



## Contents

Introduction.....	3
Features.....	3
Block Diagrams.....	4
Getting Started.....	6
Mounting the Drive.....	8
Connecting to the PC using RS-232.....	8
Connecting the Drive to Your PC using Ethernet.....	9
Addresses, Subnets, and Ports.....	9
Option 1: Connect a Drive to Your Local Area Network.....	11
Option 2: Connect a Drive Directly to Your PC.....	15
Option 3: Use Two Network Interface Cards (NICs).....	17
Connecting to a host using RS-485 option card.....	18
RS-232 to RS-485 2-wire Converter.....	19
Converting USB to RS-485.....	19
Connecting the Power Supply.....	20
Choosing a Power Supply.....	22
Connecting the Motor.....	23
Driving a Brushed Motor:.....	25
Connecting Input Signals.....	26
Connector Pin Diagram.....	26
High Speed Digital Inputs.....	27
Using High Speed Inputs with 12-24 Volt Signals.....	28
Connecting Limit Switches.....	32
Wiring a Mechanical Limit Switch.....	33
Wiring a Limit Sensor.....	33
Analog Inputs.....	34
Connecting a Potentiometer to Analog Input 1.....	34
Connecting a Motion Controller to the Analog Input.....	34
Programmable Outputs.....	35
Wiring Integral Holding Brakes.....	36
Interfacing to a Motion Controller.....	39
Encoder Outputs.....	39
Setting Drive Current Limits.....	40
What is "Peak Current Limit"?.....	40
Reference Materials.....	41
Recommended NEMA Motors.....	41
Additional Motor Information:.....	41
Recommended Metric Motors.....	42
Motor Outlines.....	43
Torque-Speed Curves.....	46
Mechanical Outline.....	50
Technical Specifications.....	51
Mating Connectors and Accessories.....	51
Alarm Codes.....	53
Connector Diagrams.....	53

## Introduction

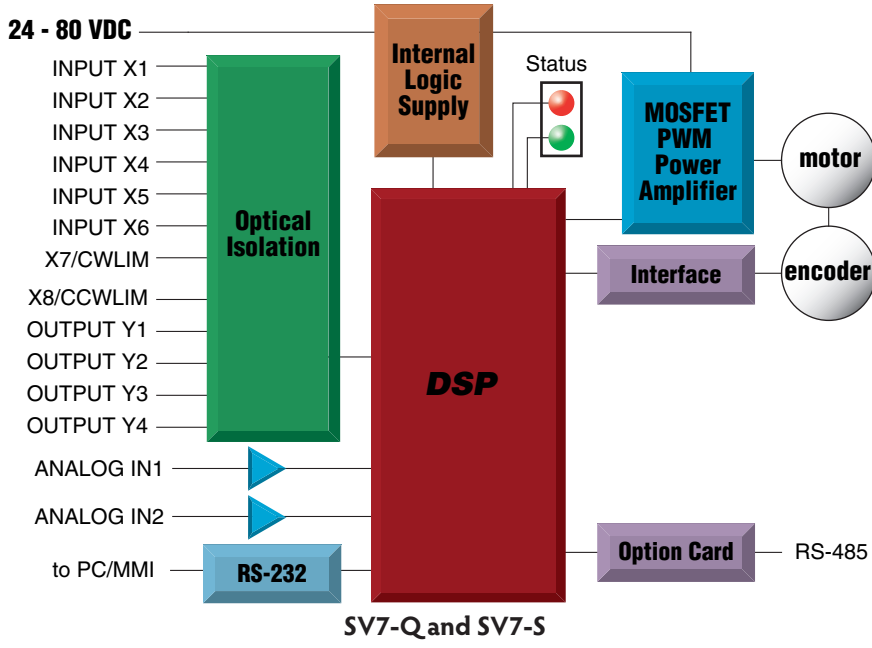
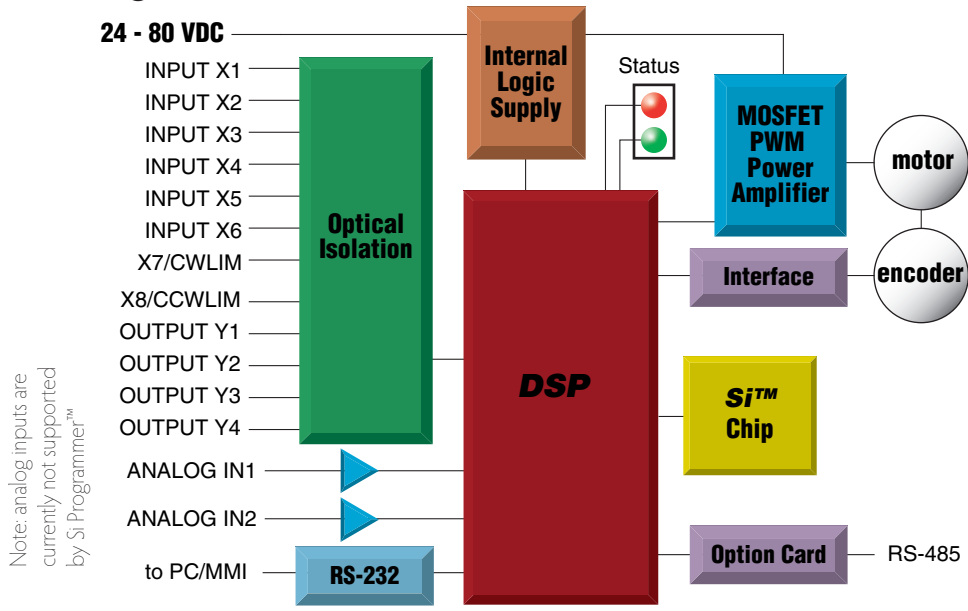
Thank you for selecting an Applied Motion Products motor control. We hope our dedication to performance, quality and economy will make your motion control project successful.

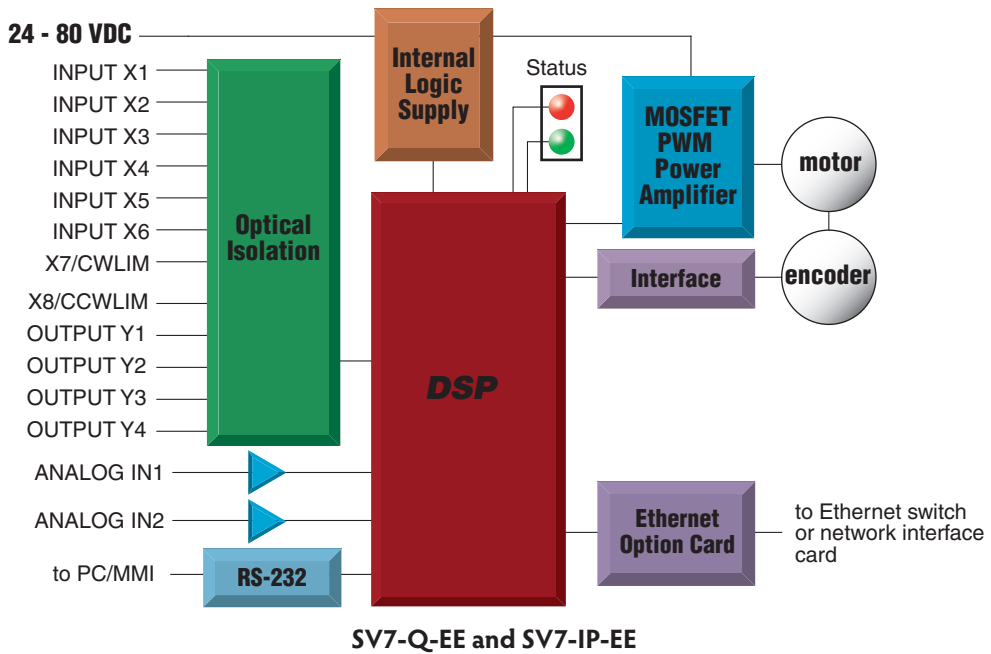
If there's anything we can do to improve our products or help you use them better, please call or fax. We'd like to hear from you. Our phone number is (800) 525-1609, or you can reach us by fax at (831) 761-6544. You can also email [support@applied-motion.com](mailto:support@applied-motion.com).

## Features

- Programmable, digital servo motor driver in compact package
- Operates from a 24 to 80 volt DC power supply
- Operates in torque, velocity or position mode
- Accepts analog signals, digital signals and RS-232 serial commands
- PID position loop with acceleration and velocity feedforward
- Highly responsive digital "DQ" current loop
- Optional RS-422/485 communication
- Optional CANopen DS301 communication with DS402 motion control
- Optional 100 Mbit Ethernet communication using SCL and Q
- Optional Ethernet/IP communication
- Quadrature encoder feedback
- Motor current up to 7 amps rms continuous, 14 amps peak
- Eight optically isolated digital inputs
- Four optically isolated digital outputs
- Two  $\pm 10$  volt analog inputs for torque, speed and position control. Can also be configured for 0 to 10V,  $\pm 5$ V or 0 to 5V signal ranges.

## Block Diagrams





## Getting Started

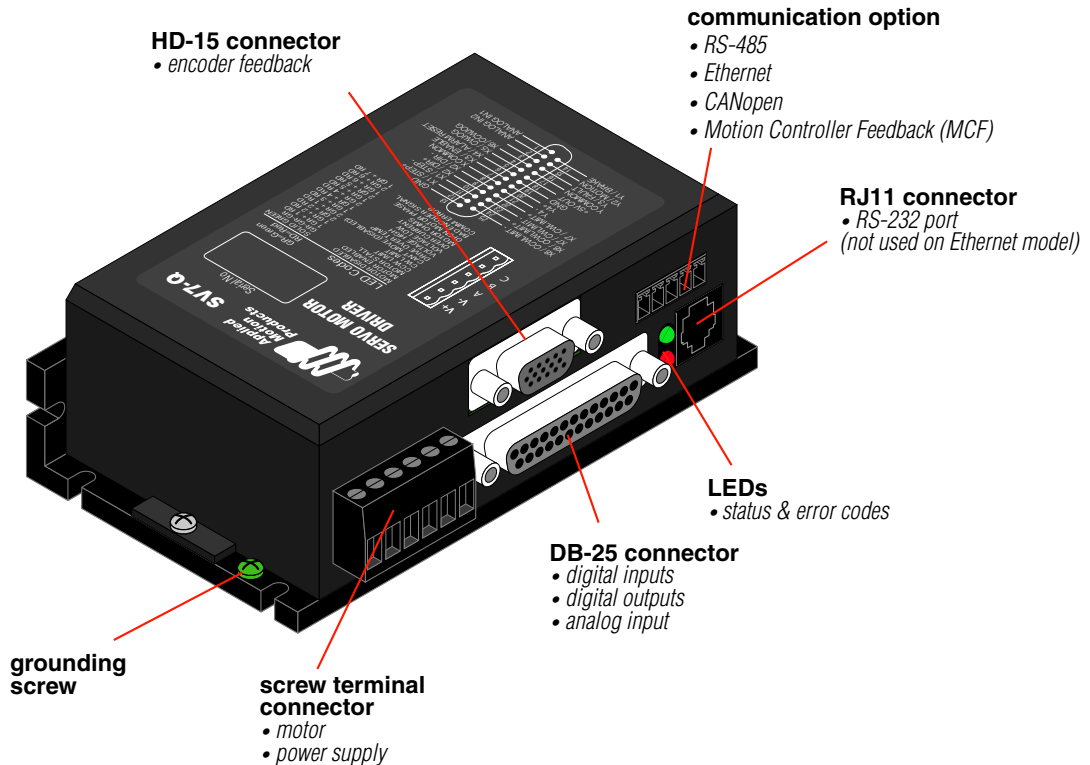
This manual describes the use of three different drive models. What you need to know and what you must have depends on the drive model. For all models, you'll need the following:

- a 24 to 80 volt DC power supply. Please read the section **Choosing a Power Supply** for help in choosing the right power supply.
- a compatible motor (see **Recommended Motors**)
- a small flat blade screwdriver for tightening the connectors (included).
- a personal computer running Windows 98, 2000, NT, Me, XP, Vista or 7. 32 or 64-bit.
- Applied Motion software (available for free download at [www.applied-motion.com/software](http://www.applied-motion.com/software))
- An Applied Motion programming cable (included with non-Ethernet drives).
- For Ethernet drives you will need a CAT5 cable (not included).

**If you've never used an SV drive before** 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 -S drives, download and install the *QuickTuner™* software application.  
For -Q and IP drives, download and install *QuickTuner™* and *QProgrammer™*.  
For -Si models, install and use the *Si Programmer™* software for configuration and programming.  
For -C drives, install the *QuickTuner™* and the *CANopen Example Program* software.  
*QProgrammer™* software may also be installed, if needed.
- 3 Launch the software by clicking Start...Programs...Applied Motion...
- 4 Connect the drive to your PC using the programming cable.
- 5 Connect the drive to the power supply.
- 6 Connect the drive to the motor.
- 7 Apply power to the drive.
- 8 For RS-232 connections, the software will recognize your drive, display the model and firmware version and be ready for action.
- 9 For Ethernet drives, once the proper IP address has been entered, the software will recognize your drive, display the model and firmware version and be ready for action.

The connectors and other points of interest are illustrated below. Depending on your drive model and application, you'll need to make connections to various parts of the drive. These are detailed later in the manual.



