

# STM24

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## Hardware Manual



**Applied  
Motion  
Products**

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## Introduction

Thank you for selecting the Applied Motion Products STM24 Drive+Motor. We hope our dedication to performance, quality and economy will make your motion control project successful. If there's anything we can do to improve our products or help you use them better, please call or fax. We'd like to hear from you. Our phone number is (800) 525-1609, or you can reach us by fax at (831) 761-6542. You can also email [support@applied-motion.com](mailto:support@applied-motion.com).



## Features

- Programmable, micro-stepping digital step Drive+Motor in an integrated package
- Operates from a 12 to 70 volt DC power supply
- Operates in velocity or position mode
- Mid-band anti-resonance
- Accepts analog signals, digital signals and streaming serial commands
- Step input signal smoothing
- Communication options: RS-232, RS-422/485, CANopen, Ethernet (UDP/TCP), and EtherNet/IP
- Optional encoder feedback
- Delivers up to 340 oz-in holding torque
- -SF & -QF: four optically isolated, 5 to 24 volt digital "flex I/O" points (each can be configured as an input or an output)
- -S, -Q, -IP, -C: three optically isolated, 5 to 24 volt digital inputs, one optically isolated 30V, 100mA digital output
- Input filtering both hardware and software
- 0 to 5V analog input for speed and position control (not available on -C, CANopen drive)

## List of STM24 Model Numbers

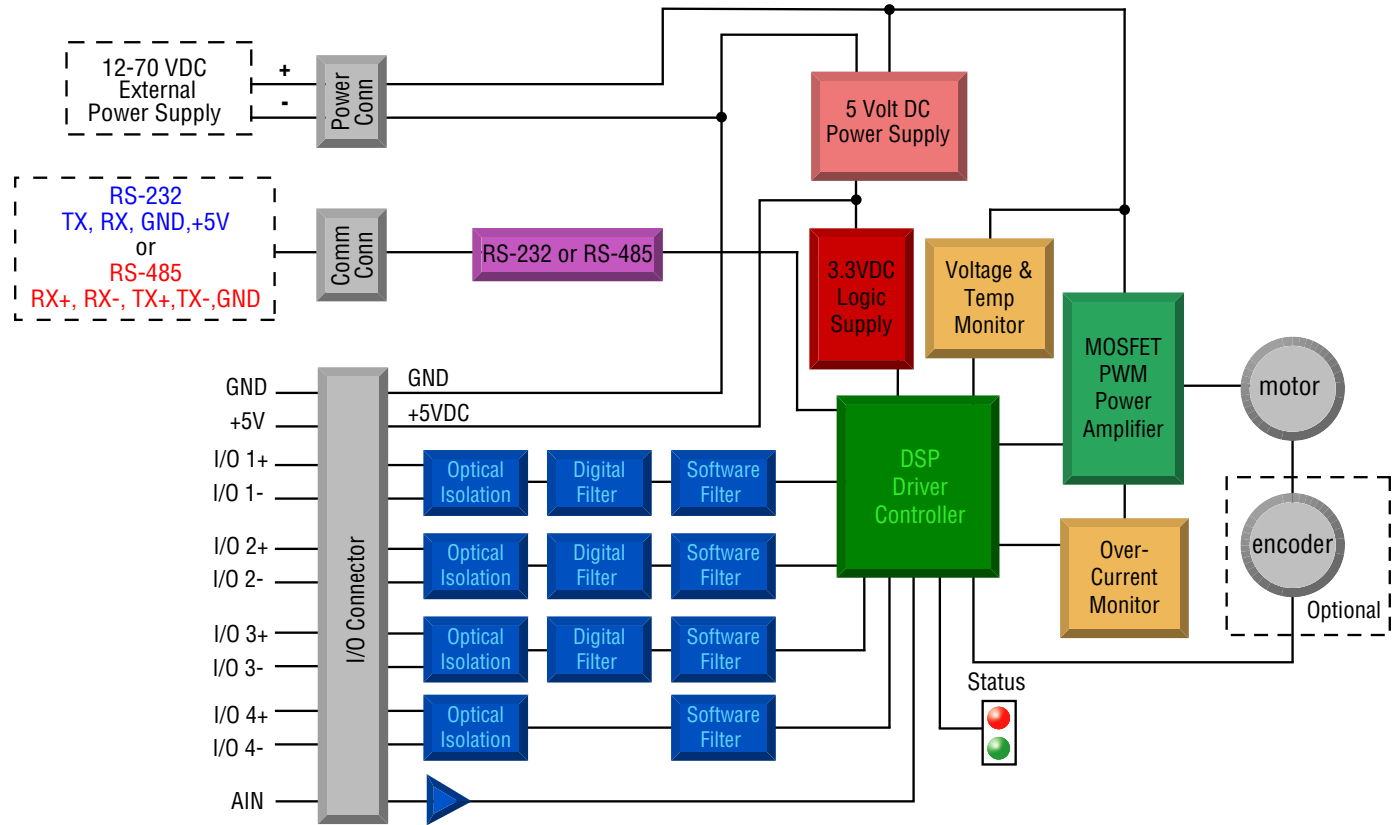
STM24SF-3AN	STM24SF-3AE	STM24S-3EN
STM24SF-3RN	STM24SF-3RE	STM24S-3EE
STM24QF-3AN	STM24QF-3AE	STM24Q-3EN
STM24QF-3RN	STM24QF-3RE	STM24Q-3EE
STM24C-3CN	STM24C-3CE	STM24IP-3EN
		STM24IP-3EE

Notes:

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

Next to last digit indicates communication interface. A = RS-232, R = RS-485, C = CANopen, E = Ethernet

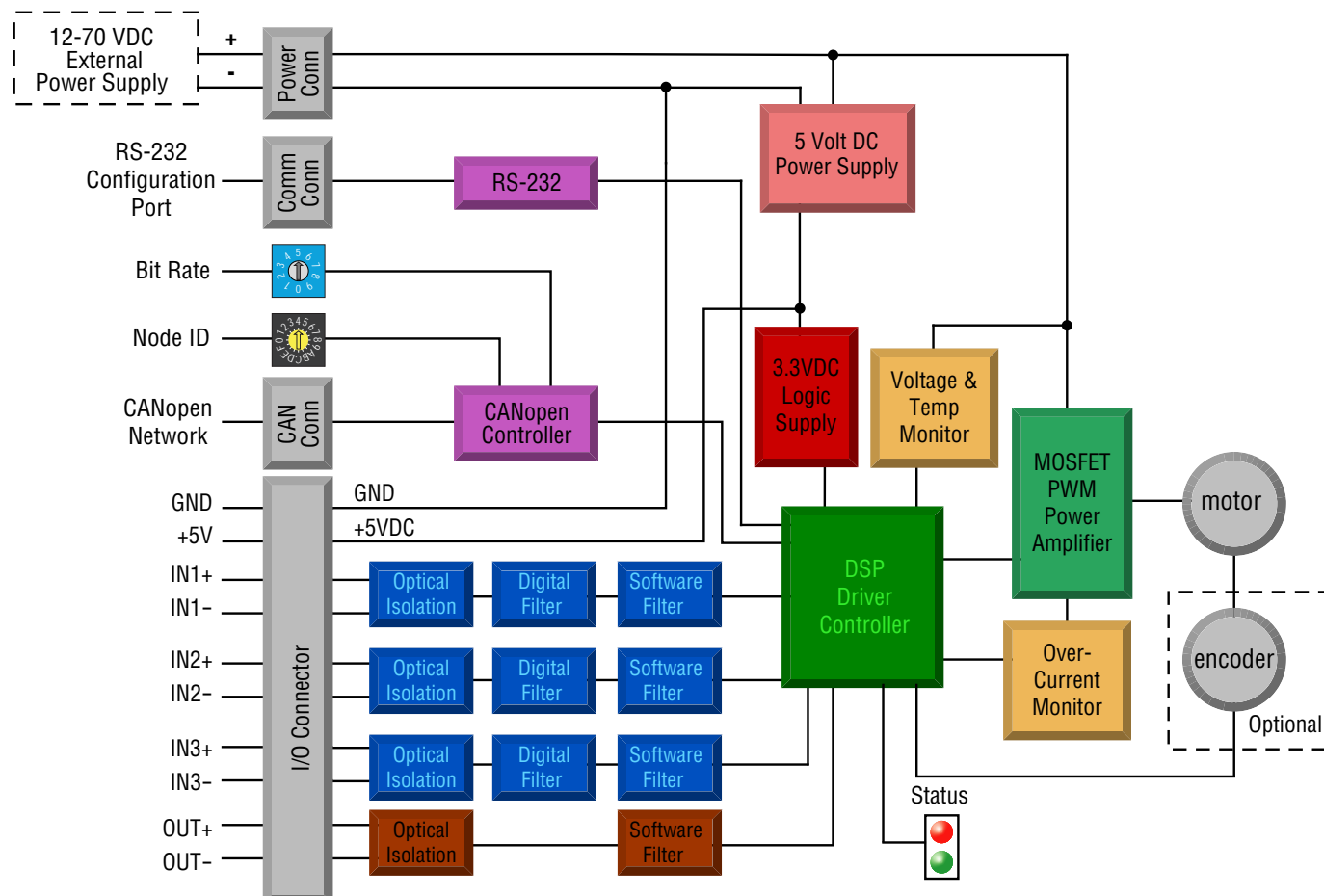
## Block Diagram (-SF and -QF)



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

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

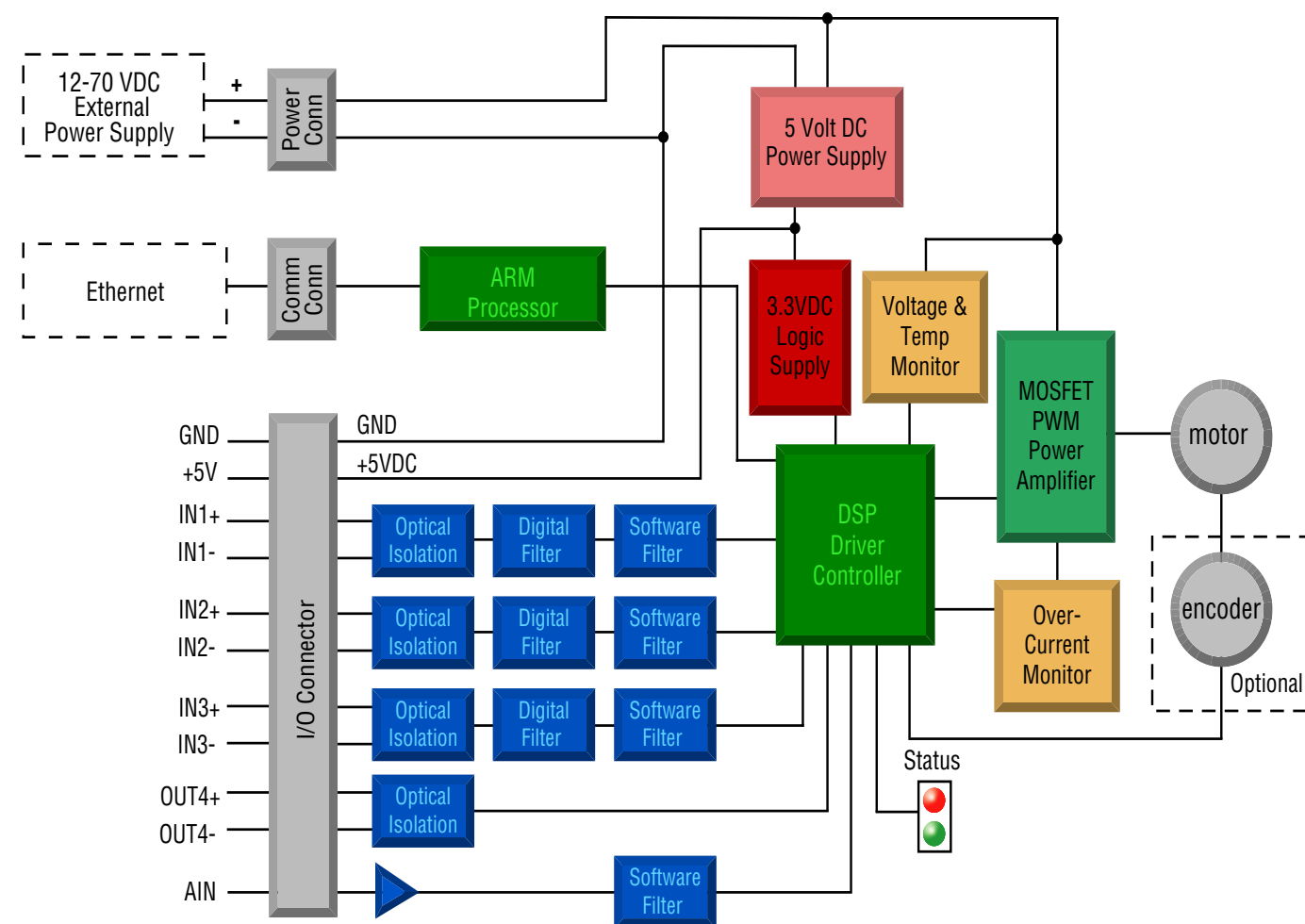
## Block Diagram (-C)



