

Si2035

Hardware Manual



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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 Si2035 contains electrostatically sensitive components that can be damaged by incorrect handling. Discharge yourself before touching the product. Avoid contact with high insulating materials (artificial fabrics, plastic film, etc.). Place the product on a conductive surface.
- During operation keep all covers and cabinet doors shut. Otherwise, there are deadly hazards that could possibly cause severe damage to health or the product.
- In operation, depending on the degree of enclosure protection, the product can have bare components that are live or have hot surfaces. Control and power cables can carry a high voltage even when the motor is not rotating.
- Never pull out or plug in the product while the system is live. There is a danger of electric arcing and danger to persons and contacts.
- After powering down the product, wait at least ten minutes before touching live sections of the equipment or undoing connections (e.g., contacts, screwed connections). Capacitors can store dangerous voltages for long periods of time after power has been switched off. To be safe, measure the contact points with a meter before touching.

Be alert to the potential for personal injury. Follow the recommended precautions and safe operating practices. 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.

Introduction

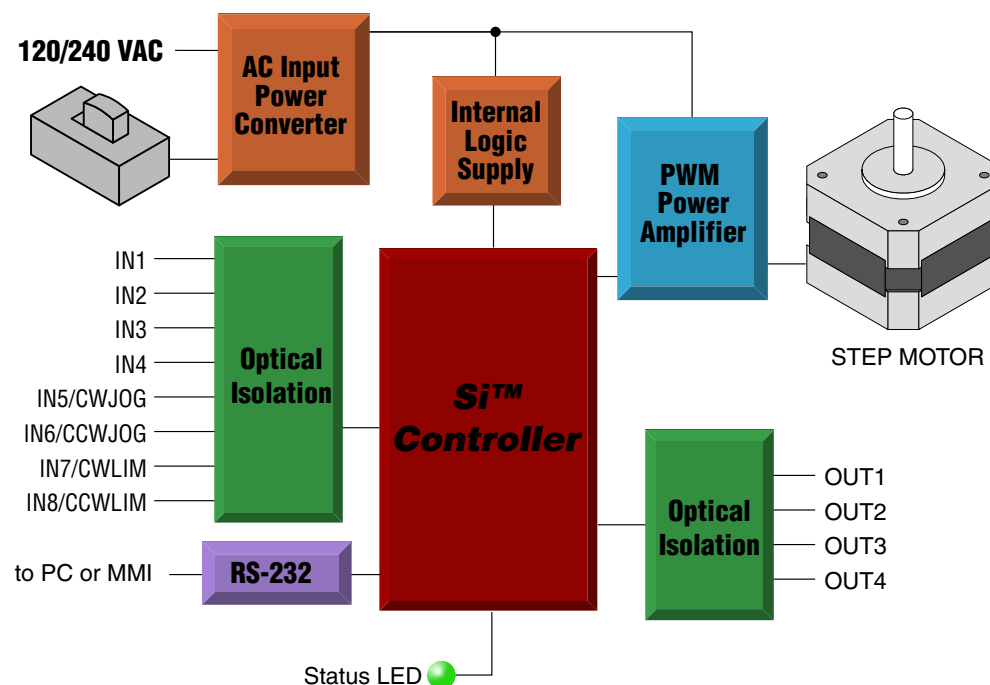
Thank you for selecting an Applied Motion Products motor control. We hope our dedication to performance, quality and economy will make your motion control project successful.

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

Si2035 Features

- Programmable step motor driver in complete fully featured package
- Built-in 30 volt DC power supply.
- Drive connects to a 120 or 240 Volt AC input, single phase, 50/60 Hz
- 8 optically isolated digital inputs for connecting end of travel limits, sensors, etc.
- 4 optically isolated programmable outputs for coordinating external equipment
- Motor current from 0.2 to 2.0 amps/phase
- 0-5V analog input (currently supported by SCL only)
- microstepping to 50,800 steps per revolution.
- Powerful, flexible, easy to use indexer.
- Connects by a simple cable to your PC for programming (cable included).
- Microsoft Windows™-based software for easy setup and programming
- In Si™ mode, operates stand alone, running internally stored programs
- In SCL mode, accepts real time commands and queries from a host PC or PLC
- Compact 1.75 x 6.8 x 4 inch overall dimensions.
- Optional man machine interface (MMI) allows operator to enter distances, speeds, cycle counts and more.