*For applications requiring encoder outputs to a motion controller, please request the Motion Controller Feedback (MCF) option.*

## Mounting the Drive

You can mount your drive on the wide or the narrow side of the chassis using #6 screws. If possible, 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. The SV7 will automatically remove power from the motor and generate an overtemperature fault at a chassis temperature of 65°C.

- ***Never use your drive in a space where there is no air flow or where other devices cause the surrounding air to be more than 40°C.***
- ***Never put the drive where it can get wet or where metal or other electrically conductive particles can get on the circuitry.***
- ***Always provide air flow around the drive. When mounting multiple SV drives near each other, maintain at least one half inch of space between drives.***

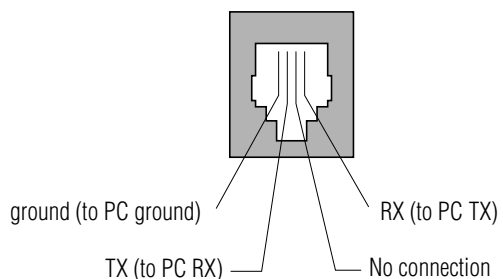
## Connecting to the PC using RS-232

(for Ethernet drives, see **Connecting the Drive to Your PC using Ethernet**)

- Locate your computer within 8 feet of the drive.
- 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 PC/MMI jack on your drive. Secure the cable to the PC with the screws on the sides.

***Never connect a drive to a telephone circuit. It uses the same connectors and cords as telephones and modems, but the voltages are not compatible.***

If your PC does not have a serial port, you should purchase a "USB Serial Converter". We recommend the USB-COM-CBL from byterunner.com. This adapter is compatible with all versions of Windows including Windows 7, 64 bit.



**Pin Assignments of the PC/MMI Port  
(RJ11 connector)**  
*Not used for Ethernet drives.*



## Connecting the Drive to Your PC using Ethernet

This process requires three steps

- Get the drive physically connected 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," which is available on the SV7-Q-EE product page at <http://www.applied-motion.com/products/servo-drives/sv7-q-ee>. For more information on Ethernet communications with the drive please refer to this 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

```
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
```

this:

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 an octet.) 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 de-

vice 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 includes a 16 position rotary switch for setting its IP address. The factory default address for each switch setting is shown in the table below.

Rotary Switch	IP Address
0	10.10.10.10
1	192.168.1.10
2	192.168.1.20
3	192.168.1.30
4	192.168.0.40
5	192.168.0.50
6	192.168.0.60
7	192.168.0.70
8	192.168.0.80
9	192.168.0.90
A	192.168.0.100
B	192.168.0.110
C	192.168.0.120
D	192.168.0.130
E	192.168.0.140
F	DHCP

Settings 1 through E can be changed using the *QuickTuner™* software. Setting 0 is always "10.10.10.10", the universal recovery address. If someone were to change the other settings 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 use the universal recovery address.

Setting F is "DHCP", which commands the drive to get an IP address from a DHCP server on the network. The IP address automatically assigned by the DHCP server may be "dynamic" or "static"

depending on how the administrator has configured DHCP. The DHCP setting is reserved for advanced users.

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

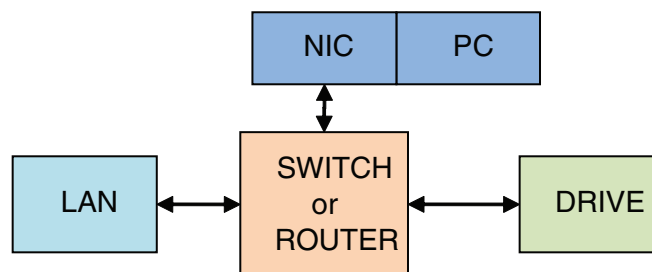
On the drive, switch settings 1 through E use the standard class B subnet mask (i.e. "255.255.0.0"). The mask for the universal recovery address is the standard class A (i.e. "255.0.0.0").

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.

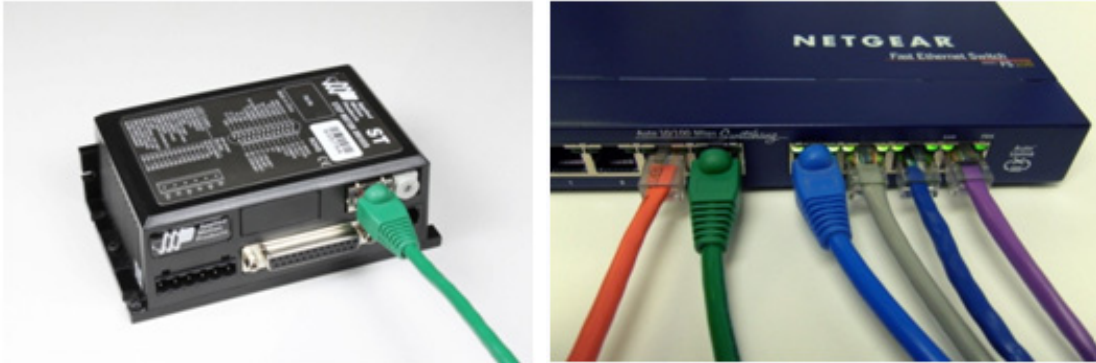
If you need help choosing a port number for your application, you can find a list of commonly used port numbers at <http://www.iana.org/assignments/port-numbers>.

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.

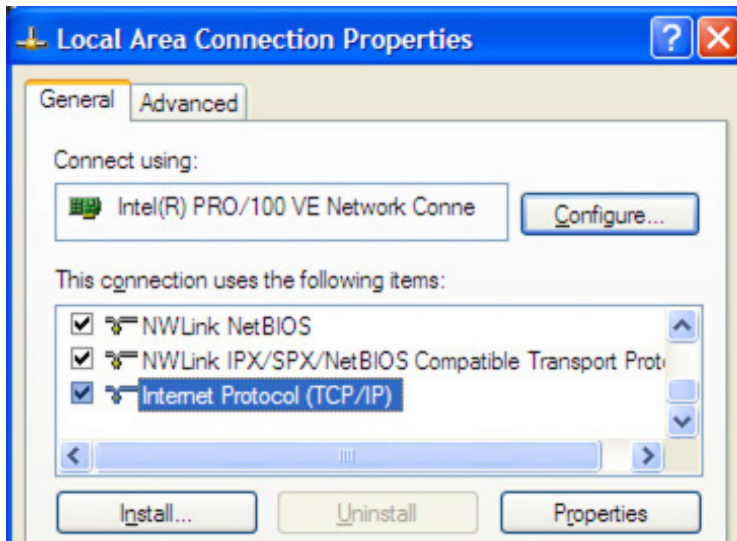


If you are not sure which addresses are already used on your network, you can find out using "Angry IP scanner", which can be downloaded free from <http://www.angryip.org/w/Download>. But be careful: an address might appear to be unused because a computer or other device is currently turned off. And 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.

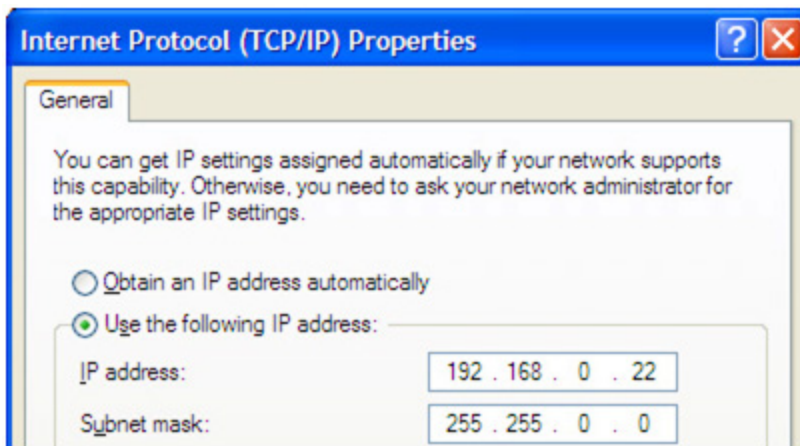
Once you've chosen an appropriate IP address for your drive, set the rotary switch according to the address table above. If none of the default addresses are acceptable for your network, you can enter a new table of IP addresses using *QuickTuner™*. If your network uses addresses starting with 192.168.0, the most common subnet, you will want to choose an address from switch settings 4 through E. Another common subnet is 192.168.1. If your network uses addresses in this range, the compatible default selections are 1, 2 and 3.

If your PC address is not in one of the above private subnets, you will have to change your subnet mask to 255.255.0.0 in order to talk to your drive. To change your 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

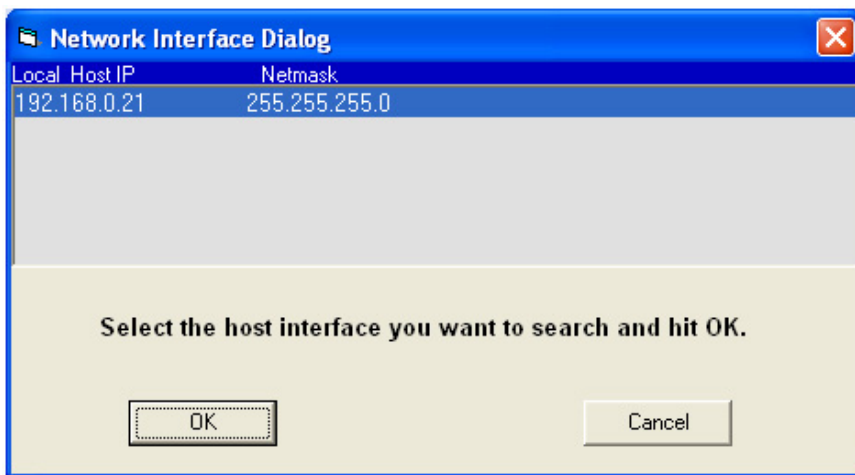


- this manual: "Using DHCP".
5. If the option "Use the following IP address" is selected, life is good. Change the subnet mask to "255.255.0.0" and click OK.

## Using DHCP

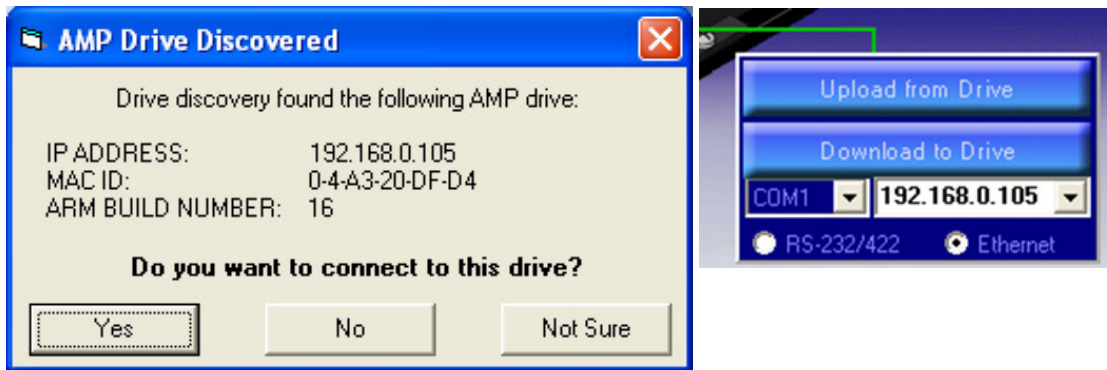
If you want to use your drive on a network where all or most of the devices use dynamic IP addresses supplied by a DHCP server, set the rotary switch to "F". When the drive is connected to the network and powered on, it will obtain an IP address and a subnet mask from the server that is compatible with your PC.

The only catch is that you won't know what address the server assigns to your drive. *QuickTuner™* can find your drive using the Drive Discovery feature, as long as your network isn't too large. With the drive connected to the network and powered on, click the Drive Discovery button on the Drive tab. You will see a dialog such as this:



Normally, Drive Discovery will only detect one network interface card (NIC), and will select it automatically. If you are using a laptop and have both wireless and wired network connections, a second NIC may appear. Please select the NIC that you use to connect to the network to which you've connected your drive. Then click OK. Drive Discovery will notify you as soon as it has detected a drive.

If you think this is the correct drive, click Yes. If you're not sure, click Not Sure and Drive Discovery will look for additional drives on you network. Once you've told Drive Discovery which drive is yours, it will automatically enter that drive's IP address in the IP address text box so that you are ready to communicate.



