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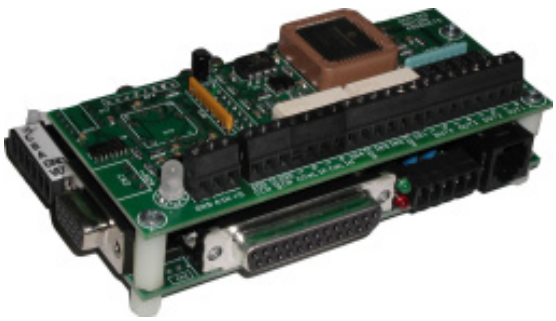
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Find the *Applied Motion Products BLUDC4-SI* at our website: *Click HERE*

BLuDC

Hardware Manual





BLUDC4-Si
BLUDC9-Si

Applied Motion Products

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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.

A Note About Names

The BLUDC9-Si was originally called the BLU200-Si. If you have a BLU200, please follow the instructions for the BLUDC9.
The BLUDC4-Si was originally called the BLU100-Si. If you have a BLU100, please follow the instructions for the BLUDC4.

Features

- Programmable digital servo motor driver in a compact package
- Operates from 24 to 48 volt DC power supply
- Easy to tune and program using *Si Programmer™* software
- Motor current: BLUDC4: 4.5A continuous, 13.5 peak
  BLUDC9: 9A continuous, 18 peak
- 15 optically isolated digital inputs, 7 optically isolated digital outputs

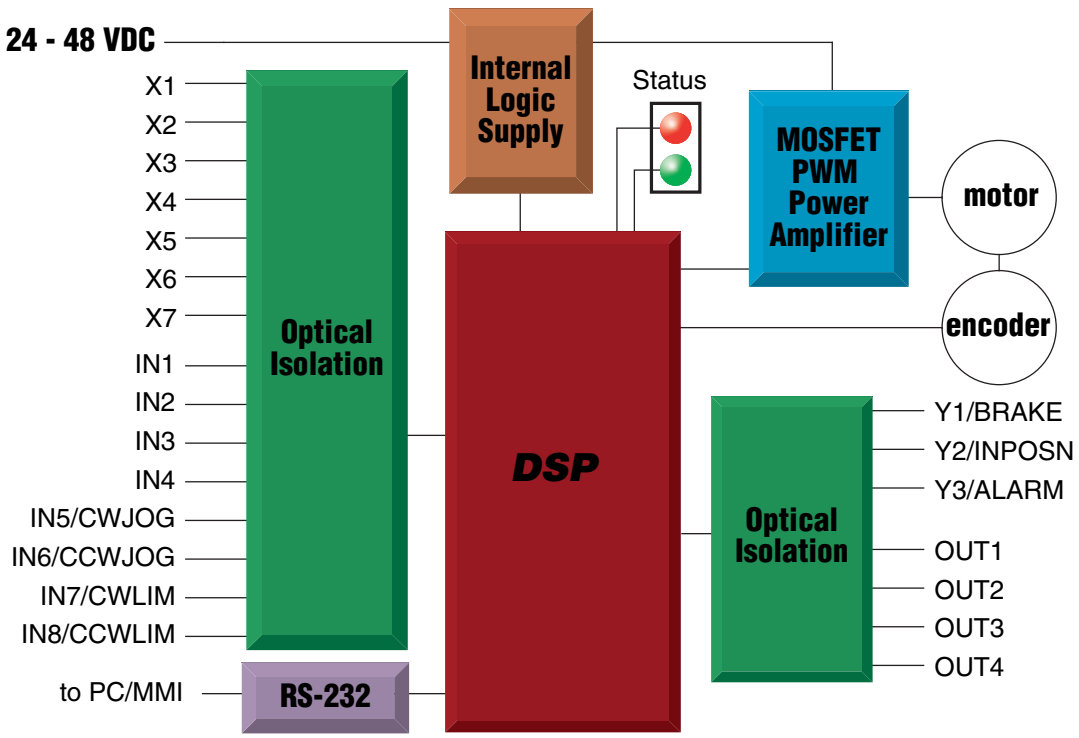
The BLuDC-Si is normally used to store and execute *Si* motion control programs. However, it can instead be used as a -S or -Q model to provide the following control modes:

- ±10V analog torque, velocity or position control
- RS-232 or RS-485 serial command (SCL) mode for digital control of torque, velocity or position
- Q Language, which provides powerful and versatile programming control of all drive functions plus host interactivity. The Q Language requires previous programming experience and is more difficult to learn than *Si*.

The *Si Programmer™* software is used to develop, test and store *Si* programs. It also provides all necessary servo set up and tuning features.

If you want to set up and tune your BLUDC-Si for torque, velocity, SCL or Q modes, use the *Quick Tuner* software. You'll also need *Q Programmer* to develop Q language programs. All of the software applications and manuals are included on a CD with each drive and are also available on our web site, www.applied-motion.com.

