Hardware Installation Manual

Integrated Stepper Motor

iST-17xx   IST-23xx

Safety Items

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 to 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 middle before trying to run the motor.
Warning	Never disconnect the motor lead when the power source is energized.

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Introduction to Integrated Easy Servo Motor

Leadshine's iST (Integrated Stepper) motor is a stepper motor integrated with an advanced DSP stepper drive. At very compact size and with all components integrated, the iST motor can save mounting space, eliminate motor wiring time, reduce interference, and cut/reduce cable and labor costs. By adopting Leadshine's latest current control technology, the drive of the iST motor can drive the stepper motor with high precision, smooth movement, and extra low noise at low speed movement with no obvious resonance area.

Applications

Leadshine's IST motor can be used in various applications such as laser cutters, laser markers, high precision X-Y tables, labeling machines, CNC router, etc. Its unique features make the IST motor an ideal choice for applications that require both low-speed smoothness and small mounting space.

Getting Start

To get start you need one integrated stepper motor, one DC power supply and one motion controller. The motion controller such as indexer, pulse generator or PLC is only required 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. There is also a DIP switch for self-motion of the IST motor without controller. However it is recommended to verify the complete function of the integrated stepper motor using a motion controller.

Wiring Diagrams
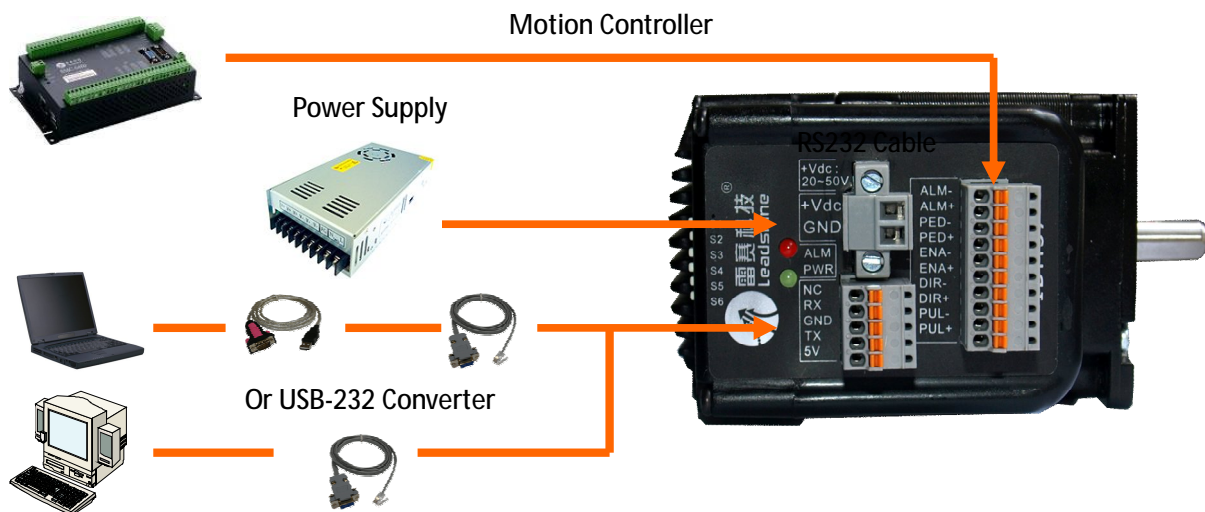
Wiring Diagram of integrated stepper motor IST-23XX
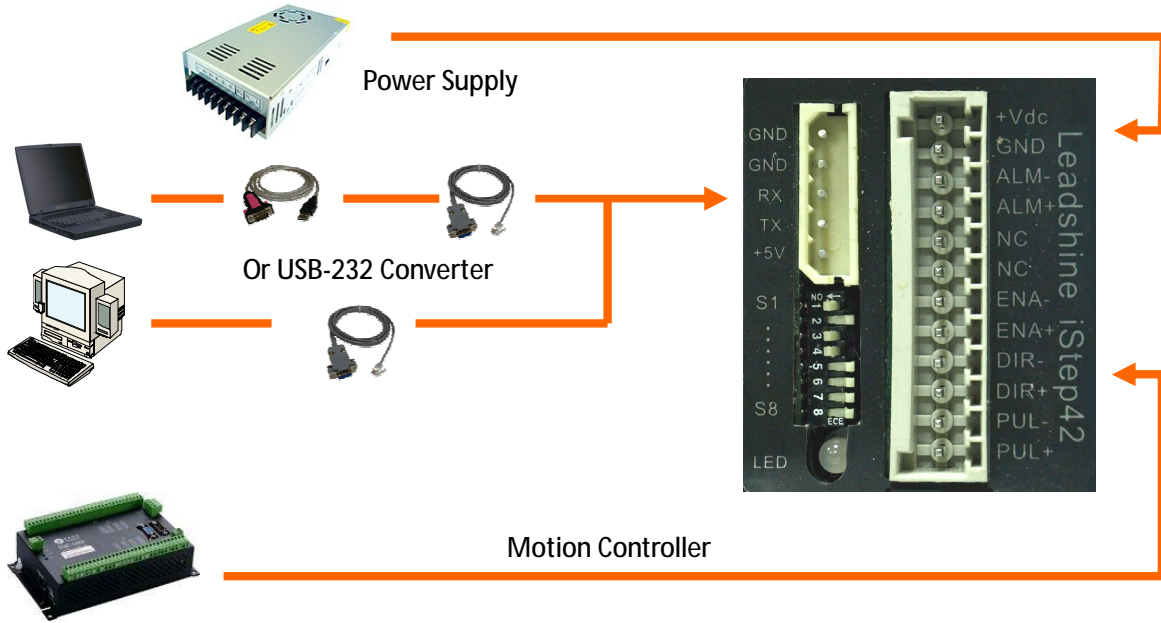
Wiring Diagram of integrated stepper IST-17XX