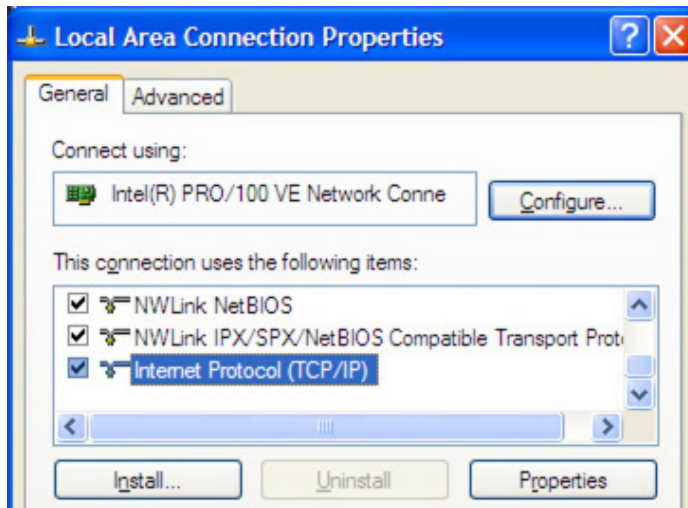
## Option 2: Connect a Drive Directly to Your PC



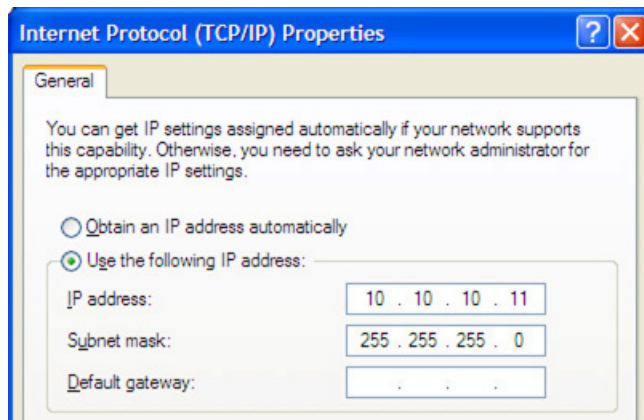
It doesn't get much simpler than this:

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" by setting the rotary switch at "0".
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)

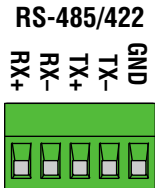


This technique allows you to keep your PC connected to your LAN, but keeps the drive off the LAN, preventing possible IP conflicts or excessive traffic.

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" by setting the rotary switch at "0".
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."

## Connecting to a host using RS-485 option card

RS-485 allows you to connect more than one drive to a single host PC, PLC, HMI or other computer. It also allows the communication cable to be long (more than 1000 feet). But the device to which you connect must have an RS-422 or RS-485 port.

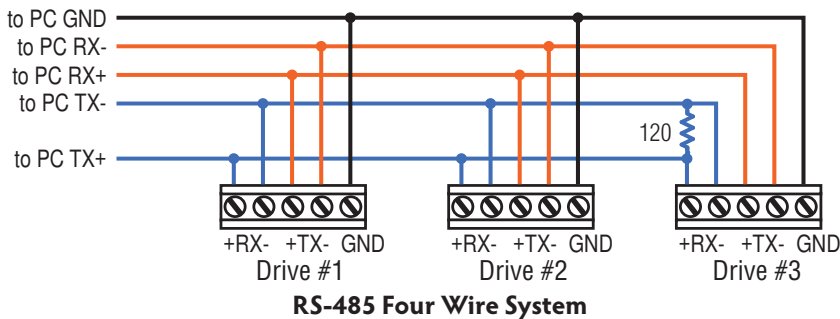


The RS-422/485 pin diagram is shown to the right. Wiring diagrams can be found below. We recommend the use of Category 5 cable. It is widely used for computer networks, it is inexpensive, easy to get and certified for quality and data integrity.

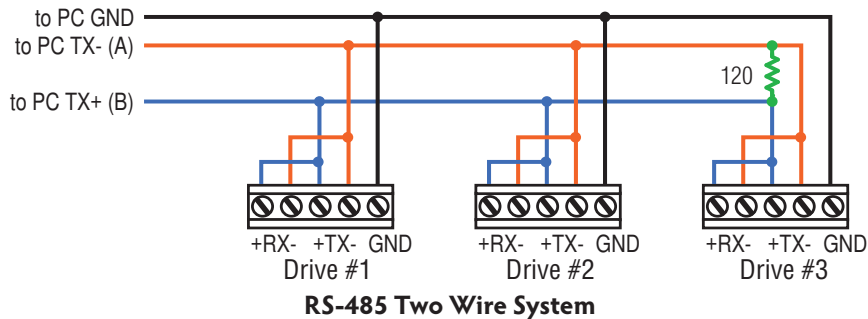
The SV drives can be used with either two wire or four wire RS-485 implementations. The connection can be point to point (i.e. one drive and one host) or a multi-drop network (one host and up to 32 drives).

**Four wire systems** utilize separate transmit and receive wires. One pair of wires must connect the host computer's transmit signals to each drive's RX+ and RX- terminals. Another pair connects the TX+ and TX- drive terminals to the host computer's receive signals. A logic ground terminal is provided on each drive and can be used to keep all drives at the same ground potential. This terminal connects internally to the DC power supply return (V-), so if all the drives on the RS-485 network are powered from the same supply it is not necessary to connect the logic grounds. **You should still connect one drive's GND terminal to the host computer ground.**

Four wire systems are better than two wire types because the host can send and receive data at the same time, increasing system throughput. Furthermore, the host never needs to disable its transmitter, which simplifies your software. We recommend that a 120 ohm terminating resistor be connected between RX+ and RX- at the farthest drive from the host.



**Two wire systems** transmit and receive on the same pair of wires, which can lead to trouble. The host must not only disable its transmitter before it can receive data, it must do so quickly, before a drive begins to answer a query. The SV drives include a “transmit delay” parameter that can be adjusted to compensate for a host that is slow to disable its transmitter. This adjustment can be made over the network using the TD command, or it can be set using the *QuickTuner™* software. It is not necessary to set the transmit delay in a four wire system.



### RS-232 to RS-485 2-wire Converter

Model 485-25E from [Integrity Instruments](http://Integrity Instruments) (800-450-2001) works well for converting your PC's RS-232 port to RS-485. It comes with everything you need. Connect the adaptor's "B" pin to the drive's TX+ and RX+ terminals. Connect "A" to the drive's TX- and RX- terminals.

### Converting USB to RS-485

The USB-COMi-M from [www.byterunner.com](http://www.byterunner.com) is an excellent choice for USB to RS-485 conversion. It can be used with 2 wire or 4 wire systems.

For two wire RS-485, set SW1 to ON and SW2-4 to OFF. On the USB-COMi-M screw terminal connector:

- Pin1 goes to RX- and TX-.
- Connect pin 2 to RX+ and TX+.
- Pin 6 is ground.
- The DB-9 is not used.



For four wire RS-485, set SW1,3,4 to ON and SW2 to OFF. On the USB-COMi-M screw terminal connector:

USB-COMi-M	SV Drive
pin 1	RX-
pin 2	RX+
pin 3	TX+
pin 4	TX-
pin 6	GND

## Assigning Addresses in Multi-axis RS-485 Systems

Before wiring the entire system, you'll need to connect each drive individually to the host computer so that a unique address can be assigned to each drive. Use the RS-232 programming cable and the *QuickTuner™* software that came with your drive for this purpose.

Connect the drive to your PC, then launch *QuickTuner™*. Finally, apply power to your drive. If you have already configured your drive, then you should click the Upload button so that the *QuickTuner™* settings match those of your drive. Click on the Motion button, then select the "SCL" operating mode. If you have a Q drive, you may want to select "Q Programming". Either way, you'll see the RS-485 Address panel appear. Just click on the address character of your choice. You can use the numerals 0-9 or the special characters ! " # \$ % & ' ( ) \* + , - . / : ; < = > ? @ . Just make sure that each drive on your network has a unique address. If you are using a 2 wire network, you may need to set the Transmit Delay, too. 10 milliseconds works on the adapters we've tried. Once you've made your choices, click Download to save the settings to your drive.

## Connecting the Power Supply

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

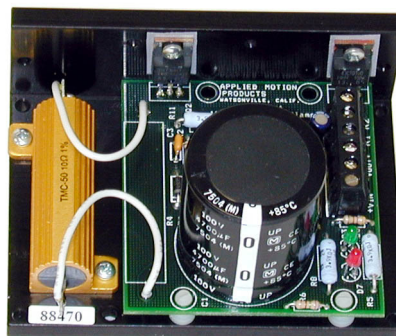
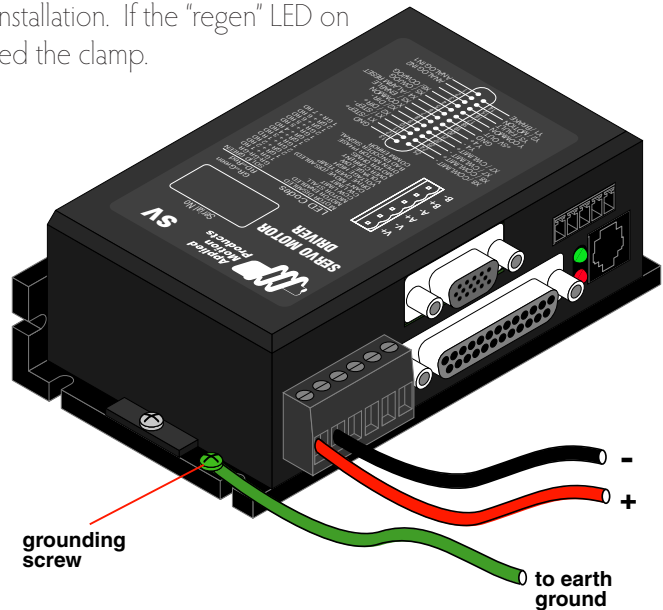
Connect the motor power supply "+" terminal to the driver terminal labeled "V+". Connect power supply "-" to the drive terminal labeled "V-". Use 18 or 20 gauge wire. The SV drives contain an internal fuse that connects to the power supply + terminal. This fuse is not user replaceable. If you want to install a user servicable fuse in your system install a fast acting fuse in line with the + power supply lead. Use a 7 amp fuse.

The green ground screw on the corner of the chassis should be connected to earth ground.



***Be careful not to reverse the wires. Reverse connection will destroy your driver, void your warranty and generally wreck your day.***

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 overvoltage protection of a switching power supply, causing it to shut down. We offer the RC050 "regeneration clamp" to solve this problem. If in doubt, buy an RC050 for your first installation. If the "regen" LED on the RC050 never flashes, you don't need the clamp.



**RC050 Regen Clamp**

## 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 get a switching supply.

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

## Voltage

PWM drives like the SV7 work by switching the voltage to the motor terminals on and off while monitoring current to achieve a precise level of phase current. Depending on how fast you want to run the motor, you may not need a power supply equal to the rated voltage of the motor. To get a rough estimate of how much voltage you need, multiply the voltage constant of the motor ( $K_e$ ) by the maximum speed required for your application. For example, if you want to operate the M0100-103-4 at 4000 rpm, you'll need  $V = K_e * \text{rpm} = (4.6\text{V/krpm})(4 \text{krpm}) = 18.4$  volts. To produce any real torque at that speed, add 30%, for a total of 24 V.

Always check the "no load" voltage of the power supply before using it with the drive, to be sure that it does not exceed 80 VDC.

## Current

The maximum supply current you could ever need is three times the motor current. However, you will generally need a lot less than that, depending on the motor type, voltage, speed and load conditions. That's because the SV servo uses a switching amplifier, 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. A motor running from a 48 volt supply can be expected to draw only half the supply current that it would with a 24 volt supply. Furthermore, the servo loop only commands the amplifier to provide as much current as load conditions require.

We recommend the following selection procedure:

1. If you plan to use only a few drives, get a power supply with at least 3X the rated continuous 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 moni-

tor the current coming out of the power supply and into the drive at various motor loads. This will tell you how much current you really need so you can design in a lower cost power supply.

If you plan to use a regulated power supply you may encounter a problem with 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 overvoltage protection of a switching power supply, causing it to shut down. See *Connecting the Power Supply* for details on the RC-050 regeneration clamp. Unregulated power supplies are better because they generally do not have overvoltage protection and have large capacitors for storing energy coming back from the drive. They are also less expensive.



### Connecting the Motor

***Never connect or disconnect the motor while the power is on.***

Applied Motion motor:

To connect an Applied Motion servo motor to your SV7, you'll need a set of extension cables. For M series (as well as N and A series) motors, use the BLUENC and the BLuMTR cables. For V series motors, use the 3004-214 and 3004-230 cables. For J-Series motors use 3004-300 and 3004-301 cables.

Connect the motor to one end of the cable. The other end of the motor extension cable has lead wires that connect to the drive's motor screw terminal connector as follows:

A = red wire

B = white wire

C = black wire

chassis ground screw = green wire

Leave the last pin on the motor/power connector unconnected.

The encoder on the back of the V series motors can connect directly to the encoder connector on the SV7, or a 3004-230 extension cable can be used when the motor must be located further than 18" from the drive. For M, N and A series motors, use a BLUENC series encoder extension cable.

#### MOTOR/POWER CONNECTOR

MOTOR  
V+ V- A B C



## Non-Applied Motion motor:

Connect the motor leads to the screw terminal connector as follows:

A = motor phase A, R or U

B = motor phase B, S or V

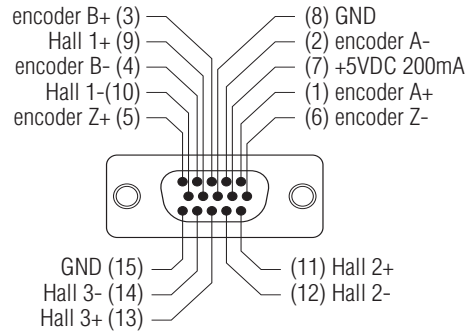
C = motor phase C, T or W

chassis ground screw = green wire

The encoder connections use a HD-15 connector, which you must connect to your encoder as shown on the right. See *Accessories* for mating connector information.

