SSM23Q/IP

Integrated Step-Servo Motor

Hardware Manual

Applied Motion Products

Contents

Sold & Serviced By:

ELECTROMATE

Rev.A
920-0090

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Model	Communications	
	Ethernet	EtherNet/IP
SSM23Q-2EG	✓	
SSM23Q-3EG	✓	
SSM23Q-4EG	✓	
SSM23IP-2EG		✓
SSM23IP-3EG		
SSM23IP-4EG		✓

1 Introduction

Thank you for selecting the Applied Motion Products SSM23Q/IP Integrated Motor.The SSM line of integrated step-servo motors combines servo technology with an integrated motor to create a product with exceptional feature and broad capability. We hope our commitment to performance, quality and economy will result in a successful motion control project.

1.1 Features

- Programmable, Digital servo driver and motor in an integrated package
- Operates from a 12 to 70 volt DC power supply
- Control Modes:

    Torque Control
    - Analog input
    - eSCL commanded

    Velocity Control
    - Digital input Control Velocity
    - Analog velocity
    - eSCL Commanded Velocity (Jogging)

    Position Control
    - Digital Signal type
        - Step & Direction
        - CW & CCW pulse
        - A/B Quadrature (Encoder Following)
    - Analog Position
    - Serial Commanded Position

    Q Programming
    - Executes stored Q programs
    - Conditional processing & multi-tasking
    - Math functions, register manipulation

- Communications:

    Ethernet TCP/IP or UDP, EtherNet/IP industrial networking
- 5000 line (20,000 counts/rev) encoder feedback
- Available torque:

    SSM23Q/IP-2EG: Up to 1.0N•m Continuous(1.3 N•m Boost)
    SSM23Q/IP-3EG: Up to 1.5N•m Continuous(2.0 N•m Boost)
    SSM23Q/IP-4EG: Up to 2.4N•m Continuous(3.2 N•m Boost)
- I/O:

    3 optically isolated digital inputs, with adjustable bandwidth digital noise rejection filter, 5 to 24 volts
    1 optically isolated digital output, 30V/100 mA max.
    1 analog input for speed and position control, 0 to 5 volts
- Technological advances:

    Full servo control, Closed loop
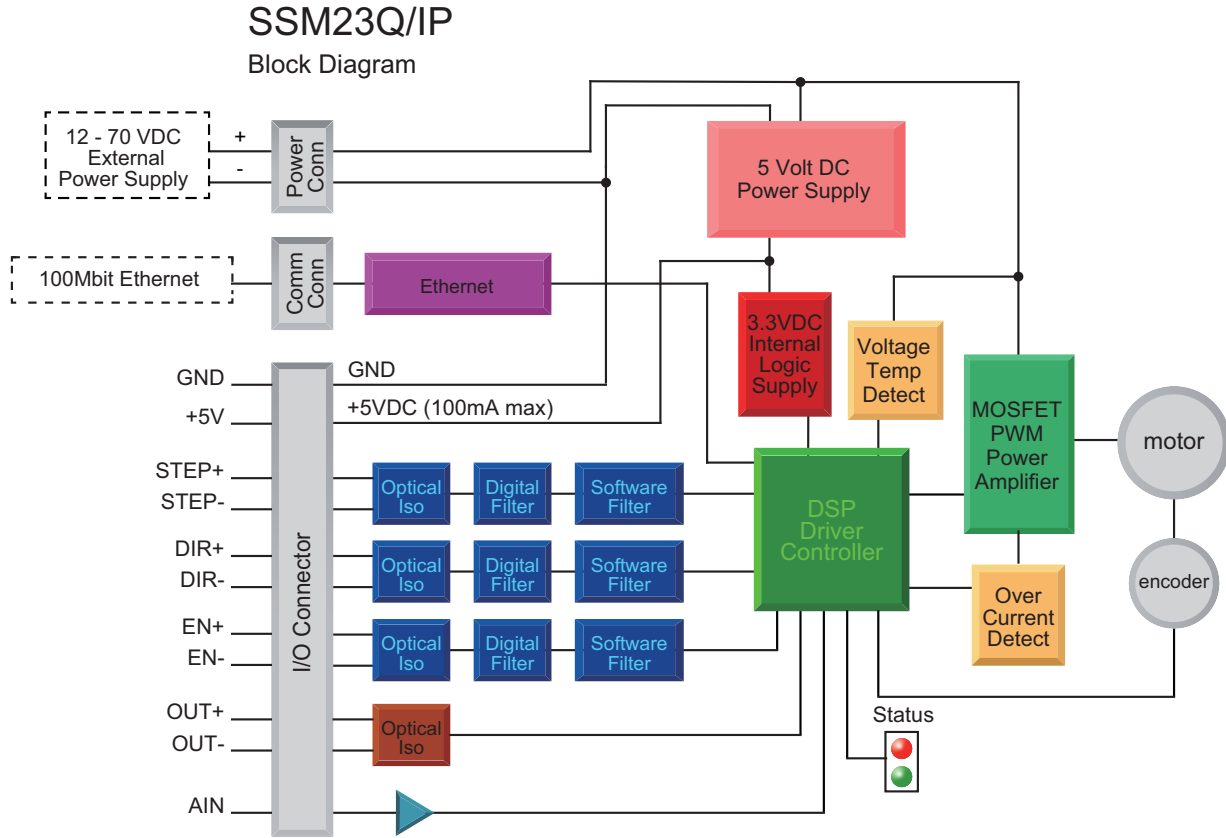   Efficient, Accurate, Fast, Smooth
    Intelligent, Compact

1.2 Block Diagram

SSM23Q/IP
Block Diagram

12 - 70 VDC External Power Supply

+
-

Power Conn

100Mbit Ethernet

Comm Conn

Ethernet

5 Volt DC Power Supply

3.3VDC Internal Logic Supply

Voltage Temp Detect

MOSFET PWM Power Amplifier

motor

encoder

Over Current Detect

DSP Driver Controller

GND
+5V
STEP+
STEP-
DIR+
DIR-
EN+
EN-
OUT+
OUT-
AIN

GND
+5VDC (100mA max)

I/O Connector

Optical Iso · Digital Filter · Software Filter

Status

I/O Configurations

STEP (5 to 24 volts)	DIR (5 to 24 volts)	EN (5 to 24 volts)	OUT (30V, 100mA)
Step	Direction	Enable	Fault
CW step	CCW step	Alarm/fault reset	Motion
A quadrature (encoder following)	B quadrature (encoder following)	Speed 1/speed 2 (oscillator mode)	Tach
CW limit	CCW limit	General purpose input	In position
CW jog	CCW jog		Brake
Start/stop (oscillator mode)	Direction (oscillator mode)		General purpose programmable
General purpose input	General purpose input		

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1.3 Safety Instructions

Only qualified personnel should transport, assemble, install, operate, or maintain this equipment. Properly qualified personnel are persons who are familiar with the transport, assembly, installation, operation, and maintenance of motors, and who meet the appropriate qualifications for their jobs.

To minimize the risk of potential safety problems, all applicable local and national codes regulating the installation and operation of equipment should be followed. These codes may vary from area to area and it is the responsibility of the operating personnel 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. Applied Motion Products does not guarantee the products described in this publication are suitable for a particular application, nor do they assume any responsibility for product design, installation, or operation.

- Read all available documentation before assembly and operation. Incorrect handling of the products referenced in this manual can result in injury and damage to persons and machinery. All technical information concerning the installation requirements must be strictly adhered to.

- It is vital to ensure that all system components are connected to earth ground. Electrical safety is impossible without a low-resistance earth connection.

- This product contains electrostatically sensitive components that can be damaged by incorrect handling. Follow qualified anti-static procedures before touching the product.

- During operation keep all covers and cabinet doors shut to avoid any hazards that could possibly cause severe damage to the product or personal health.

- During operation, the product may have components that are live or have hot surfaces.

- Never plug in or unplug the Integrated Motor while the system is live. The possibility of electric arcing can cause damage.

Be alert to the potential for personal injury. Follow recommended precautions and safe operating practices emphasized with 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 the possible safety hazards associated with this equipment and the precautions necessary to reduce the risk of personal injury and damage to equipment. Failure to observe these precautions could result in serious bodily injury, damage to the equipment, or operational difficulty.

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2 Getting Started

The following items are needed:

- a 12 - 70 volt DC power supply, see the section below entitled "Choosing a Power Supply" for help in choosing the right one
- a small flat blade screwdriver for tightening the connectors (included)
- a PC running Microsoft Windows XP, Vista, or Windows 7 or 8
- A CAT5 network cable (not included).

