motors convert electrical power from the driver into mechanical power to move a load. Because step motors are not perfectly efficient, some of the electrical power turns into heat on its way through the motor. This heating is not so much dependent on the load being driven but rather the motor speed and power supply voltage. There are certain combinations of speed and voltage at which a motor cannot be continuously operated without damage.

We have characterized the SWM24 in our lab and provided curves showing the maximum duty cycle versus speed for commonly used power supply voltages. Please refer to these curves when planning your application.

Please also keep in mind that a step motor typically reaches maximum temperature after 30 to 45 minutes of operation. If you run the motor for one minute then let it sit idle for one minute, that is a 50% duty cycle. Five minutes on and five minutes off is also 50% duty. However, one hour on and one hour off has the effect of 100% duty because during the first hour the motor will reach full (and possibly excessive) temperature.

The actual temperature of the motor depends on how much heat is conducted, convected or radiated out of it. Our measurements were made in a 40°C (104°F) environment with the motor mounted to an aluminum plate sized to provide a surface area consistent with the motor power dissipation. Your results may vary.





## Mating Connectors and Accessories

Connector	Part Number - Manufacturer
DC Power (4 Pin A-Coded M12 Male)	1523450 - Phoenix
I/O (12 Pin A-Coded M12 Female)	1556252 - Phoenix
RS-232 (5 Pin A-Coded M12 Female)	1542729 - Phoenix
Ethernet (4 Pin D-Coded M12 Female)	1535202 - Phoenix

### Accessories

Serial programming cable for programming units with RS-232 ports (SWM24x-xAx): P/N 3004-278-xM (see Mating Cables list below)

Note: Prolific-based USB serial adapters do not work with Vista 64 or Windows 7 64 bit operating systems. Suggested serial adapters are Applied Motion Products 3004-235, 8500-003 or Byterunner USB-COM-CBL.