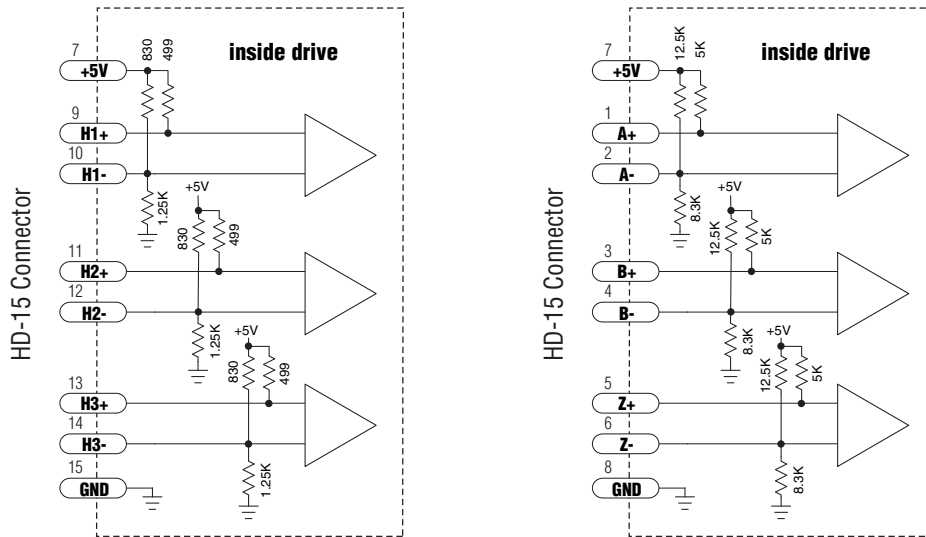
If your encoder is single ended, connect the encoder outputs to the A+, B+ and Z+ inputs. Leave A-, B- and Z- unconnected. (Z is the encoder index signal and is optional)

Single-end halls should also be connected to the "+" inputs with the "-" inputs left unconnected.



Front View

Pin Assignments (facing drive)



Internal Encoder Circuits



## **Driving a Brushed Motor:**

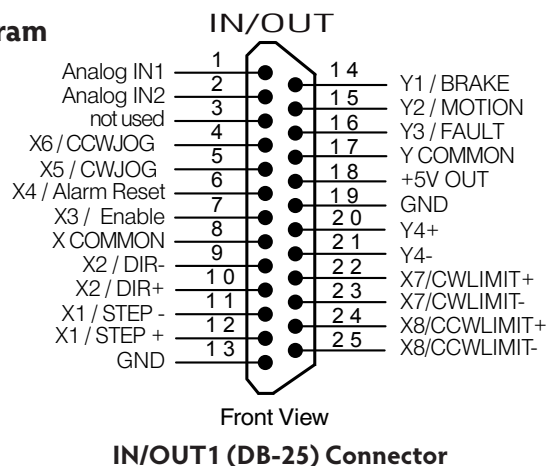
1. Connect the encoder so the counts increase when the shaft is turned CW as viewed from the front.
2. Connect motor leads to A and B, leave C open.
3. The + direction of commanded motion will result in terminal B being positive with respect to terminal A.
4. Armature inductance should be between .5mH and 15mH for best performance.
5. Use the Motor-Encoder tab in *QuickTuner™* to configure the drive for a brushed motor.

## Connecting Input Signals

The SV drives have 8 digital inputs and 2 analog inputs categorized as follows:

- Two high speed digital inputs, 5 volt logic: X1/STEP and X2/DIR.  
Digital signals for commanding position. Quadrature signals from encoders can also be used. These inputs can also be connected to sensors, switches and other devices for use with Q and Si™ commands such as Wait input, Seek Home, Feed to Sensor, If Input and others.
- Four single-ended digital inputs, 12-24 volt logic: X3, X4, X5, and X6.  
Software programmable inputs can be used for motor enable, alarm reset or jogging. These inputs can also be connected to sensors, switches and other devices for use with Q and Si™ Wait Input, Seek Home, Feed to Sensor, If Input and other commands.
- Two differential digital inputs, 12-24 volt logic: X7/CWLIMIT and X8/CCWLIMIT.  
Can be used to inhibit motion in a given direction, forcing the motor and load to travel within mechanical limits. Can be configured for active closed, active open, or not used which makes the inputs act as general purpose inputs.
- Two single-ended analog inputs, +/- 10 volt logic: Analog IN1 and Analog IN2.  
Support 0-10, +/-5, or 0-5 volt logic as well. Can be wired together to create one differential analog input. Analog velocity or position command signal. Note: the analog inputs are currently not supported by the *Si Programmer™* software.

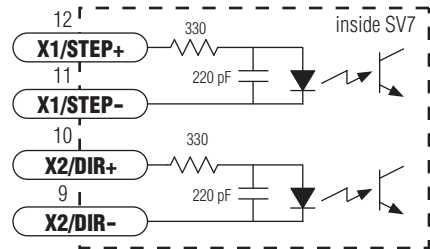
## Connector Pin Diagram



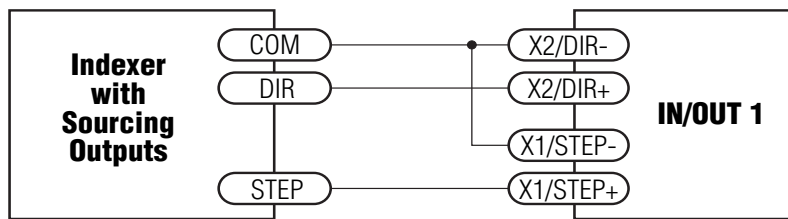
## High Speed Digital Inputs

The SV drives include two high speed inputs called STEP and DIR. They accept 5 volt single-ended or differential signals, up to 2 MHz. Normally 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. Or you can use these inputs with **Wait Input, If Input, Feed to Sensor, Seek Home** and other such commands.

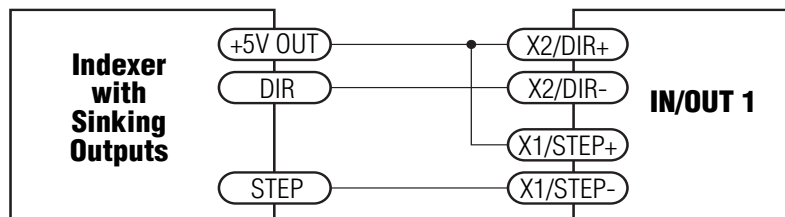
Connection diagrams follow.



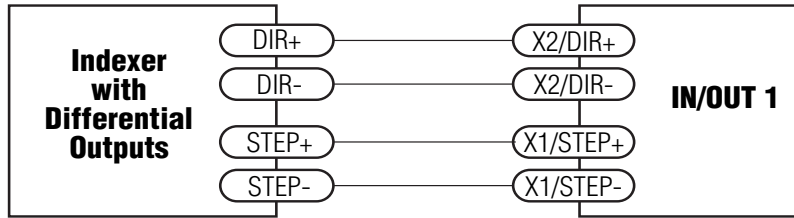
**SV7 Step & Direction Inputs**



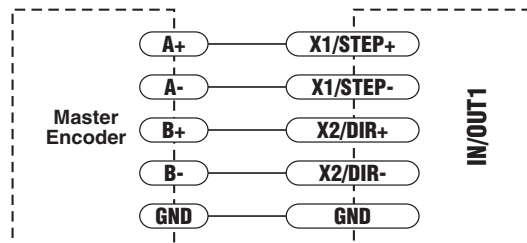
**Connecting to indexer with Sourcing Outputs**



**Connecting to Indexer with Sinking Outputs**



**Connecting to Indexer with Differential Outputs**  
(Many High Speed Indexers have Differential Outputs)



**Wiring for Encoder Following**

## Using High Speed Inputs with 12-24 Volt Signals

Most PLCs don't use 5 volt logic. You can connect signal levels as high as 24 volts to the STEP and DIR inputs if you add external dropping resistors, as shown below.

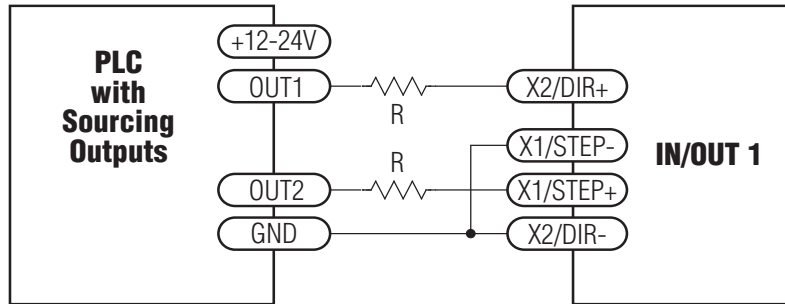
- For 12 volt logic, add 820 ohm, 1/4 watt resistors
- For 24 volt logic, use 2200 ohm, 1/4 watt resistors



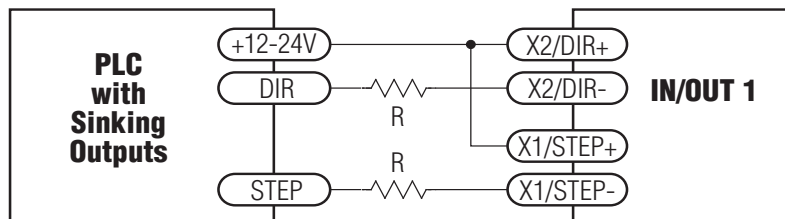
***The maximum voltage that can be applied to an input terminal is 24 volts DC. Never apply AC voltage to an input terminal.***



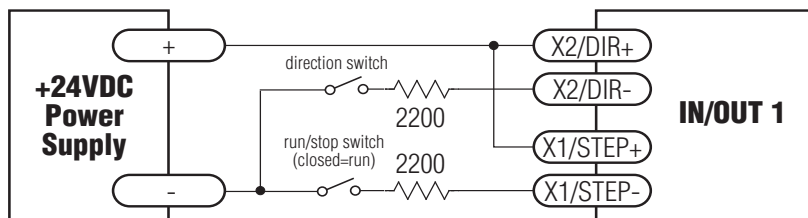
***The pulse and direction wiring can pick up noise especially if resistors are placed on terminal strips next to "noisy" wiring, resulting in stray step pulses and a loss of position accuracy.***



**Connecting to PLC with Sourcing (PNP) Outputs**  
(Most PLC's use 24 volt logic)



**Connecting to PLC with Sinking (NPN) Outputs**  
(Most PLC's use 24 volt logic)



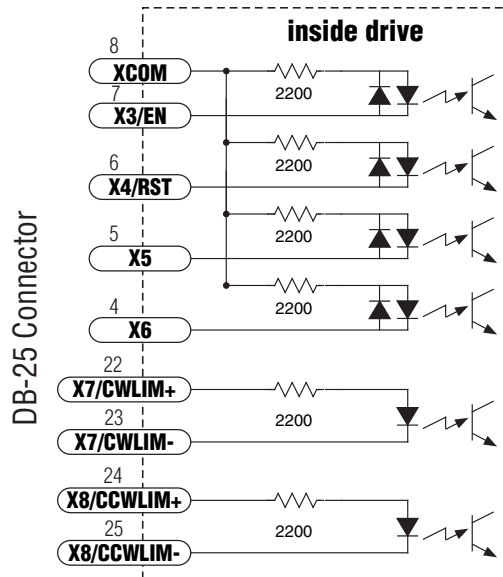
**Using Mechanical Switches at 24 Volts**

## Other Digital Inputs

As we mentioned in the previous section, the high speed STEP and DIR inputs are configured for five volt logic. All other digital inputs are designed for operation between 12 and 24 volts DC.

### Single Ended Inputs

The SV drives include four single ended, optically isolated input circuits that can be used with sourcing or sinking signals, 12 to 24 volts. This allows connection to PLCs, sensors, relays and mechanical switches. Because the input circuits are isolated, they require a source of power. If you are connecting to a PLC, you should be able to get power from the PLC power supply. If you are using relays or mechanical switches, you will need a 12-24 V power supply. This also applies if you are connecting the inputs to the programmable outputs of an Si product from Applied Motion.

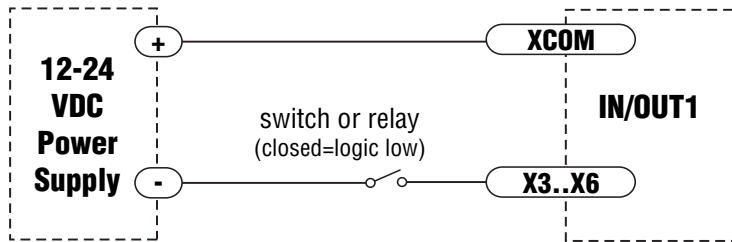


### What is COM?

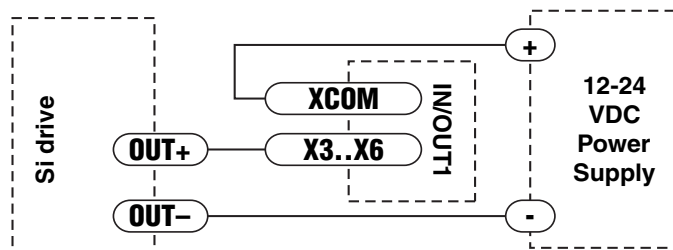
"Common" is an electronics term for an electrical connection to a common voltage. Sometimes "common" means the same thing as "ground", but not always. In the case of the SV drives, if you are using sourcing (PNP) input signals, then you will want to connect COM to ground (power supply -). If you are using sinking (NPN) signals, then COM must connect to power supply +.

**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.

The diagrams on the following pages show how to connect the inputs to various commonly used devices.