Block Diagram



Getting Started

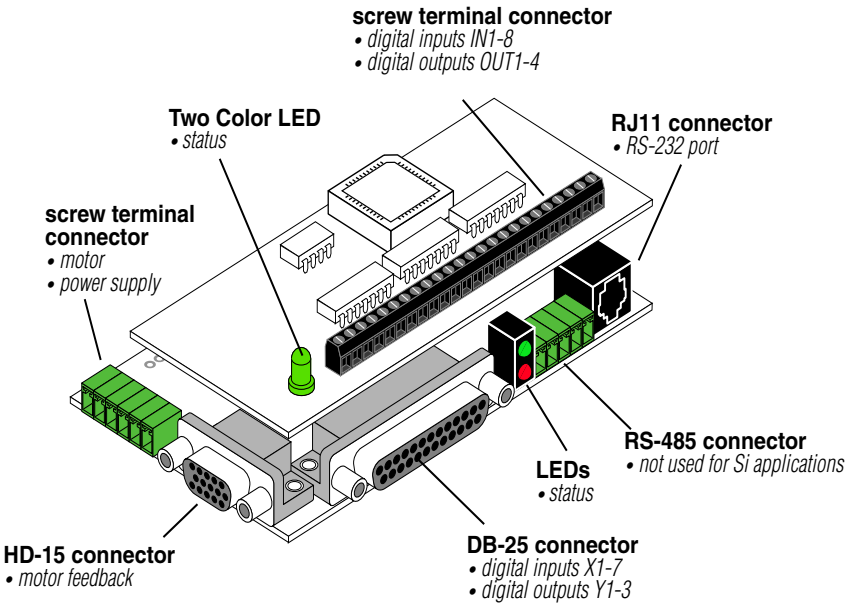
To use your BLuDC programmable servo drive, you must have the following:

- a 24-48 volt DC power supply for the motor. Please read the section entitled *Choosing a Power Supply* for help in choosing the right power supply.
- a compatible servo motor
- cables to connect the motor to the drive. If you are using an Applied Motion A, N or M series motor, use BLUENC and BLuMTR cables (one of each).
- a small flat blade screwdriver for tightening the connectors (included).
- a personal computer running Microsoft Windows 98, 2000, NT, ME or XP.
- The Applied Motion "Si™" CD (included)
- An Applied Motion Si™ programming cable (included)

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

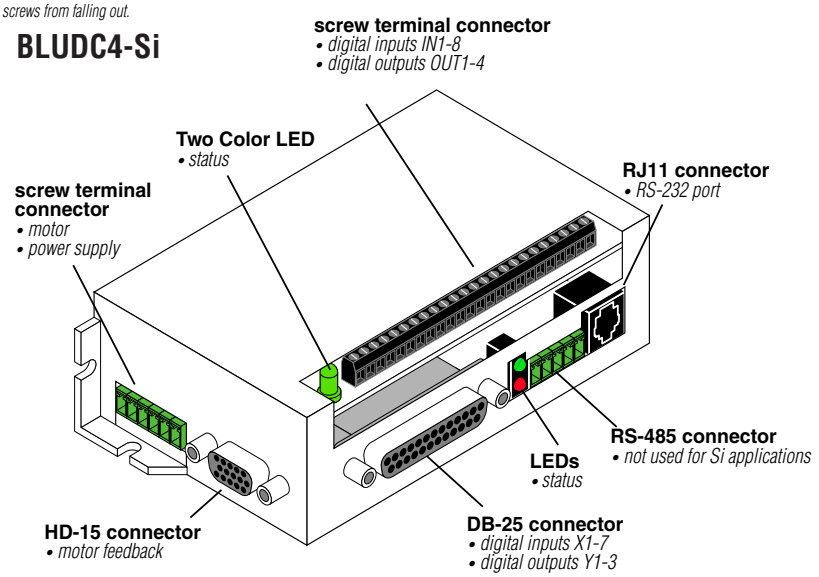
1. Install the *Si Programmer™* software from the CD.
2. Launch the software by clicking Start...Programs...Applied Motion...Si Programmer
3. Connect the drive to your PC using the Si™ Programming cable.
4. Connect the drive to the power supply.
5. Connect the drive to the motor.
6. Apply power to the drive.
7. Follow the instructions in the *Si Programmer™* manual, which you can access by clicking on the Help button in the software.

The connectors and other points of interest are illustrated on page 6. Depending on your application, you'll need to make connections to various parts of the drive. These are detailed later in the manual.



Always use the blue & white Applied Motion screwdriver to tighten the screw terminal connectors. Larger screwdrivers may remove the plastic dimples that prevent the screws from falling out.

BLUDC4-Si



Always use the blue & white Applied Motion screwdriver to tighten the screw terminal connectors. Larger screwdrivers may remove the plastic dimples that prevent the screws from falling out.

BLUDC9-Si

Connecting to the PC using RS-232

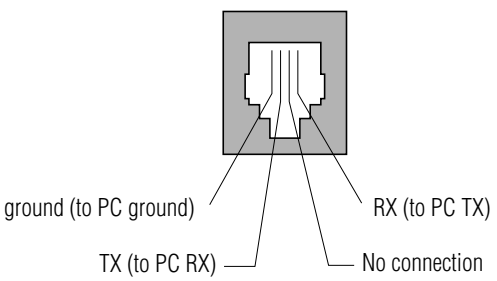
• Locate your computer within 8 feet of the BLU servo drive.

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

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

If your PC does not have a serial port, you should purchase a "USB Serial Converter". We 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.



Pin Assignments of the PC/MMI Port
(RJ11 connector)

Connecting the Power Supply

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

If you plan to use a regulated power supply you may encounter a problem with regeneration. If you rapidly decelerate a load from a high speed, much of the kinetic energy of that load is transferred back to the power supply. This can trip the overvoltage protection of a switching power supply, causing it to shut down. We offer two “regeneration clamps” that can solve this problem: the RC010 and RC050. If in doubt, buy an RC050 for your first installation. If the “regen” LED on the RC050 never flashes, you don’t need the clamp.

