

# STM23

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## Hardware Manual



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## Introduction

Thank you for selecting the Applied Motion Products **STM23 Motor+Drive**. 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).



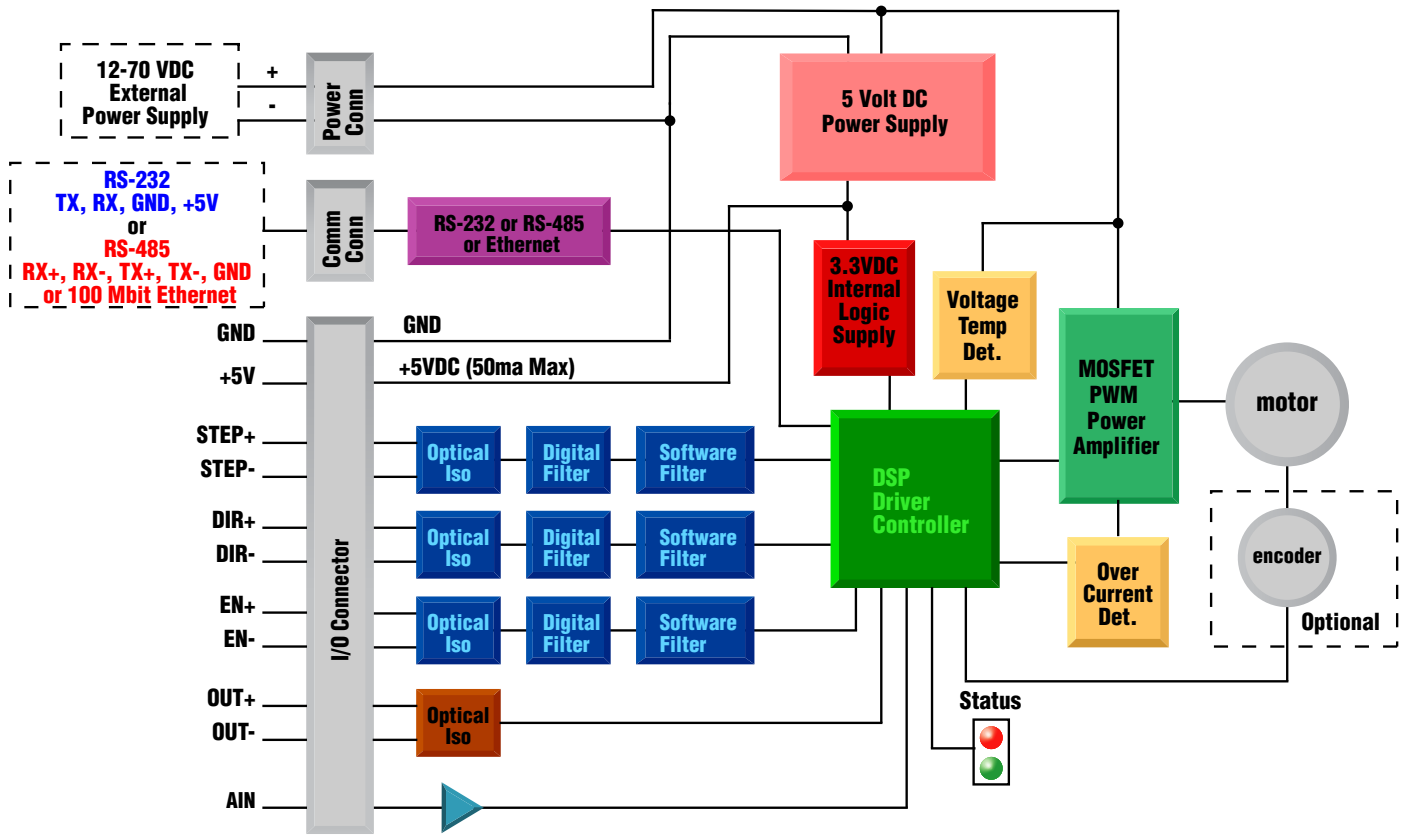
## Features

- Programmable, micro-stepping digital Step Motor+Driver 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 RS-232 serial commands
- Step input signal smoothing
- Q programming over Ethernet and Ethernet/IP models
- RS-422/485 communication models
- Optional encoder feedback
- STM23S/Q-2 delivers up to 125 oz-in
- STM23S/Q-3 delivers up to 210 oz-in
- 3 - optically isolated, 5 to 24 volt digital inputs
- Input filtering both hardware and software
- 1 - optically isolated, 30V 40ma digital output
- 1 - 0 to 5V analog input for speed and position control

**Available model numbers:**

STM23S-2AE	STM23Q-2AE
STM23S-2AN	STM23Q-2AN
STM23S-2EE	STM23Q-2EE
STM23S-2EN	STM23Q-2EN
STM23S-2RE	STM23Q-2RE
STM23S-2RN	STM23Q-2RN
STM23S-3AE	STM23Q-3AE
STM23S-3AN	STM23Q-3AN
STM23S-3EE	STM23Q-3EE
STM23S-3EN	STM23Q-3EN
STM23S-3RE	STM23Q-3RE
STM23S-3RN	STM23Q-3RN
STM23IP-2EE	STM23C-3CE
STM23IP-2EN	STM23C-3CN
STM23IP-3EE	
STM23IP-3EN	

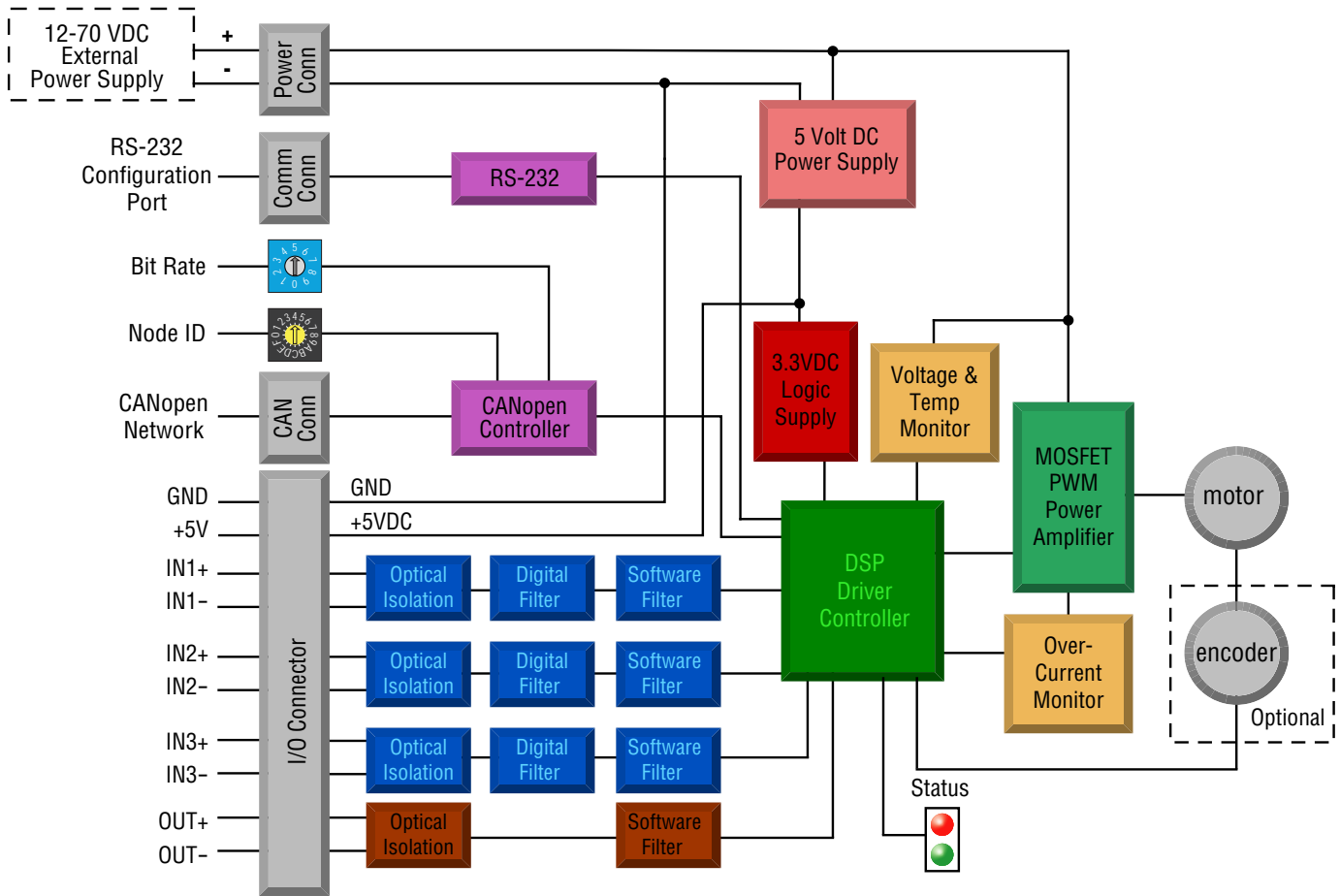
## Block Diagram - STM23S/Q/IP



### I/O Configurations

STEP (5 to 24 Volts)	DIR (5 to 24 Volts)	EN (5 to 24 Volts)	OUT (30V, 40mA)
Step Input	Direction Input	Enable Input	Brake Output
Jog CW	Jog CCW	Reset Input	Alarm Output
Limit CW	Limit CCW	Change Speed	Motion Output
Start/Stop	General Purpose	General Purpose	Tach Output
General Purpose			General Purpose

## Block Diagram - STM23C



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
		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 STM23 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 at least ten minutes before touching live sections of the equipment or undoing connections (e.g., contacts, screwed connections). Capacitors can store dangerous voltages for long periods of time after power has been switched off. 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 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.
- *ST Configurator™* and *Q Programmer™* software applications, available at <http://www.applied-motion.com/products/software>.
- An Applied Motion programming cable (included in RS-232 Models, RS-485 converters are available from AMP) or a CAT5 patch cable for Ethernet models.

If you've never used an STM23 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 *Q/IP/C* models, download and install the *ST Configurator™* and *Q Programmer™* software applications, available at [www.applied-motion.com/products/software](http://www.applied-motion.com/products/software). For *S* models, install the *ST Configurator™*.
2. Launch the software by clicking Start...Programs...Applied Motion...
3. Connect the drive to your PC using the programming cable. When using RS-485, it must be set up in the 4-Wire configuration (See "Connecting to a host using RS-485" below). For Ethernet models, connect directly to your PC's Ethernet port or connect the STM23 to a router or switch. See page 20 for more information.
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 Motor+Drive

As with any stepper motor the STM23 motors must be mounted so as to provide maximum heat-sinking and air-flow. Keep space around the STM23 Motor+Drive to allow convected air-flow.

- **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.**



## Choosing a Power Supply

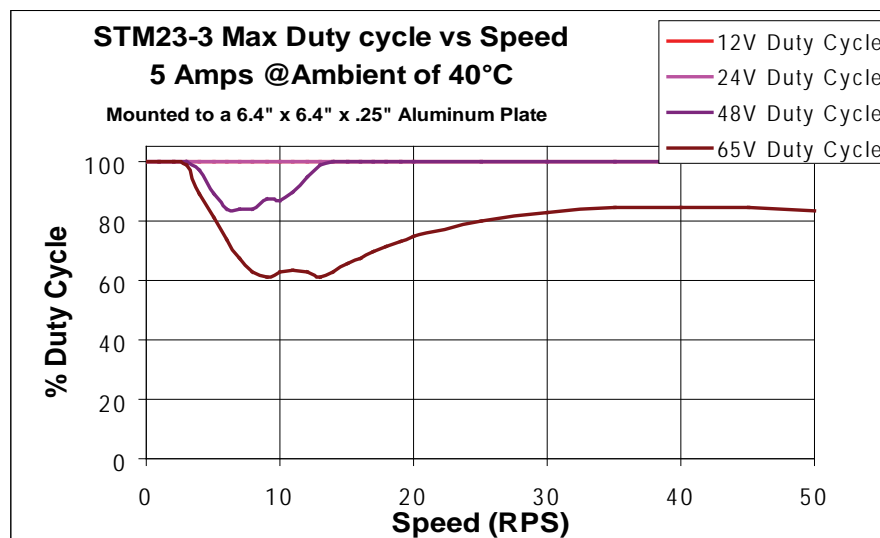
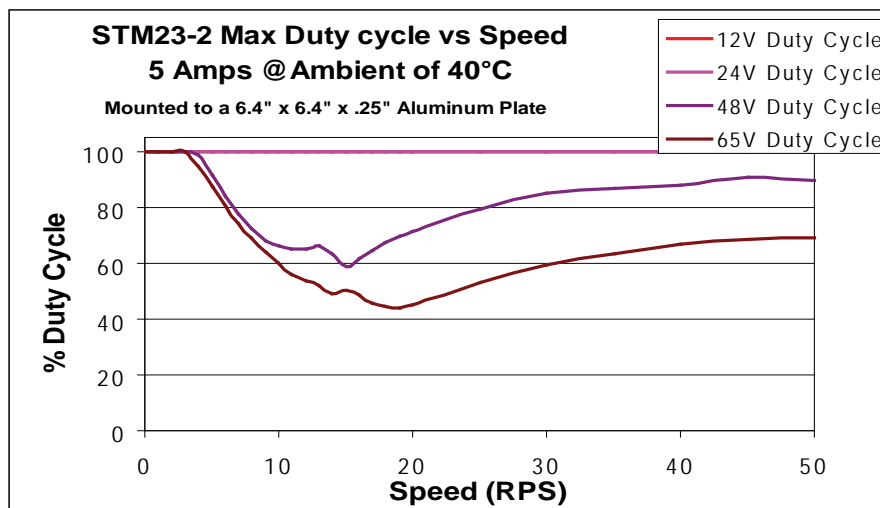
When choosing a power supply, there are many things to consider. If you are manufacturing equipment that will be sold to others, you probably want a supply with all the safety agency approvals. If size and weight are an issue use a switching supply.

