Hardware Manual of the Easy Servo Drives

ES-D508, ES-D808 & ES-D1008

Safety Items

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⚠ Notice	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.
⚠ Caution	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.
⚠ Warning	Do not set high current for small stepper motor. It is possible that the motor will be damaged.
⚠ Caution	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.
⚠ Warning	Never disconnect the motor lead when the power source is energized.

Table of Contents

Introduction to the Easy Servo

The ES (easy servo) series easy 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 many capabilities and enhancements over both, while at a fraction of the cost of a servo system.
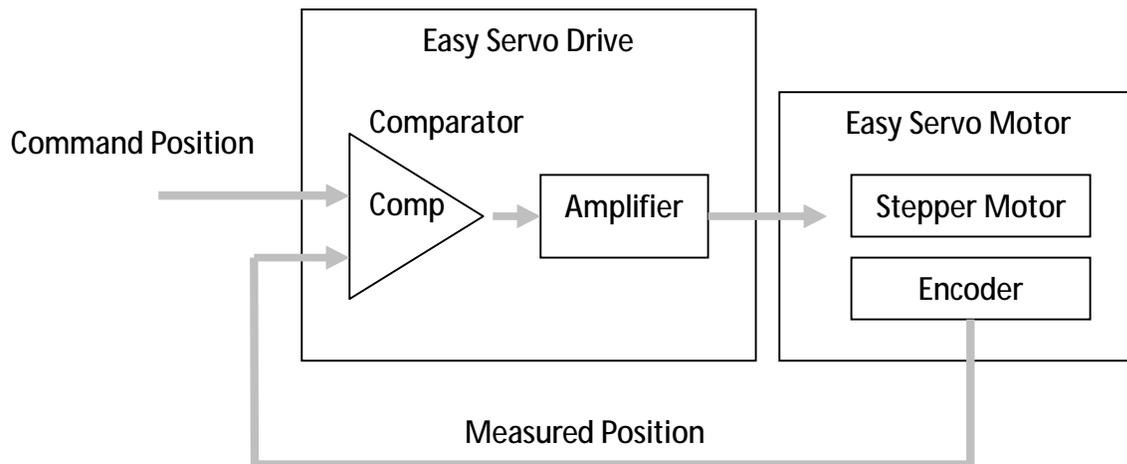
Getting Start

To get start you need one easy servo drive, one easy servo motor (stepper motor with encoder) and an AC / DC power supply to set up a minimum easy servo system. 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 via PC software, ProTuner. However it is recommended to verify all function of an easy servo with a motion controller.

Drive Appearance and Connector Location

ES-D508

RS232 Communication Connector
(RJ11)

2-bit DIP Switch
(SW1: Direction, SW2: Self-test)

Indicator
(Green LED: Power, Red LED: Fault)

Control signals connectors including digital
inputs and digital outputs
(Screw Terminal Blocks)

Encoder feedback signals connector
(HDD15)

Power & motor connector
(Screw Terminal Block)
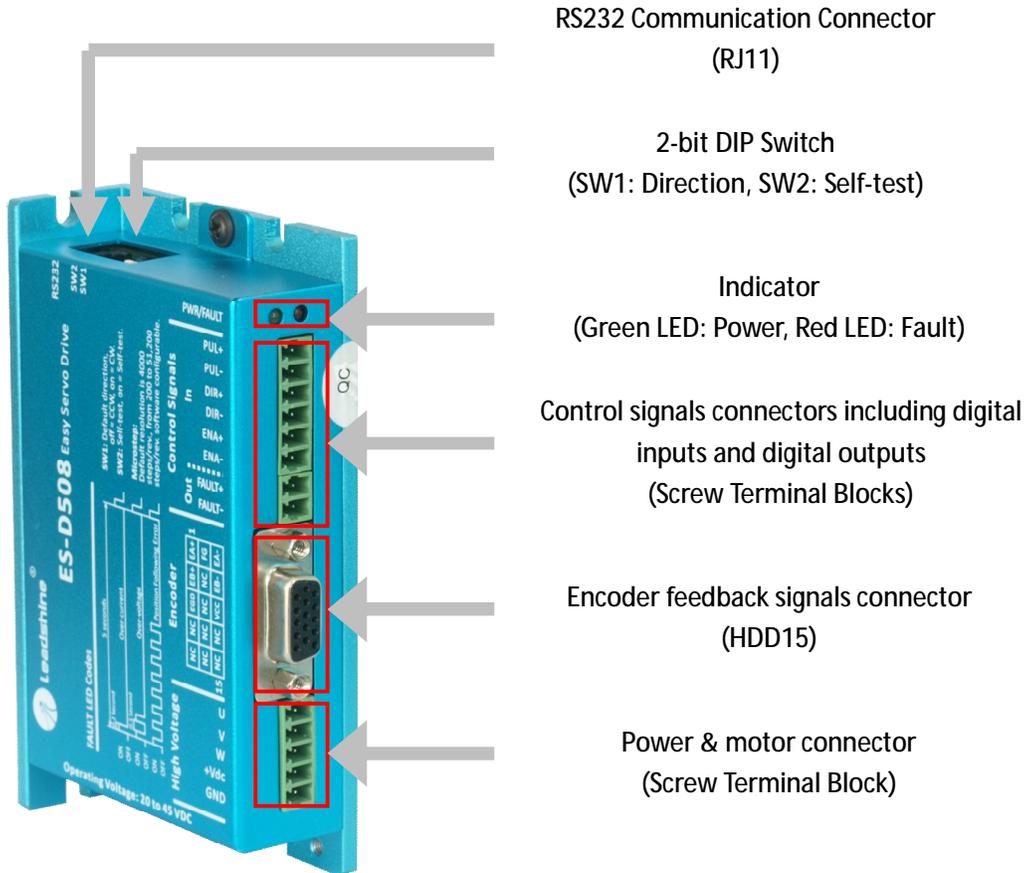
Drive appearance and connector location of the ES-D508

Drive Appearance and Connector Location (Continued)

ES-D808 / ES-D1008

RS232 Communication Connector
(RJ11)

6-bit DIP Switch
(SW1-4: Micro Step, SW5: Direction, SW6: Self-test)

Indicator
(Green LED: Power, Red LED: Fault)

Control signals connectors including digital
inputs and digital outputs
(Screw Terminal Block)

Encoder feedback signals connector
(Screw Terminal Block)

