Basic Components of Motion Control System

Many different components are used in a variety of combinations to create a modern motion control system. Usually, the system will be comprised of the following basic elements: controller, drive/amplifier, actuator. And for a more integrated motion control system will be comprised of feedback, operator interface and host, besides elements mentioned above. A simplified block diagram of a motion control system would appear as shown below.

An Open-loop or a Simi-closed-loop Motion Control System
(ie. a traditional stepper system, a simi-closed-loop servo system)

A Closed-loop Motion Control System

*** Operator Interface and Host**

Operator interface and host are present to input control logic, modify programs, or provide real time operations, such as system shut down or schedule changes.

*** Controller**

The controller acts as brain of the system by taking the desired target positions and motion profiles and creating the trajectories for the motors to follow. It will include a means of entering a set of instructions or code into its memory which are then translated into a series of electrical pulses or analog signals or network commands and output to a drive for controlling some types of actuator.

*** Drive/Amplifier**

The drive/amplifier receives the signals from the controller and generate the current required to drive or turn the actuator.

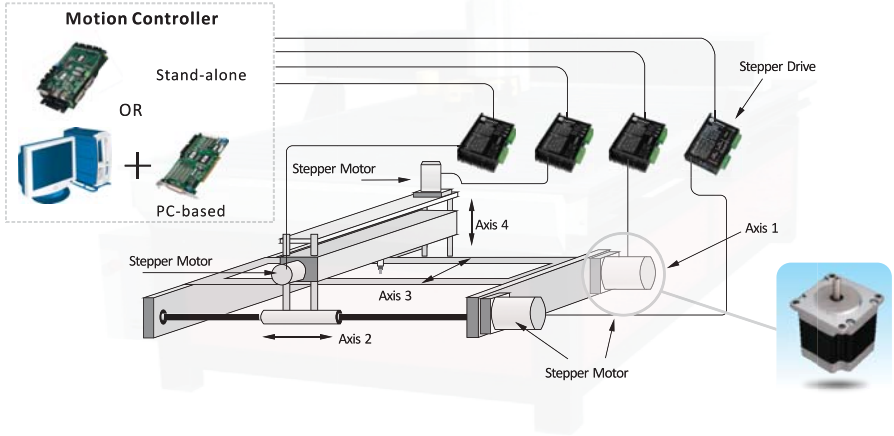
*** Actuator**

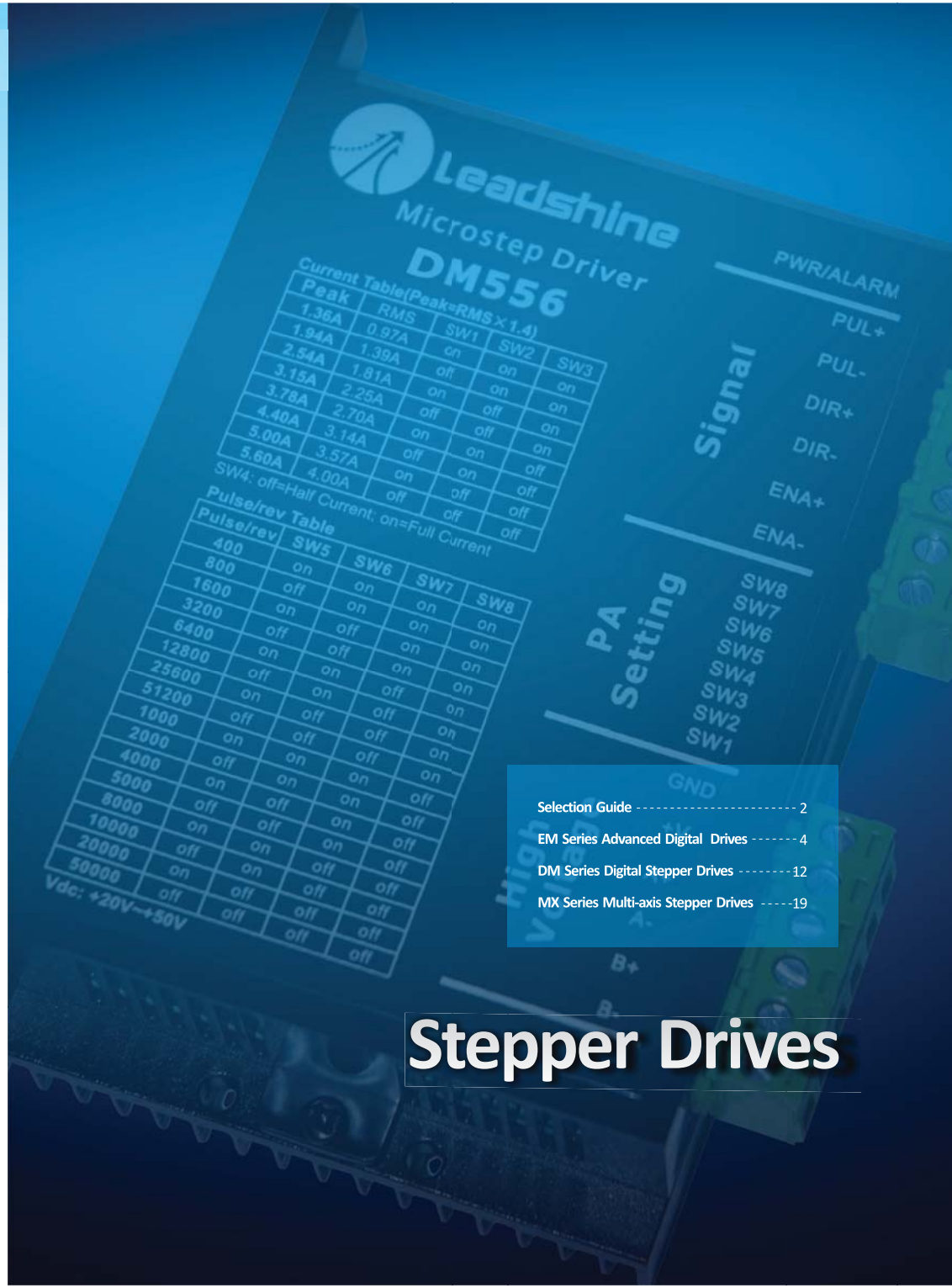
The actuator provides the actual physical motion and will be closely coupled to the design characteristics of the drive. The drive/actuator set may be any one of several different design classifications. Typically, but by no means always, they will the form of an electronic drive and an electric motor. Other common means of motion are pneumatic or hydraulic actuators.

*** Feedback Device**

There are a wide variety of feedback devices that are commonly used in motion control systems today which provide information on linear or rotary motion, such as optical encoders, magnetic encoders and resolvers.

A Typical Stepper System





Stepper Drives

Selection Guide for Stepper Drives

A stepper motor requires an electrical sequencer and it is called a stepper drive. The stepper drive is one of the key components in a stepper system. When you select a stepper drive for a specific application, you can follow the following steps. Firstly, you should choose the drive type and determine the drive operating mode. Secondly, choose right supply voltage and output current according with the application and motor. In the end, you should consider whether the acceptable control signals of the drive are right for those of your motion controller or not. Of course, the price of the chosen drive should be acceptable too.

Drive Types

The output torque and power from a stepper motor are determined by the operating current, motor size, motor heat sinking, motor winding, and the type of the drive used. You can get much different performances from a given motor by choosing different type stepper drives.

There are some commonly-used drive types, such as unipolar constant voltage drive, unipolar L/nR constant voltage drive, unipolar timed bi-level drive, unipolar constant current drive, unipolar constant current drive and bipolar constant current microstep drive. The highest output power and motor utilization for a given motor is achieved with the bipolar constant current drive. DC-losses is kept at a minimum due to maximum utilization of the copper in the winding and no power losses from leakage inductance and snubbing circuits since every winding only consists of one part.

Bipolar constant current microstep drive is an improved version of the basic full- and half-step bipolar constant-current drive. Here, the winding currents form a sine/cosine pair. This greatly improves low frequency performances by eliminating overshot movements, ringing, and resonances. Performances at medium and high-stepper rates are close to those of full- and half-step. Microstep can also increase resolution and step accuracy of the stepper systems.

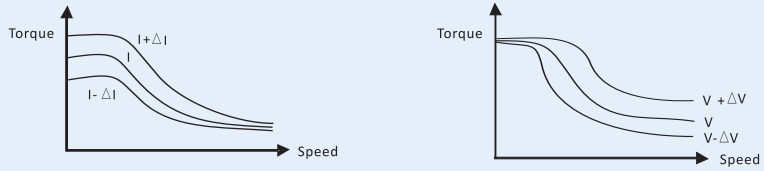
Supply Voltage and Output Current

Although both regulated and unregulated power supplies can be used to power the drives, unregulated power supplies are preferred due to their ability to withstand current surge. The power supply voltage must be within the drive's allowable operating voltage range. Beyond that, the choice of voltage is dependent on the application and the motor used.