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

## Voltage

The STM23 series drives are designed to give optimum performance between 24 and 48 volts DC. Choosing the voltage depends on the performance needed and Motor+Drive heating that is acceptable and/or does not cause a drive over-temperature. Higher voltages will give higher speed performance but will cause the Motor+Drive 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

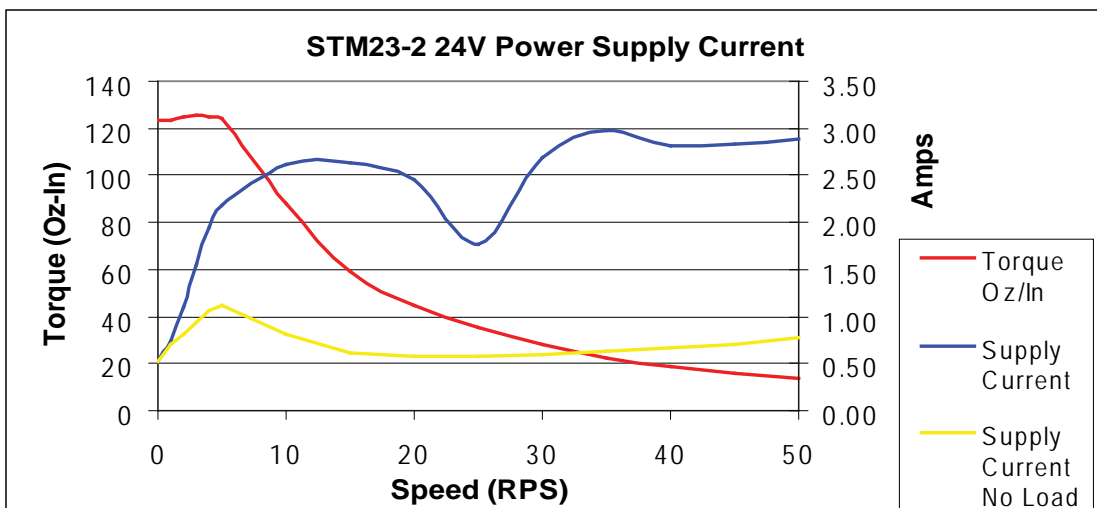
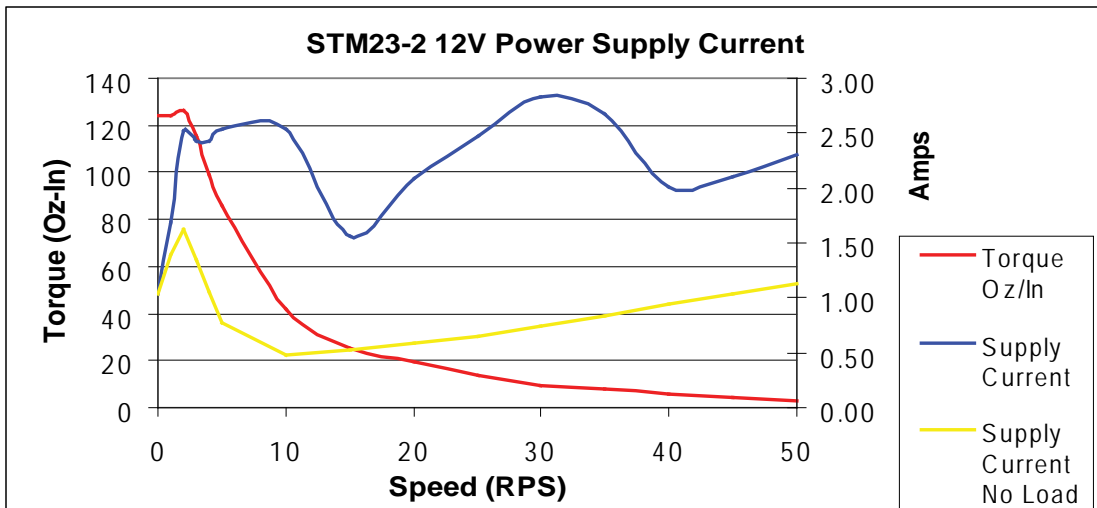
**If you choose an unregulated power supply, make sure the no load voltage of the supply does not exceed the drive's maximum input voltage specification.**

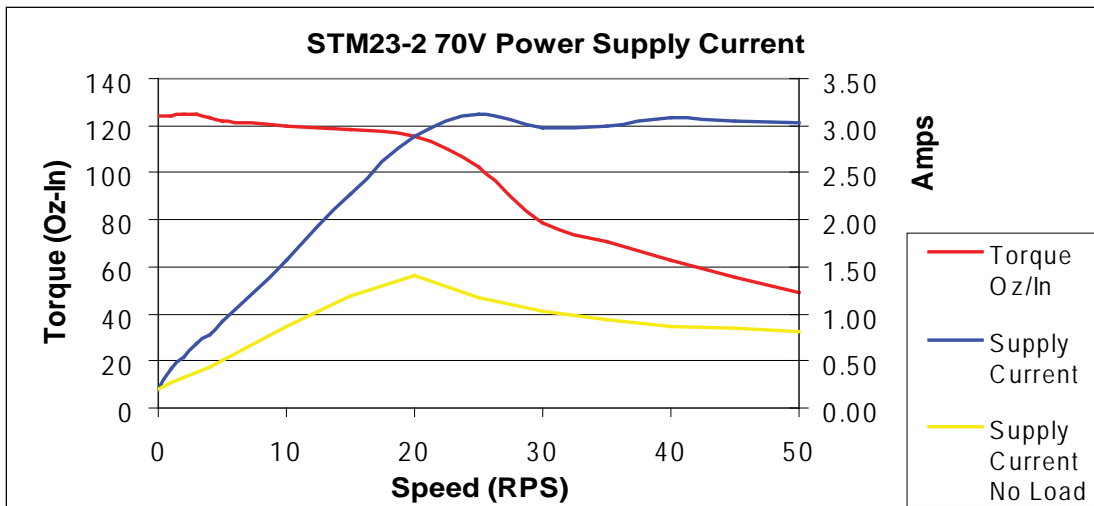
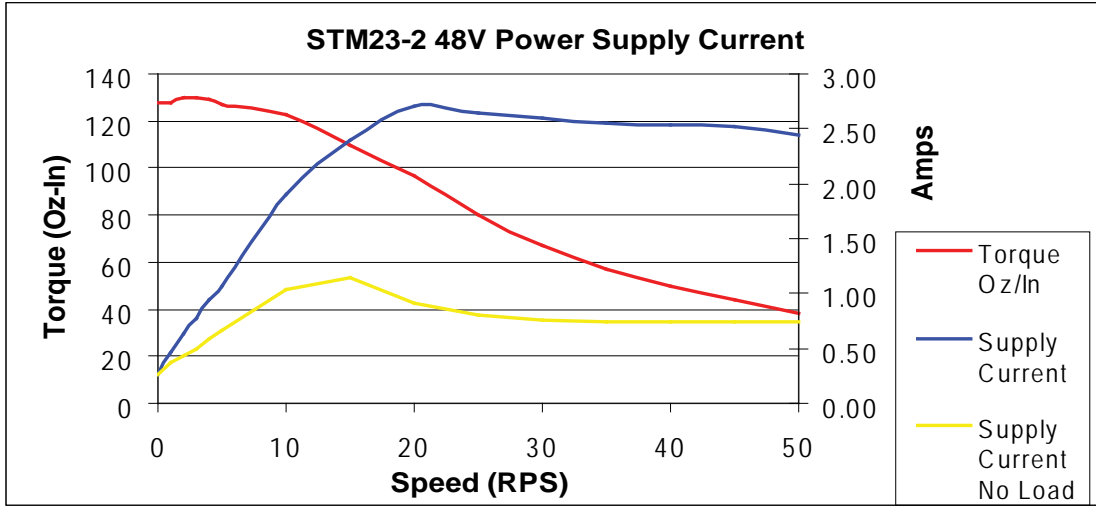


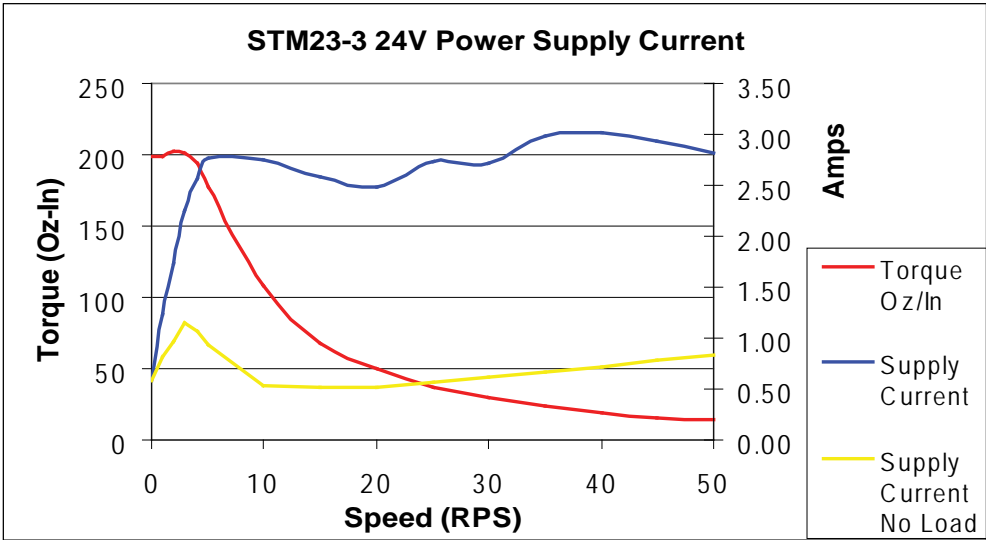
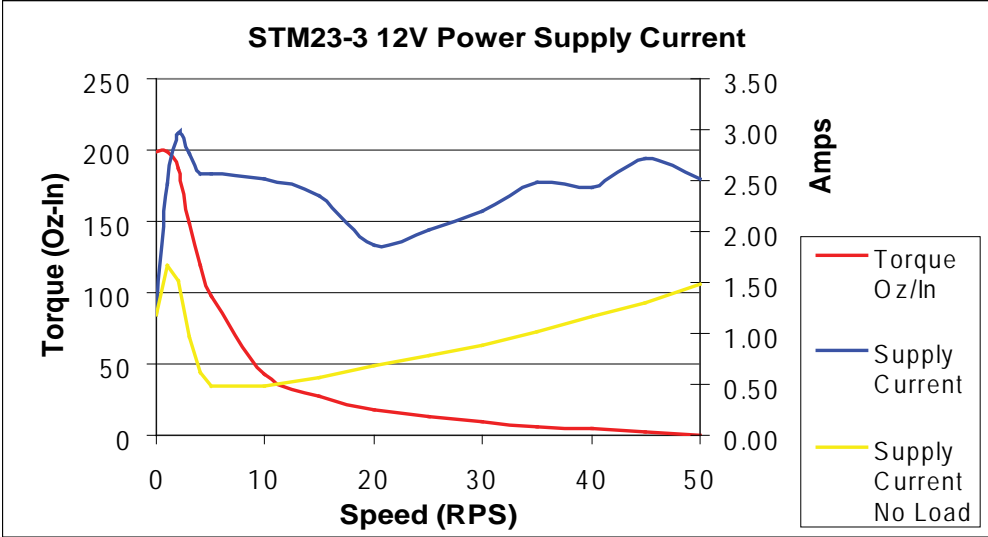
## Current