Connecting Power Supply

The IST motor accepts DC power input. The power connections are only the positive and negative wires. However you need to pay attention to wire polarity. A 2-pin pluggable screw connector is used for power supply connection. Looking at the drive front 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 switch off when you make the connections. *Note: Do not exceed the input voltage range of the IST drive. Please consult Power Supply Selection chapter in the manual for the recommended supply voltage.*
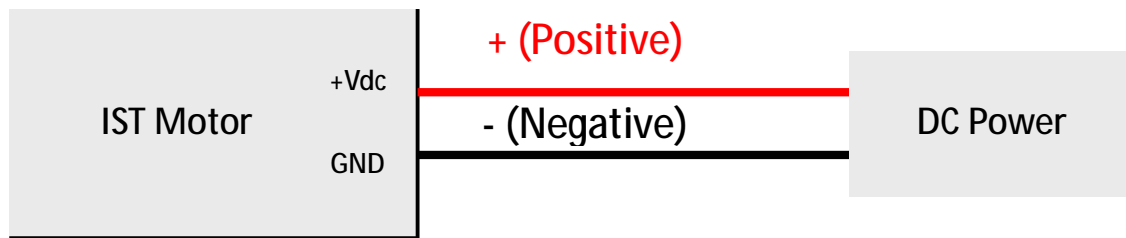
DC power connection of IST motor

Connecting Motion Controller

Pulse, Direction, Enable Input

The pulse, direction and enable input of the IST motor 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 drivel. If it is needn't to disable the drive, just leave it unconnected.

