Hardware Installation Manual for DM805-AI

Digital Stepper Drive with Analog 0-5V Input

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1. Introduction, Features and Applications

Introduction

The DM805-AI is a 0-5V input stepper drive with built-in oscillator which is based on the latest digital control algorithm. It brings a unique level of system smoothness, providing optimum torque and nulls mid-range instability. Motor self-test and parameter auto-setup technology offers optimum responses with different motors and easy-to-use. The driven motors can run with much smaller noise, lower heating, smoother movement than most of the drivers in the markets. Its unique features make the DM805-AI an ideal solution for applications that require low-speed smoothness.

The three built-in potentiometers are used to preset and adjust the velocity, acceleration and deceleration. In 0-5V speed mode, the motor speed is controllable and follows the analog 0-5V input. In Low/HIGH speed mode, the motor speed is selected by digital input and adjusted by the high/low speed potentiometers. The user can run the motor with the least configuration and connection. In position mode, the DM805-AI is a traditional stepper drive. There is a 5V power supply output for customer use.

Features

- Anti-Resonance, provides optimum torque and nulls mid-range instability
- Motor self-test and parameter auto-setup technology, offers optimum responses with different motors
- Multi-Stepping allows a low resolution step input to produce a higher microstep output for smooth system performance
- Command Source: 0-5V, built-in potentiometer and pulse
- Two preset velocity and adjust by built-in potentiometer
- Preset acceleration/deceleration and adjust by built-in potentiometer
- Velocity control mode via analog 0-5V and position control mode via pulse
- Built-in pulse generator nulls external motion controller
- Supply voltage up to +80 VDC
- Output current programmable, from 0.3A -5.0A(RMS)
- TTL compatible and optically isolated digital input
- Automatic current reduction
- Over-voltage, over-current, phase-error protections

Applications

This drive is suitable for the application which needs to adjust the velocity via the potentiometer or analog 0-5V command. It can work with the NEMA17/23/34 stepper motor to replace the brushless motor with gearbox due to its high torque and less motor noise at low speed. If necessary, it can be used in various kinds of machines, such as rotary heat exchange, conveyor belts, transport vehicle, laser cutters, laser markers, high precision X-Y tables, labeling machines, and so on.

2. Specifications

General Specifications

Parameter	Min	Typical	Max	Unit
Isolation Resistance	500	-	-	MΩ
Logic Signal Current	7	10	16	mA

Electrical Specifications

Input Voltage

Input Voltage				
Drive Model	Min	Typical	Max	Unit
DM805-AI	18	60	80	VDC

Pulse Input Frequency

Pulse Input Frequency				
Drive Model	Min	Typical	Max	Unit
DM805-AI	0	-	200	kHz

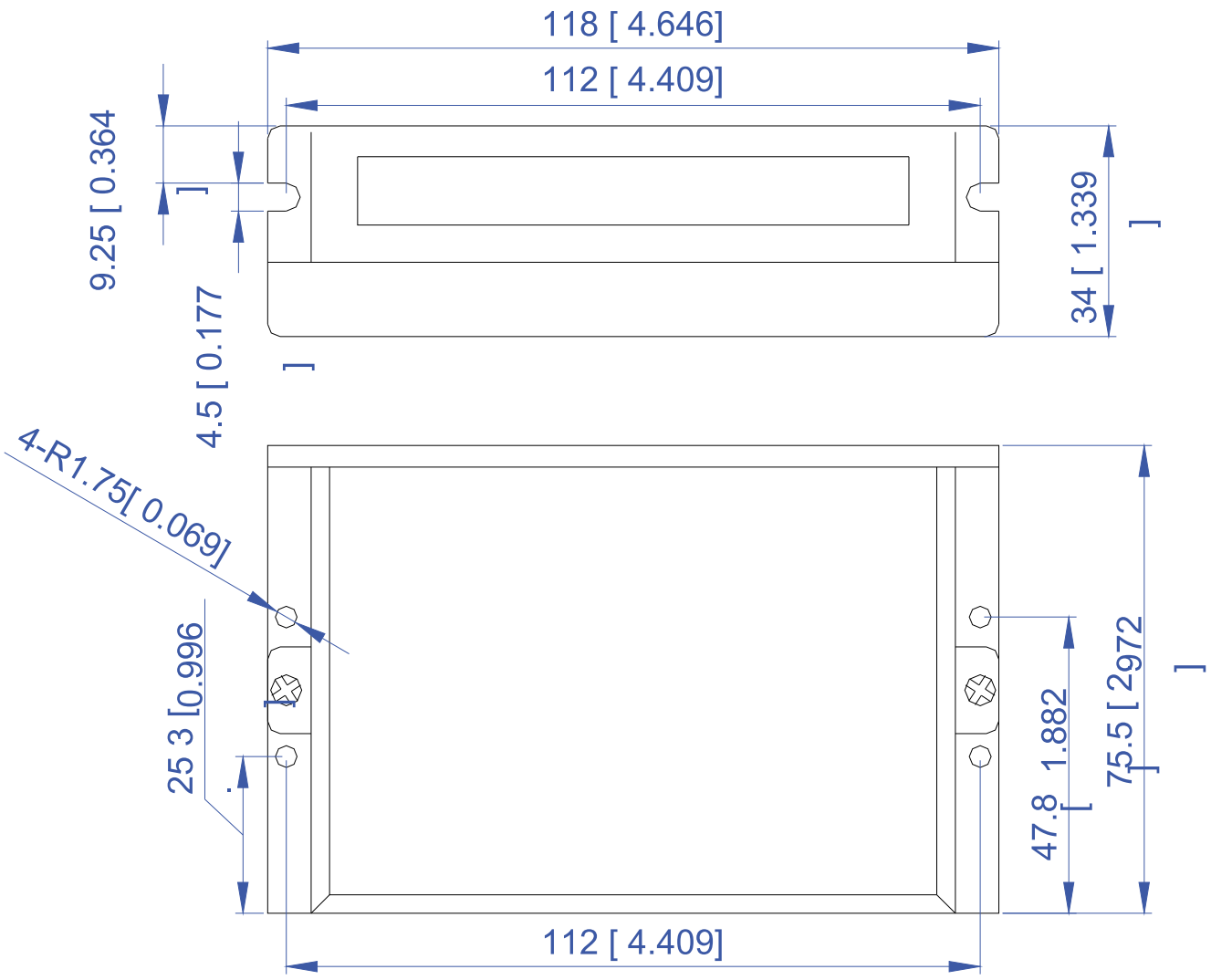
Velocity Control

Item		Specification	Dead Band	Resolution	Min	Max
Analog Input	0-5V Speed Mode	0-5 V	10 mV	10 mV	0 Rev/s	25 ± 0.5 Rev/s
	External POT Mode		20 mV			
Accel / Decel / Ramp Potentiometer		0-25 turns	10 mV	10 mV	0.5 Rev/s^2	250 ± 1 Rev/s^2
LoSpeed Potentiometer		0-25 turns	10 mV	10 mV	0 Rev/s	5 ± 0.01 Rev/s
HiSpeed Potentiometer		0-25 turns	10 mV	10 mV	0 Rev/s	25 ± 0.5 Rev/s

Operating Environment

Cooling	Natural Cooling or Forced cooling	
Operating Environment	Environment	Avoid dust, oil fog and corrosive gases
	Ambient Temperature	0℃ — 50℃ (32℉ — 122℉)
	Humidity	40%RH — 90%RH
	Operating Temperature	70℃ (158℉) Max
	Vibration	5.9m/s^2 Max
Storage Temperature	-20℃ — 65 C (-4℉ — 149℉)	

Mechanical Specifications



Elimination of Heat

- Driver's reliable working temperature should be <70°C(158°F), and motor working temperature should be <80°C(176°F);
- It is recommended to use automatic idle-current mode, namely current automatically reduce to 60% when motor stops, so as to reduce driver heating and motor heating;
- It is recommended to mount the driver vertically to maximize heat sink area. Use forced cooling method to cool the system if necessary.

3. Connectors and Interface

The DM805-AI has three connectors, connector for digital I/O signals connections, connector for analog 0-5V signal connections and connector for power and motor connections. The three parameters are used to preset or adjust the speed, acceleration and deceleration ramp. They have different functions in different modes. The green indicator turns on when the drive is powered on. When error happens, the red indicator flashes periodicity to indicate the error type.

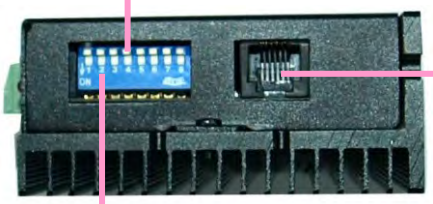
Indicator Green: Power, Red: Fault

Potentiometers Adjusting Speed, Acceleration, Deceleration

Digital I/O Signal Connector, 6-pin screw terminal, 3.81 mm

Analog Signal Connector, 6-pin screw terminal, 3.81 mm

Power Connector, 6-pin screw terminal, 3.81 mm space



Auto Tuning: Switch SW4 two times in one second.

RS232 communication port, RJ11, communicating PC software

Note: It is used to configure and current loop tuning, anti-resonance tuning with the PC software. However, the drive can still work properly without it. The DM805-AI can be fully tuned by the the auto-tuning..

DIP switch, 8 bits, current setting, selecting microstep, operating mode

4. Operating Mode

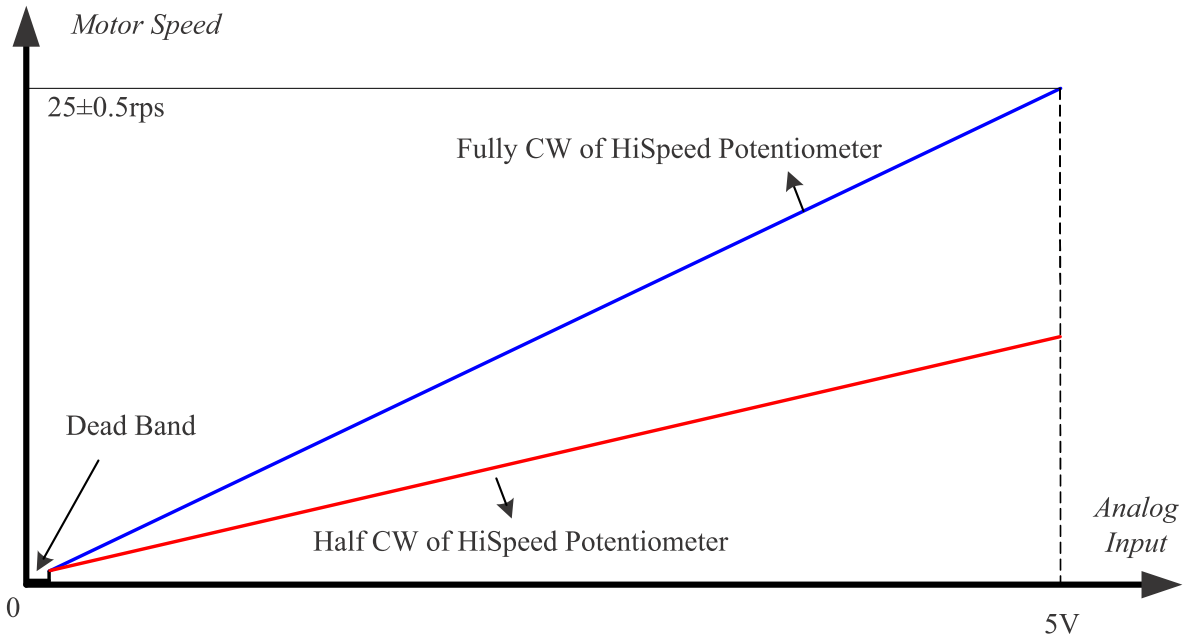
The DM805-AI supports four operating modes selected by the DIP switch SW7 and SW8, shown as the following table.

Mode	SW7	SW8	Description
0~5V Speed	on	on	Analog 0-5V Speed Mode
Lo/Hi Speed	off	on	Low and High Speed Mode
External POT	on	off	External Potentiometer Speed Mode
Pulse/Direction	off	off	Pulse and Direction Position Mode

Analog 0-5V Speed Mode

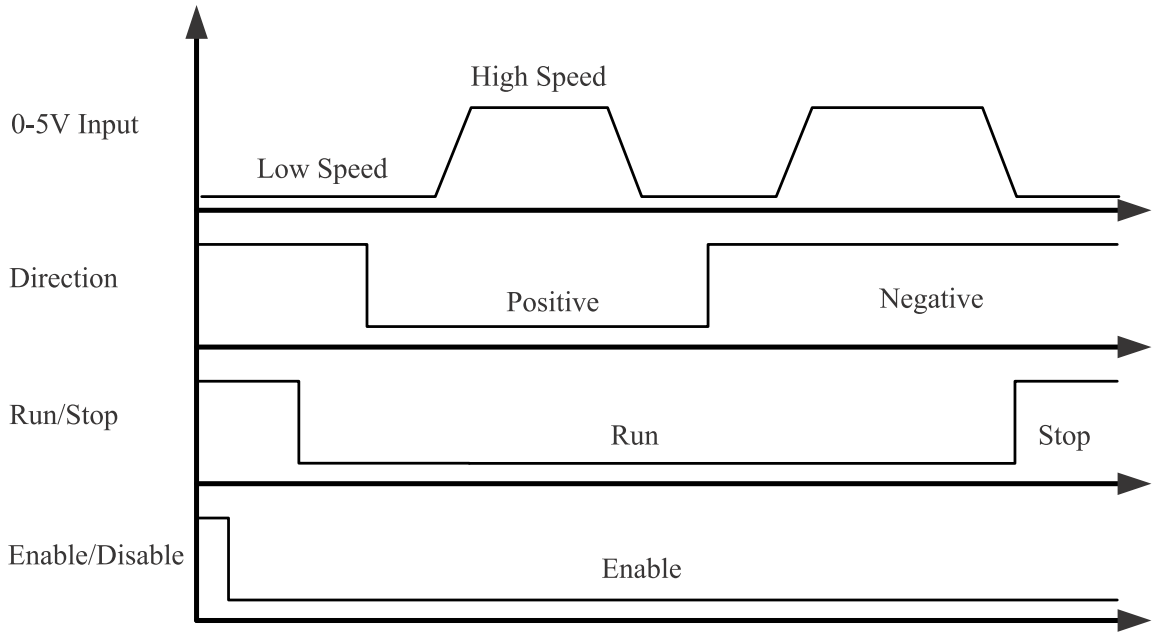
In this mode motor speed follows the analog 0-5V input voltage. Motor speed is also proportional to the HiSpeed potentiometer. Direction input controls the motor direction. The actual motor speed is calculated as follows:

$$Speed(RPS) = 25 \pm 0.5(RPS) \times \frac{Analog\ Input}{5V} \times \frac{Turns\ of\ HiSpeed\ Potentiometer}{25Turns}$$