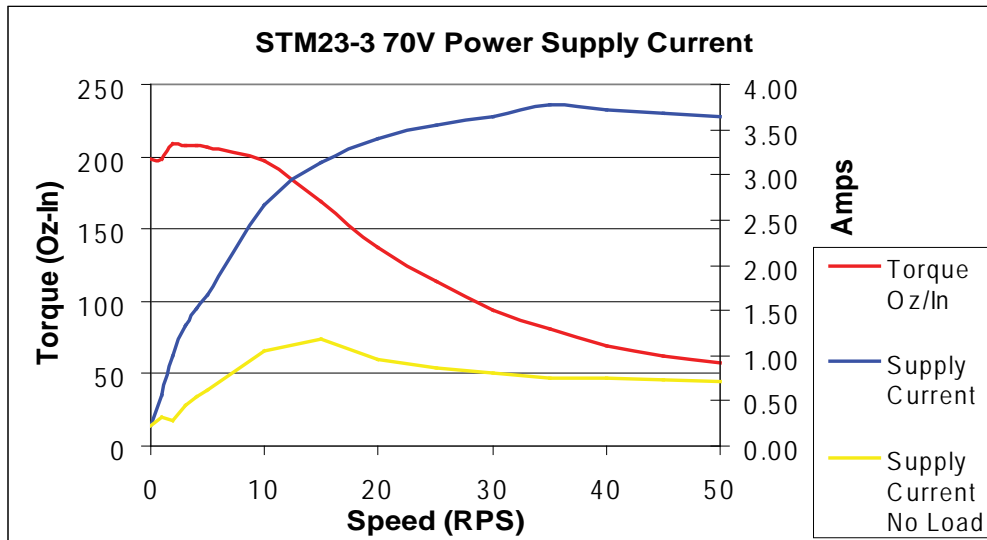
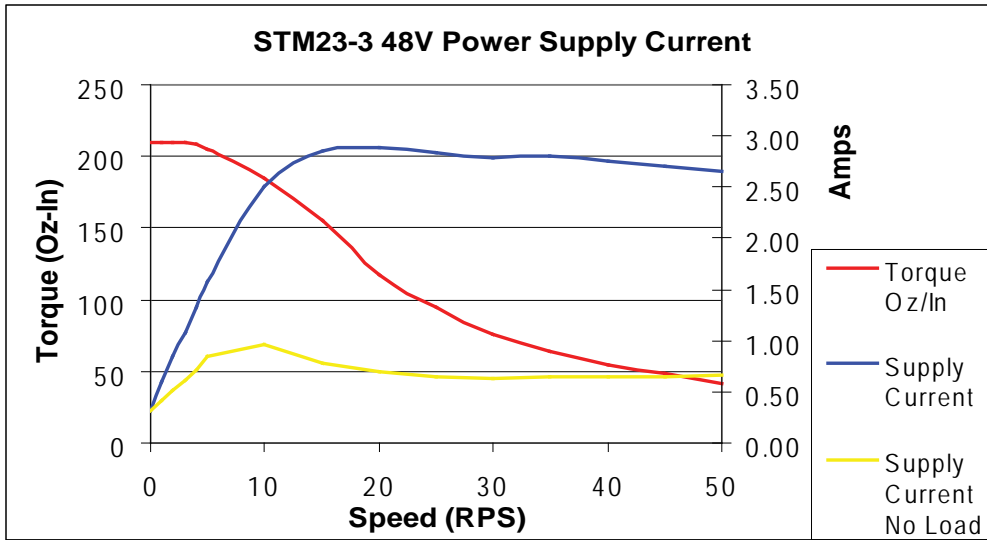
The power supply current required by the STM23 at various voltages is shown in the charts below. Note that the supply current flowing into the STM23 is less than the motor phase current. That's because the STM23's switching amplifier converts high voltages and low currents from the DC power supply into the higher current and lower voltage required by the motor. Using a higher voltage power supply will increase high speed torque, but will also increase motor heating (see page 40).

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.







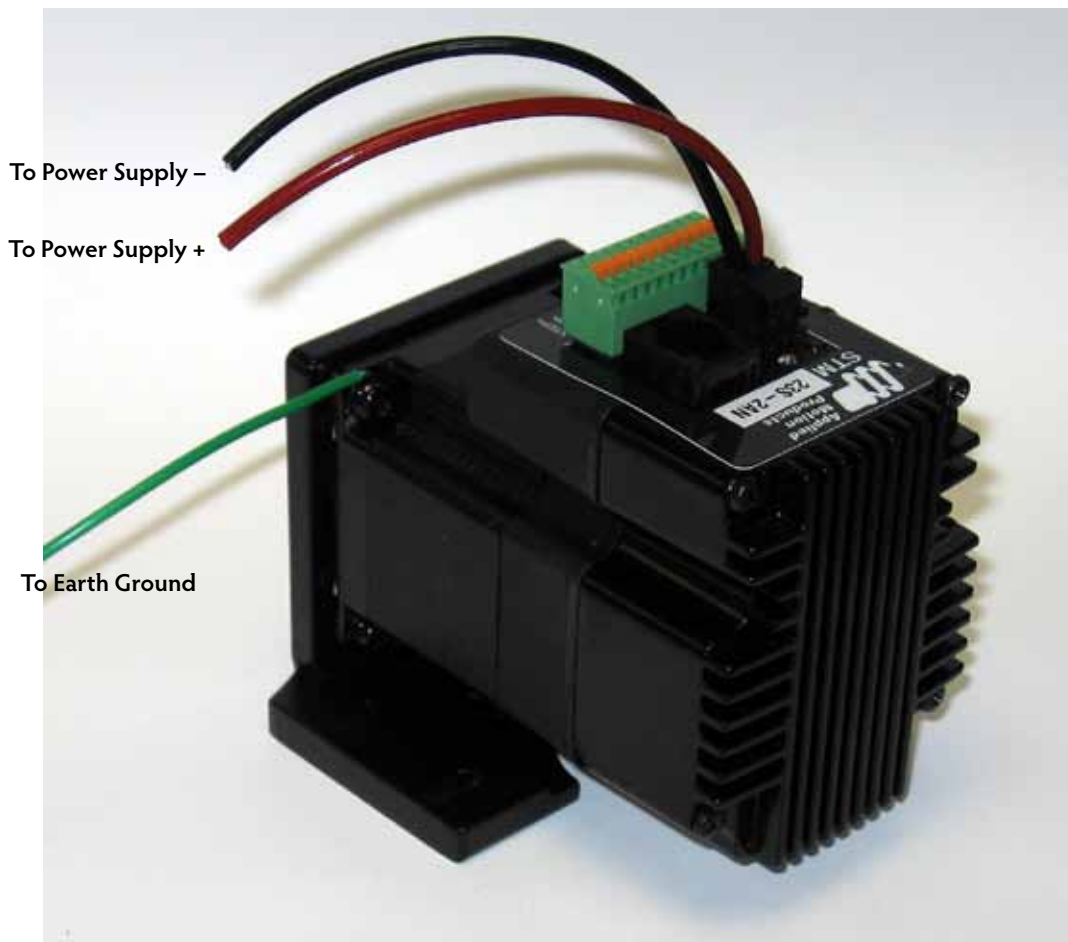


## Connecting the Power Supply

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

Connect the motor power supply "+" terminal to the driver terminal labeled "+". Connect power supply "-" to the drive terminal labeled "-". Use wire in the range of 16 to 20 AWG. The STM23 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 serviceable fuse in your system install a 4 amp fast acting fuse in line with the + power supply lead.

It is important that the motor frame be electrically connected to ground. When the motor is mounted on an insulated surface, a ground wire is required as shown in the diagram below. Also, in applications where multiple STMs are used on a machine, individual ground wires may reduce the overall electrical noise level.



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

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 and/or over-voltage your STM. 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

## Connecting the STM23 Communications

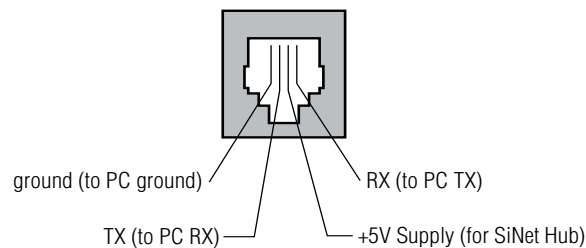
The STM23 is available with four types of communications: RS-232, RS-422/485, Ethernet and CANopen/RS-232. Each type requires a different hardware connection for interface to a PC or other host system. The RS-232 version (STM23x-xAx) comes with a cable that will provide the interface to an RS-232 port through a DB9 style connector. The RS-422/485 version (STM23x-xRx) requires the user to provide both the cabling and the RS-422/485 interface. The Ethernet versions (STM23Q-xEx and STM23IP-xEx) require the user to provide a CAT5 or better Ethernet cable for interfacing to the drive. This cable can be either a straight-thru or cross-over type. The CANopen/RS-232 version (STM23C-xCx) also includes an RS-232 port for configuration. Below are descriptions of how to interface various STM23 Drive+Motors 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 (RJ-11 connector) 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.***

NOTE: If the PC does not have an RS-232 serial port, a USB Serial Converter will be needed. For more information, please read *Connecting to an STM23 Using USB*.



### Pin Assignments of the RS-232 Port (RJ11 connector)

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. If this is a concern the RS-422/485 version should be used.

***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.***

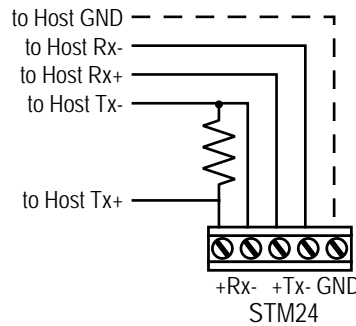
### Connecting to a Host Using RS-422/485

RS-422/485 communication allows connection of more than one drive to a single host PC, PLC, HMI or other controller. It also allows the communication cable to be long (more than 300 meters or 1000 feet). We recommend using Category 5 cable in low electrical-noise environments. Category 5 cable is widely used for computer networks, inexpensive, easily obtained and certified for quality and data integrity. For electrically noisy environments we recommend twisted pair cable with an overall shield and drain wire. Connect the drain wire at one end of the cable to earth ground.

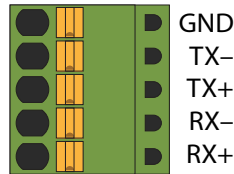
RS-422/485 versions of the STM23 can be used with either four-wire or two-wire configurations. Both types of configurations can be used for point-to-point (i.e. one drive and one host) or multi-drop networks (one host and up to 32 drives).



**NOTE:** To use the STM23 RS-422/485 version with the ST Configurator software, the STM23 must be connected to the PC in the four-wire "point to point" configuration (see below) and configured one axis at a time.



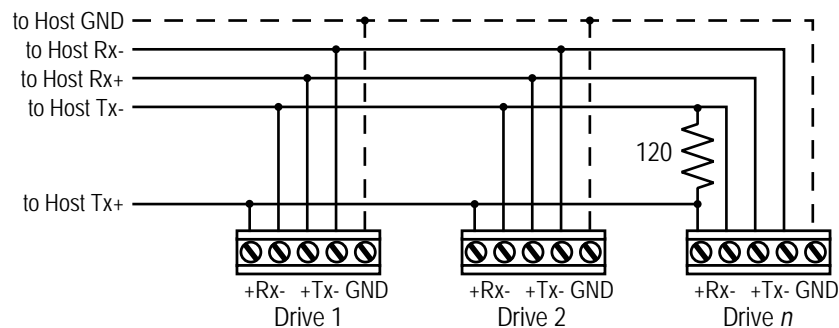
**RS-422/485 4-wire "Point to Point" Wiring**



**RS-422/485 Connector diagram**

## Four-Wire Configuration

Four-wire systems utilize separate transmit and receive wires. One pair of wires must connect the host's transmit signals to each drive's RX+ and RX- terminals. The other pair connects the drive's TX+ and TX- terminals to the host'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-422/485 network are powered from the same supply it is not necessary to connect the logic grounds. One drive's GND terminal should still be connected to the host ground.

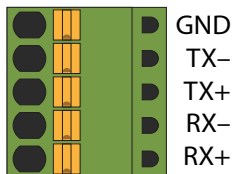


**RS-422/485 4-wire system**

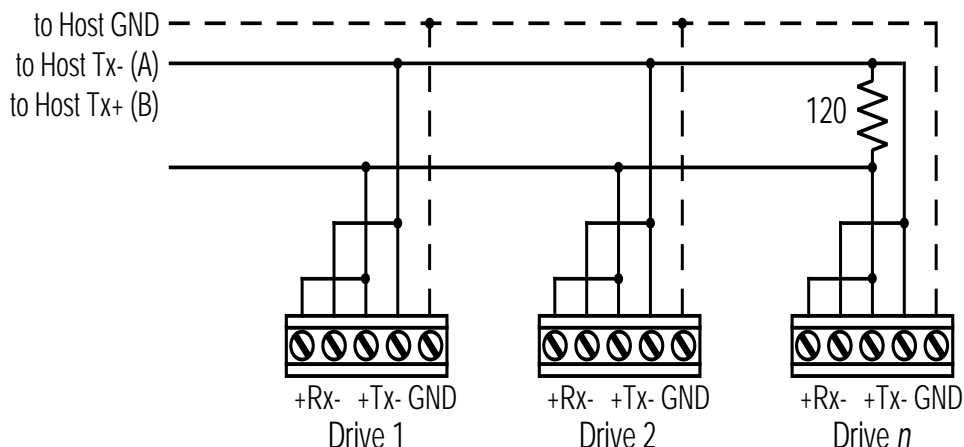
**NOTE:** a 120 ohm terminating resistor is required at the end of a four wire network.

**NOTE:** If the PC does not have an RS-422/485 serial port, a converter will be required.

## Two-Wire Configuration



RS-422/485 Connector diagram



Typical RS-422/485 Two-Wire System

Transmit and receive on the same pair of wires 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 STM23 includes 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 *ST Configurator* software. It is not necessary to set the transmit delay in a four-wire system.

**NOTE: a 120 ohm terminating resistor is required at the end of a two wire network.**

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

Model 485-25E from [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+Motor's TX+ and RX+ terminals. Connect "A" to the drive's TX- and RX- terminals.