Connect the motor power supply "+" terminal to the driver terminal labeled "VDC". Connect power supply "-" to the drive terminal labeled "GND". Use 18 or 20 gauge wire.

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



RC050 Regen Clamp

Connecting the Motor

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

Applied Motion motor:

To connect an Applied Motion servo motor to your BLU Servo, you'll need a set of mating cables called the BLUENC and the BLuMTR.

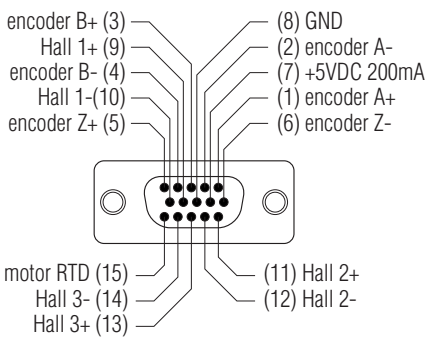
Connect the small motor connector to one end of the BLuMTR cable. The other end of the BLuMTR has lead wires that connect to the drive's screw terminal connector as follows:
A = red wire
B = white wire
C = black wire
"-" = green wire

Connect the large motor connector to one end of the BLUENC cable. The other end of the BLUENC plugs into the BLU servo.

Non-Applied Motion motor:

Connect the motor leads to the screw terminal connector as follows:
A = motor phase A, R or U
B = motor phase B, S or V
C = motor phase C, T or W
"-" = ground wire

The encoder connections use a HD-15 connector, which you must connect to your encoder as shown below. See back page for mating connector information.

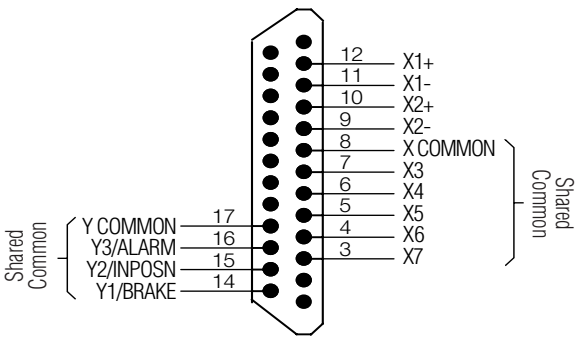


Pin Assignments (facing drive)

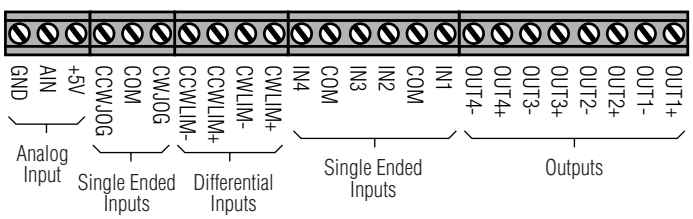
Connecting Input Signals

Inputs

The BLUDC-Si drives include 15 digital inputs. Some of these inputs appear on the lower board "DB-25" connector and the rest are on the upper board "screw terminal" connector.



Lower Board "DB-25" Connector

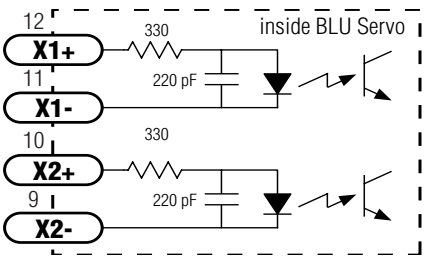


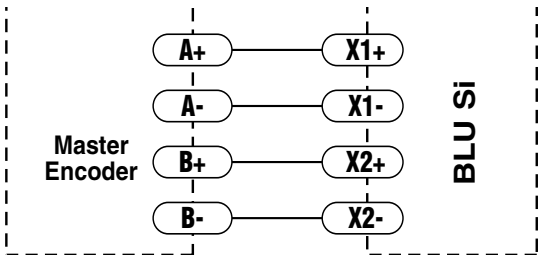
Upper "Screw Terminal" Input/Output Connector

5 Volt Digital Inputs

The BLU-Si includes two high speed inputs called X1 and X2. They accept 5 volt single-ended or differential signals, up to 2 MHz. You can connect a master encoder to the high speed inputs for following applications using the Hand Wheel instruction. Or you can use X1 and X2 as general purpose inputs for Wait Input, If Input, Feed to Sensor or Seek Home instructions.

Connection diagrams for inputs X1 and X2 follow.





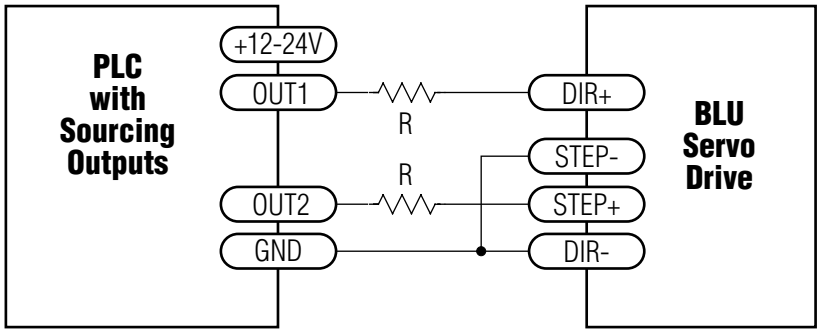
Wiring for Encoder Following

Using High Speed Inputs with 12-24 Volt Signals

Most PLCs and many sensors don't use 5 volt logic. You can connect signal levels as high as 24 volts to the X1 and X2 inputs if you add external dropping resistors, as shown below.