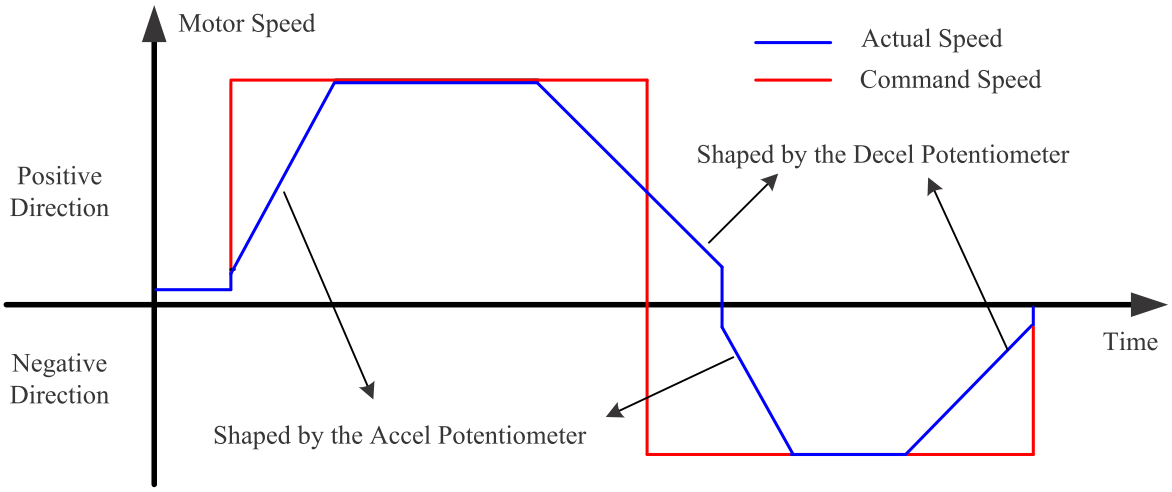
Signal Sequence

After power-up, the DM805-AI does not response to the analog 0-5V input immediately. The Enable and Run signal should be activated prior to the analog 0-5V input. The drive is enabled when the Enable/Disable input is unconnected and the motor shaft has holding torque at that time. After Run signal is active, the motor speed follows the analog 0-5V input.



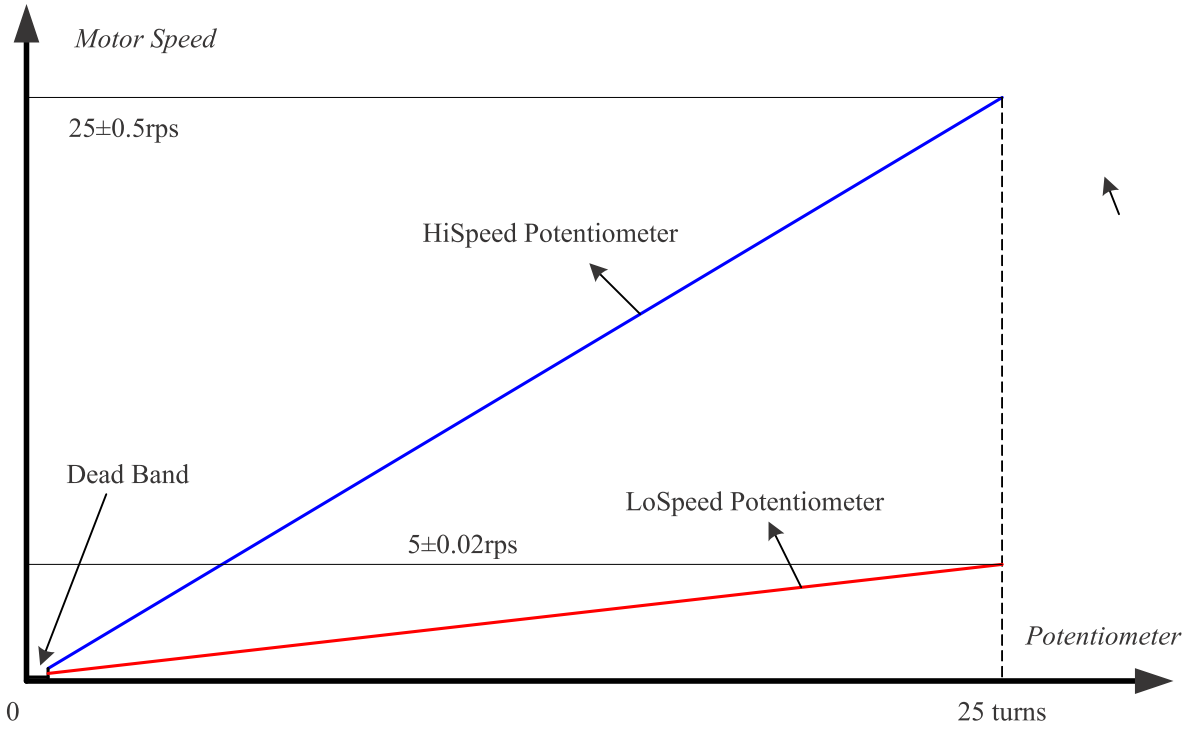
Ramp Shaping

There are two potentiometers Accel and Decel for adjusting the acceleration ramp and deceleration ramp, respectively. When the input ramp exceeds the value set by the potentiometer, the actual output ramp will be limited by the potentiometer value.



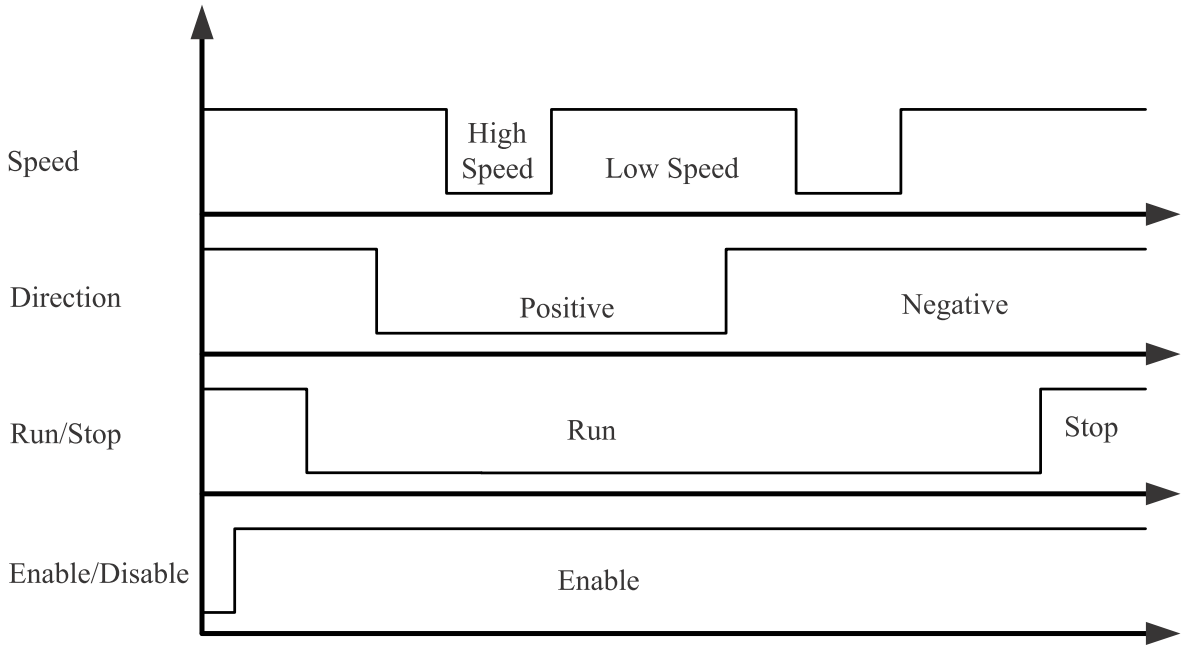
Low/High Speed Mode

In low/high speed mode, motor speed is fixed to the value adjusted by the **LoSpeed** or **HiSpeed** Potentiometer, depending on the level of **Speed** input. When the **Speed** input is LOW level, the maximum motor speed adjusted by the LoSpeed potentiometer is 5rps. When the **Speed** input is HIGH level, the maximum motor speed adjusted by the **HighSpeed** is 25rps.



Signal Sequence

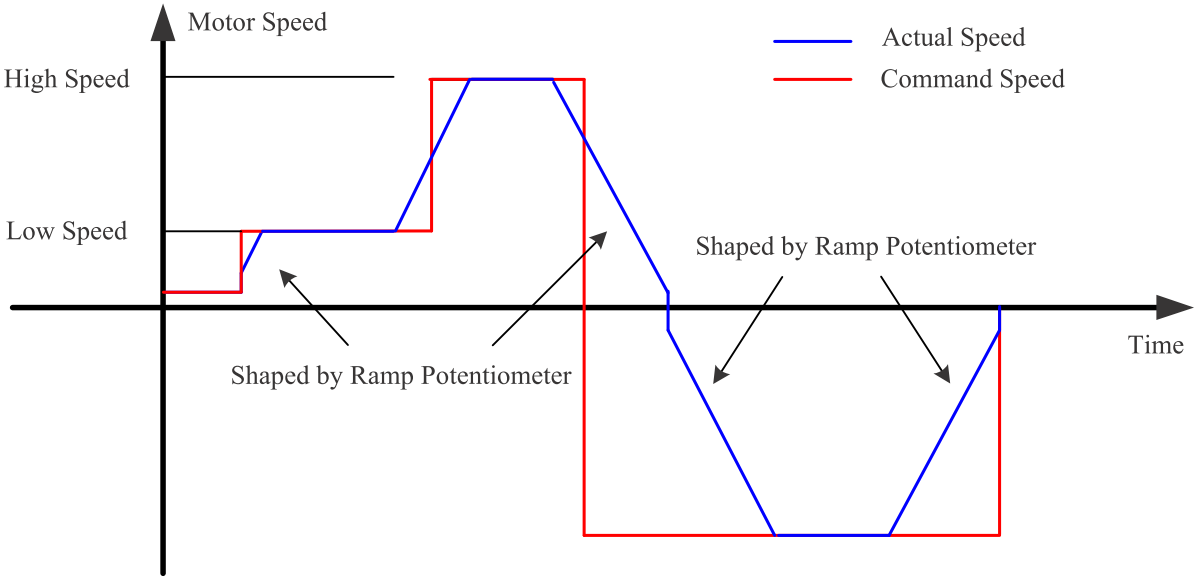
After power-up, the DM805-AI does not make the motor run immediately. The Enable and Run signal should be activated firstly. Drive is enabled when the Enable/Disable input is unconnected. After **Run** signal is activated, the **Speed** can be applied to the drive for low/high speed selection.



Ramp Shaping

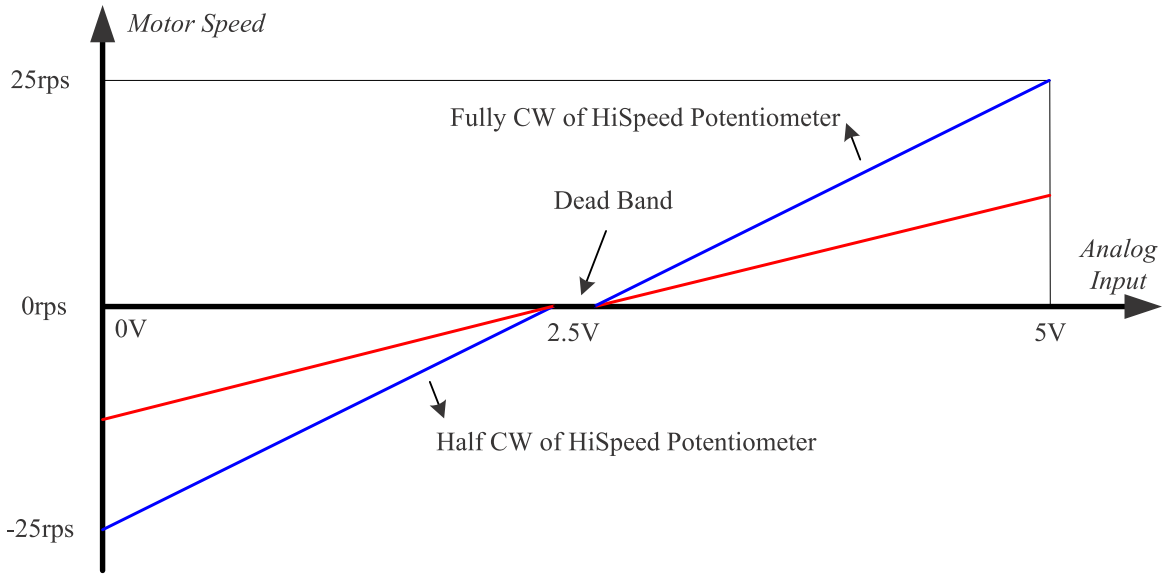
When motor speed switches between low and high or changes direction, the acceleration/deceleration ramp adjusted by the Ramp potentiometer will be inserted automatically for smooth motion.

Note: Do not adjust too small or too high Ramp. Otherwise the stepper motor may stall when switching between low and high speed.

