



Leadshine

Hardware Installation Manual Of the Easy servo Drives



Version 0.0.1

Safety Items



Read this manual carefully before trying to install the stepper drive into your system. The people who setup the stepper drive should have a better understanding on electronics and mechanics. Contact Leadshine technical guys when you have questions on this document.



Make sure the power supply voltage dose not exceed the drive's input range. Double check the connections and make sure the power lead polarity is correct.



Do not set high current for small stepper motor. It is possible that the motor will be damaged.



Disconnect the motor from the load if you are not sure the move direction. Adjust the axis in the center before trying to run the motor.



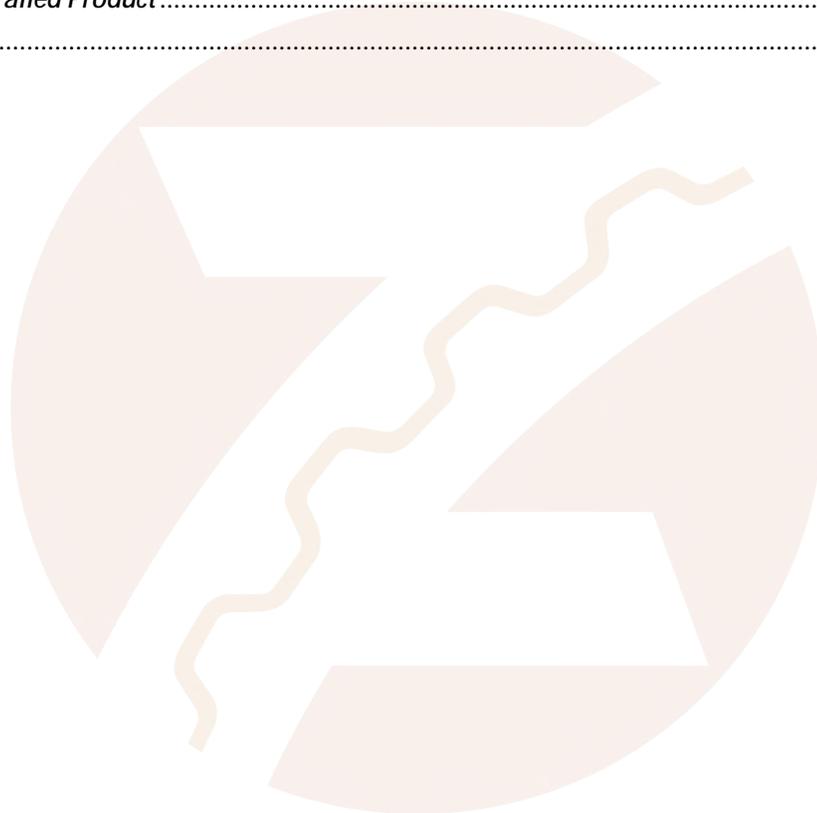
Never disconnect the motor lead when the power source is energized.

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Table of Contents

| | |
|--|----|
| <i>Introduction to the Easy Servo</i> | 1 |
| <i>Getting Start</i> | 1 |
| <i>Wiring Diagrams</i> | 2 |
| <i>Connecting Power Supply</i> | 3 |
| <i>ES-D508, ES-D808</i> | 3 |
| <i>ES-D1008</i> | 3 |
| <i>Connecting Motor</i> | 4 |
| <i>ES-D508 and ES-M3 series motor</i> | 4 |
| <i>ES-D808 and ES-M223 (NEMA23) series motor</i> | 4 |
| <i>ES-D808/1008 and ES-M234 (NEMA 34) series motor</i> | 5 |
| <i>Connecting Encoder</i> | 5 |
| <i>ES-D508 and the ES-M3 series motor</i> | 5 |
| <i>ES-D808/1008 and the ES-M2 series motor</i> | 5 |
| <i>Connecting Control Signal</i> | 6 |
| <i>Pulse, Direction, Enable Input</i> | 6 |
| <i>Alarm, In-position Output</i> | 8 |
| <i>Connecting PC</i> | 8 |
| <i>Typical Connections</i> | 9 |
| <i>Wiring Notes</i> | 11 |
| <i>Configuration</i> | 11 |
| <i>Configuring ES drive by the DIP Switches</i> | 12 |
| <i>ES-D508</i> | 12 |
| <i>ES-D808/D1008</i> | 12 |
| <i>Configuring ES drive in the PC Software</i> | 13 |
| <i>Calculating Rotation Speed and Angle</i> | 14 |
| <i>Rotating the Motor by Motion Controller</i> | 14 |
| <i>Rotating the Motor in PC Software</i> | 15 |
| <i>Power Supply Selection</i> | 16 |
| <i>Regulated or Unregulated Power Supply</i> | 16 |
| <i>Multiple Drives</i> | 16 |
| <i>Selecting Supply Voltage</i> | 16 |
| <i>Recommended Supply Voltage</i> | 17 |
| <i>Control Signal Setup Timing</i> | 18 |
| <i>Current Control Detail</i> | 18 |
| <i>Fine Tuning</i> | 19 |
| <i>Protection Functions</i> | 19 |
| <i>Over-current Protection</i> | 19 |
| <i>Over-voltage Protection</i> | 19 |
| <i>Position Following Error Protection</i> | 20 |
| <i>Frequently Asked Questions</i> | 20 |

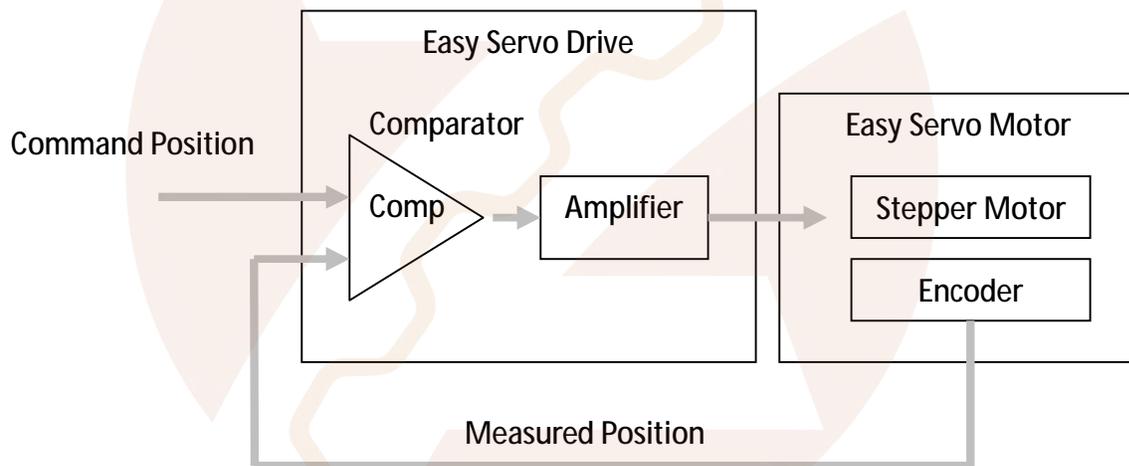
| | |
|---|----|
| <i>Problem Symptoms and Possible Causes</i> | 20 |
| <i>Warranty</i> | 21 |
| <i>Exclusions</i> | 21 |
| <i>Obtaining Warranty Service</i> | 21 |
| <i>Warranty Limitations</i> | 21 |
| <i>Shipping Failed Product</i> | 21 |
| <i>Contact Us</i> | 22 |



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Introduction to the Easy Servo