## 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

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



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

IN1	IN2	IN3	OUT
Clockwise Limit	Counterclockwise Limit	Home Sensor	Fault
General Purpose Input	General Purpose Input	Enable Input	Brake
STEP	DIR	General Purpose Input	Motion
Master Encoder Ch A	Master Encoder Ch B		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 STM24 drives contain electrostatically sensitive components that can be damaged by incorrect handling. Discharge yourself before touching the product. Avoid contact with high insulating materials (artificial fabrics, plastic film, etc.). Place the product on a conductive surface.
- During operation keep all covers and cabinet doors shut. Otherwise, there are deadly hazards that could possibly cause severe damage to health or the product.
- In operation, depending on the degree of enclosure protection, the product can have bare components that are live or have hot surfaces. Control and power cables can carry a high voltage even when the motor is not rotating.
- Never pull out or plug in the product while the system is live. There is a danger of electric arcing and danger to persons and contacts.
- After powering down the product, wait until both LEDs are completely dark before touching live sections of the equipment or undoing connections (e.g., contacts, screwed connections). To be safe, measure the contact points with a meter before touching.

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

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

## Getting Started

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

- a 12 - 70 volt DC power supply. Please read the section entitled Choosing a Power Supply for help in choosing the right power supply.
- a small flat blade screwdriver for tightening the connectors (included).
- a personal computer running Microsoft Windows 98, 2000, NT, Me , XP, Vista or 7 (32 or 64 bit).
- *ST Configurator™* and *Q Programmer™* software applications, available at [www.applied-motion.com/products/software](http://www.applied-motion.com/products/software).
- An Applied Motion programming cable (included with RS-232 models; USB and RS-485 adaptors are available from Applied Motion, see the Accessories section for part numbers)
- for Ethernet models, a CAT5 Ethernet patch cable.

If you've never used an STM24 drive you'll need to get familiar with the drive and the set up software before you try to deploy the system in your application. We strongly recommend the following:

1. For -Q drives, download and install the *ST Configurator™* and *Q Programmer™* software applications, available at [www.applied-motion.com/products/software](http://www.applied-motion.com/products/software). For -S , -IP, and -C 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 or CAT5 patch cable, depending upon drive type. When using RS-485, it must be set up in the 4-Wire configuration (See "Connecting to a host using RS-485" below). When using Ethernet, see section "Connecting the Drive to Your PC using Ethernet".
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 STM24

As with any stepper motor the STM24 must be mounted so as to provide maximum heat-sinking and air-flow. Keep space around the Drive+Motor to allow convected air-flow.

- ***Never use your Drive+Motor in a space where there is no air flow or where other devices cause the surrounding air to be more than 40°C.***
- ***Never put the drive where it can get wet or where metal or other electrically conductive particles can get on the circuitry.***
- ***Always provide airflow around the Drive+Motor .***



## Choosing a Power Supply

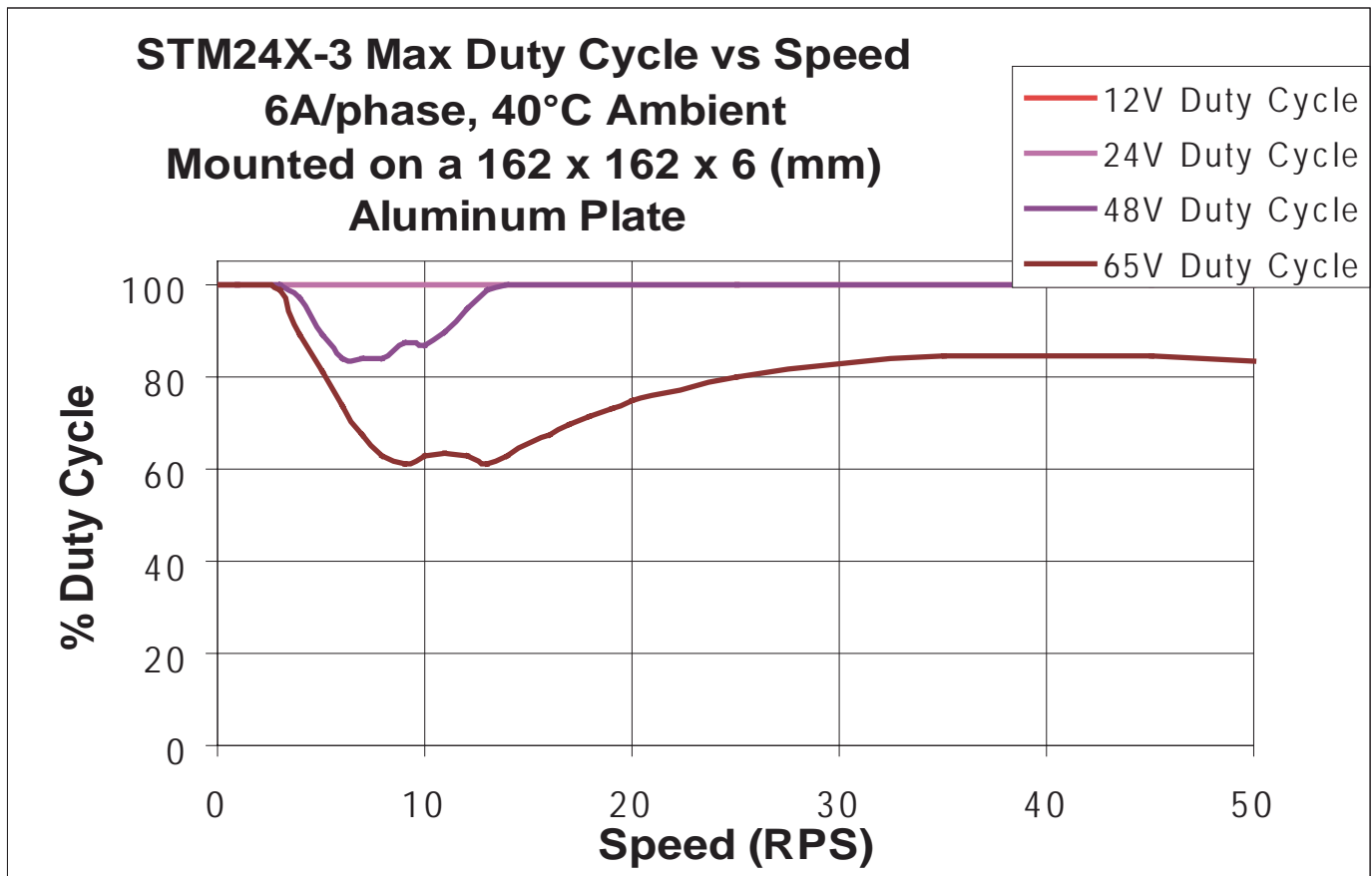
When choosing a power supply, there are many things to consider. If you are manufacturing equipment that will be sold to others, you probably want a supply with all the safety agency approvals. If size and weight are an issue use a switching supply.

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

## Voltage

The STM24 is designed to give optimum performance between 24 and 70 volts DC. Choosing the voltage depends on the performance needed and Drive+Motor heating that is acceptable and/or does not cause a drive over-temperature. Higher voltages will give higher speed performance but will cause the Drive+Motor to operate at higher temperatures. Using power supplies with voltage outputs that are near the drive maximum may reduce the operational duty-cycle significantly. See the chart below to determine thermal performance at different power supply voltages

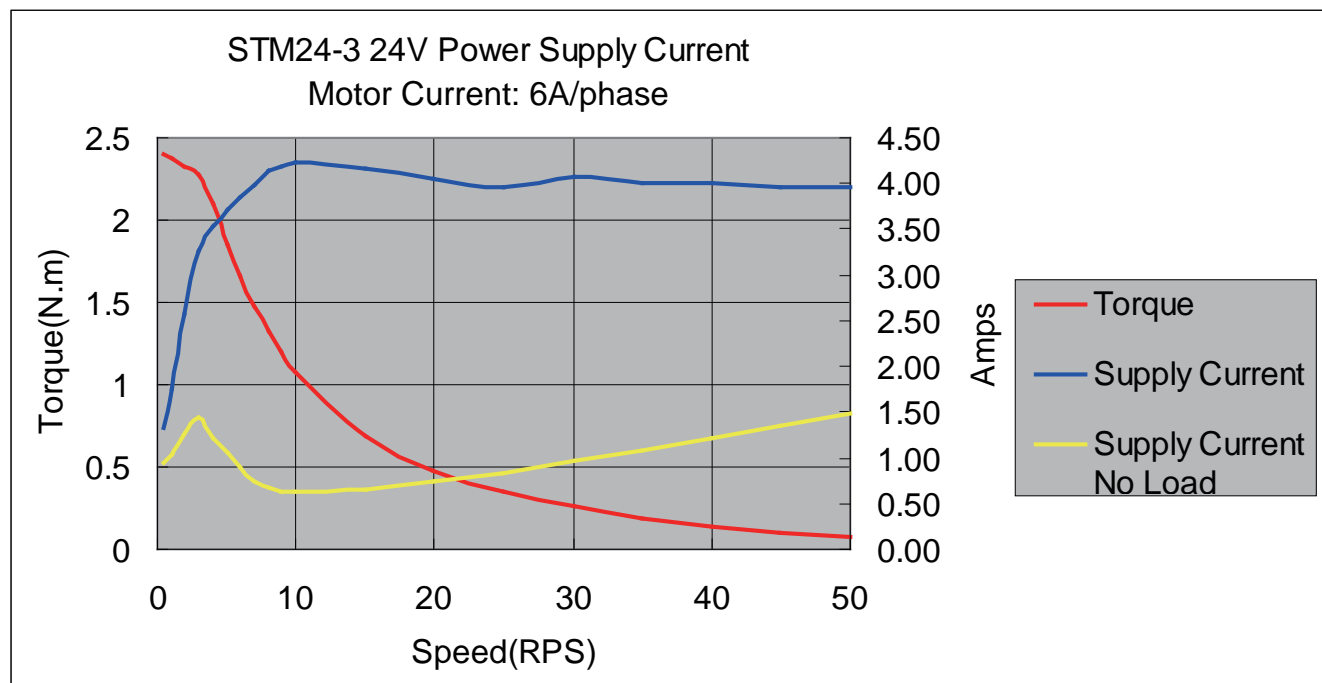
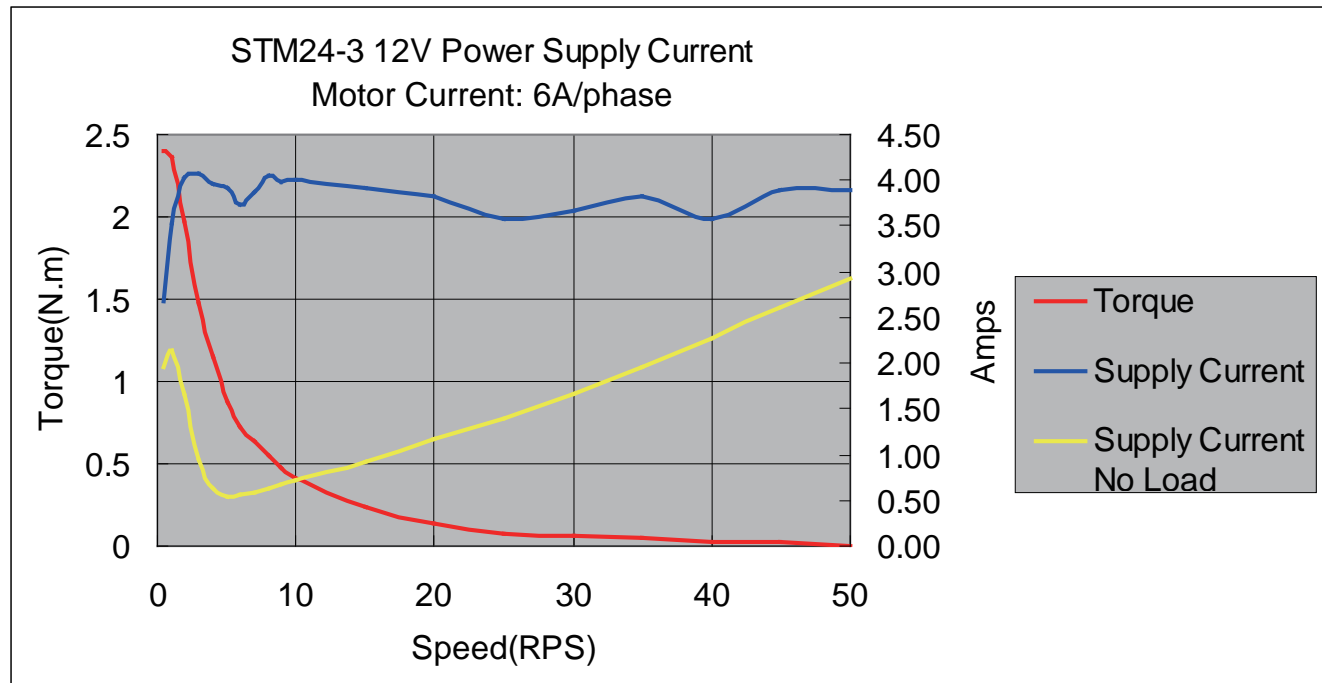
If you choose an unregulated power supply, make sure the no load voltage of the supply does not exceed the drive's maximum input voltage specification.