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

For a given motor, higher drive current will make the motor output more torque, but it also 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. Phase current rating supplied by motor manufacturer is important when setting a drive's output current, however the current setting also depends on the leads and motor connections. Since parallel and series connections of motor coils will significantly change the resulting inductance and resistance, it is important to set drive output current based on motor's phase current and connection types.

Leadshine's stepper drives cover a broad operating voltage range, from 18 to 312VDC or 18 to 220VAC. And most of Leadshine's stepper drives have over-voltage and over-current protection functions. All of Leadshine's stepper drives use DIP switches to set motor's operating current, and all of them have automatic idle-current reduction function for lower heating.



Drive Modes

The most common drive modes are full-step, half-step and microstepping.

FULL-STEP MODE: This is the basic stepper driving mode, it offers the simplest control electronics and it is recommended for high and medium frequency operation. At these frequencies, the inertia of the motor and the load smooth out the torque, resulting in less vibration and noise compared to low-speed operation.

1step (1.8° for 2-phase)

HALF-STEP MODE: Half-step gives smoother movement at low step rates compared to full-step and can be used to lower resonances at low speeds. Half-step doubles the system resolution. Observe that for most stepper motors, the step accuracy specification only is valid for 2-phase-on positions. The accuracy is lower and the stop-position hysteresis is larger for 1-phase-on positions.

1step (0.9° for 2-phase)

Microstepping: The smoothest movement at low frequencies can be achieved with microstepping. If resonance-free movement at low step rates is important, the microstepping drive is the best choice. Microstepping can also be used to increase stop position accuracy beyond the normal motor limits.

1step (1.8° / n for 2-phase)

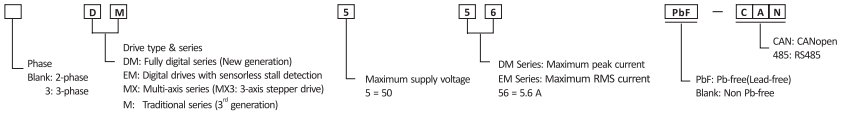
Leadshine's stepper drives cover all drive modes. Both our digital stepper drives and analog stepper drives can operate in full-step, half-step and microstepping modes.

Leadshine Stepper Drives

Since releasing its first stepper drive in 1997, Leadshine has been designing stepper drives to satisfy the requirements of its customers. Today, Leadshine is one of the **LARGEST** stepper drive manufacturers in the world. Every year, over **900,000** Leadshine stepper drives are implemented in thousands of applications around the world. The applications include CNC routers, laser machines, electronic equipment, medical equipment, packaging machines, textile equipment, pick-and-place devices, etc.

Currently, Leadshine offers three main series of 2-phase microstepping drives, the digital EM series, DM series and analog MX series. The high performance DM drives are based on powerful 32-bit DSP control technology. Their features include super-low stepper noise, anti-resonance, low-speed ripple smoothing, and low motor heating. The EM series drives are leadshine's highest performance discrete stepper drives. They adopt even more innovative technologies than the DM series, thus have more features, such as sensorless stall detection, drive configuration protection, etc. The MX series was specially designed to allow easy and rapid implementation of multiple axis stepper solutions. Their integrated breakout board and built-in IO's offer easy implementation for many applications at very effect costs.

Part Number



Selection Table

Phase	Series	Model	Output Current (A)	Operating Voltage (V)	Microstep Resolution	Driving Motors (NEMA Size)	Weight (kg)	Size (mm)	Control Signals	
									PUL/DIR; CW/CCW	Single-ended; Differential
2	EM	EM402	0.3 - 2.2	DC(20-40)	1-512	14, 17, 23	0.12	86*55*20	PUL/DIR;	Single-ended; Differential
		EM503	0.5 - 4.5	DC(20-50)	1-512	14, 17, 23	0.2	116*69*26.5	PUL/DIR; CW/CCW	Single-ended; Differential
		EM705	0.5 - 7.8	DC(20-75)	1-512	17, 23, 34	0.29	118*75.5*34	PUL/DIR; CW/CCW	Single-ended; Differential
		EM806	0.5 - 8.4	DC(24-80)	1-512	17, 23, 34	0.58	151*97*48	PUL/DIR;	Single-ended; Differential
	DM	DM422	0.3 - 2.2	DC(18-40)	1-512	14, 17, 23	0.115	86*55*20	PUL/DIR; CW/CCW	Single-ended;
		DM556	0.5 - 5.6	DC(18-50)	1-512	14, 17, 23	0.28	118*75.5*34	PUL/DIR; CW/CCW	Single-ended; Differential
		DM870	0.5 - 7.0	DC(18-80)	1-512	17, 23, 34	0.28	118*75.5*34	PUL/DIR; CW/CCW	Single-ended; Differential
		DM1182	0.5-8.2	AC(80-150)	1-512	34, 42	1.3	202*167*63	PUL/DIR; CW/CCW	Single-ended; Differential
		DM2282	0.5-8.2	AC(80-220)	1-512	34, 42	1.3	202*167*63	PUL/DIR; CW/CCW	Single-ended; Differential
		DM805-AI**	0.5-7.0	DC(18-80)	1-512	17, 23, 34	0.28	118*75.5*34	PUL/DIR; CW/CCW	Single-ended; Differential
		DM556-CAN	0.5-7.0	DC(20-50)	1-512	14, 17, 23	0.28	118*75.5*34	CANopen	
	M	M542	1.0-4.2	DC(20-50)	2-128, 5-125	14, 17, 23	0.28	118*75.5*34	PUL/DIR; CW/CCW	Single-ended; Differential
		M760	1.45 - 6.0	DC(20-75)	2-256, 5-200	17, 23, 34	0.57	118*75.5*34	PUL/DIR; CW/CCW	Single-ended; Differential
		M860	2.4 - 7.2	DC(24-80)	2-256, 5-200	17, 23, 34	0.57	151*97*48	PUL/DIR; CW/CCW	Single-ended; Differential
		M880A	2.8 - 7.8	DC(24-80)	2-256, 5-200	17, 23, 34	0.57	151*97*48	PUL/DIR; CW/CCW	Single-ended; Differential
3	DM	3DM683	0.5 - 8.3	DC(18-60)	200-51200s/r	17, 23, 34	0.30	118*75.5*34	PUL/DIR; CW/CCW	Single-ended; Differential
		3DM2283	0.5 - 11.7	AC(150-220)	200-25600s/r	34, 42, 51	1.3	200*137*81	PUL/DIR; CW/CCW	Single-ended; Differential
2	MX (DM)	MX3660	1.4 - 6.0	DC(20-60)	2-64	17, 23, 34	0.68	168*77.5*37	PUL/DIR;	Single-ended;
		MX4660	1.0 - 6.0	DC(20-60)	2-64	17, 23, 34	0.73	220*77.5*40	PUL/DIR;	Single-ended;

Operating Environment for Leadshine's Standard Drives

Cooling	Natural cooling or forced cooling	
Operating Environment	Environment	Avoid dust, oil fog and corrosive gases
	Ambient Temperature	0 to +50 °C
	Humidity	40-90% RH
	Vibration	5.9m/s² MAX
Storage Temperature		-20 to 125 °C

Tips

1. Operating temperature of Leadshine standard drives should below 70°C (158°F); and motor working temperature should be below 80°C (176°F). Use automatic idle-current function to reduce drive and motor heating when a motor stops. Use forced cooling to cool the system if necessary.

2. To improve anti-interference performance of the system, use twisted pair shielded cable for control signals and correctly ground the system. To prevent noise coupling on pulse/direction signals, pulse/direction signal wires, motor wires and power wires should not be tied up together. Separate them by at least 10 centimeters (4 inches) to avoid disturbing signals generated by a stepper motor, which can easily disturb pulse and direction signals and cause motor position error, system instability and other failures.

3. Don't pull and plug motor or power wires while a stepper drive is powered ON, because there is high current flowing through motor coils (even stopped). Doing that would result in extremely high voltage surge, and could damage the drive.

4. If a power supply serves multiple drives, separately connecting the drives (each in a star arrangements) is recommended instead of daisy-chain arrangement.

* UL approved products are available.
** Command sources include step/direction, analog(0-5V).

EM Series Digital Stepper Drives

Sensorless stall detection and Extra-low motor noise

Innovative Technologies

- Sensorless Stall Detection
- Extra-low Motor Noise
- Drive Configuration Protection
- Anti-Resonance Technology
- Low-speed Ripple Smoothing
- Multi-stepping Technology
- Soft Start Technology
- Self-test and Auto-configuration

Specifications

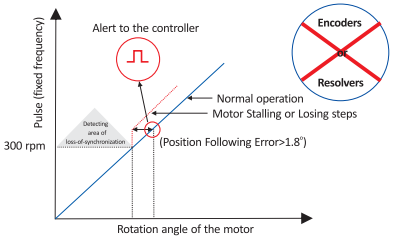
Type	Model	Voltage	RMS Cur.	Matching Motors
DC Input	EM402	20-40 VDC	0.07-1.6A	NEMA8 to 23
	EM503	20-50 VDC	0.21-3.2A	NEMA14 to 23
	EM705	20-75 VDC	0.35-5.5A	NEMA17 to 34
	EM806	24-80 VDC	0.35-6.0A	NEMA23 to 34
AC Input	EM1206H*	80-150 VAC	0.35-6.0A	NEMA34 to 42
	EM2306H*	80-230 VAC	0.35-6.0A	NEMA34 to 51

●Over voltage, over current, short-circuit protections and fault out.
*Available time: to be determined.