Block Diagram

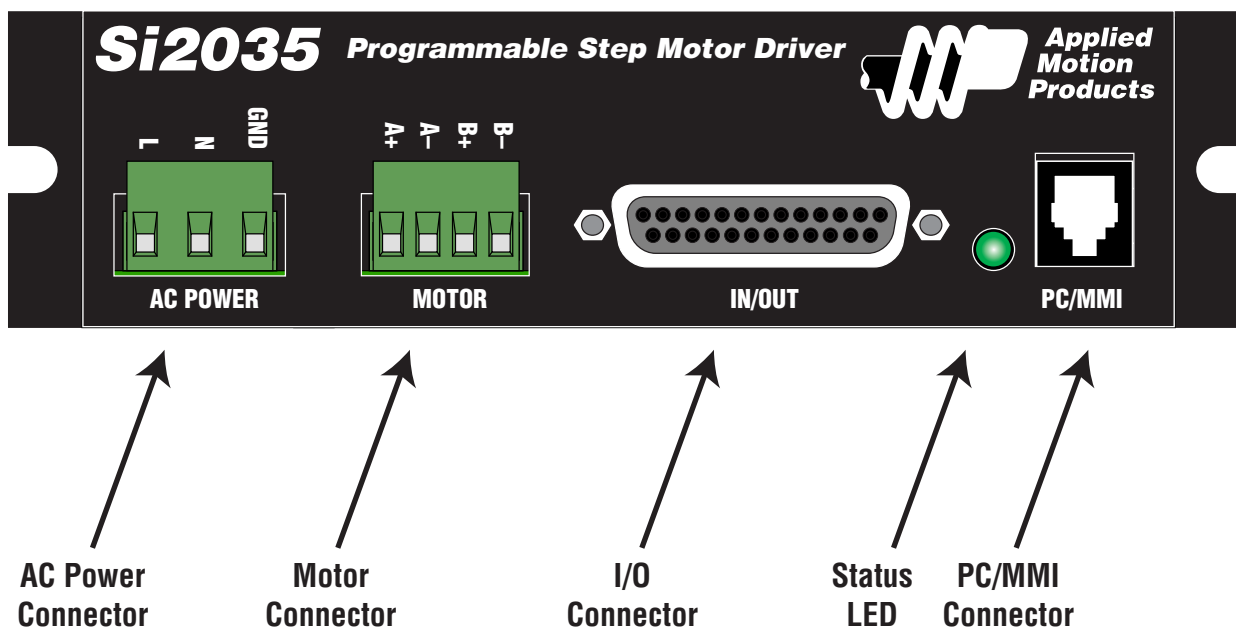


Getting Started

To use your Si2035 motor control, you will need the following :

- ✓ a line cord for connecting to 110 or 220 volts AC.
- ✓ a compatible step motor (see page 14 for [recommended motors](#)).
- ✓ a small flat blade screwdriver for tightening the connectors - an Applied Motion Products screwdriver suitable for this purpose is included with your drive.
- ✓ a personal computer running Windows 98, 2000 or NT, ME or XP with a 9 pin serial port (or [USB serial adapter](#))
- ✓ the *Si Programmer™* software that came with your drive (on the CD)
- ✓ the programming cable that came with your drive
- ✓ *Si Programmer™* software manual - on the CD that came with your drive. The manual and context-sensitive help are available in the *Si Programmer™* software. You can get software updates and additional literature at www.applied-motion.com.

The sketch below shows where to find the important connection and adjustment points. Please examine it now.



Status LED & Error Codes

The Si2035 includes a bi-color (red/green) LED to indicate status. Normal status is indicated by a solid green LED. If the LED changes to red, an error has occurred. The errors are indicated by combinations of red and green “flashes” as follows:

LED Pattern	Code	Description
●	1 red, no green	program halted due to unexpected end of travel limit
● ● ● ●	1 red, 3 green	subroutine stack overflow
● ● ● ● ●	2 red, 3 green	subroutine stack underflow
● ● ● ● ● ● ● ●	4 red, 3 green	user program or eeprom memory error (bad Si opcode)
● ● ● ● ● ● ● ● ● ●	7 red, 1 green	communication error (incoming RS-232 data has overrun the buffer)

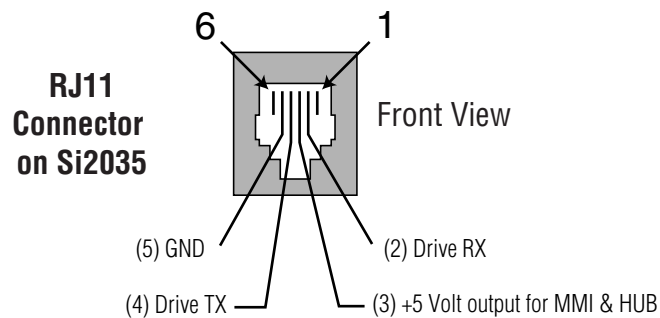
Connecting to the PC using RS-232

- Locate your computer within 6 feet of the drive.
- Your drive was shipped with a communication cable. Plug the large end into the serial port of your PC and the small end into the PC/MMI jack on your drive. Secure the cable to the PC with the screws on the sides.