Power & motor connector
(Screw Terminal Block)
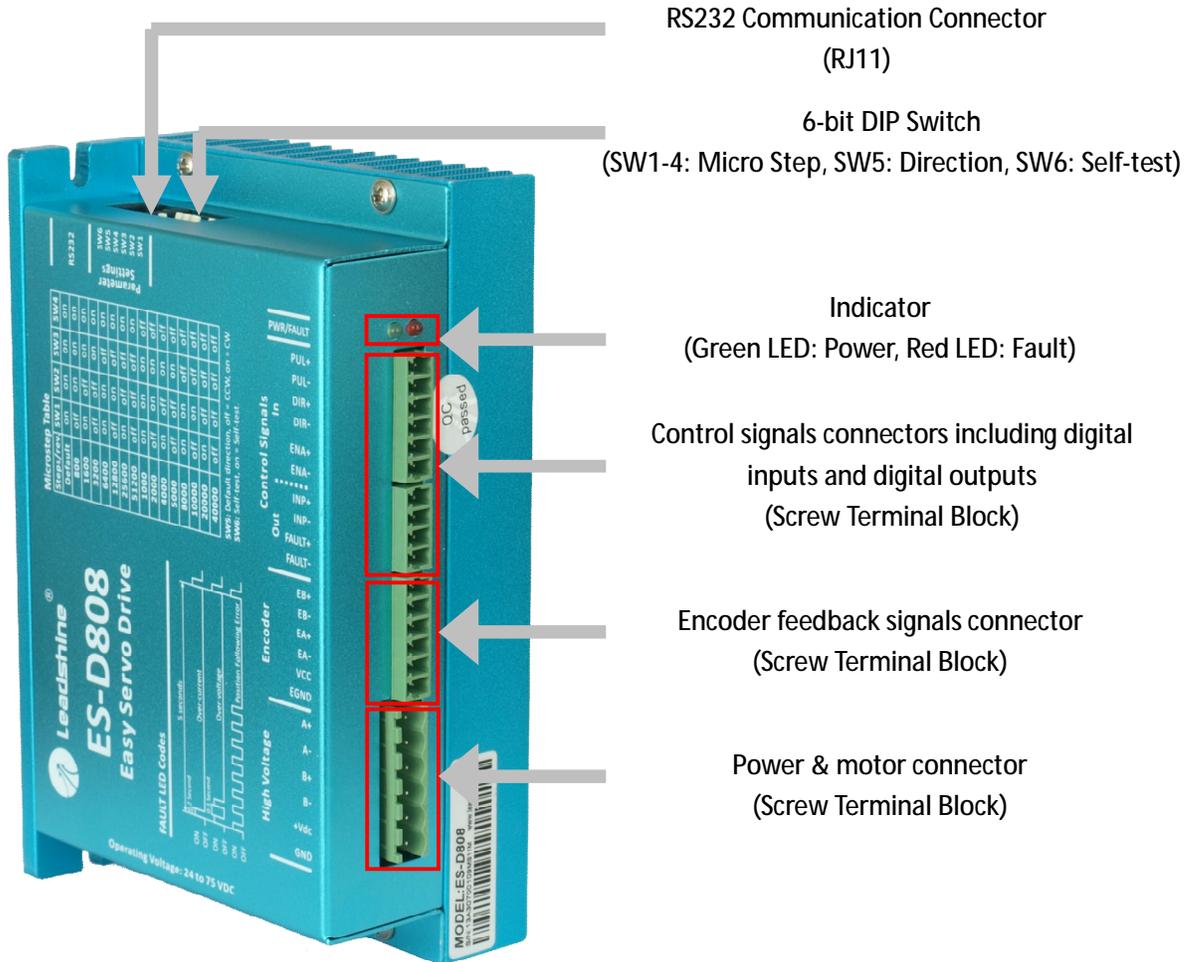
Drive appearance and connector location of the ES-D808 / ES-D1008

Wiring Diagrams

RS232 Cable

Or   USB-232 Converter

Motion Controller

Encoder Cable * (must be used)

Power Supply

Power Extension Cable
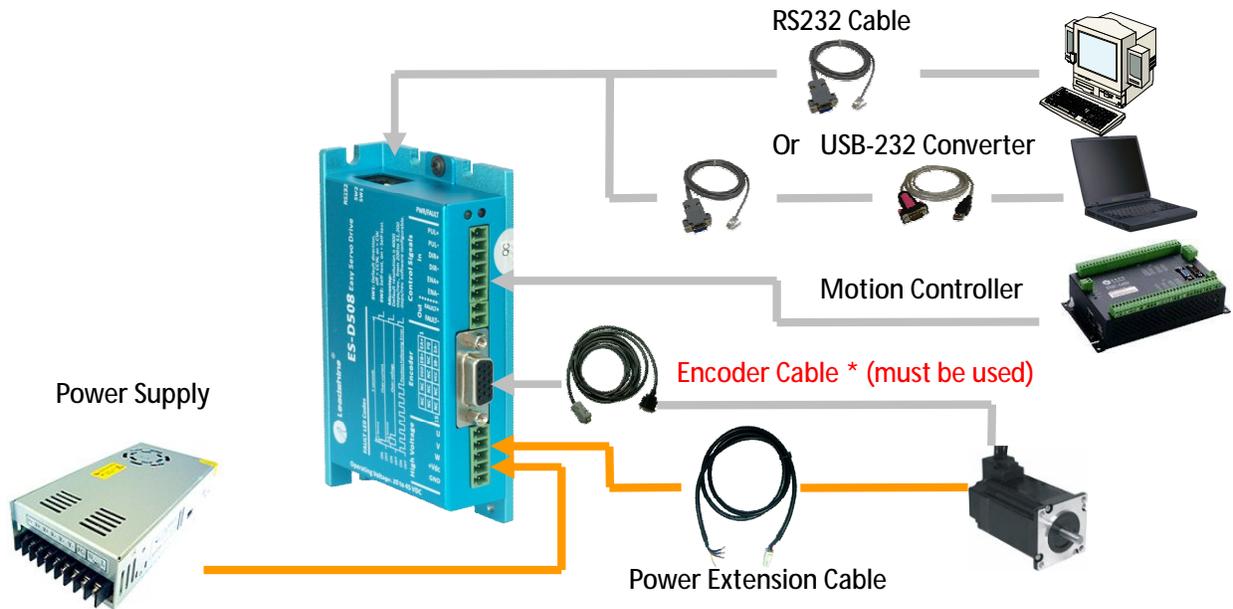
Wiring diagram of the ES-D508 and ES-M3 series motors

RS232 Cable

Or   USB-232 Converter

Motion Controller

Encoder Cable * (must be used)