Innovative Technologies

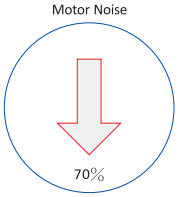
1 Sensorless Stall Detection

By detecting motor voltage, current, and back-emf signal, EM series drives can detect loss of synchronization of stepper motors without encoders. The sensorless stall detection eliminates cost of feedback devices and time of cable connection.



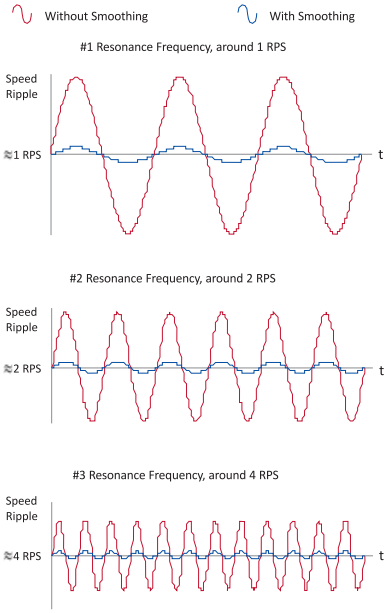
2 Extra-low Motor Noise

Precision current control technology and multi-stepping technology can reduce about 70% of motor noise, making the EM series to be an ideal solution for the applications require extra-low motor noise.



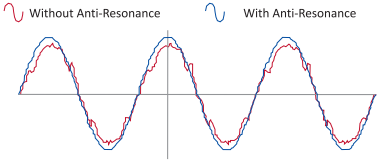
3 Low-speed Ripple Smoothing

Electronic damping for 3 major resonance frequencies for stepper motors at low speed range, eliminating undesirable motor speed oscillation and delivering unique level of smoothness.



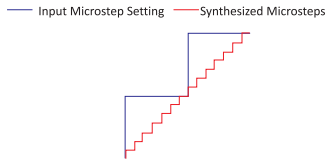
4 Anti-Resonance at Mid-range

Most stepper systems resonate at mid-range speed between 10 to 18 rps. The EM stepper drives can calculate natural frequency of the stepper system and apply damping in control algorithm for anti-resonance, Providing optimizing torque and nulling mid-range instability.



5 Multi-stepping Technology

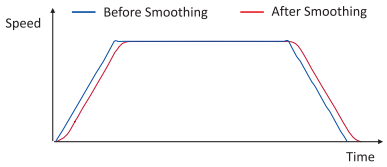
Multi-stepping allows a low resolution input to produce a higher microstep output for smoother system performance. This function can improve smoothness of the stepper systems without upgrading your motion controllers.



Innovative Technologies

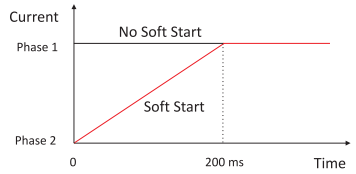
6 Command Signal Smoothing

Command signal smoothing can soften the effect of sudden changes in velocity and direction, thus delivering smoother performance and improving system lifetime.



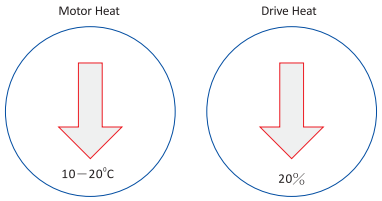
7 Soft Start Technology

On power up of a stepper motor, soft start technology allows a stepper motor gradually applying the shaft torque to the load and avoid "starting shock" to the machine. This function is implemented through software, so no additional hardware needed.



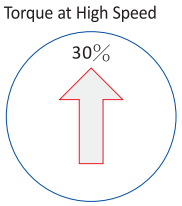
8 Lower Heating Technology

Due to DSP precision current control algorithm, motor heat is 10 — 20 °C lower compared with a traditional stepper drive. Longer motor lifetime can be achieved, reducing maintenance cost. Drive heat is also 20% lower, offering higher drive stability and energy efficiency.



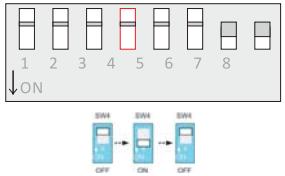
9 Torque Improvement

Torque improvement increases torque up to 30% at high speed, therefore they can drive a normal stepper motor to 3000 RPM or even higher, and significantly increase production efficiency.



10 Self-test and Auto-configuration

Motor-self-test and parameter-auto-configuration technology offers optimum performance for different motors. It is easier for users to configure different axes or build different machines.



Turn SW4 2 times switch in 1 second .

11 Drive Configuration Protection

Drive configuration protection allows you to prevent others from copying your stepper drive configuration.

Features

- **Sensorless stall detection** eliminates cost of feedback devices and time of cable connection
- **Extra-low motor noise** offers excellent quietness
- **Drive Configuration protection** prevents others from copying your drive configurations
- **Anti-Resonance** optimizes torque and nulls mid-range instability
- **Self-test and Auto-configuration** technology offers optimum performance for different motors
- **Multi-stepping** allows a low resolution input to produce a higher microstep output for smoother system performance
- Built-in controller for simple test, easier to test the drive or system
- Options to set output current and microstep resolutions via DIP switch or software
- Command input of step&direction and CW/CCW pulse*
- Over-current, over-voltage, short-circuit protections besides sensorless stall detection
- **Fault out** prevents damages to your machines or the materials

Introduction

By implementing the latest motion control technologies, Leadshine's EM series DSP-based stepper drives deliver extra high performance not available before. Unique features of sensorless stall detection, extra smoothness and excellent high speed performance make the EM stepper drives deliver servo-like performance at the cost of stepper drives. They are capable of delivering high performance with sensorless stall detection to make the system more reliable. Leadshine EM series stepper drives are able to drive 2-phase stepper motors from NEMA8 to NEMA51.

Part Number

3	EM	80	6	H	—	C
Phase	**Series**	**Max Input**	**Max RMS Current**	**Power Input Type**		**Communication Type**
Blank: 2-phase 3: 3-phase	EM: EM series	40: 40 V 80: 80 V ...	2: 1.5 A 6: 6.0 A ...	Blank: DC H: AC and DC		Blank: Step & Direction C: CANopen R: RS485

Electrical Specifications

Parameters / Model	Input Voltage (VDC)			RMS Current (A)		
	Min	Typical	Max	Min	Typical	Max
EM402	+20	+24	+40	0.07	-	2.0
EM503	+20	+24	+50	0.21	-	3.2
EM705	+20	+48	+75	0.35	-	5.5
EM806	+24	+68	+80	0.35	-	6.0
EM1206H	80VAC/112VDC	120VAC/170VDC	150VAC/212VDC	0.35	-	6.0
EM2306H	80VAC/112VDC	230VAC/325VDC	240VAC/339VDC	0.35	-	6.0

Parameters / Model	Pulse Input Frequency (kHz)			Logic Signal Current (mA)			Isolation Resistance (MΩ)		
	Min	Typical	Max	Min	Typical	Max	Min	Typical	Max
EM Series	0	-	250**	7	10	16	500	-	-

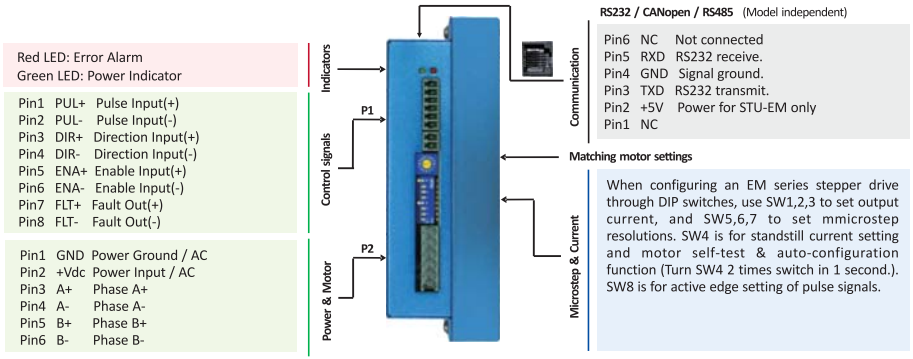
* The EM402 and E806 only support step&direction command.
** That of the EM402 is 20 kHz, and that of the other models is 250 kHz.

