



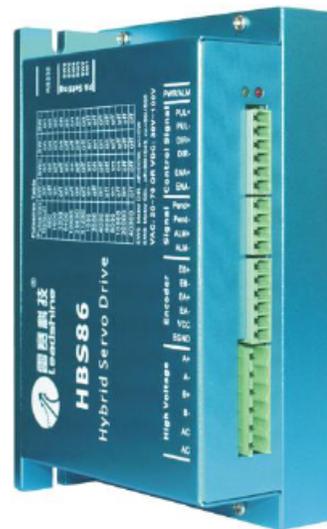
# Hardware Installation Manual

## HBS Series Hybrid Servo

HBS57

HBS86

HBS86H



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## Safety Items

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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.

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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.

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

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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.

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

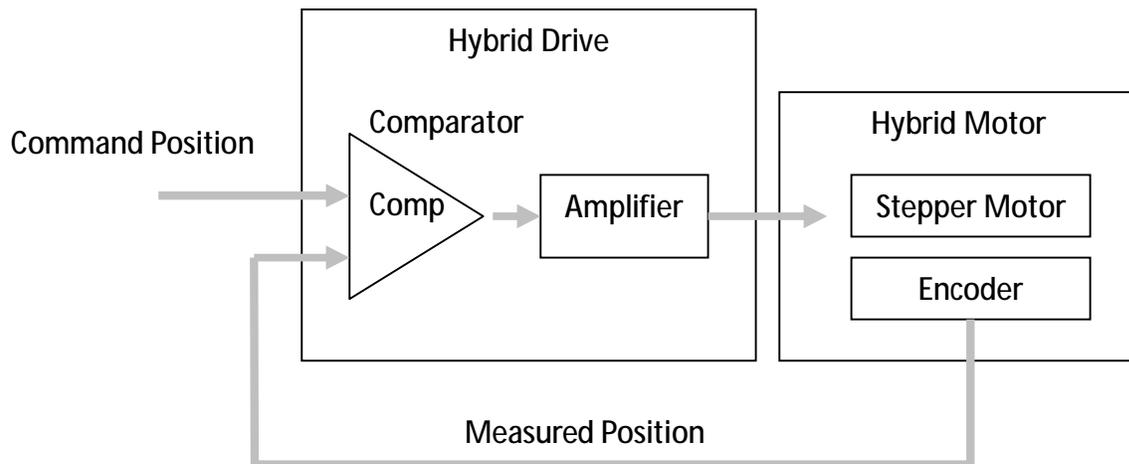
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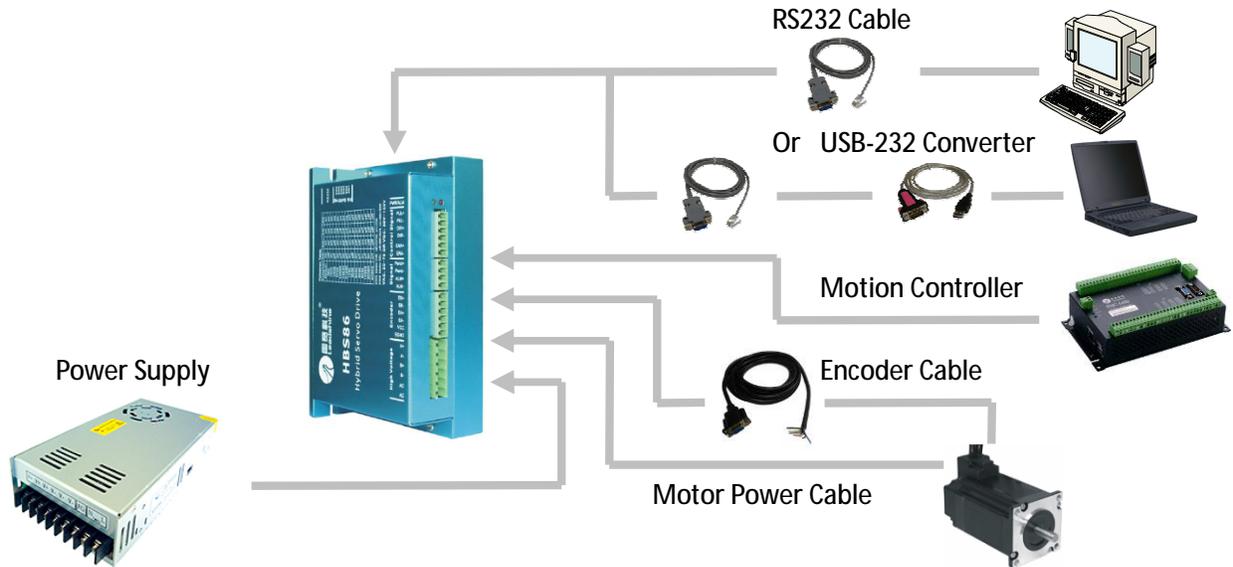
## ***Introduction to HBS***

The HBS (Hybrid Servo Series) series hybrid servos offer an alternative for applications requiring high performance and high reliability when the servo was the only choice, while it remains cost-effective. The system includes a hybrid 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***