2.1 Installing Software

Before utilizing the SSM23Q/IPIntegrated Step-Servo Motor and Step-Servo Quick Tuner Software in an application, the following steps are necessary:

- Download and install the Step-Servo Quick Tuner software.
- If you intend to connect the drive directly to your PC, configure your computer to use IP address 10.10.10.11. (For instructions on connecting your SSM drive to a local area network (LAN), please consult the appropriate hardware manual)
- On the SSM drive, select switch position 0, which will assign IP address 10.10.10.10. (See the hardware manual for further details on selecting IP addresses for the drive and PC)
- Launch the software by clicking: Start / All Programs / Applied Motion Products / Step-Servo Quick Tuner
- Apply power to the drive.
- The software will recognize the drive and display the model and firmware version. At this point, it is ready for use.

2.2 Mounting the Hardware

As with any step motor, the SSM23Q/IPmust be mounted so as to provide maximum heat sinking and airflow. Keep enough space around the Integrated Motor to allow for airflow.

- Never use the drive where there is no airflow or where other devices cause the surrounding air to be more than 40°C (104°F).
- Never put the drive where it can get wet.
- Never use the drive where metal or other electrically conductive particles can infiltrate the drive.
- Always provide airflow around the drive.

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2.3 Choosing a Power Supply

The main considerations when choosing a power supply are the voltage and current requirements for the application.

2.3.1 Voltage

The SSM23Q/IPis 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 SSM23Q/IPto produce higher temperatures. Using power supplies with voltage outputs that are near the drive maximum may significantly reduce the operational duty-cycle.

The extended range of operation can be as low as 10 VDC minimum to as high as 75 VDC maximum. When operating below 18 VDC, the power supply input may require larger capacitance to prevent under-voltage and internal-supply alarms. Current spikes may make supply readings erratic. The supply input cannot go below 10 VDC for reliable operation. Absolute minimum power supply input is 10 VDC. If the Input supply drops below 10 VDC the low voltage alarm will be triggered. This will not fault the drive.

Absolute maximum power supply input is 75 VDC at which point an over-voltage alarm and fault will occur. When using a power supply that is regulated and is near the drive maximum voltage of 75 VDC, a voltage clamp may be required to prevent over-voltage when regeneration occurs. When using an unregulated power supply, make sure the no-load voltage of the supply does not exceed the drive's maximum input voltage of 75 VDC.

2.3.2 Regeneration Clamp

If a regulated power supply is being used, there may be a problem with regeneration. When a load decelerates rapidly from a high speed, some of the kinetic energy of the load is transferred back to the power supply, possibly tripping the over-voltage protection of a regulated power supply, causing it to shut down. This problem can be solved with the use of an Applied Motion Products RC880 Regeneration Clamp. It is recommended that an RC880 initially be installed in an application. If the "regen" LED on the RC880 never flashes, the clamp is not necessary.