Applications

Leadshine EM stepper drives are suitable for driving a wide range of stepper motors, from NEMA frame size 8 to 51. Typical applications includ CNC routers, laser cutters, laser markers, medical equipments, X-Y tables, measurement equipments, etc.

Pin Assignment

There are two connector types for an EM stepper drive. Connector type P1 (See figure below.) is for control signal connections, and connector type P2 is for power and motor connections. The RS232 communication port is for parameter configurations via computer. See brief descriptions for these connectors and interface below.

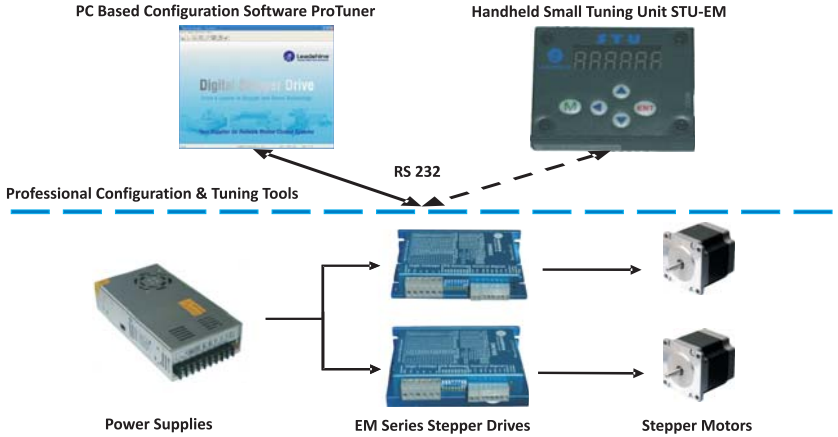


Tips:

1. Users are suggested to use motor **self-test and auto-configuration** function when powering up the system (with the motor) for the first time, or replacing a new motor.
2. To operate at current and microstep settings configured by software or STU, DIP switch must set to default mode.
3. Only software **ProTuner** can be used to configure anti-resonance parameter settings.
4. How many times the RED light blinks on in a periodic time indicates what protection has been activated. See manuals for details.

PC Based and Handheld Configuration/Tuning Tools

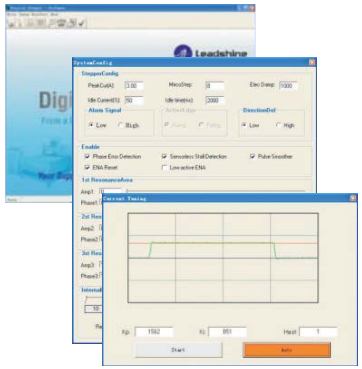
For most of applications, configurations set by self-test and auto-configuration function should be good enough to meet the application requirements. However, a user can also configure the advanced features such as anti-resonance and advanced current loop tuning through software or STU-EM, a simple device specially designed for easy tuning.



ProTuner (Windows Based Setup Software)

- User password setting
- Upload and Download parameter settings
- PI parameter settings for current loop
- Microstep resolution and output current setting
- Electronic damping coefficient setting
- Anti-resonance parameter settings for 3 resonance areas
- DIR and FLT logic level setting
- Enable and disable sensorless stall detection, ENA reset function and command signal smoothing
- Parameter settings for self motion test
- Save, open, upload and download a configuration file
- Read the latest 10 failure events and clear these events

* 1 PC RS232 interface is necessary.
** Leadshine offers special cable for communication between ProTuner and the drive.

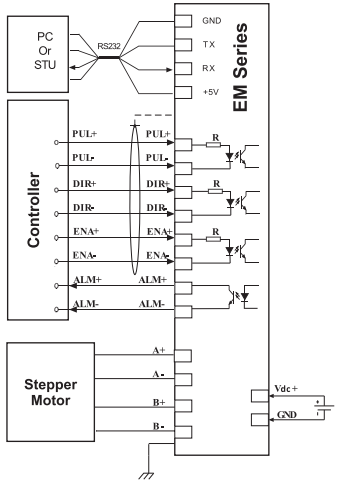


STU-EM (Handheld Configuration and Tuning Unit)

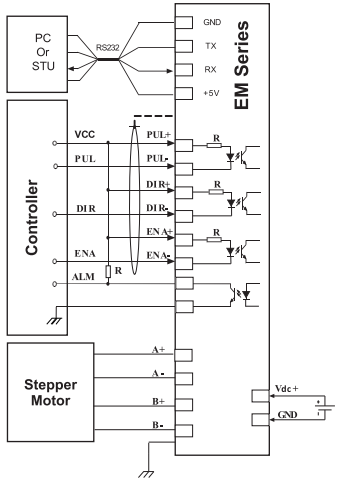
- Upload and Download parameter settings
- PI parameter settings for current loop
- Microstep resolution and output current setting
- Electronic damping coefficient setting
- DIR and FLT logic level setting
- Enable and disable sensorless stall detection, ENA reset function and command signal smoothing
- Parameter settings for self motion test
- Upload and download a configuration file

* Leadshine offers special cable for communication between the STU-EM and the drive.

Typical Connections



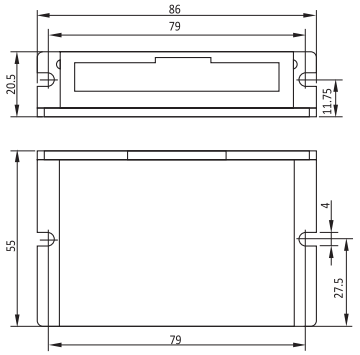
(a) Differential control signals



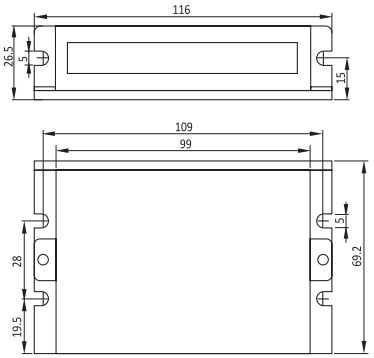
(b) Single-ended (NPN) control signals

Mechanical Specifications (Unit: mm 1 inch=25.4mm)

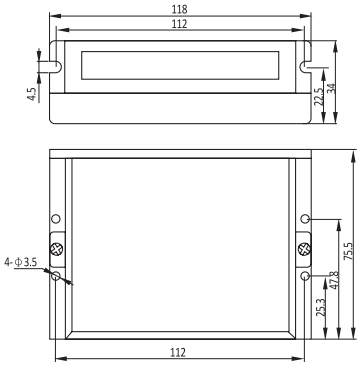
Units: mm 1 inch=25.4mm



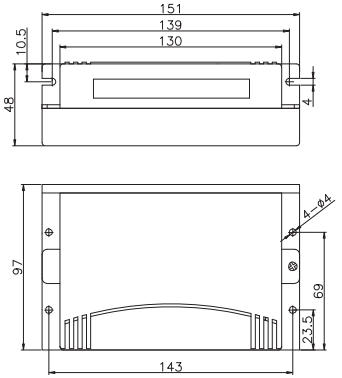
(a) Mechanical specifications of the EM402



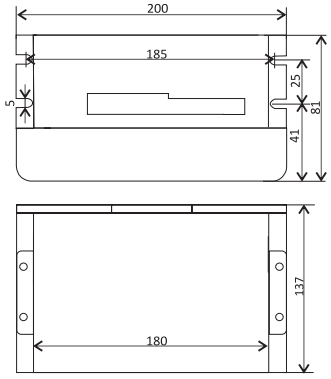
(b) Mechanical specifications of the EM503



(c) Mechanical specifications of the EM705



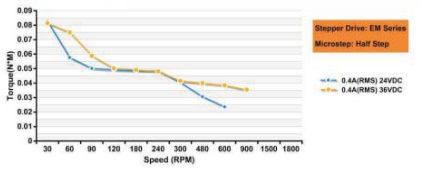
(d) Mechanical specifications of the EM806



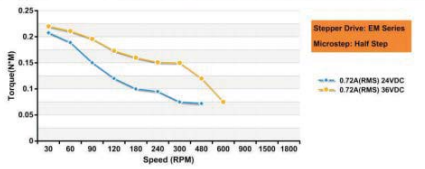
(e) Mechanical specifications of the EM1206H and EM2306H

Speed-Torque Curves of Pre-set Matching Motors*

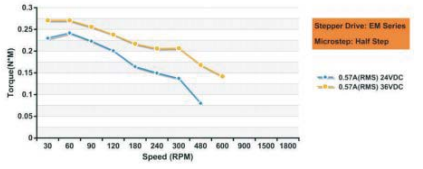
Stepper Motor: 35HS01 (NEMA14, Holding Torque: 0.1 Nm)



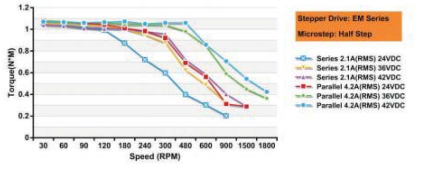
Stepper Motor: 39HS02 (NEMA16, Holding Torque: 0.2 Nm)