### Assigning RS-485 Addresses

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 *ST Configurator*™ software, available at Applied Motion's website for this purpose.

Connect the drive to your PC and then launch the *ST Configurator*™ software. Finally, apply power to your drive. If you have already configured your drive, then you should click the Upload button so that the *ST Configurator*™ 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.

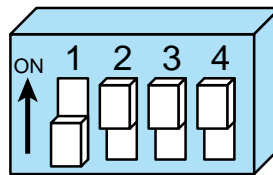
## Connecting to an STM23 using USB

The USB-COMi-M (8500-003) from Applied Motion is an excellent choice for USB to serial conversion. It can be used for all RS-232, RS-422 and RS-485 applications. The USB-COM-CBL from *byterunner.com* can be used for USB to RS-232 connection only. These adapters use the FTDI chip set and are compatible with Windows XP and later, including 64 bit versions.

*Note: Prolific-based USB serial adapters do not work with Vista 64 or Windows 7 64 bit operating systems.*

For RS-232 conversion using the USB-COMi-M (8500-003), use the DB9 connector and set the switches according to the diagram below. The DB-9 connector is not used for RS-485.

### RS-232

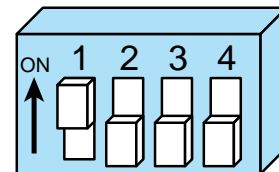


USB-COMi-M (8500-003) Switch Settings

For RS-485 two wire systems, set the switches and make the connections to the STM23 according to the diagrams below.

USB-COMi-M (8500-003) 6 pin screw terminal connector	STM23 5 pin connector
1	RX-, TX-
2	RX+, TX+
6	GND

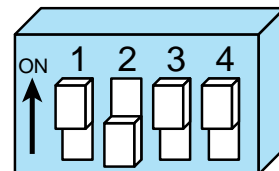
### 2 Wire RS-485



For RS-485 four wire systems, set the switches and make the connections to the STM23 according to the diagrams below.

USB-COMi-M (8500-003) 6 pin screw terminal connector	STM23 5 pin connector
1	RX-
2	RX+
3	TX+
4	TX-
6	GND

### 4 Wire RS-485



## Connecting the Drive to Your PC 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:

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

```
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
```

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

Settings 1 through E can be changed using the *ST Configurator* 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

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

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.

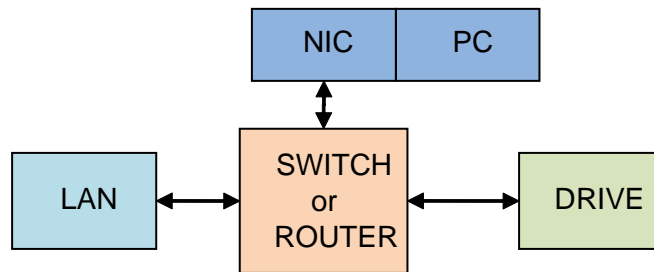
If you need help choosing a port number for your application, you can find a list of commonly used port numbers at <http://www.iana.org/assignments/port-numbers>.

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.

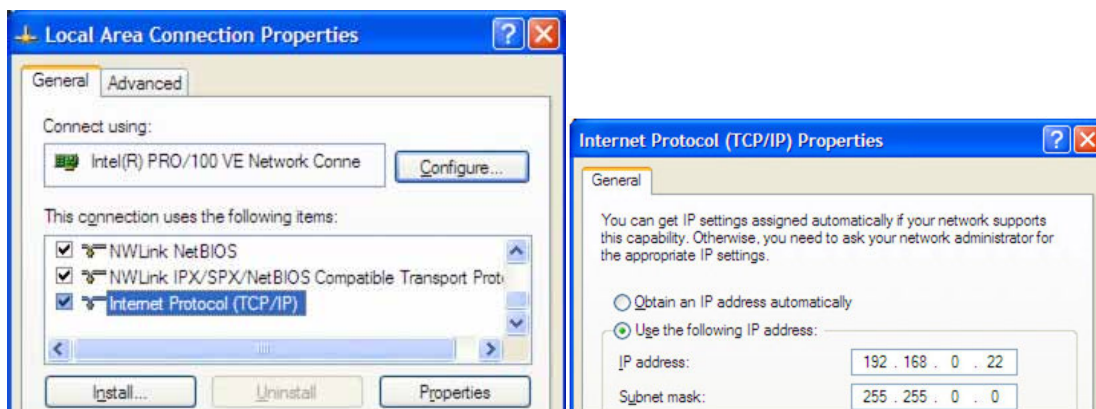
Once you've chosen an appropriate IP address for your drive, set the rotary switch according the address table above. If none of the default addresses are acceptable for your network, you can enter a new table of IP addresses using Configurator. If your network uses addresses starting with 192.168.0, 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".

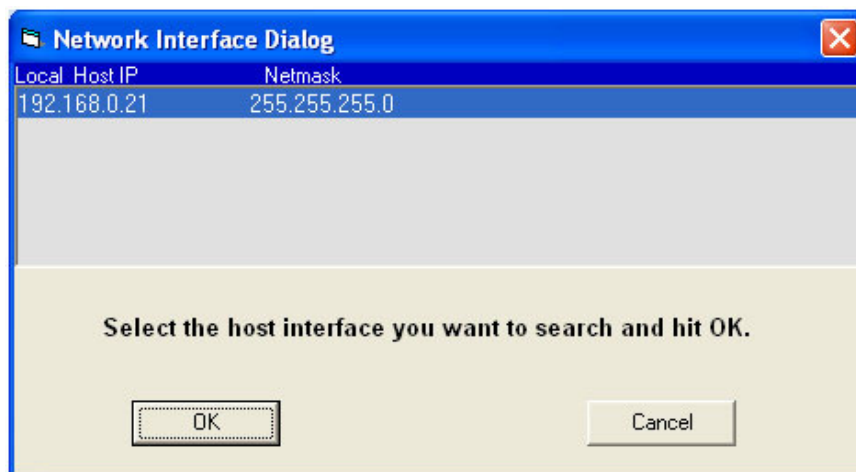
5. If the option "Use the following IP address" is selected, life is good. Change the subnet mask to "255.255.0.0" and click OK.

### 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. *ST Configurator* 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, select Drive Discovery from the Drive menu.

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.

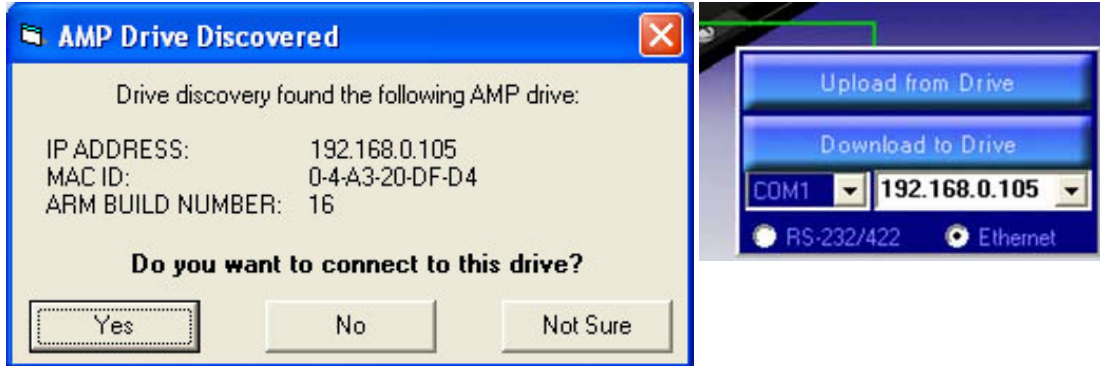
If you think this is the correct drive, click Yes. If you're not sure, click Not Sure and Drive Discovery will look for additional drives on your network. Once you've told Drive Discovery which drive is yours, it will automatically enter that drive's IP address in the IP address text box so that you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

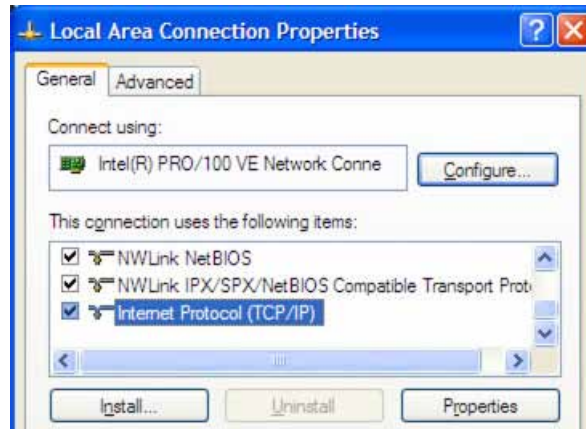


the necessary physical layer changes.

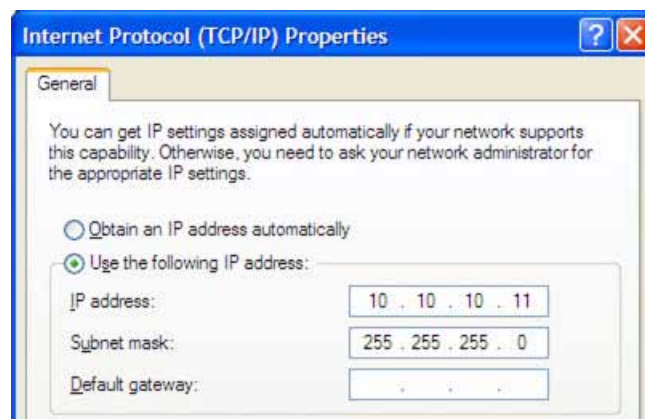
2. Set the IP address on the drive to "10.10.10.10" by setting the rotary switch at "0".
3. To set the IP address of your PC:
  - a. On Windows XP, right click on "My Network Places" and select properties.
  - b. On Windows 7, click Computer. Scroll down the left pane until you see "Network". Right click 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.

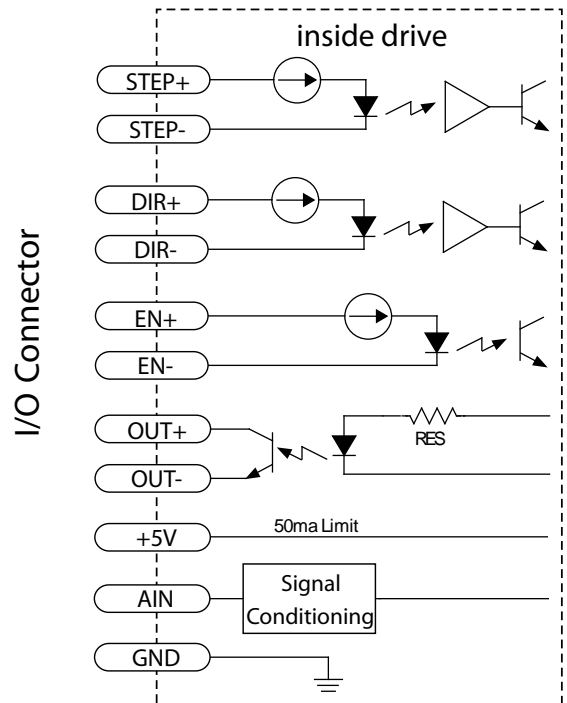
2. If you use a laptop and only connect to your LAN using wireless networking, you can use the built-in RJ45 Ethernet connection as your second NIC.
3. Set the IP address on the drive to "10.10.10.10" by setting the rotary switch at "0".
4. To set the IP address of the second NIC:
  - a. On Windows XP, 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."

### STM23 Inputs and Outputs

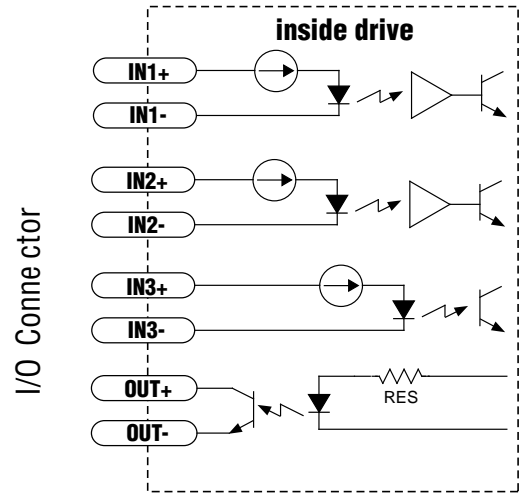
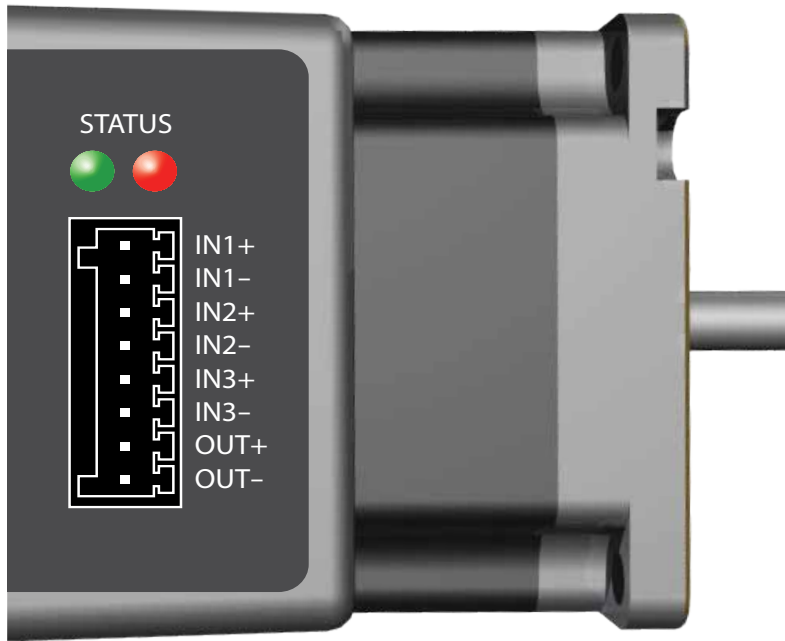
The STM23 drives include 3 digital inputs and 1 analog input (no analog input on STM23C models).