LEDs

Green - Power

Red - Regen on
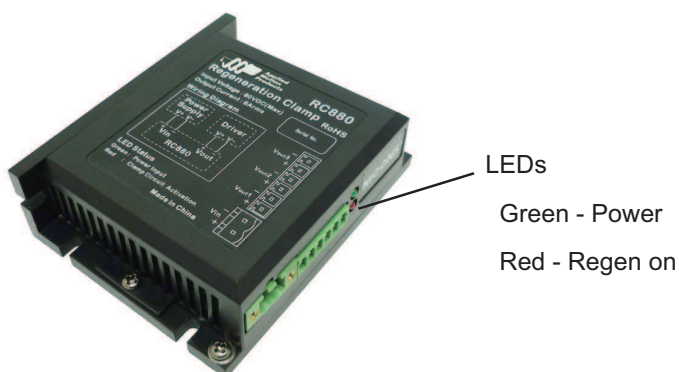
RC880 Regen Clamp

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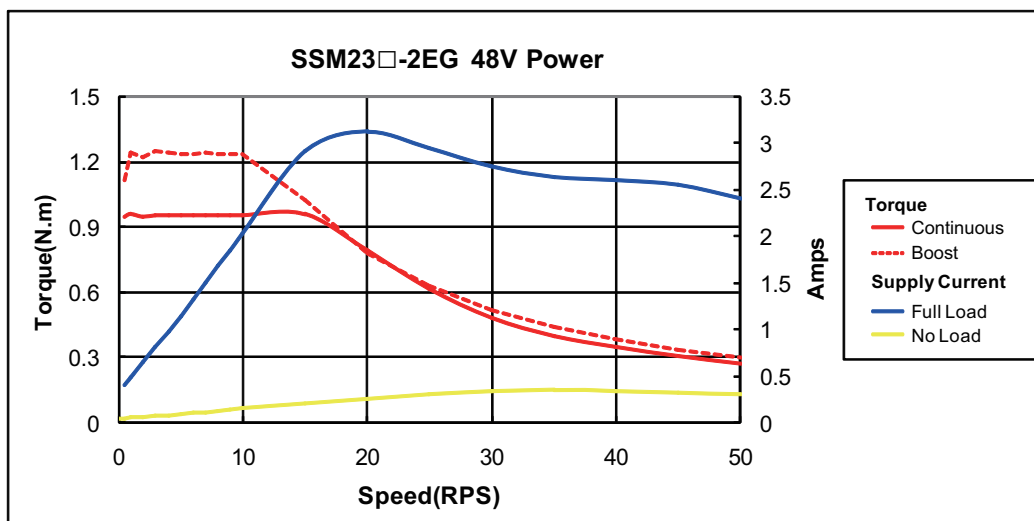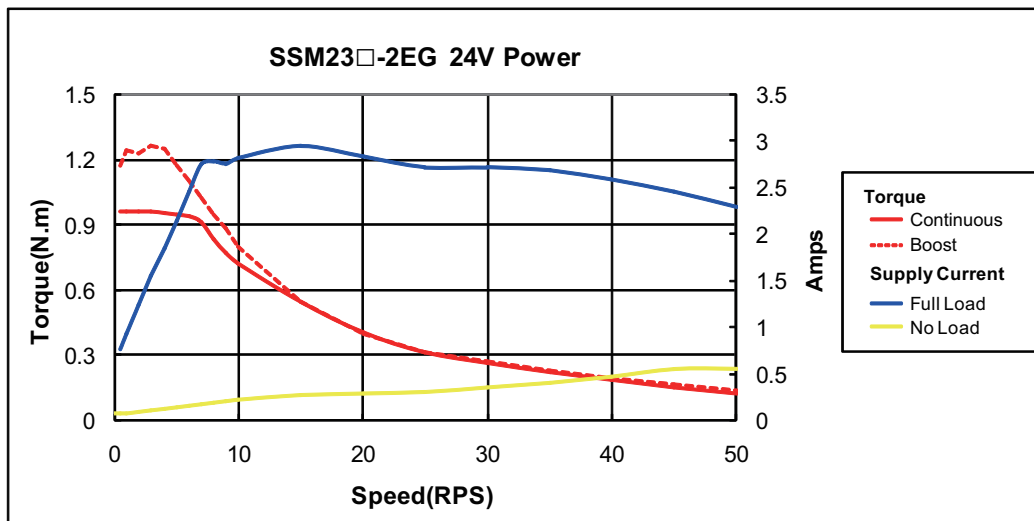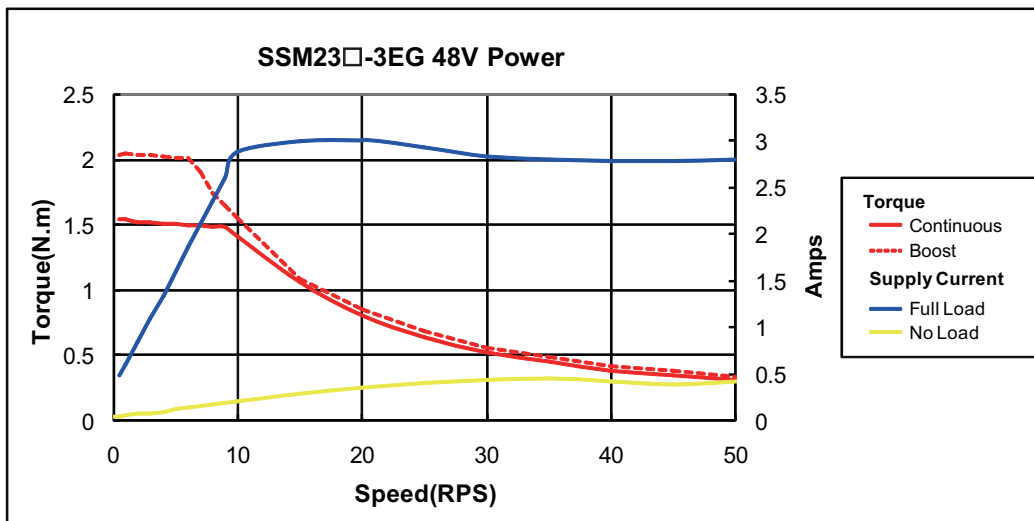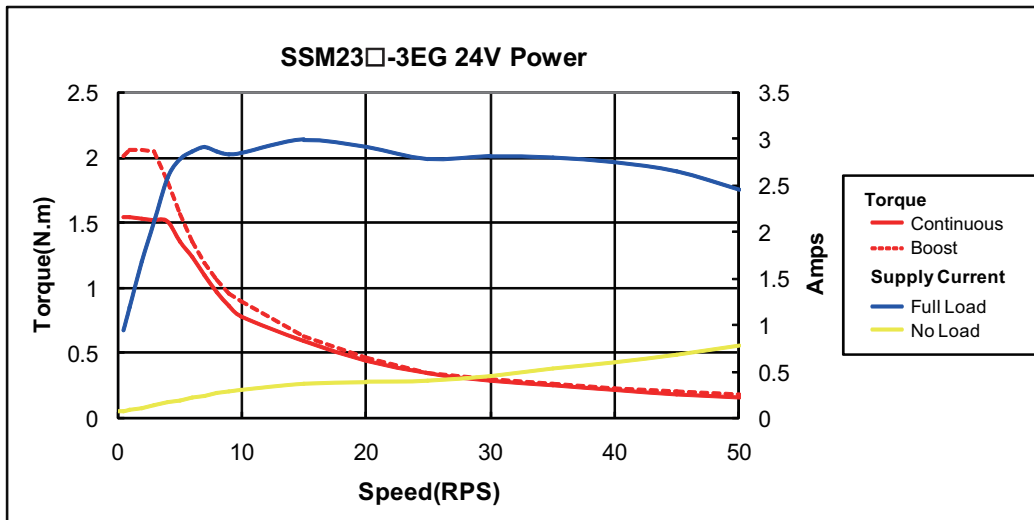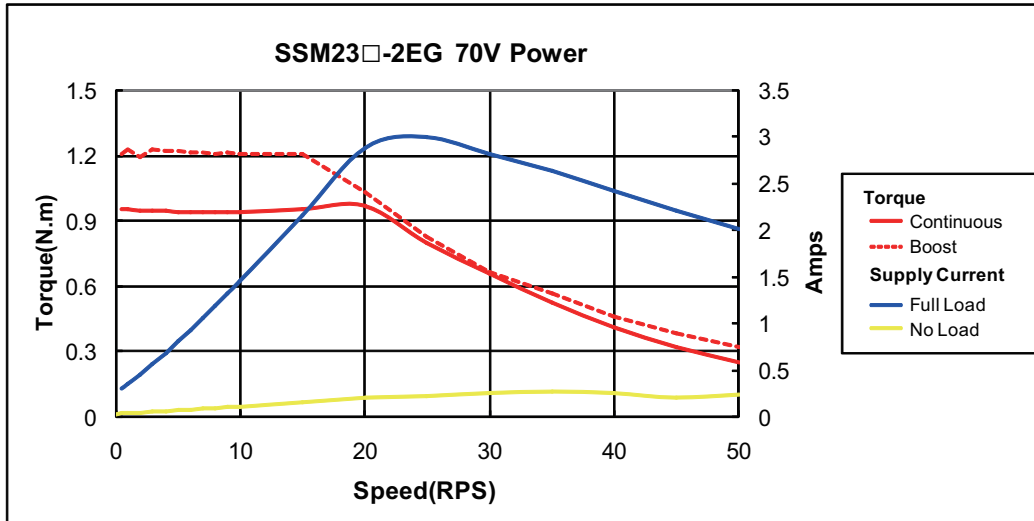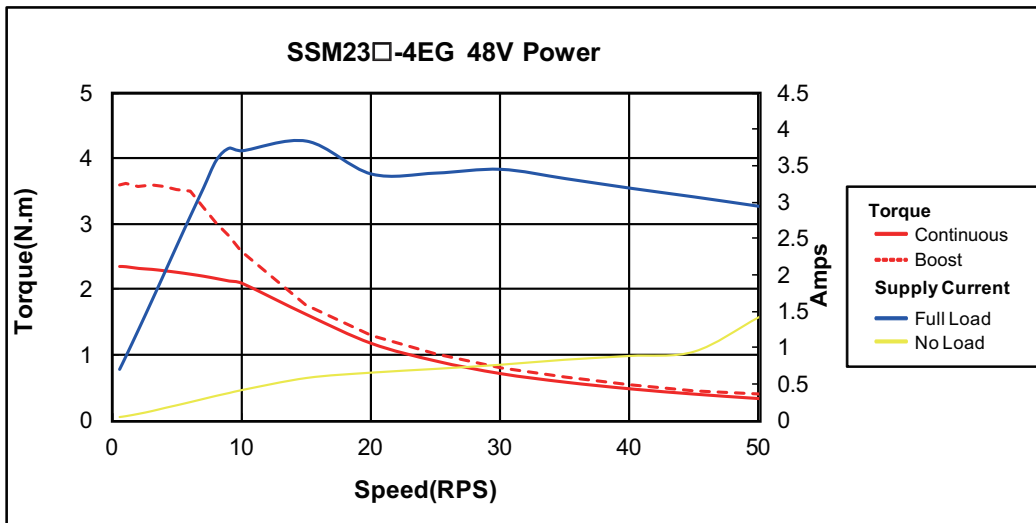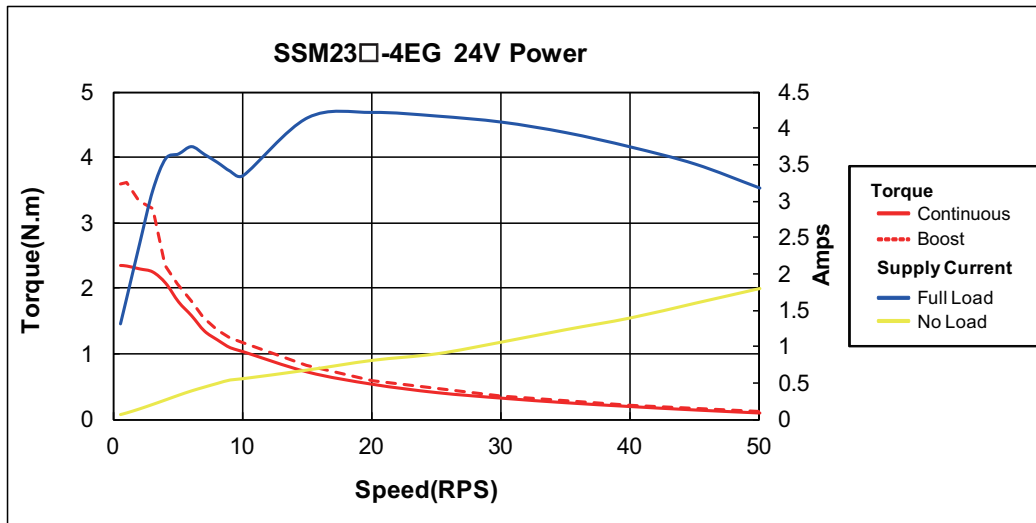Toll Free Phone 8 (877) SERVO98
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2.3.3 Current

The maximum supply currents required by the SSM23Q/IP are shown in the charts below at different power supply voltage inputs. The SSM23Q/IP power supply current is lower than the winding currents because it uses switching amplifiers to convert 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 will be required from the power supply.

It is important to note that the current draw is significantly different at higher speeds depending on the torque load to the motor. Estimating how much current is necessary may require a good analysis of the load the motor will encounter.