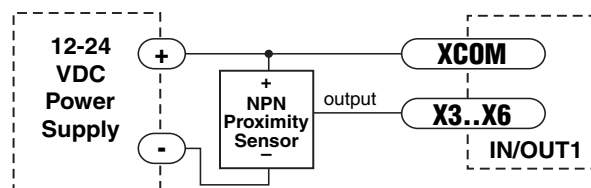


**Connecting an Input to a Switch or Relay**



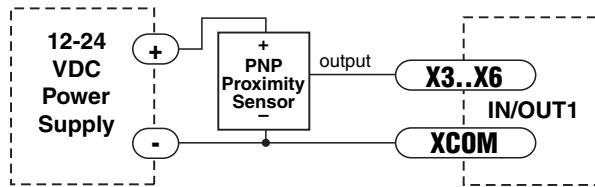
**Connecting another drive to the SV**

*(When output closes, input goes low).*



**Connecting an NPN Type Proximity Sensor to an input**

*(When prox sensor activates, input goes low).*

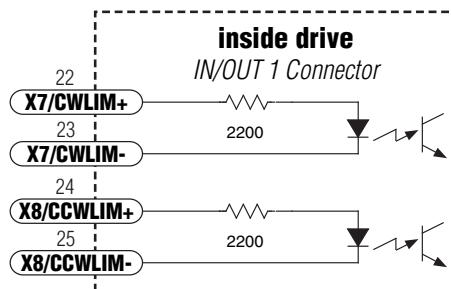


**Connecting a PNP Type Proximity Sensor to a an input**  
*(When prox sensor activates, input goes low).*

## Connecting Limit Switches

The CWLIMIT and CCWLIMIT inputs are used for connecting end of travel sensors. These inputs can be driven by signals that are sinking (NPN), sourcing (PNP) or differential (line driver). By connecting switches or sensors that are triggered by the motion of the motor or load, you can force the motor to operate within certain limits. This is useful if a program or operator error could cause damage to your system by traveling too far.

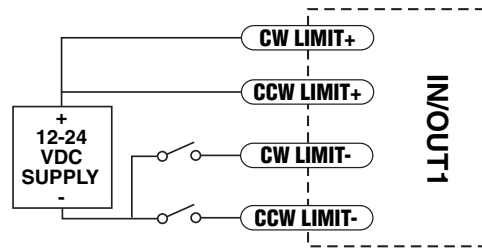
The limit inputs are optically isolated. This allows you to choose a voltage for your limit circuits of 12 to 24 volts DC. This also allows you to have long wires on limit sensors that may be far from the drive with less risk of introducing noise to the drive electronics. The schematic diagram of the limit switch input circuit is shown below.





## Wiring a Mechanical Limit Switch

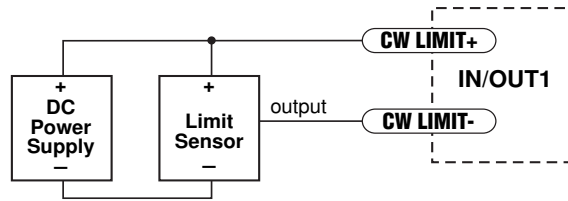
You can use normally open or normally closed limit switches. Either way, wire them as shown here. Be sure to set the polarity using the Si Programmer™ for Si™ drives or *QuickTuner™* software for the SV7-S and SV7-Q.



## Wiring a Limit Sensor

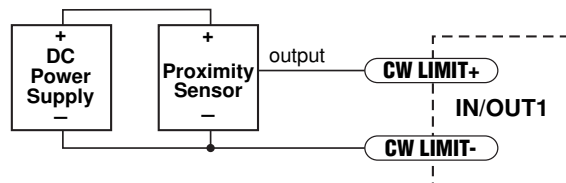
Some systems use active limit sensors that produce a voltage output rather than a switch or relay closure. These devices must be wired differently than switches.

If your sensor has an open collector output or a sinking output, wire it like this:



If the sensor output goes low at the limit, select the option “closed” (in the software). If the output is open, or high voltage, choose “open”.

Other sensors have sourcing outputs. That means that current can flow out of the sensor output, but not into it. In that case, wire the sensor this way:

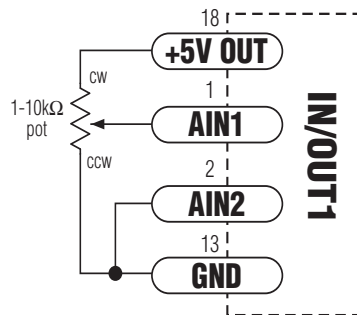
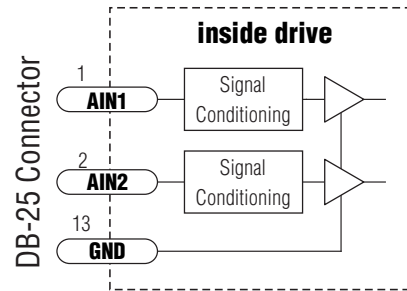


## Analog Inputs

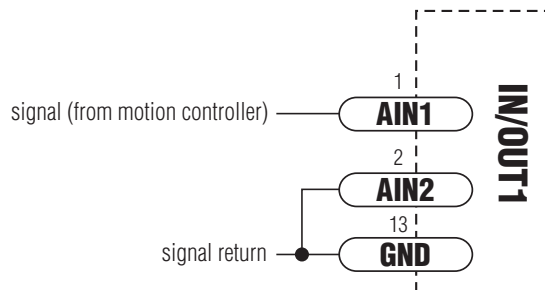
The SV drives feature two analog inputs. Each input can accept a signal range of 0 to 5 VDC,  $\pm 5$  VDC, 0 to 10 VDC or  $\pm 10$  VDC. The drive can be configured to operate in torque, speed or position modes. Input impedance of each analog input is 10K ohms to GND.

*Note: The analog inputs and the communications circuitry are referenced to GND only. Therefore a connection must be made to the SV7 GND to complete the signal path.*

Use *QuickTuner™* to set the signal function, range, offset, deadband and filter frequency. Please see the *QuickTuner™* manual or consult the software help for more information.



**Connecting a Potentiometer to Analog Input 1**

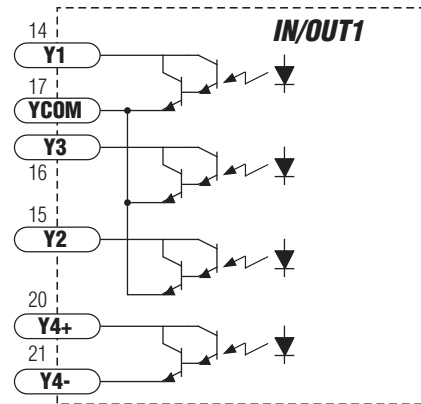


**Connecting a Motion Controller to the Analog Input**

## Programmable Outputs

The SV drives feature four digital outputs. These outputs 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). Or the outputs can be turned on and off by program instructions like Set Output.

**Note:** an electric brake cannot be connected directly to the programmable output of the SV. A relay must be added between the output and brake coil. See example relay wiring diagrams below.

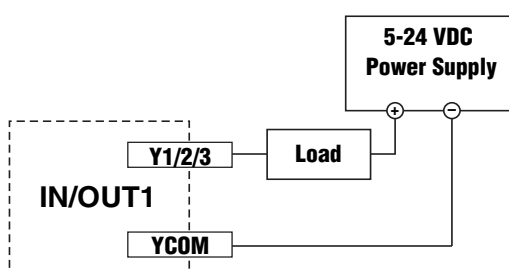


The outputs can be used to drive LEDs, relays and the inputs of other electronic devices like PLCs and counters. For OUT4, the "+" (collector) and "-" (emitter) terminals of each transistor are available at the connector. This allows you to configure each output for current sourcing or sinking. The OUT1-3 outputs can only sink current. The COM terminal must be tied to power supply (-).

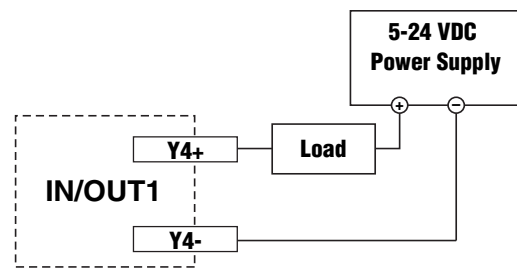
Diagrams of each type of connection follow.



***Do not connect the outputs to more than 30VDC.  
The current through each output terminal must not exceed 80 mA.***



**Sinking Output  
Y1, Y2 or Y3**



**Sinking Output  
Using Y4**

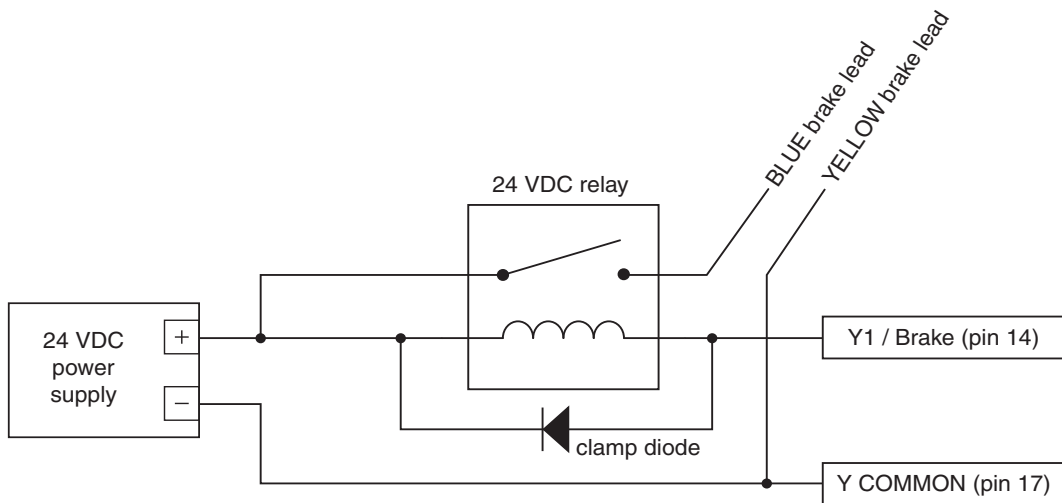
## Wiring Integral Holding Brakes

The integral holding brakes of AMP servo motors require between 200 and 400 mA at 24 VDC to operate properly. To wire and operate a holding brake from the Y1/Brake output of an Applied Motion servo drive requires the following items:

- A 24 VDC power supply with minimum output of 450 mA
- A 24 VDC relay\*
- A clamp diode such as 1N4935\*
- An AMP servo motor with integral holding brake, designated by a "5" in the 7th position of the motor part number. Example: M0400-151-4-000
- A "BK" type motor power cable or separate brake cable. Example: BLUMTR-BK-FA-10

\* Relays with an integral clamp diode, like IDEC part number RU2S-D-D24, greatly simplify the wiring effort by including the relay and a clamp diode in one unit.

Following the diagram below, connect the power supply, relay, and diode to the brake leads of the servo motor, as well as the Y1/Brake output connections of the servo drive.



The holding brakes of J Series servo motors are fail-safe brakes, which means they are engaged when no power is applied to the brake. When setting up a servo drive in *QuickTuner™*, be sure to set the Brake output options in the "Inputs-Outputs" tab as shown in the diagram below. Make sure to select the check box for "Automatically release brake when moving by" and selecting the radio button "closing the Brake output".

**Brake**

Automatically release brake when moving by  closing the Brake output

opening the Brake output

Wait  msec before moving for brake to release

Wait  msec for brake to engage before disabling servo

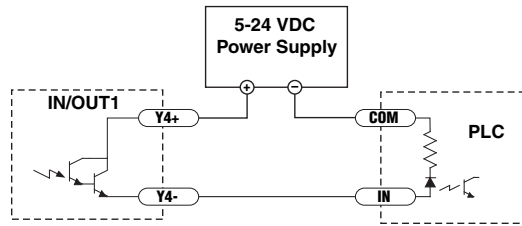
The engaging and disengaging of the brake is done automatically by the servo drive. When the drive is enabled and not faulted the brake will be disengaged. When the drive is disabled and/or faulted the brake will be engaged.

There are two time delays associated with the Brake output function which are also set in *QuickTuner™* (see diagram above). The first time delay controls how long the drive will delay a move command if the move command immediately follows the disengagement of the brake. The second time delay controls how long the drive will delay disabling the motor after engaging the brake when a motor disable command is issued.

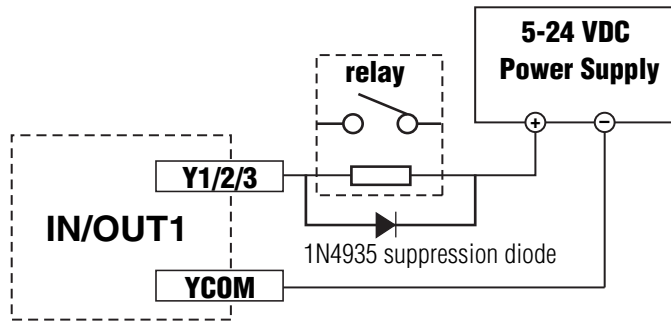
### Reference Information

Below is a summary of specifications for the integral holding brakes available with J Series servo motors. Refer to motor drawing for details.