If your PC does not have a serial port, you should purchase a “USB Serial Converter”. We have had good results with the Port Authority “USB Serial DB9” Adapter from CablesToGo.com and with the SW1301 from SewellDirect.com.

For laptops, a PCMCIA converter card is a good choice. Our applications engineers use the [SSP-100](#) from Sewell Direct.

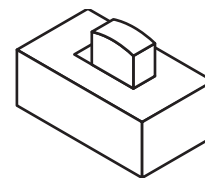
Never connect an Si2035 to a telephone circuit. It uses the same connector as telephones and modems, but the voltages are not compatible.



Connecting the AC Power Input

110 Volts

The Si2035 is set for 110 volt operation at the factory. All you need to do is install a power cord and plug it in. If you want to direct wire the Si2035 to AC power, you must consult a qualified electrician and observe all building and electrical codes.



You can install the AC cord yourself, but be careful: AC power can be dangerous.

220 Volts

The Si2035 is set for 110 volt operation at the factory. In order to use 220 volts, you'll need to remove the cover and slide the switch to the "220V" setting.

First, disconnect all power from the system. Next, remove all four of the green connector plugs from the front panel. Then, using your small Phillips screwdriver, remove the five screws that hold the cover on plus the two "jack screws" that secure the "IN/OUT" connector. The cover will slide off easily once all of the screws are removed. You should see a black switch near the "AC POWER" connector, right next to the big transformer. Push the switch to the "220V" side. Now put the cover back on and replace all screws, tightening them carefully.

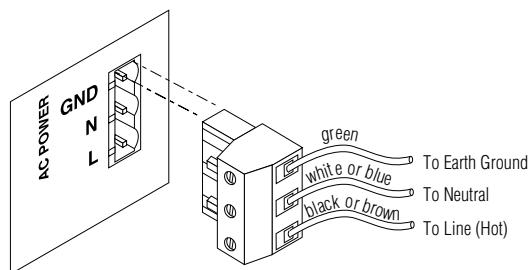


Never operate the drive with the cover off

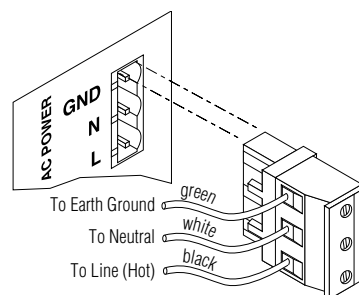
Installing an AC Line Cord

Remove about 5 mm (3/16 inches) of insulation from each of the three wires of your line cord. (That's right, three wires. For safety, always use a three wire power cord on anything with a metal case.) Depending on where you got your power cord, it may have black, white and green wires or brown/blue/green.

The AC power plug that was shipped with your Si2035 might be one of two types. The "old style" is shown below, on the left. The "new style" (shown on the right) comes with an insulating rubber boot. Make sure you follow the proper sketch for your connector style.



"Old Style" AC Power Plug



"New Style" AC Power Plug

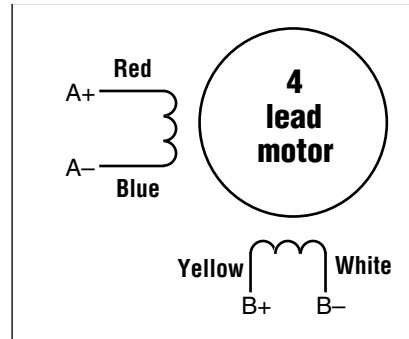
Connecting the Motor



Never connect the motor to the driver when the AC power is on.
Secure any unused motor leads.
Never disconnect the motor while the AC power is on.
Never connect motor leads to ground or to a power supply.

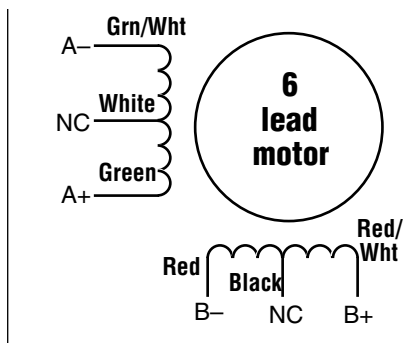
You must now decide how to connect your motor to the drive.

Four lead motors can only be connected one way. Please follow the sketch at the right.

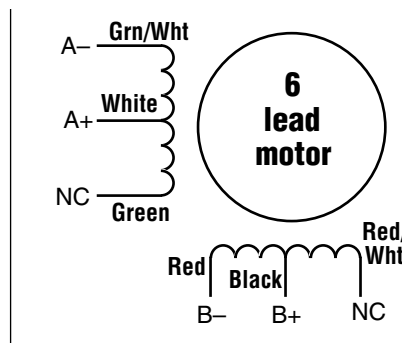


4 Leads

Six lead motors can be connected in series or center tap. In series mode, motors produce more torque at low speeds, but cannot run as fast as in the center tap configuration. In series operation, the motor should be operated at 30% less than the rated current to prevent overheating. Winding diagrams for both connection methods are shown below. NC means not connected.