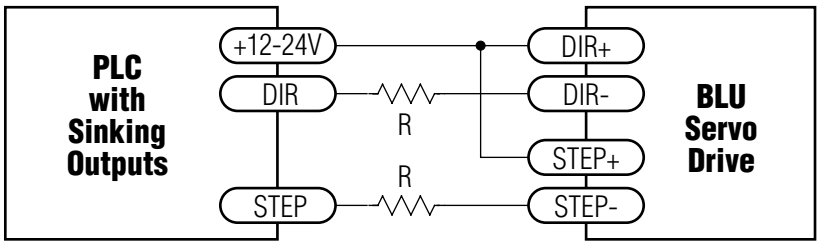
- For 12 volt logic, add 820 ohm, 1/4 watt resistors
- For 24 volt logic, use 2200 ohm, 1/4 watt resistors

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



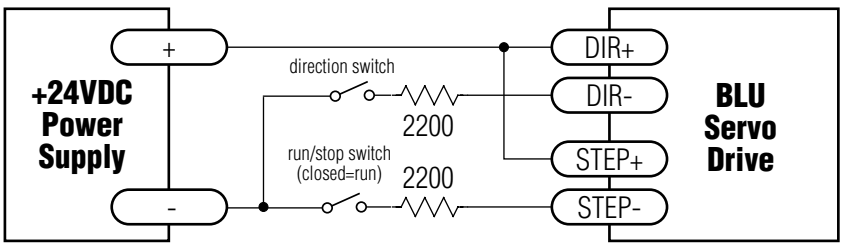
Connecting to PLC with Sourcing (PNP) Outputs

(Most PLC's use 24 volt logic)



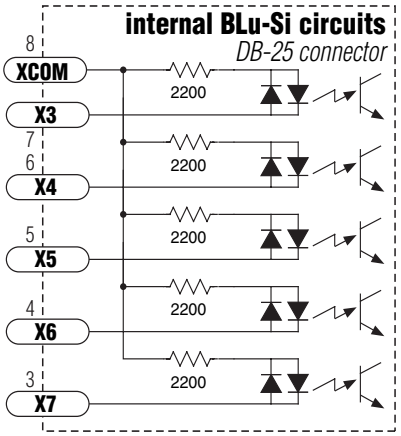
Connecting to PLC with Sinking (NPN) Outputs

(Most PLC's use 24 volt logic)



Using Mechanical Switches at 24 Volts.

Other Digital Inputs



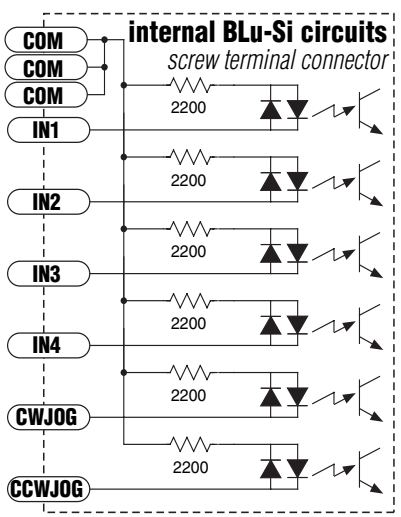
As we mentioned in the previous section, the high speed X1 and X2 inputs are configured for five volt logic. All other digital inputs are designed for operation between 12 and 24 volts DC. This includes five inputs on the main board and the eight digital inputs on the Si™ board.

Single Ended Inputs

The BLU servos include 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.

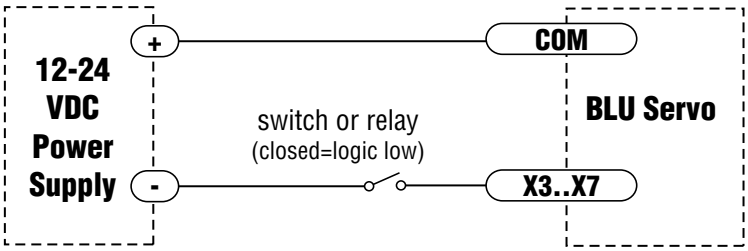
What is COM?

"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 BLU Servo, if you are using sourcing (PNP) input signals, then you will want to connect COM to ground (power supply -). If you are using sinking (NPN) signals, then COM must connect to power supply +.

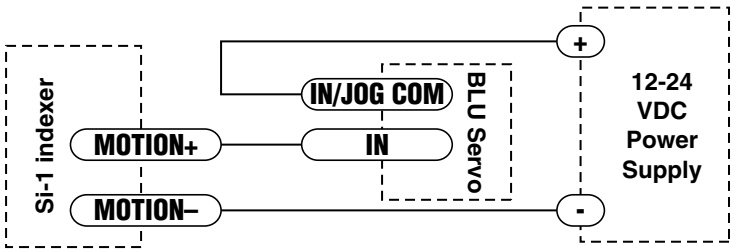


Note: If current is flowing into or out of an input, the logic state of that input is low or closed. If no current is flowing, or the input is not connected, the logic state is high or open.