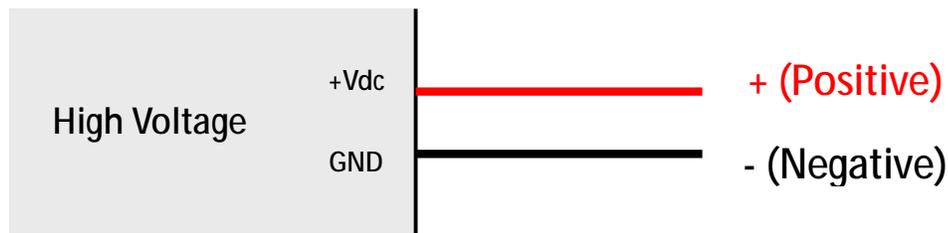
To get start you need one HBS drive, one hybrid motor (stepper drive with encoder) and one power supply for a first time evaluation. A full installation should include an indexer such as pulse generator, PLC or motion controller. A PC with at least one serial port or one PC with USB-RS232 converter, you can rotate the motor in PC software. It is recommended to use an indexer instead of PC software to verify the full function of the HBS drive and motor.



## Connecting Power Supply

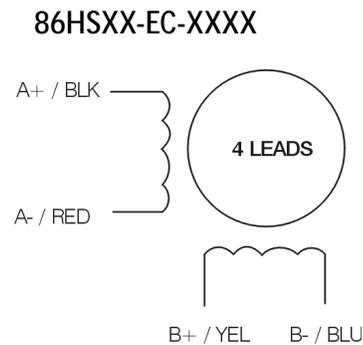
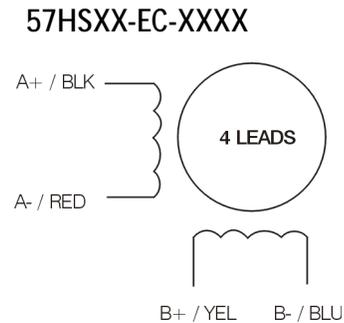
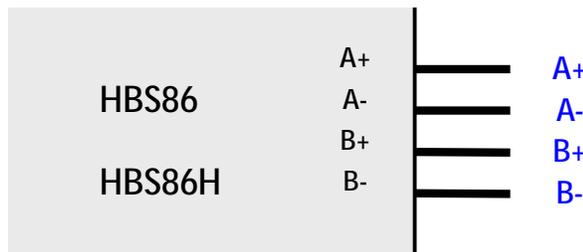
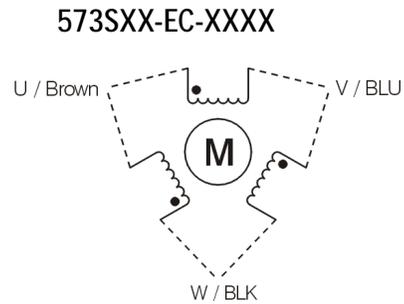
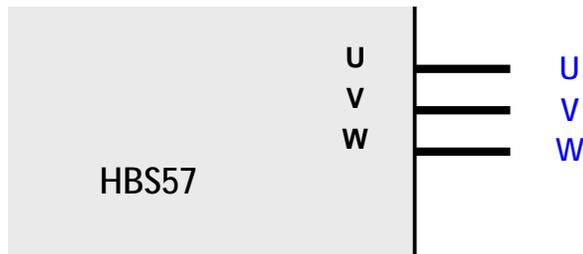
Power supply connection is the simplest thing through this manual because it has only two wires: positive wire and negative wire. However you should caution the incorrect connection polarity. The HBS drive has a 6-pin pluggable screw connector that is used for both power supply connection and motor connection. 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 off when you make the above connection.

*Note: Do not exceed the input voltage range of the HBS drive. Please consult Power Supply Selection chapter for the recommended supply voltage.*



## Connecting Motor

The HBS motor has 4 wires: A+, A-, B+ and B-. Just connect them to the corresponding terminals of the HBS drive. Refer to the HBS drive or the HBS motor datasheet for the detailed motor specification and wiring diagram.