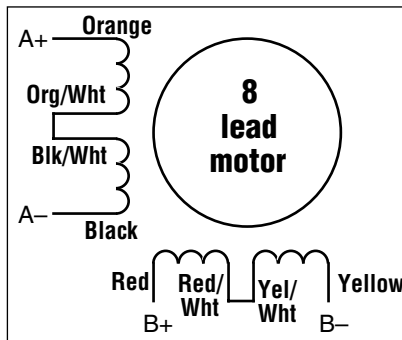


6 Leads Series Connected

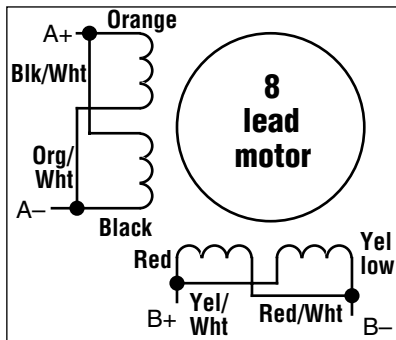


6 Leads Center Tap Connected

Eight lead motors can also be connected in two ways: series and parallel. As with six lead motors, series operation gives you more torque at low speeds and less torque at high speeds. In series operation, the motor should be operated at 30% less than the rated current to prevent over heating. The wiring diagrams for eight lead motors are shown below.



8 Leads Series Connected



8 Leads Parallel Connected

Connecting Input Signals

Single Ended Inputs

The Si2035 includes 6 single ended, optically isolated input circuits that can be used with sourcing or sinking signals, 12 to 24 volts. This allows connection to PLCs, sensors, relays and mechanical switches. Because the input circuits are isolated, they require a source of power. If you are connecting to a PLC, you should be able to get power from the PLC power supply. If you are using relays or mechanical switches, you will need a 12-24 V power supply. This also applies if you are connecting the inputs to the programmable outputs of another Si product from Applied Motion.

What is COM?

"Common" is an electronics term for an electrical connection to a common voltage. Sometimes "common" means the same thing as "ground", but not always. In the case of the Si2035, if you are using sourcing (PNP) input signals, then you will want to connect COM to ground (power supply -). If you are using sinking (NPN) signals, then COM must connect to power supply +.

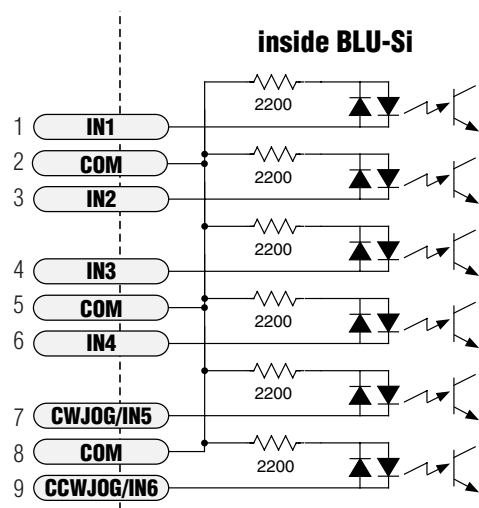
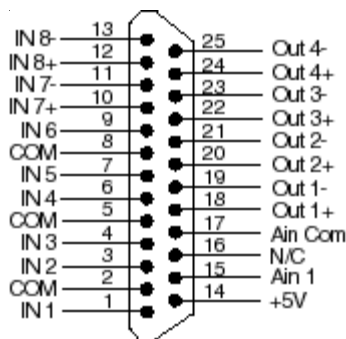
Note: If current is flowing into or out of an input, the logic state of that input is low or closed. If no current is flowing, or the input is not connected, the logic state is high or open.