Motor Power (W)	30	50	100	100	200	400	200	400	600	750
Motor Frame Size	NEMA 17 40 mm	NEMA 17 40 mm	NEMA 17 40 mm	NEMA 23 60 mm	NEMA 23 60mm	NEMA 23 60 mm	NEMA 34 80 mm	NEMA 34 80 mm	NEMA 34 80 mm	NEMA 34 80 mm
Rated Voltage	24 VDC									
Static Friction (in-lb)	2.83			11.24				22.5		
Input Power (W)	5		9	9		9.5		9.5		
Input Current (A)	0.2		0.375	0.375		0.39		0.39		
Armature Release Time (msec Max)	20		20	20		50		50		
Armature Pull-In Time (msec Max)	40		40	50		80		80		

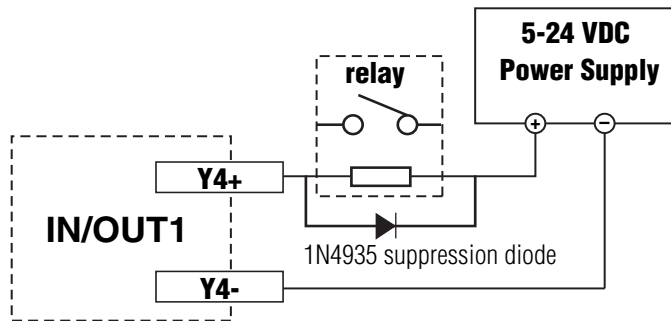


**Sourcing Output  
Using Y4**



**Driving a Relay  
Y1, Y2 or Y3**

*useful for connecting a motor brake*



**Driving a Relay  
Using Y4**

*useful for connecting a motor brake*

## Interfacing to a Motion Controller

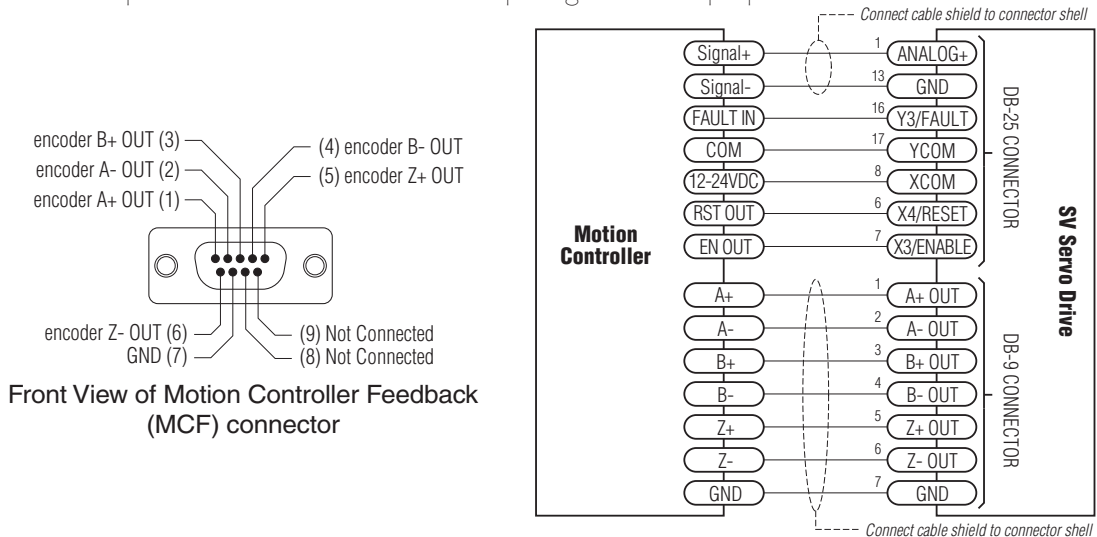
In some applications, servo control is provided by a motion controller and the drive simply obeys a velocity or torque command. The industry standard for this command signal is  $\pm 10V$ . In most cases, the encoder signals from the motor must feed back to the controller. The SV7-S-AF servo drive includes a special Motion Controller Feedback board to accommodate such applications.

To connect an SV7-S-AF to a motion controller, you must make a cable to connect the motion controller to the DB9 connector on the motion controller feedback board. Diagrams are shown below. Providing the motion controller with access to the analog command, servo enable, alarm reset, and fault output signals requires an additional cable to the SV7's DB25 connector. See the diagram below for pin numbers. **Note: this diagram assumes that FAULT IN of the motion controller can accept a sinking signal.**

You'll also need to use our *QuickTuner™* software to set the drive for torque or velocity mode, to set the scaling and offset of the analog input, and to configure the motor.

## Encoder Outputs

If you are using the SV servo in torque or velocity mode with a servo controller, you may need to feed the encoder signals back to the controller. The DB-9 connector on the motion controller feedback option board includes encoder output signals for this purpose.



Connecting a Motion Controller with Analog ( $\pm 10V$ ) Output

## Setting Drive Current Limits

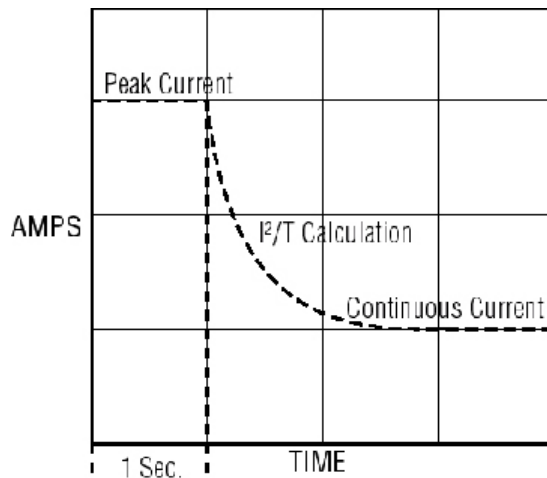
The SV7 allows the user to set both the Motor Continuous and Peak current limits. Current settings are an RMS value. Using the *QuickTuner™* the current settings can be uploaded and downloaded.

Setting the current limits requires the user to know the limitations of the motor. In most cases referring to the motor manufacturers specification will give the proper information. For AMP motors, motor settings are available in parameter files that are located on the PC where *QuickTuner™* was installed.

## What is "Peak Current"?

The SV7 uses this current value to establish the maximum possible RMS current that will be driven to the motor. The peak current time is set to one second. That is, if the drive attempts to run at peak current for more then one second it will fold back the current to the continuous current setting.

The peak current time is actually calculated on a curve using an  $I^2/T$  method. For current values that are less than the peak but greater than the continuous, the current foldback time is calculated from the peak and continuous settings. As shown in the diagram below, current values below the peak value can be used for longer periods of time.





## Reference Materials

### Recommended NEMA Motors

Model	V0050-214-A	V0100-214-B	V0200-214-B	V0250-214-B
Length "L" (mm)	45	52	78	104
Rated Output (W)	50	100	200	200
Power Supply (VDC)	48	48	48	48
Rated Current (A <sub>rms</sub> )	5.3	6.3	5.7	5.8
Peak Current (A <sub>rms</sub> ) <sup>1</sup>	14.0	14.0	14.0	14.0
Rated Torque				
N-m	0.095	0.19	0.38	0.57
oz-in	13.4	26.9	53.8	80.7
Peak Torque <sup>1</sup>				
N-m	0.25	0.42	0.93	1.38
oz-in	34	59	132	195
Torque Constant <sup>2</sup>				
N-m/A	0.019	0.03	0.07	0.1
oz-in/A	2.7	4.2	9.9	14.2
Rated Speed (RPM)	5000	5000	5000	3350
Max Speed(RPM)	8000	8000	5900	4000
Voltage Constant <sup>2</sup> (V/kRPM)	2.00	3.5	7.4	10.7
Resistance (Ω) <sup>2</sup>	0.45	0.45	0.6	0.89
Rotor Inertia (g-cm <sup>2</sup> )	29	93	182	270

### Additional Motor Information:

Model	V Series	J Series
Encoder Counts/rev:	8192 CPT	2500 CPT
Poles	4	8

<sup>1</sup>With SV7 drive.

<sup>2</sup>EDCM rating (equivalent DC motor). These values simplify performance calculations but differ from values measured at motor terminals.

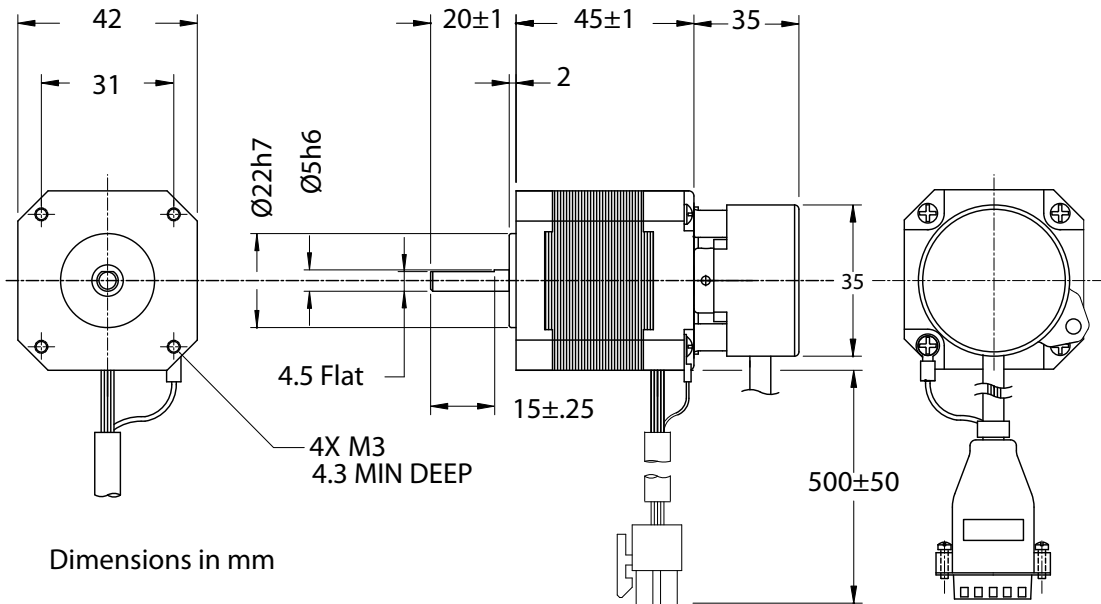
## Recommended Metric Motors

<b>Model</b>	<b>J0100-303-3</b>	<b>J0200-304-4</b>	<b>J0400-305-4</b>
<b>Length "L" (mm)</b>	110	106	118
<b>Rated Output (W)</b>	100	200	400
<b>Power Supply (VDC)</b>	24	48	60
<b>Cont/Peak Current<sup>1</sup> (A)</b>	5.2/15.6	4.9/14.7	6.5/19.5
<b>Cont/Peak Torque<sup>1</sup></b>			
<b>N-m</b>	0.32/0.91	0.64/1.7	1.27/3.5
<b>Torque Constant<sup>2</sup></b>			
<b>N-m/A</b>	0.61	0.133	0.197
<b>Rated Speed (RPM)</b>	3000	3000	3000
<b>Max Speed (RPM)</b>	6000	6000	6000
<b>Voltage Const<sup>2</sup> (V/krpm)</b>	3.8	7.6	11.4
<b>Resistance (<math>\Omega</math>)<sup>2</sup></b>	0.48	0.57	0.57
<b>Rotor Inertia (g-cm<sup>2</sup>)</b>	42.2	94	190

<sup>1</sup>With SV7 drive.

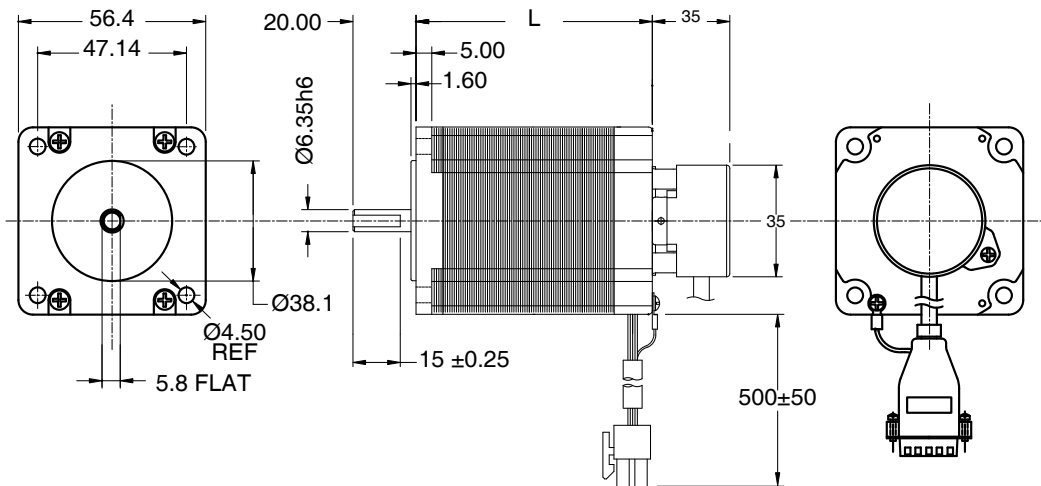
<sup>2</sup>EDCM rating (equivalent DC motor). These values simplify performance calculations but differ from values measured at motor terminals.