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

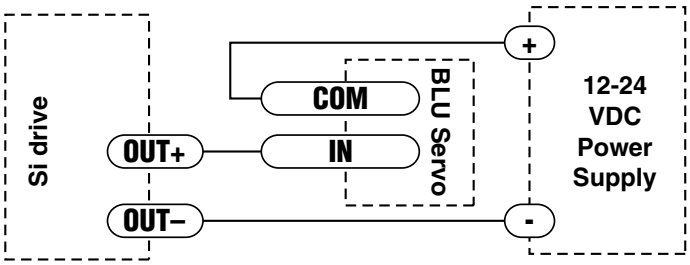


Connecting an Input to a Switch or Relay



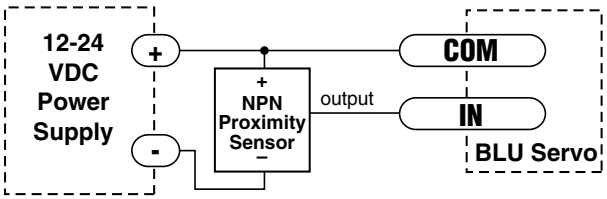
Connecting an Input to the Si-1 Motion Output

(Set Si-1 motion signal to "in position". Si-1 will trigger servo drive at end of each move).



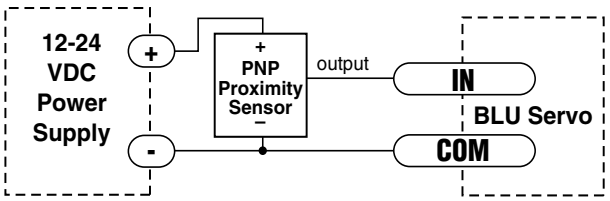
Connecting an Si™ drive to the BLU servo

(When output closes, input goes low).



Connecting an NPN Type Proximity Sensor to an input

(When prox sensor activates, input goes low).

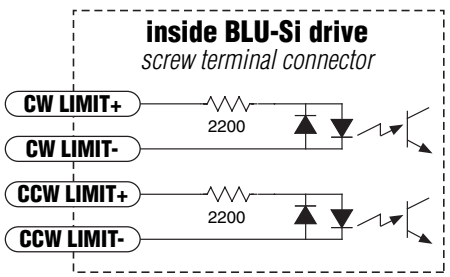


Connecting a PNP Type Proximity Sensor to a an input
(When prox sensor activates, input goes low).

Connecting Limit Switches to the BLU Drives

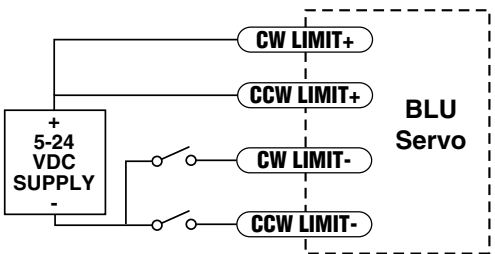
The CWLIMIT and CCWLIMIT inputs are used for connecting end of travel sensors. These inputs are differential, which allows you to use signals that are sinking (NPN), sourcing (PNP) or differential (line driver). By connecting switches or sensors that are triggered by the motion of the motor or load, 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.



Wiring a Mechanical Limit Switch

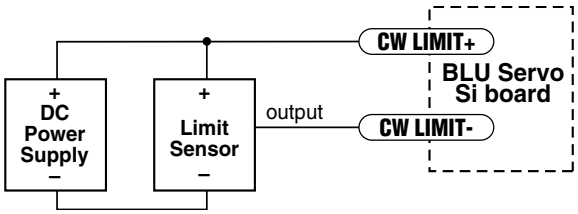
You can use normally open or normally closed limit switches. Either way, wire them as shown here.



Wiring a Limit Sensor

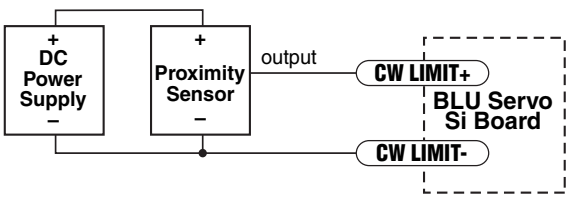
Some systems use active limit sensors that produce a voltage output rather than a switch or relay closure. These devices must be wired differently than switches.

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



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

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



If the sensor output goes high at the limit, choose the program option “closed”. If the output is low at the limit, select “open”.

Programmable Outputs

The BLU-Si drives feature seven digital outputs:

Brake/Y1: controls an electric brake relay, automatically releasing and engaging as the drive requires

Alarm/Y2: closes when a drive fault or alarm condition occurs. The red and green LEDs will flash an error code.

In Position/Y3: indicates that the drive has achieved a desired goal, such as a target position.

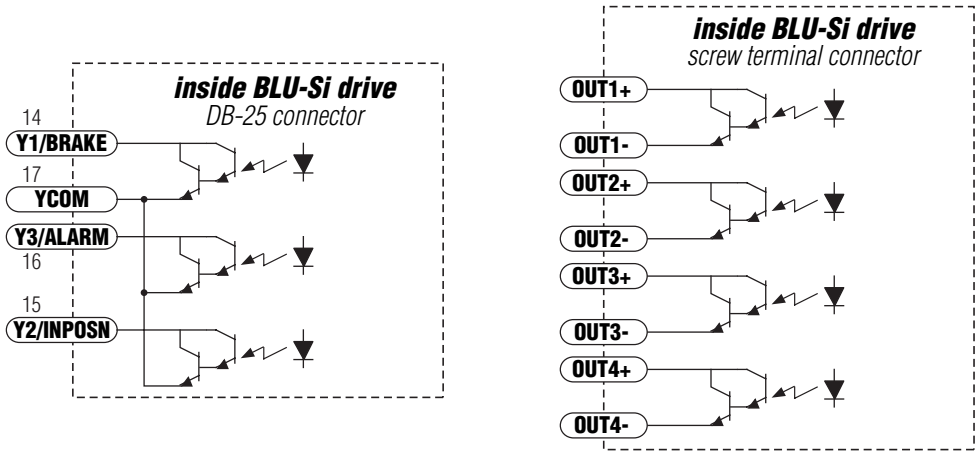
Y1, Y2 and Y3 can be configured as dedicated, automatic Brake, Fault and In Position outputs or