SSM23□-2EG 24V Power

SSM23□-2EG 48V Power

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SSM23☐-2EG 70V Power

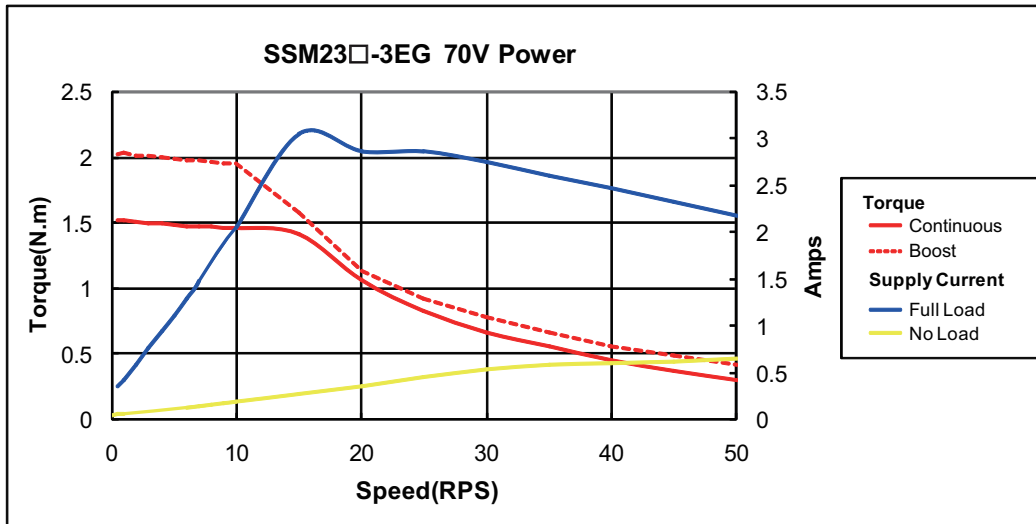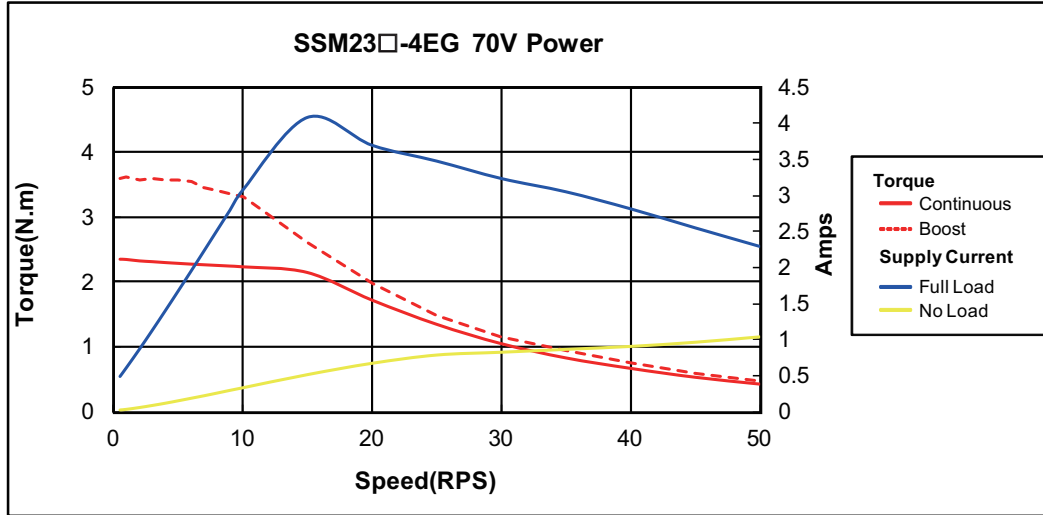**SSM23☐-3EG 24V Power**

SSM23☐-3EG 48V Power

SSM23☐-3EG 70V Power

SSM23☐-4EG 24V Power

**SSM23☐-4EG 48V Power**

SSM23☐-4EG 70V Power

3 Installation/Connections

3.1 Connecting the Power Supply

Use 16 to 20-gauge wire to connect the SSM23 to a power supply. It contains an internal fuse connected to the "+" terminal that is not user replaceable. If a user serviceable fuse is desired, install a 4 amp fast acting fuse in line with the "+" power supply lead.

⚠ **Be careful not to reverse the wires. Reversing the connection may open the internal fuse on the drive and void the warranty.**

To Earth Ground

To Power Supply+

To Power Supply-

Power Supply

V-   V+

Vin

RC880

Vout

V-   V+

SSM
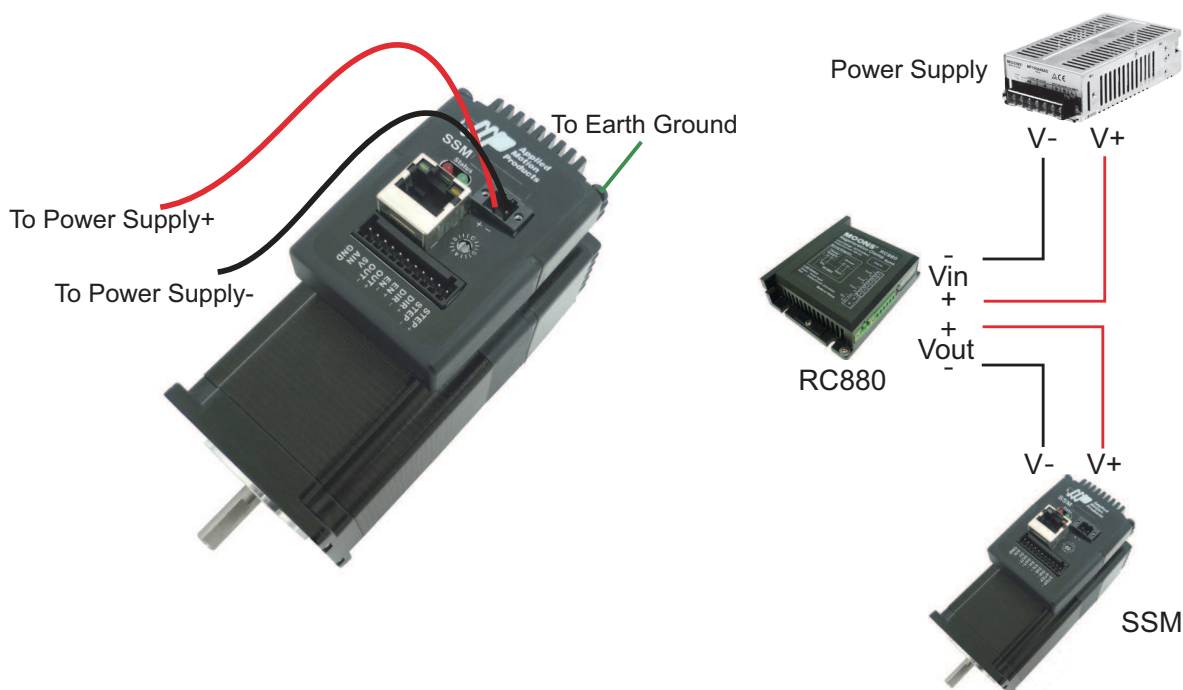
Applied Motion Products offers two matched power supplies for use with the SSM.
A 24VDC, 150W(P/N PS150A24) and a 48VDC 320W(P/N PS320A48).
These power supplies have current over load capability making them ideal for use.
(To use with a switch power supplier, a RC880 regen must be connected in system)

The RC880 regeneration clamp is for use where regeneration from the motor may cause damage to the drive. In these cases the RC880 is connected between the drive and power supply and absorbs regenerated energy.

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3.2 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 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.

```
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
```

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

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.

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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.

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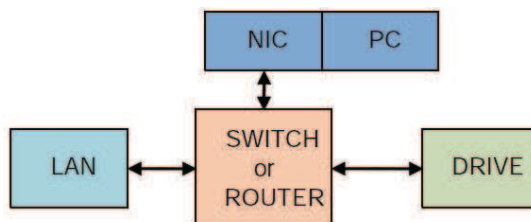
Once you've chosen an appropriate IP address for your drive, set the rotary switch according the address table above. If none of the default addresses are acceptable for your network, you can enter a new table of IP addresses using Configurator. If your network uses addresses starting with 192.168.0, 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.
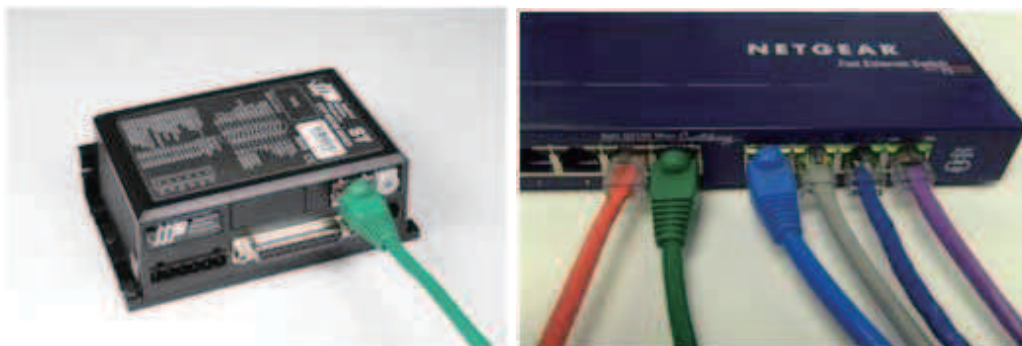
If your PC address is not in one of the above private subnets, you will have to change your subnet mask to 255.255.0.0 in order to talk to your drive. To change your subnet mask:

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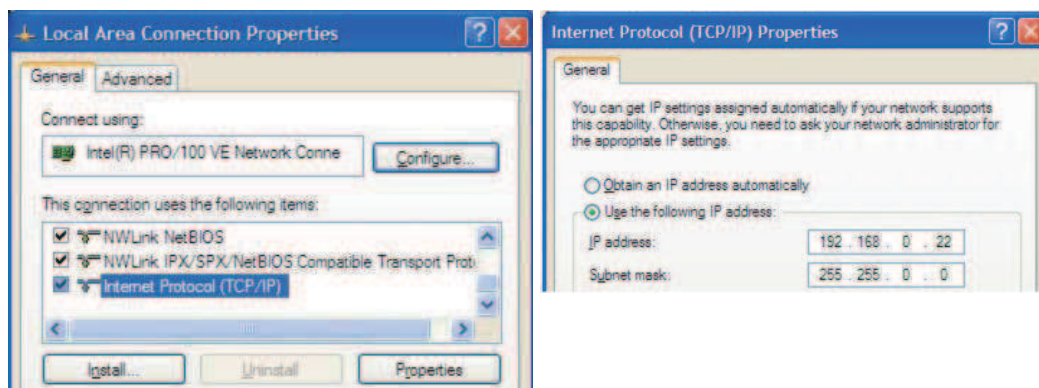
5. If the option "Use the following IP address" is selected, life is good. Change the subnet mask to "255.255.0.0" and click OK.