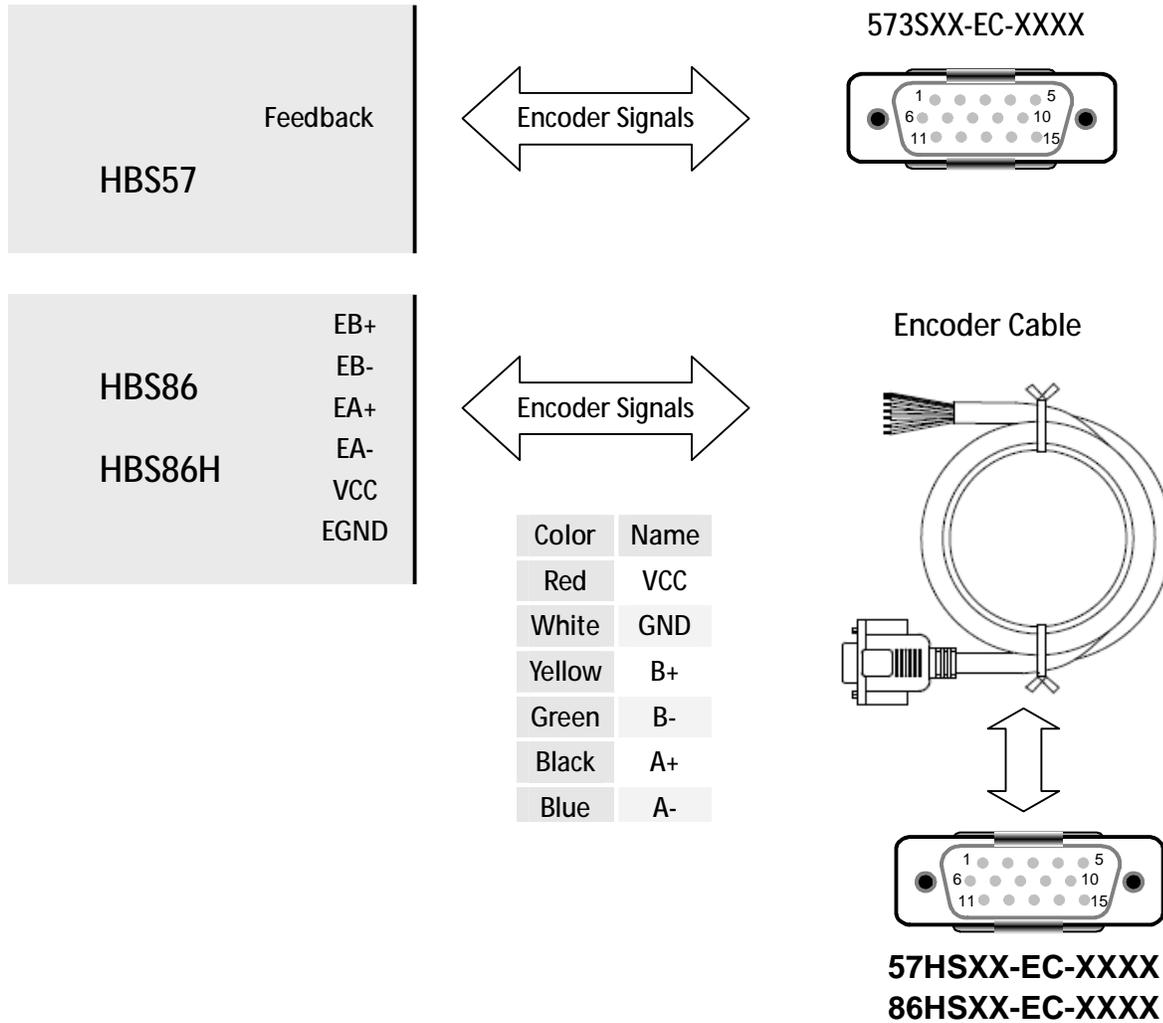


## Connecting Encoder

As the HBS drive works in close-loop mode, it must know the actual motor position. The encoder mounted in the motor offers such information. Note that the HBS drive will not work without encoder feedback.

For HBS86 or HBS86H, as the encoder output of the motor is a HDD15 (High Density D-Sub 15-pin connector) but the drive's encoder input is a screw terminal, you need one more extension/conversion cable for the encoder signal connection between drive and motor. One end of this extension/conversion cable is a HDD15 socket and the other end is 6 flying wires with the cable shielding. For HBS57, the encoder output can be connected to HBS drive directly.

Please refer to the HBS motors datasheet for the HDD15 connector pin out the extension/conversion cable wire color definition.

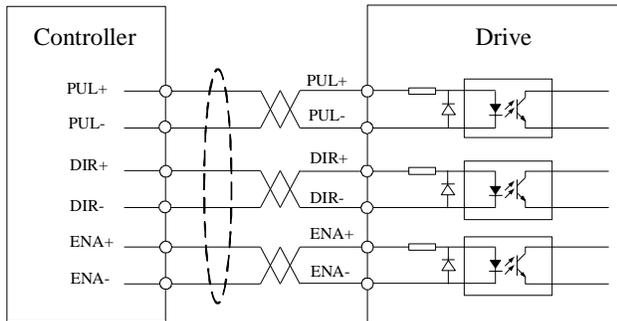


## Connecting Control Signal

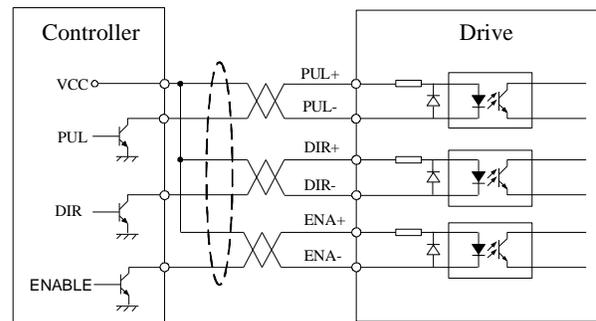
The HBS drive accepts Pulse/Direction or CW/CCW control signals from 5V to 24V. As the drive's signal input is differential, it can also interface with PNP (Sourcing) or NPN (Sinking) type control signal. If the controller's output circuit is PNP (Sourcing) type, the pulse, direction and enable signal share the same ground terminal from the controller. And if the controller's output circuit is NPN (Sinking) type, both the pulse, direction and enable signal are refer to the same positive terminal (5V/24V) from the controller.