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

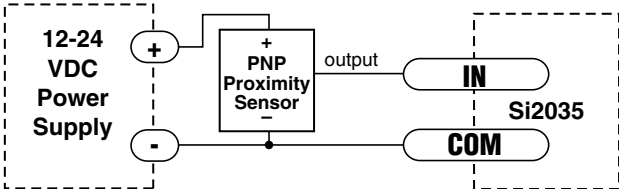
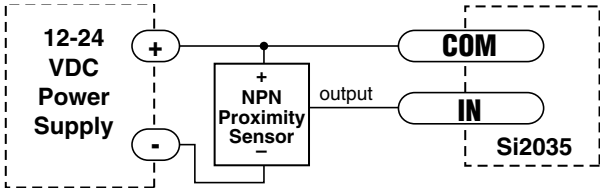
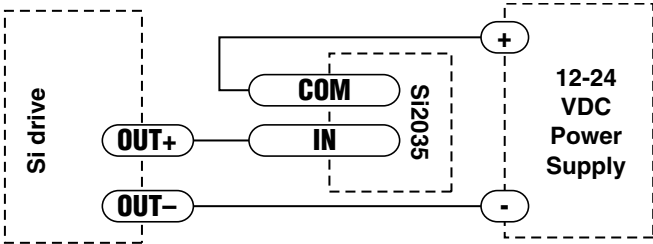
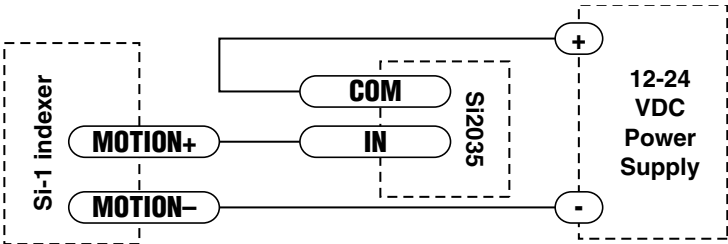
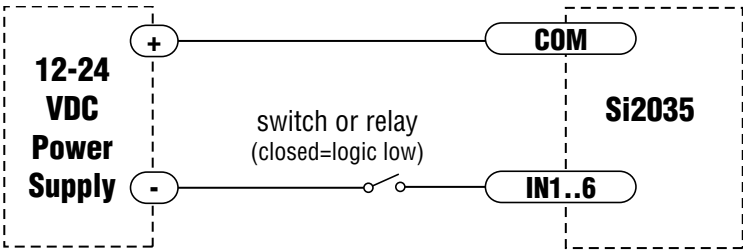


The maximum voltage that can be applied to an input terminal is 24 volts DC. Never apply AC voltage to an input terminal. Maximum current is 20 mA per input.

IN/OUT Connector Pinout Diagram



Digital Input Connection Examples

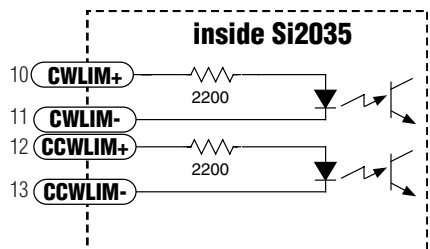


Connecting Limit Switches

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

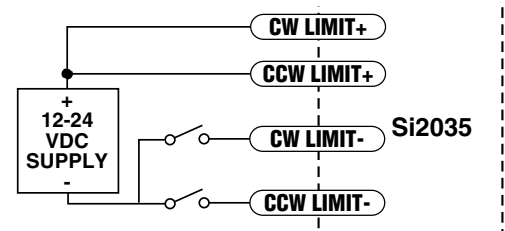
The limit inputs are optically isolated. This allows you to choose a voltage for your limit circuits of 12 to 24 volts DC. This also allows you to have long wires on limit sensors that may be far from the drive with less risk of introducing noise to the drive electronics. The schematic diagram of the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

Si2035 Limit Input diagram



Wiring a Mechanical Limit Switch

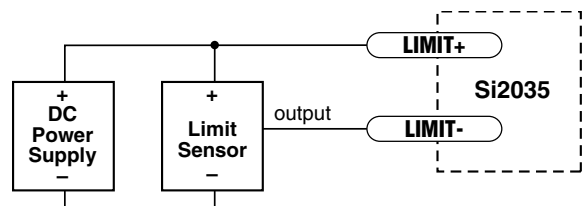
You can use normally open or normally closed limit switches. Either way, wire them as shown here.



Wiring a Limit Sensor

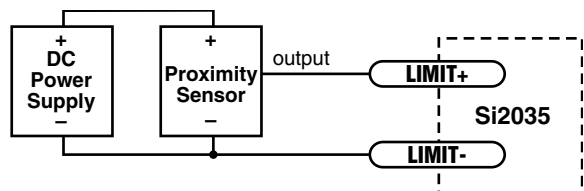
Some systems use active limit sensors that produce a voltage output rather than a switch or relay closure. These devices must be wired differently than switches.

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



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

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



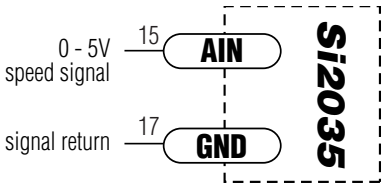
Connecting to the Analog Input

The analog input can be used only in SCL mode. The analog input can be read back to the “Host” using the “IA” immediate type and “RA” buffered type commands. Readings are in Volts.