## Motor Outlines

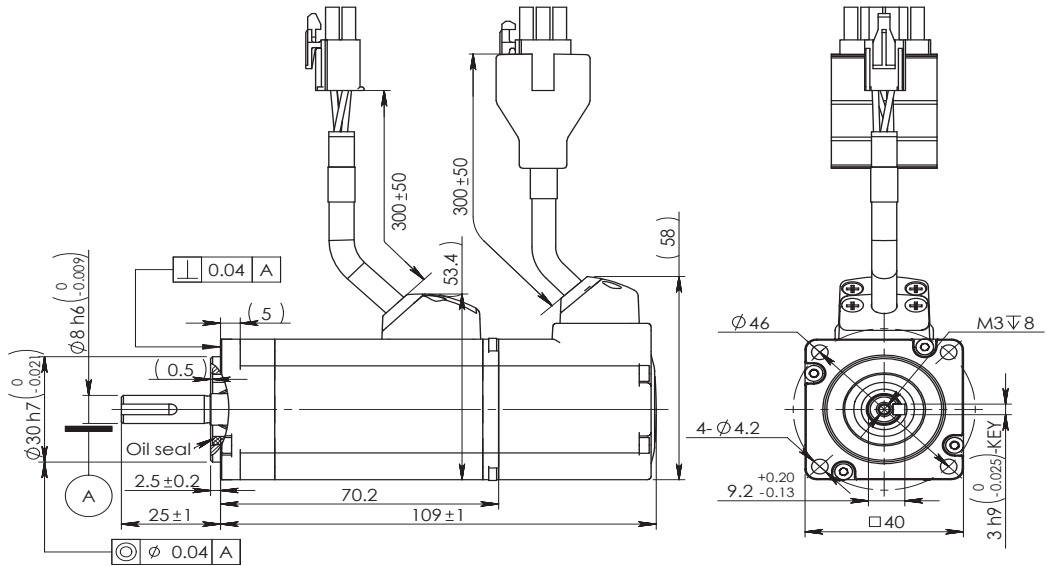


Dimensions in mm

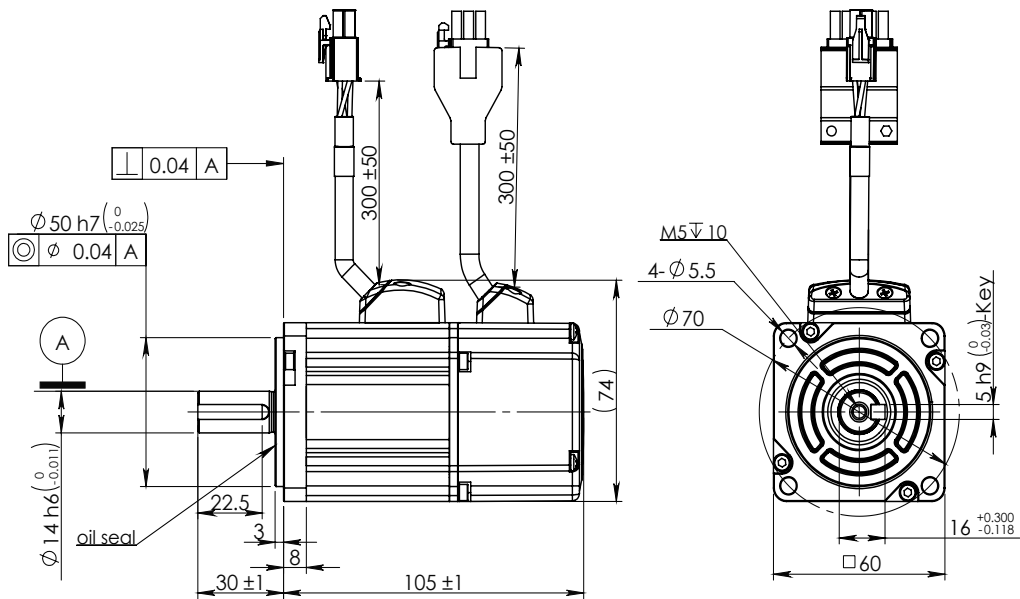
V0050 Outline Drawing



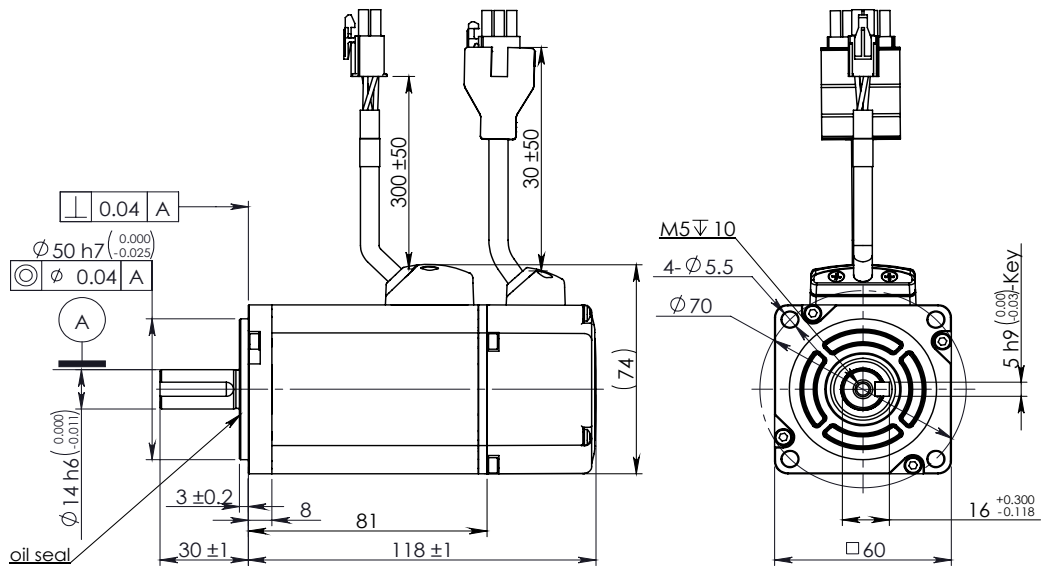
V0100, V0200, V0250 Outline Drawing



J0100-303-3 Outline Drawing



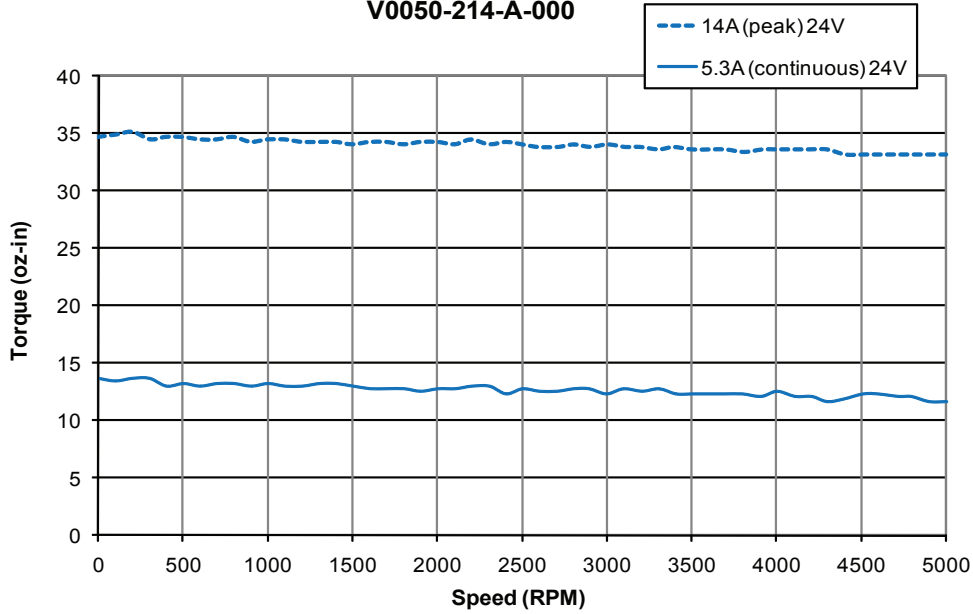
J0200-304-4 Outline Drawing



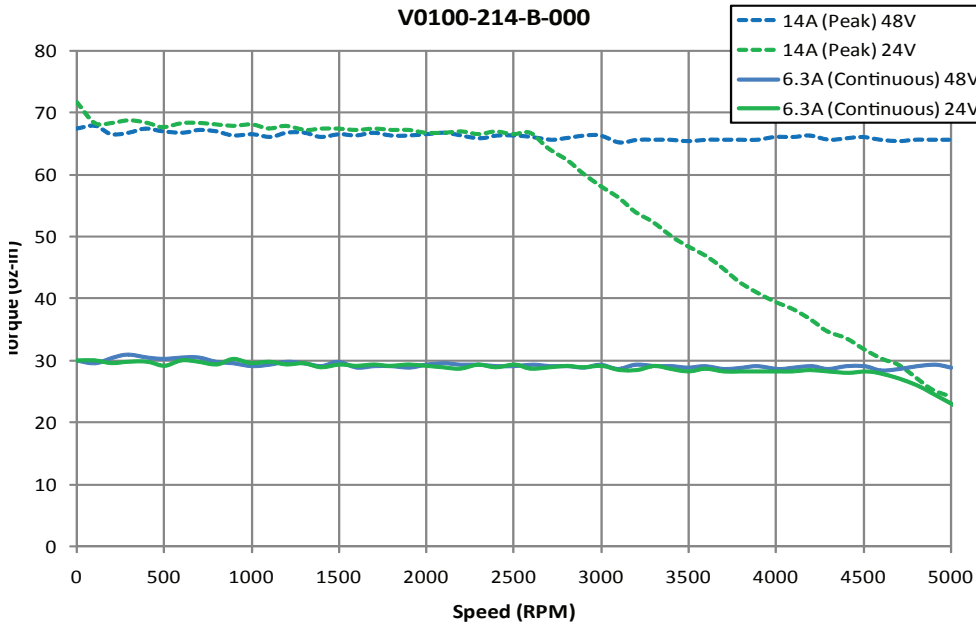
**J0400-305-4 Outline Drawing**

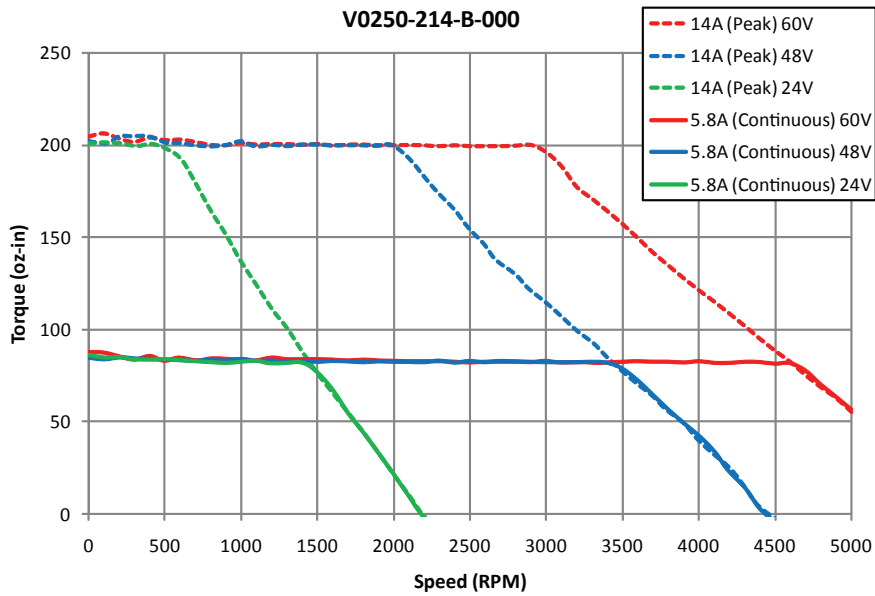
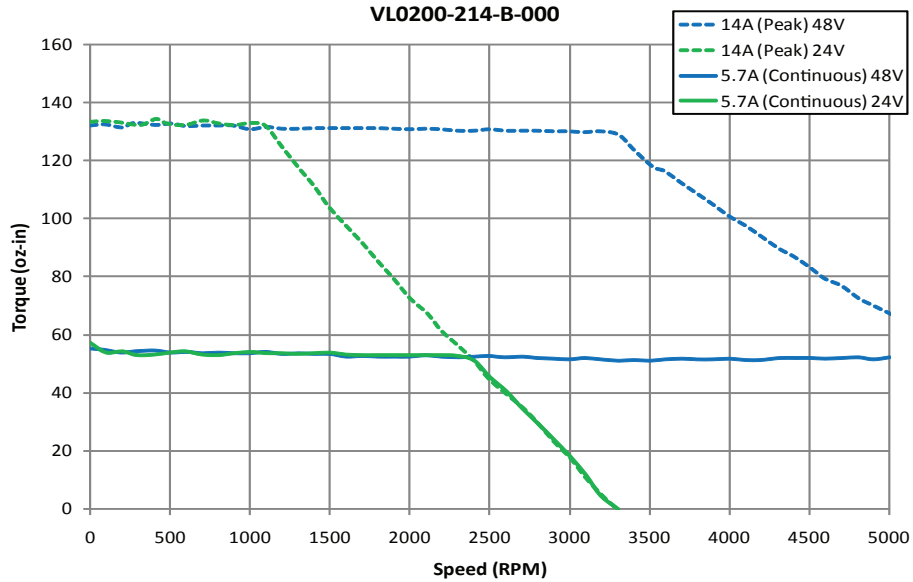
## Torque-Speed Curves