For the enable signal, apply 0V between ENA+ and ENA- or leave them unconnected to enables the drivel. If it is unnecessary to disable the drive, just leave it unconnected.

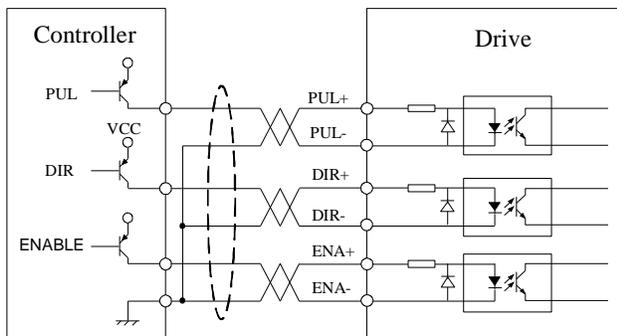
### Connecting to Differential Control Signal



### Connecting to NPN (sinking) Control Signal



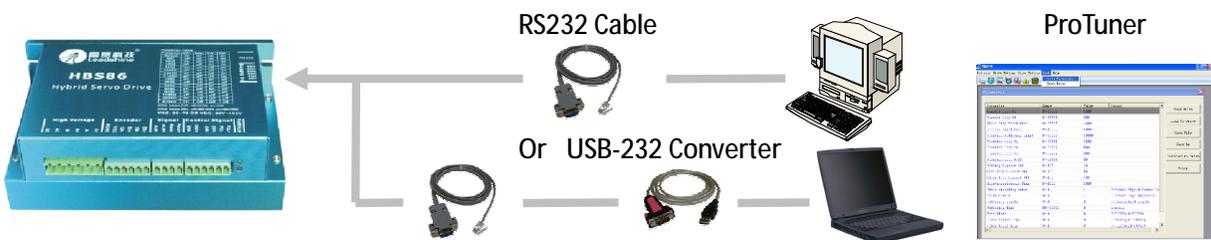
### Connecting to PNP (sourcing) Control



## Connecting to PC Software

There is a RS232 communication port in the HBS drive. It is used to communicate with the tuning software in PC and configured the drive. You can even rotate the motor in the software if you don't have a motion controller.

To connect HBS drive to PC software, first download the software from our website: <http://www.leadshine.com>. You may also get it from our CD however it is recommended to get it from the website because it is always the latest one. Install this software in your PC and make it ready for use later.

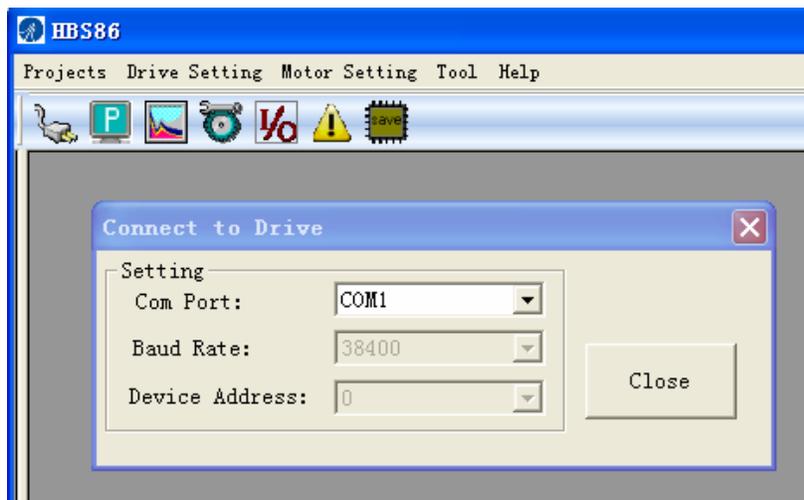


The second thing is the RS232 communication cable. It should be shipped with the kit if you include it in the order. It is still possible to make this cable by yourself. One end of this cable is a RJ-11 header and the other end of cable is a 9 pin D-Sub female connector.

The third thing is the serial port. If your PC does not have serial port, a USB-to-Serial converter is needed. Thus you can use this converter to simulate the serial port from a USB port.

Connect the HBS drive to the PC's serial port or the UBS-232 converter via the RS232 communication cable. The power should be turned off when you perform any connections! Turn on the power and start the software in PC.

The software appears a Connect to drive window when you open it. The baud rate and device address are fixed and you only need to select the com port as per 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.



## HBS Drive Configuration

It is necessary to configure the HBS drive for different HBS motor before sending pulse to it. The drive should be properly configured before power-up. Otherwise you may encounter the problems like high motor heating, big motor noise or even motor stall due to weak torque. For a quick start of the HBS servo, there are not much parameters need to be configured. The following table gives the most significant parameters of the HBS drive.