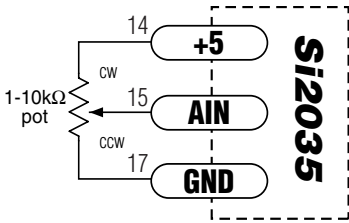
+5 volt DC is provided for powering potentiometers. A 1000 to 10000 ohm potentiometer is recommended and should be connected as shown below.

A 0 to 5 volt analog signal may also be used. Usually this signal comes from a PLC, a PC with data acquisition card or a motion controller. Connections are shown below.

The +5V terminal is an output. Do not connect it to a power supply.



Connecting an Analog Input to an Active Signal



Connecting an Analog Input to a Potentiometer

Programmable Outputs

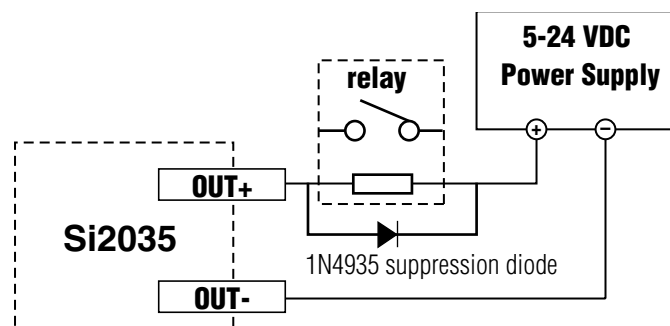
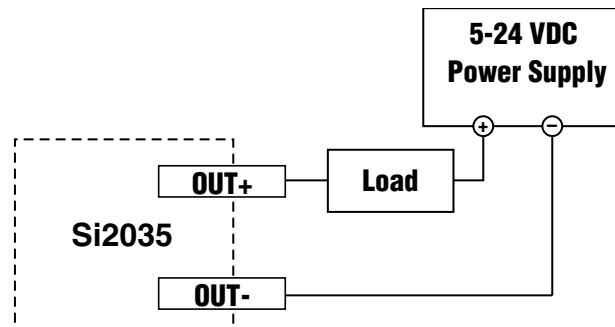
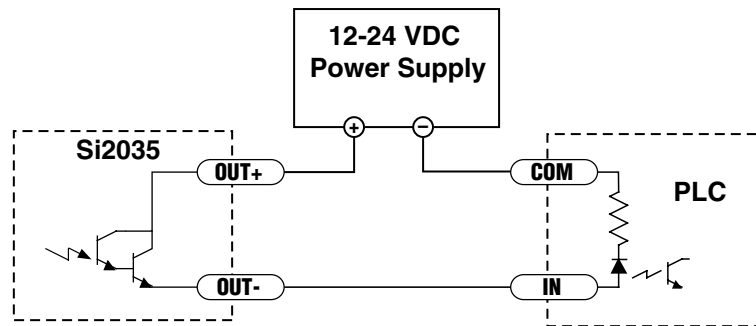
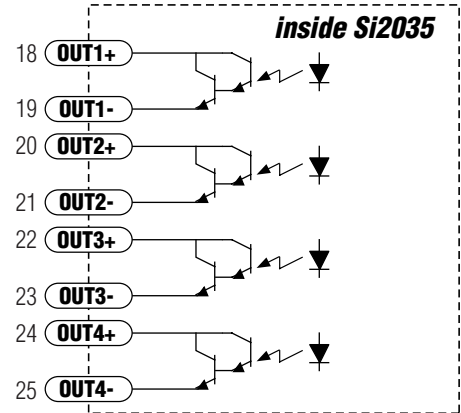
The Si2035 has four programmable outputs.

These optically isolated, photodarlington outputs can be used to drive LEDs, relays and the inputs of other electronic devices like PLCs and counters. On the IN/OUT connector outputs, both the "+" (collector) and "-" (emitter) terminals of each transistor are available on the connector pins. This allows you to configure each output for current sourcing or sinking.

Diagrams of each type of connection follow.

Do not connect the outputs to more than 30VDC.

The current through each output terminal must not exceed 100 mA.



Recommended AMP Motors

Motor Number	Size inches	Winding Connection	Max Torque oz-in	Current Amps
HT11-012	1.1 x 1.1 x 1.32	4 lead	7	1.0
HT11-013	1.1 x 1.1 x 1.87	4 lead	15	1.0
5014-842	1.38 x 1.38 x 1.57	4 lead	22	1.0
HT17-068	1.65 x 1.65 x 1.30	parallel	31	1.3
HT17-071	1.65 x 1.65 x 1.54	parallel	51	1.7
HT17-075	1.65 x 1.65 x 1.85	parallel	62	1.7
5023-100	2.22 x 2.22 x 2.0	4 lead	81	2.0
HT23-394	2.22 x 2.22 x 1.54	parallel	54	2.0

For more information, including speed-torque curves, please visit www.applied-motion.com.