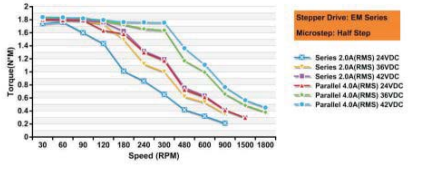
Stepper Motor: 42HS03 (NEMA17, Holding Torque: 0.3 Nm)



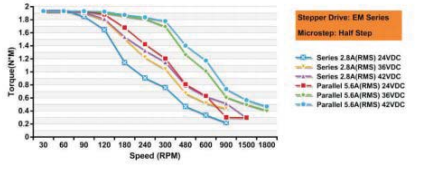
Stepper Motor: 57HS09 (NEMA23, Holding Torque: 0.9 Nm)



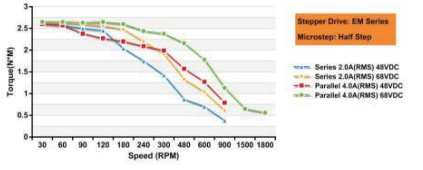
Stepper Motor: 57HS13 (NEMA23, Holding Torque: 1.3 Nm)



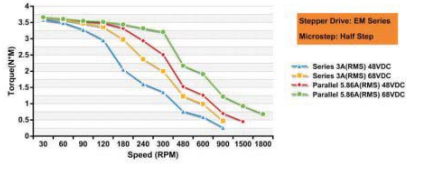
Stepper Motor: 57HS22 (NEMA23, Holding Torque: 2.0 Nm)



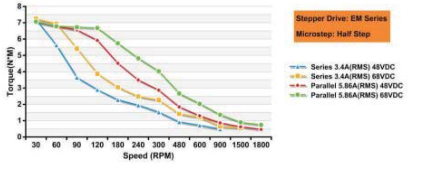
Stepper Motor: 86HS35 (NEMA34, Holding Torque: 3.5 Nm)



Stepper Motor: 86HS45 (NEMA34, Holding Torque: 4.5 Nm)



Stepper Motor: 86HS85 (NEMA34, Holding Torque: 8.5 Nm)



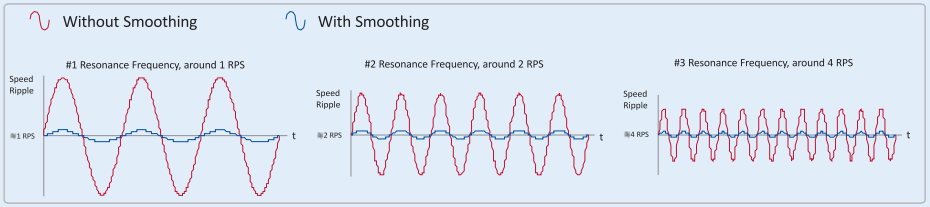
* Other curves will be released soon.

DM Series Digital Stepper Drives

Innovative Technologies

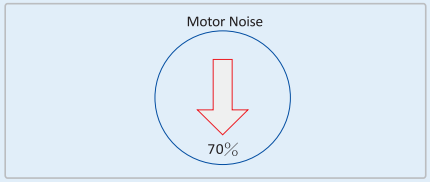
Low-speed Ripple Smoothing

Electronic damping for 3 major resonance frequencies for stepper motors at low speed range, eliminating undesirable motor speed oscillation and delivering unique level of smoothness.



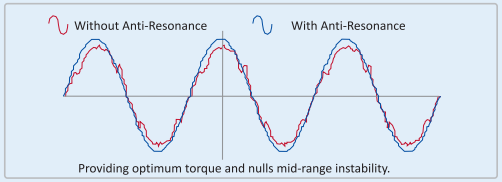
Extra-low Motor Noise

Precision current control technology and multi-stepping technology can reduce about 70% motor noise, making the DM series to be an ideal solution for the applications require extra low motor noise.



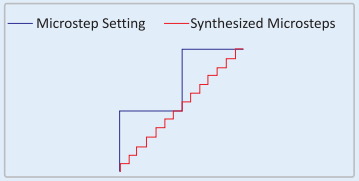
Anti-Resonance at Mid-range

Most stepper systems resonate at mid-range speed between 10 to 18 rps. The DM stepper drives can calculate natural frequency of the stepper system and apply damping in control algorithm for anti-resonance, providing optimizing torque and nulling mid-range instability.



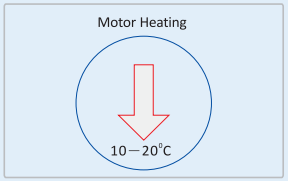
Multi-Stepping Technology

Multi-stepping allows a low resolution input to produce a higher microstep output for smoother system performance. This function can improve smoothness of the stepper systems without upgrading your motion controllers.



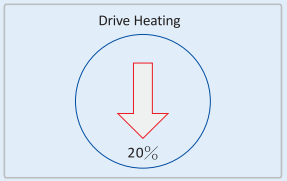
Lower Motor Heating

Due to DSP precision current control algorithm, motor heat is 10 - 20 °C lower compare to using a traditional stepper drive. Longer motor lifetime can be achieved, reducing maintenance cost.



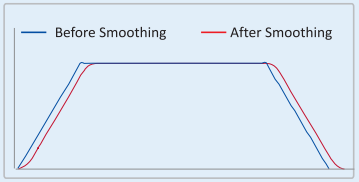
Lower Drive Heating

Drive heat is also 20% lower, offering higher drive stability and energy efficiency.



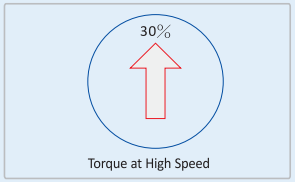
Command Signal Smoothing

Command signal smoothing can soften the effect of suddent changes in velocity and direction, thus delivering smoother performance and improving system liftime.



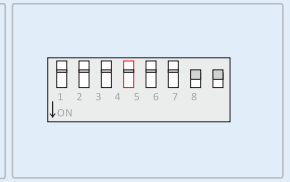
Torque Improving

Torque improvement increases torque up to 30% at high speed, therefore they can drive a normal stepper motor to 3000 RPM or even higher, and significantly increase production efficiency.



Self-test and Auto-config

Motor-self-test and parameter-auto-configuration technology offers optimum performance for different motors. It is easier for users to configure different axes or build different machines.



Features

- **Anti-Resonance** optimizes torque and nulls mid-range instability
- **Extra-low motor noise** offers excellent quietness
- **Self-test and Auto-configuration** technology offers optimum performance for different motors
- **Multi-stepping** allows a low resolution input to produce a higher microstep output for smoother system performance
- 2-phase and 3-phase stepper drives are available
- Options to set output current and microstep relolutions via DIP switch or software
- Command input of PUL/DIR and CW/CCW
- Over-current, over-voltage, short-circuit protections

Introduction

By implementing the latest motion control technologies, Leadshine's DM series DSP-based stepper drives deliver excellent performance not available before. Unique features of extra smoothness and excellent high speed performance make the DM stepper drives deliver servo-like performance at the cost of stepper drives. They are capable of delivering high performance without damages to your machines or the materials. Leadshine DM series stepper drives are able to drive 2-phase or 3-phase stepper motors from NEMA8 to NEMA42.

Applications

Leadshine DM stepper drives are suitable for driving a wide range of stepper motors, from NEMA frame size 8 to 42. Typical applications includ CNC routers, laser cutters, laser markers, medical equipments, X-Y tables, measurement equipments, etc.

Electrical Specifications

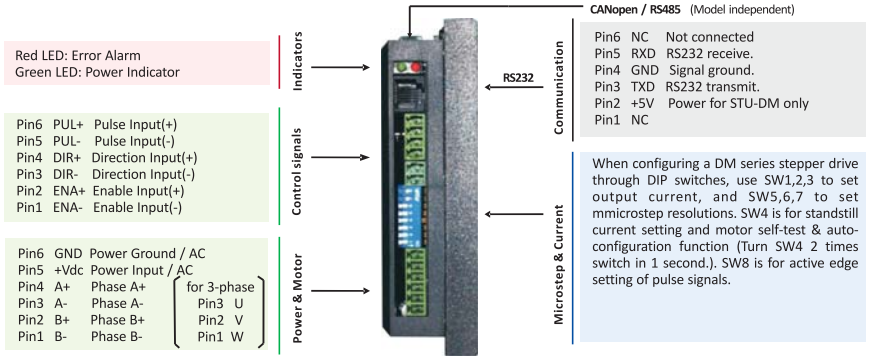
Parameters / Model	Input Voltage (VDC)			Output Current (A)		
	Min	Typical	Max	Min	Typical	Max
DM422C*	+18	+24	+40	0.3	-	2.2
DM556*	+18	+36	+50	0.5	-	5.6
DM870*	+18	+60	+80	0.5	-	7.0
DM1182	80 (VAC)	120 (VAC)	150 (VAC)	0.5	-	8.2
DM2282	80 (VAC)	230 (VAC)	240 (VAC)	0.5	-	8.2
3DM683	+18	+48	+60	0.5	-	8.3
3DM2283	80 (VAC)	230 (VAC)	240 (VAC)	0.5	-	11.7
DM805-AI	+18	+60	+80	0.5	-	7.0
DM556-CAN	+18	+36	+50	0.5	-	5.6

Parameters / Model	Pulse Input Frequency (kHz)			Logic Signal Current (mA)			Isolation Resistance (MΩ)		
	Min	Typical	Max	Min	Typical	Max	Min	Typical	Max
DM Series	0	-	200**	7	10	16	500	-	-

* UL approved products are available.
** Maximum pulse input frequency of the DM422C is 75 kHz.