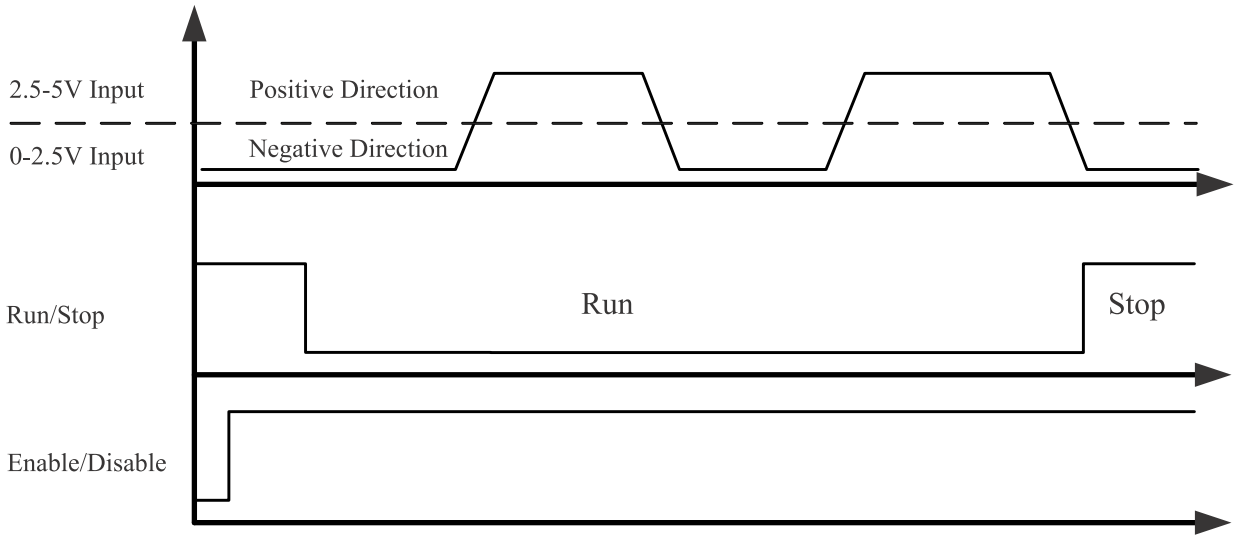


External Potentiometer Mode

In this mode motor speed follows the analog 0-5V input voltage. Motor speed is also proportional to the HiSpeed potentiometer. When the analog input is 0-2.5V, the motor runs in negative direction. While the analog input is 2.5-5V, the motor runs in positive direction.



Signal Sequence



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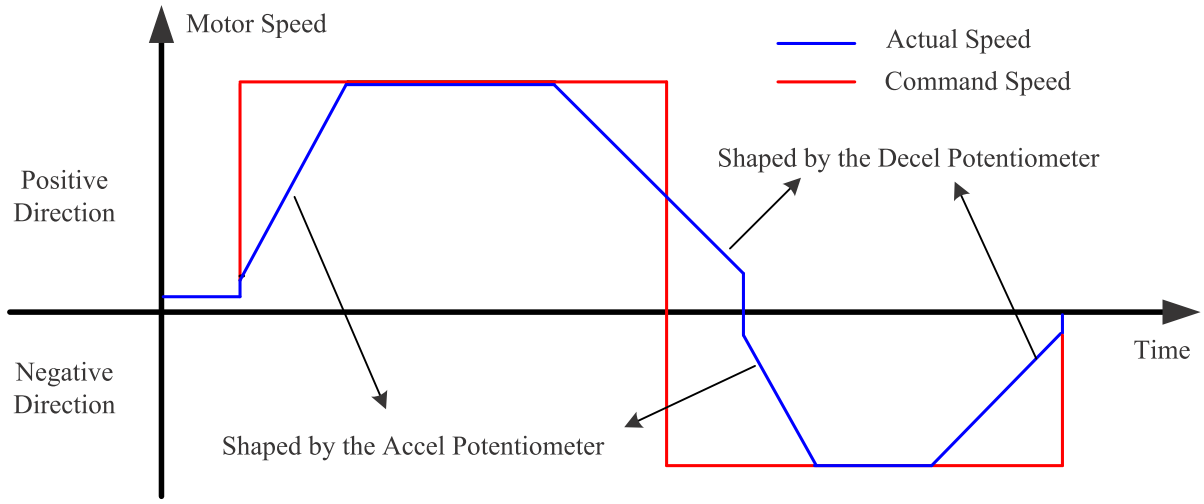


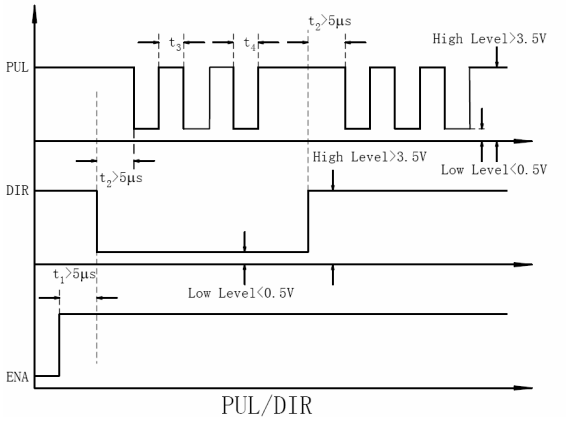
Pulse/Direction Mode

In this mode motor speed is the proportional to the pulse input frequency and motor rotary angle is controlled by the pulse counts. The microstep can be selected by the DIP switch SW5 and SW6.

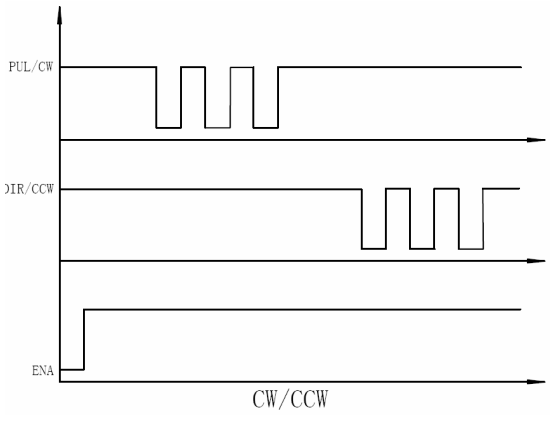
5. Control Signal Requirement

Pulse/Direction Mode

DM805-AI can support Pulse/Direction and CW/CCW control signal modes. In order to avoid some fault operations and deviations, PUL, DIR and ENA should abide by some rules, shown as following diagram:



PUL/DIR



CW/CCW

Remark:

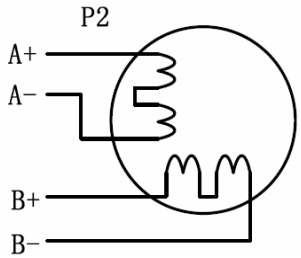
a) ENA must be ahead of DIR by at least 5us. Usually, ENA+ and ENA- are NC (not connected).
b) DIR must be ahead of PUL active edge by 5us to ensure correct direction;
c) Pulse width not less than2.5us;
d) Low level width not less than 2.5us.

6. Connecting the Motor

The DM805-AI can drive any 2-pahse and 4-pahse hybrid stepping motors.

4-lead Motors Connections

4 lead motors are the least flexible but easiest to wire. Speed and torque will depend on winding inductance. In setting the drive output current, multiply the specified phase current by 1.4 to determine the peak output current.

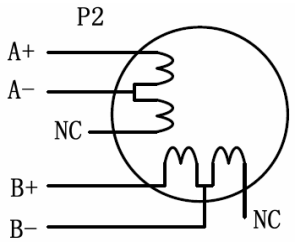


6-lead Motors Connections

Like 8 lead stepping motors, 6 lead motors have two configurations available for high speed or high torque operation. The higher speed configuration, or half coil, is so described because it uses one half of the motor's inductor windings. The higher torque configuration, or full coil, uses the full windings of the phases.

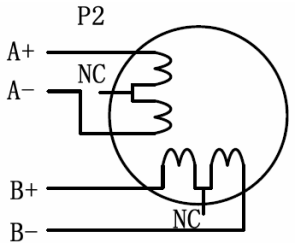
Half Coil Configurations

As previously stated, the half coil configuration uses 50% of the motor phase windings. This gives lower inductance, hence, lower torque output. Like the parallel connection of 8 lead motor, the torque output will be more stable at higher speeds. This configuration is also referred to as half chopper. In setting the drive output current multiply the specified per phase (or unipolar) current rating by 1.4 to determine the peak output current.



Full Coil Configurations

The full coil configuration on a six lead motor should be used in applications where higher torque at lower speeds is desired. This configuration is also referred to as full copper. In full coil mode, the motors should be run at only 70% of their rated current to prevent over heating.

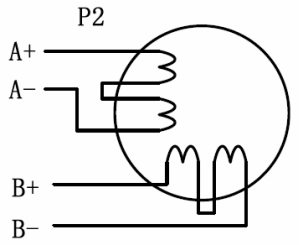


8-lead Motors Connections

8 lead motors offer a high degree of flexibility to the system designer in that they may be connected in series or parallel, thus satisfying a wide range of applications.

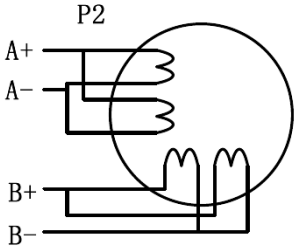
Series Connections

A series motor configuration would typically be used in applications where a higher torque at lower speeds is required. Because this configuration has the most inductance, the performance will start to degrade at higher speeds. In series mode, the motors should also be run at only 70% of their rated current to prevent over heating.



Parallel Connections

An 8 lead motor in a parallel configuration offers a more stable, but lower torque at lower speeds. But because of the lower inductance, there will be higher torque at higher speeds. Multiply the per phase (or unipolar) current rating by 1.96, or the bipolar current rating by 1.4, to determine the peak output current.



NEVER disconnect or connect the motor while the power source is energized.

7. Power Supply Selection

The DM805-AI can match medium and small size stepping motors (from NEMA frame size 14 to 34) made by Leadshine or other motor manufactures around the world. 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

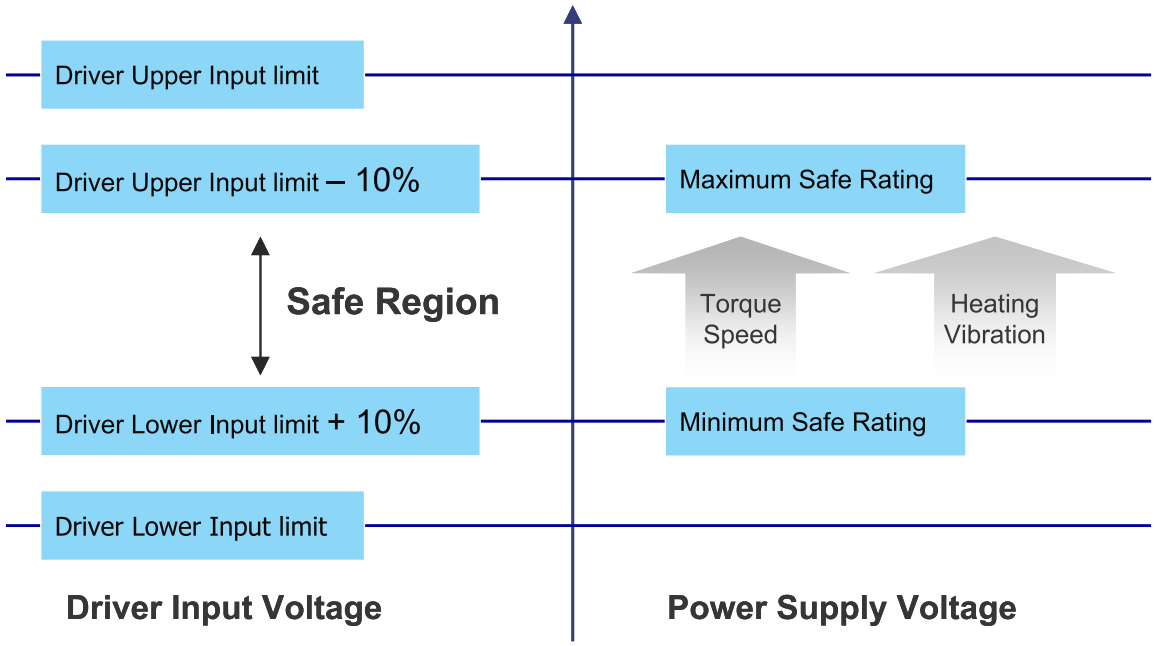
Both regulated and unregulated power supplies can be used to supply the drive. However, unregulated power supplies are preferred due to their ability to withstand current surge. If regulated power supplies (such as most switching supplies.) are indeed used, it is important to have large current output 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

The power MOSFETS inside the DM805-AI can actually operate with wider voltage range than the input specification. 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.

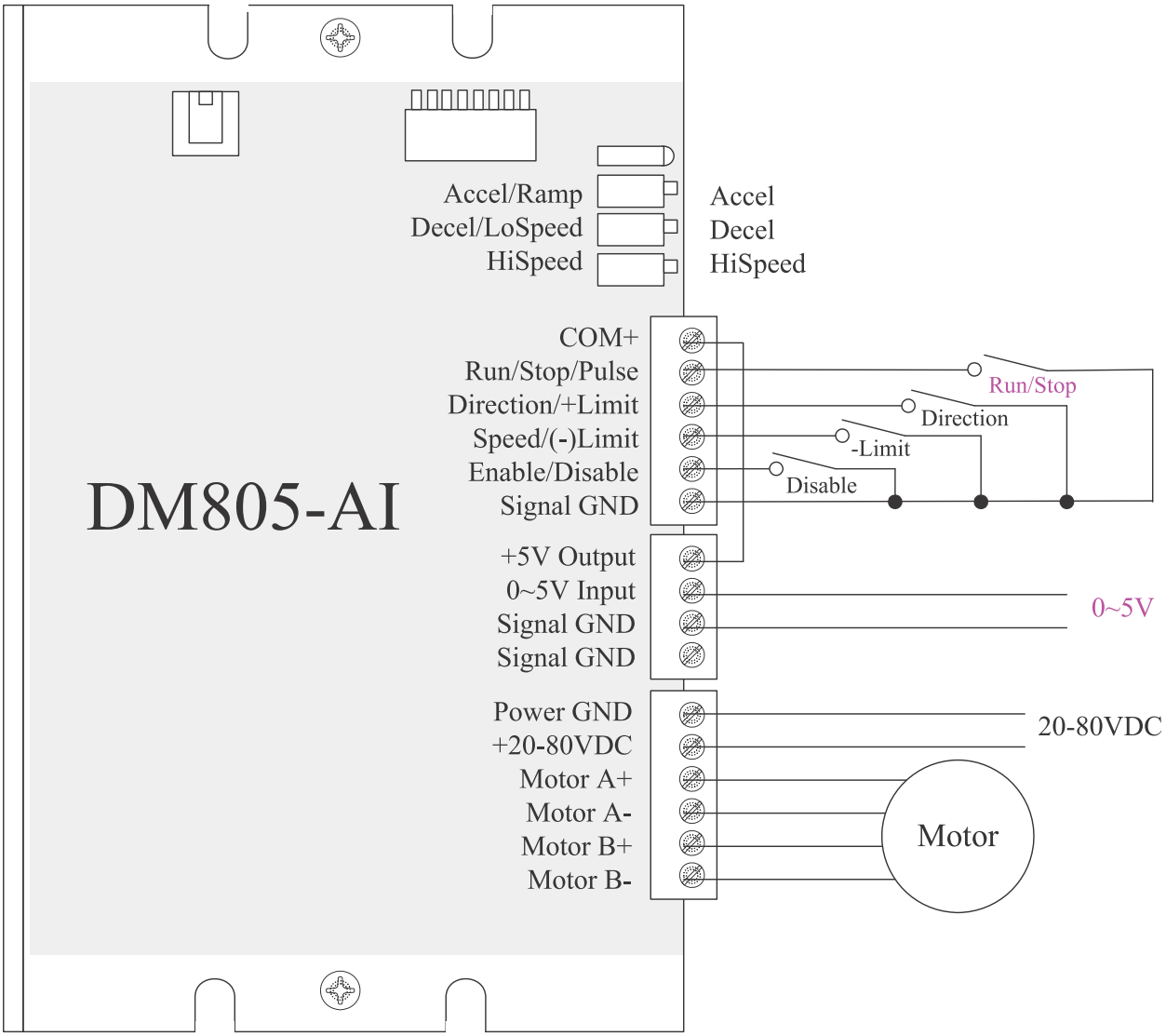


The recommended power supply voltage for DM805-AI is 24-72VDC:

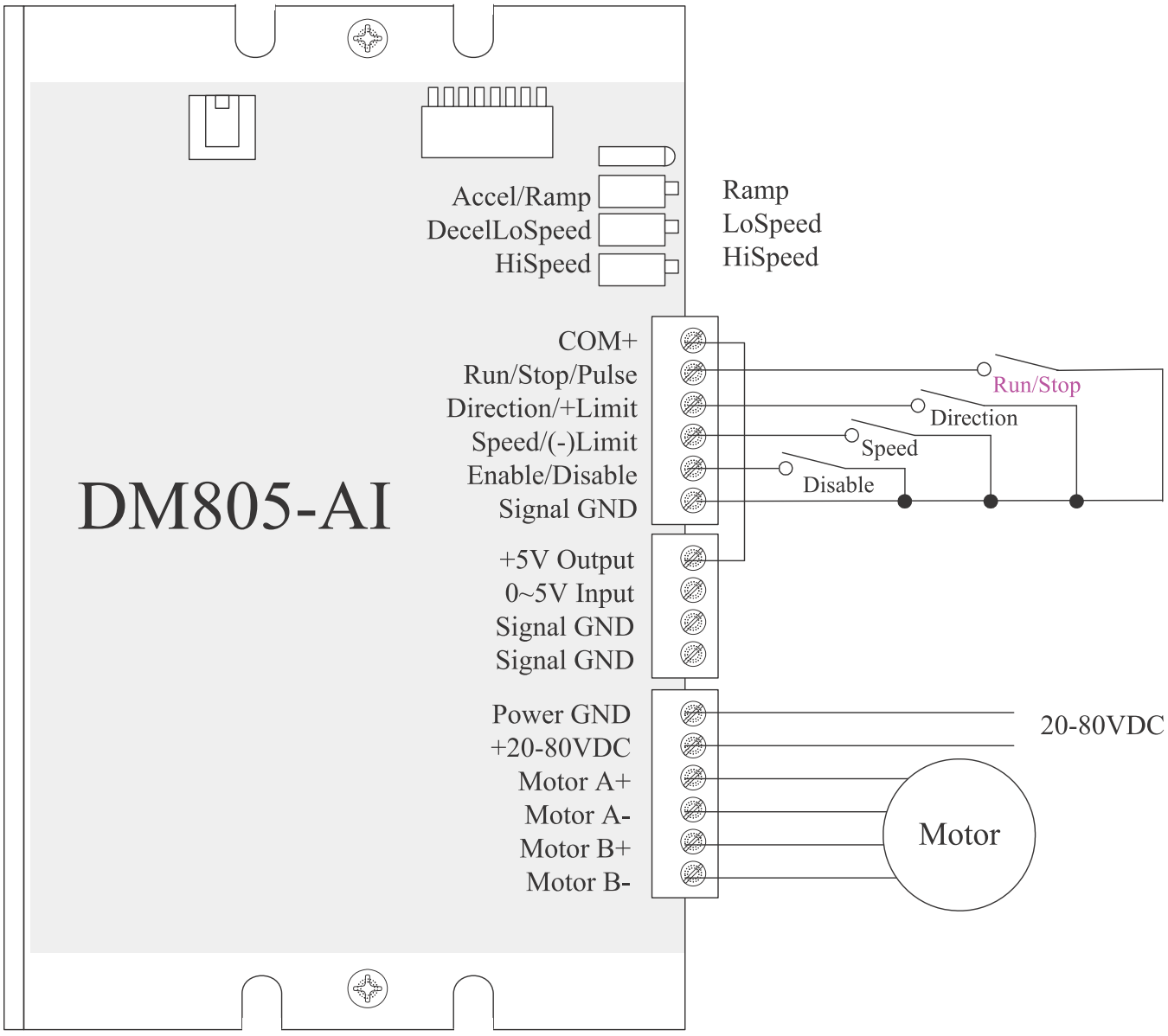
8. Typical Connection

Analog 0-5V Speed Mode

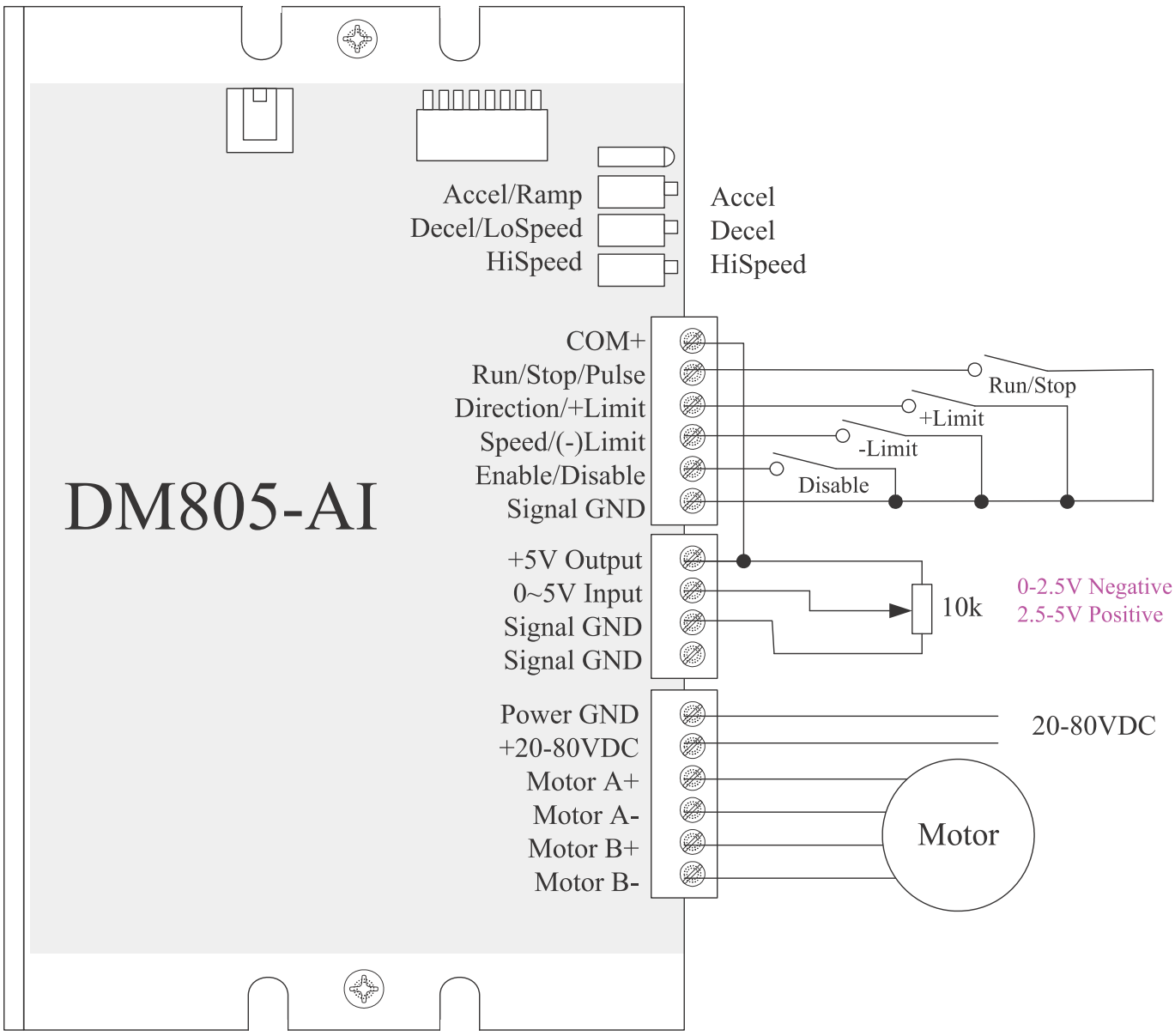
The 5V output of DM805-AI is connected to the COM+. The input signal is activated when it is short circuit to the signal GND. When the **Limit** switch is activated, the motor shaft will be free and the red indicator is on.



Low/High Speed Mode

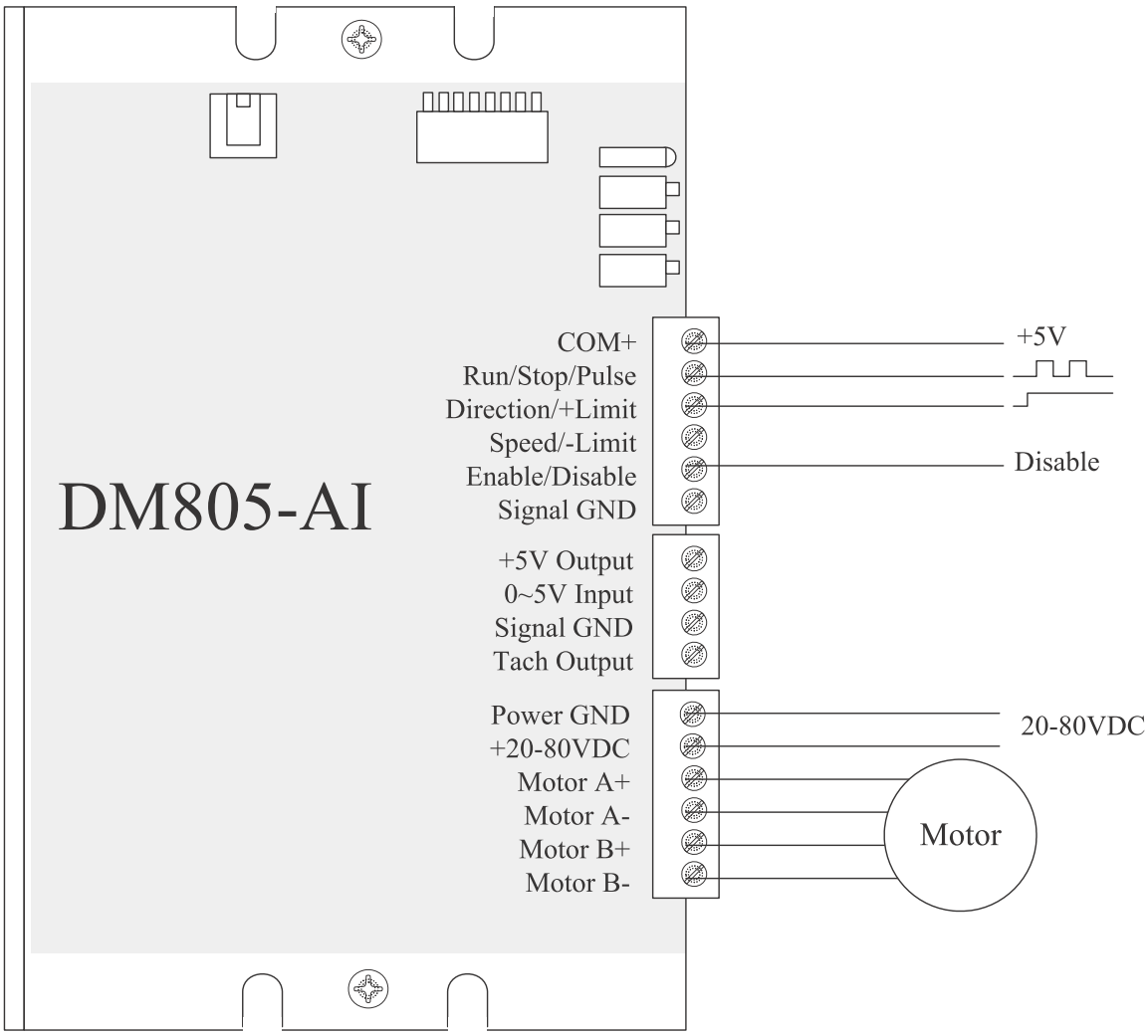


External Potentiometer Mode



Pulse/Direction Mode

A complete stepping system should include stepping motor, stepping drive, power supply and controller (pulse generator).

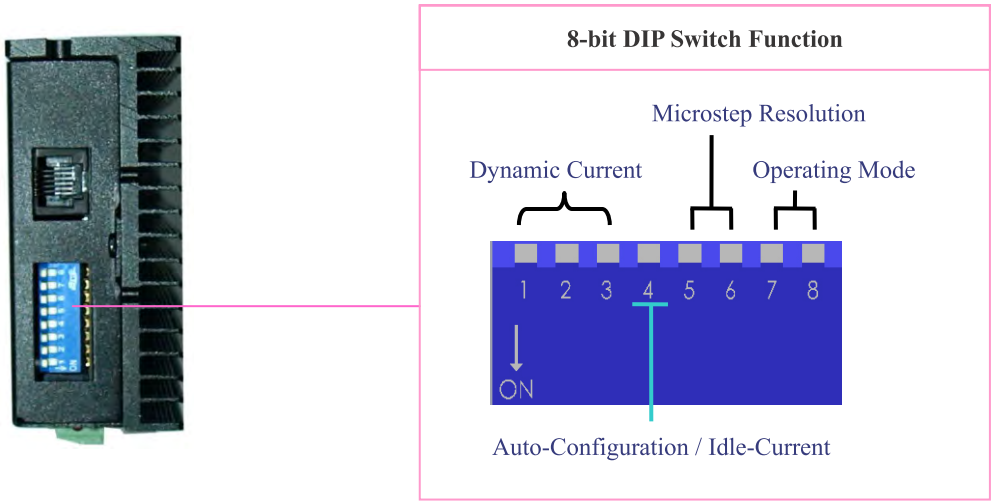


9. Wiring Notes

- In order to improve anti-interference performance of the drive, it is recommended to use twisted pair shield cable.
- 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.
- If a power supply serves several drives, separately connecting the drives is recommended instead of daisy-chaining.
- It is prohibited to pull and plug connector P2 while the drive is powered ON, because there is high current flowing through motor coils (even when motor is at standstill). Pulling or plugging connector P2 with power on will cause extremely high back-EMF voltage surge, which may damage the drive.