- Two high speed digital inputs, 5-24 volt logic, labeled **STEP** (or **IN1**) and **DIR** (or **IN2**), for commanding position. Pulse & direction, CW/CCW pulse, and A/B quadrature encoder signals can be used as position commands with these inputs. The **STEP/IN1** and **DIR/IN2** inputs can also be connected to sensors, switches and other devices for use with streaming SCL and Q programming commands such as Wait Input (WI), Seek Home (SH), Feed to Sensor (FS), etc. When not being used for commanding position, these inputs can also be used for CW/CCW end-of-travel limits, CW/CCW jog inputs, or Run/stop & direction velocity-mode inputs. *NOTE: the available functionality of these inputs is determined by the STM23 control option (S, Q, C or IP) as well as the motion control mode selected in ST Configurator.*
- One digital input, 5-24 volt logic, labeled **EN** (or **IN3**), which can be used for motor enable/disable and/or alarm reset. It can also be connected to a sensor, switch or other device for use with streaming SCL and Q programming commands such as Wait Input, Seek Home, Feed to Sensor, etc.
- One analog input, 0-5 volt logic, labeled **AIN**, which can be used as an analog velocity or position command. It can also be used with streaming SCL and Q programming commands such as Wait Input, Seek Home, Feed to Sensor, etc. *NOTE: The analog input is not available on STM23C (CANopen) models.*

### Connector Pin Diagram - STM23



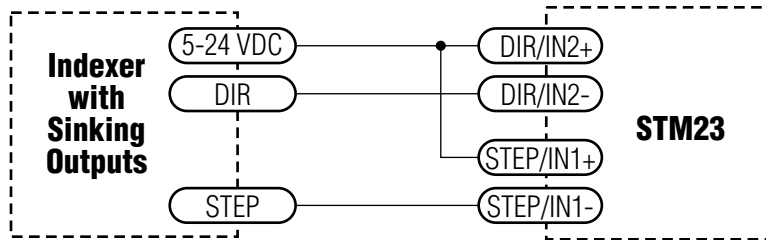
## Connector Pin Diagram - STM23C



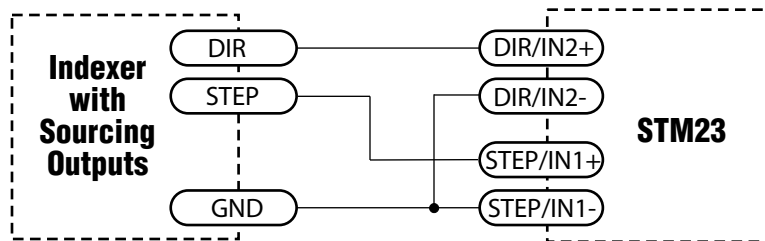
### High Speed Digital Inputs

The STM23 drives include two high-speed inputs labeled STEP (or IN1) and DIR (or IN2). They accept 5 to 24 volt single-ended or differential signals, up to 2 MHz. 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. Or you can use these inputs with Wait Input, If Input, Feed to Sensor, Seek Home and other SCL or Q\_commands.

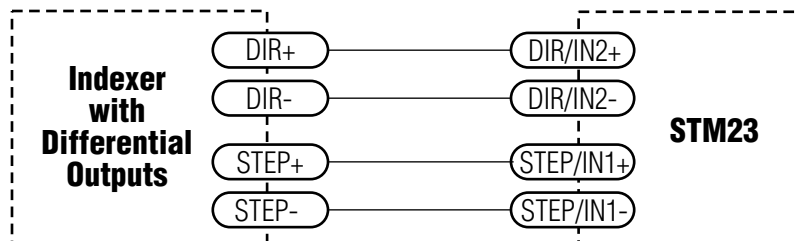
Connection diagrams follow.



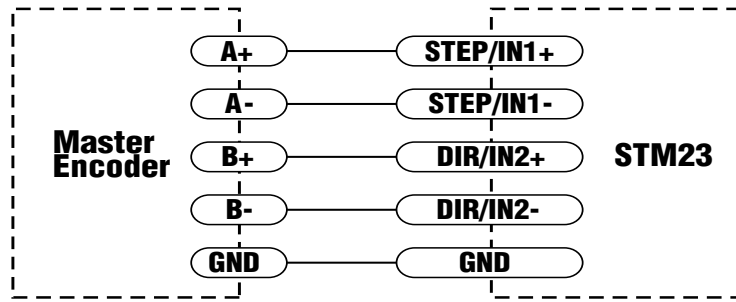
Connecting to indexer with Sinking Outputs



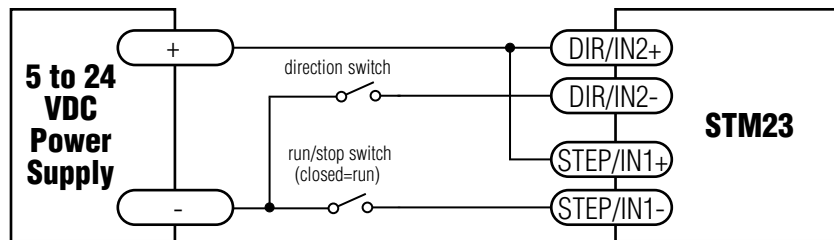
Connecting to indexer with Sourcing Outputs



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



Wiring for Encoder Following



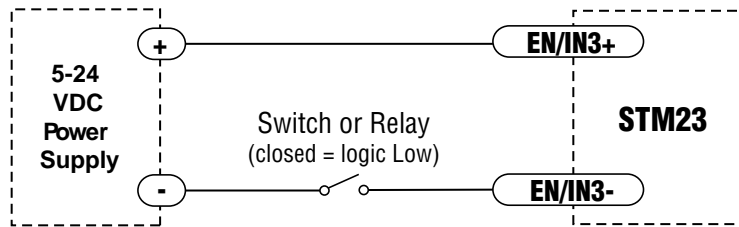
Using Mechanical Switches

## The Enable (EN) Digital Input

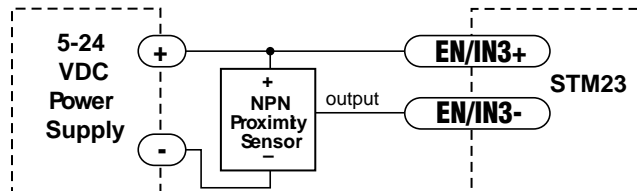
As mentioned in the previous section, the high-speed STEP and DIR inputs are designed for high speed operation. The Enable digital input is designed for high speed digital input operation between 5 and 24 volts DC.

*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.*

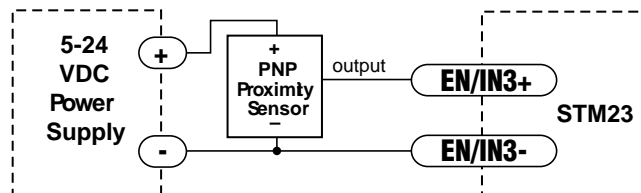
The diagrams on the following pages show how to connect the input to various commonly used devices.



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



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

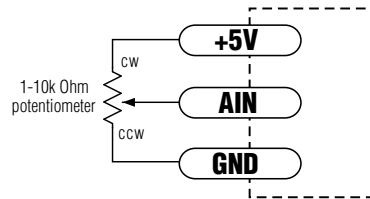
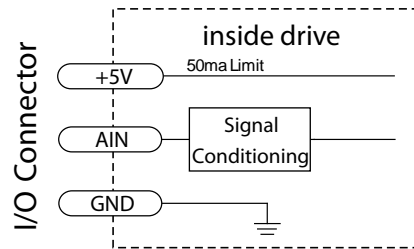


**Connecting a PNP Type Proximity Sensor to an input**  
(When prox sensor activates, input goes low).



## Analog Input

The STM23S/Q/IP drives feature an analog input (not available on STM23C drives). 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 analog signal. Use the *ST Configurator* software to set the signal range, offset, dead-band and filter frequency. The STM23 drives provide a 5 volt DC, 50 mA output labeled +5V 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.



**Connecting a Potentiometer to the Analog Input**

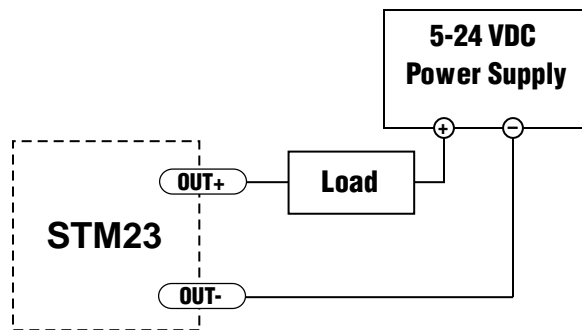
## Programmable Output

The STM23 drives feature one optically isolated digital output. This 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). The output can also be turned on and off by program instructions like the Set Output (SO) command. The output can be used to drive LEDs, relays and the inputs of other electronic devices like PLCs and counters. The output transistor's collector, labeled OUT+, and emitter, labeled OUT-, are available at the connector. This allows you to configure the output for current sourcing or sinking.

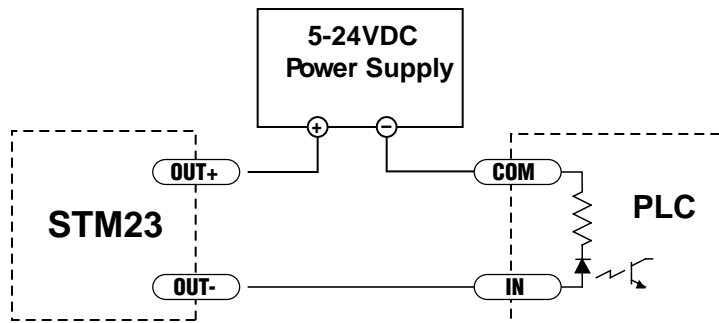
Diagrams of various connection types follow.

**Do not connect the output to more than 30VDC.**

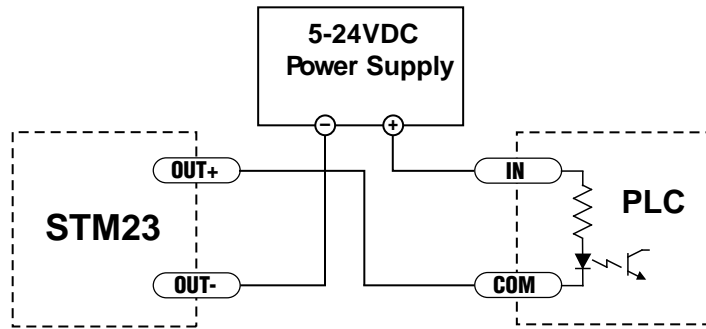
**The current through the output terminal must not exceed 40mA.**