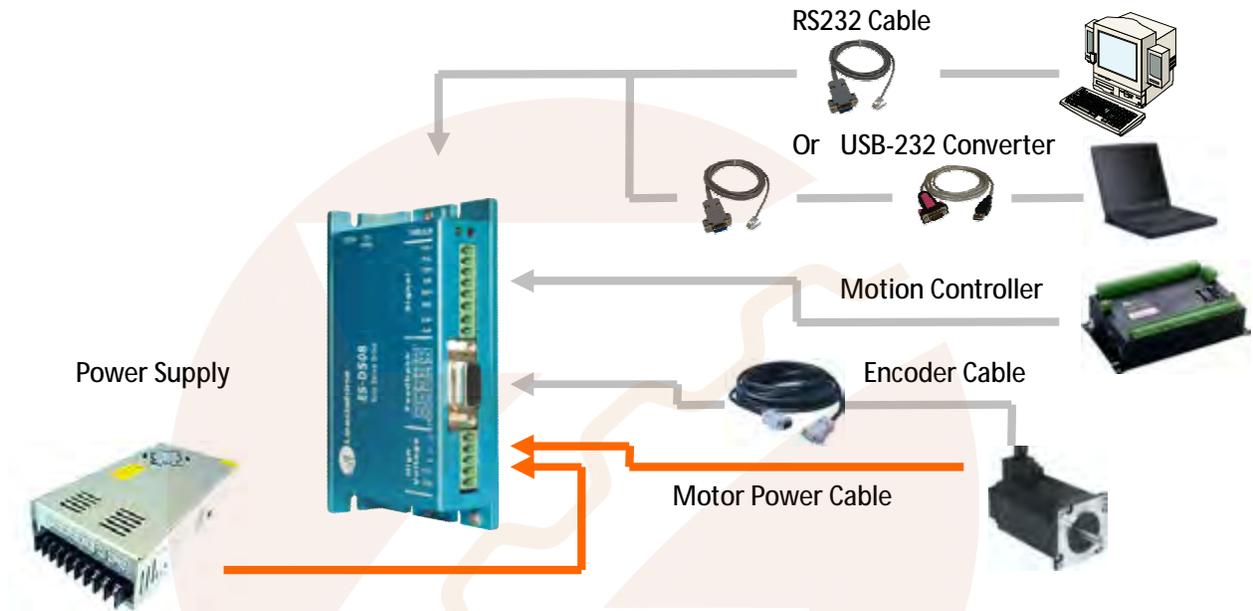
The ES (easy servo) series close-loop stepper servos offer an alternative for applications requiring high performance and high reliability when the traditional servo was the only choice, while it remains cost-effective. The system includes an easy servo motor combined with a fully digital, high performance easy servo drive. The internal encoder is used to close the position, velocity and current loops in real time, just like servo systems. It combines the best of servo and stepper motor technologies, and delivers unique capabilities and enhancements over both, while at a fraction of the cost of a servo system.



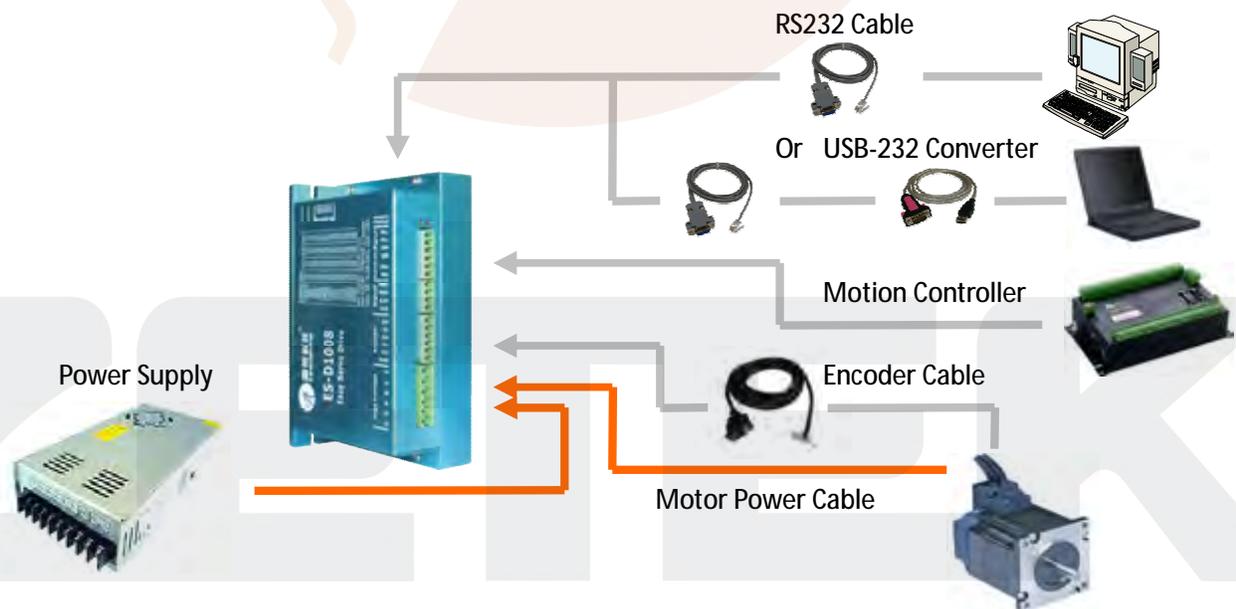
Getting Start

To get start you need one easy servo drive, one easy servo motor (stepper drive with encoder) and a AC / DC power supply for the first time evaluation. A motion controller - like indexer, pulse generator or PLC is required too when you need to rotate the motor. If you have a PC with one serial port or one PC with USB-RS232 converter, you can also rotate the motor in the PC software. However it is recommended to verify the complete function of the Easy Servo using a motion controller.

Wiring Diagrams



Wiring diagram of ES-D508 and the ES-M3 series motor

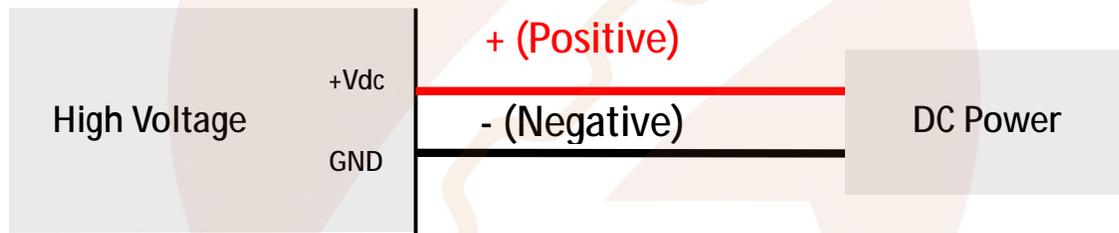


Wiring diagram of ES-D808/1008 and ES-M2 series motor

Connecting Power Supply

ES-D508, ES-D808

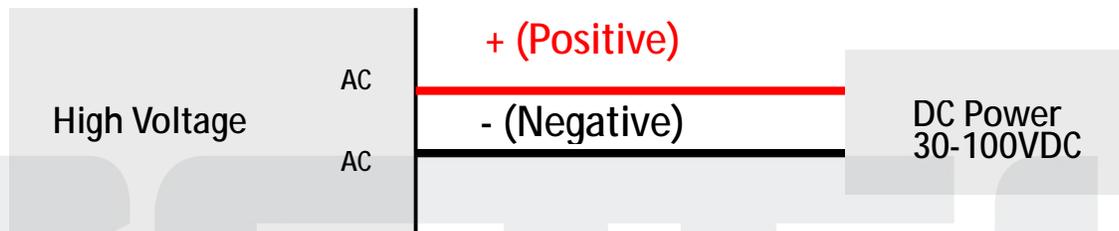
The ES-D508 and ES-D808 only accept DC power input. The power supply connections include only one positive terminal and one negative terminal. However you need to pay attention to terminal polarity. A 6-pin pluggable screw connector is used for both power supply and motor connection. Looking at the drive cover you should find the printed “+Vdc” and “GND” symbol. Connect the positive wire to “+Vdc” terminal and connect the negative wire to “GND” terminal. Note that the power should be switched off when you make any connections. *Note: Do not exceed the input voltage range of the easy servo drive. Please consult the “Power Supply Selection” chapter for the recommended supply voltage.*



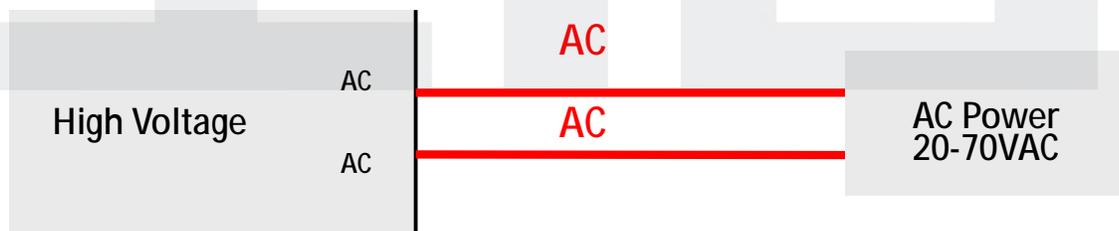
DC Power Connection of the ES-D508 and ES-D808

ES-D1008

The ES-D1008 can accept both DC and AC power input. There is no power input polarity for the AC power connection.