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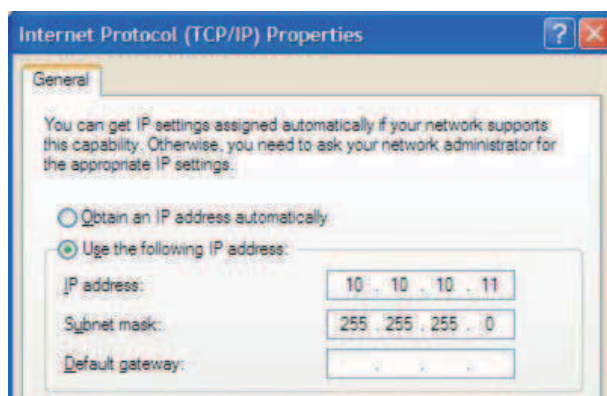www.electromate.com
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Using DCHP

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.
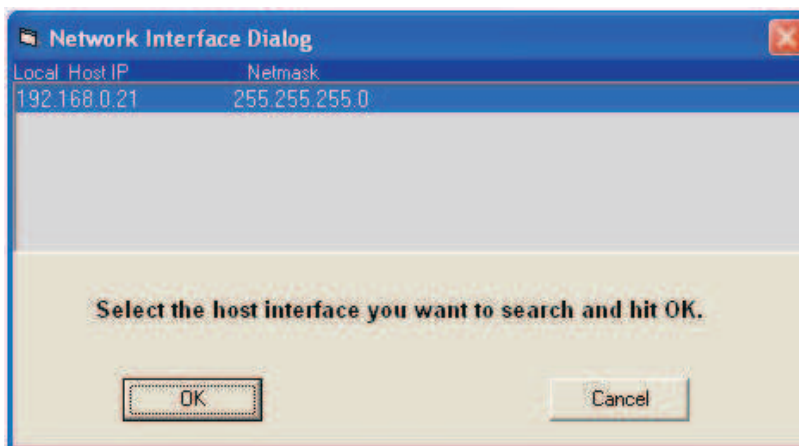
If you think this is the correct drive, click Yes. If you're not sure, click Not Sure and Drive Discovery will look for additional drives on your network. Once you've told Drive Discovery which drive is yours, it will automatically enter that drive's IP address in the IP address text box so that you 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.
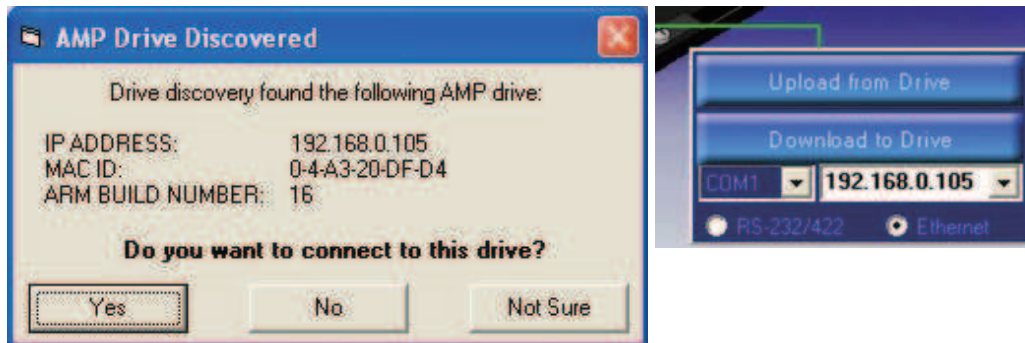
You don't need a special "crossover cable"; the drive will automatically detect the direct connection and make the necessary physical layer changes.

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)"

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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.
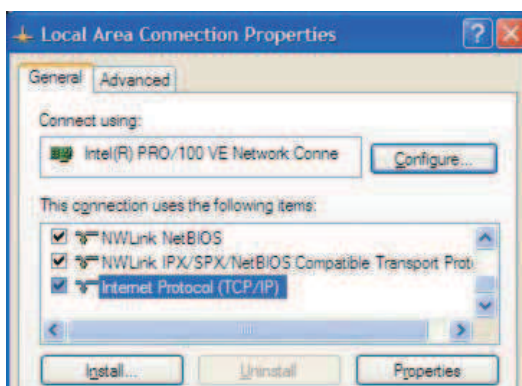
6. Next, enter the subnet mask as "255.255.255.0".

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."

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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 RJ4
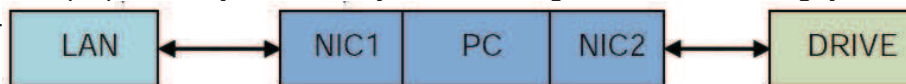
3. Set the IP address on the drive to "10.10.10.10" by setting the rotary switch at "0".

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."

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3.3 Inputs and Outputs

The SSM23Q/IP has three types of inputs:

- High speed digital inputs for step & direction commands or encoder following, 5 to 24 volt logic
- Low speed digital input for other signals, 5 to 24 volt logic
- Analog input for analog speed and positioning modes

All drives include 3 digital inputs and 1 analog input

- STEP & DIR are high-speed digital inputs for commanding position. Quadrature signals from encoders can also be used. When not being used for the Step & Direction function these inputs can be used for CW & CCW Limit, CW & CCW Jogging and Run/Stop & Direction Velocity modes.
- EN is a low speed software programmable input and can be used for Motor Enable and/or Alarm Reset. This input can also be connected to a sensor, switch or other device for use with Wait Input (WI), Seek Home (SH), Feed to Sensor (FS), On Input (OI) and other commands.
- AIN is an analog input for a velocity or position command signal. It can accept 0-5 volts and has gain, filtering, offset and dead-band settings.

3.3.1 Connector Pin Diagram
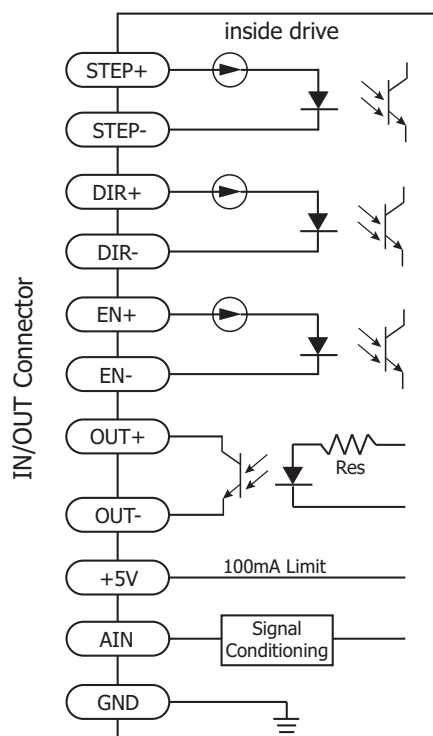
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3.3.2 STEP & DIR Digital Inputs