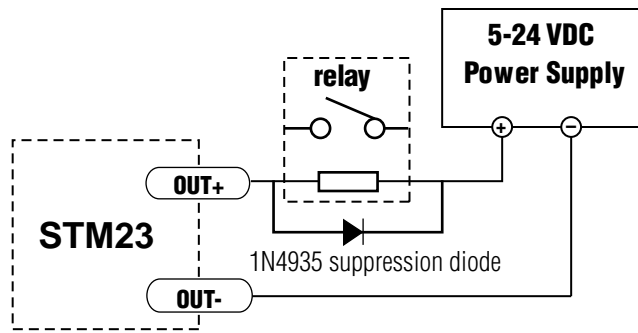
Connecting a Sinking Output



Connecting a Sourcing Output



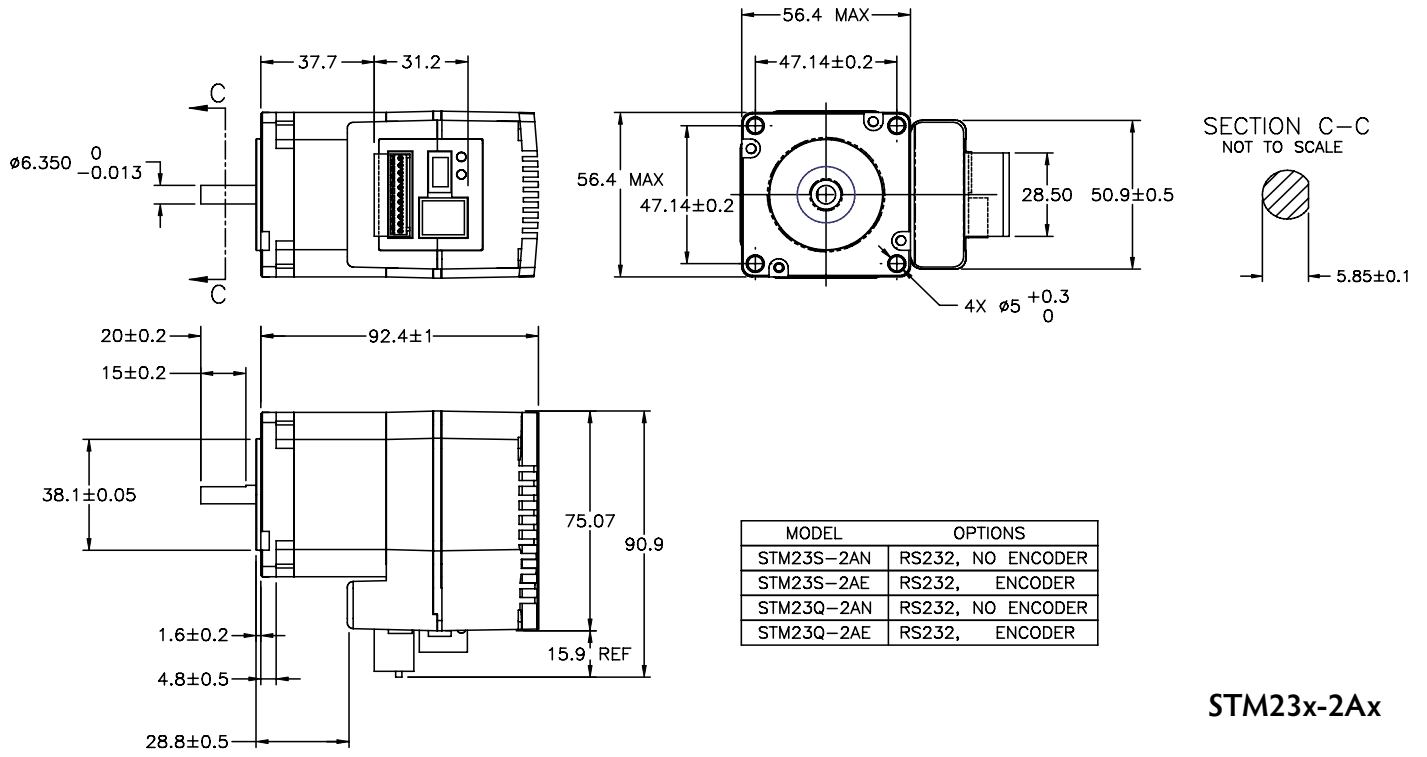
Connecting a Sinking Output again



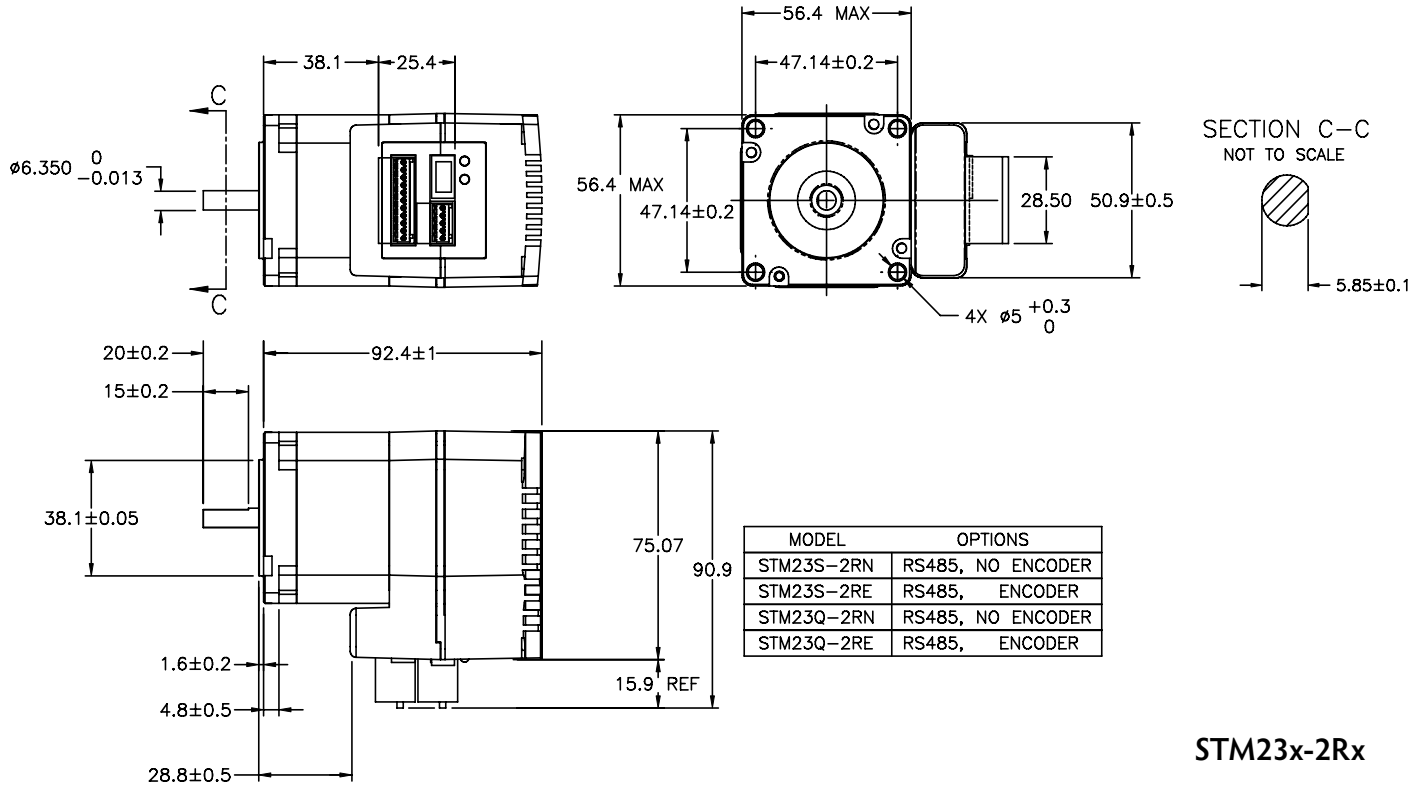
Driving a Relay

Reference Materials

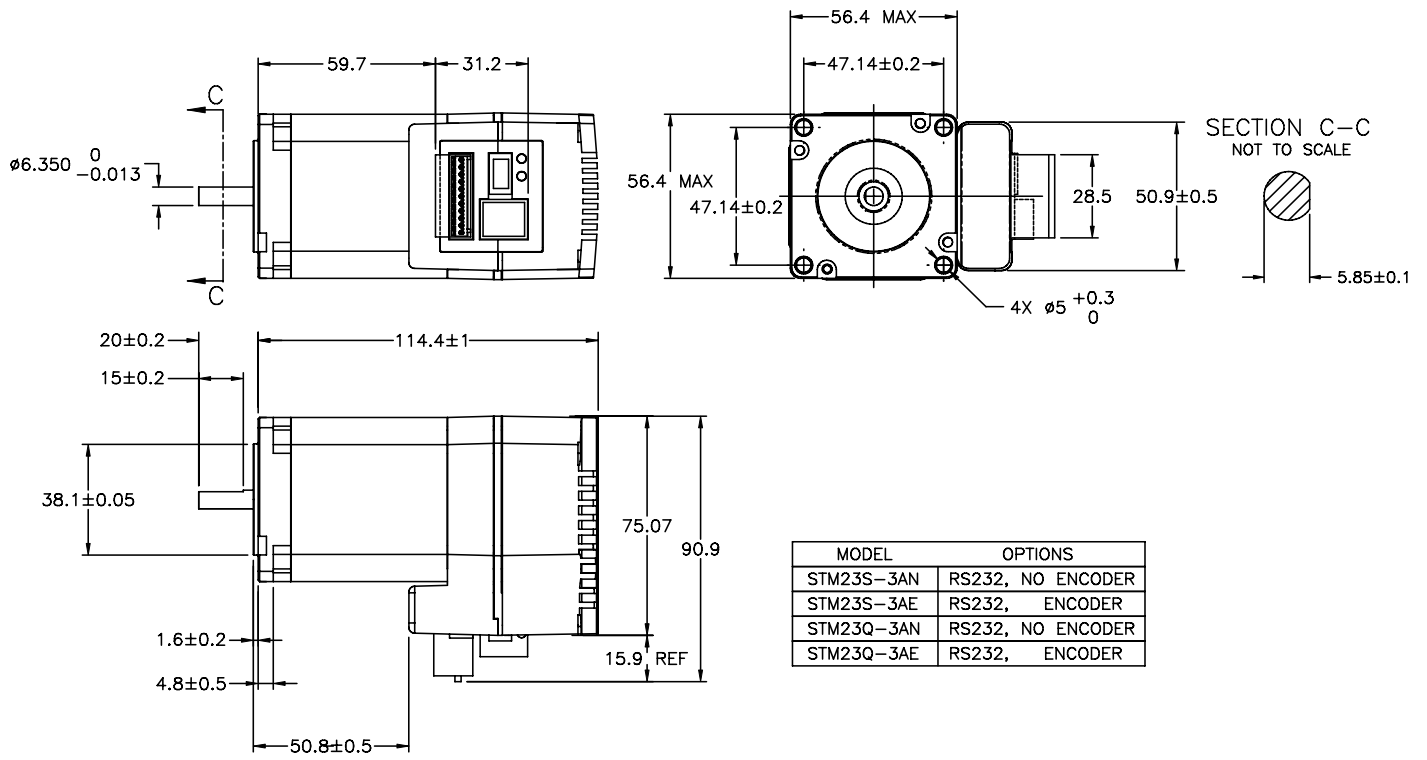
Mechanical Outlines



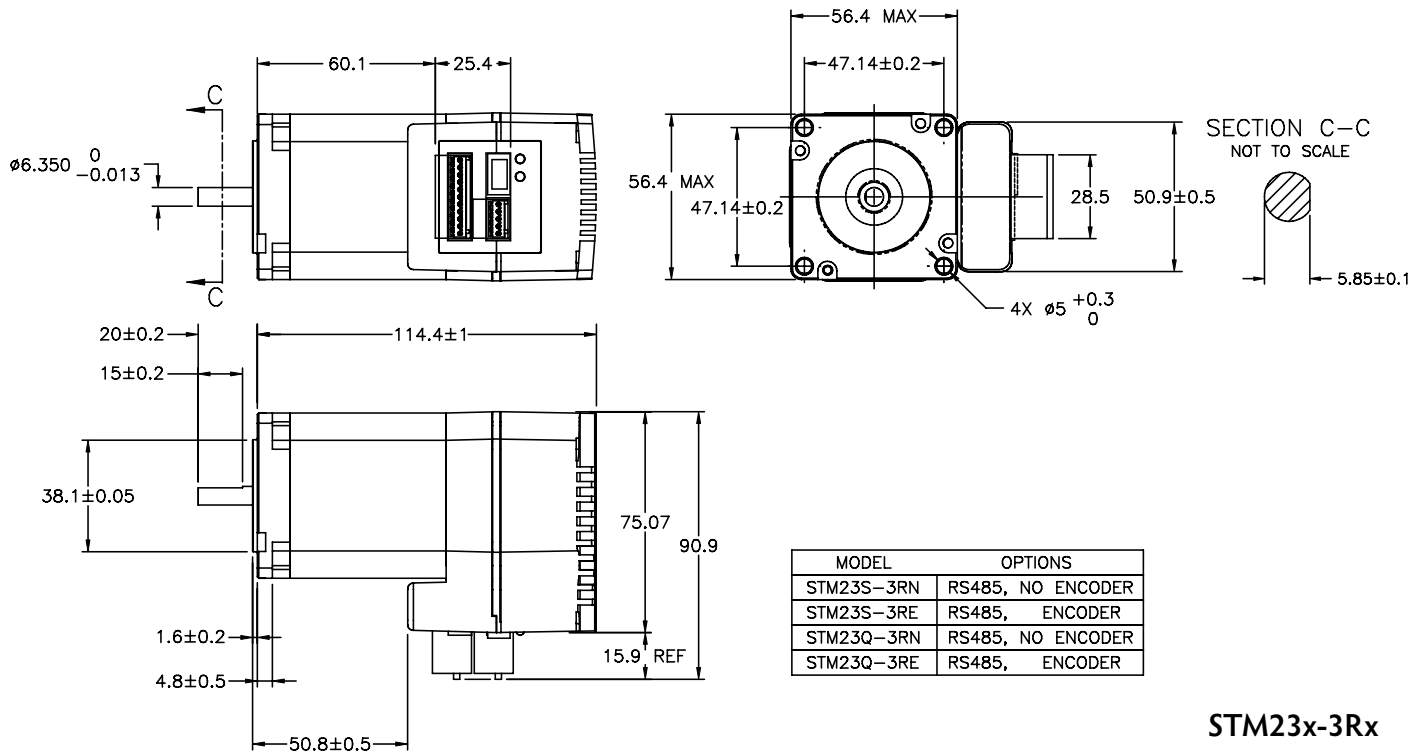
STM23x-2Ax



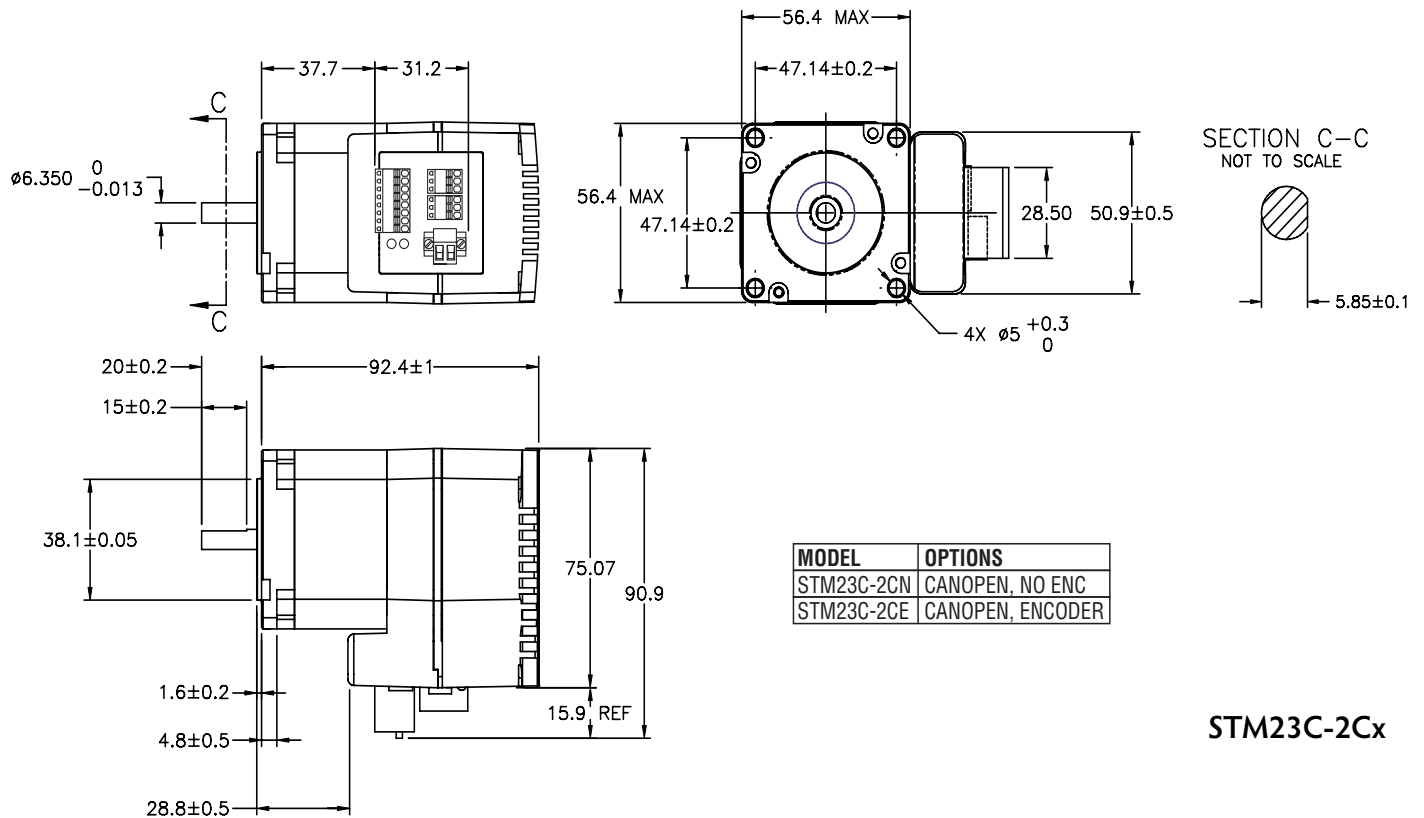
**STM23x-2Rx**



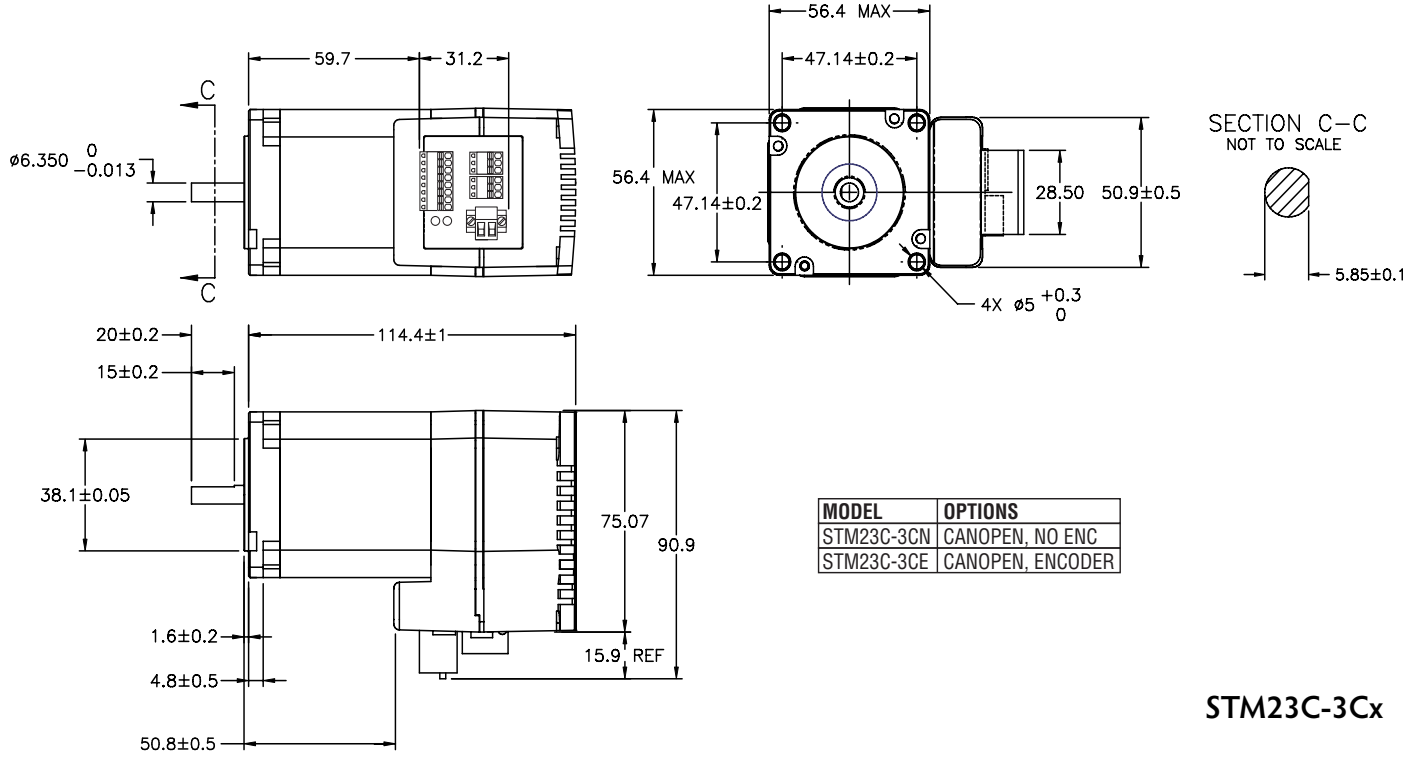
**STM23x-3Ax**



**STM23x-3Rx**



**STM23C-2Cx**



STM23C-3Cx

**Technical Specifications**

<b>POWER AMPLIFIER</b>	
AMPLIFIER TYPE	Dual H-Bridge, 4 Quadrant
CURRENT CONTROL	4 state PWM at 20 Khz
OUTPUT TORQUE	STM23x-2xx: 125 oz-in with suitable power supply STM23x-3xx: 210 oz-in with suitable power supply
POWER SUPPLY	External 12 - 70 VDC power supply required