Most Significant Parameters of the HBS Drive

	HBS57	HBS86, HBS86H
Micro Step Resolution (PPR)	4000 (Software)	1600 (DIP Switch)
Holding Current Percentage (%)	60% (Software)	60% (Software)
Close-loop Current Limit Percentage (%)	100% (Software)	100% (Software)
Current Loop Kp	<i>Auto Tuning At Power-up</i>	1500 (Software)
Current Loop Ki	<i>Auto Tuning At Power-up</i>	200(Software)
Applied Motor	573S09-EC-XXXX 573S20-EC-XXXX	86HS80-EC-XXXX 86HS40-EC-XXXX
Matching Supply Voltage	24-36VDC	60-100VDC

By default, the HBS86 and HBS86H are configured according to the 86HSXX-EC-XXXX on 60VDC. The HBS57 is configured automatically at power-up according to the connected motor and supply voltage. For other HBS motors, it is recommended to modify these settings to get the optimizing performance as shown in the following tables.

Recommended Holding / Close-loop Current Percentage

	573S09-EC	573S20-EC	57HS10-EC	57HS20-EC	86HS40-EC	86HS80-EC
Holding Current (%)	60%	60%	40%	60%	60%	60%
Close-loop Current Limit (%)	100%	100%	100%	100%	100%	100%
HBS Drive	HBS57	HBS57	HBS86	HBS86	HBS86	HBS86

Recommended Current Loop Kp / Ki of Different Supply Voltage

HBS Motor	HBS Drive	24VDC	36VDC	48VDC	60VDC
57HS10-EC-XXXX	HBS86	1500 / 200	1000 / 300	800 / 250	N/A
57HS20-EC-XXXX	HBS86	3700 / 200	2000 / 300	1500 / 200	N/A
86HS40-EC-XXXX	HBS86(H)	N/A	4400 / 200	3000 / 200	2300 / 200
86HS80-EC-XXXX	HBS86(H)	N/A	4400 / 200	3000 / 200	2300 / 200

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

### Configuring HBS Drive by DIP Switches

There are 6 bits DIP switches in the HBS86 and HBS86H drive. SW1 to SW4 are used to set the micro step resolution and SW5 are used to set the direction polarity.



- 1) The 2-bit DIP switch in the HBS57 drive is not used. Ignore it.
- 2) The SW6 in HBS86 and HBS86H has no used.