Pin Assignment and Description

There are two connector types for a DM stepper drive. Connector type P1 (See figure below.) is for control signal connections, and connector type P2 is for power and motor connections. The RS232 communication port is for parameter configurations via computer. See brief descriptions for these connectors and interface below (Not including the DM805-AI, and see related contents in page 17 for more information about the DM805-AI.).

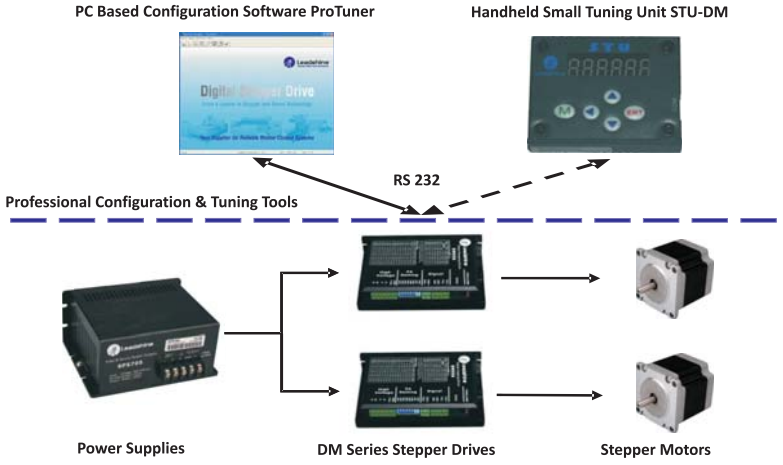


Tips:

1. Users are suggested to use motor **self-test and auto-configuration** function when powering up the system (with the motor) for the first time, or replacing a new motor.
2. To operate at current and microstep settings configured by software or STU, DIP switch must set to default mode.
3. Only software **ProTuner** can be used to configure anti-resonance parameter settings.
4. How many times the RED light blinks on in a periodic time indicates what protection has been activated. See manuals for details.

PC Based and Handheld Configuration & Tuning Tools

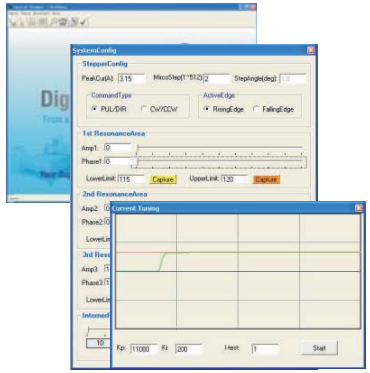
For most of applications, configurations set by self-test and auto-configuration function should be good enough to meet the application requirements. However, a user can also configure the advanced features such as anti-resonance and advanced current loop tuning through software or STU-DM, a simple device specially designed for easy tuning.



ProTuner (Windows Based Setup Software)

- Upload and download parameter settings
- PI parameter settings for current loop
- Microstep resolution and output current settings
- Operation mode configuration :PUL/DIR, CW/CCW, analog*
- DIR logic level setting
- Active edge of pulse signal setting
- Electronic damping coefficient setting
- Anti-resonance parameter settings for 3 resonance area
- Parameter settings for self motion test or a simple application
- Read the latest 10 failure events and clear these events

* 1 PC RS232 interface is necessary.
** Leadshine offers special cable for communication between ProTuner and the drive.

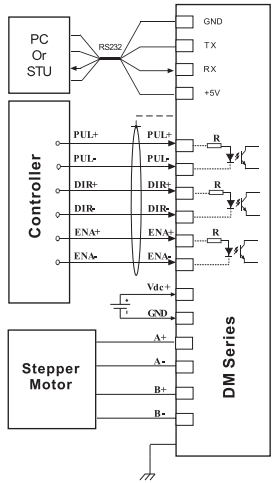


STU-DM (Handheld Configuration and Tuning Unit)

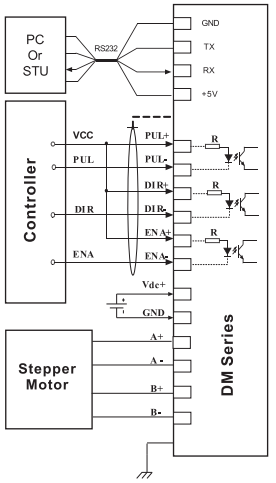
- Upload and download parameter settings
- PI parameter settings for current loop
- Microstep resolution and output current settings
- Operation mode configuration :PUL/DIR, CW/CCW, analog*
- DIR logic level setting
- Active edge of pulse signal setting
- Parameter settings for self motion test or a simple application

* Leadshine offers special cable for communication between the STU-DM and the drive.

Typical Connections



(a) Differential control signals

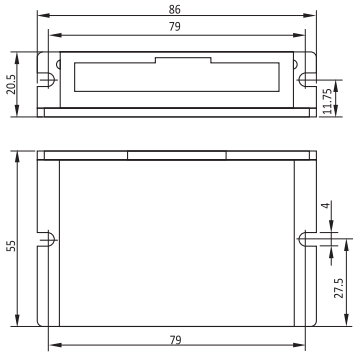


(b) Single-ended (NPN) control signals

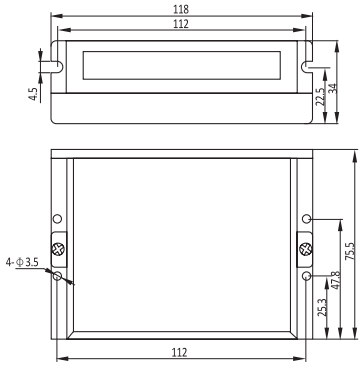
* Only the DM805-AI supports analog command for the moment.

Mechanical Specifications (Unit: mm 1 inch=25.4mm)

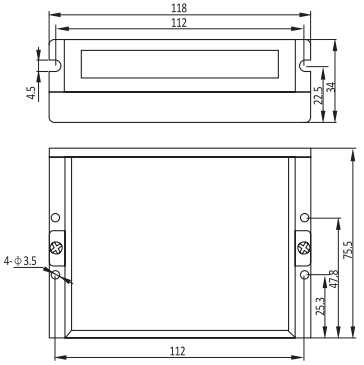
Units: mm 1 inch=25.4mm



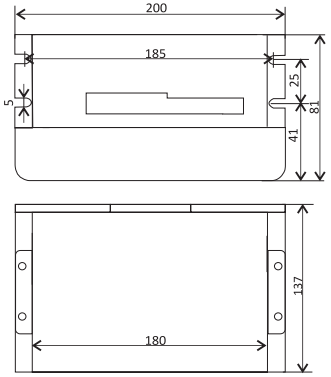
(a) Mechanical specifications of the DM422C



(b) Mechanical specifications of the DM556, DM556-CAN and DM870



(c) Mechanical specifications of the 3DM683 and DM805-AI



(d) Mechanical specifications of the DM1182, DM2282 and 3DM2283

DM805-AI

Introduction

The DM805-AI is a multi-function digital stepper drive and it belongs to DM series stepper drives. It has all the features that other DM drives have. The DM805-AI is distinguished from other DM series drives by it's operating modes. The DM805-AI can be operated in 4 different modes. They are 0-5V speed, low/high speed, external POT and pulse/direction modes.

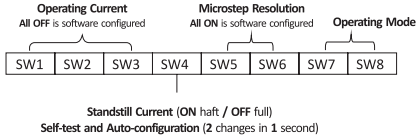
Three built-in potentiometers can be used to set the velocity, acceleration and deceleration. In 0-5V speed mode, the motor speed follows the analog 0-5V input. In Low/HIGH speed mode, the motor speed is selected by the digital input and adjusted by the high/low speed potentiometers. In pulse/direction mode, the DM805-AI acts as a traditional stepper drive. There is a 5V auxiliary output for customer to use. The user can run the motor with the least configuration and connection, without buying an expensive motion controller.