10. Configure the Drive

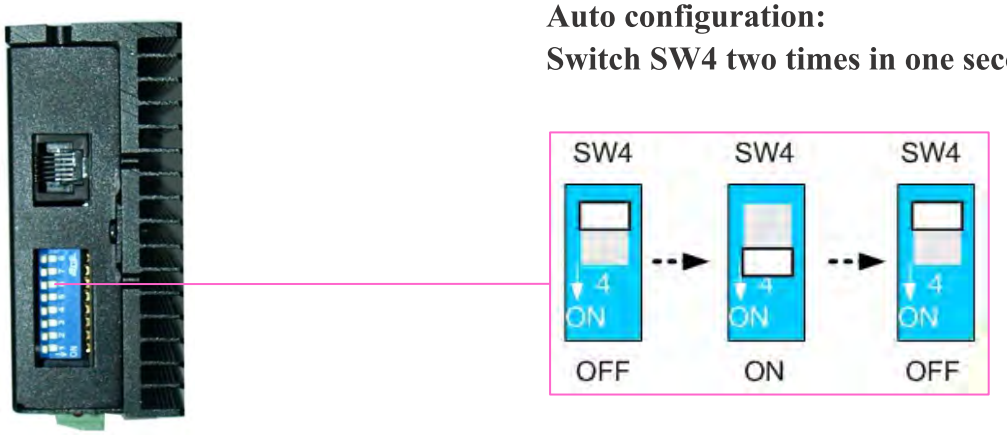
The DM805-AI uses an 8-bit DIP switch to set operating mode, microstep resolution and motor operating current as follows. The dynamic current setting by SW1, SW2 and SW3 is active for all operating mode. The microstep resolution setting by SW5 and SW6 only takes effect in Pulse/Direction mode. SW4 is used to set the idle current and auto-configure the drive when it is first time installation.



Auto Configuration by SW4

To get the optimized performance, switch SW4 two times in one second to identify the motor parameter after power-up if it is the first time installation. The motor parameter is identified and the drive's current loop parameters are calculated automatically when SW4 is activated. The motor shaft will have a little vibration during auto-configuration. If the user changes the motor or the power supply, don't forget to activate SW4 once again.

Sometimes the result of the auto-configuration is not good. This will happen to the stepper motor with large inductance or resistance. The user needs to tune the current loop parameter manually. Please refer to the software manual of the DM805-AI.



Selecting Operating Mode

Mode	SW7	SW8	Description
0~5V Speed	on	on	Analog 0-5V Speed Mode
Lo/Hi Speed	off	on	Low and High Speed Mode
External POT	on	off	External Potentiometer Speed Mode
Pulse/Direction	off	off	Pulse and Direction Position Mode

Note: Remove power supply before changing operating mode.

Microstep Resolution Selection

In Pulse/Direction mode, microstep resolution is selected by SW4 and SW5. The stepper motor moves one step when one pulse is applied to the stepper drive. If microstep is 1, the step angle is a full step which is 1.8 degree for 2-phase stepper motor and 1.2 degree for 3-hpase stepper motor. Microstep can be taken as the divisions of one full step. For example, stepper motor moves half of the full step when the microstep is 2. For 2-phase stepper motor and drive, we have the following formula to calculate the microstep resolution, or pulse counts of one motor shaft revolution:

$$Microstep \quad \text{Re}\, solution = 200 \times Microstep$$

The motor speed can be calculated as follows:

$$Motor \quad Speed \ RPS) = \left(\frac{Pulse \quad Input \quad Frequency}{Microstep \quad \text{Re}\, solution}\right.$$

When selecting the drive's microstep resolution for the system:

- Consider the MAX speed needed, MAX input frequency of driver and MAX output frequency of the controller.
- 1600 pulses/revolution (8 Microstep) is suitable for most application.
- >1600 pulses/revolution only increase smoothness but not resolution.
- For digital driver, Microstep resolution is not important.

Current Settings

Dynamic current setting

For a given motor, higher drive current will make the motor to output more torque, but at the same time causes more heating in the motor and drive. Therefore, output current is generally set to be such that the motor will not overheat for long time operation. Since parallel and serial connections of motor coils will significantly change resulting inductance and resistance, it is therefore important to set drive output current depending on motor phase current, motor leads and connection methods. Phase current rating supplied by motor manufacturer is important in selecting drive current, however the selection also depends on leads and connections.

Idle current setting

When there is no pulse applied to the DM805-AI and the time exceeds the idle-time which can be configured via the PC based software, the drive goes into idle status. SW4 is used to set the idle-current, OFF meaning that the motor coil current is automatic reduced, and ON meaning that current is the same as the selected dynamic current.

By default, the current automatically reduced to 60% of the selected dynamic current two second after the last pulse. Theoretically, this will reduce motor heating to 36% (due to $P=I^2*R$) of the original value. If the user wants to change the idle time and current reduction rate, please consult the DM805-AI's software manual.

11. Protection Functions

To improve reliability, the drive incorporates some built-in protection functions. The DM805-AI uses one RED LED to indicate what protection has been activated. The periodic time of RED is 3 or 5 s (seconds), and how many times the RED turns on 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.

Over-current Protection

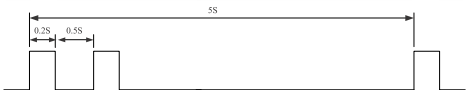
Over-current protection will be activated when continuous current exceeds the limit or in case of short circuit between motor coils or between motor coil and ground, and RED LED will turn on once within each periodic time.

Over-voltage Protection

When power supply voltage exceeds the limit, protection will be activated and RED LED will turn on twice within each periodic time.

Note: 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.

Protection Indications

Priority	Time(s) of ON	Sequence wave of RED LED	Description
1st	1		Over-current protection
2nd	2		Over-voltage protection

12. 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
	DIP switch current setting is wrong
	Fault condition exists
	The drive is disabled
Motor rotates in the wrong direction	Motor phases may be connected in reverse
The drive in fault	DIP switch current setting is wrong
	Something wrong with motor coil
Erratic motor motion	Control signal is too weak
	Control signal is interfered
	Wrong motor connection
	Something wrong with motor coil
	Current setting is too small, losing steps
Motor stalls during acceleration	Current setting is too small
	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
	Automatic current reduction function not being utilized
	Current is set too high

APPENDIX

Twelve Month Limited 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: Leadshine Technology Co., Ltd. 3/F, Block 2, Nanyou Tianan Industrial Park, Nanshan Dist, Shenzhen, China. Also enclose information regarding the circumstances prior to product failure.

DM805-AI

Digital Stepper Drive with Analog 0-5V Input and Built-in Oscillator

Features

- Anti-Resonance, provides optimum torque and nulls mid-range instability
- Motor self-test and parameter auto-setup technology, offers optimum responses with different motors
- Multi-Stepping allows a low resolution step input to produce a higher microstep output for smooth system performance
- Command Source: 0-5V, built-in potentiometer and pulse
- Two preset velocity and adjust by built-in potentiometer
- Preset acceleration/deceleration and adjust by built-in potentiometer
- Velocity control mode via 0-5V and position control mode via pulse
- Built-in pulse generator nulls external motion controller
- Supply voltage up to +80 VDC
- Output current programmable, from 0.3A -5.0A(RMS)
- TTL compatible and optically isolated digital input
- Automatic current reduction
- Over-voltage, over-current, phase-error protections

Descriptions

The DM805-AI is a 0-5V input stepper drive with built-in oscillator which is based on the latest digital control algorithm. It brings a unique level of system smoothness, providing optimum torque and nulls mid-range instability. Motor self-test and parameter auto-setup technology offers optimum responses with different motors and easy-to-use. The driven motors can run with much smaller noise, lower heating, smoother movement than most of the drivers in the markets. Its unique features make the DM805-AI an ideal solution for applications that require low-speed smoothness.

The three built-in potentiometers are used to preset and adjust the velocity, acceleration and deceleration. In 0-5V speed mode, the motor speed is controllable and follows the analog 0-5V input. In high/low speed mode, the motor speed is selected by digital input and adjusted by the high/low speed potentiometers. The user can run the motor with the least configuration and connection. In position mode, the DM805-AI is a traditional stepper drive. There is a 5V power supply output for customer use.

Applications

This drive is suitable for the application which needs to adjust the velocity via the potentiometer or analog 0-5V command. It can work with the NEMA17/23/34 stepper motor to replace the brushless motor with gearbox due to its high torque and less motor noise at low speed. If necessary, it can be used in various kinds of machines, such as rotary heat exchange, conveyor belts, transport vehicle, laser cutters, laser markers, high precision X-Y tables, labeling machines, and so on.

Specifications

Electrical Specifications

Parameter	Min	Typical	Max	Unit
Input Voltage	18	60	80	VDC
Pulse Input Frequency	0	-	200	kHz
Logic Signal Current	7	10	16	mA
Isolation Resistance	500	-	-	MΩ

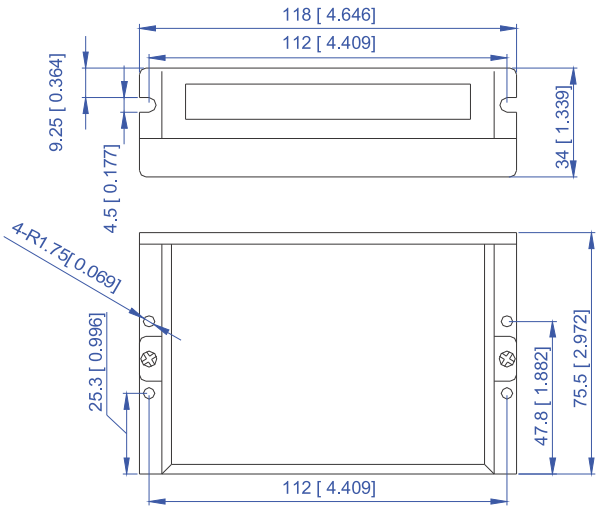
Velocity Control

Item		Specification	Dead Band	Resolution	Min	Max
Analog Input	0-5V Speed Mode	0-5 V	10 mV	10 mV	0 Rev/s	25 ± 0.5 Rev/s
	External POT Mode		20 mV			
Accel / Decel / Ramp Potentiometer		0-25 turns	10 mV	10 mV	0.5 Rev/s^2	250 ± 1 Rev/s^2
LoSpeed Potentiometer		0-25 turns	10 mV	10 mV	0 Rev/s	5 ± 0.01 Rev/s
HiSpeed Potentiometer		0-25 turns	10 mV	10 mV	0 Rev/s	25 ± 0.5 Rev/s

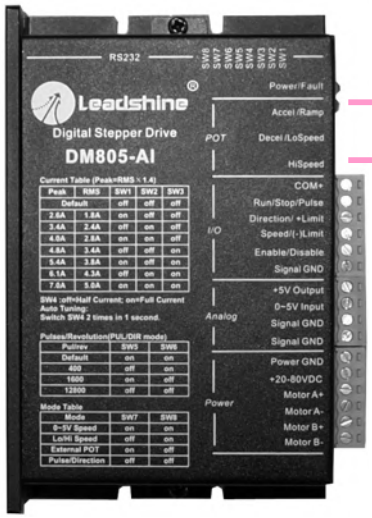
Operating Environment

Cooling	Natural Cooling or Forced cooling	
Operating Environment	Environment	Avoid dust, oil fog and corrosive gases
	Ambient Temperature	0°C — 50°C (32°F — 122°F)
	Humidity	40%RH — 90%RH
	Operating Temperature	70°C (158°F) Max
	Vibration	5.9m/s^2 Max
Storage Temperature	-20°C — 65°C (-4°F — 149°F)	
Weight	350g (12.34oz)	

Mechanical Specifications



Drive Interface



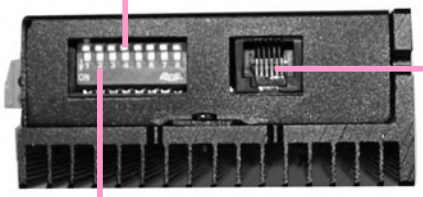
Indicator Green: Power, Red: Fault

Potentiometers Adjusting Speed, Acceleration and Deceleration

Digital I/O Signal Connector, 6-pin screw terminal, 3.81 mm space

Analog Signal Connector, 6-pin screw terminal, 3.81 mm space

Power Connector, 6-pin screw terminal, 3.81 mm space



Auto Tuning: Switch SW4 two times in one second.

RS232 communication port, RJ11, communicating PC software

Note: It is used to configure and current loop tuning, anti-resonance tuning with the PC software. However, the drive can still work properly without it. The DM805-AI can be fully tuned by the auto-tuning.

DIP switch, 8 bits, current setting, selecting microstep, operating mode

Protection Indications

Priority	Time(s) of ON	Sequence wave of RED LED	Description
1st	1		Over-current protection
2nd	2		Over-voltage protection

Connectors and Pin Assignment

The DM805-AI has three connectors, connector for digital I/O signals connections, connector for analog 0-5V signal connections and connector for power and motor connections. The three parameters are used to preset or adjust the speed, acceleration and deceleration ramp. They have different functions in different modes. The green indicator turns on when the drive is powered on. When error happens, the red indicator flashes periodicity to indicate the error type.