DC power connection of the ES-D1008



AC power connection of the ES-D1008

Connecting Motor

ES-D508 and ES-M3 series motor

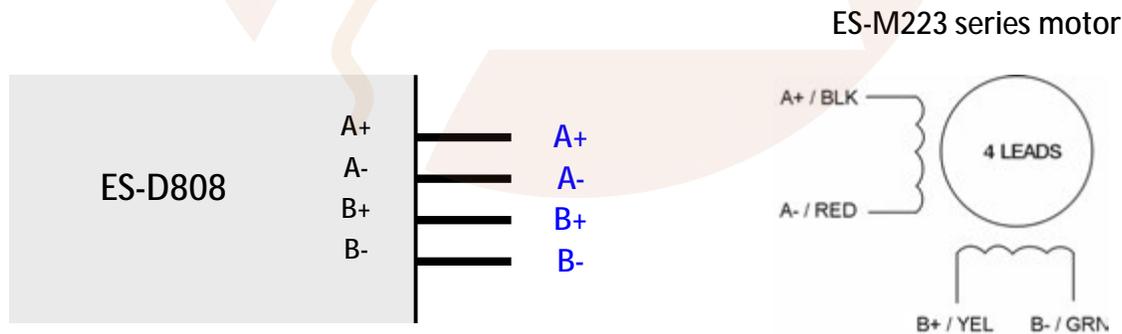
The ES-M3 series motor has only three wires: U, V and W. Just connect them to the corresponding terminals in the ES-D508 as follows.



Connect Leadshine ES-M3 series motor to ES-D508

ES-D808 and ES-M223 (NEMA23) series motor

The ES-M223(NEMA23) series motor has four wires: A+, A-, B+ and B-. Just connect them to the corresponding terminals in the ES-D808 as follows.

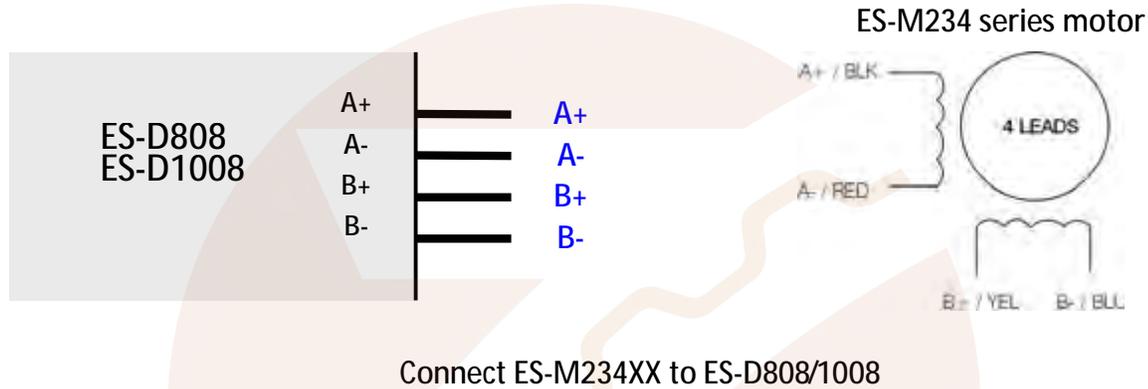


Connect Leadsine ES-M2 series motor to ES-D808

Connecting Motor (Continued)

ES-D808/1008 and ES-M234 (NEMA 34) series motor

The ES-M234 (NEMA34) series motor has four wires: A+, A-, B+ and B-. Just connect them to the corresponding terminals in the ES-D808/1008 as follows.

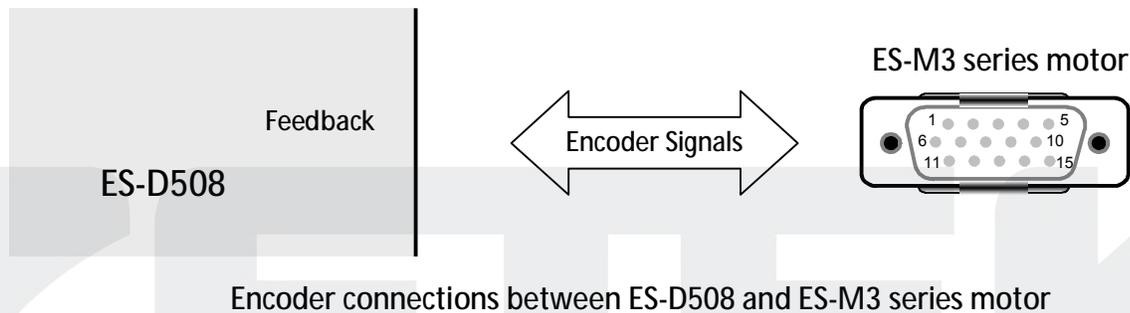


Connecting Encoder

As the easy servo drive works in close-loop mode, it needs to know the actual motor position. The encoder mounted in the motor offers such information. Please note that the easy servo drive can not work without encoder feedback.

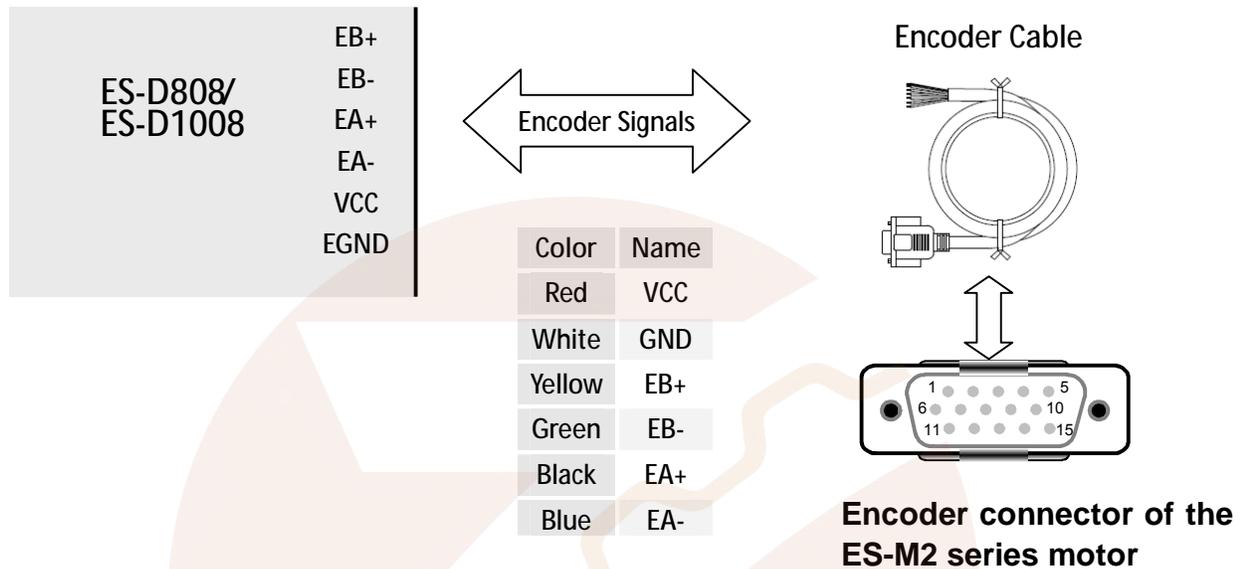
ES-D508 and the ES-M3 series motor

The encoder output of the ES-M3 series motor is a HDD15 male connector. Just plug it to the ES-D508's feedback (encoder) connector.



ES-D808/1008 and the ES-M2 series motor

The encoder output of the ES-M2 series motor is a HDD15 connector but the drive's encoder input is screw terminal, so an extension cable is needed to connect the motor's encoder signal to the drive. The extension cable outputs are 6 flying wires.