6-bit DIP Switches in HBS86/HBS86H

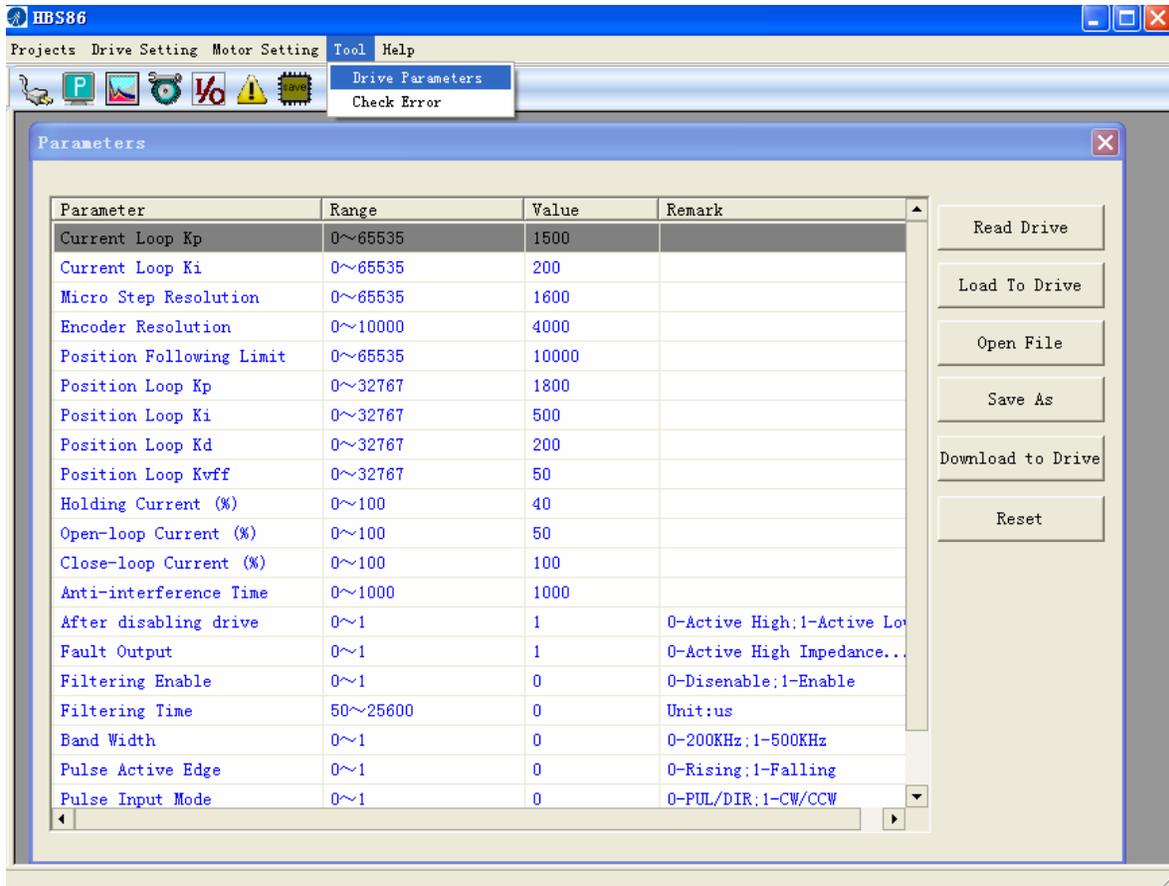


## HBS86 and HBS86H Micro Step Resolution Setting

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 HBS Drive in PC Software

Please consult the Connecting to PC Software chapter for how to connect the HBS 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. Please consult the HBS Drive Configuration chapter for the recommended settings of different HBS motor. Please refer to the software manual for more information.



## 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:

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

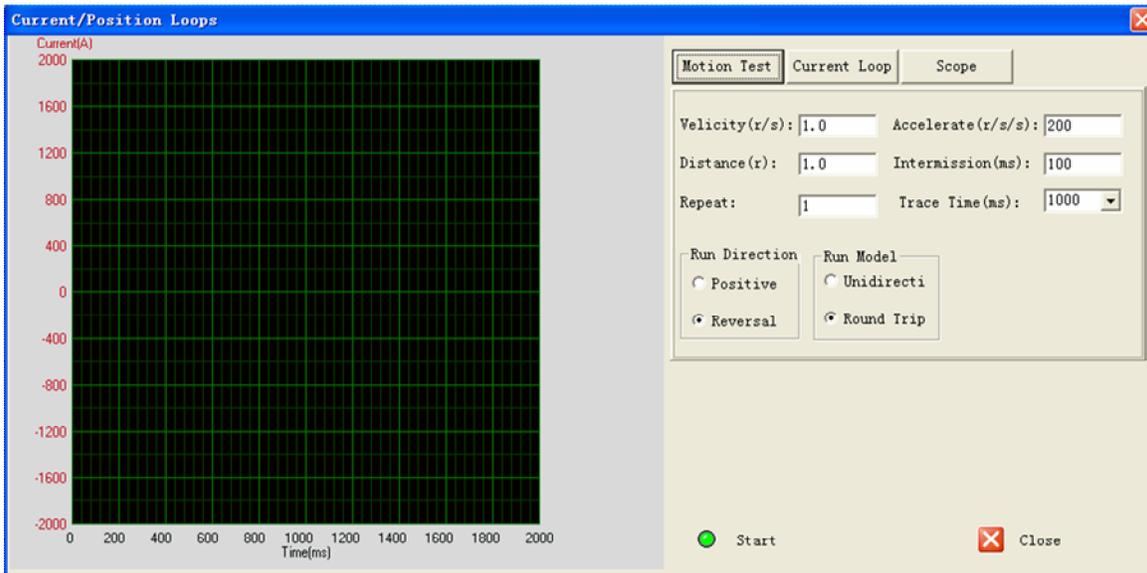
$$\text{Rotation Angle (}^\circ\text{)} = 360 * \text{Pulse (Step) Counts} / \text{Micro Step Resolution}$$

## Rotating the HBS Motor by Motion Controller

Now everything is ready. 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 HBS servo however the maximum running speed will be determined by the input voltage and current setting.

## Rotating the HBS Motor in PC Software

Not everyone has a motion controller. Or you may not know what motion controller is and how to buy one. But you should have a personal computer which has at least one serial port or USB port. You can rotate the HBS motor in PC software! There is a simple emulating controller that is used for self-test in the HBS 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 HBS drives or verify the connection in case of problem. However, the performance you see in this emulating controller PC software CAN NOT represents 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.

## Power Supply Selection

To achieve good driving performances, it is important to select supply voltage and output current properly. 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.