Power Supply

Power Extension Cable
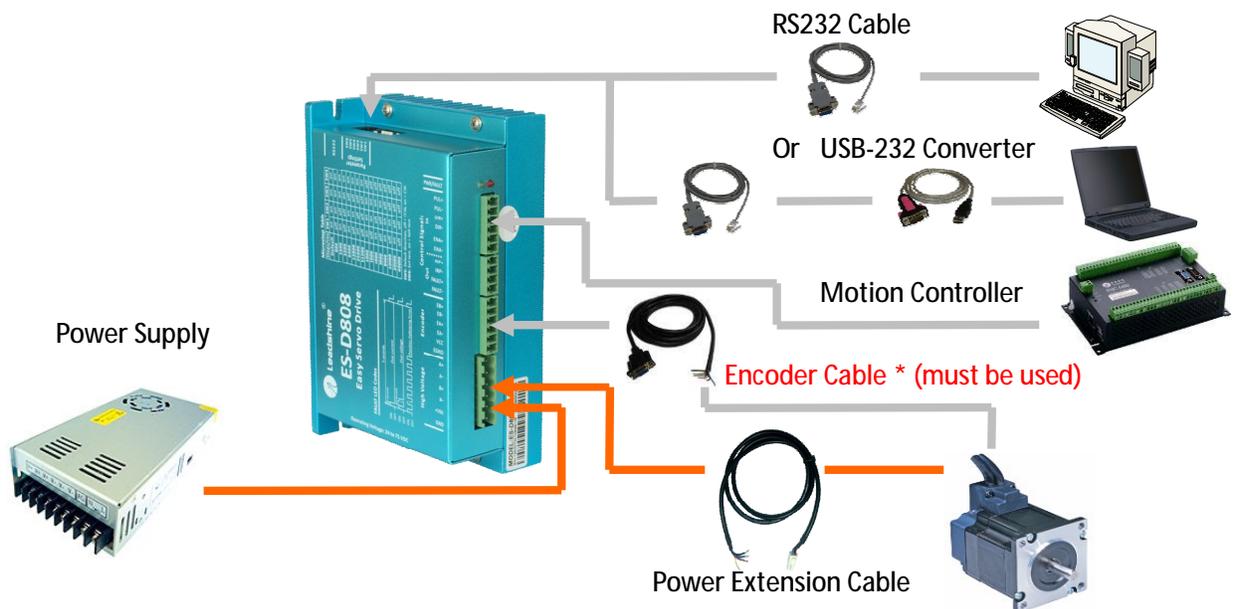
Wiring diagram of the ES-D808 / ES-D1008 and ES-M2 series motors

Connecting Power Supply

ES-D508 and 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 connections. 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.*
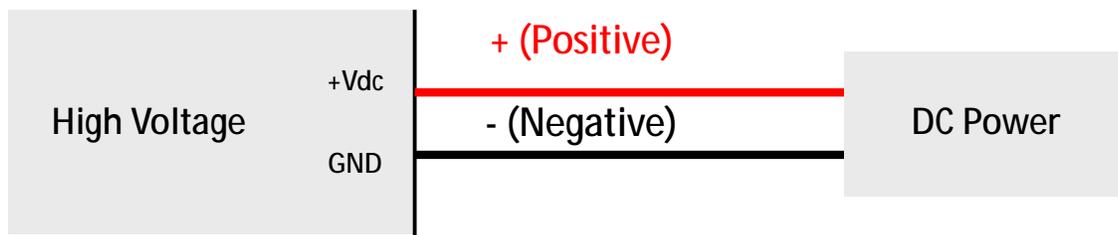
DC Power Connection of the ES-D508 and ES-D808

ES-D1008

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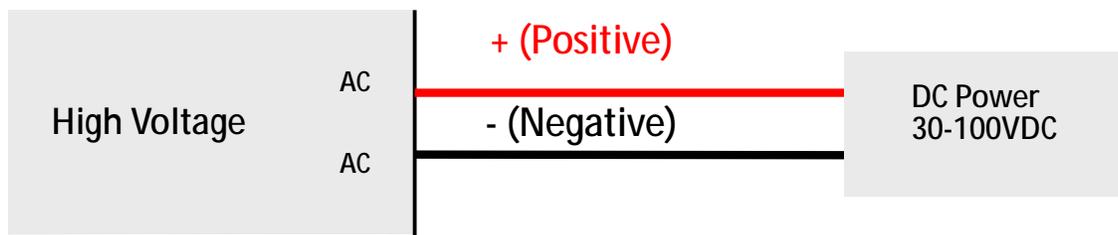
DC power connection of the ES-D1008
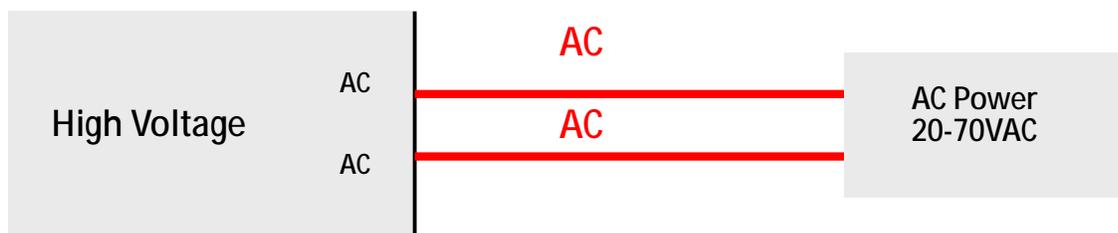
AC power connection of the ES-D1008

Connecting Motor

ES-D508 and ES-M3 Series Motor

A power extension cable is needed to be connected between the ES-M3 series motors and the ES-D508. One end of this power extension cable includes four flying wires. You can connect these wires to the drive's corresponding terminals as follows. Just cut off the yellow/green wire or leave it unconnected.
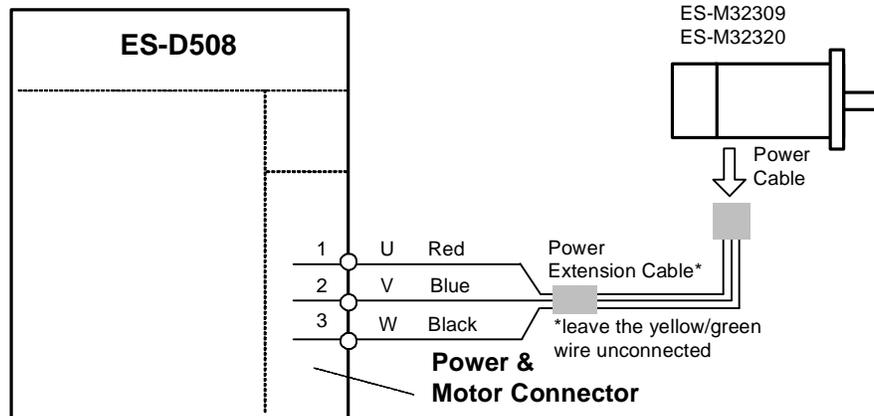
Connect Leadshine ES-M3 series motors to ES-D508

ES-D808 / ES-D1008 and ES-M2 Series Motors

A power extension cable is needed to be connected between the ES-M2 series motor and the ES-D808 / ES-D808. One end of this power extension cable includes four flying wires. You can connect these wires to the drive's corresponding terminals as follows.
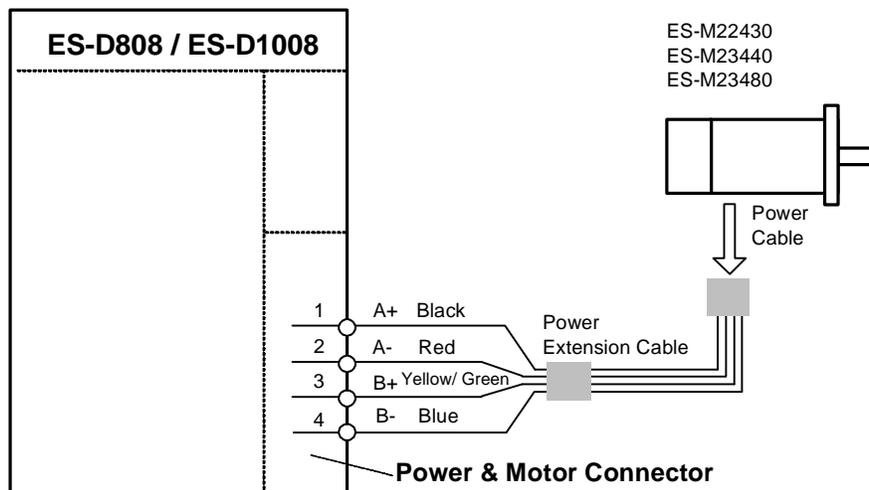
Connect Leadshine ES-M2 series motors to ES-D808 / ES-D1008