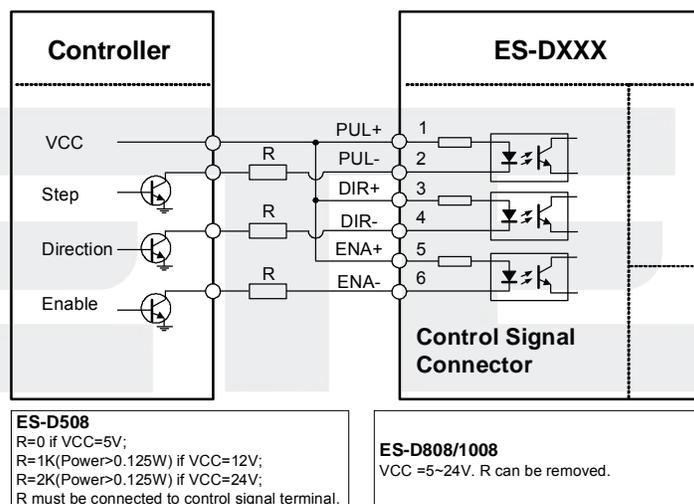
Encoder connections between ES-D808/1008 and ES-M2 series motor

Connecting Control Signal

Pulse, Direction, Enable Input

The pulse, direction and enable input of the easy servo drive is differential. It can also be connected to PNP (sourcing) or NPN (sinking) type controller. For the enable signal, apply 0V between ENA+ and ENA- or leave them unconnected to enable the drive. If it is needn't to disable the drive, just leave them unconnected.

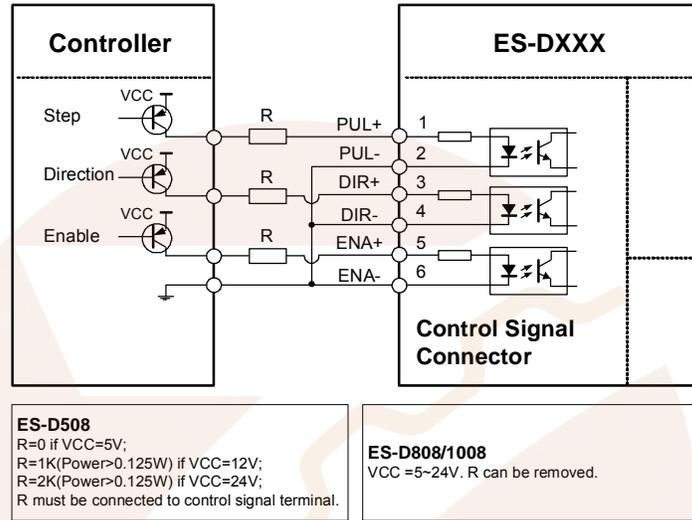
In a NPN (sourcing) type output, the control signals share the same positive terminal.



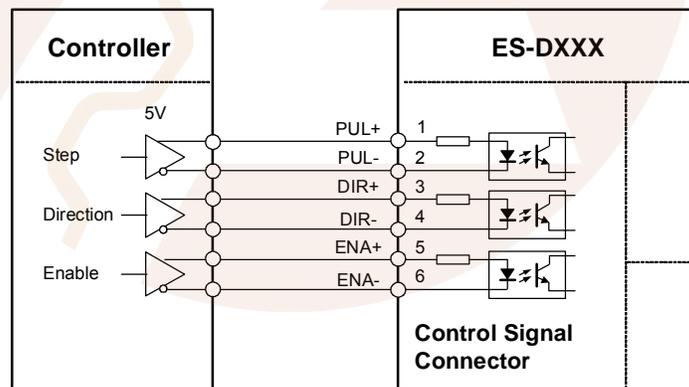
Connect the ES-D drive to the NPN (sinking) type controller

Pulse, Direction, Enable Input (Continued)

In a PNP (sinking) type output, the control signals are refer to the same ground terminal.



Connect the ES-D drive to the PNP (sourcing) type controller

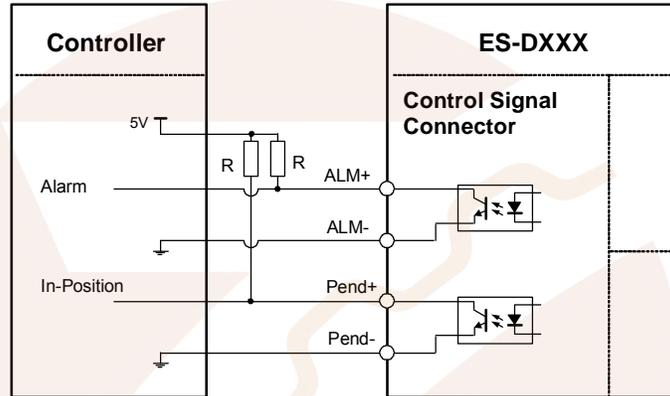


Connect the ES-D drive to differential type controller

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Alarm, In-position Output

The outputs are isolated and you can take them as electronic switch. An upper resistor is used to limit the current. Its resistance is depending on the input current requirement of the controller. The source voltage for those outputs can also be 24V. The resistor R is depending on the input current of the controller.

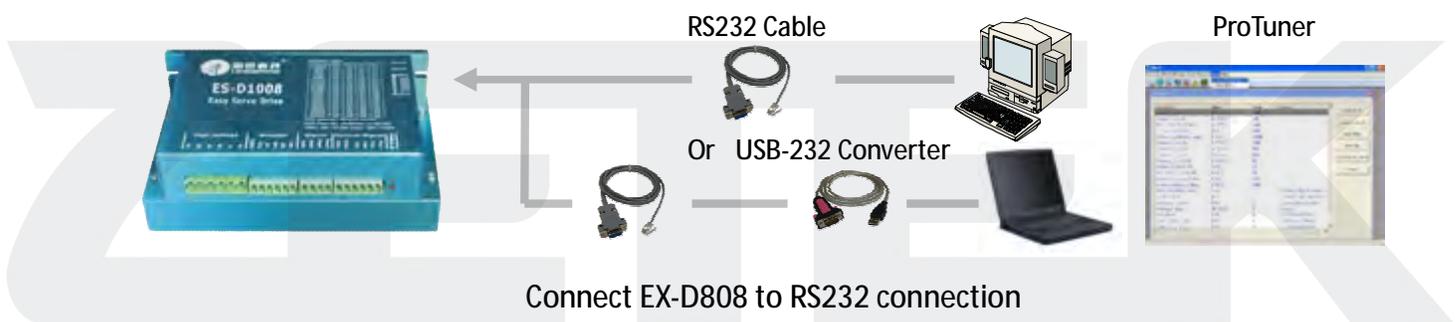


Alarm, in-position signal connection of the ES-D drive
(Note: there is no in-position output for ES-D508)

Connecting PC

A built-in RS232 communication port in the easy servo drive is used for communication and configuration. Connect this port to the PC's serial port. Then you can turn the motor in PC software. This software - ProTuner, is designed to configure the easy servo drive. You can define the control mode, microstep resolution, current rate, active level of inputs/outputs in ProTuner.

The ProTuner can be downloaded from our website: <http://www.leadshine.com> or you may also get it from our CD. It is recommended to get it from the website because it is always the latest. Install it in your PC and make it ready for use later.

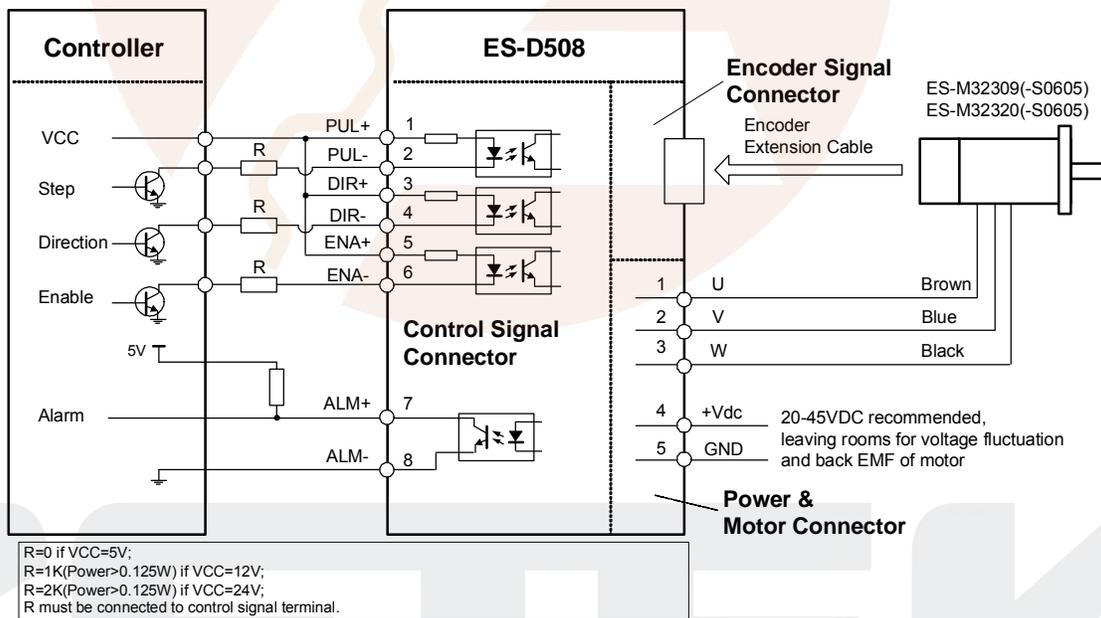


A RS232 cable is needed for the communication between the drive's RS232 port and the PC's serial port. It will be shipped with the kit if you include it in the order. It is also possible to make this cable by yourself. One end of this cable is a RJ-11 header and the other end of cable is a 9 pin D-Sub female connector. If your PC does not have a serial port, a USB-to-Serial converter which simulates the serial port is required. Note that the power should be turned off when you perform any connections!