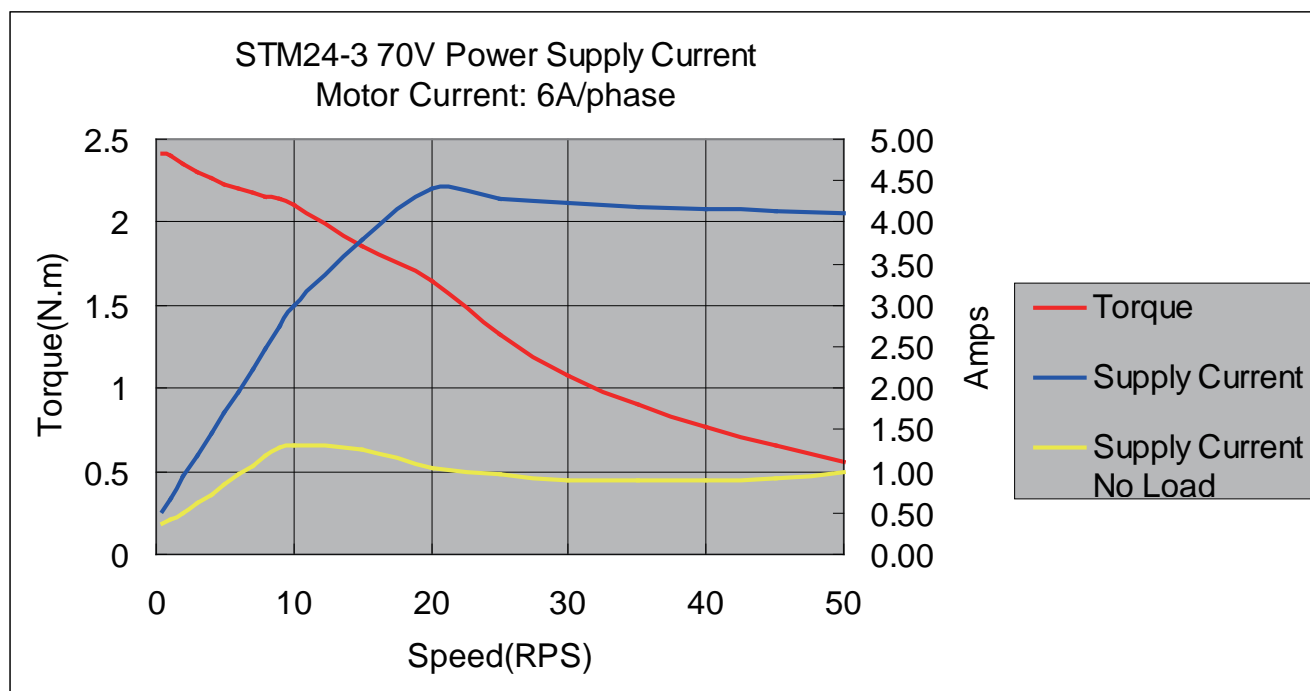
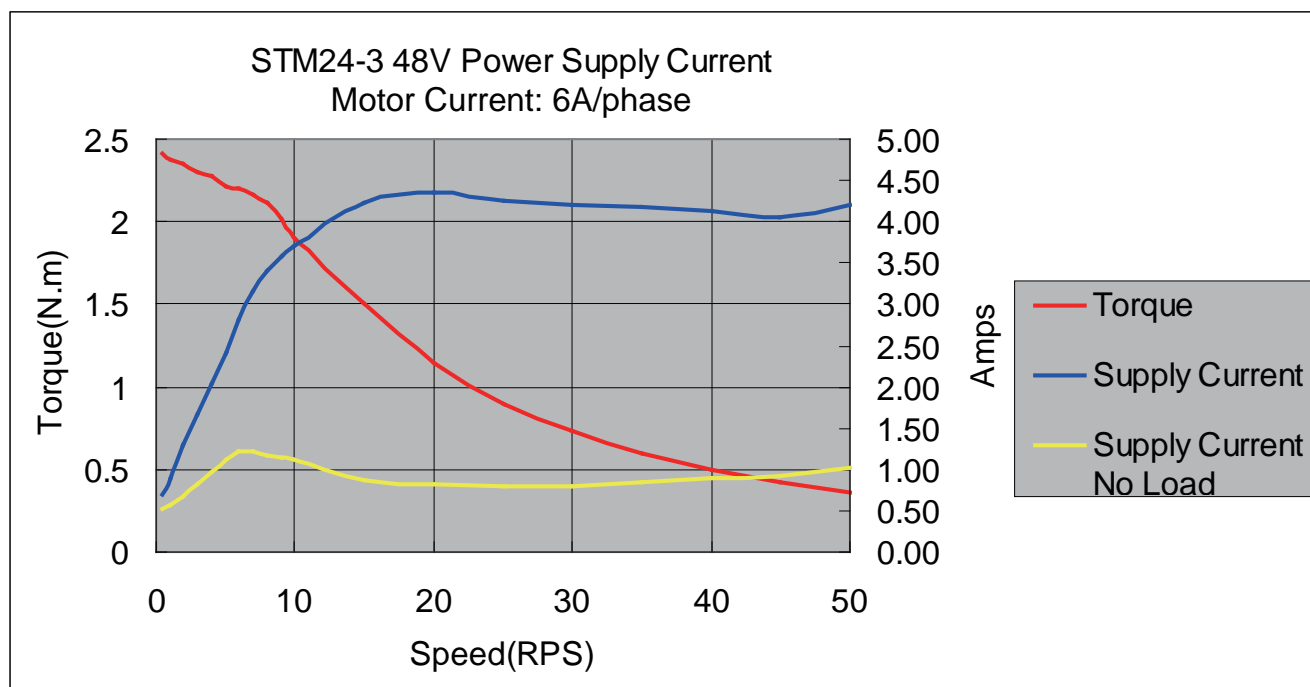


## Current

The maximum supply current required by the STM24 is shown in the chart below with different power supply voltage inputs. You will note in the chart that the Drive+Motor does not draw as much current as the motor itself. That's because the STM24 uses switching amplifiers, converting a high voltage and low current into lower voltage and higher current. The more the power supply voltage exceeds the motor voltage, the less current you'll need from the power supply.

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





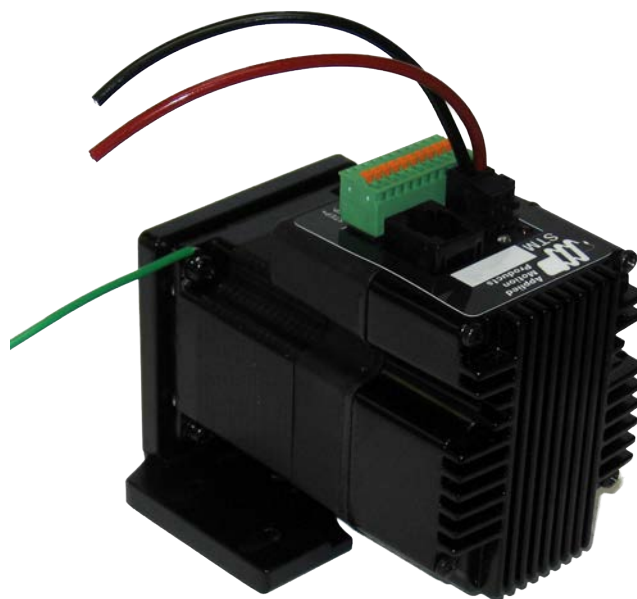
## Connecting the Power Supply

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

Connect the motor power supply "+" terminal to the driver terminal labeled "+". Connect power supply "-" to the drive terminal labeled "-". Use 16 to 20-gauge wire. The STM24 contains an internal fuse that connects to the power supply + terminal. This fuse is not user replaceable. If you want to install a user serviceable fuse in your system install a 5 amp fast acting fuse in line with the + power supply lead.

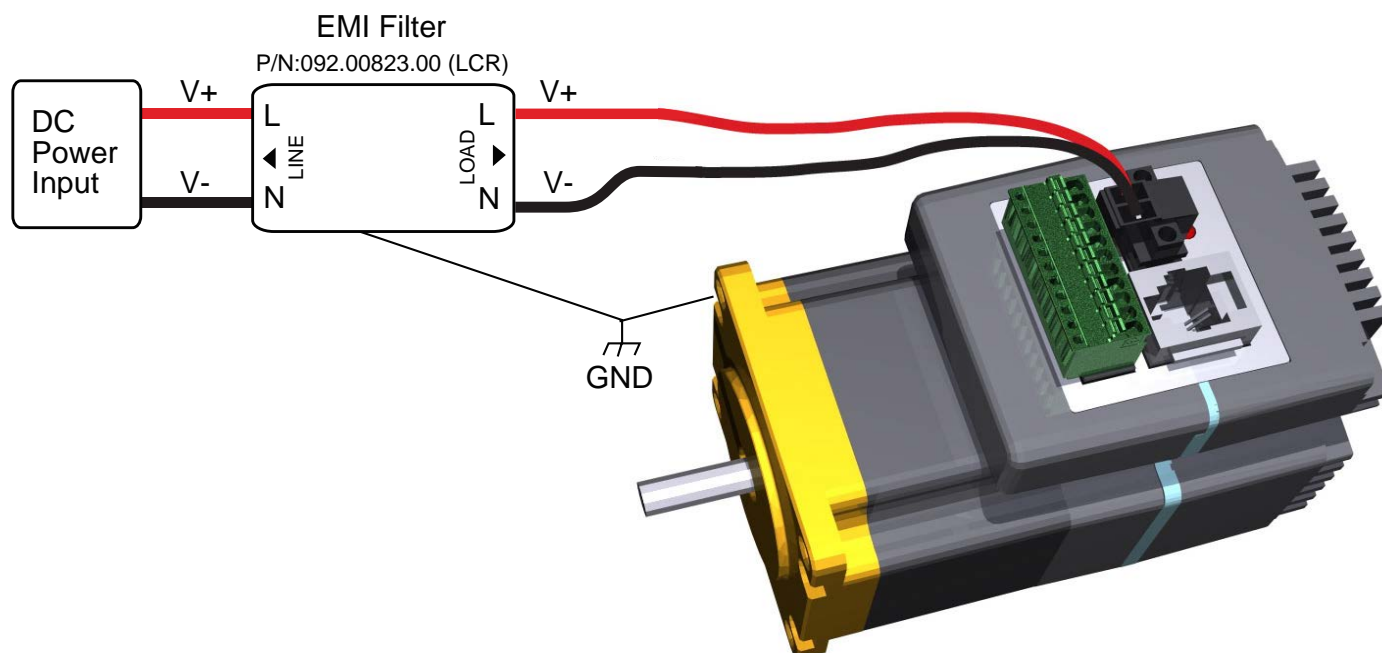
- Connect the red wire to power supply +
- Connect the black wire to power supply -
- Connect the green wire to earth ground