Function Description

Function	Description
Microstep Setting	Microstep resolution is programmable. When not in software configured mode, microstep resolution is set by SW5, 6, 7, 8 of the DIP switch. In order to avoid losing steps, do not change the microstep resolution on the fly.
Current Setting	Output current is programmable. When not in software configured mode, operating current is set by SW1,2,3 of the DIP switch. Up to 7.0 A. Select a current setting closest to your motor's required current.
Automatic standstill current reduction;	SW4 is used for the automatic standstill current reduction, self-test and auto-configuration function. When the former active, the current will automatically reduced to 60% of the selected operating current 0.4 second after the last pulse. Theoretically, this will reduce motor heating to 36% (due to $P=I^2*R$) of the original value.
Self-test and auto-configuration	If the user changes the status/position of SW4 twice in 1 second, the drive will self-test the driven motor and automatically configure control parameters, offering optimized performance with different motors.
Control Signals	The DM805-AI is a multi-function digital stepper drive. It can be operated in 0-5V speed, low/high speed, externalPOT and pulse/direction modes. There are 3 potentiometers, 4 digital inputs and 1 analog input can be configured to control the acceleration, speed, position and direction in different modes.
Motor Connector	A+, A- and B+, B- are for motor connections. Exchanging the connection of two wires for a coil to the drive will reverse default motion direction.
Power Connector	Recommended to use power supplies with output of 20 to 72 VDC, leaving room for power fluctuation and back-EMF.
Indicators	There are two LED indicators on the drive for power and alarm signals. When the Green LED is on means the drive is powered up, and when the Red LED is on means the drive is in fault status. When in fault status, the motor shaft will be free. Reset the drive by re-powering it to make it function properly after removing problem(s). See its manual for more information.

Parameter Settings

Microstep resolution, output current and operating mode are programmable. When not in software configured mode, the drive uses an 8-bit DIP switch to set microstep resolution, and motor operating current, as shown below:



Operating Current Setting

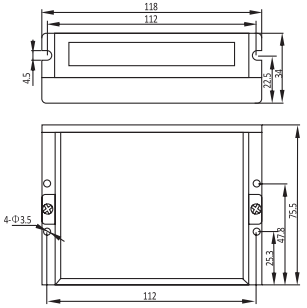
Peak Current	RMS Current	SW1	SW2	SW3
Default (software configured, 0.5-7.0 A)		off	off	off
2.6 A	1.8 A	on	off	off
3.4 A	2.4 A	off	on	off
4.0 A	2.8 A	on	on	off
4.8 A	3.4 A	off	off	on
5.4 A	3.8 A	on	off	on
6.1 A	4.3 A	off	on	on
7.0 A	5.0 A	on	on	on

Microstep Resolution Setting

Steps/rev.	SW5	SW6
Default (software configured, 1-512)	on	on
400	off	on
1600	on	off
12800	off	off

Mechanical Specifications

Units: mm 1 inch = 25.4mm



Applications

The DM805-AI is particularly suitable for the applications which need to adjust the velocity via the potentiometer or analog 0-5V command. Owing to high torque, smooth movement and extra-low motor noise at low speed, stepper solutions based on the DM805-AI can be used to replace the solutions using brushless motors and gearboxes. Such kind of motion soltuions are used in various kinds of machines, such as rotary heat exchange, conveyor belts, transport vehicle, offering longer life time and lower cost than the later.

Operating Mode Setting

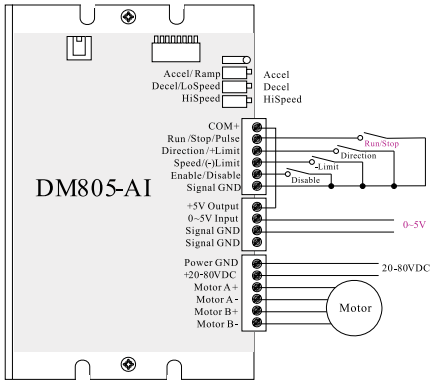
Operating Modes	SW7	SW8	Descriptions
0~5 V Speed	on	on	Speed controlled by the 0~5V, and direction controlled by the direction input.
Low/High Speed	off	on	Speed controlled by the preset low speed and high speed, and direction control by the direction input.
External POT	on	off	Both speed and direction are controlled by the 0~5V. 0~2.5 V, negative direction; 2.5~5V, positive direction.
Pulse/Direction	off	off	Speed and movement distance are controlled by the pulse, and direction controlled by the direction input.

Potentiometer Function in Different Operating Modes

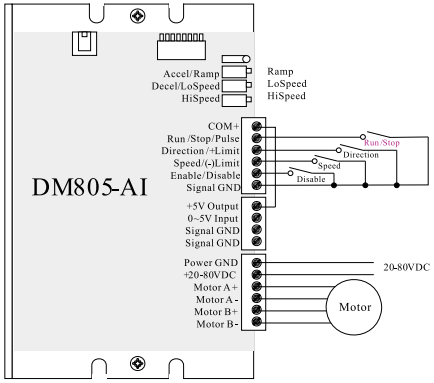
Potentiometers	0~5V Speed Mode	Low/High Speed Mode	External POT Mode	Pulse/Direction Mode
Accel / Ramp	Acceleration	Ramp	Acceleration	N/A
Decel / LoSpeed	Deceleration	Low Speed	Deceleration	N/A
HiSpeed	High Speed	High Speed	High Speed	N/A

Typical Connections

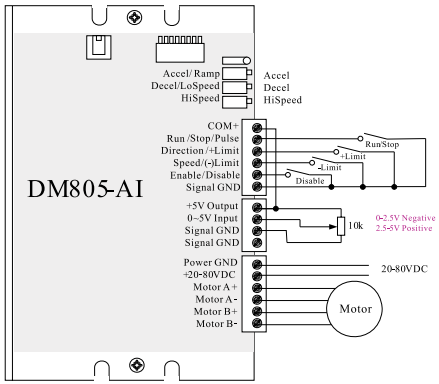
(a) 0~5 V Speed Mode



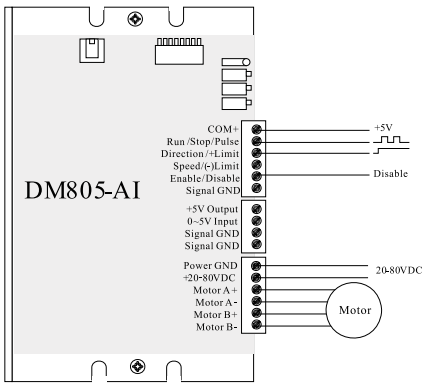
(b) Low/High Speed Mode



(c) External POT Mode



(d) Pulse/Direction Mode



Multi-Axis Stepper Drives

Features

- Multiple-axis digital stepper drives built on latest DSP technology
- Step & direction control
- VDC working voltage up to 60 VDC
- Output current up to 6.0A
- Anti-resonance for low and middle speed
- Built-in breakout boards and IO's
- DIP switches for micro step and output current configurations
- Automatic idle current reduction to 50%
- Motor-self-test and parameter-auto-configuration
- Able to drive NEMA 17, 23, 24, and 34 stepper motors
- Direct connection to popular control systems like Mach3 and EMC

Introduction

Based on the latest DSP technology and adopting Leadshine's advanced control algorithms, Leadshine MX series was specially designed to allow easy and rapid implementation of multiple axis stepper solutions. With up to 60VDC working voltage and output current to 6.0A, Leadshine multi-axis stepper drives are capable of driving multiple 2-phase stepper motors in frame size 17, 23, 24, and 34. Leadshine multiple axis stepper drives can drive stepper systems at excellent low-to-high speed performance with high precision, extra low motor heating, smooth movement, and low motor noise. They are featured with anti-resonance, multi-stepping, digital smoothing, options of different configuration for each axis, automatic idle current reduction, and easy configurations of microstepping and output currents via DIP switches. Their integrated breakout board and built-in IO's offer easy implementation for many applications at very effect costs. The MX3660 is a 3-axis stepper drive with 4DI&4DO, and the MX4660 is a 4-axis stepper drive with 8DI&6DO.

Applications

With integrated breakout boards and built-in IO's, Leadshine MX series stepper drives can be easily implemented as general purpose stepper drives to power 3/4 two-phase stepper motors in frame size 17, 23, 24, and 34. They are ideal solutions to many applications with 3-4 axis stepper systems such as CNC machinery, electronics, semiconductors, medical, packaging, lab automation, etc. They can be easily adopted in stepper control systems for machines like CNC routers/engravers, light-duty CNC mills, CNC lathes/cutters, laser cutters/markers/engravers, CNC welders, waterjet cutters, X-Y tables, CNC dispensing machines, medical equipments, etc.

The unique design of MX series drives with integrated breakout boards and built-in IO's makes them fit seamlessly with many popular CNC control systems like Mach3, EMC, etc.