When you open ProTuner, a “Connect to drive” window appears. The “Baud Rate” and “Device Address” are fixed. You only need to select the “Com Port” regarding to the actual serial port or the mapping port of a USB-232 converter. Check the Device Manager for the mapping port number of the USB-232 converter.

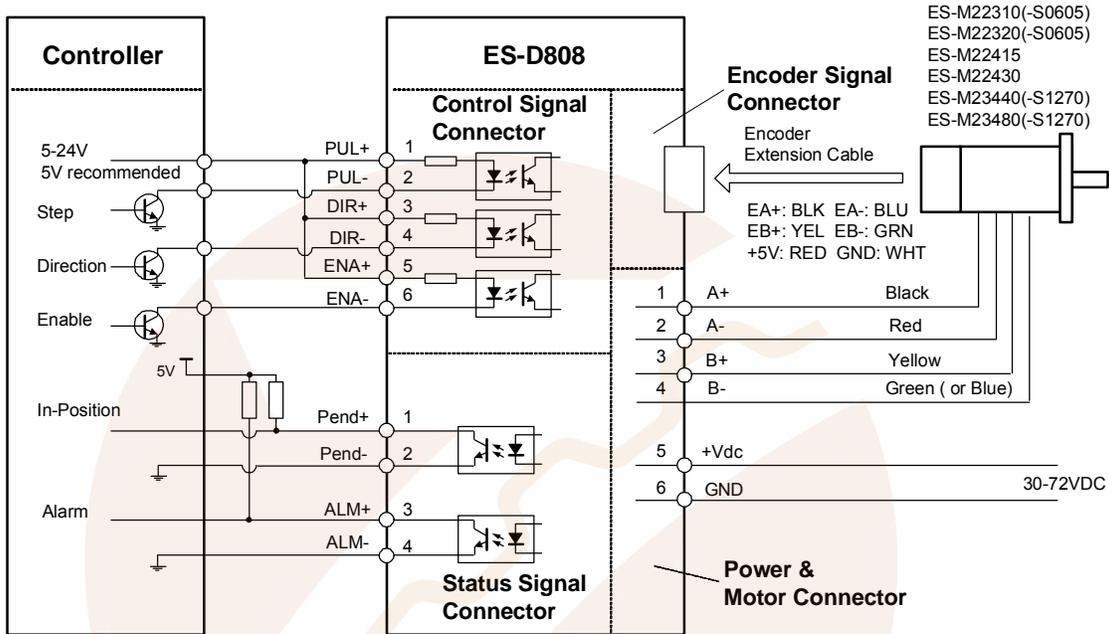


Typical Connections

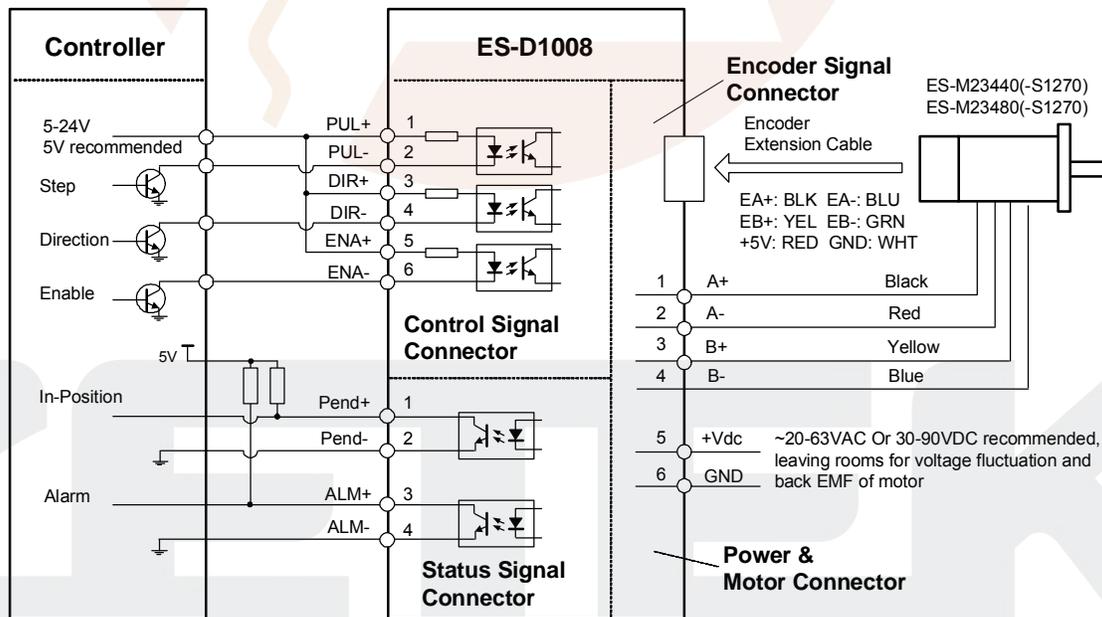


Typical Connections of ES-D508 with controller of sinking output

Typical Connections (Continued)



Typical Connections of ES-D808 with controller of sinking output



Typical Connections of ES-D1008 with controller of sinking output

Wiring Notes

- I In order to improve anti-interference performance of the drive, it is recommended to use twisted pair shield cable.
- I To prevent noise incurred in PUL/DIR signal, pulse/direction signal wires and motor wires should not be tied up together. It is better to separate them by at least 10 cm, otherwise the disturbing signals generated by motor will easily disturb pulse direction signals, causing motor position error, system instability and other failures.
- I If a power supply serves several drives, separately connecting the drives is recommended instead of daisy-chaining.
- I It is prohibited to pull and plug power connector while the drive is powered ON, because there is high current flowing through motor coils (even when motor is at standstill). Pulling or plugging power connector with power on will cause extremely high back-EMF voltage surge, which may damage the drive.

Configuration

When the default setting of the Easy servo drive is not suitable for your application, it is necessary to configure it via the DIP switch or ProTuner (the setup software). Otherwise you may encounter problems like high motor heating, big motor noise or even motor stall due to weak torque. For a quick start of the easy servo drive, there are not much parameters need to be configured. The following table gives the most significant settings of the Easy servo drive.

Most Significant Settings of the Easy servo drive

| Parameters | ES-D508 | ES-D808, ES-D1008 |
|------------------------------|------------------------------------|---|
| Micro Step Resolution (PPR) | Default 4000, Software Adjustable | Default 1600, DIP Switch or Software Adjustable |
| Holding Current (%) | Default 60%, Software Adjustable | Default 60%, Software Adjustable |
| Close-loop Current Limit (%) | Default 100% , Software Adjustable | Default 100%, Software Adjustable |
| Current Loop Kp | <i>Auto Tuning at Power-up</i> | Default 1500, Software Adjustable |
| Current Loop Ki | <i>Auto Tuning at Power-up</i> | Default 200, Software Adjustable |

The holding current affects the holding torque when the motor is stop. The close-loop current limit affects the dynamic torque. Increase them if the torque is not enough. By default, the ES-D808/ES-D1008 is configured for the ES-M234XX (NEMA 34 motor, 4Nm or 8Nm) on 60VDC. If you use them to drive other leadshine motor, it is recommended to tune the current loop Kp and Ki for optimizing performance. Refer to the software manual for the detail. The ES-D508's Kp and Ki are calculated automatically at power-up regarding to motor and supply voltage. There is no need to tune them.