The diagrams below show how to connect the STEP & DIR Inputs to various commonly used devices.
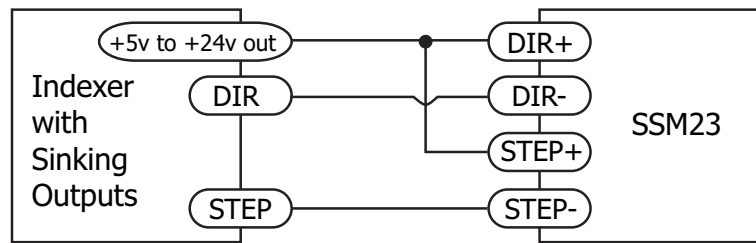
Connecting to Indexer with Sinking Outputs
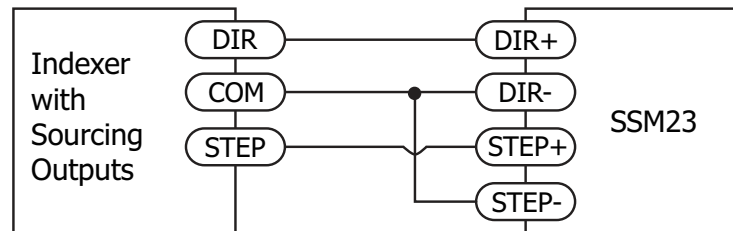
Connecting to Indexer with Sourcing Outputs
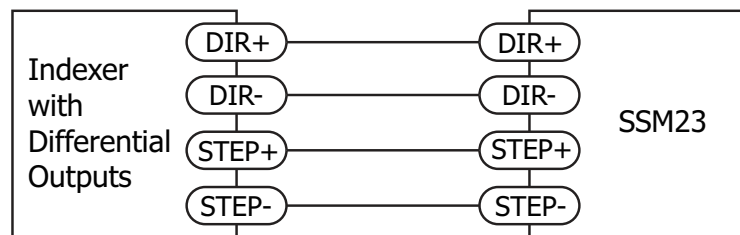
Connecting to Indexer with Differential Outputs
Many high-speed indexers have differential outputs
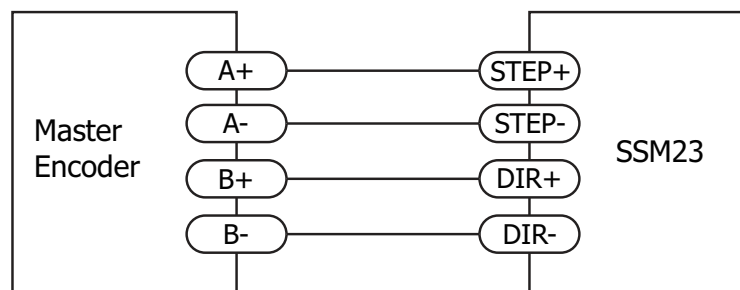
Wiring for Encoder Following
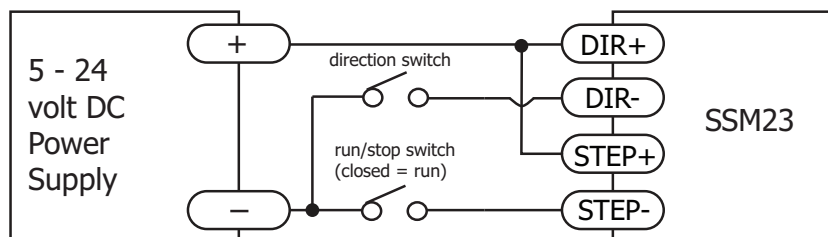
Using Mechanical Switches

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3.3.3 EN Digital Input

While the STEP and DIR inputs are designed for high-speed digital input operation, the Enable (EN) input is designed for low speed digital input operation between 5 and 24 volts.

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 below show how to connect the EN input to various commonly used devices.
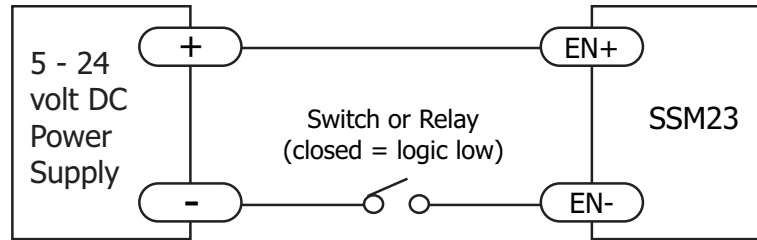
Connecting the Input to a Switch or Relay
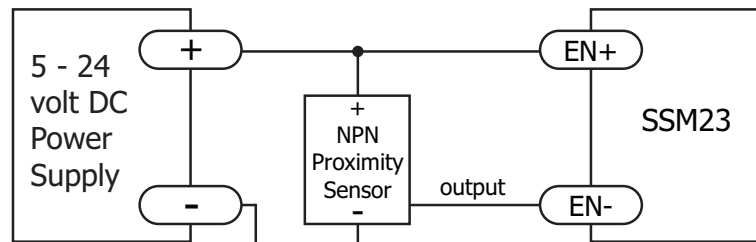
Connecting an NPN type Proximity Sensor to an Input
(when prox sensor activates, input goes low)
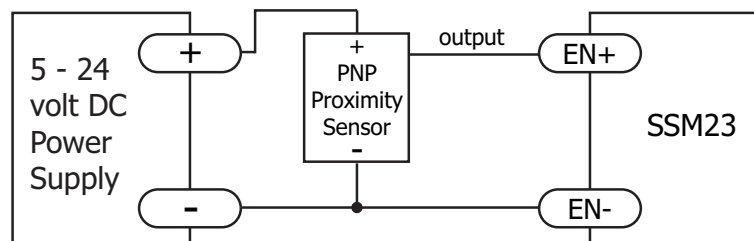
Connecting a PNP type Proximity Sensor to an Input
(when prox sensor activates, input goes low)

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3.3.4 AIN Input

The SSM23Q/IP drives have an analog input (AIN) which can accept a signal range of 0 to 5 volts. The drive can be configured to operate at a speed or position that is proportional to the analog signal. Use the Step-Servo Quick Tuner software to set the signal range, offset, dead-band and filter frequency. The SSM23Q/IP provides a +5 volt 100mA limit voltage supply 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.

inside drive

I/O Connector

100 mA limit

+5v

AIN — Signal Conditioning

GND

+5v OUT

1 - 10k Ω pot

AIN   SSM23

GND

Connecting a Potentiometer to the Analog Input
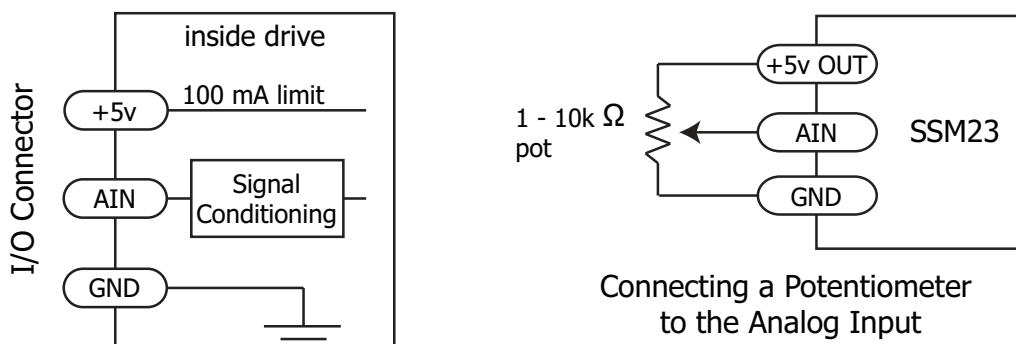
3.3.5 Programmable Output

The SSM23Q/IP drives feature one optically isolated digital output (OUT). 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). Or the output can be turned on and off by program instructions like Set Output (SO). The 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 the output to be configured for current sourcing or sinking.

Diagrams of various connection types follow.

Do not connect the output to more than 30 volts. The current through the output terminal must not exceed 100mA.
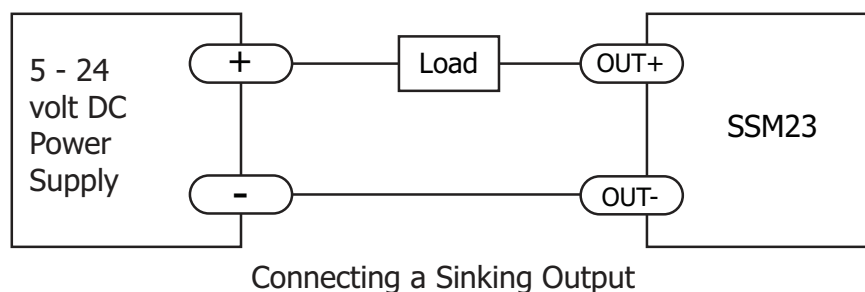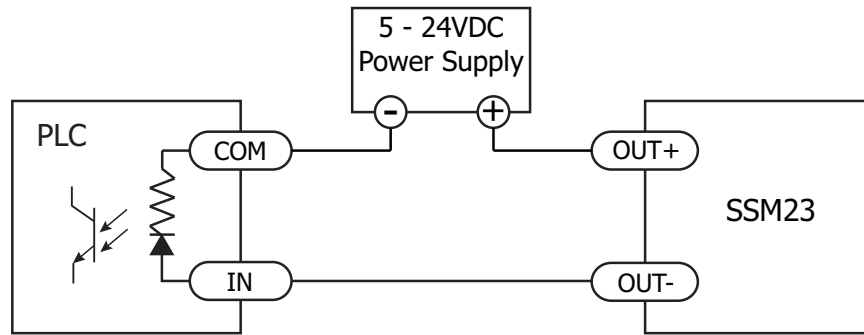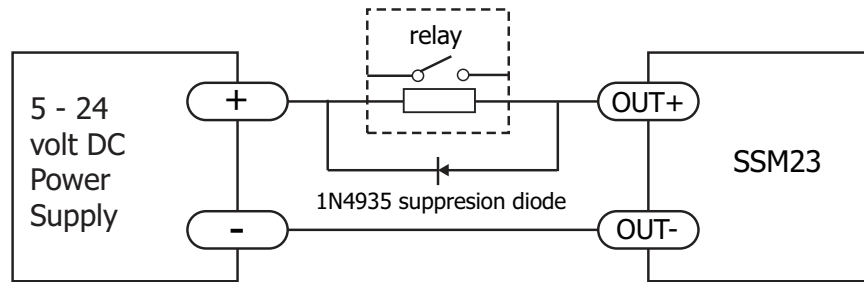
5 - 24 volt DC Power Supply

+   Load   OUT+

SSM23

-              OUT-

Connecting a Sinking Output

Connecting a Sourcing Output

Driving a Relay

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4 Troubleshooting

LED Error Codes

The SSM23Q/IP uses 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 shown below. This feature can be disabled for certain warnings but not for alarms. See Step-Servo Quick Tuner software help manual on how to do this and which warnings may be masked.