Connecting Encoder

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

ES-D508 and ES-M3 series motors

The encoder extension cable is required to connect the motor and ES-D508. The drive will not work properly if you connect the motor's encoder cable to the ES-D508 directly.
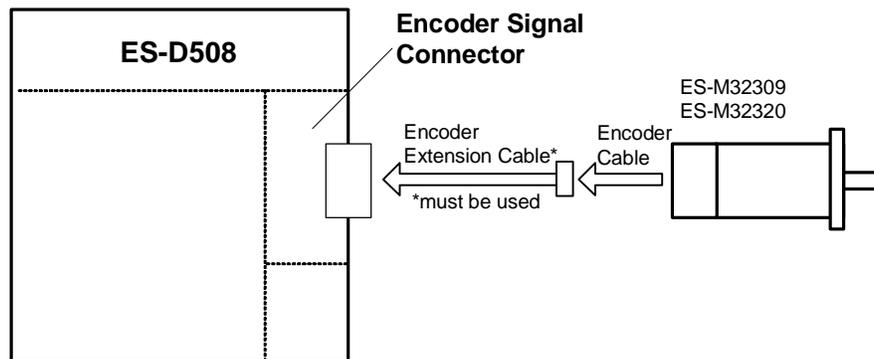
Encoder connections between the ES-D508 and ES-M3 series motors

ES-D808/ ES-D1008 and ES-M2 series motors

The encoder output of the ES-M2 series motor is a HDD15 connector while the encoder input of the ES-D808 / ES-D1008 is screw terminal, so an extension cable is required between the drive and motor.
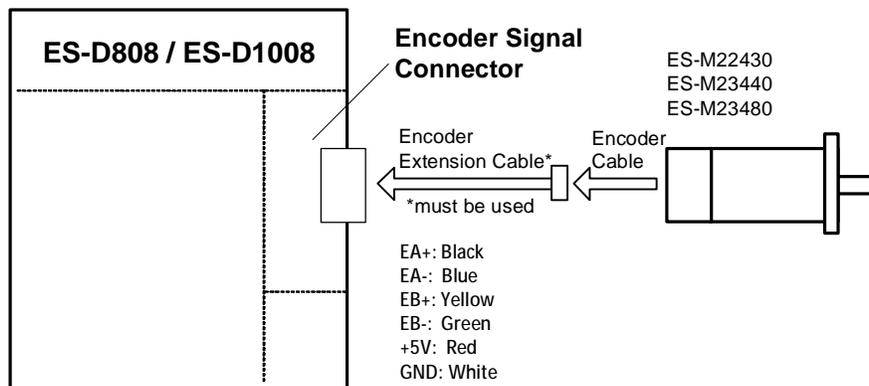
Encoder connections between ES-D808 / ES-D1008 and ES-M2 series motors

Connecting Control Signal

Pulse, Direction, Enable Input Connections

The ES-D series drives can accept differential, PNP(sourcing) and NPN(sinking) pulse, direction and enable control signals. For the enable signal, apply 0V between ENA+ and ENA- or leave them unconnected to enable the drive. Recommend to leave the enable signal unconnected if you don't need to disable the drive.

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

ES-D508
R=0 if VCC=5V;
R=1K(Power>0.125W) if VCC=12V;
R=2K(Power>0.125W) if VCC=24V;
R must be connected to control signal terminal.

ES-D808 / ES-D1008
VCC =5~24V. R is not required.
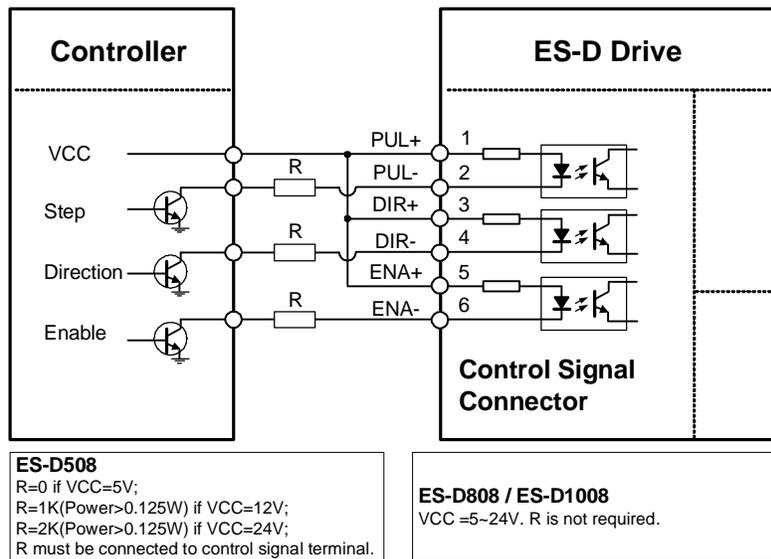
Connect the ES-D drives to the NPN (sinking) type controllers

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

ES-D508
R=0 if VCC=5V;
R=1K(Power>0.125W) if VCC=12V;
R=2K(Power>0.125W) if VCC=24V;
R must be connected to control signal terminal.

ES-D808 / ES-D1008
VCC =5~24V. R is not required.
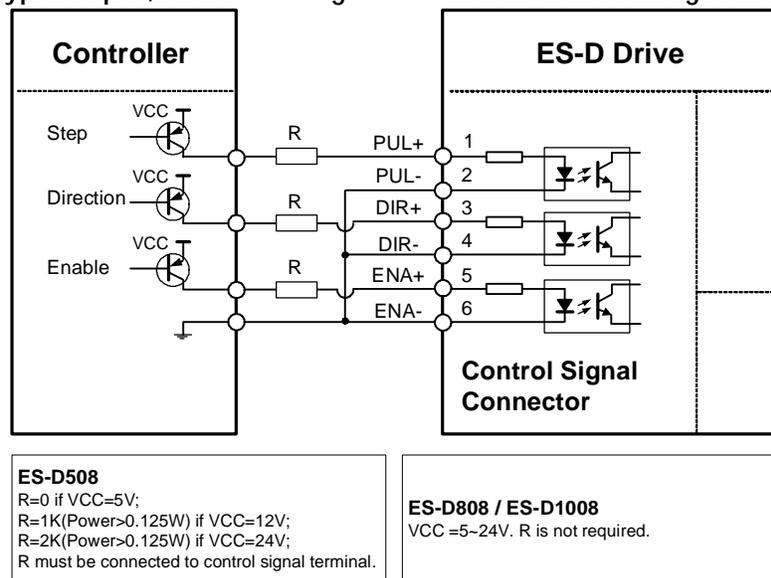
Connect the ES-D drives to the PNP (sourcing) type controllers