**V0050-214-A-000**

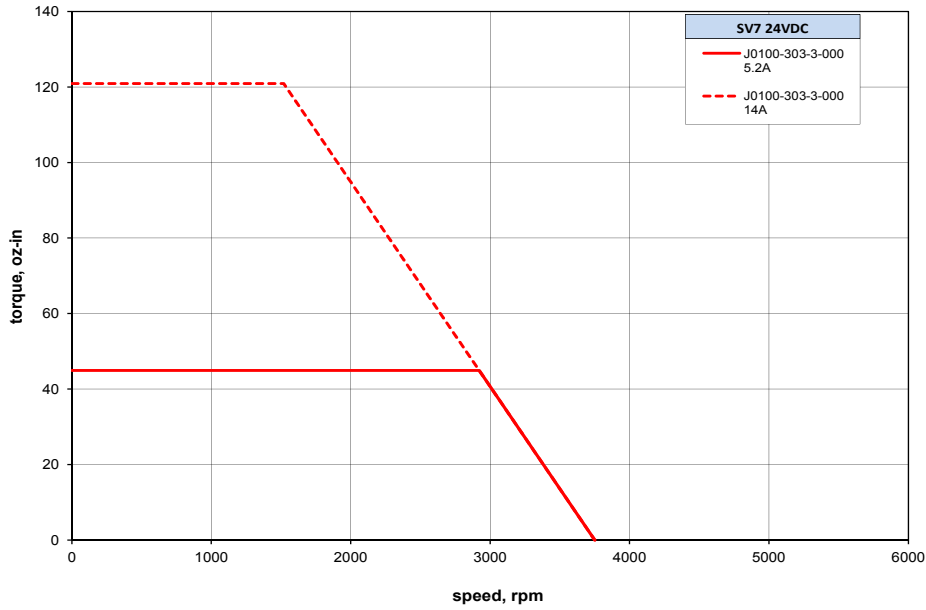


**V0100-214-B-000**

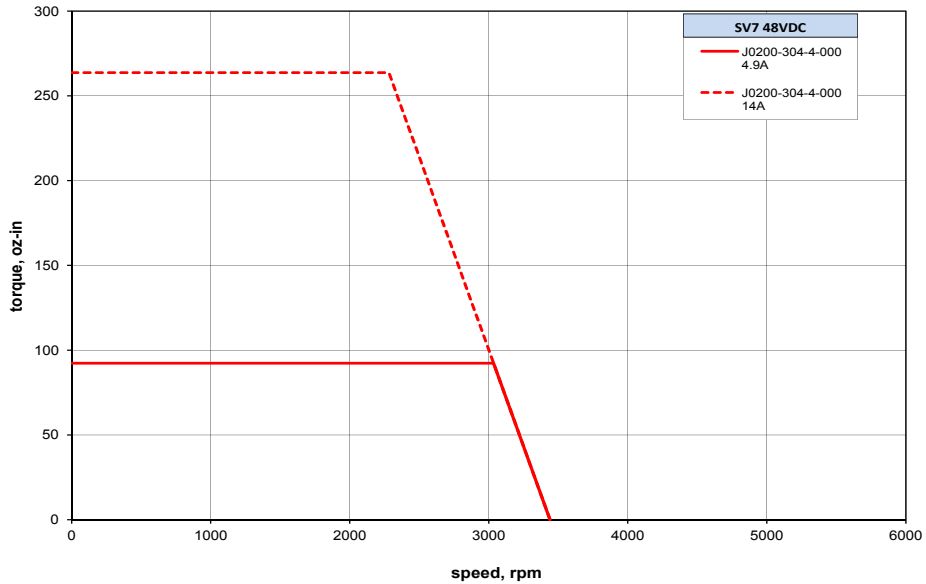




## J0100-303-4

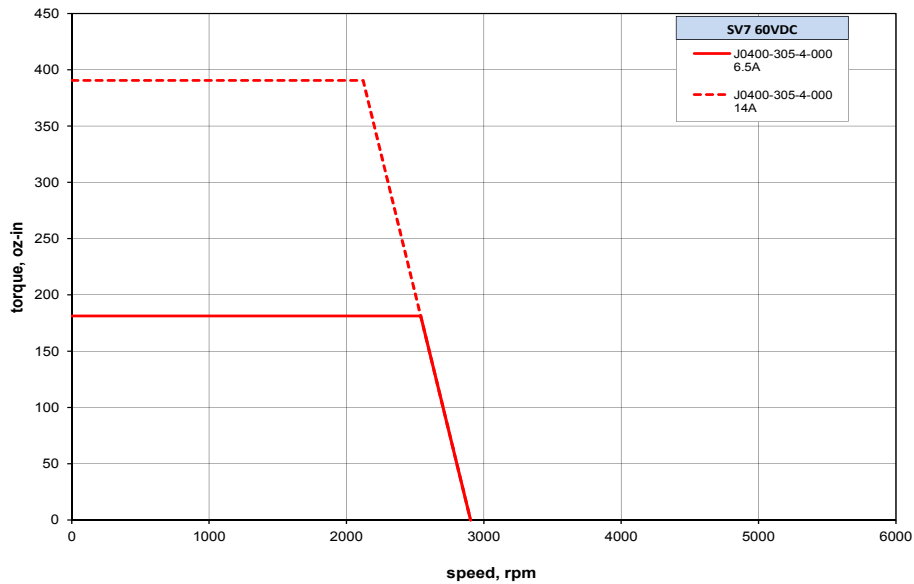


## J0200-304-4

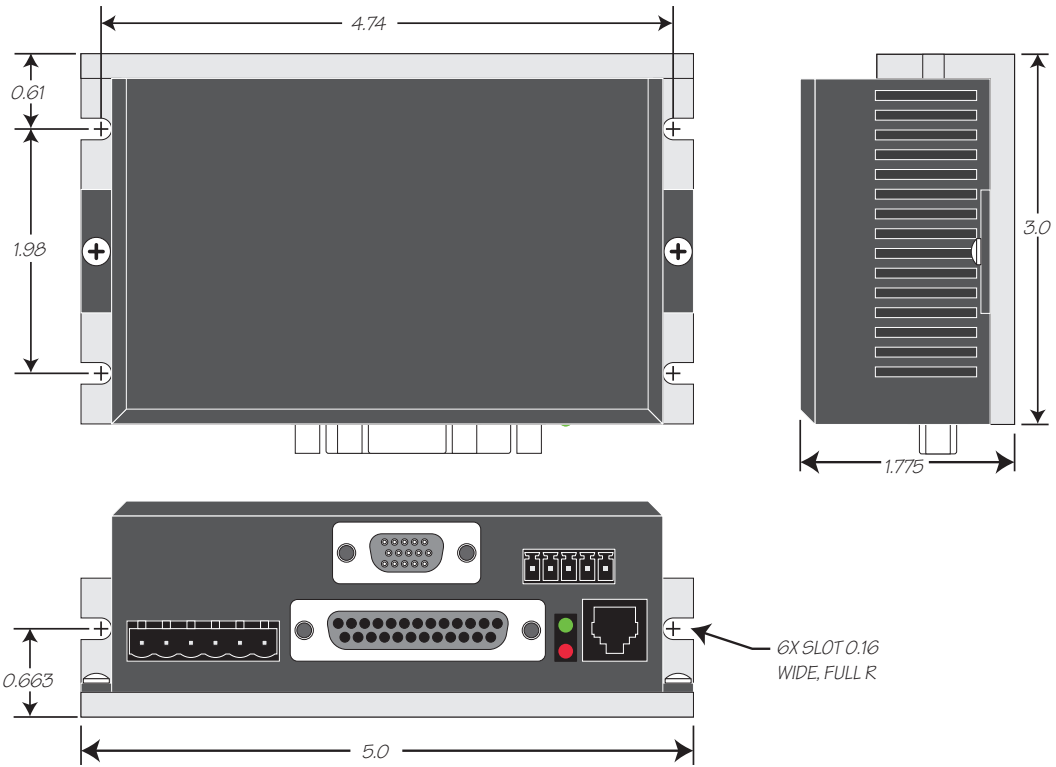




## J0400-305-4



## Mechanical Outline



## Technical Specifications

<b>Amplifier</b>	Digital MOSFET. 16 kHz PWM. Supply voltage: 18 - 88 VDC, motor current: 0.5 to 7 amps rms continuous, 0.5 to 14 amps rms peak (2 seconds max, i <sup>2</sup> t limiting)
<b>Digital Inputs</b>	Step & Direction: differential, optically isolated, 5V logic. 330 ohms internal resistance. 0.5 μsec minimum pulse width. 2 μsec minimum set up time for direction signal.  All other digital inputs: optically isolated, 12 - 24V logic. 2200 ohms. Maximum current: 10 mA.
<b>Analog Inputs</b>	±10VDC, 12 bit ADC, 100k ohms internal impedance.
<b>Outputs</b>	Photodarlington, 80 mA, 30 VDC max. Voltage drop: 1.2V max at 80 mA.
<b>Physical</b>	1.775 x 3 x 5 inches overall. 10 oz (280 g) Ambient temperature range: 0°C to 40°C.
<b>Encoder Inputs</b>	Differential line receiver, 5V logic. Minimum resolution 400 lines (1600 counts/rev). Maximum resolution: 32768 lines (131,072 counts/rev)

## Mating Connectors and Accessories

### Mating Connectors

Motor/power supply: PCD P/N ELV06100, included with drive.  
IN/OUT1: DB-25 male. AMP P/N 747912-2. Shell Kit AMP P/N748678-3. Included.  
Optional encoder feedback: HD-15 male. Norcomp P/N 180-015-102-001. Shell Kit AMP P/N 748678-1. Not included.

## Accessories

Breakout Box for DB-25 Connector  
BOB-1, includes cable

Screw Terminal Connectors that mate directly to the DB-25 connector on the front panel of the drive:

Phoenix Contact P/N [2761622](#)

**This connector is not available from Applied Motion. You must purchase it from a Phoenix distributor.**

See App. Note 16 for more detail: [http://www.applied-motion.com/sites/default/files/APPN0016\\_Simple-25-pin-mating-connections.pdf](http://www.applied-motion.com/sites/default/files/APPN0016_Simple-25-pin-mating-connections.pdf)

Mating Cable for IN/OUT connector with "flying leads"

Black Box P/N: BC00702

**This cable is not available from Applied Motion. You must purchase it from Black Box.**

Useful for custom wired applications. This shielded cable has a DB-25 connector on each end. You can cut off the female end to create a 6 foot "DB-25 to flying lead cable".

It'll be easier to wire if you get the [cable color chart from Black Box's web site](#).

See App. Note 16 for more detail: [http://www.applied-motion.com/sites/default/files/APPN0016\\_Simple-25-pin-mating-connections.pdf](http://www.applied-motion.com/sites/default/files/APPN0016_Simple-25-pin-mating-connections.pdf)

Regeneration Clamp:

Applied Motion Products [RC050](#).

Operator Terminal (-Si drives only)

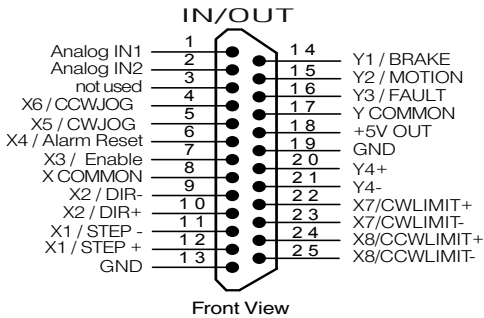
Applied Motion Products MMI-01 or MMI-02 (backlit).

# Alarm Codes

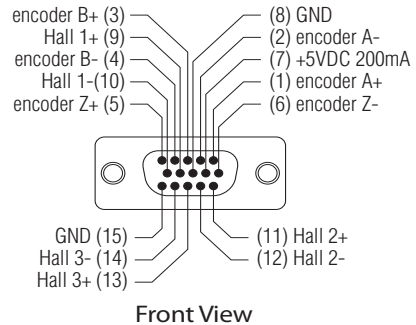
In the event of an error, the green LED on the main board will flash one or two times, followed by a series of red flashes. The pattern repeats until the alarm is cleared.

Code	Error
● solid green	no alarm, motor disabled
●● flashing green	no alarm, motor enabled
●●● 1 red, 1 green	position error limit
●●●● 1 red, 2 green	move attempted while drive disabled
●●●●● 1 red, 3 green	subroutine stack overflow (Si only)
●●●●●● 2 red, 1 green	ccw end of travel limit
●●●●●●● 2 red, 2 green	cw end of travel limit
●●●●●●●● 2 red, 3 green	subroutine stack underflow (Si only)
●●●●●●●●● 3 red, 1 green	drive overheating
●●●●●●●●●● 3 red, 2 green	internal voltage out of range
●●●●●●●●●●● 3 red, 3 green	attempt to load blank Q segment
●●●●●●●●●●●● 4 red, 1 green	power supply overvoltage
●●●●●●●●●●●●● 4 red, 2 green	power supply undervoltage
●●●●●●●●●●●●●● 4 red, 3 green	bad instruction in Si program
●●●●●●●●●●●●●●● 5 red, 1 green	over current / short circuit
●●●●●●●●●●●●●●●● 5 red, 2 green	peak current foldback
●●●●●●●●●●●●●●●●● 6 red, 1 green	bad hall pattern
●●●●●●●●●●●●●●●●●● 6 red, 2 green	bad encoder signal
●●●●●●●●●●●●●●●●●●● 7 red, 1 green	serial communication error
●●●●●●●●●●●●●●●●●●●● 7 red, 2 green	flash memory error

# Connector Diagrams

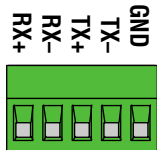


DB-25 I/O Connector



HD-15 Encoder Connector

## RS-485/422



## CANopen