I/O Signal Assignment in Different Mode				
I/O Signal	**0-5V Speed Mode**	**Lo/Hi Speed Mode**	**External POT mode**	**Pulse/Direction**
Run/Stop/Pulse	Run/Stop	Run/Stop	Run/Stop	Pulse
Direction / +Limit	Direction	Direction	+Limit	Direction
Speed / (-)Limit	-Limit	Speed	-Limit	N/A

Digital I/O Signal Connector			
6-pin screw terminal, 3.81 mm space			
Pin	**Name**	**I/O**	**Description**
1	**COM+**	Power	+5V Power Input, common reference of all inputs
2	**Run/Stop/Pulse**	I	Run/Stop signal for 0-5V analog, Lo/Hi Speed and External POT mode. In Pulse/Direction mode, it accepts pulse input.
3	**Direction / +Limit**	I	Direction input for 0-5V analog, Lo/Hi Speed and Pulse/Direction mode. It is the +limit switch input in External POT mode. When +Limit is activated, the motor speed decelerates to zero in the acceleration set by Ramp potentiometer. The +Limit is only activated when the voltage applied to 0-5V input is 2.5-5V.
4	**Speed / (-)Limit**	I	Speed selection input in Lo/Hi speed mode. It is the -limit switch input in External POT and 0-5V Speed mode. When +Limit is activated, the motor speed decelerates to zero in the acceleration set by Ramp potentiometer. In External POT mode, the –Limit is activated only when the voltage applied to 0-5V input is 0-2.5V. In 0-5V speed mode, the –Limit is activated only when Direction input is connected to Signal GND.
5	**Enable / Disable**	I	This signal is used to enable or disable the power stage. Usually left it unconnected to enable the power stage.
6	**Signal GND**	GND	Signal ground. It is common with the power ground.

Analog Signal Connector			
4-pin screw terminal, 3.81 mm space			
Pin	**Name**	**I/O**	**Description**
1	**+5V Output**	O	+5V Power Output, reference to signal ground
2	**0-5V Input**	I	Analog 0-5V reference input
3	**Signal GND**	GND	Signal ground. It is common with the power ground.
4	**Signal GND**	GND	Signal ground. It is common with the power ground.

Power Connector			
6-pin screw terminal, 3.81 mm space			
Pin	**Name**	**I/O**	**Description**
1	**Power GND**	GND	Power ground
2	**+20-80VDC**	I	Power supply input, 24-72VDC recommended, leaving rooms for voltage fluctuation and back-EMF.
3	**Motor A+**	O	Motor Phase A+
4	**Motor A-**	O	Motor Phase A-
5	**Motor B+**	O	Motor Phase B+
6	**Motor B-**	O	Motor Phase B-

DIP Switch Settings

Operating Mode

Mode	SW7	SW8	Description
0~5V Speed	on	on	Analog 0-5V Speed Mode
Lo/Hi Speed	off	on	Low and High Speed Mode
External POT	on	off	External Potentiometer Speed Mode
Pulse/Direction	off	off	Pulse and Direction Position Mode

Note: Can not change mode on-the-fly and need to repower the drive.

Dynamic Current

PEAK	RMS	SW1	SW2	SW3
Default	**Default**	off	off	off
2.6A	**1.8A**	on	off	off
3.4A	**2.8A**	off	on	off
4.0A	**2.4A**	on	on	off
4.8A	**3.4A**	off	off	on
5.4A	**3.8A**	on	off	on
6.1A	**4.3A**	off	on	on
7.0A	**5.0A**	on	on	on

Note: Due to motor inductance, the actual current in the coil may be smaller than the dynamic current setting, particularly under high speed condition.

Microstep Resolution

Pulses/Rev.	SW5	SW6
Default	on	on
400	off	on
1600	on	off
12800	off	off

Note: It is only active in Pulse/Direction mode.

Idle-Current

SW4 decides the idle current is reduced automatic or remains the same as the dynamic current setting.

	ON	OFF
SW4	The motor idle current reduces automatically when there is no pulse applied to the DM805-AI.	The motor idle current is the same as the dynamic current when there is no pulse applied to the DM805-AI.

Auto Configuration by SW4

Switch SW4 two times in one second to auto-configure the drive's current loop parameter.

Potentiometers

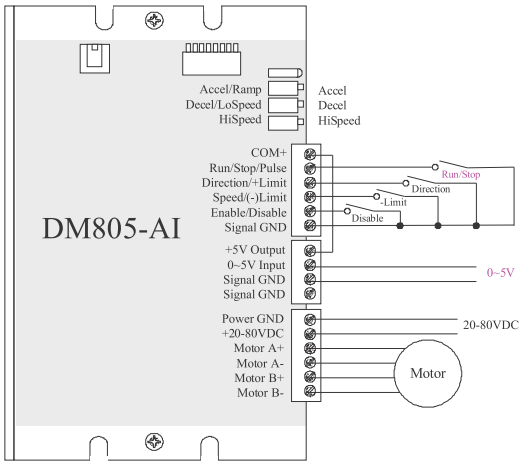
Potentiometer	0-5V Speed Mode	Lo/Hi Speed Mode	External POT mode	Pulse/Direction
Accel / Ramp	Acceleration	Ramp	Acceleration	N/A
Decel / LoSpeed	Deceleration	Low Speed	Deceleration	N/A
HiSpeed	High Speed	High Speed	High Speed	N/A

RS232 Communication Port

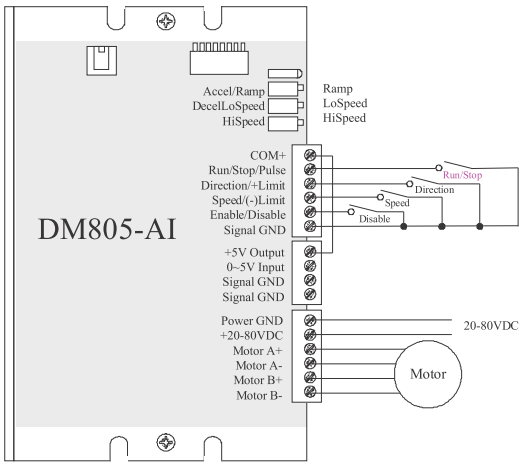
It is used to configure and current loop tuning, anti-resonance tuning with the PC software. However, the drive can still work properly without it. The DM805-AI can be fully configured by the auto-tuning by DIP switch SW4.

Typical Connections

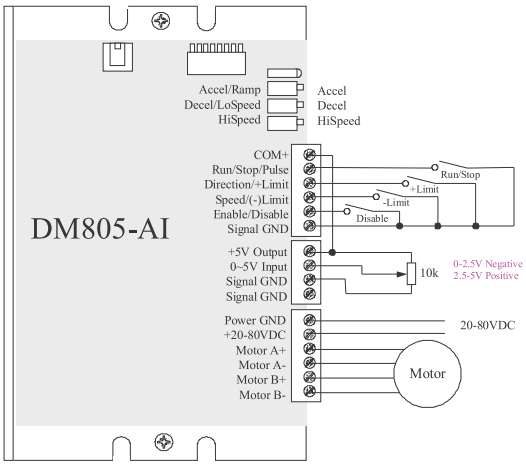
0-5V Speed Mode



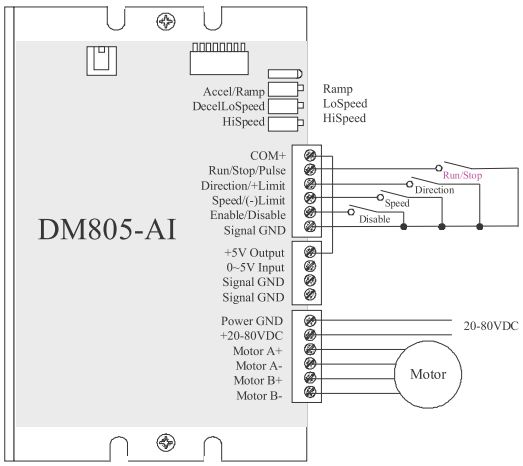
Low/High Speed Mode



External POT Mode



Pulse/Direction Mode



Introduction

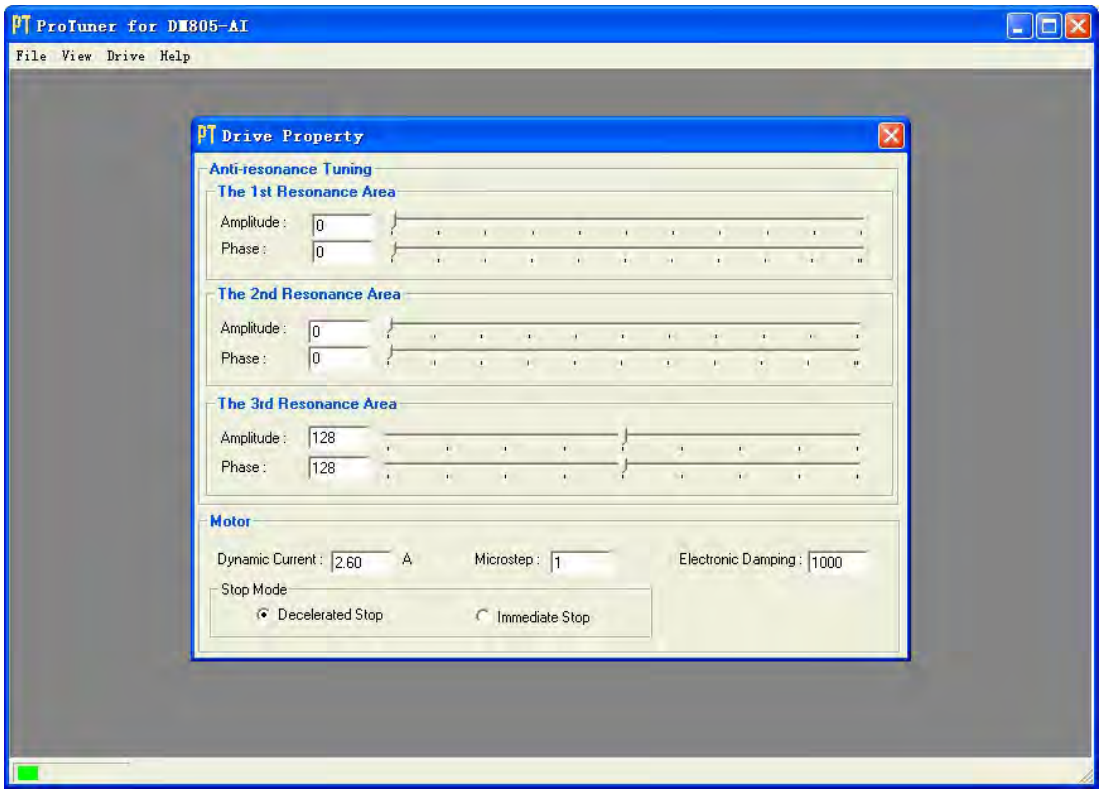
The ProTuner for DM805-AI is a software tool designed to configure and tune the Leadshine digital drive DM805-AI. The user can tune the current loop and adjust the anti-resonance parameters in this software.

Workspace

After installing the software and open it, the software is displayed as follows.

Menu

Tuning and Property



Menus and Toolbar

Menu is at the top of the workspace. You can click menu bar to view the pull-down menu.

Menu	Pull Down	Function
File ->	Open	Open a file
	Save As	Save as a file
	Exit	Exit ProTuner

Menu	Pull Down	Function
View ->	Error Log	Check the error log
	Drive Information	DM805-AI specification
Drive->	Connect to Drive	Connect to drive
	Current Loop Tuning	Set current loop parameters Kp and Ki and test.
	Property	Set drive properties like I/O logic, motor parameters.
	Offset	Check analog and potentiometer offset
	Save to Drive	Save all data to drive
	Restore Factory Setting	Restore factory setting
Help->	About	Software Information

Using the Software

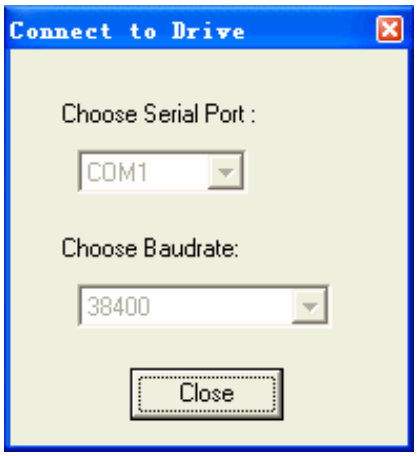
Opening a file

If you want to reload the configuration data from a file in the PC, click on the File->Open. The parameters in the software's workspace will be updated

Save as a file

Save the data in current workspace to a file and rename it.

Connecting to Drive Window



Connect to Drive window appears when you open the software. Choose correct serial port and leave the baud rate as default 38400. The software will try to connect to the drive after you click on the Open button.

Notice

Before clicking on the Open button, please make sure:

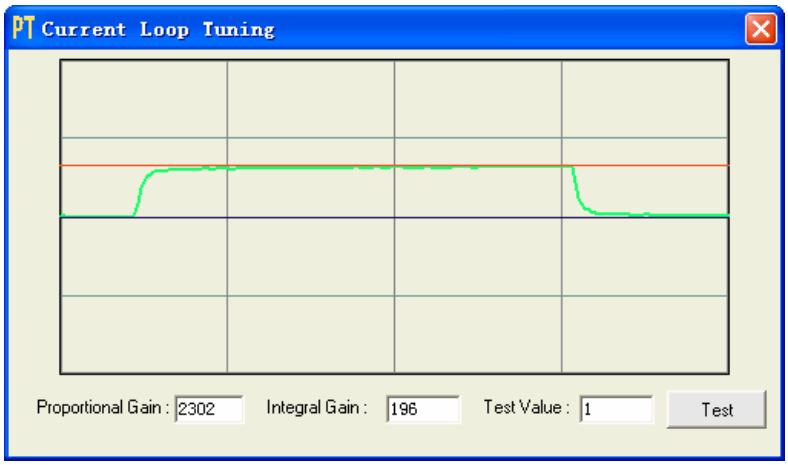
1) The RS232 cable .has been connected between the drive and the PC's serial port.
2) The drive has been powered on and the green LED is turned on.

The stepper motor is unnecessary connecting to the drive if you just want to set the parameters but not tuning.

Caution

Do not connect or disconnect serial cable when the drive is powered on. The drive's communication circuit may be damaged.