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

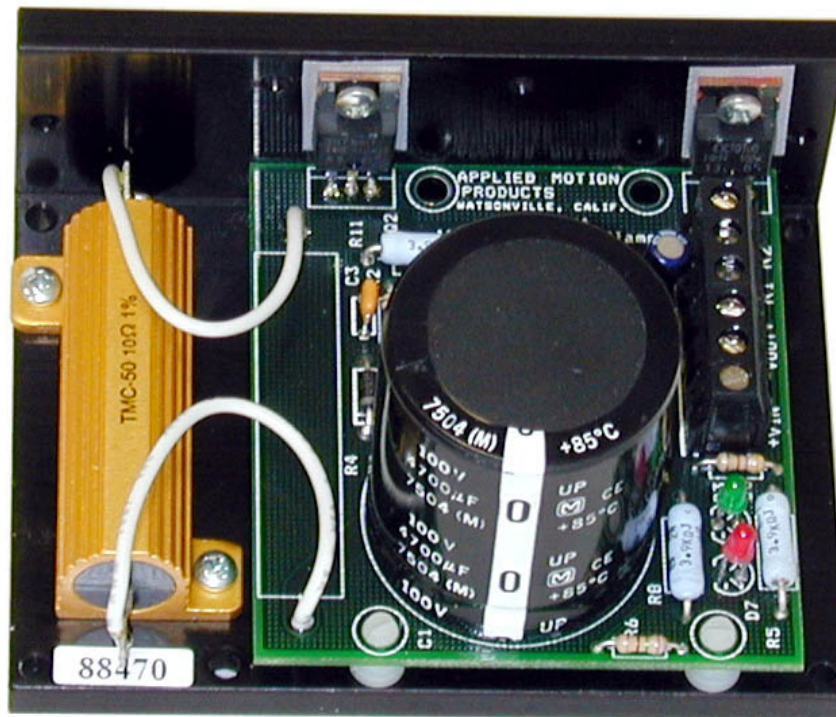


## Installation Requirements for CE Compliance

In order to meet the EMC Directive of CE, a line filter must be installed between the DC power supply and the STM24 as shown below.



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



RC-050 Regen Clamp

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

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

## Connecting the STM24 Communications

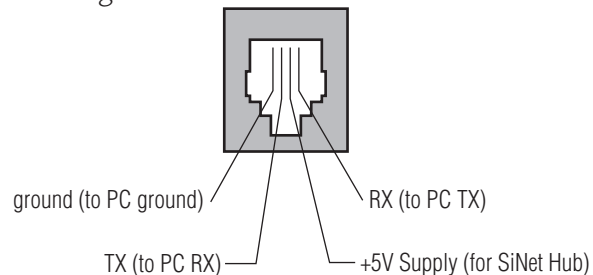
The STM24 is available with two types of serial communication: RS-232 (STM24x-xAx) or RS-422/485 (STM24x-xRx). Each type requires a different hardware connection for interface to a PC or other host system. The RS-232 version comes with a cable that will provide the interface to an RS-232 port through a DB9 style connector. The RS-422/485 version requires the user to provide both the cabling and the RS-422/485 interface. The CANopen (-C) version also includes an RS-232 port for configuration. Below are descriptions of how to interface the STM24 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 STM24 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.

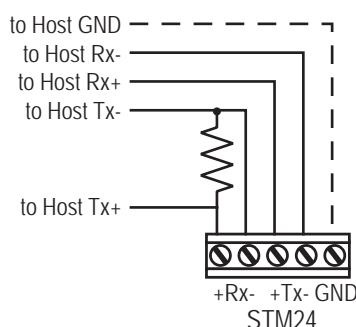
***Do not plug or unplug the RS-232 connection while power is applied to the drive. This is known as "hot plugging" and should be avoided.***

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

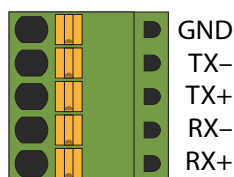
RS-422/485 communication allows connection of more than one drive to a single host PC, PLC, HMI or other controller. It also allows the communication cable to be long (more than 300 meters or 1000 feet). We recommend using Category 5 cable in low electrical-noise environments. Category 5 cable is widely 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 STM24 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 STM24 RS-422/485 version with the ST Configurator software, the STM24 must be connected to the PC in the four-wire "point to point" configuration (see below) and configured one axis at a time.



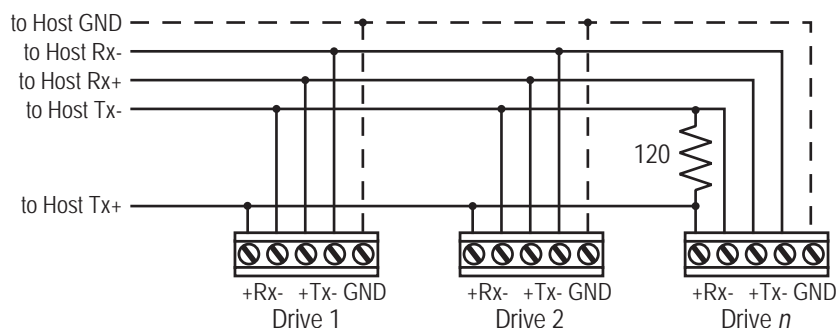
**RS-422/485 4-wire "Point to Point" Wiring**



**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 computer ground.



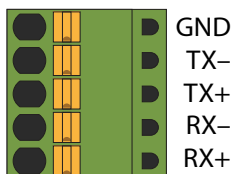
**RS-422/485 4-wire system**

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

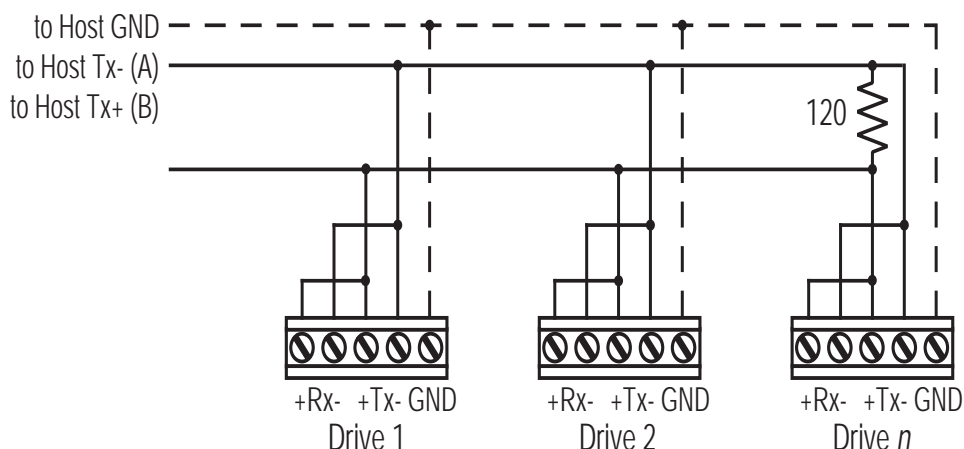
**NOTE:** If the PC does not have an RS-422/485 serial port, a converter will be required.



## 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 STM24 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 the 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 that came with your drive 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.

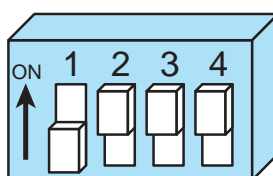
### Connecting to an STM24 using USB

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

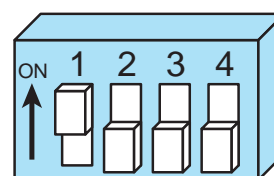


USB-COMi-M (8500-003) Switch Settings

For RS-485 two wire systems, set the switches and make the connections to the STM24 according to the diagrams below.

USB-COMi-M (8500-003) 6 pin screw terminal connector	STM24 5 pin connector
1	RX-, TX-
2	RX+, TX+
6	GND

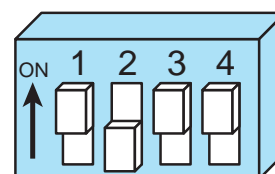
#### 2 Wire RS-485



For RS-485 four wire systems, set the switches and make the connections to the STM24 according to the diagrams below.

USB-COMi-M (8500-003) 6 pin screw terminal connector	STM24 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:

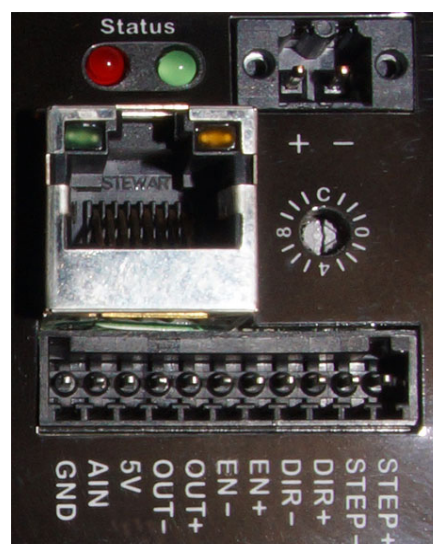
    Connection-specific DNS Suffix . : 
    IP Address. . . . . : 192.168.0.22
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.0.254
```

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 drive. The only way to "recover" it is to use the universal recovery address.

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



**STM24IP-3EN**  
**IP Address rotary switch shown**

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.

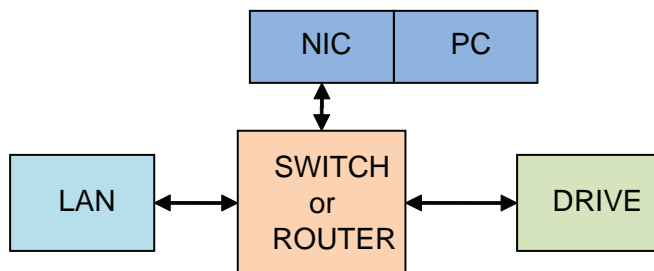
If you need help choosing a port number for your application, you can find a list of commonly used port numbers at <http://www.iana.org/assignments/port-numbers>.

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

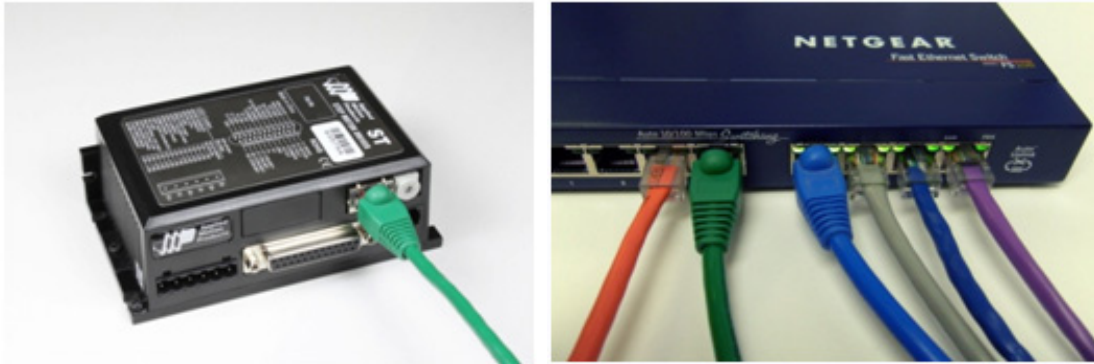
If you have a spare port on a switch or router and if you are able to set your drive to an IP address that is compatible with your network, and not used by anything else, this is a simple way to get connected. This technique also allows you to connect multiple drives to your PC. If you are on a corporate 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.

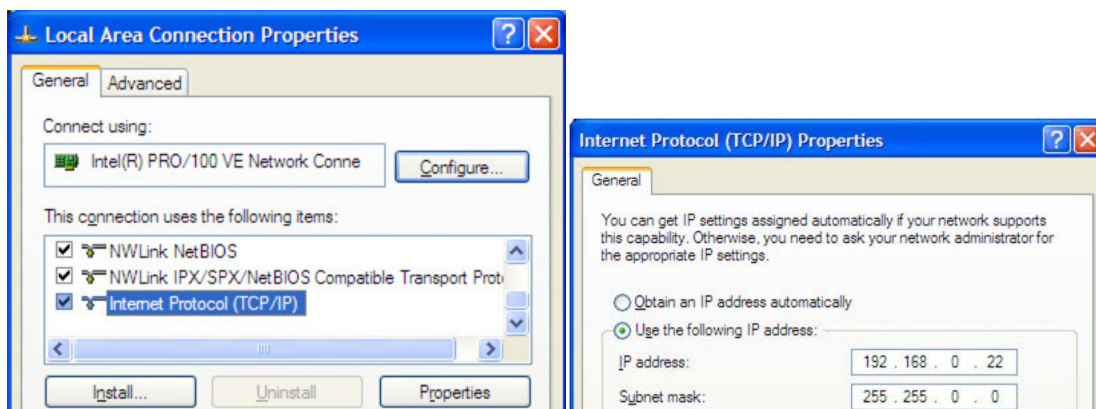
Once you've chosen an appropriate IP address for your drive, set the rotary switch according the address table above. If none of the default addresses are acceptable for your network, you can enter a new table of IP addresses using Configurator. If your network uses addresses starting with 192.168.0,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

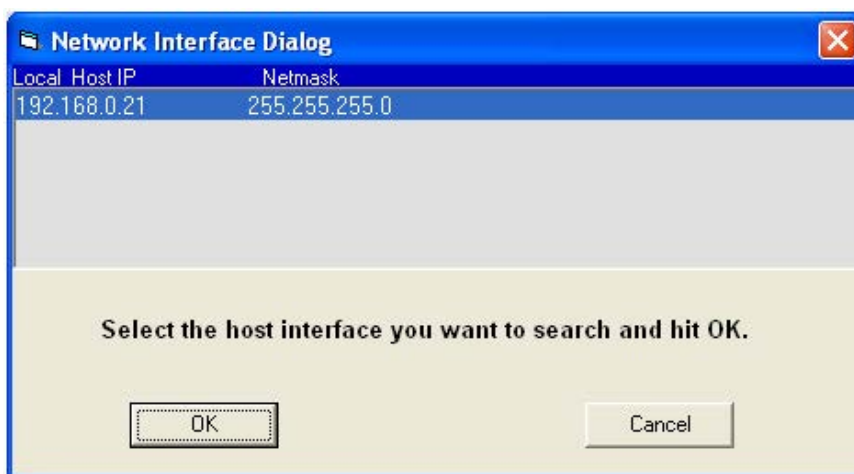
5. If the option "Use the following IP address" is selected, life is good. Change the subnet mask to "255.255.0.0" and click OK.

## 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.

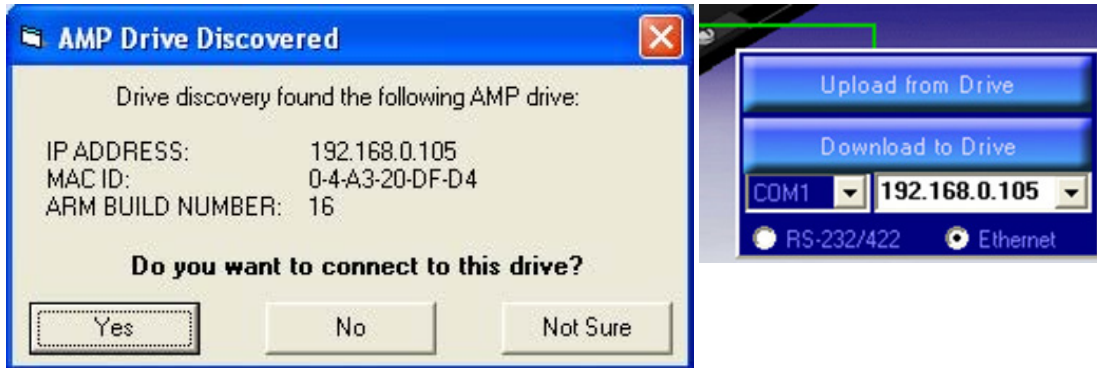
If you think this is the correct drive, click Yes. If you're not sure, click Not Sure and Drive Discovery will look for additional drives on your network. Once you've told Drive Discovery which drive is yours, it will automatically enter that drive's IP address in the IP address text box so that you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

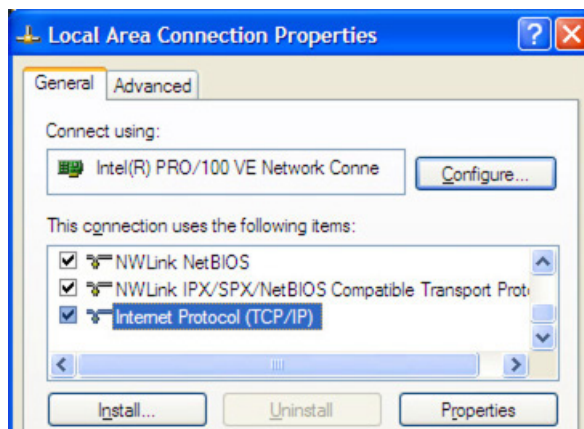


the necessary physical layer changes.

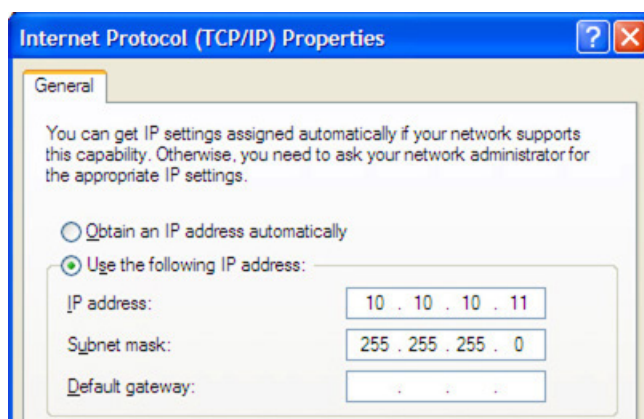
2. Set the IP address on the drive to "10.10.10.10" by setting the rotary switch at "0".
3. To set the IP address of your PC:
  - a. On Windows XP, right click on "My Network Places" and select properties.
  - b. On Windows 7, click Computer. Scroll down the left pane until you see "Network". Right click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

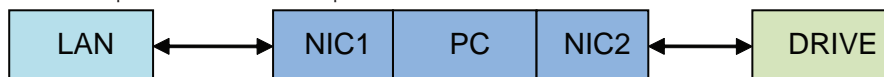




**Option 3: Use Two Network Interface Cards (NICs)**

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.

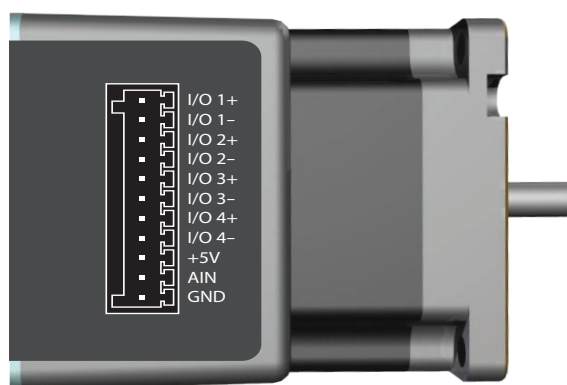
2. If you use a laptop and only connect to your LAN using wireless networking, you can use the built-in RJ45 Ethernet connection as your second NIC.
3. Set the IP address on the drive to "10.10.10.10" by setting the rotary switch at "0".
4. To set the IP address of the second NIC:
  - a. On Windows XP,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

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

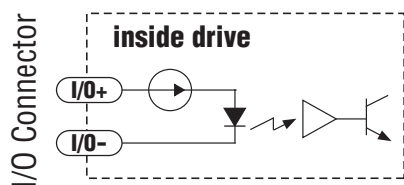
The STM24SF and STM24QF have four “flex I/O” points. Each can be configured as a digital input or a digital output. In addition, pre-defined functions such as motor enable or fault output can be assigned, providing the flexibility to handle a diverse range of applications.