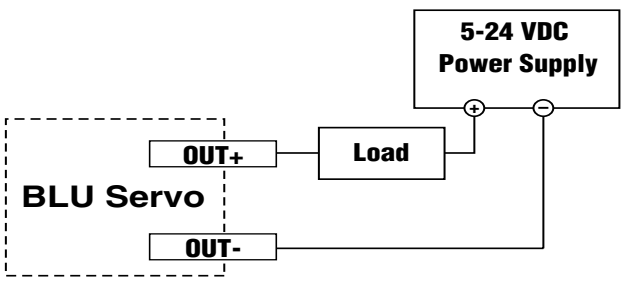
they can be used as general purpose outputs and controlled by *Set Output* instructions. The *Si Programmer's Configure IO* dialog allows you to choose the function of each output.

Any of the outputs can be used to drive LEDs, relays and the inputs of other electronic devices like PLCs and counters. On OUT 1-4, the "+" (collector) and "-" (emitter) terminals of each transistor are available at the connector. This allows you to configure each output for current sourcing or sinking. Y1, Y2 and Y3 can only sink current. The YCOM terminal must be tied to power supply "-".

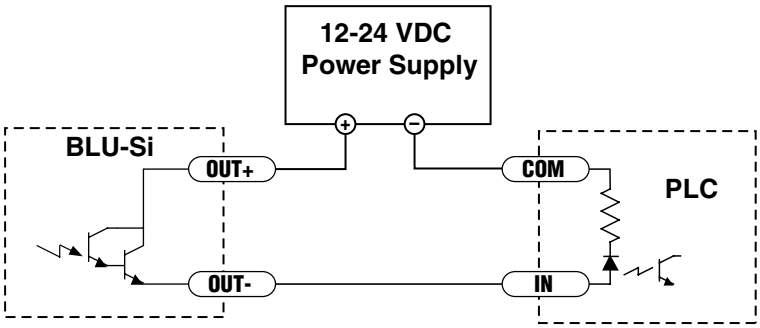
Diagrams of each type of connection follow.

Do not connect the outputs to more than 30VDC.
The current through each output terminal must not exceed 100 mA.

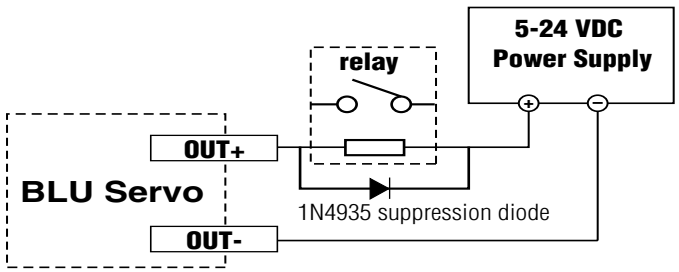




Sinking Output



Sourcing Output



Driving a Relay

Choosing a Power Supply

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

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

Voltage

PWM drives like the BLU Servo work by switching the voltage to the motor terminals on and off while monitoring current to achieve a precise level of phase current. Depending on how fast you want to run the motor, you may not need a power supply equal to the rated voltage of the

motor. To get a rough estimate of how much voltage you need, multiply the voltage constant of the motor (Ke) by the maximum speed required for your application. For example, if you want to operate the A0100-103-3 at 4000 rpm, you'll need V = Ke * rpm = (4.04V/krpm)(4 krpm) = 16 volts. To produce any real torque at that speed, add 50%, for a total of 24 V.

Always check the "no load" voltage of the power supply before using it with the drive, to be sure that it does not exceed 52 VDC.

Current

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

We recommend the following selection procedure:

1. If you plan to use only a few drives, get a power supply with at least 3X the rated continuous current of the motor.
2. If you are designing for mass production and must minimize cost, get one power supply with more than twice the rated current of the motor. Install the motor in the application and monitor the current coming out of the power supply and into the drive at various motor loads. This will tell you how much current you really need so you can design in a lower cost power supply.

If you plan to use a regulated power supply you may encounter a problem with regeneration. If you rapidly decelerate a load from a high speed, much of the kinetic energy of that load is transferred back to the power supply. This can trip the overvoltage protection of a switching power supply, causing it to shut down. Unregulated power supplies are better because they generally do not have overvoltage protection and have large capacitors for storing energy coming back from the drive. They are also less expensive.