PROTECTION	Over-voltage (shutdown at 74VDC), under-voltage (shutdown at 11VDC), 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.
OPERATING TEMPERATURE	0 to 85°C (32 to 185°F) Internal temperature of the electronics section and encoder 0 to 100°C (32 to 212°F) Temperature of motor body
AMBIENT TEMPERATURE	0 to 40°C (32 - 104°F) (mounted to suitable heatsink)
HUMIDITY	90% max, non-condensing
AGENCY APPROVALS	RoHS, CE EN61800-3:2004

<b>CONTROLLER</b>	
MICROSTEP RESOLUTION	Software selectable from 200 to 51200 steps/rev in increments of 2 steps/rev.
MICROSTEP EMULATION	Performs high resolution stepping by synthesizing fine microsteps from coarse steps (step & direction mode only)
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%.
COMMAND SIGNAL SMOOTHING	Software configurable filtering reduces jerk and excitation of extraneous system resonances (step & direction mode only).

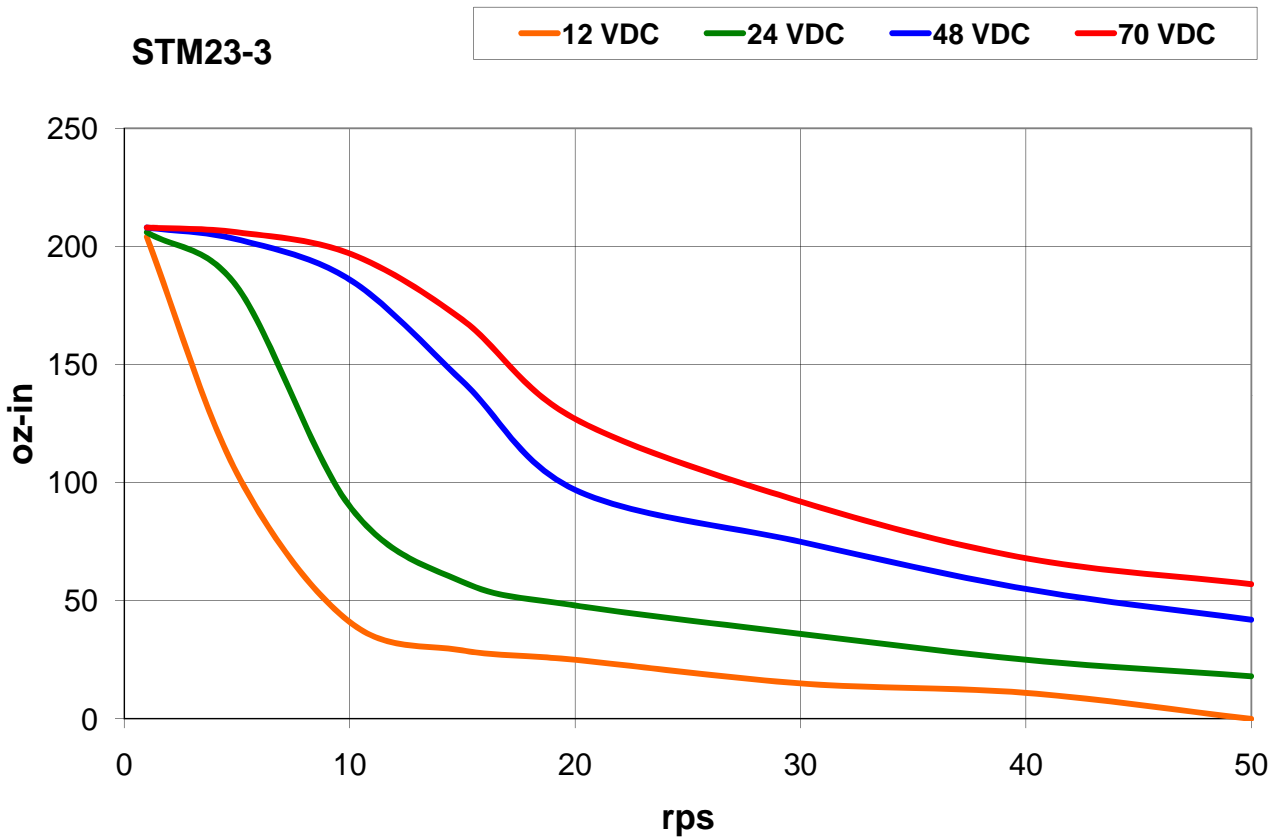
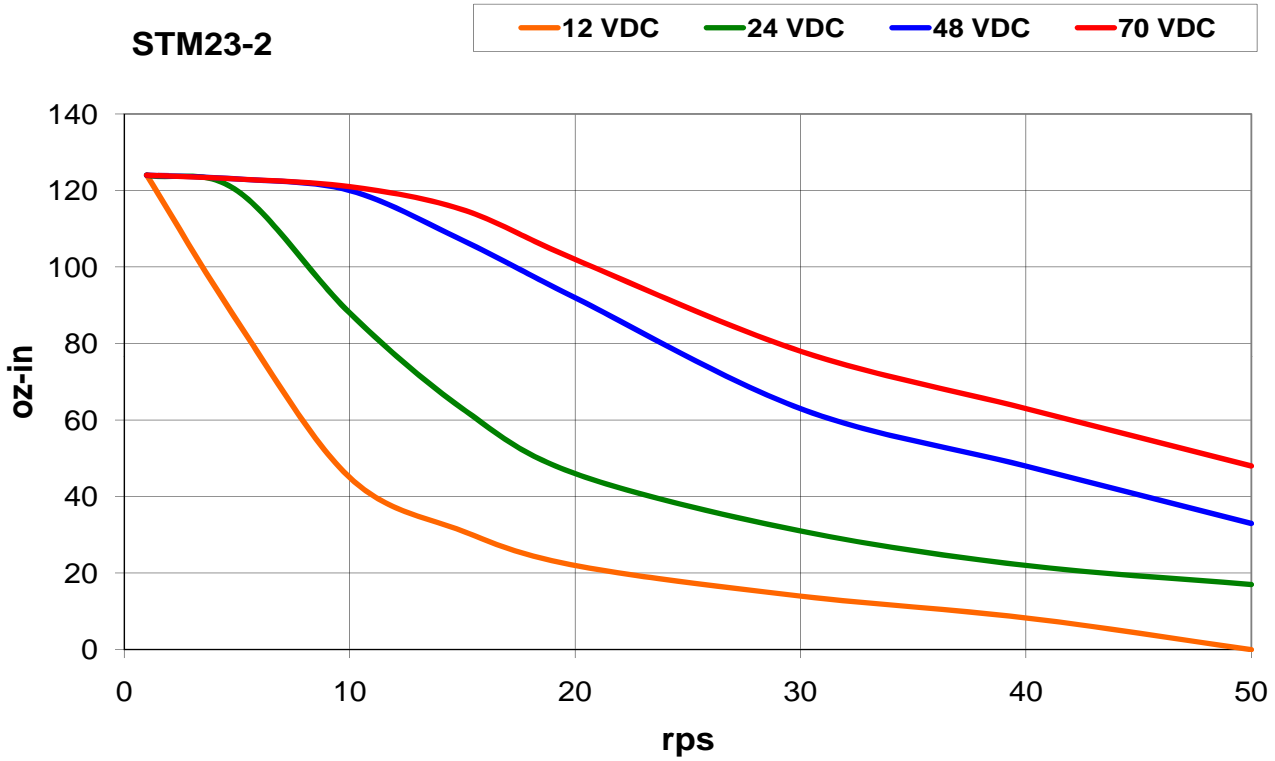