In a NPN (sourcing) type output, the control signals share the same positive terminal VCC.
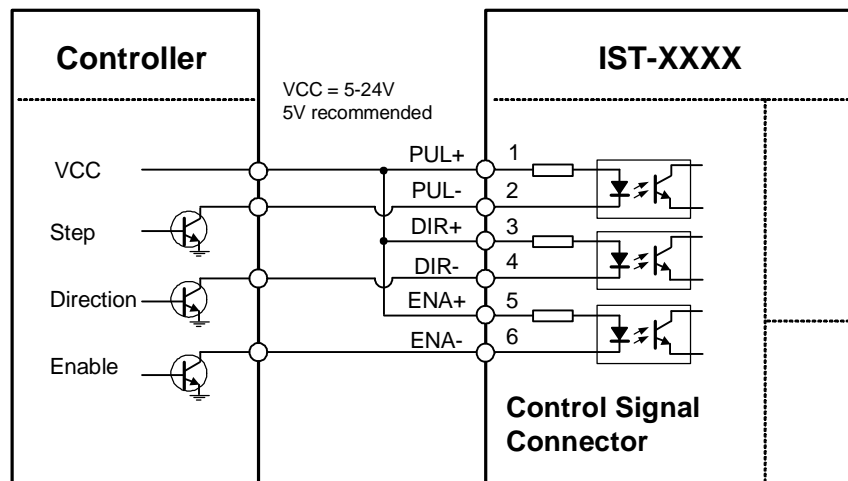
Connect IST-XXXX to NPN (sinking) type controller

In a PNP (sinking) type output, the control signals are refer to the same ground terminal.
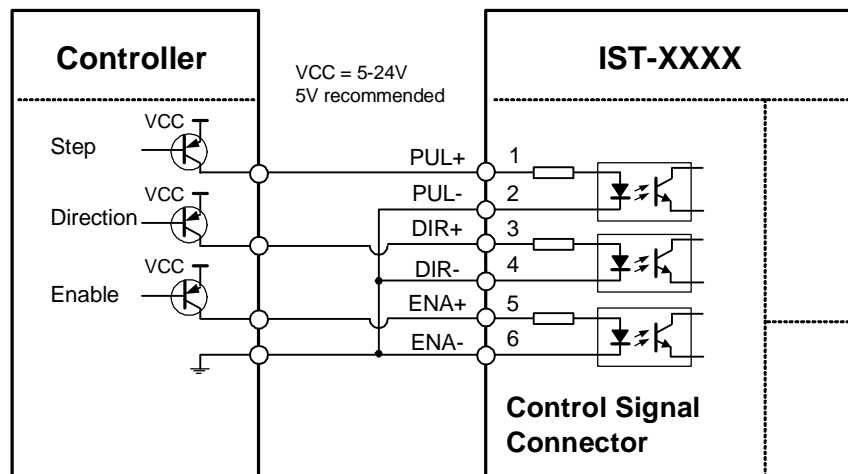
Connect IST-XXXX to PNP (sourcing) type controller

Leadshine

Pulse, Direction, Enable Input (Continued)
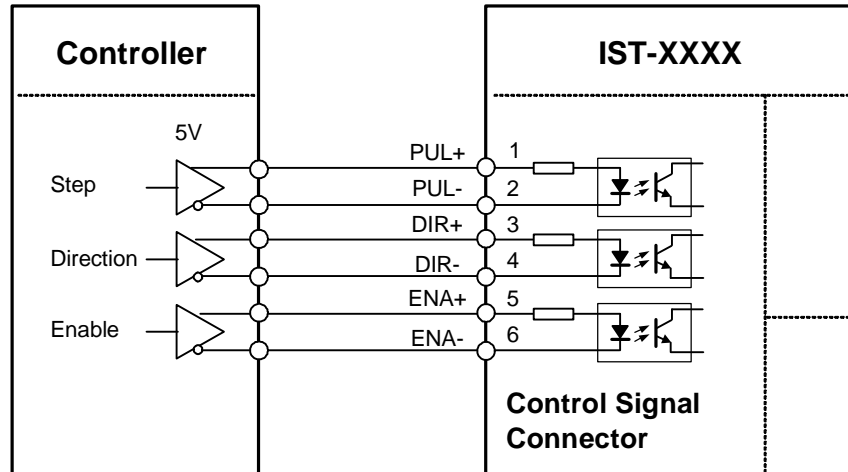
Connect IST-XXXX to differential type controller