Recommended Holding / Close-loop Current Percentage

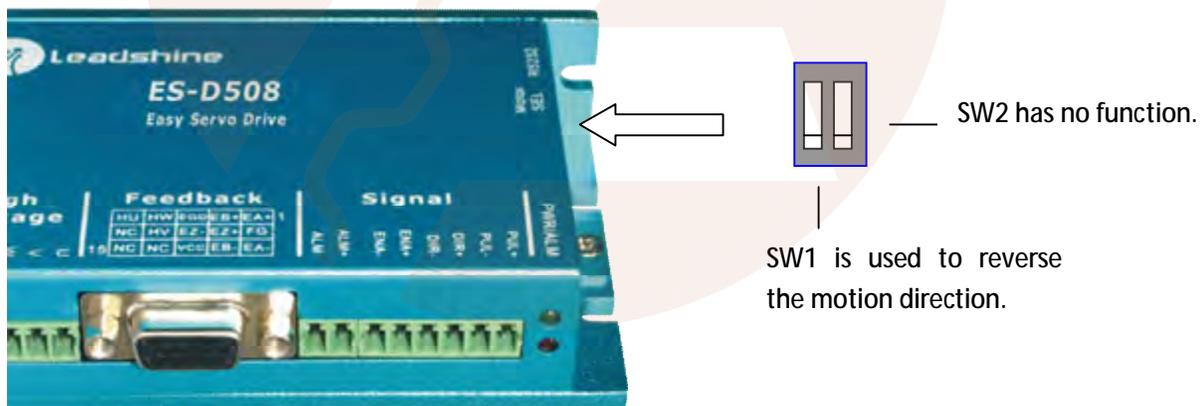
| | ES-M32309 | ES-M32320 | ES-M22310 | ES-M22320 | ES-M23440 | ES-M23480 |
|------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Holding Current (%) | 60% | 60% | 40% | 60% | 60% | 60% |
| Close-loop Current Limit (%) | 100% | 100% | 100% | 100% | 100% | 100% |
| Easy servo drive | ES-D508 | ES-D508 | ES-D808 | ES-D808 | ES-D808 | ES-D808 |

There are possible two methods to configure the easy servo drive as follows, depending on the specific drive.

Configuring ES drive by the DIP Switches

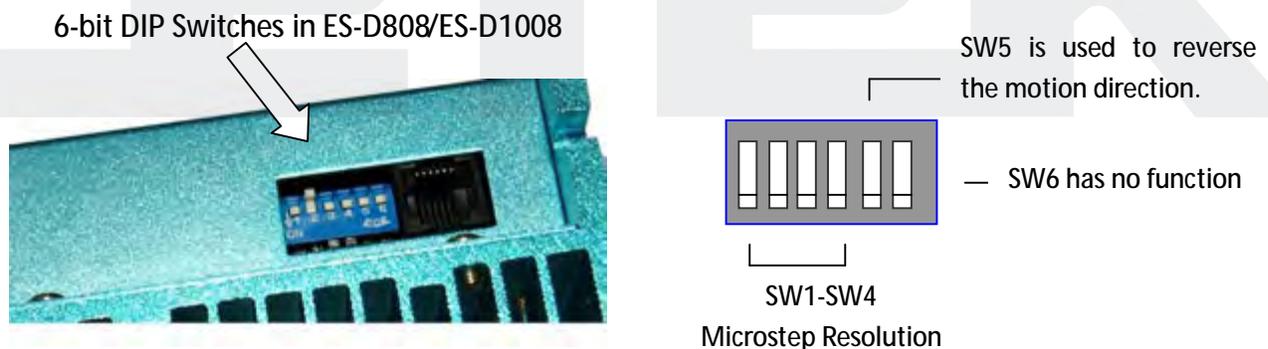
ES-D508

There is a 2-bit DIP switch on the ES-D508 which can be used to reverse the motion direction.



ES-D808/D1008

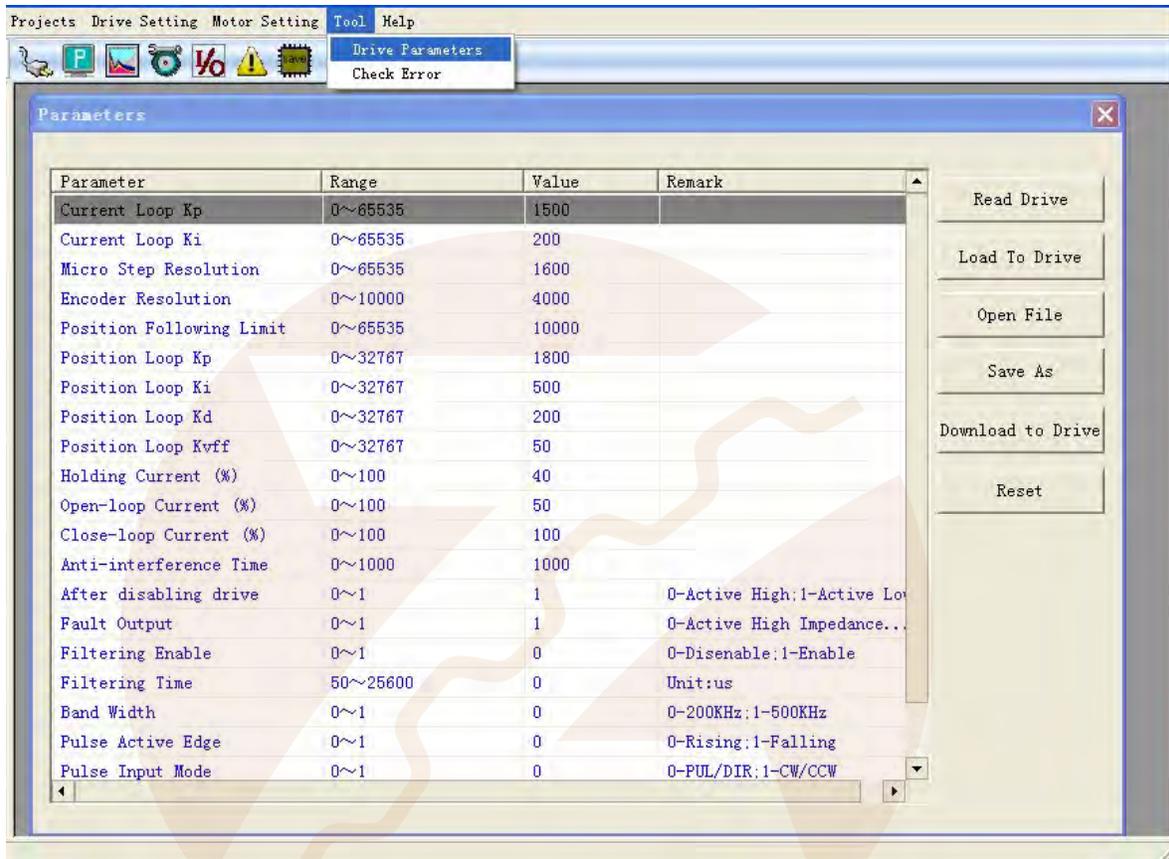
There is a 6-bit DIP switch in the ES-D808 and ES-D1008 drive. SW1 to SW4 are used to set the micro step resolution and SW5 are used to set the direction polarity.



| ES-D808 and ES-D1008 Micro Step Resolution Setting | | | | |
|--|-----|-----|-----|-----|
| Steps/Revolution | SW1 | SW2 | SW3 | SW4 |
| Software Configured (Default 200) | on | on | on | on |
| 800 | off | on | on | on |
| 1600 (Factory Setting) | on | off | on | on |
| 3200 | off | off | on | on |
| 6400 | on | on | off | on |
| 12800 | off | on | off | on |
| 25600 | on | off | off | on |
| 51200 | off | off | off | on |
| 1000 | on | on | on | off |
| 2000 | off | on | on | off |
| 4000 | on | off | on | off |
| 5000 | off | off | on | off |
| 8000 | on | on | off | off |
| 10000 | off | on | off | off |
| 20000 | on | off | off | off |
| 40000 | off | off | off | off |

Configuring ES drive in the PC Software

Consult the “Connecting to PC Software” chapter for how to connect the Easy servo drive to PC. Suppose the tuning software has been open, click the “Drive->Parameters” to open the Tool->Drive Parameters window. Double click the Value column to modify the parameter. Don’t forget to click “Download to Drive” to store the change to drive’s NVM. Consult the “Configuration” chapter for the recommended settings of different Easy servo kit. Refer to the software manual for more information about the parameters.