Pulse, Direction, Enable Input Connections (Continued)
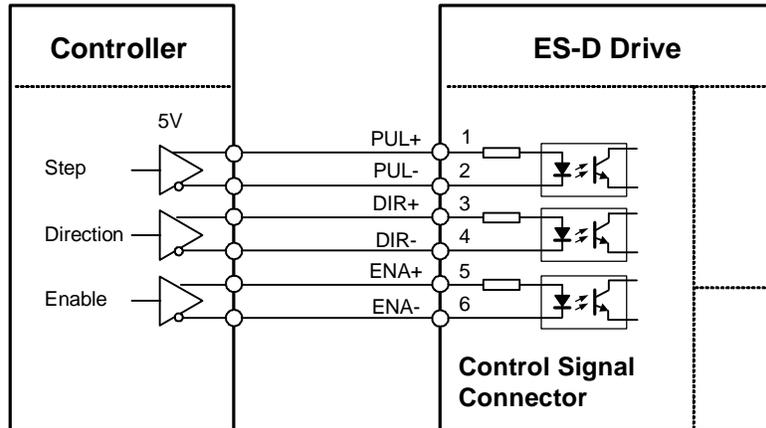
Connect the ES-D drives to differential type controllers

Fault, In-position Output Connections

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.
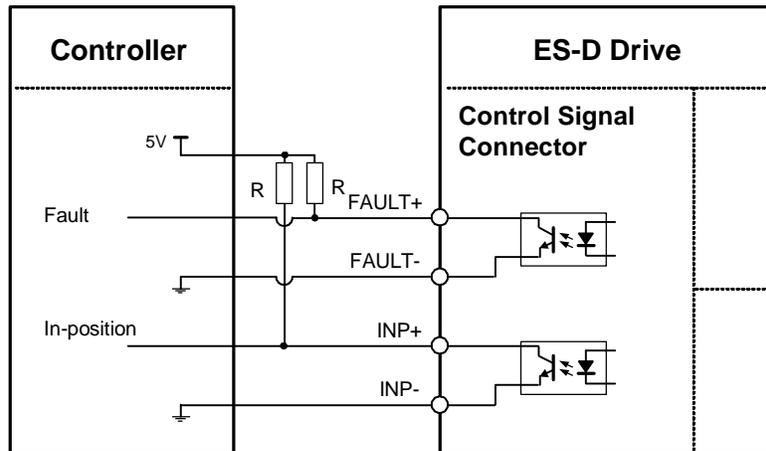
Fault, in-position signal connection of the ES-D drive
(Note: The ES-D508 does not have in-position output)

Connecting PC

There is a built-in RS232 port in each easy servo drive for communication and configuration. Connect this port to the PC's serial port. Then you can rotate the motor in the setup software. This setup 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 software from the website is always the latest. Install it in your PC and make it ready for use later.
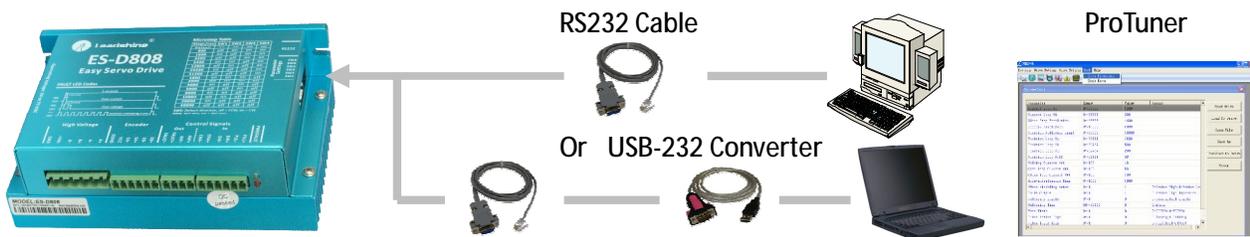
Connect ES-D808 / ES-D1008 to PC

A RS232 cable is needed for the communication between the drives and the ProTuner. 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-232 converter is required.

Note: 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" according 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.
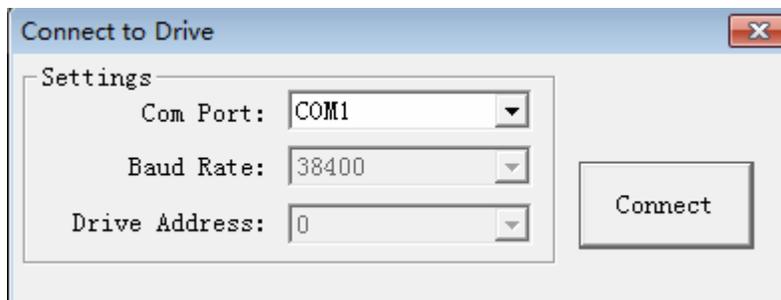
Typical Connections
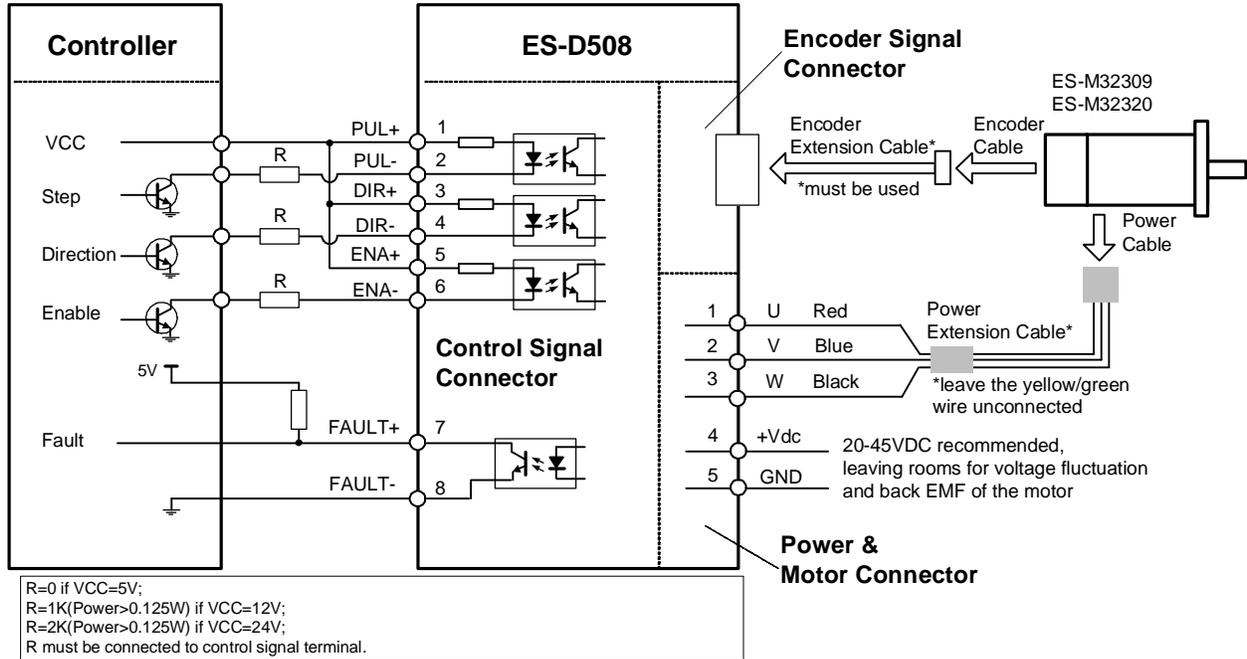
Typical connections of the ES-D508 with controller of sinking output
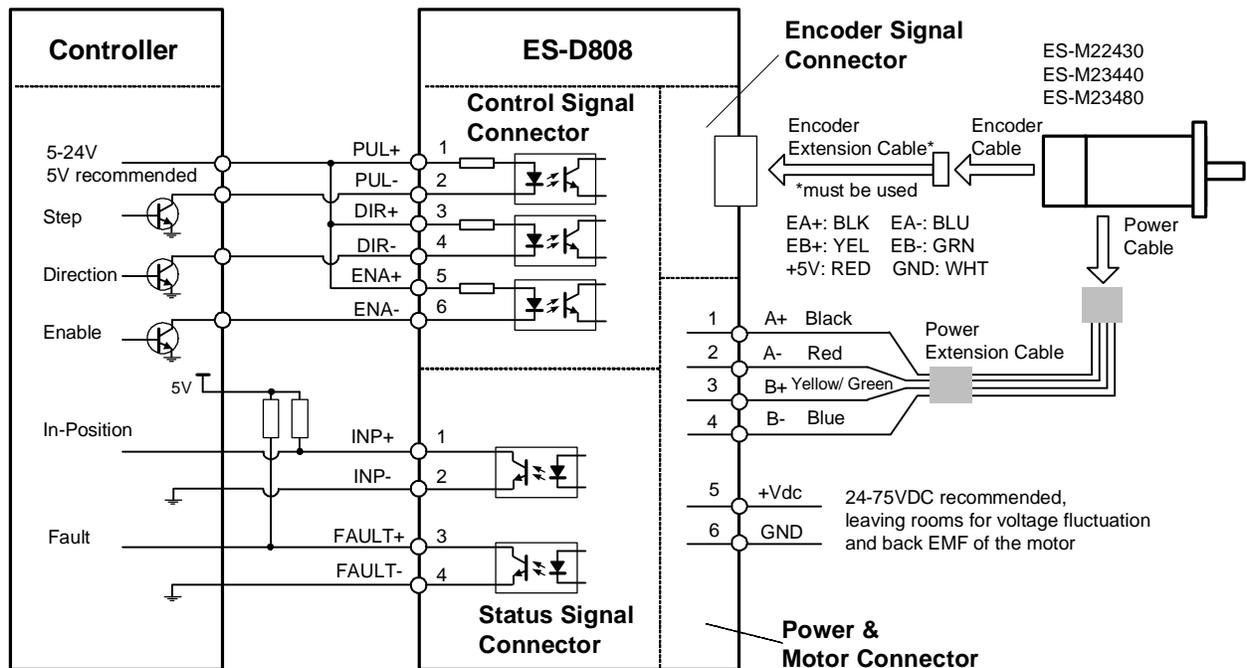
Typical connections of the ES-D808 with controller of sinking output