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.
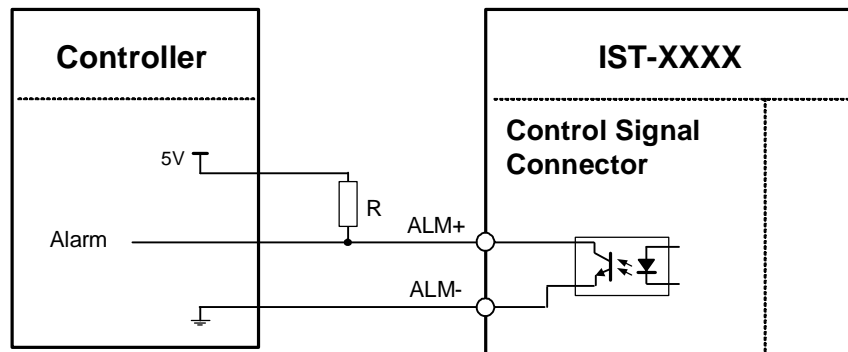
Alarm, in-position signal connection of IST-XXXX

Connecting PC

A RS232 communication port is built into the integrated servo drive 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 integrated 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 on your PC and make it ready for use later.

RS232 Cable   ProTuner

Or   USB-232 Converter

RS232 connection of IST-XXXX
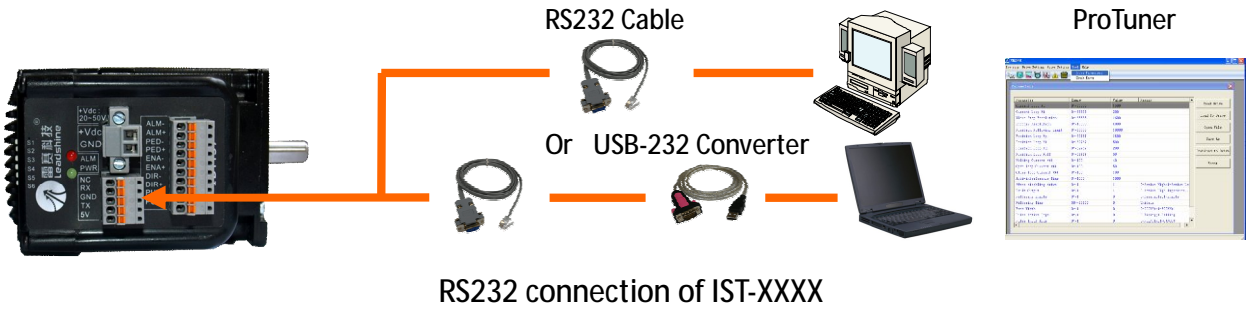
A RS232 cable is needed for the communication between the drive's RS232 port and the PC's serial port. It will be shipped with the kit if you include it in the order. It is also possible to make this cable yourself. One end of this cable is a RJ-11 header and the other end of cable is a 9 pin D-Sub female connector. If your PC does not have a serial port, a USB-to-Serial converter which simulates the serial port is required. 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.
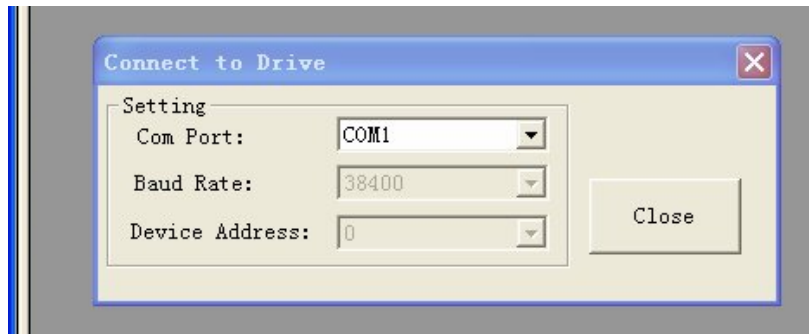
Configuration

There are not much parameters need to be configured for the integrated servo motor. You can configure it by the DIP switch or PC software.