Current loop tuning Window



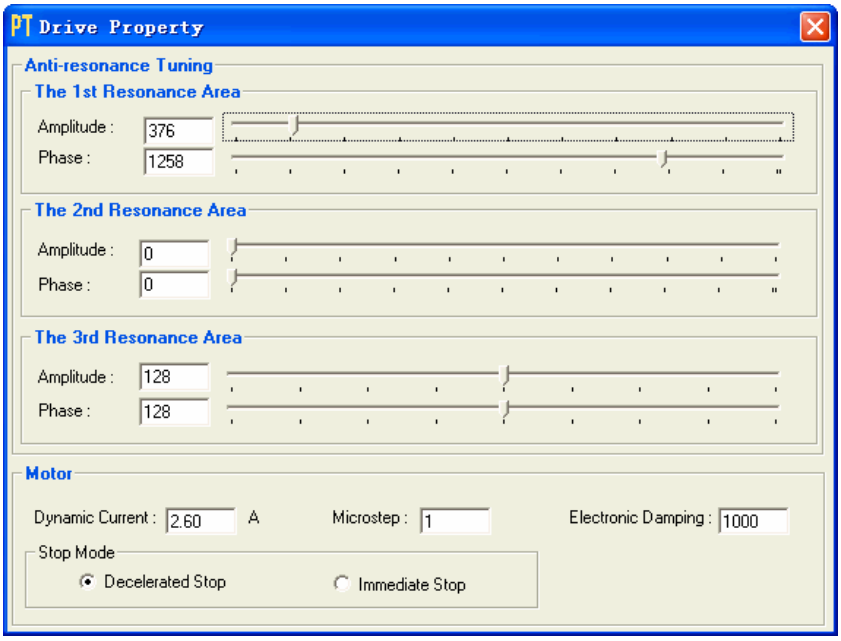
It is used to configure current loop parameters according to different motor. In the tuning window, user can set proportional gain, integral gain and test value.

Notice

After finishing the input of the number, don't forget to hit the "Enter" key in the keyboard to confirm new value.

Item	Description	Range
Proportional Gain	Increase this parameter to make current rise fast. Proportional Gain determines the response of the driver to current setting command. Low Proportional Gain provides a stable system (doesn't oscillate), has low stiffness, and large current error, causing poor performances in tracking current setting command in each step. Too large Proportional Gain values will cause oscillations and unstable systems.	1 – 65535
Integral Gain	Adjust this parameter to reduce the steady error. Integral Gain helps the driver to overcome static current errors. A low or zero value for the Integral Gain may have current errors at rest. Increasing the Integral Gain can reduce the error. If the Integral Gain is too large, the systems may "hunt" (oscillate) about the desired position.	1 – 65535
Test Value	The current amplitude for the step response.	0.5 – 5 A
Test Button	Click this button to activate the test. A target curve (red) and an actual curve (green) will be displayed on the screen for user analysis.	-

Property Window



The user can set the drive's anti-resonance parameters, output current, microstep, electronic damping and stop mode according the motor and application.

Notice

Microstep setting is only effective in Pulse/Direction mode.

Item	Description	Range
The 1st Resonance Area	It is usually between 0.6 to 1.2 RPS.	-
The 2nd Resonance Area	It is usually between 1.2 to 2.4 RPS.	-
The 3rd Resonance Area	It is usually between 2.4 to 4.8 RPS.	-
Amplitude	Amplitude adjustment for anti-resonance tuning. 0 – 3500 for the 1st, 2nd resonance area and 0- 256 for the 3rd resonance area. The user can enter a value directly in the text box or move the slider bar back and forth to get an optimum value.	0 – 3500 or 0-256
Phase	Phase adjustment for anti-resonance tuning. The user can enter a value directly in the text box or move the slider bar back and forth to get an optimum value.	0 – 1608 or 0-256
Dynamic Current	Drive's output current setting according to the motor. It should be less than the motor's related current * 1.414. Note: The DIP switch setting must be SW1 = off, SW2 = off, SW3 = off if you wan to set this parameter in ProTuner.	0.5 – 7.0 A
MicroStep	Drive's Microstep setting for the motor. Note1: The DIP switch setting must be SW5 = off, SW6 = off, SW7 = off, SW8 = off if you wan to set this parameter in ProTuner. Note2: The microstep is effective only in Pulse/Direction mode.	1 – 512
Electronic Damping	Adjust this parameter to improve the drive's high speed performance. The optimal value depends on the system.	0 - 6000
Stop Mode	The motor stops immediately when a stop command is applied to the drive if this parameter is immediate stop. Otherwise the motor stops with a acceleration set by the Accel/Ramp or Decel/LoSpeed potentiometers.	-

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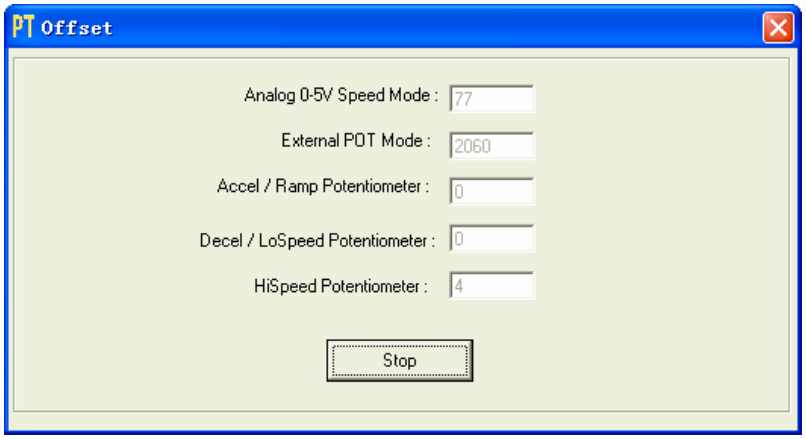
فکس : (021) 33985603

Offset



It is used to check the offset of the potentiometers and analog input in factory. The user can ignore it.

Save to Drive

After the drive's configuration and tuning is done, you need to click Drive->Save To Drive to save the data to drive's nonvolatile memory. Otherwise the data will not be lost after power-off.

Restore Factory Setting

This command is used to restore the factory data when the drive is out of control or the user want to do that.

Configuring the drive

If it is the first time setup, you can follow the steps below to configure the drive.

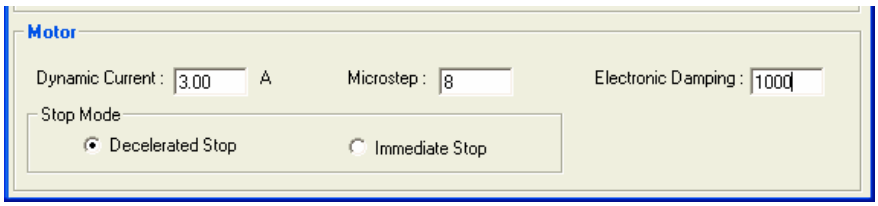
1) Set motor related parameters such as dynamic current, microstep and stop mode according to the motor and application.
2) Tune the current loop parameters.
3) Tune the anti-resonance parameters if necessary.
4) Adjust the electronic damping when the high speed performance is not good.

The motor must be connected to the drive before trying to configure the drive.

After finishing the input of the number, don't forget to hit the "Enter" key in the keyboard to confirm new value

Set motor related parameters

Click Drive->Property to open the Property window. You can set the motor's dynamic current, microstep and stop mode.



The motor's dynamic current is related to the related current. Usually, the motor manufacturer states the RMS (root mean square) current in datasheet. Please relate to the hardware installation manual for how to set the dynamic current.

Notice

The DIP switch setting must be SW1 = off, SW2 = off, SW3 = off if you wan to set this parameter in ProTuner.

The microstep is so important is only effective in Pulse and Direction command mode. High resolution microstep makes the motor move more smoothly. Low microstep resolution reduces the high frequency requirement to the controller.

Notice

1. The DIP switch setting must be SW5 = off, SW6 = off, SW7 = off, SW8 = off if you wan to set this parameter in ProTuner.

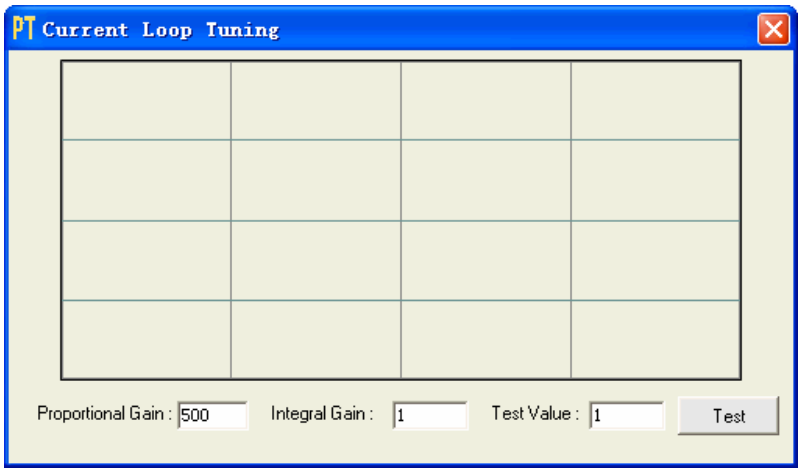
2. The microstep is effective only in Pulse/Direction mode.

The motor stops in the acceleration set by the potentiometer. If the application needs fast stop, please click Immediate Stop.

Tune the current loop

The DM805-AI's current loop need to be tuned before normal operation in order to get optimize responses with different motors. Otherwise the motor will be easily stall or howls when power-up. Below is the tuning process for a NEMA 23 motor with 24VDC supply voltage.

Step 1: Set **Test Value** 1 and start the tuning with small **Proportional Gain** and "zero" **Integral Gain**. Here we set **Proportional Gain** 500.

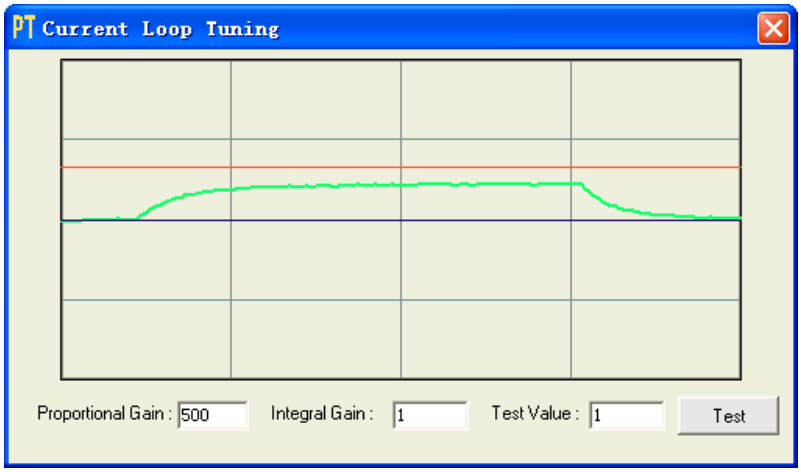


Initial Value

Proportional Gain = 500

Integral Gain =1

Step 2: Click the **Test** button and the plot window will show two curves. The red one is target current and the green one is actual current. There is large gap between them in the scope. It indicates that a large **Proportional Gain** needs to be introduced.

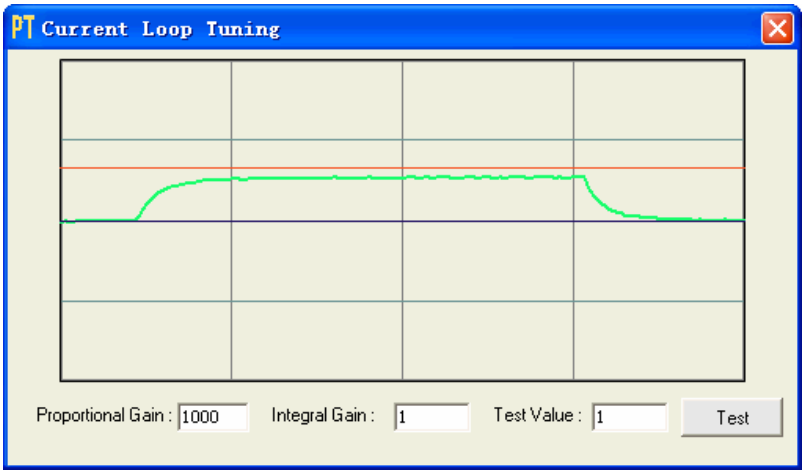


Start Test:

Proportional Gain = 500

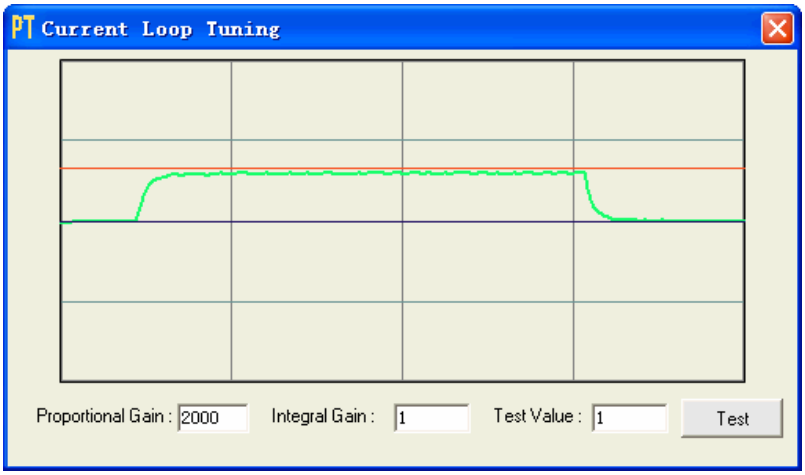
Integral Gain = 1

Step 3: Increase **Proportional Gain** to 1000 and click **Start**. The gap between target value and actual value is smaller but a higher **Proportional Gain** is still needed.

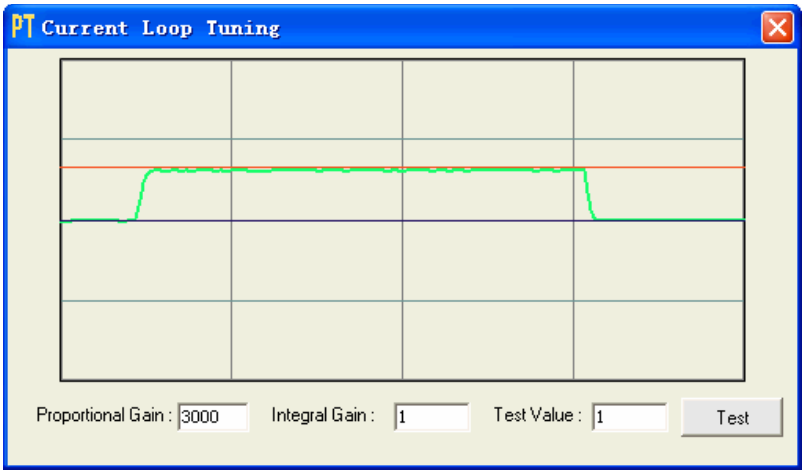


↑ Proportional Gain:
Proportional Gain = 1000
Integral Gain = 0

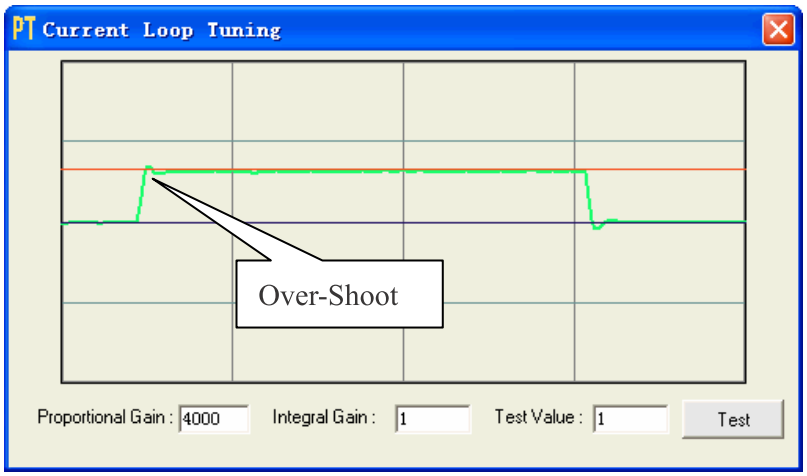
Step 3: Give **Proportional Gain** 2000, 3000, 4000 and click **Test button,** respectively. The green curve is getting more and more close to the red curve. Over-shoot is obvious when we increase **Proportional Gain** to 4000. It indicates that you need to stop increasing Kp and back off. Our purpose is to make the green curve (the actual current) a little higher than the red curve (the target). So we decrease Kp to 3700 until the actual value is exactly over the target value.