Mounting the Drive

You should mount the Si2035 on the heat transfer plate as shown below. Use #8 or #10 screws.

The amplifiers in the drive generate heat. Unless you are running at 1 amp or below, you may need a heat sink. To operate the Si 2035 continuously at maximum power you must properly mount it on a heat sinking surface with a thermal constant of no more than 4°C/watt. Often, the metal chassis or enclosure of your system will work as an effective heat sink.

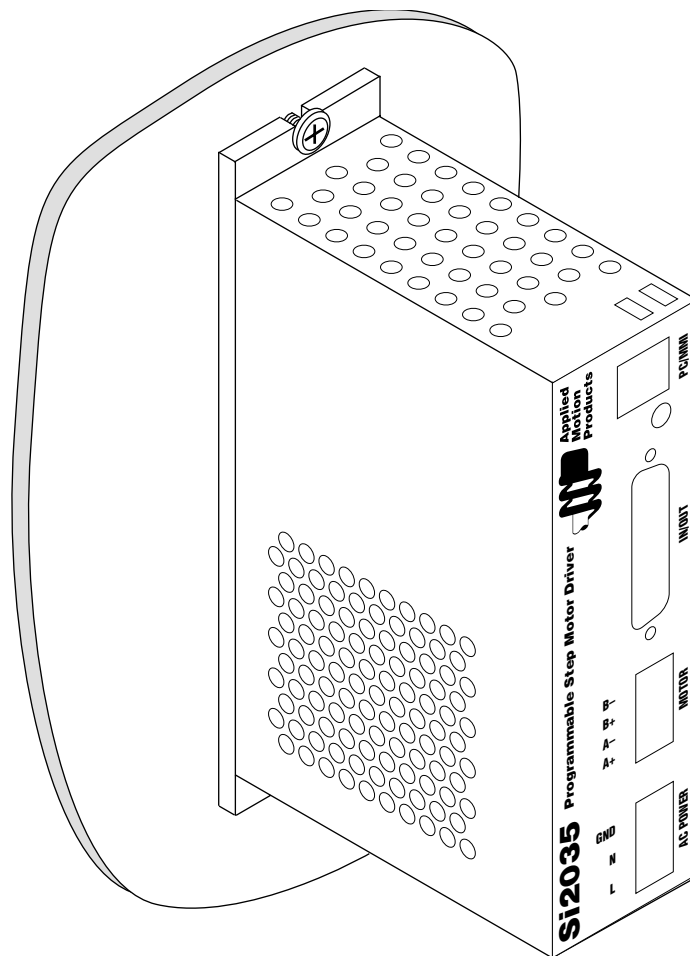


Never use your drive in a space where there is no air flow or where the ambient temperature exceeds 50°C (120°F).

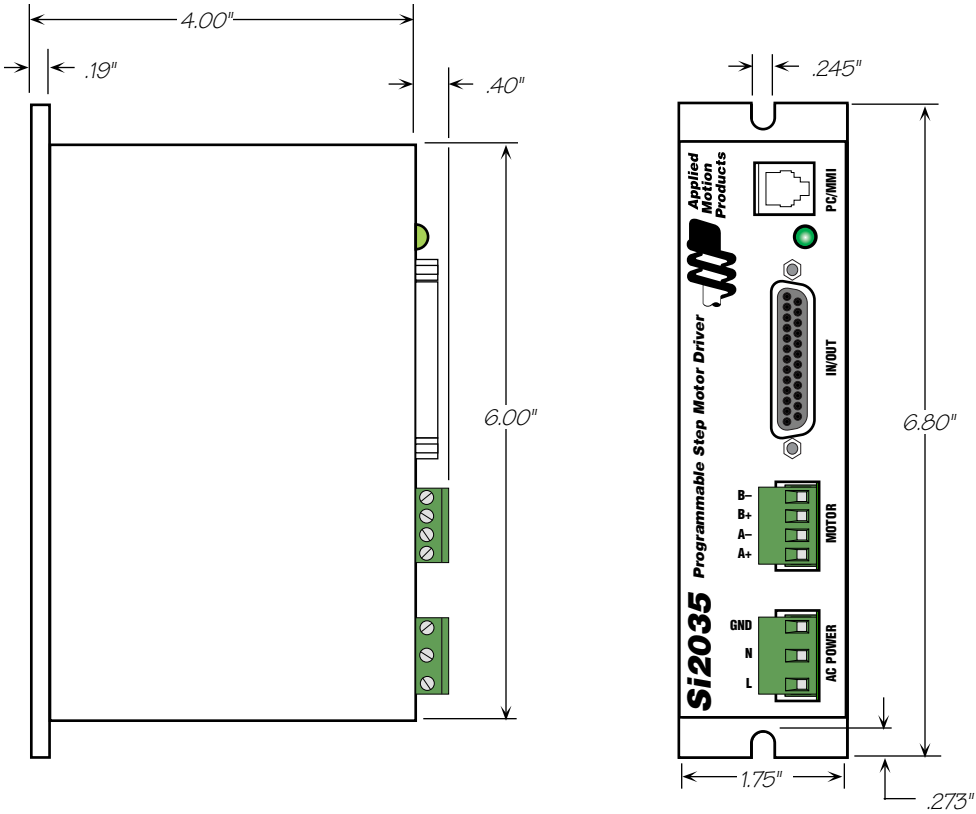
Never block the vent holes.