Configuring IST drive by DIP Switches

IST-23XX

A 6-bit DIP switch on side of the IST-23XX can be used to set the micro step, motion direction and active of pulse.

Micro Step Resolution-S1-S4				
Steps/Revolution	S1	S2	S3	S4
Software Configured (Default 4000)	On	On	On	On
800	Off	On	On	On
1600	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

Motor Rotation Direction – S5
DIP switch S5 is used for changing motor shaft rotation direction. Changing position from "ON" to "OFF", or "OFF" to "ON" will reverse IST-XXXX motor's rotation direction.

Self-test – S6
Off: Normal mode. On: Self-test mode, 5/4 revolutions CW and then 5/4 revolutions CCW.

Configuring IST drive by DIP Switches (Continued)

IST-17XX

Micro Step Resolution-S1-S4				
Steps/Revolution	S1	S2	S3	S4
Software Configured (Default 400)	On	On	On	On
800	Off	On	On	On
1600	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

Motor Rotation Direction – S5
DIP switch S5 is used for changing motor shaft rotation direction. Changing position from "ON" to "OFF", or "OFF" to "ON" will reverse IST-XXXX motor's rotation direction.

Pulse Active of Input Edge – S6
On: Active rising edge of input pulse, Off: Active falling edge of input pulse

Self-test – S7
Off: Normal mode. On: Self-test mode, 5/4 revolutions CW and then 5/4 revolutions CCW.

Auto Current Reduction – S8
Off: Enable auto current reduction. The reduction rate is software-configurable and its default value is 50%. On: Disable auto current reduction.

Configuring IST drive in PC Software

There are not much configurable parameters in ProTuner. The default values of them should suitable for most of the application. 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:

Rotation Speed (RPM) = 60 * Pulse (Step) Frequency / Micro Step Resolution
Rotation Angle (°)   = 360 * Pulse (Step) Counts / Micro Step Resolution

Rotating the IST Motor

Rotating the IST Motor by Motion Controller

You can start the motion controller (indexer, PLC, pulse generator...) to rotate the motor. Actually, any euipment which gives high-to-low or low-to-high level changes can be used to rotate 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 IST however the maximum running speed will be determined by the input voltage and current setting.

Rotating the IST Motor in Self-test Mode

Double check the power connection and apply power to the IST motor. The green LED should be on. The red LED should be off. Toggle the SW7 (IST-17XX) or SW6 (IST-23XX) to "ON" position. The motor shaft rotates 1 revolutions CW and then 1 revolutions CCW. It repeats until S7 (IST-17XX) or S6 (IST-23XX)) is set to the "Off" position (the motor shaft will stop immediately).

Rotating the IST Motor in PC Software

There is a simple emulating controller built inside ProTuner. It is not a full functionality controller but it is useful when you do not have a motion controller rotate the motor. You can specify the speed, acceleration and move distance for a motion. However, the performance in the emulating controller of the PC software CAN NOT represent the actual motion controller. Refer to the software manual for more information.

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
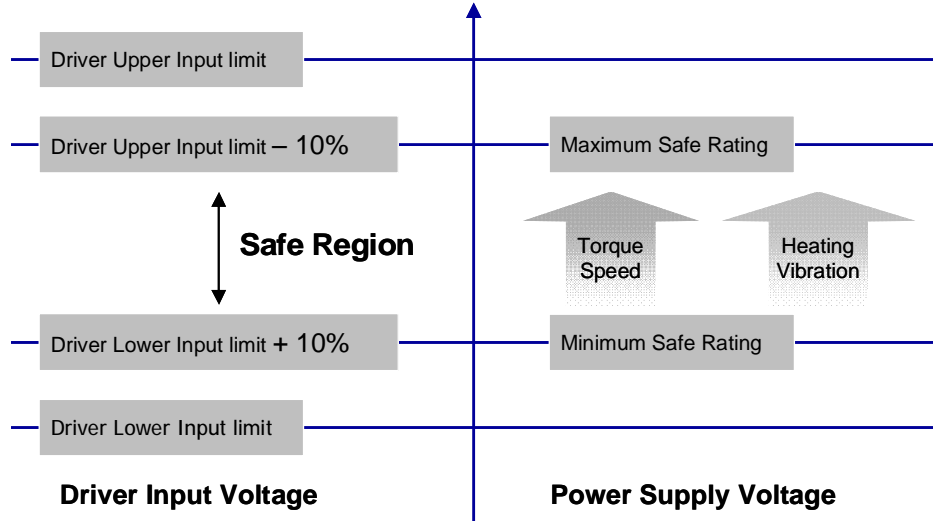
Recommended Supply Voltage