Recommended Motors

Part Number	Current[1] amps	Voltage VDC	Rotor Inertia g-cm2	Power watts	Torque[1] oz-in	Torque[1] N-m
M series metric motors						
M0050-153-3*	3.9	24	20	50	22.5	.159
M0100-103-3	7.4	24	30	100	45.0	.318
M0100-103-4	7.7	24	90	100	45.0	.318
M0200-104-4	6.4	48	180	200	90.6	.64
M0200-154-4*	6.4	48	180	200	90.6	.64
N series NEMA motors						
N0100-103-A	7.4	24	30	100	45.0	.318
N0100-103-B	7.7	24	90	100	45.0	.318
N0100-153-B*	7.7	24	90	100	45.0	.318
N0200-104-B	6.4	48	180	200	90.6	.64
N0200-154-B*	6.4	48	180	200	90.6	.64
low cost ValueLine NEMA 23 motors						
VL23-020D	6.6	24	103	72	32.6	.23
VL23-021D	3.0	48	103	72	32.6	.23
VL23-030D	7.9	24	190	132	59.4	.42
VL23-031D	4.8	48	190	132	59.4	.42
A series metric motors, not recommended for new designs						
A0030-103-2	2.90	24	10	30	13.4	.095
A0030-104-2	1.38	48	10	30	13.4	.095
A0050-103-3	3.10	24	23	50	22.5	.159
A0050-104-3	2.00	48	23	50	22.5	.159
A0100-103-3	4.70	24	42	100	45.0	.318
A0100-104-3	4.00	48	42	100	45.0	.318
A0200-104-4	6.68	48	200	200	90.6	.64

* includes brake

[1] continuous (stall) ratings

Note: to connect these motors to a BLU servo drive, an extension cable is required. They are available in lengths of 4, 10 and 20 feet. Please contact your distributor or call the factory to order.

Other People's Motors

If you want to use a motor other than those recommended here, it must be a three phase motor with 120° commutation timing. The motor must also have an incremental encoder (index signal is not required) with no fewer than 100 lines and no greater than 12,500 lines. The halls and encoder must operate from +5VDC, 200 mA max (supplied by the BLU drive). The hall signals may be single-ended or differential. We strongly recommend that the encoder have differential line driver outputs, but single-ended may be acceptable if you use a shielded cable.

The BLU servo drives feature sine commutation, which makes motors run more smoothly than trapezoidal drives. *If you choose a low cost motor with internal hall effect devices instead of a quality motor with precision commutation tracks on the encoder disk, your performance may suffer.*

Mounting the Drive

BLUDC4-Si

This drive has two pc boards fixed together. Plastic mounting feet which accept #4-40 screws are built-in. The hole pattern and drive outline are shown on page 22.

BLUDC9-Si

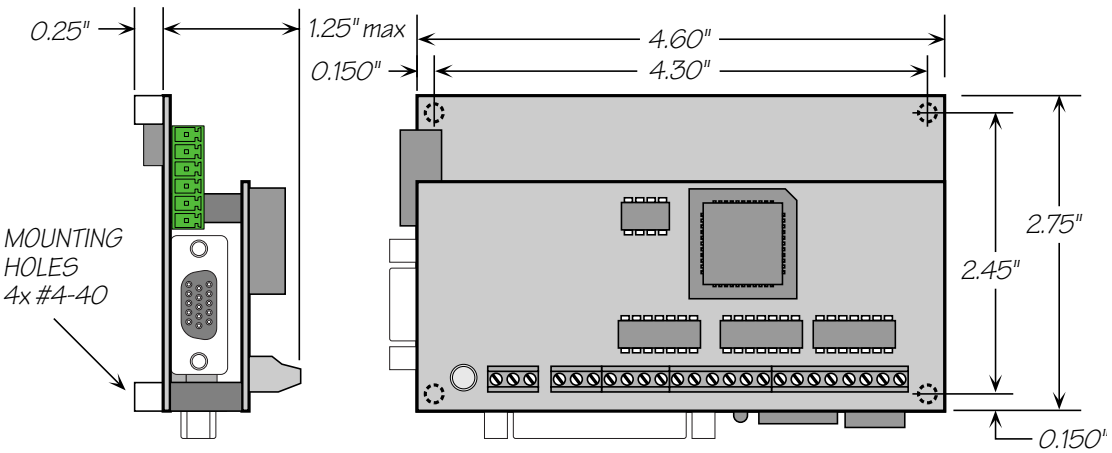
These drives can be mounted on the narrow (1.48 x 5.35) side or the wide (2.9 x 5.35) side. Either way, you'll need two #6 screws to secure the drive using the 0.17" mounting slots. The hole pattern and drive outline are shown on page 22

Never use your drive in a space where there is no air flow or where other devices cause the surrounding air to be more than 40°C.

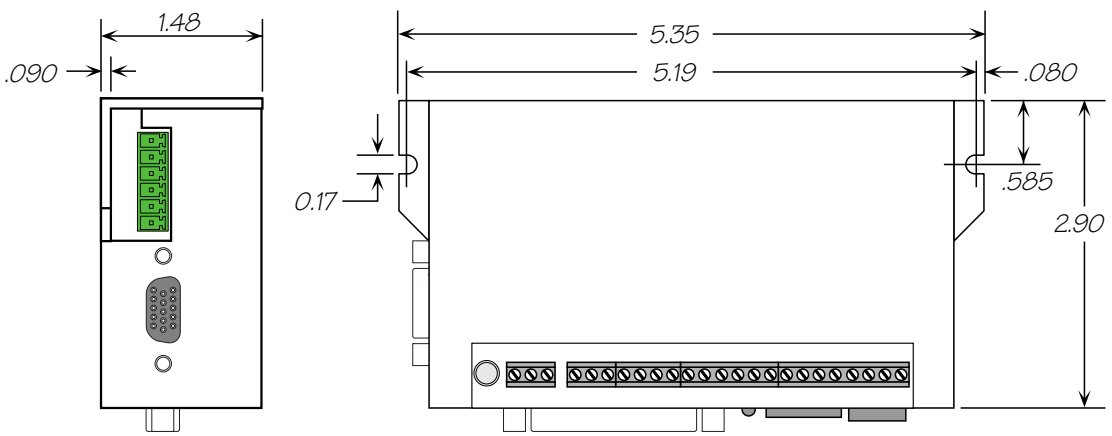
Never put the drive where it can get wet or where metal particles can get on it.