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

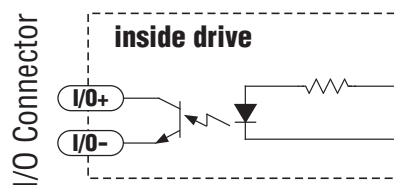
STM24SF and STM24QF Connector Pin Diagram



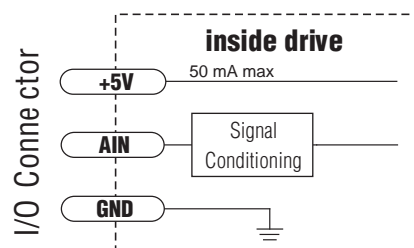
I/O Functions (configure in software)			
I/O 1	I/O 2	I/O 3	I/O 4
Step Input	Direction Input		
Jog CW Input	Jog CCW Input	Limit CW Input	Limit CCW Input
Enable Input	Alarm Reset Input	Enable Input	Alarm Reset Input
Start/Stop Input		Change Speed Input	
General Purpose Input	General Purpose Input	General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



Equivalent Circuit: Flex I/O Point Set as Input



Equivalent Circuit: Flex I/O Point Set as Output

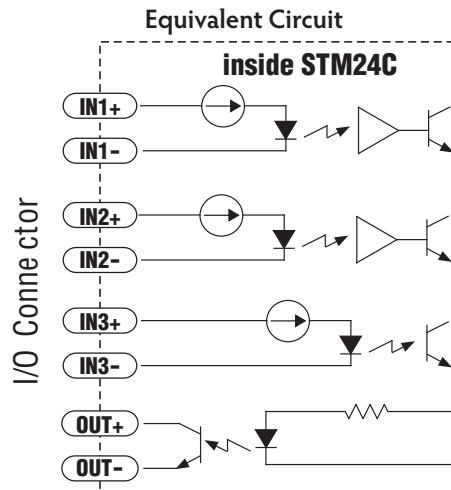
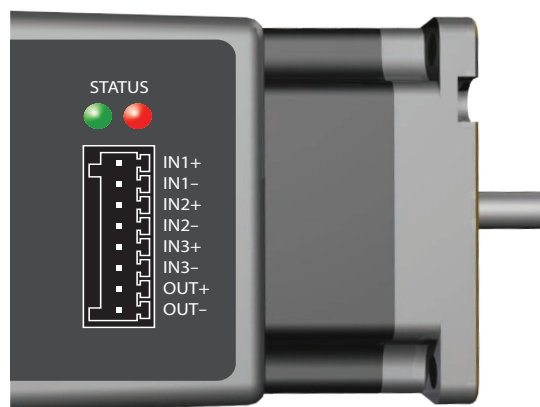


Equivalent Circuit: Analog Input

## Inputs and Outputs (-C)

The STM24C has three digital inputs and one digital output. The inputs can be used for end of travel limits and a position sensor in support of the CANopen DSP402 homing modes, or as general purpose inputs to be read over the CANopen network. The output has no predefined purpose in the CANopen specs but can be used as a brake, fault, motion or tach output, or it can be used as a general purpose output which can be opened or closed over the CANopen network. Example connection diagrams can be found on the following pages.

STM24C Connector Pin Diagram



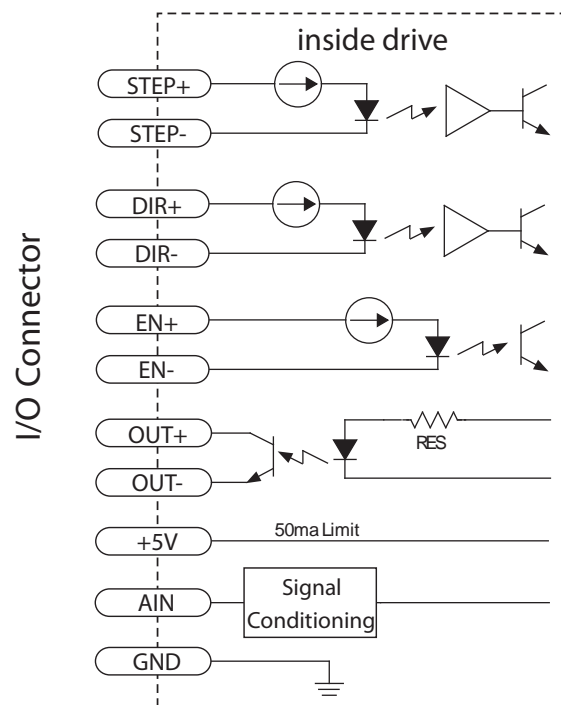
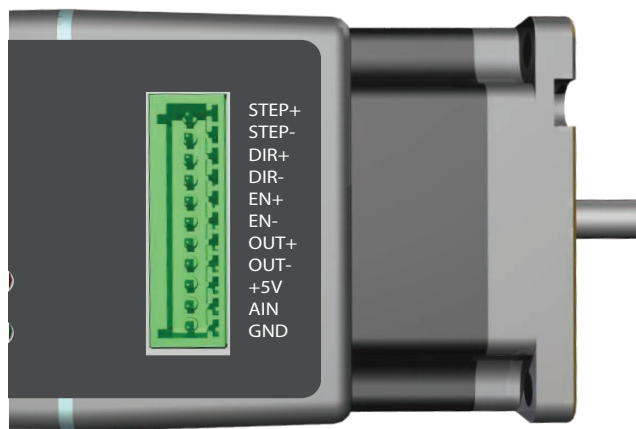
I/O Functions (configure in software)			
IN1	IN2	IN3	OUT
Clockwise Limit	Counterclockwise Limit	Home Sensor	Fault
General Purpose Input	General Purpose Input	Enable Input	Brake
		General Purpose Input	Motion
			Tach
			General Purpose Output

## STM24 Inputs and Outputs

The STM24-S, -Q and -IP drives include 3 digital inputs and 1 analog input (no analog input on STM24C 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 STM24 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 STM24C (CANopen) models.*

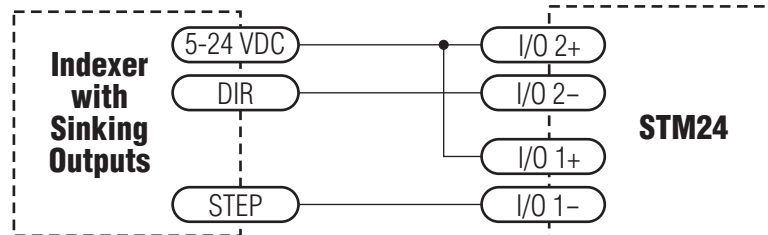
STM24 -S, -Q, and -IP Connector Pin Diagram



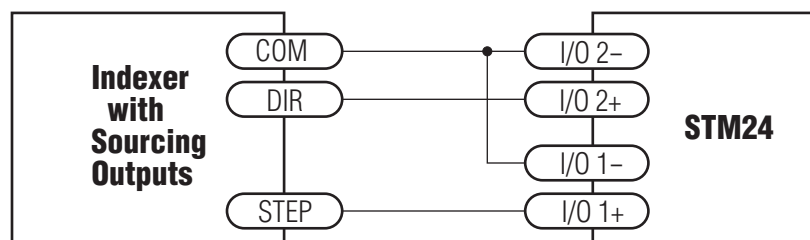
## Connecting Step and Direction Signals

The STM24-QF and STM24-SF drives include two high-speed inputs that can accept 5 to 24 volt single-ended or differential signals, up to 3 MHz. These inputs can be connected to an external controller that provides step & direction (or step CW and step CCW) command signals. You can also connect a master encoder to the high-speed inputs for “following” applications. Or you can use these inputs with Wait Input, If Input, Feed to Sensor, Seek Home and other SCL or Q commands.

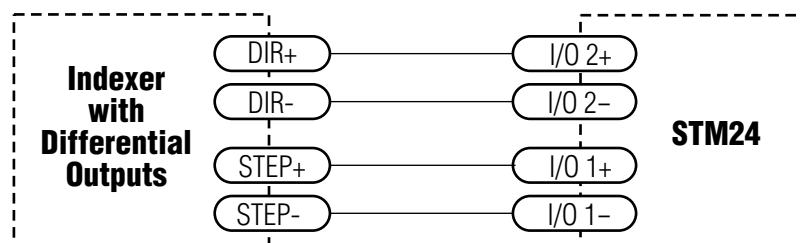
Connection diagrams follow.



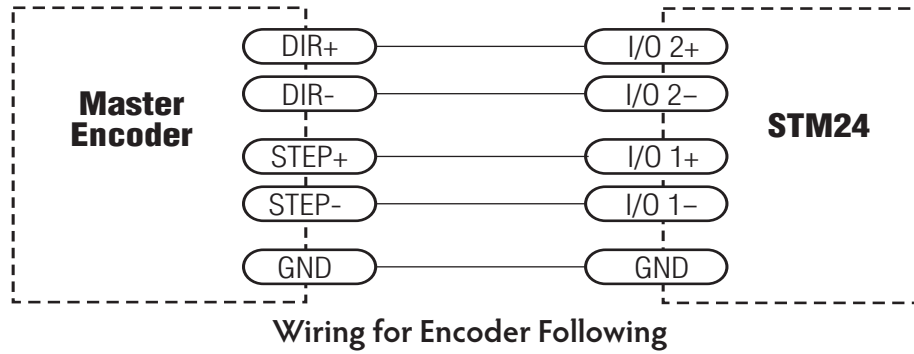
Connecting to indexer with Sinking Outputs



Connecting to indexer with Sourcing Outputs



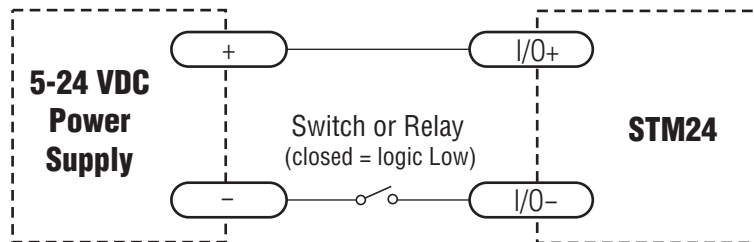
Connecting to Indexer with Differential Outputs



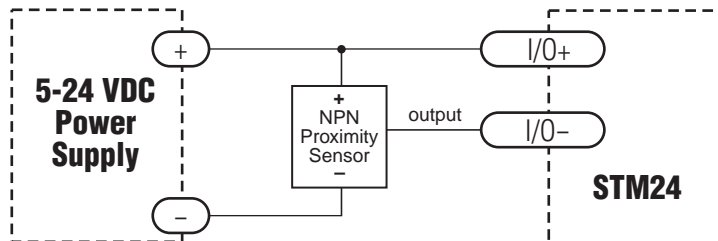
## Connecting Other Signals

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

### Using Mechanical Switches

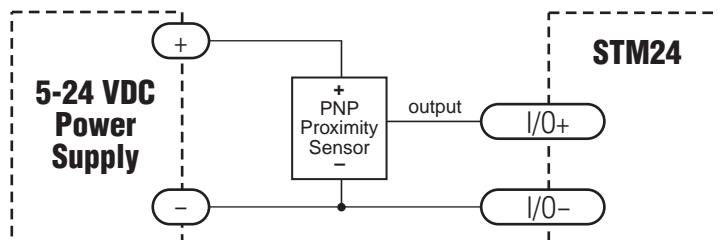


### Connecting an NPN Type Proximity Sensor to an Input



(When prox sensor activates, input goes low).

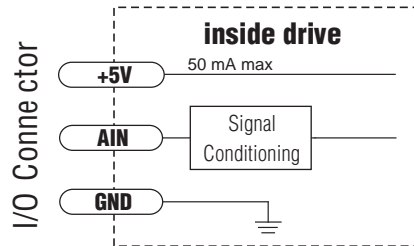
### Connecting a PNP Type Proximity Sensor to an Input



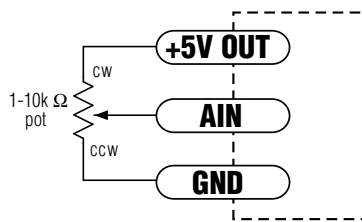
(When prox sensor activates, input goes low).