Both Leadshine's regulated and unregulated power supply has been designed specially for motion control.
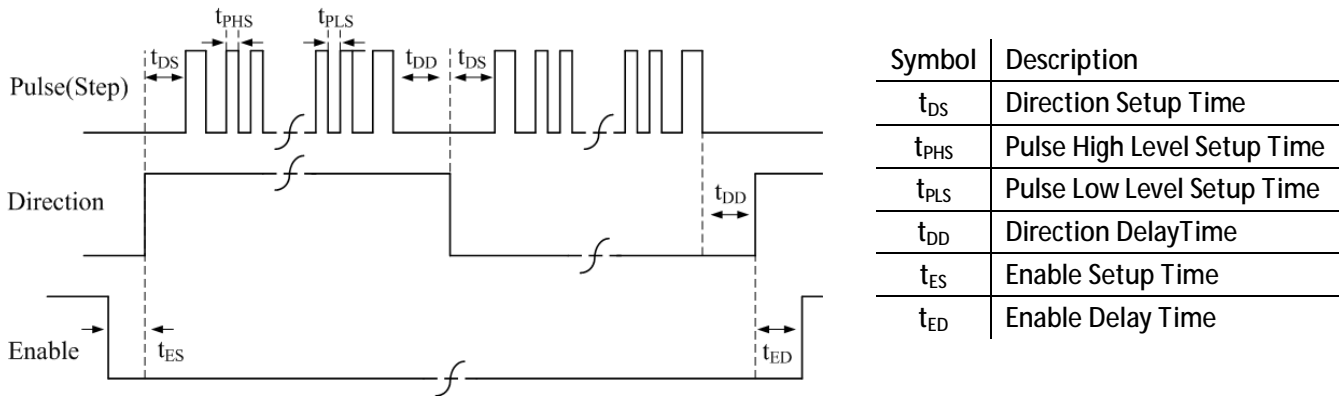
Model	Input Voltage Range	Typical Voltage	Leadshine Power Supply
IST-17XX	DC(18-38)V	DC 24V	RPS2410(-L)
IST-23XX	DC(18-50)V	DC 36V	RPS369

Wiring Notes

l   In order to improve anti-interference performance of the drive, 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 and 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.

Control Signal Setup Timing

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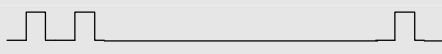

Symbol	Description
t_{DS}	Direction Setup Time
t_{PHS}	Pulse High Level Setup Time
t_{PLS}	Pulse Low Level Setup Time
t_{DD}	Direction DelayTime
t_{ES}	Enable Setup Time
t_{ED}	Enable Delay Time

Control Signal Setup Time

Drive	Frequency	t_{DS}	t_{PHS} / t_{PLS}	t_{DD}	t_{ES}	t_{ED}
IST-17xx	200K / 500K	>5uS	>2.5us / >1.0us	-	>50ms	>5us
IST-23xx	200K / 500K	>5uS	>2.5us / >1.0us	-	>50ms	>5us

Protection Functions & indications

To improve reliability, the IST incorporates some built-in protection functions. The Integrated stepper 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 activated when peak current is greater than the limit
2nd	2		Over-voltage protection activated when drive working voltage is greater than the limit.

Protection Functions & indications (Continued)

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 limit, 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 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.

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
	Micro step 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

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