↑ Proportional Gain:
Proportional Gain =2000
Integral Gain = 1



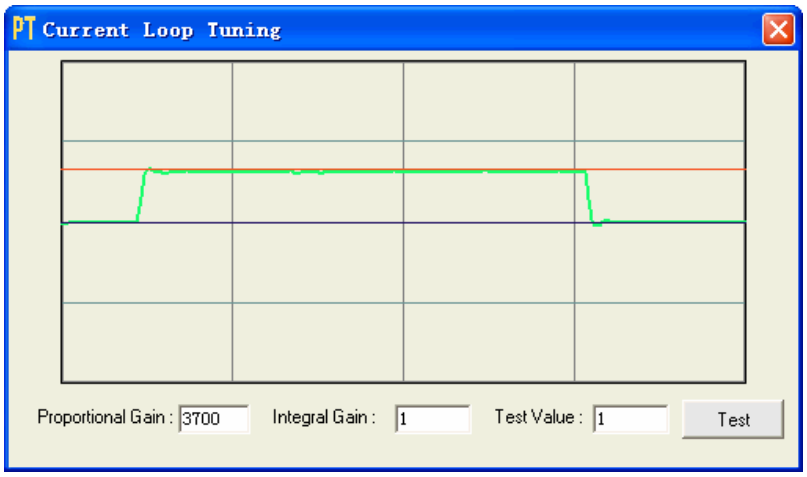
↑ Proportional Gain:
Proportional Gain =3000
Integral Gain = 1



↑ Proportional Gain:

Proportional Gain =4000

Integral Gain = 1

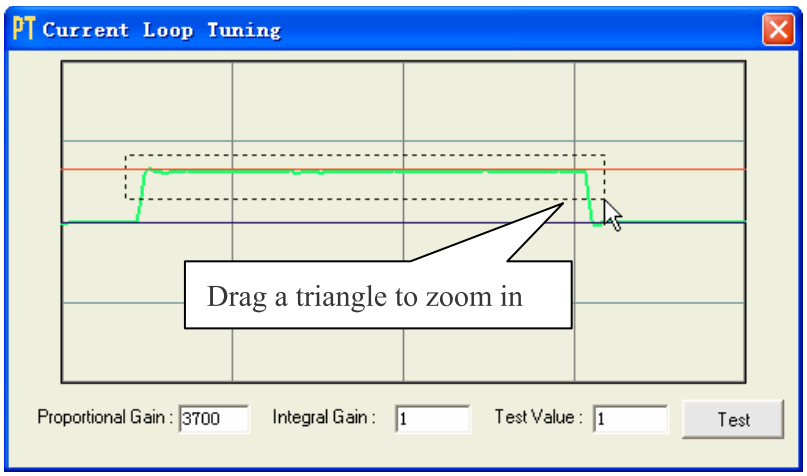


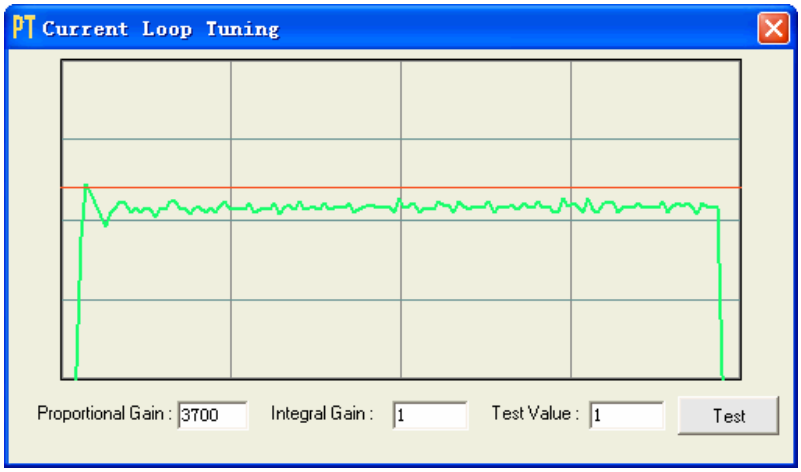
↓ Proportional Gain:

Proportional Gain =3700

Integral Gain = 1

Step 4: Now the **Proportional Gain** is relatively good enough. But there is still gap between the green curve and the red curve when we use the mouse to zoom in the green curve. So we need to introduce **Integral Gain** to reduce the "gap" or steady error at the constant part. It follows the same procedure as **Proportional Gain**. High **Integral Gain** causes big vibration, system lag and makes the performance worse. The following figures show how to tune the integral gain.

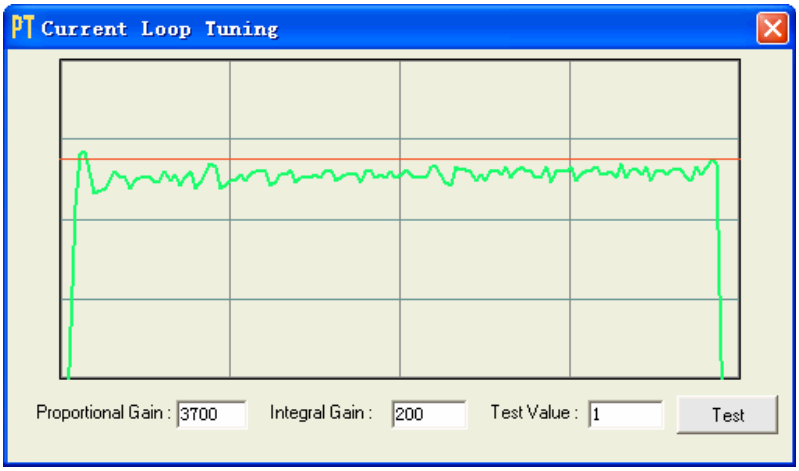




Zero Integral Gain:

Proportional Gain =3700

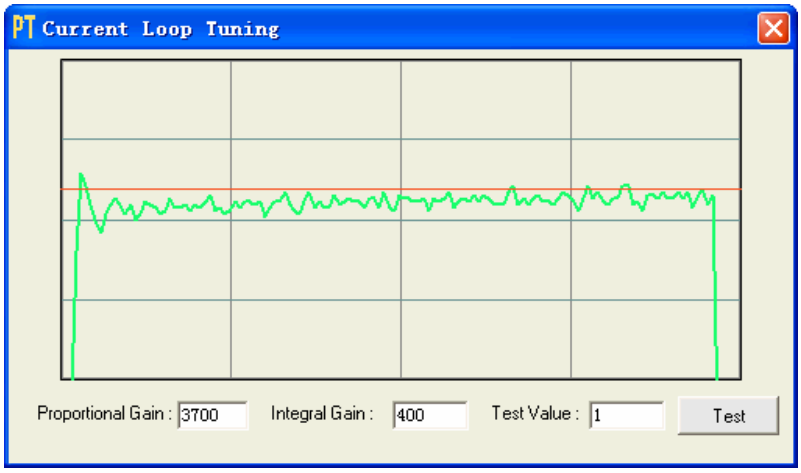
Integral Gain = 1



↑ Integral Gain:

Proportional Gain =3700

Integral Gain = 200

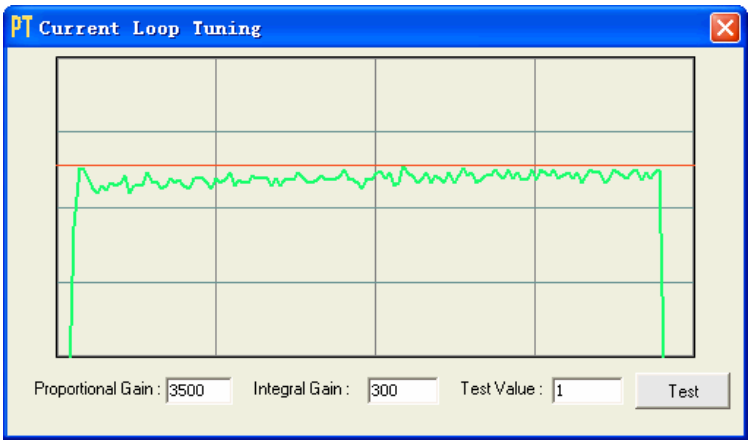


↑ Integral Gain:

Proportional Gain =3700

Integral Gain = 400

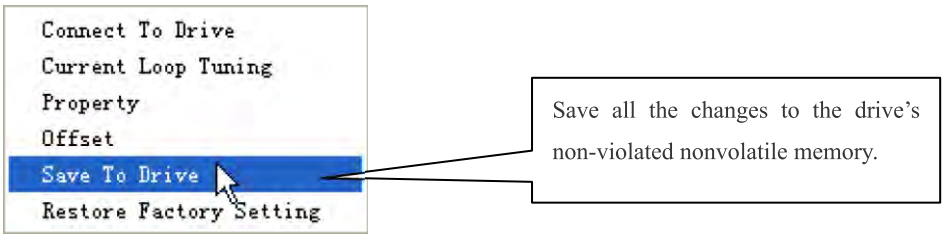
Step 5: The current loop tuning is basically finished. You can continue to adjust Kp and Ki for better performance. Now the updated Kp and Ki is just stored in the driver's RAM. They will be lost when we power off the driver. **Don't forget to click Drive->Save To Drive to store the changed value to the drive's EEPROM.**



Further Adjustment:

Proportional Gain =3500

Integral Gain = 300

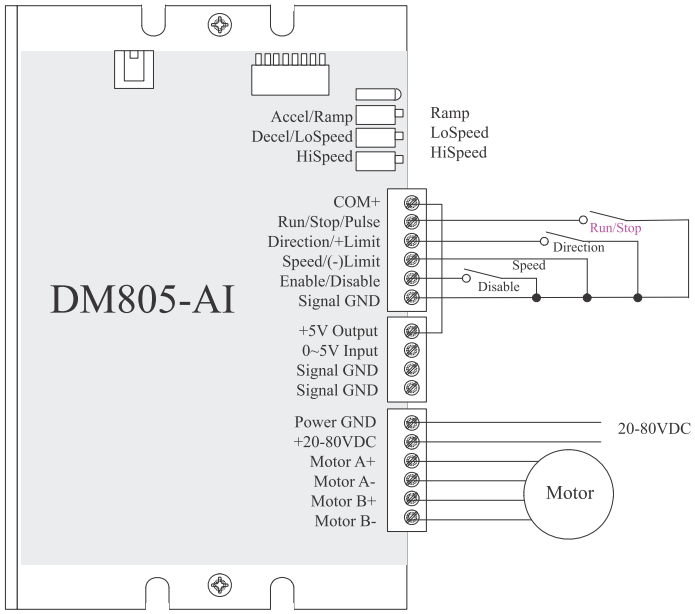


Anti-resonance Tuning

Step motors are highly resonant, which results in vibration and ringing. The ringing utilizes a large fraction of the motor's available torque – thereby wasting performance. Furthermore, at mid-range velocities, the resonance can become so severe that the motor looses synchronization and stalls. The DM442 drive provides robust anti-resonance control to stop the vibrations and maintain equilibrium. This feature requires that the drive be configured with respect to the total inertia in the system. If set improperly, the effectiveness of the feature may be diminished.

1. For most of the application, it is not needed to tune DM805-AI's anti-resonance parameters. We only recommend the advance user to use this function as it is a boring process.
2. In most of the case, only the tuning of the 1st and 2nd anti-resonance area has obvious effect.

Step 1: Connect the drive as follows and configure it in Low/High Speed mode by set SW7 = OFF and SW8 = ON. As the Speed input is connected to Signal GND, the motor speed is determined by the LoSpeed potentiometer and it can be adjusted from 0RPS to 5RPS.



Step 2: Start to move the motor by activating the Run/Stop input. Find a resonance speed by slightly adjusting the LoSpeed parameter CW and CCW.

Step 3: Keep the motor running at the resonance speed and verify the motor smoothness. You may find a better smoothing value by slightly moving the slider bars of **Amplitude** and **Phase** back and forth. If the motor speed is 0.6-1.2RPS, you should tune the Amplitude and Phase at the 1st resonance area. The 2nd resonance area is 1.2-2.4 RPS and the 3rd resonance area is 2.4 4.8 RPS.

Notice

1. You can calculate the motor speed roughly as follows:

$$Speed(RPS) = 5 \pm 0.01(RPS) \times \frac{Turns\ of\ LoSpeed\ Potentiometer}{25Turns}$$

2. It is very important to make the **Amplitude** and **Phase** adjustments at the resonance speed.

For example, we find a resonance speed at 0.98 RPS. We begin to move the Amp1 slider forth and the motor vibration and noise be came lower and lower. Finally we find the move is the smoothest when **Amplitude** is 3300. The motor vibrat ion and noise increase if **Amplitude** exceeds 3300. Then we follow the same procedure to search the best point for **Phase**. See Figure 26. Anti-resonance tuning is done.

Step 4: Click **Drive->Save To Drive** to save all the parameters to DM805-AI.

Adjusting the Electronic Damping

The factory setting for the electronic damping is 1000. If the mo tor is easily stalled and generates odd noise at middle speed, you can try other values such as 500, 1500, 2000, 2500.