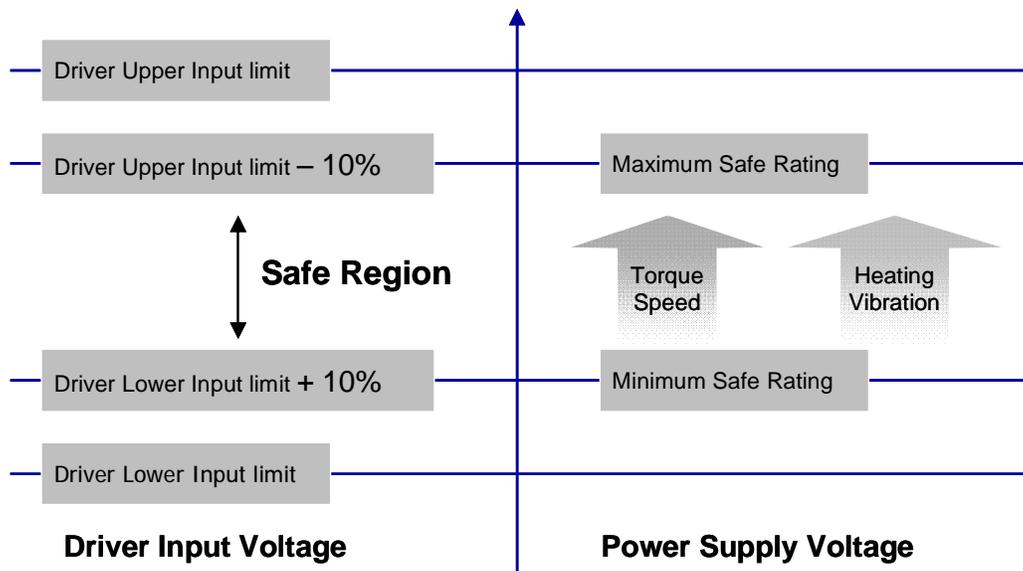
## Multiple Drives

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
57HS09-EC-XXXX	HBS57	DC(20-50)V	DC 24V	RPS2410(-L)
57HS20-EC-XXXX	HBS57	DC(20-50)V	DC 36V	RPS369
57HS10-EC-XXXX	HBS86	DC(30-80)V	DC 36V	RPS369
57HS20-EC-XXXX	HBS86	DC(30-80)V	DC 36V	RPS369
86HS40-EC-XXXX	HBS86	DC(30-80)V	DC 60V	RPS608
86HS80-EC-XXXX	HBS86	DC(30-80)V	DC 60V	RPS608

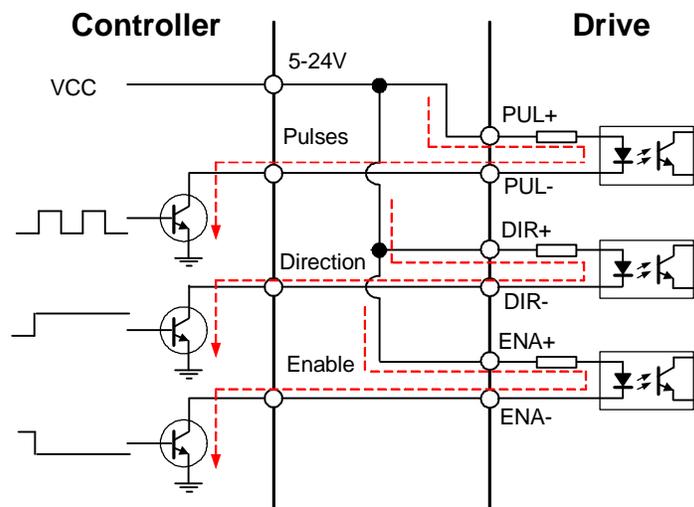
## Control Signal Wiring

The HBS drive accepts both differential and single-ended control signals (including open-collector and PNP output). Make sure the output port of the controller can sink or source 10mA at the least. If you encounter the problem that motor does not rotating or losing steps, check whether or not the controller can maintain 5V/24V output at any current and pulse frequency.

If the cable length is greater than 50cm, it is recommended to use twisted shielded pair cable for these signal. Do not put the control signal cable together with the cables which is used for high power or high current equipment, in case of electronic interference coupled into the control signal.

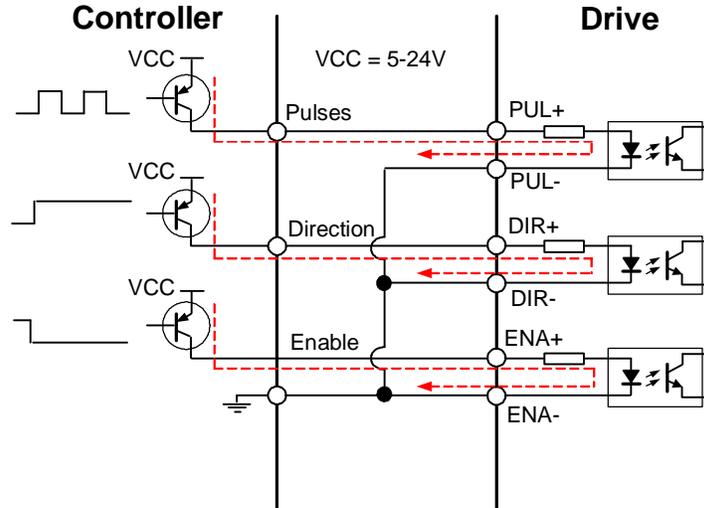
### NPN (Sinking) Control Signal Wiring

If the motion controller is not differential output type, NPN type is recommended as it can sink more current than PNP type. In this wiring, Pulse, Direction and Enable signal share the same VCC (positive) terminal.