Typical Connections (Continued)
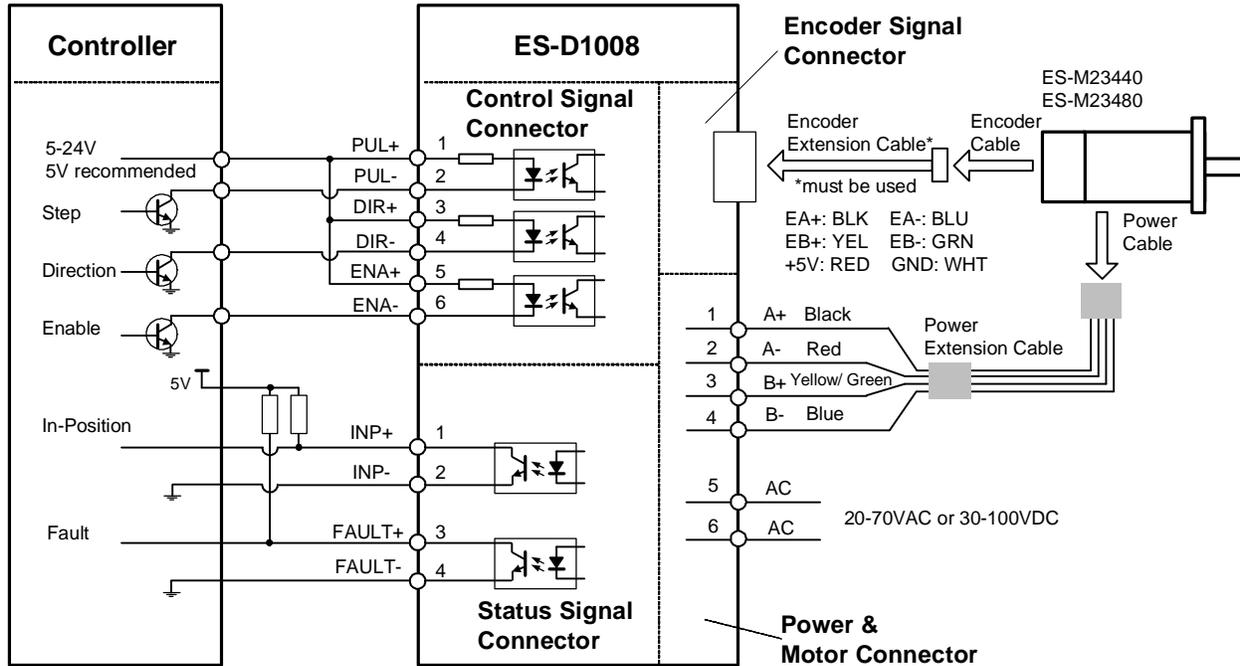
Typical Connections of the ES-D1008 with controller of sinking output

Wiring Notes

l   In order to improve anti-interference performance of the system, it is recommended to use twisted pair shield cable.

l   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 or other failures.

l   If a power supply serves several drives, separately connecting the drives is recommended instead of daisy-chaining.

l   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 settings of the easy servo drive are not suitable for your application, it is necessary to configure the drive 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 parameters of the easy servo drive.

Most Significant Parameters 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 40%, Software Adjustable	Default 50%, Software Adjustable
Close-loop Current (%)	Default 100% , Software Adjustable	Default 100%, Software Adjustable
Current Loop Kp	*Auto Tuning at Power-up	*Auto Tuning at Power-up
Current Loop Ki	*Auto Tuning at Power-up	*Auto Tuning at Power-up

*Auto Tuning at Power-up: It is possible to disable this feature in the setup software in order to tune the current loop Kp and current loop Ki manually if the auto tuning result is not good enough. This happens when the motor's inductance or resistance is too high or too low.

The holding current affects the holding torque when the motor is stop. The close-loop current affects the dynamic torque. Increase them if the torque is not enough.