Never put the drive where it can get wet.

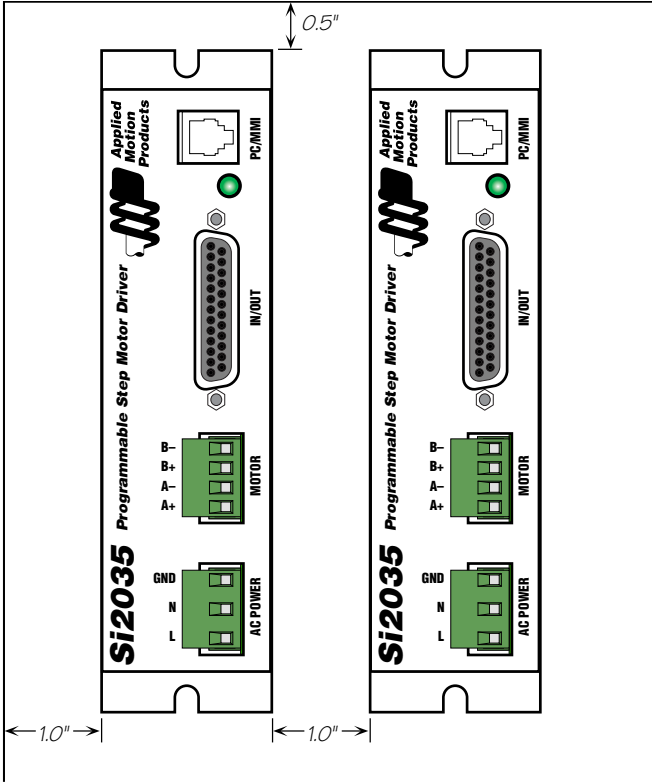
Never allow metal particles near the drive.



Mechanical Outline



Minimum Spacing and Clearance



Technical Specifications

Amplifier	Dual, microstepping bipolar recirculating H-bridge, pulse width modulated switching at 20 kHz. 0.2 - 2.0 amps/phase output current, software programmable. 50 watts maximum output power. Automatic idle current reduction. Min. motor inductance 1 mH.
Power Supply	110 or 220 VAC input, switch selectable. 50 - 60 Hz. 75 W max. DC voltage at nominal line voltage: 28 VDC full load, 40 VDC no load.
Digital Inputs	8, optically isolated, 2200 ohms input, 12 - 24 VDC.
Digital Outputs	4, Optically isolated, uncommitted (open collector, open emitter) darlington photo transistor. 30V, 100 mA max.
Physical	Constructed on black anodized aluminum heat transfer plate. Covered by heavy gauge ventilated steel housing. 1.75 x 4.0 x 6.8 inches overall. Power on/status LED. See drawing on back cover for more information. Ambient temperature range: 0 - 50°C.
Fuse	1A UL rated, fast acting, TR5 style. Available from Digikey (800-DIGIKEY) as part number WK3048BK.

Mating Connectors and Accessories

Mating Connectors

Motor: Mating connector included. Phoenix P/N 1753075.

AC Power: Phoenix P/N 1832536. Included with drive.

IN/OUT: DB-25 female. Mating connector included, NORCOMP P/N 171-025-202-001.

Shell Kit: AMP P/N748678-3 (included).

Accessories

Breakout Box for IN/OUT Connector: BOB-2, includes cable

Screw Terminal Connectors that mate directly to the IN/OUT connector on the front panel of the drive: Phoenix Contact P/N [2761619](#) *This connector is not available from Applied Motion. You must purchase it from a [Phoenix distributor](#).*

Mating Cable for IN/OUT connector with “flying leads”

Black Box P/N: BC00702. *This cable is not available from Applied Motion. You must purchase it from [Black Box](#).* Useful for custom wired applications. This shielded cable has a DB-25 connector on each end. If you cut one end off it will provide a 6 foot “DB-25 to flying lead cable” for the IN/OUT connector. It’ll be easier to wire if you get the [cable color chart](#) from [Black Box’s web site](#).

Surge Protector with Line Filter:

For 120VAC: [Leviton 51010-WM](#)

For 220VAC: [Leviton 51240-WM](#)

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