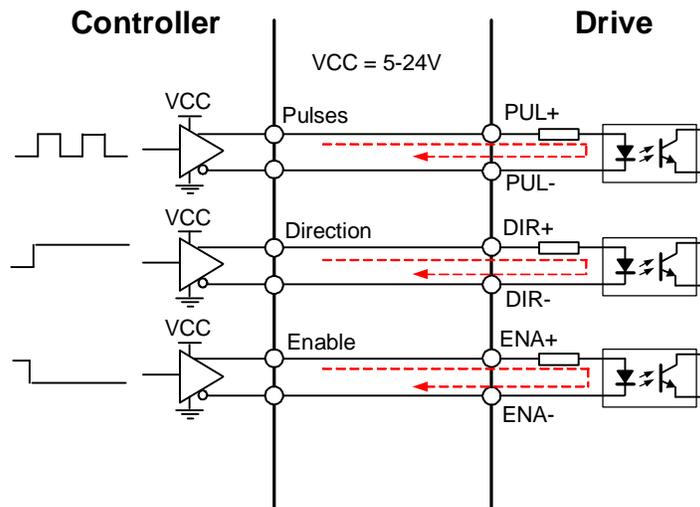
## PNP (Sourcing) Control Signal Wiring

In this wiring, Pulse, Direction and Enable signal share the same ground (negative) terminal.



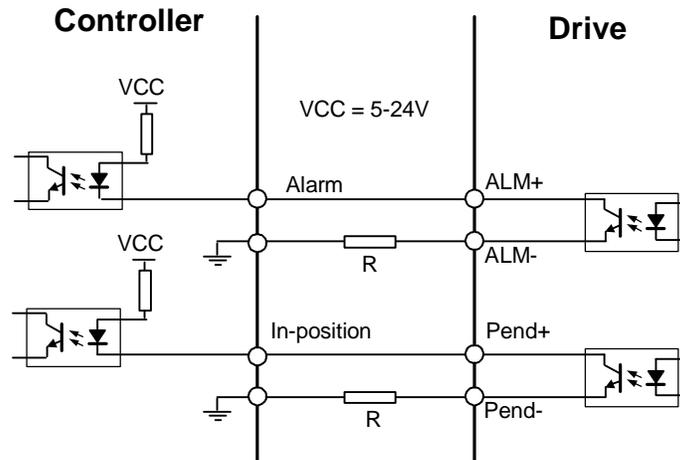
## Differential Control Signal Wiring

For the differential output controller, connect to the HBS drive accordingly.



## Output Signal Wiring

The HBS drives offers ALM (alarm) signal to indicate the error status. The HBS86 has the in-position (Pend+ / Pend-) to indicate the achievements of the target position. That is, the motor have been in the position you want it to be. These signals are OC (Open Collector) output and can sink or source 50mA current.



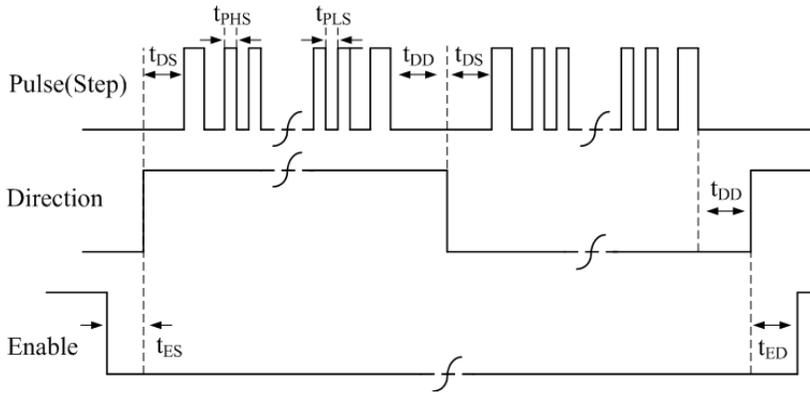
Note: Series resistor R should be added when there is no limit resistor in the controller.

## 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.

## Control Signal Setup Timing

To make a reliable operation, the HBS 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 DelayTime
$t_{ES}$	Enable Setup Time
$t_{ED}$	Enable Delay Time

### Control Signal Setup Time

Drive	Frequency	$t_{DS}$	$t_{PHS} / t_{PLS}$	$t_{DD}$	$t_{ES}$	$t_{ED}$
HBS57	200K	>50uS	>2.5us	>50uS	>200ms	>200ms
HBS86(H)	200K	>50uS	>2.5us	>50uS	>200ms	>200ms

## 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 HBS 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 HBS 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.

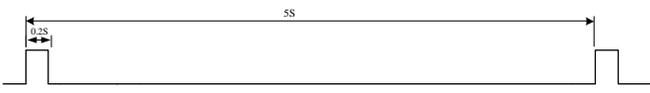
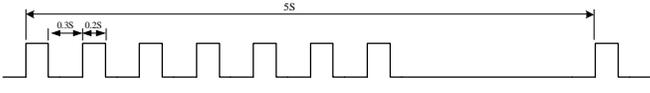
Low holding current can reduce motor heating however also reduces the holding torque which is used to lock the motor shaft at standstill. It is recommended to determine the holding current by whether or not there is big vibration at start-up and how much lock torque is required, based on your actual 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 HBS incorporates some built-in protection functions. The HBS 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
	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](mailto: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](mailto:tech@leadshine.com)(for All)

Leadshine U.S.A

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Tel: 1-949-608-7270

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