## Analog Input

All STM24 models except the -C feature an analog input. The input can accept a signal range of 0 to 5 VDC. The drive can be configured to operate at a speed or position that is proportional to the incoming analog signal. Use the *ST Configurator™* software to set the signal range, offset, dead-band and filter frequency. The STM24 provides a +5VDC 50ma output that can be used to power external devices such as potentiometers. It is not the most accurate supply for reference; for more precise readings use an external supply that can provide the desired accuracy.



### Analog Input Circuit



### Connecting a Potentiometer to the Analog Input

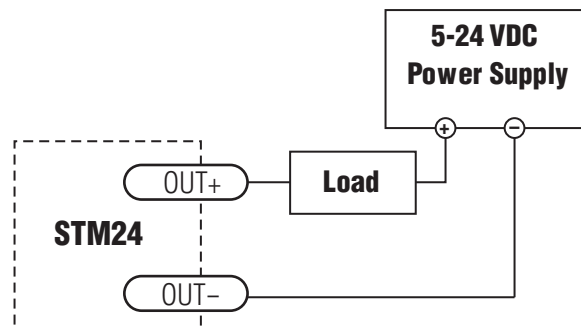
## Programmable Output

The STM24SF and STM24QF include four “flex I/O” points which can be individually configured to act as digital outputs. The STM24C, -S, -Q and -IP include one dedicated digital output. Each output can be set to automatically control a motor brake, to signal a fault condition, to indicate when the motor is moving or to provide an output frequency proportional to motor speed (tach signal). An output can also be turned on and off by program instructions like Set Output. An output can be used to drive LEDs, relays and the inputs of other electronic devices like PLCs and counters. The “OUT+” (collector) and “OUT-” (emitter) terminals of the transistor are available at the connector. This allows you to configure the output for current sourcing or sinking.

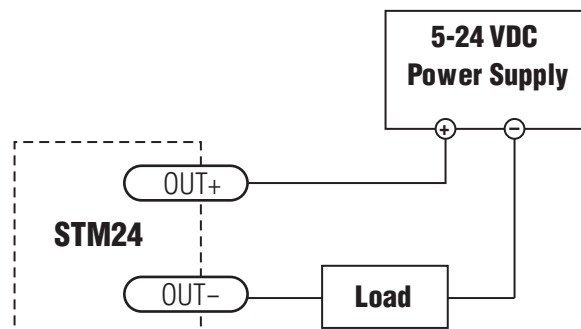
Diagrams of various connection types follow.

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

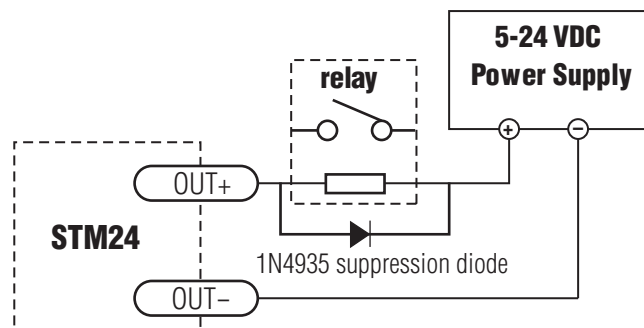
***The current through the output terminal must not exceed 80mA.***



Connecting a Sinking Output



Connecting a Sourcing Output

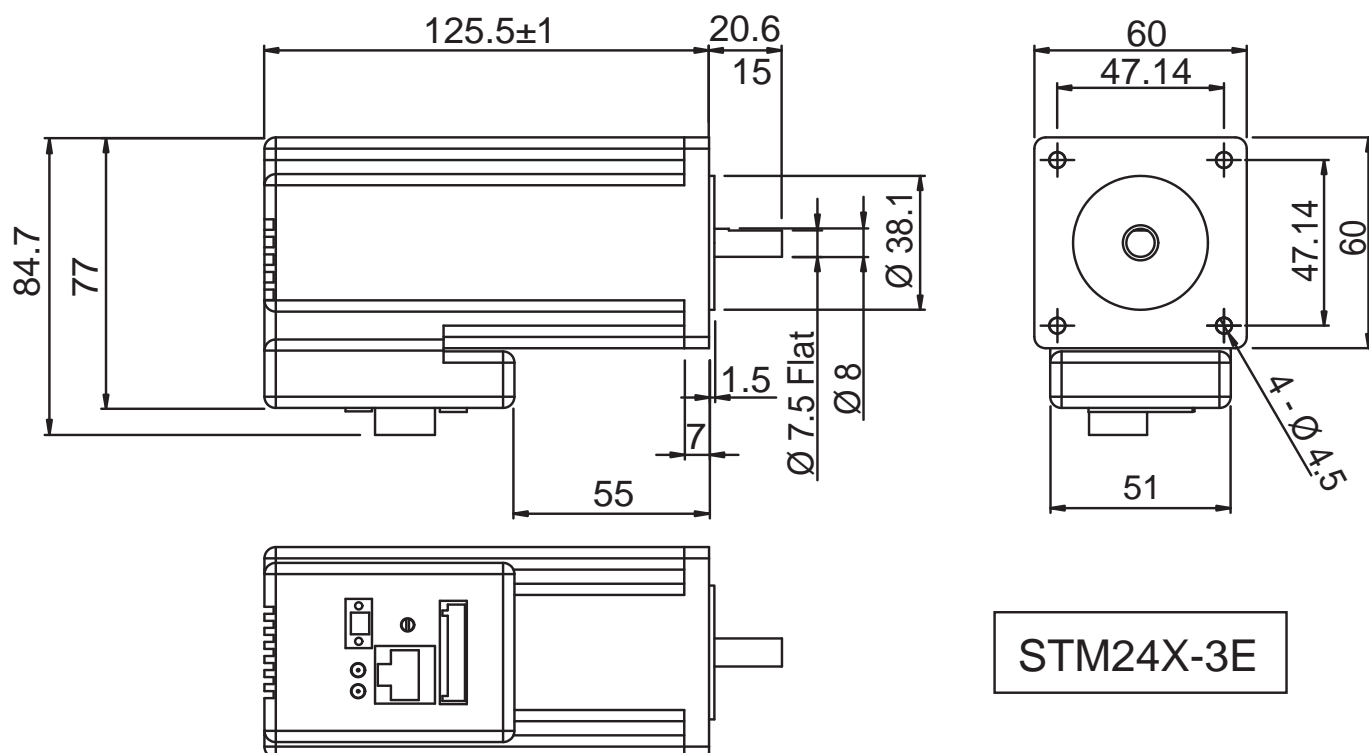
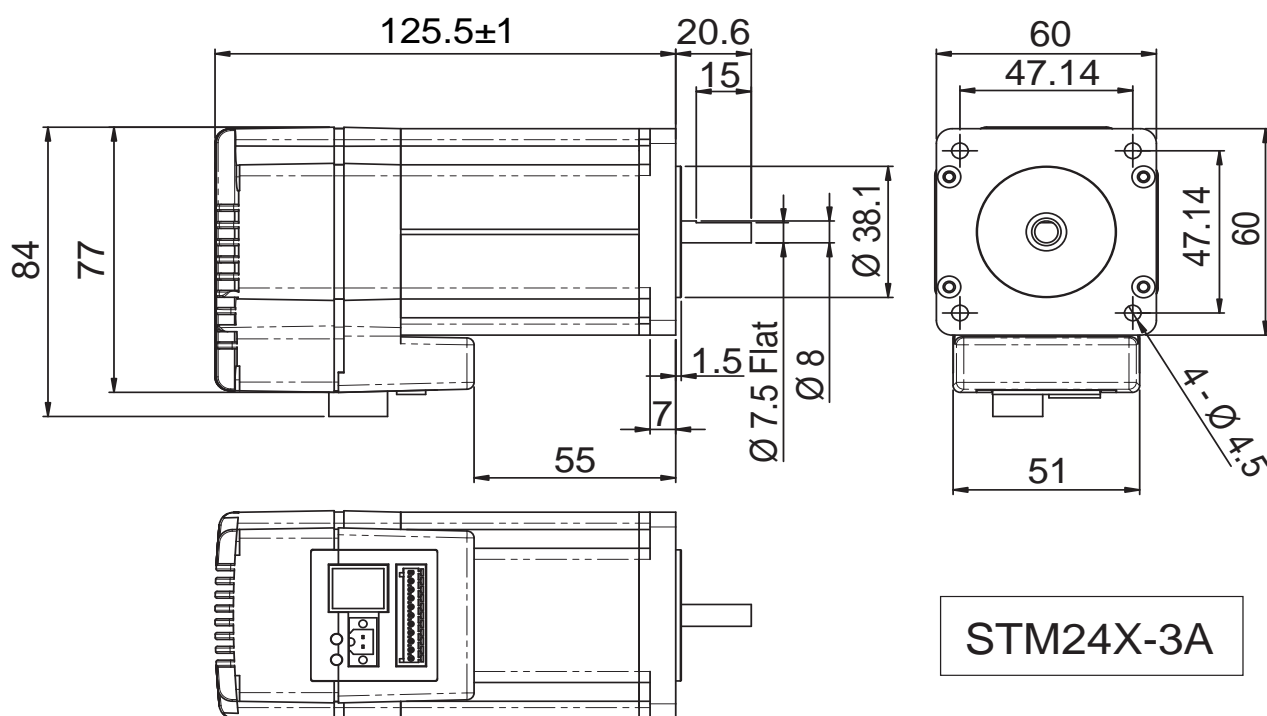


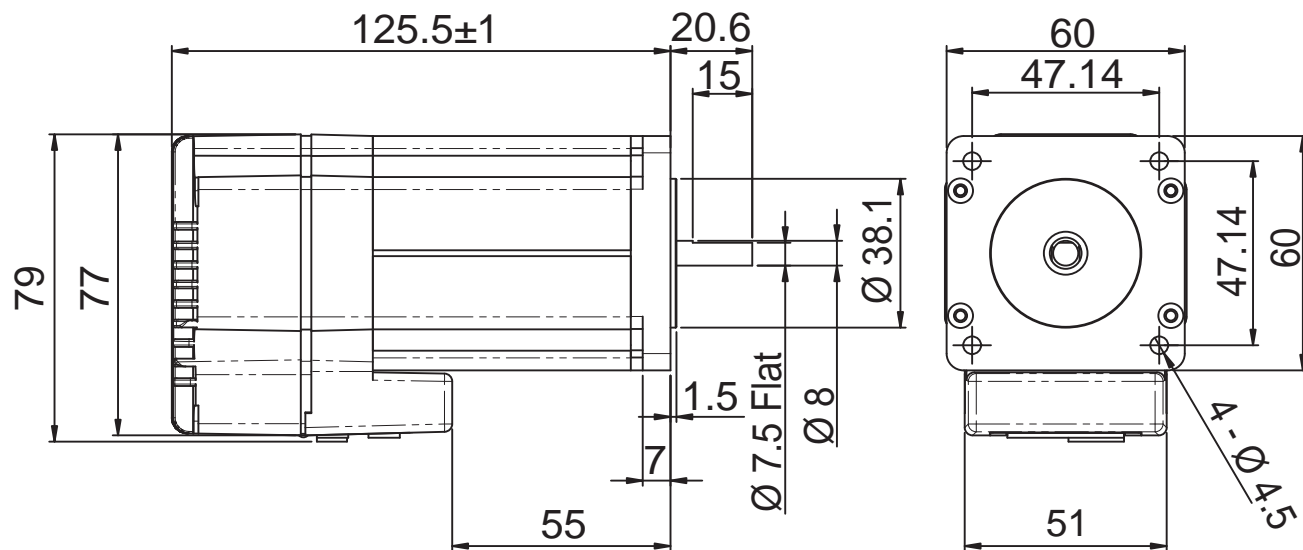
Connecting a Relay



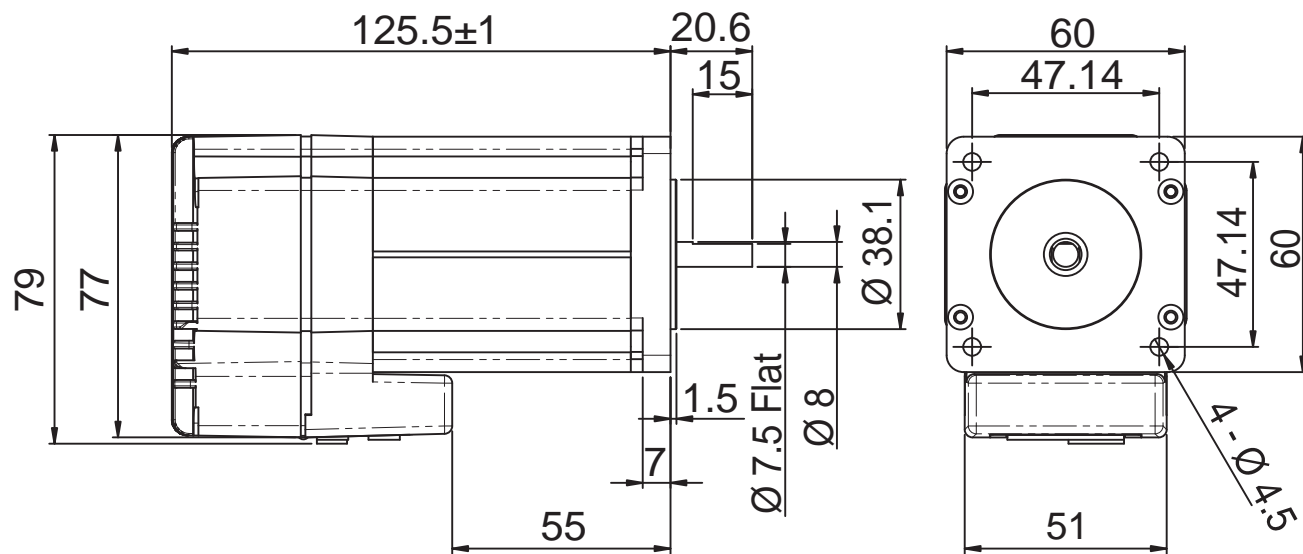
## Reference Materials

## Mechanical Outlines





STM24X-3R



STM24C-3C

## Technical Specifications

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

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

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

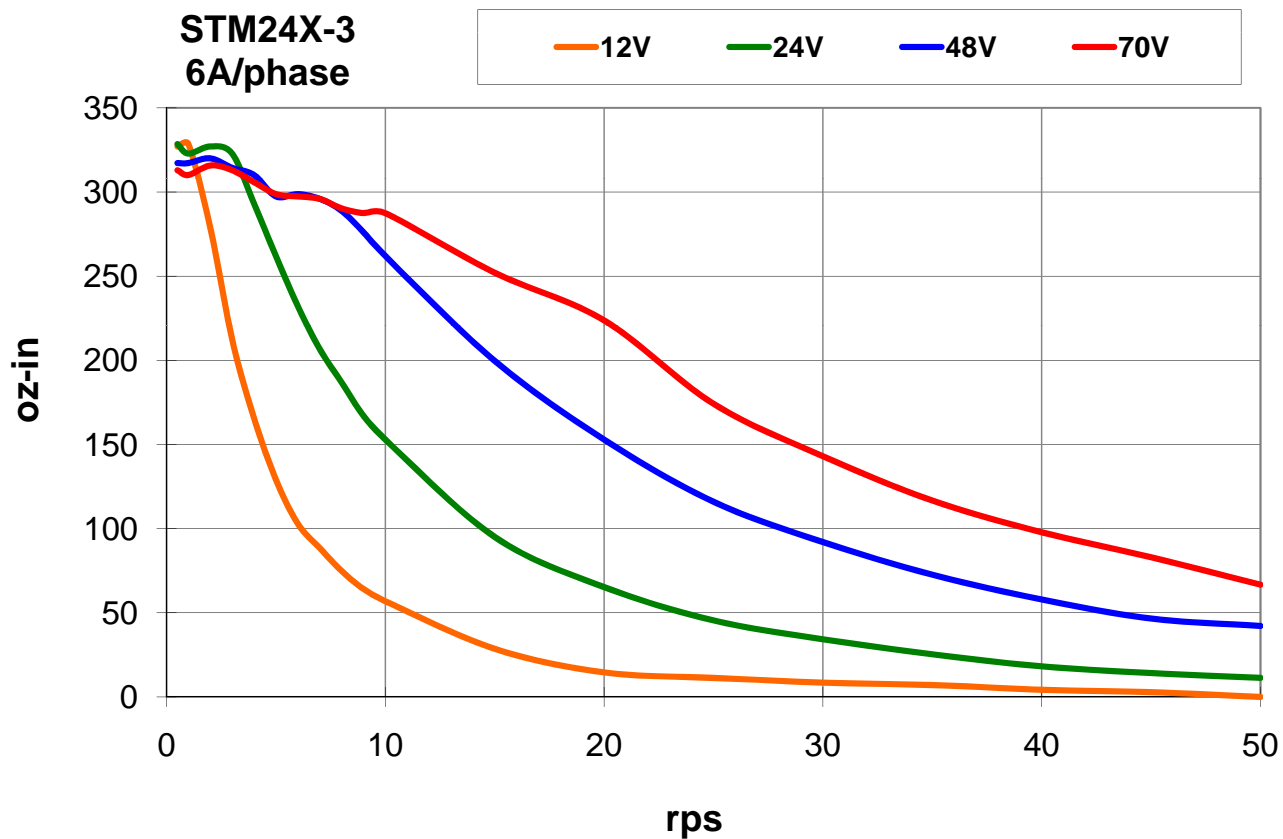
<b>CONTROLLER: SF &amp; QF Models</b>	
MODES OF OPERATION	Step & direction, CW/CCW pulse, A/B quadrature, oscillator, joystick, SCL streaming commands, stored programs (Q only).
I/O 1 (STEP)	<p>INPUT: Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter.</p> <p>Function: Step, CW Step, A quadrature, CW jog, Start/stop (oscillator mode), motor enable, general purpose Input.</p> <p>OUTPUT: Optically isolated, open emitter/collector, 30V, 80 mA max. 10 kHz max. Function: fault, motion, tach, brake, general purpose</p>
I/O 2 (DIR)	<p>INPUT: Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter. Function: direction (step &amp; direction or oscillator modes), CCW step, B quadrature, alarm reset, CCW jog, sensor, general purpose input.</p> <p>OUTPUT: Optically isolated, open emitter/collector, 30V, 80 mA max. 10 kHz max. Function: fault, motion, tach, brake, general purpose</p>
I/O 3	<p>INPUT: Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter. Function: speed change (oscillator mode), CW limit, sensor, motor enable, general purpose input.</p> <p>OUTPUT: Optically isolated, open emitter/collector, 30V, 80 mA max. 10 kHz max. Function: fault, motion, tach, brake, general purpose</p>
I/O 4	<p>INPUT: Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter.</p> <p>Function: Alarm reset, CCW limit, sensor, general purpose input.</p> <p>OUTPUT: Optically isolated, open emitter/collector, 30V, 80 mA max. 10 kHz max. Function: fault, motion, tach, brake, general purpose</p>