### DC Power Supplies

24 V, 150 W switching power supply, P/N PS150A24

48 V, 320 W switching power supply, P/N PS320A48

Regeneration clamp for use with high inertial loads: RC-050

### Mating Cables

Usually available from stock in 5 meter (16.4 foot) lengths

DC Power Cable - AMP 3004-277-xM

RS-232 Cable - AMP 3004-278-xM

Ethernet Cable - AMP 3004-280-xM




















I/O Cable - AMP 3004-290-xM

## LED Error Codes

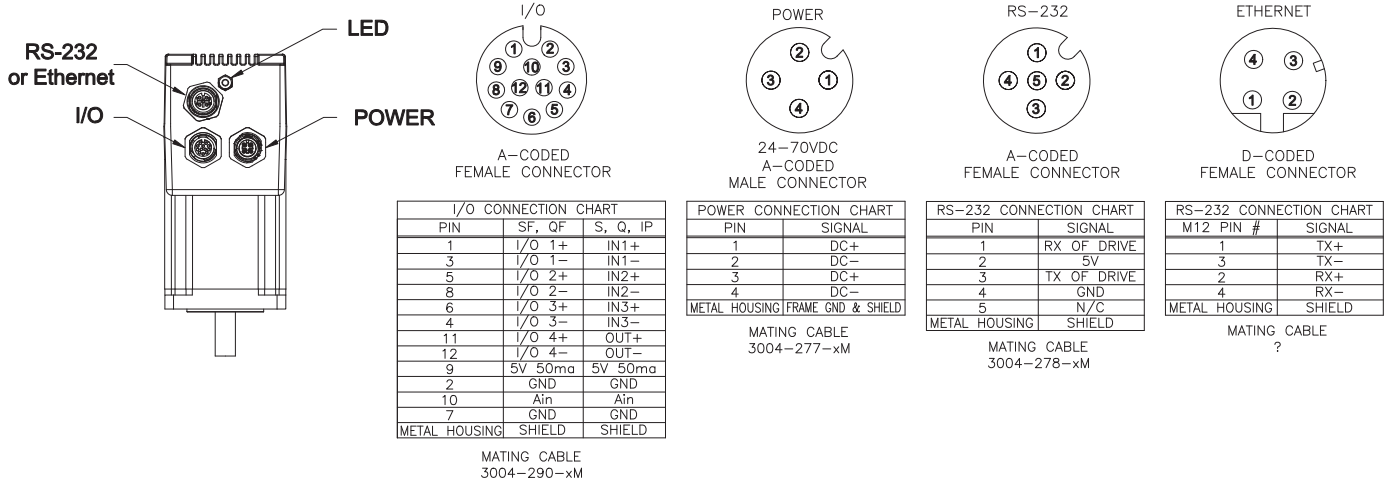
### Status LED SWM

The SWM24 drive+motor includes a red/green LED to indicate status. When the motor is enabled, the LED flashes green slowly. When the green LED is solid, the motor is disabled.

Errors are indicated by combinations of red and green "flashes" as follows:

Code	Error
 solid green	no alarm, motor disabled
 flashing green	no alarm, motor enabled
 fast green	Q program running
 1 red, 1 green	motor disabled after a stall condition occurred
 1 red, 2 green	move attempted while drive disabled
 2 red, 1 green	ccw limit
 2 red, 2 green	cw limit
 3 red, 1 green	drive overheating
 3 red, 2 green	internal voltage out of range
 3 red, 3 green	blank Q segment
 4 red, 1 green	power supply overvoltage
 4 red, 2 green	power supply undervoltage
 4 red, 3 green	flash memory backup error
 5 red, 1 green	over current / short circuit
 5 red, 2 green	I/O occupied
 6 red, 1 green	open motor winding
 6 red, 2 green	bad encoder signal
 7 red, 1 green	serial communication error
 7 red, 2 green	flash memory error

## SWM24x-3x Connector Pin Diagrams



## SWM24x-3x Cable Connection Charts

RS-232 CORD  
3004-278-XX

M12 CONN PIN	SIGNAL	WIRE COLOR	DB-9 CONN PIN
1	Rx OF DRIVE	BRN	3
2	5V	WHT	N/C
3	Tx OF DRIVE	BLU	2
4	GND	BLK	5
5	N/C	GRY	N/C
METAL HOUSING	SHIELD	SHIELD	N/C

ETHERNET CABLE  
3004-280-XX

RJ45 PIN#	DESCRIPTION	M12 PIN#	SIGNAL
1	TWISTED PAIR	1	TX+
2		3	TX-
3	TWISTED PAIR	2	RX+
6		4	RX-
SHIELD		METAL HOUSING	

I/O CORD  
3004-290-XX

DESCRIPTION	WIRE COLOR	PIN	SIGNAL (SF, QF)	SIGNAL (S, Q, IP)
TWISTED PAIR	BRN	1	I/O 1+	IN1+
	WHT	3	I/O 1-	IN1-
TWISTED PAIR	YEL	6	I/O 3+	IN3+
	GRN	4	I/O 3-	IN3-
TWISTED PAIR	PNK	5	I/O 2+	IN2+
	GRY	8	I/O 2-	IN2-
TWISTED PAIR	BLK	7	GND	GND
	VIO	10	Ain	Ain
TWISTED PAIR	RED	9	5V 50ma	5V 50ma
	BLU	2	GND	GND
TWISTED PAIR	GRY/PNK	11	I/O 4+	OUT+
	RED/BLU	12	I/O 4-	OUT-
METAL HOUSING			SHIELD	SHIELD

POWER CORD  
3004-277-XX

PIN	SIGNAL	WIRE COLOR
1	DC+	BRN
2	DC-	WHT
3	DC+	BLU
4	DC-	BLK
METAL HOUSING	FRAME GND & SHIELD	SHIELD

Ethernet cable (3004-280-xM) is used on all SWM24x-3EE models.

## Contacting Applied Motion Products

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[support@applied-motion.com](mailto:support@applied-motion.com)