<b>CONTROLLER</b>	
NON-VOLATILE STORAGE	Configurations are saved in FLASH memory on-board the DSP.
MODE OF OPERATION	Step & direction, CW/CCW pulse, A/B quadrature pulse, velocity (oscillator, joystick), SCL streaming commands, SiNet Hub.
STEP AND DIRECTION INPUTS	<p><b>STEP+/- (IN1+/1)</b>            Optically Isolated, 5-24 Volt. 8-12mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3MHz.            Function: Step, CW step, A quadrature, CW limit , CW jog, START/STOP (oscillator mode), general purpose input.            Adjustable bandwidth digital noise rejection filter on all inputs</p> <p><b>DIR+/- (IN2+/-)</b>            Optically Isolated, 5-24 Volt. 8-12mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz.            Function: Direction, CCW step, B quadrature, CCW limit , CCW jog, sensor, direction (oscillator mode), general purpose input.            Adjustable bandwidth digital noise rejection filter on all inputs</p>
ENABLE INPUT	<p><b>EN+/- (IN3+/-)</b>            Optically Isolated, 5-24 Volt. 8-12mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz.            Function: Enable, alarm/fault reset, speed 1/speed 2(oscillator mode). Adjustable bandwidth digital noise rejection filter on all inputs</p>
OUTPUT	Optically isolated, 30V, 40mA MAX. Function: Fault, motion, tach or general purpose programmable
ANALOG INPUT RANGE	AIN referenced to GND. Range = 0 to 5 VDC. Resolution = 12 bits.
COMMUNICATION INTERFACE	STM23x-xAx: RS-232 STM23x-xEx: Ethernet STM23x-xRx: RS-485 STM23C-xCx: CANopen, RS-232 STM23IP-xEx: Ethernet, EtherNet/IP
+ 5 VOLT USER OUTPUT	4.8V to 5.0V @ 50mA Maximum

<b>MOTOR DATA</b>	
MASS	STM23x-2xx = 1 lb, 14 oz (850 g) STM23x-3xx = 42 oz (1191 g)
ROTOR INERTIA	STM23x-2xx = $3.68 \times 10^{-3}$ oz-in-sec <sup>2</sup> (260 g-cm <sup>2</sup> ) STM23x-3xx = $6.5 \times 10^{-3}$ oz-in-sec <sup>2</sup> (460 g-cm <sup>2</sup> )

## 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.

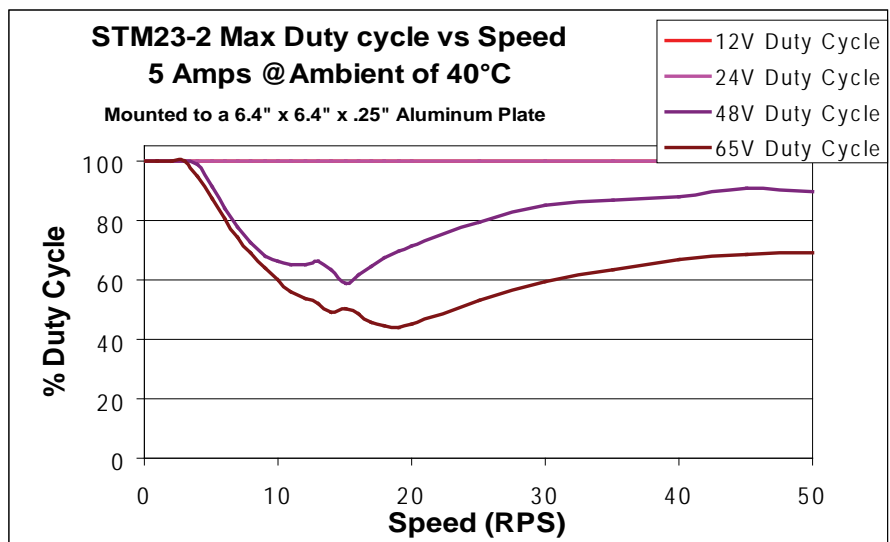
We have characterized the STM23 drive+motors in our lab and provided curves showing the maximum duty cycle versus speed at commonly used power supply voltages. Please refer to these curves when planning your application.

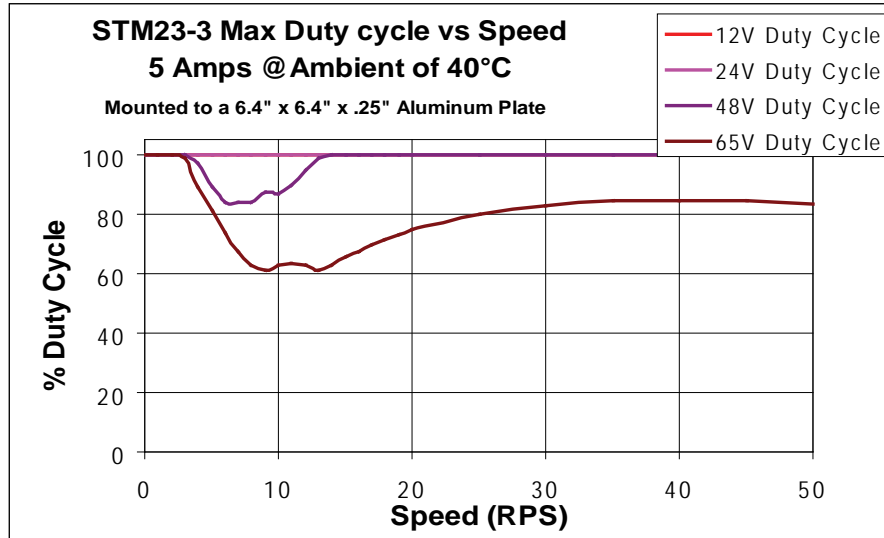
Please also keep in mind that a step motor typically reaches maximum temperature after 30 to 45 minutes of operation. If you run the motor for one minute then let it sit idle for one minute, that is a 50% duty cycle. Five minutes on and five minutes off is also 50% duty. However, one hour on and one 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.

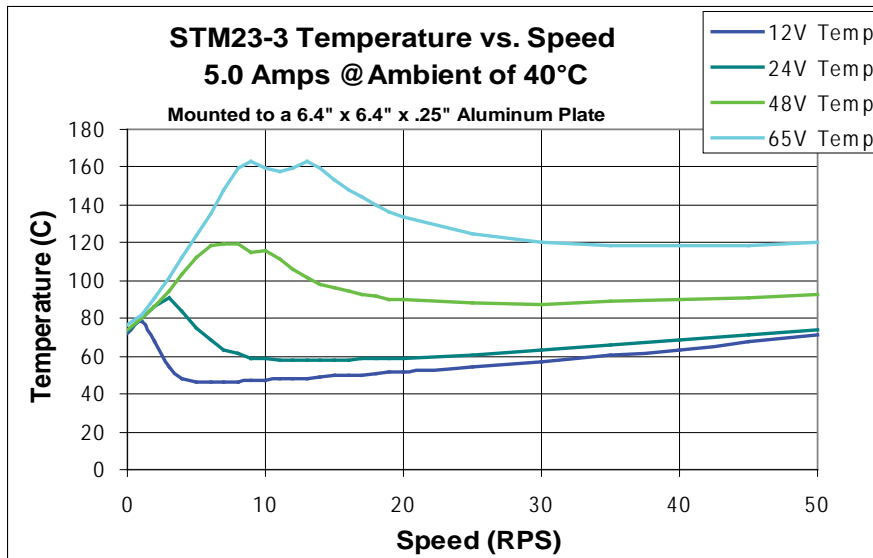
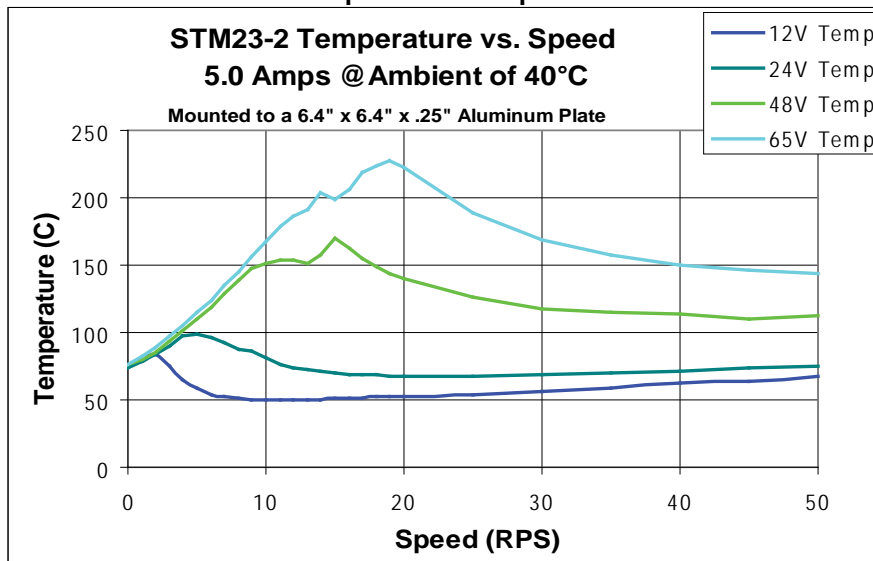
Please use the curves below, which show the motor body temperature, to determine the maximum duty cycle of the STM23 drive+motors under various conditions.

Maximum Duty Cycle vs Speed





Temperature vs Speed



## Mating Connectors and Accessories

Mating Connector (Type)	STM23x-xAxSTM23x-xEx	STM23x-xRx	STM23C-xCx
DC Power (2-position, screw terminal)	1615780000 - Weidmuller	1615780000 - Weidmuller	1615780000 - Weidmuller
I/O (11-position, spring cage)	1881419 - Phoenix	1881419 - Phoenix	1881419 - Phoenix
RS-485 (5-position, spring cage)	-	1881354 - Phoenix	1881419 - Phoenix
RS-232/CANopen	-	-	[mating connector for CANopen/ RS-232]

### Accessories

Serial programming cable for programming units with RS-232 ports (STM23x-xAx): P/N 3004-189

Serial programming cable for RS-232/CANopen ports (STM23C-xCx): P/N 3004-256

USB-Serial Adapter with one RS-232 port and one RS-485 port: P/N 8500-003

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

DC Power Supplies:

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









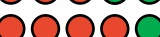





48 V, 320 W switching power supply, P/N PS320A48

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

## LED Error Codes

### Status LED STM

The STM drive+motor includes red and green LEDs to indicate status. When the motor is enabled, the green LED flashes slowly. When the green LED is solid, the motor is disabled. Conditions and errors are indicated by combinations of red and green “flashes” as follows:

Code	Condition
 solid green	no alarm, motor disabled
 flashing green(slow)	no alarm, motor enabled
 flashing green(fast)	Q Program running
 1 red, 1 green	motor stall (optional encoder only)*
 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*
 4 red, 1 green	power supply overvoltage*
 4 red, 2 green	power supply undervoltage
 5 red, 1 green	over current / short circuit*
 6 red, 1 green	open motor winding*
 7 red, 1 green	serial communication error

\*These errors are faults and will disable the motor. They also cause the output to activate if it is so configured.

## **Contacting Applied Motion Products**

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