Always provide air flow around the drive. The BLUDC4 can only eliminate excess heat by convection , so make sure it has air flow above and below the circuit board.

Mechanical Outlines



BLUDC4-Si



BLUDC9-Si

Technical Specifications

Amplifier
Sine commutation MOSFET. 16 kHz PWM.
18 - 53 VDC input
BLUDC4 motor current: 4.5A continuous, 13.5A peak
BLUDC9 motor current: 9A continuous, 18A peak

Digital Inputs
X1 & X2: differential, optically isolated, 5V logic. 330 ohms internal resistance.
All other digital inputs: optically isolated, 12 - 24V logic. 2200 ohms. Maximum current: 10 mA

Outputs
Photodarlington, 100 mA, 30 VDC max. Voltage drop: 1.2V max at 100 mA.

Physical
BLUDC4-Si: 1.50 x 2.75 x 4.6 inches overall. 5.0 oz (140 g)
BLUDC9-Si: 1.48 x 5.35 x 2.90 inches overall. 10 oz (280 g)
Ambient temperature range: 0 to 40° C.

Mating Connectors and Accessories

Mating Connectors

Motor/power supply: PCD P/N ELVP06100, included with drive.
X1-X7 & Y1-Y3: DB-25 male. AMP P/N 747912-2. Shell Kit AMP P/N748678-3. Included.
Motor feedback: HD-15 male. Norcomp P/N 180-015-102-001. Shell Kit AMP P/N 748678-1. Not included.

Accessories

Motor Cables for Applied Motion “A”, “N” and “M” series servo motors:
- BLUMTR-CA-04, four foot shielded cable
- BLUMTR-CA-10, ten foot shielded cable
- BLUMTR-CA-20, twenty foot shielded cable

Encoder Cables for Applied Motion “A”, “N” and “M” series servo motors:
- BLUENC-CA-04, four foot shielded cable
- BLUENC-CA-10, ten foot shielded cable
- BLUENC-CA-20, twenty foot shielded cable

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

Screw Terminal Connectors that mate directly to the DB-25 connector on the front panel of the drive:
Phoenix Contact P/N 2761622
This connector is not available from Applied Motion. You must purchase it from a Phoenix distributor.

Mating Cable for IN/OUT connector with "flying leads"
Black Box P/N: BC00702
This cable is not available from Applied Motion. You must purchase it from Black Box.
Useful for custom wired applications. This shielded cable has a DB-25 connector on each end. You can cut off the female end to create a 6 foot "DB-25 to flying lead cable".
It'll be easier to wire if you get the cable color chart from Black Box's web site.

Regeneration Clamp:
Applied Motion Products RC050.

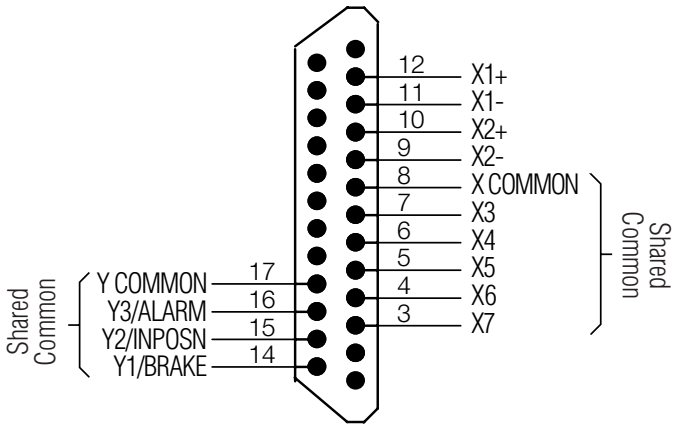
Alarm Codes

1/30/06
JK

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

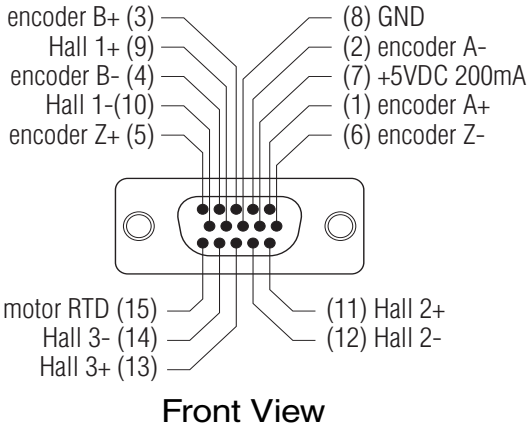
Code	Error
1 red, 1 green	position error exceeds fault limit
2 red, 1 green	ccw limit
2 red, 2 green	cw limit
3 red, 1 green	drive internal temperature exceeds 85°C
3 red, 2 green	motor over temperature
4 red, 1 green	power supply voltage is more than 55 VDC
4 red, 2 green	power supply voltage is less than 18 VDC
5 red, 1 green	over current / short circuit
6 red, 1 green	bad commutation(Hall) signal
6 red, 2 green	bad encoder signal
7 red, 1 green	serial communication error

Connector Diagrams



Front View

DB-25 I/O Connector



Front View

HD-15 Encoder Connector

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