Recommended Holding / Close-loop Current Percentage

	ES-M32309	ES-M32320	ES-M23440	ES-M23480
Holding Current (%)	60%	60%	60%	60%
Close-loop Current (%)	100%	100%	100%	100%
Easy servo drive	ES-D508	ES-D508	ES-D808 / ES-D1008	ES-D808 / ES-D1008

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 default motion direction and perform motor self-test.

Set SW2 on to activate the motor self-test.

SW1 is used to reverse the default motion direction.

ES-D808 / ES-D1008

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

6-bit DIP switches on ES-D808 / ES-D1008

SW5 is used to reverse the default motion direction.

Set SW6 on to activate the motor self-test.

SW1-SW4
Microstep Resolutions
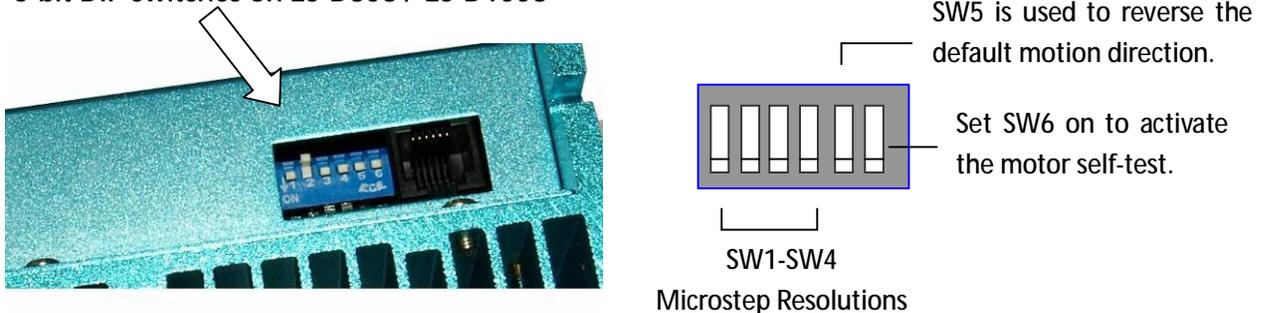
ES-D808 / ES-D1008 Resolution Settings				
Steps/Revolution	SW1	SW2	SW3	SW4
Software Configured (Default 400)	on	on	on	on
800	off	on	on	on
1600 (Factory Setting)	on	off	on	on
3200	off	off	on	on
6400	on	on	off	on
12800	off	on	off	on

ES-D808 / ES-D1008 Resolution Settings (Continued)				
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 Parameters window. Double click the Value column to modify the parameter. Don't forget to click "Save" to store the change to drive's NVM. Consult the "Configuration" chapter for the recommended settings of different easy servo kits. Refer to the software manual for more information about the parameters.
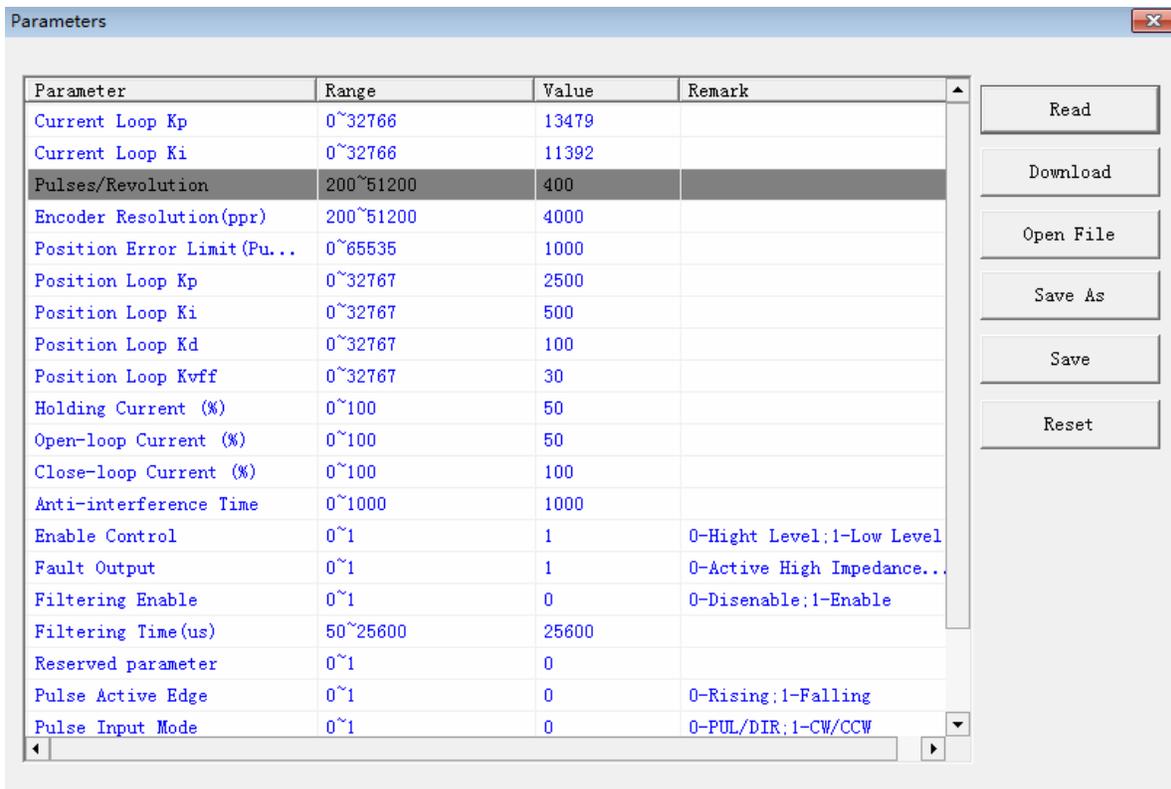
Rotating the Motor

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:

Rotation Speed (RPM) = 60 * Pulse (Step) Frequency / Micro Step Resolution
Rotation Angle (°)　　= 360 * Pulse (Step) Counts / 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 are no minimum speed limits for the ES servos, however the maximum running speed will be determined by the input voltage, current settings or maximum input frequency of the drive.

Rotating the Motor in Self-test Mode

When the drive is configured in self-test mode by setting the SW2 to the ON position, the connecting motor will rotates 1 revolution CW and 1 revolution CCW then repeat, until you set the SW2 to the OFF position.