Calculating Rotation Speed and Angle

You may also want to calculate the motor rotation speed and rotation angle, before commanding any motion. If the pulse frequency and counts are known, they can be calculated as follows:

$$\text{Rotation Speed (RPM)} = 60 * \text{Pulse (Step) Frequency} / \text{Micro Step Resolution}$$

$$\text{Rotation Angle (}^\circ\text{)} = 360 * \text{Pulse (Step) Counts} / \text{Micro Step Resolution}$$

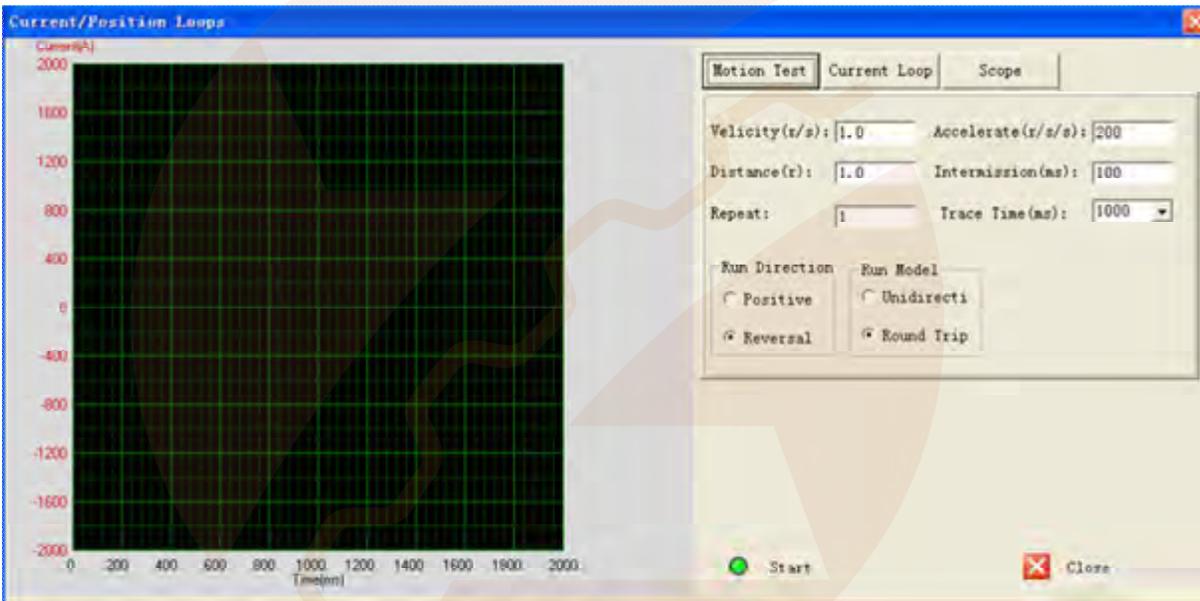


Rotating the Motor by Motion Controller

You can start the controller or pulse generator to rotate the motor. Actually, any device which gives high-to-low or low-to-high level changes can be used to move the motor. If it is your first time installation, it is recommended to disconnect the motor shaft from the load in case of accident. You can start from low pulse frequency then going to high. One triggered edge of the pulse makes the motor move one micro angle. There is no minimum speed limit for ES servo however the maximum running speed will be determined by the input voltage and current setting.

Rotating the Motor in PC Software

There is a simple emulating controller that is used for self-test in the ES-D drive. It is not a full functionality controller but it do eliminates the troubles to setup a real motion controller when you want to test the ES drives or verify the connection in case of problem. However, the performance in the emulating controller of the PC software CAN NOT represent the actual motion controller.



Click Drive Setting->Current Loop / Motion Test to open the test window. Then click the Motion Test tab to open the emulating controller. Edit the trapezoid velocity profile and click the Start button to issue the motion.

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Power Supply Selection

To achieve good driving performances, it is important to choose a suitable supply voltage and use a matching current value. Generally speaking, supply voltage determines the high speed performance of the motor, while output current determines the output torque of the driven motor (particularly at lower speed). Higher supply voltage will allow higher motor speed to be achieved, at the price of more noise and heating. If the motion speed requirement is low, it's better to use lower supply voltage to decrease noise, heating and improve reliability.

Regulated or Unregulated Power Supply

Both regulated and unregulated power supplies can be used to supply the drive. If regulated power supplies (such as most switching supplies.) are indeed used, it is important to have large current output rating to avoid problems like current clamp, for example using 4A supply for 3A motor-drive operation. On the other hand, if unregulated supply is used, one may use a power supply of lower current rating than that of motor (typically 50%~70% of motor current). The reason is that the drive draws current from the power supply capacitor of the unregulated supply only during the ON duration of the PWM cycle, but not during the OFF duration. Therefore, the average current withdrawn from power supply is considerably less than motor current. For example, two 3A motors can be well supplied by one power supply of 4A rating.

Multiple Drives

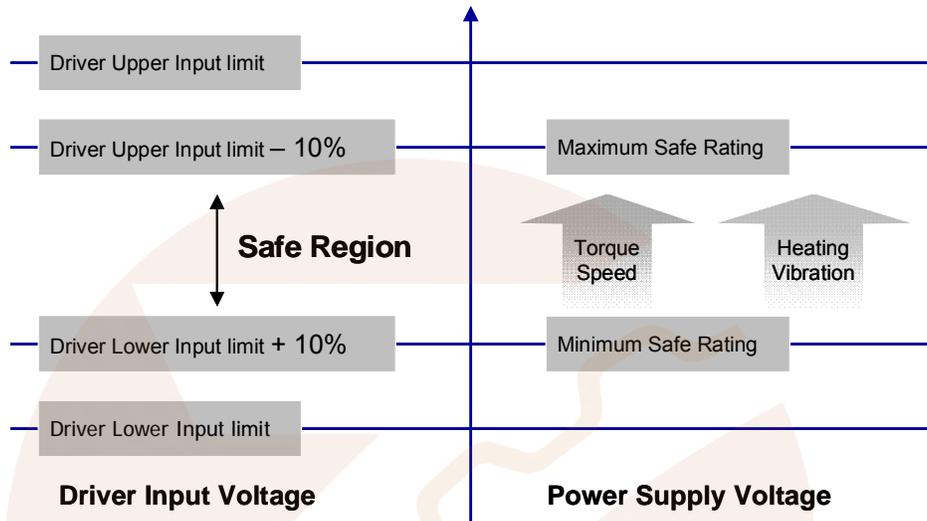
It is recommended to have multiple drives to share one power supply to reduce cost, if the supply has enough capacity. To avoid cross interference, DO NOT daisy-chain the power supply input pins of the drives. Instead, please connect them to power supply separately.

Selecting Supply Voltage

Higher supply voltage can increase motor torque at higher speeds, thus helpful for avoiding losing steps. However, higher voltage may cause bigger motor vibration at lower speed, and it may also cause over-voltage protection or even drive damage. Therefore, it is suggested to choose only sufficiently high supply voltage for intended applications, and it is suggested to use power supplies with theoretical output voltage of drive's minimum + 10% to drive's maximum – 10%, leaving room for power fluctuation and back-EMF.