	Code	Error
🟢	solid green	motor disabled
🟢🟢	flashing green	motor enabled
🔴🟢	1 red, 1 green	position limit
🔴🟢🟢	1 red, 2 green	drive disabled
🔴🔴🟢	2 red, 1 green	ccw limit
🔴🔴🟢🟢	2 red, 2 green	cw limit
🔴🔴🔴🟢	3 red, 1 green	over temperature
🔴🔴🔴🟢🟢	3 red, 2 green	internal voltage
🔴🔴🔴🟢🟢🟢	3 red, 3 green	non-volatile memory error
🔴🔴🔴🔴🟢	4 red, 1 green	over voltage
🔴🔴🔴🔴🟢🟢	4 red, 2 green	under voltage
🔴🔴🔴🔴🟢🟢🟢	4 red, 3 green	non-volatile double error
🔴🔴🔴🔴🔴🟢	5 red, 1 green	over current
🔴🔴🔴🔴🔴🟢🟢	5 red, 2 green	current limit
🔴🔴🔴🔴🔴🔴🟢	6 red, 1 green	open winding
🔴🔴🔴🔴🔴🔴🟢🟢	6 red, 2 green	encoder failure
🔴🔴🔴🔴🔴🔴🔴🟢	7 red, 1 green	communication error
🔴🔴🔴🔴🔴🔴🔴🟢🟢	7 red, 2 green	save failed

5 Reference Materials

5.1 Mechanical Outlines
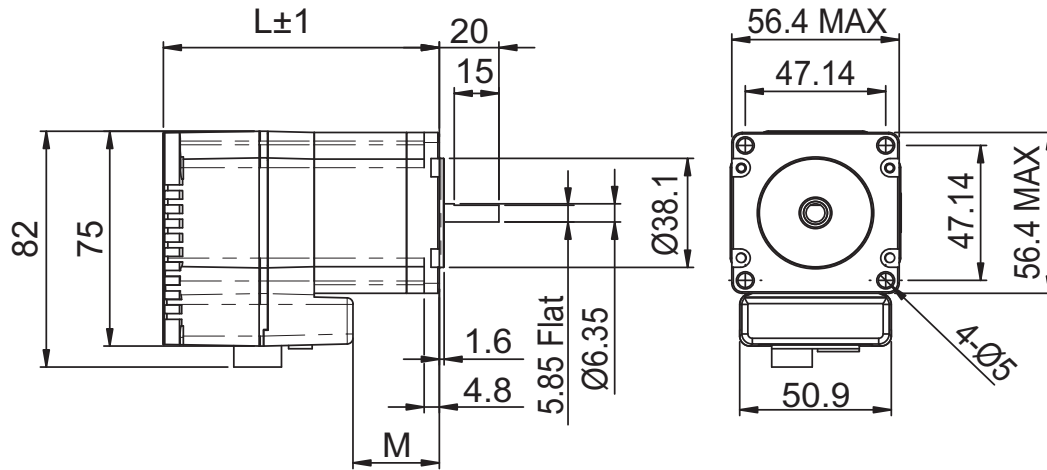
Unit:mm

Model	Length"L"	Length"M"
SSM23□-2EG	92.4	22
SSM23□-3EG	114.4	44

SSM23□−4EG

SECTION C−C
NOT TO SCALE
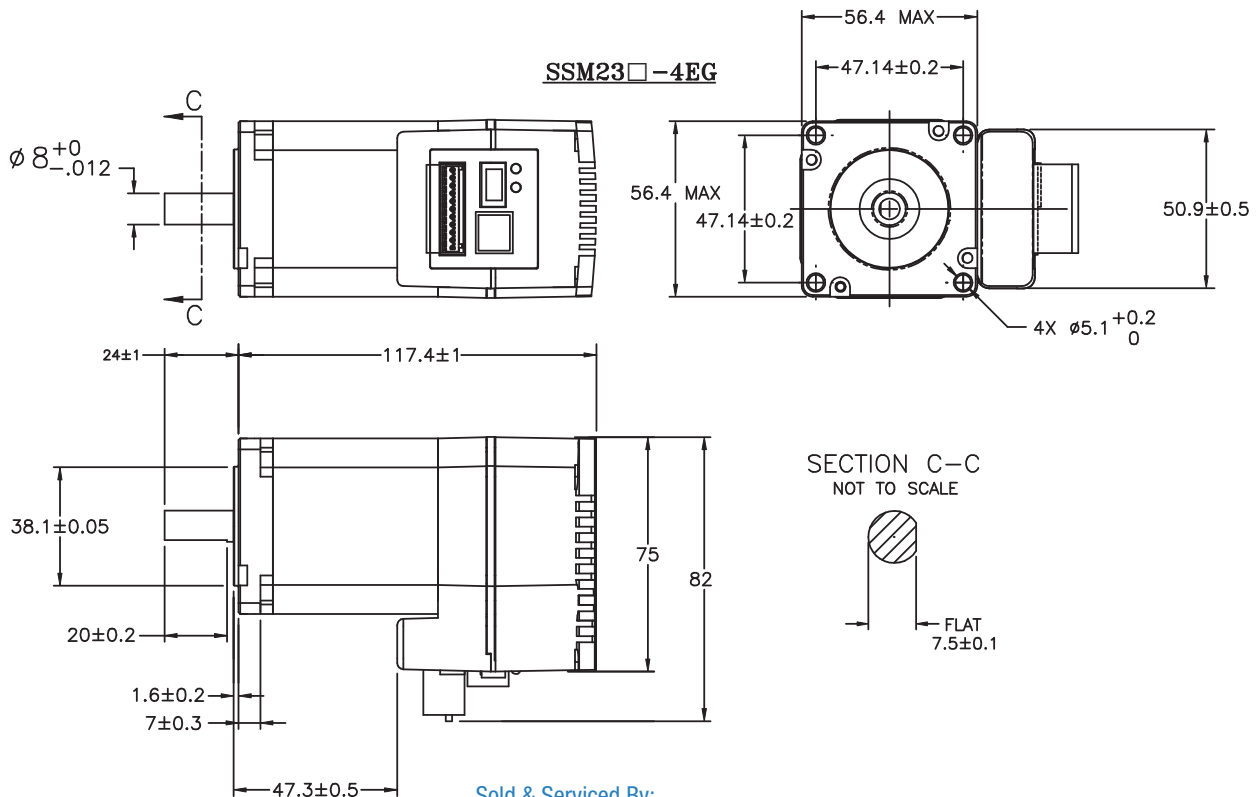
5.2 Technical Specifications