ANALOG INPUT RANGE (AIN)	0 to 5VDC
ANALOG INPUT RESOLUTION	12 bits
COMMUNICATION	RS-232 or RS-485
5 VOLT USER OUTPUT	4.8 to 5.0 VDC, 50 mA maximum

<b>CONTROLLER: C Model</b>	
IN1	Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter Function: CW limit, general purpose input.
IN2	Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter Function: CCW limit, general purpose input.
IN3	Optically isolated, 5-24 V, 8-12 mA. Function: home sensor, general purpose input.
OUT	Optically isolated, 30V, 80mA MAX. open emitter/collector. Function: fault, motion, alarm, tach or general purpose
COMMUNICATION INTERFACE	CAN 2.0b (for CANOpen network), RS-232 (for configuration)
CANOPEN CONFORMANCE	DS301, DSP402
CANOPEN MOTION	Homing, Profile Velocity, Profile Position (single set-point and set of set-points)

<b>CONTROLLER: -S, -Q and -IP Modes</b>	
IN1	Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter Function: CW limit, general purpose input. STEP input, master encoder ch A
IN2	Optically isolated, 5-24 V, 8-12 mA. Minimum pulse width = 250 ns. Maximum pulse frequency = 3 MHz. Adjustable bandwidth digital noise rejection filter Function: CCW limit, general purpose input. DIR input, master encoder Ch B
IN3	Optically isolated, 5-24 V, 8-12 mA. Function: home sensor, general purpose input.
OUT	Optically isolated, 30V, 40mA MAX. open emitter/collector. Function: fault, motion, alarm, tach or general purpose
COMMUNICATION INTERFACE	100 MBit Ethernet, RJ45 connector. Auto-crossover.
ANALOG INPUT RANGE (AIN)	0 to 5VDC
ANALOG INPUT RESOLUTION	12 bits

## Torque-Speed Curves

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



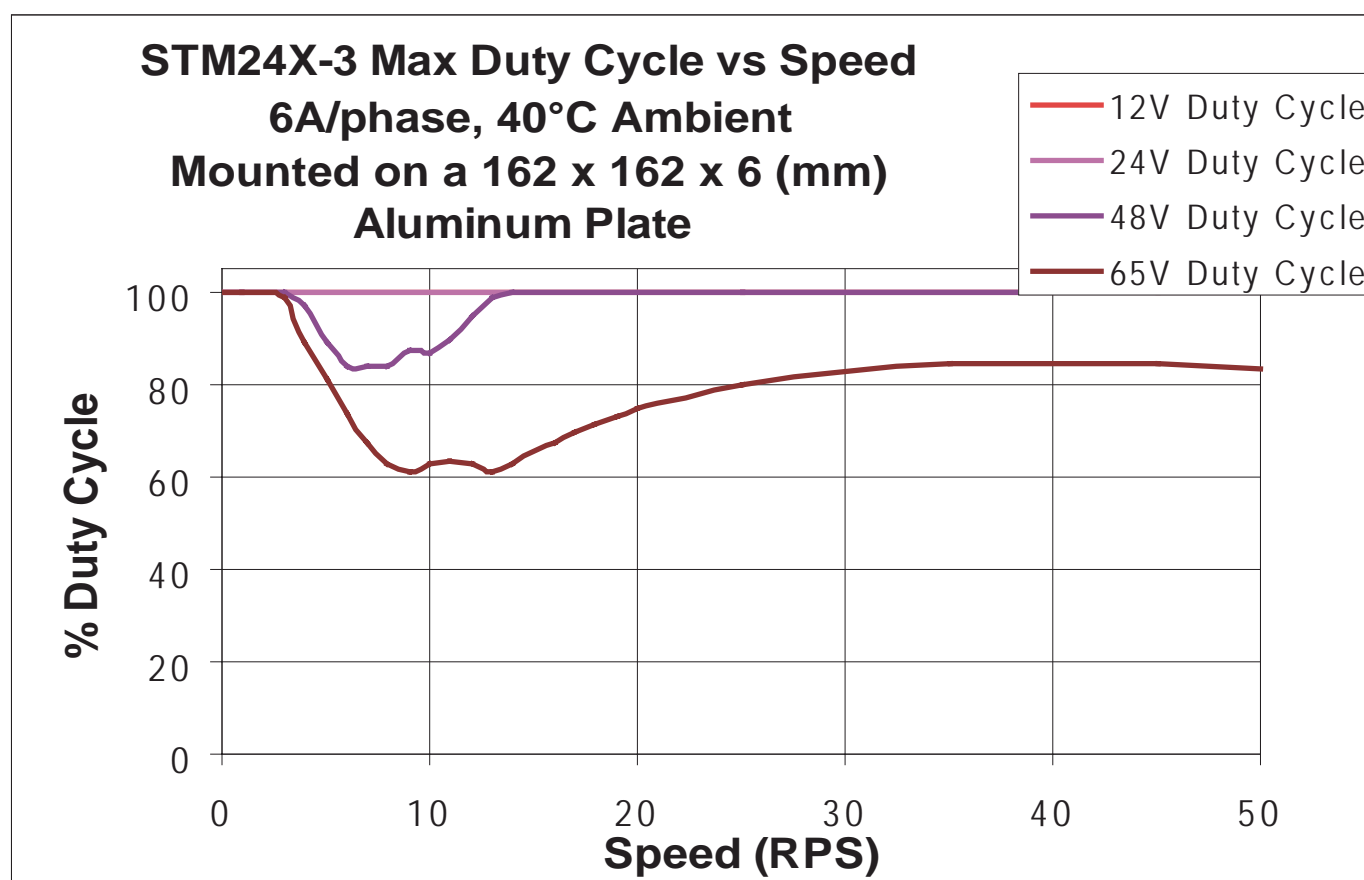
## Drive/Motor Heating

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 STM24 in our lab and provided curves showing the maximum duty cycle versus speed for commonly used power supply voltages. Please refer to these curves when planning your application.

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

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



## Mating Connectors and Accessories

Connector	Part Number - Manufacturer
DC Power (2-position, screw terminal)	1615780000 - Weidmuller
I/O (11-position, spring cage)	1881419 - Phoenix
RS-485 (5-position, spring cage)	1881354 - Phoenix

### Accessories

Serial programming cable for programming units with RS-232 ports (STM24x-xAx): P/N 3004-189

USB serial adapter with one RS-232 port and one RS-485 port for programming all units: P/N 8500-003

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




















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



## LED Error Codes

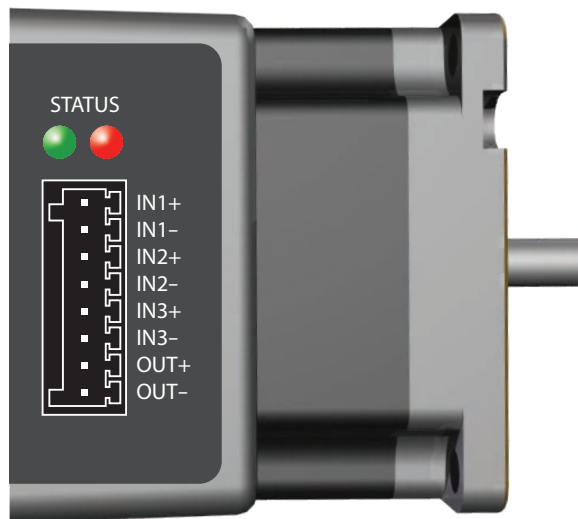
### Status LED STM

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

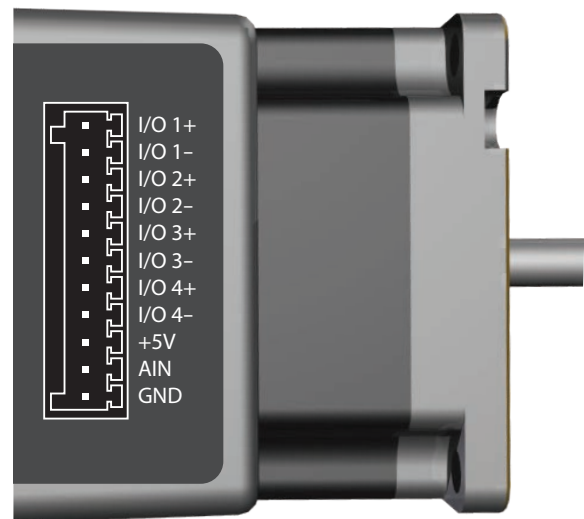
Code	Error
 solid green	no alarm, motor disabled
 flashing green	no alarm, motor enabled
 fast green	Q program running
 1 red, 1 green	motor stall (optional encoder only)
 1 red, 2 green	move attempted while drive disabled
 2 red, 1 green	ccw limit
 2 red, 2 green	cw limit
 3 red, 1 green	drive overheating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

## Connector Pin Diagrams

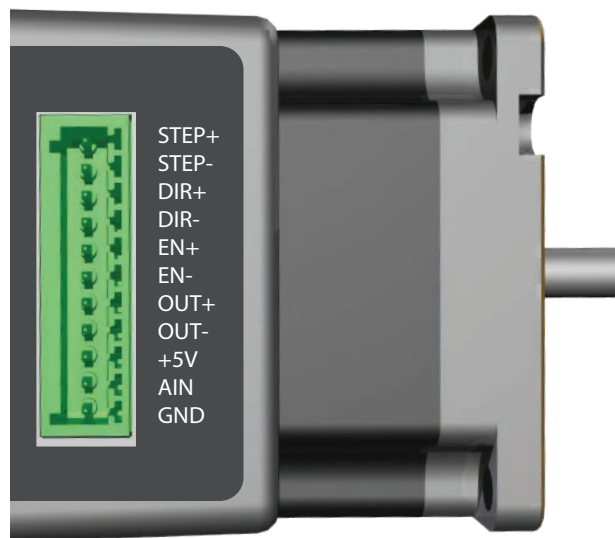
STM24C Connector Pin Diagram



STM24SF & STM24QF Connector Pin Diagram



STM24 -S, -Q, and -IP Connector Pin Diagram



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