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 an external 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 DOES NOT represent that of using an external motion controller.
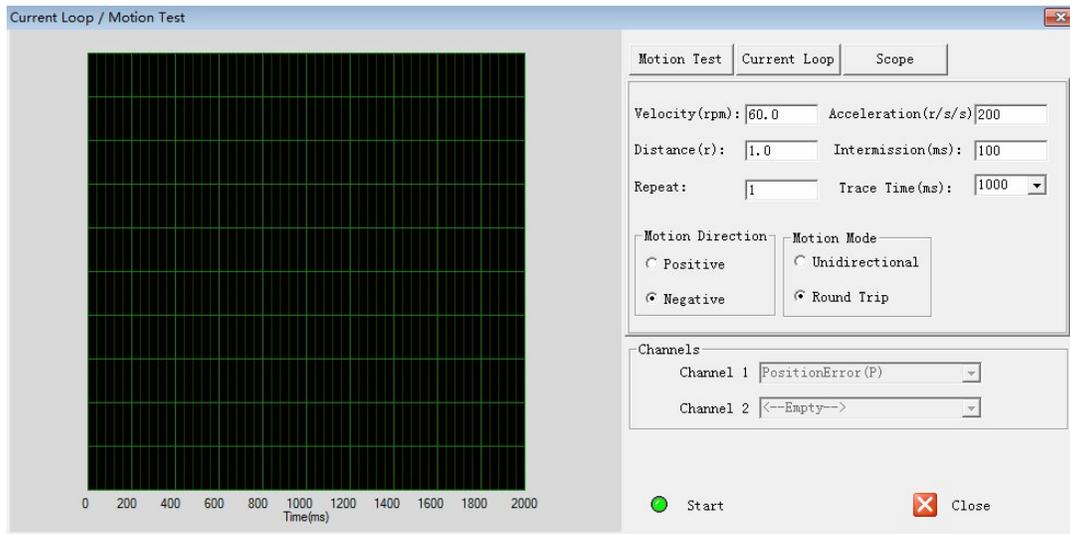
Click Drive Settings->Current Loop / Motion Test to open the test window. Then click the Motion Test tab to open the emulating controller. Edit the trapezoidal velocity profile and click the Start button to execute the motion.

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.

Drive Input Voltage	Power Supply Voltage
Drive Upper Input Limit	
Drive Upper Input Limit – 10%	Maximum Safe Rating
Safe Region	Torque & Speed Heating & Vibration
Drive Upper Input Limit + 10%	Minimum Safe Rating
Drive Lower Input Limit	
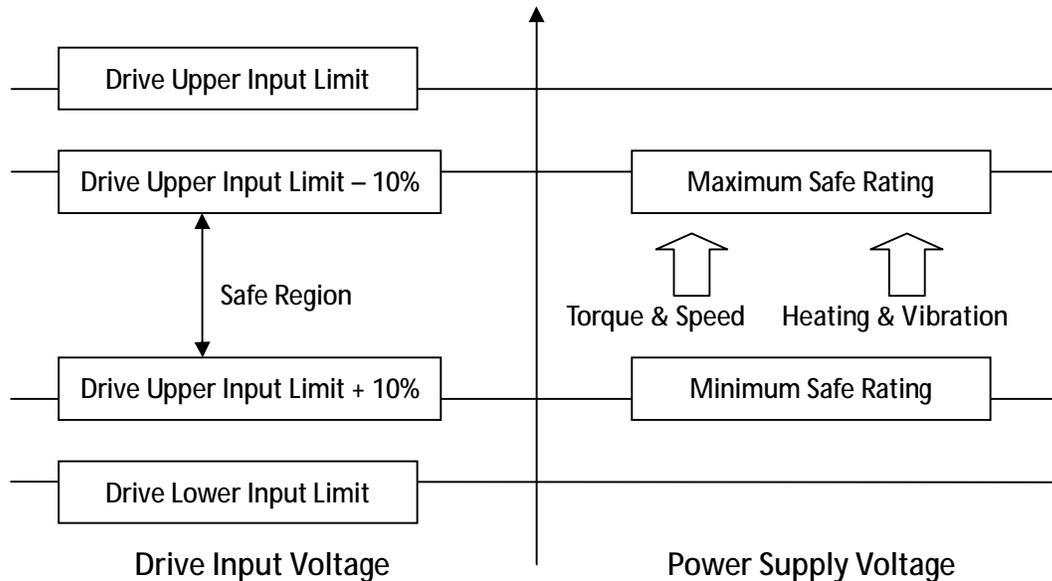
Recommended Supply Voltage

Both Leadshine's regulated and unregulated power supplies are specially designed for motion control.

Motor	Drive	Voltage Range	Typical Voltage	Leadshine Power Supply
ES-M32309	ES-D508	DC(20-50)V	DC 24V	RPS2410
ES-M32320	ES-D508	DC(20-50)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

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.
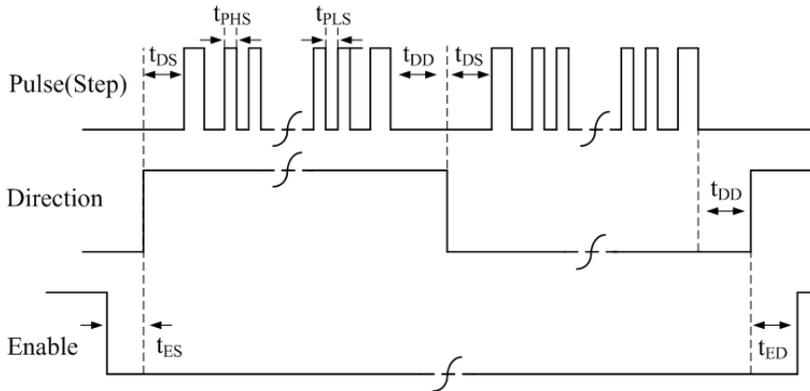
Symbol	Description
t_{DS}	Direction Setup Time
t_{PHS}	Pulse High Level Setup Time
t_{PLS}	Pulse Low Level Setup Time
t_{DD}	Direction Delay Time
t_{ES}	Enable Setup Time
t_{ED}	Enable Delay Time

Control Signal Setup Time

Drive	Frequency	t_{DS}	t_{PHS} / t_{PLS}	t_{DD}	t_{ES}	t_{ED}
ES-D508	200K	>5uS	>2.5us	>5uS	>50ms	>50ms
ES-D808 / ES-D1008	200K	>5uS	>2.5us	>5uS	>50ms	>50ms

Current Control Detail

Leadshine's easy 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 ES-D 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-D 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.
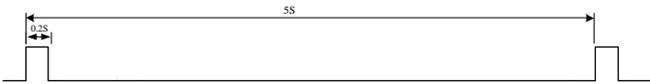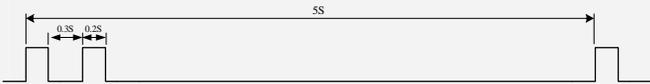
Low holding current can reduce motor heating, however also reduces the holding torque which is used to lock the motor shaft at standstill. It is recommended to determine the holding current by whether or not there is big vibration at start-up and how much lock torque is required, based on your actual 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 ES 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 is 5 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 input voltage including voltage fluctuation and back EMF of the motor exceeds the limits, protection will be activated and red LED will blink twice within each periodic time.

Caution

When above protections are active, the motor shaft will be free and the LED will blinks. 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
	Power supply voltage too low
Excessive motor and drive heating	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: 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 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.

Contact Us

China Headquarters
Address: 3/F, Block 2, Nanyou Tianan Industrial Park, Nanshan District Shenzhen, China
Web: http://www.leadshine.com

Sales Hot Line:
Tel: 86-755-2641-7674 (for Asia, Australia, Africa areas)
     86-755-2640-9254 (for Europe areas)
     86-755-2641-7617 (for America areas)
Fax: 86-755-2640-2718
Email: sales@leadshine.com.

Technical Support:
Tel: 86-755-2641-8447, 86-755-2641-8774, 86-755-2641-0546
Fax: 86-755-2640-2718
Email: tech@leadshine.com(for All)

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