Specification Summary

Model	MX3660	MX4660
Axis No.	3	4
Phase	2	2
Control Type	Step & Direction	Step & Direction
Operating Voltage	20 - 60 VDC	20 - 60 VDC
Suggested Power Input	24 - 54 VDC	24 - 54 VDC
Output Current (Per Axis)	1.41 - 6.0 A	1.41 - 6.0 A
Max Input Frequency	200 KHz	200 KHz
Microstep Settings	Full, Half, 1/4, 1/8, 1/10, 1/16, 1/32, 1/64	Full, Half, 1/4, 1/8, 1/10, 1/16, 1/32, 1/64
Output Current Settings (Peak)	1.41A, 2.12A, 2.83A, 3.54A, 3.96A, 4.24A, 4.95A, 6.0A	1.41A, 2.12A, 2.83A, 3.54A, 3.96A, 4.24A, 4.95A, 6.0A
Output Current Settings (RMS)	1.0A, 1.5A, 2.0A, 2.5A, 2.8A, 3.0A, 3.5A, 4.25A	1.0A, 1.5A, 2.0A, 2.5A, 2.8A, 3.0A, 3.5A, 4.25A
# of Digital Inputs	4	8
# of Digital Outputs	4	6
# of Analog Inputs	1	1
Digital Input Voltage	0 - 12 VDC	0 - 12 VDC or optional
Digital Output Voltage	0 - 24 VDC or optional	0 - 24 VDC or optional
Analog Output Signal Voltage	0 - 8.9 VDC (at 10VDC supplied voltage)	0 - 8.9 VDC (at 10VDC supplied voltage)
Minimum Step Width	2.5 μs	2.5 μs
Minimum Direction Setup Time	5 μs	5 μs
Idle Current Percentage	50%	50%
Protection Functions	Over current, over-voltage, emergency	Over current, over-voltage, emergency
Dimension	169 X 77.5 X 37 mm	220 X 77.5 X 40 mm

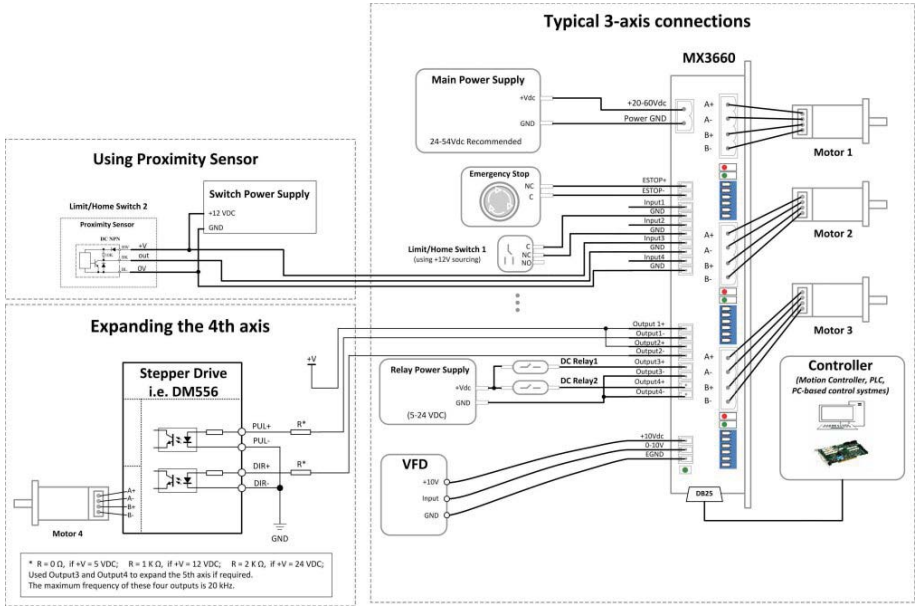
MX3660

Parameter Settings

Via DIP switches of a MX3660, a user can easily set stepper motor current and resolution configurations. Each individual axis can be set with different configurations. For example, you can configure axis 1 with 1/16 micro step & 6.0A to drive a large NEMA 34 stepper motor, axis 2 with 1/10 micro step & 2.83A to drive a NEMA 23 stepper motor, and axis 3 with 1/8 micro step & 1.41A current to drive a NEMA 17 stepper motor.

Operating Current Setting					Microstep Resolution Setting			
Peak Current	RMS Current	SW1	SW2	SW3	Steps / rev.	SW4	SW5	SW6
1.41 A	1.0 A	on	on	on	200	on	on	on
2.12 A	1.5 A	off	on	on	400	off	on	on
2.83 A	2.0 A	on	off	on	800	on	off	on
3.54 A	2.5 A	off	off	on	1600	off	off	on
3.96 A	2.8 A	on	on	off	2000	on	on	off
4.24 A	3.0 A	off	on	off	3200	off	on	off
4.95 A	3.5 A	on	off	off	6400	on	off	off
6.0 A	4.25 A	off	off	off	12800	off	off	off

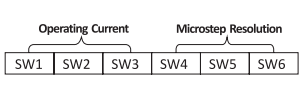
Typical Connections



MX4660

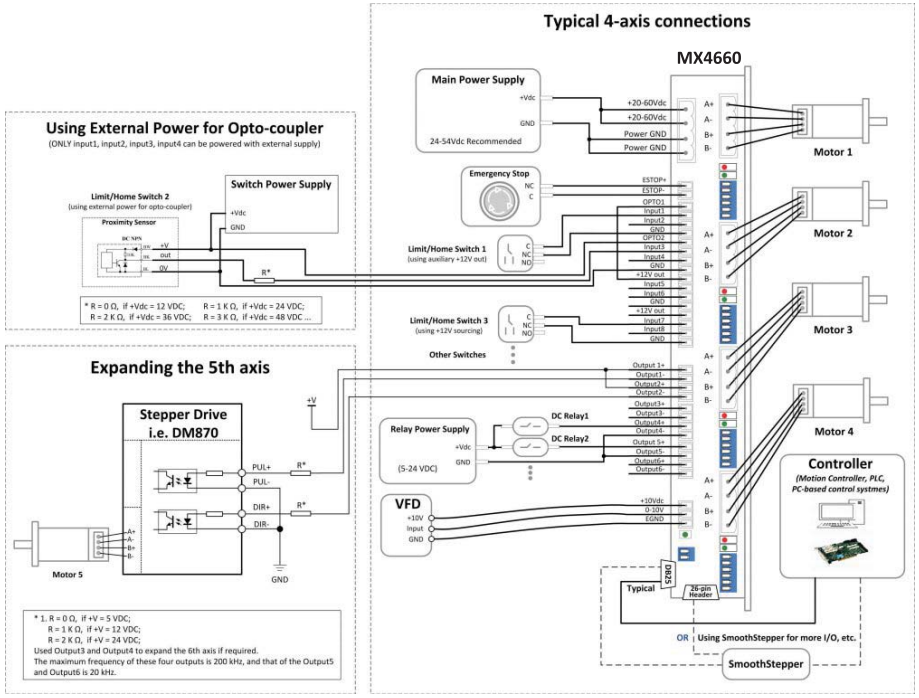
Parameter Settings

Via DIP switches of a MX4660, a user can easily set stepper motor current and resolution configurations. Each individual axis can be set with different configurations. For example, you can configure axis 1 with 1/16 micro step & 6.0A to drive a large NEMA 34 stepper motor, axis 2 and axis 3 with 1/10 micro step & 2.83A to drive two NEMA 23 stepper motors, and axis 4 with 1/8 micro step & 1.41A current to drive a NEMA 17 stepper motor.



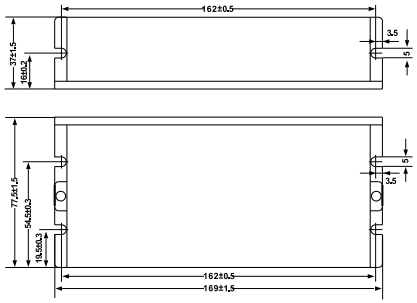
Operating Current Setting					Microstep Resolution Setting			
Peak Current	RMS Current	SW1	SW2	SW3	Steps / rev.	SW4	SW5	SW6
1.41 A	1.0 A	on	on	on	200	on	on	on
2.12 A	1.5 A	off	on	on	400	off	on	on
2.83 A	2.0 A	on	off	on	800	on	off	on
3.54 A	2.5 A	off	off	on	1600	off	off	on
3.96 A	2.8 A	on	on	off	2000	on	on	off
4.24 A	3.0 A	off	on	off	3200	off	on	off
4.95 A	3.5 A	on	off	off	6400	on	off	off
6.0 A	4.25 A	off	off	off	12800	off	off	off

Typical Connections

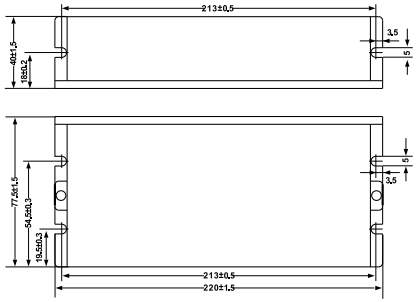


Mechanical Specifications

Units: mm 1 inch = 25.4mm



(a) Mechanical specifications of the MX3660



(b) Mechanical specifications of the MX4660