Select Power Supply Voltage



Recommended Supply Voltage

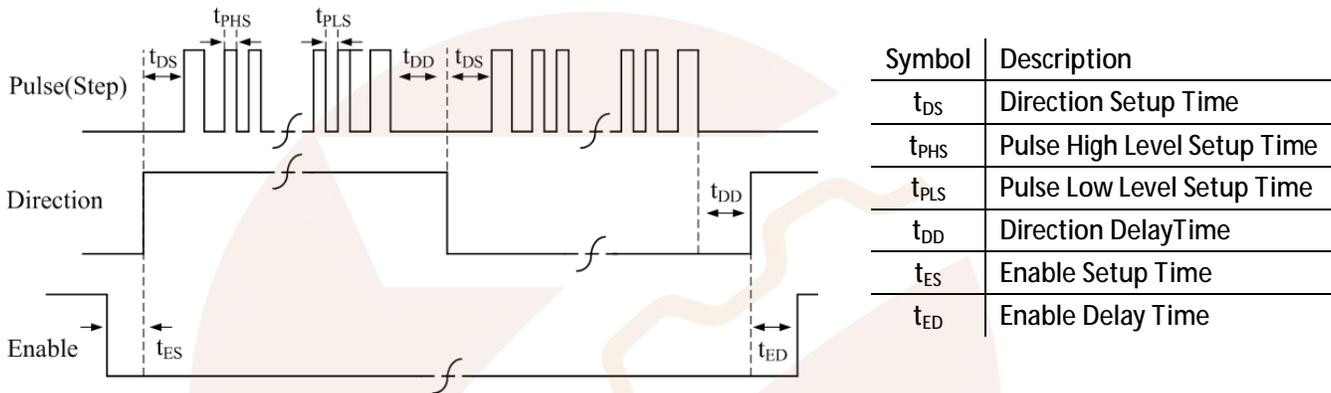
Both Leadshine's regulated and unregulated power supply has been designed specially for motion control.

| Motor | Drive | Voltage Range | Typical Voltage | Leadshine Power Supply |
|-----------|---------|---------------|-----------------|------------------------|
| ES-M32309 | ES-D508 | DC(20-50)V | DC 24V | RPS2410(-L) |
| ES-M32320 | ES-D508 | DC(20-50)V | DC 36V | RPS369 |
| ES-M22310 | ES-D808 | DC(30-80)V | DC 36V | RPS369 |
| ES-M22320 | ES-D808 | DC(30-80)V | DC 36V | RPS369 |
| ES-M23440 | ES-D808 | DC(30-80)V | DC 60V | RPS608 |
| ES-M23480 | ES-D808 | DC(30-80)V | DC 60V | RPS608 |

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Control Signal Setup Timing

To make a reliable operation, the ES drive requires the control signals to meet the setup time requirements as follows. Otherwise losing of steps may happen.



Control Signal Setup Time

| Drive | Frequency | t_{DS} | t_{PHS} / t_{PLS} | t_{DD} | t_{ES} | t_{ED} |
|----------------|-----------|----------|---------------------|----------|----------|----------|
| ES-D508 | 200K | >50uS | >2.5uS | >50uS | >50ms | >50ms |
| ES-D808 / 1008 | 200K | >50uS | >2.5uS | >50uS | >50ms | >50ms |

Current Control Detail

Leadshine's hybrid servo motor is integrated with a high-resolution 1,000-line optical incremental encoder. That encoder can send the real-time shaft position back to the hybrid drive. Like traditional servo controls, the drive can automatically adjust the output current to the motor. The output current ranges between the holding current and the close-loop current. When there is no pulse sent to the drive, the ES drive goes into idle mode and the actual motor current is determined by the holding current percentage (similar to "idle current" of open loop stepper drives). In normal working mode, the ES monitors the actual shaft position all the time. The current outputted to the motor changes dynamically based on the tracking error between the actual position and the commanded position.

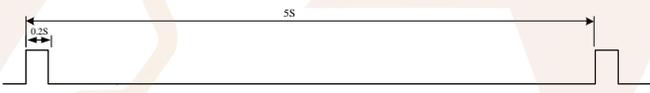
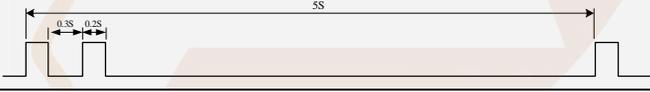
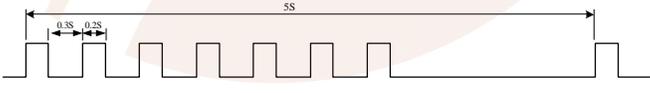
Low holding current can reduce motor heating however also reduces the holding torque which is used to lock the motor shaft at standstill. It is recommended to determine the holding current by whether or not there is big vibration at start-up and how much lock torque is required, based on your actual applications.

Fine Tuning

Leadshine already loads default current-loop parameters and position-loop parameters. Those default parameter values have been optimized. They should be good enough for most industrial applications, and there is no need to tune them. However, if you want to fine tune the IES for best performance for your applications, Leadshine also offers tuning software, ProTuner, which allows you to adjust those current-loop and position-loop parameters (see software manual).

Protection Functions

To improve reliability, the ES-D drive incorporates some built-in protection functions. The ES-D drive uses one red LED to indicate the protection type. The periodic time of red is 4 s (seconds), and the blinking times of red LED indicates what protection has been activated. Because only one protection can be displayed by red LED, so the drive will decide what error to display according to their priorities. See the following protection Indications table for displaying priorities.

| Priority | Time(s) of Blink | Sequence wave of RED LED | Description |
|----------|------------------|--|--------------------------|
| 1st | 1 |  | Over-current protection |
| 2nd | 2 |  | Over-voltage protection |
| 3rd | 7 |  | Position Following Error |

Over-current Protection

Over-current protection will be activated when continuous current exceeds the limit or in case of short circuit between motor coils or between motor coil and ground, and RED LED will blink once within each periodic time.

Over-voltage Protection

When power supply voltage exceeds the limits, protection will be activated and red LED will blink twice within each periodic time.



When above protections are active, the motor shaft will be free or the LED will blink. Reset the drive by repowering it to make it function properly after removing above problems. Since there is no protection against power leads (+, -) reversal, it is critical to make sure that power supply leads correctly connected to drive. Otherwise, the drive will be damaged instantly.

Position Following Error Protection

When the position error exceeds the limit (software configurable, see software manual), position protection will be activated and red LED will blink seven times within each periodic time.

Frequently Asked Questions

In the event that your drive doesn't operate properly, the first step is to identify whether the problem is electrical or mechanical in nature. The next step is to isolate the system component that is causing the problem. As part of this process you may have to disconnect the individual components that make up your system and verify that they operate independently. It is important to document each step in the troubleshooting process. You may need this documentation to refer back to at a later date, and these details will greatly assist our Technical Support staff in determining the problem should you need assistance.

Many of the problems that affect motion control systems can be traced to electrical noise, controller software errors, or mistake in wiring.

Problem Symptoms and Possible Causes

| Symptoms | Possible Problems |
|--------------------------------------|---|
| Motor is not rotating | No power |
| | Microstep resolution setting is wrong |
| | Fault condition exists |
| | The drive is disabled |
| Motor rotates in the wrong direction | The Direction signal level is reverse |
| The Drive In Fault | Power supply voltage beyond drive's input range |
| | Something wrong with motor coil |
| | Wrong connection |
| Erratic Motor Motion | Control signal is too weak |
| | Control signal is interfered |
| | Something wrong with motor coil |
| | Motor is undersized for the application |
| | Acceleration is set too high |
| Excessive motor and drive heating | Power supply voltage too low |
| | Inadequate heat sinking / cooling |
| | Load is too high |

Warranty

Leadshine Technology Co., Ltd. warrants its products against defects in materials and workmanship for a period of 12 months from shipment out of factory. During the warranty period, Leadshine will either, at its option, repair or replace products which proved to be defective.

Exclusions

The above warranty does not extend to any product damaged by reasons of improper or inadequate handlings by customer, improper or inadequate customer wirings, unauthorized modification or misuse, or operation beyond the electrical specifications of the product and/or operation beyond environmental specifications for the product.

Obtaining Warranty Service

To obtain warranty service, a returned material authorization number (RMA) must be obtained from customer service at e-mail: service@leadshine.com before returning product for service. Customer shall prepay shipping charges for products returned to Leadshine for warranty service, and Leadshine shall pay for return of products to customer.

Warranty Limitations

Leadshine makes no other warranty, either expressed or implied, with respect to the product. Leadshine specifically disclaims the implied warranties of merchantability and fitness for a particular purpose. Some jurisdictions do not allow limitations on how long and implied warranty lasts, so the above limitation or exclusion may not apply to you. However, any implied warranty of merchantability or fitness is limited to the 12-month duration of this written warranty.

Shipping Failed Product

If your product fail during the warranty period, e-mail customer service at service@leadshine.com to obtain a returned material authorization number (RMA) before returning product for service. Please include a written description of the problem along with contact name and address. Send failed product to distributor in your area or: ULeadshine Technology Co., Ltd. 3/F, Block 2, Nanyou Tianan Industrial Park, Nanshan Dist, Shenzhen, China.U Also enclose information regarding the circumstances prior to product failure.