| Power Amplifier	
Amplifier Type	Dual H-Bridge, 4 Quadrant
Current Control	4 state PWM at 20 KHz
Output Torque	SSM23Q/IP-2EG: Up to 1.0N•m Continuous(1.3 N•m Boost) SSM23Q/IP-3EG: Up to 1.5N•m Continuous(2.0 N•m Boost) SSM23Q/IP-4EG: Up to 2.4N•m Continuous(3.2 N•m Boost)
Power Supply	External 12 - 70 VDC power supply required
Protection	Over-voltage, under-voltage, over-temp, motor/wiring shorts (phase-to-phase, phase-to-ground)
Controller	
Electronic Gearing	Software selectable from 200 to 51200 steps/rev in increments of 2 steps/rev
Encoder Resolution	20000 counts/rev
Speed Range	Up to 4800rpm
Filters	Digital input noise filter, Analog input noise filter, Smoothing filter, PID filter, Notch filter
Non-Volatile Storage	Configurations are saved in FLASH memory on-board the DSP
Modes of Operation	Step & direction, CW/CCW pulse, A/B quadrature pulse, velocity (oscillator, joystick), streaming commands(SCL), stored Q program execution
Digital Inputs	Digital Inputs Adjustable bandwidth digital noise rejection filter on all inputs **STEP+/-** : Optically isolated, 5-24 volt. Minimum pulse width = 250 ns, Maximum pulse frequency = 2 MHz Function: Step, CW step, A quadrature (encoder following), CW limit, CW jog, start/stop (oscillator mode), or general purpose input **DIR+/-** : Optically isolated, 5-24 volt. Minimum pulse width = 250 ns, Maximum pulse frequency = 2 MHz Function: Direction, CCW step, B quadrature (encoder following), CCW limit, CCW jog, direction (oscillator mode), or general purpose input **EN+/-** : Optically isolated, 5-24 volt. Minimum pulse width = 100 µs, Maximum pulse frequeny = 10 KHz Function: Enable, alarm/fault reset, speed 1/speed 2 (oscillator mode), or general purpose input
Digital Output	**OUT+/-**: Optically isolated, 30V/100 mA max. Function: Fault, motion, tach, in position, brake, or general purpose programmable
Analog Input	AIN referenced to GND. Range = 0 to 5 VDC. Resolution = 12 bits
Communication Interface	Ethernet TCP/IP or UDP, EtherNet/IP industrial networking
Physical	
Ambilent Temperature	0 to 40°C (32 to 104°F) When mounted to a suitable heatsink
Humdity	90% Max., non-condensing
Mass	SSM23Q/IP-2EG: 850 g SSM23Q/IP-3EG: 1200 g SSM23Q/IP-4EG: 1400 g
Rotor Inertia	SSM23Q/IP-2EG: 260 g•cm^2 SSM23Q/IP-3EG: 460 g•cm^2 SSM23Q/IP-4EG: 365 g•cm^2

5.3 Torque-Speed Curves

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

Note: 5 amp rating is continuous, 7.5 amp rating is boost
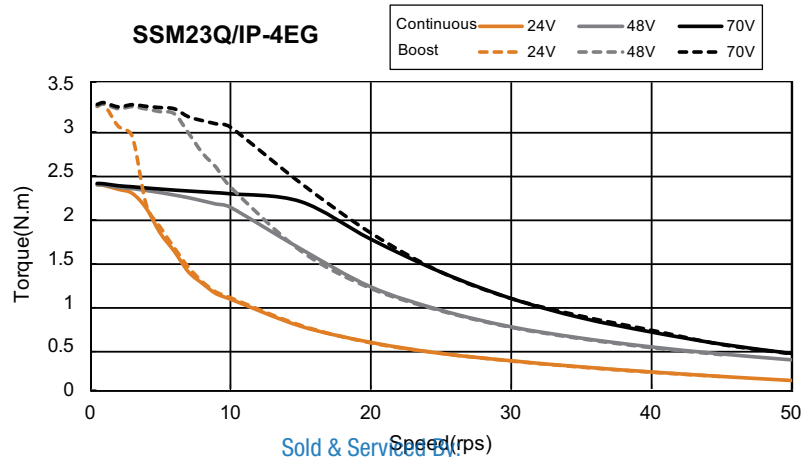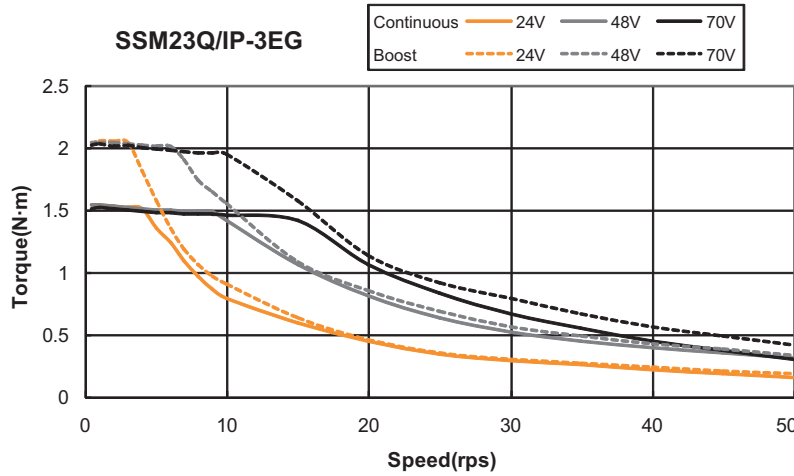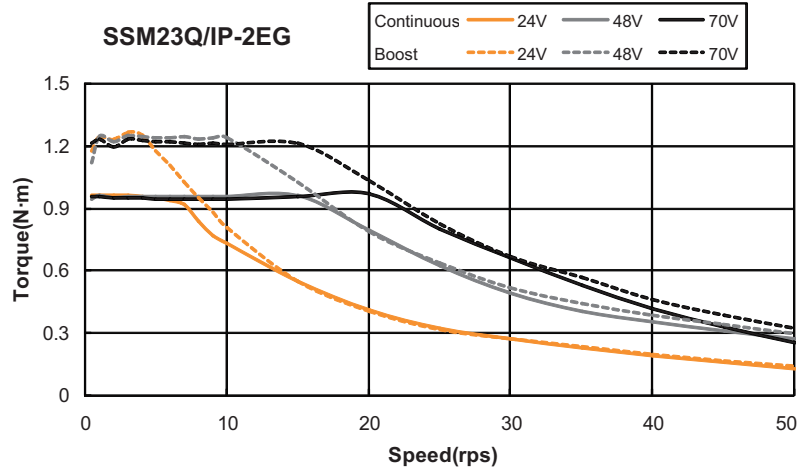
SSM23Q/IP-2EG

SSM23Q/IP-3EG

SSM23Q/IP-4EG

5.4 SCL Command Reference

The Serial Command Language (SCL) was developed to give users a simple way to control a motor drive via a serial port. This eliminates the need for separate motion controllers or indexers to supply Pulse and Direction signals to the drive. It also provides an easy way to interface to a variety of other industrial devices such as PLCs and HMIs, which often have standard or optional serial ports for communicating to other devices. Some examples of typical host devices might be:

- A Windows based PC running Applied Motion Products software
- An industrial PC running a custom or other proprietary software application
- A PLC with an ASCII module/serial port for sending text strings
- An HMI with a serial connection for sending text strings

SCL commands control the motion of the step motor, use of the inputs and outputs, and configure aspects of the drive such as motor current and microstep resolution.

In SCL mode, the SSM23Q/IP receives commands from the host, executing them immediately or sending them to a command buffer and then executing them directly from the buffer. It cannot, however, create a stored program for stand-alone operation. For that function, the SSM23Q is needed.

The communications protocol of SCL is simple in that the host initiates all communication, with one exception. The only time the drive will initiate communication is at power-up. At that time, the drive will send an identifier to tell the software which drive is connected and what the firmware version is.

There are two types of SCL commands: buffered and immediate. Buffered commands are loaded into and then executed out of the drive's command buffer. Buffered commands are executed one at a time and in sequential order. The buffer can be filled with commands without the host controller needing to wait for a specific command to execute before sending the next command. Special buffer commands enable the buffer to be loaded and to pause for a desired time.

Immediate commands are not buffered, but are executed immediately, running in parallel with a buffered command if necessary. Immediate commands are designed to access the drive at any time and can be sent as often as needed. This allows a host controller to get information from the drive at a high rate, most often for checking drive status or motor position.

The basic structure of a command packet from the host to the drive is always a text string followed by a carriage return. The text string is composed of the command itself, followed by any required parameters. A carriage return denotes the end of transmission to the drive.

The syntax of the command is

XXAB<cr>

where **XX** designates the command (always composed of 2 uppercase letters), and **A** and **B** define the possible parameters. These parameters can vary in length, can be letters or numbers, and are often optional. Once a drive receives the **<cr>** (carriage return), it will determine whether or not it understood the command-if it did, it will either execute or buffer the command. The drive can also be programmed ahead of time to send a response as to whether or not it understood the command as well as any error code

Some SCL commands transfer data to the drive for immediate or later use. These data values are stored in data registers and remain there until new commands change the values or power is removed from the drive. Some data registers in a drive are Read-Only and contain predefined information about the drive which can also be read through SCL commands.

Because of the intense nature of serial communications required in host mode applications, there is a serial communication Protocol (PR) command available that will adjust a drive's serial communications protocol to best fit an application. Typically this command is used when configuring a drive and saved as part of the startup parameters. But it can be used at any time to dynamically alter the serial communications.

The SCL Utility Software Manual contains the complete command listing as well as instructions on connecting and configuring the SSM23Q/IP for use in SCL mode, using the Data Registers and the Protocol command. It also contains detailed information on:

- Host Serial Communications
- Host Serial Connections
- Alarm and Status Codes
- Working with Inputs and Outputs

The Host Command Reference is available from the Applied Motion Products website at http://www.applied-motion.com under the SCL Utility download section.