ASTROSYN
ADVANCING THE DRIVE TOWARDS MOTOR EFFICIENCY

User Manual

Model P403

High Performance Microstepping Driver

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1. General

The P403 is a high performance microstepping driver based on the most advanced technology in the world today. It is suitable for driving any 2-phase and 4-phase hybrid step motors (current 3.5A). By using advanced bipolar constant-current chopping techniques, it can output more speed and power from the same motor, compared with traditional technologies such as L/R drivers. It has patented current control technology, which allows coil currents to be accurately controlled, generating much less current ripple and motor heating than other drivers on the market.

Features of this driver

- High performance at low cost
- Supply voltage to +40VDC, current to 3.5A for P403
- Inaudible 20khz chopping frequency
- TTL compatible and optically isolated input signals
- Automatic idle-current reduction
- Mixed-decay current control for less motor heating
- 14 selectable step resolutions in decimal and binary
- Microstep resolutions up to 51,200 steps/rev
- Suitable for 4, 6 or 8 lead motors
- Over-current, over-voltage and short-circuit protection
- Small size

Applications of this driver

Suitable for a wide range of stepping motors of size NEMA 17, 23, and 34, usable for various kinds of machines, such as X-Y tables, labelling machines, laser cutters, engraving machines, and pick-place devices; particularly useful in applications with low noise, low vibration, high speed and high precision requirements.

2. Specifications and Operating Environment

Electrical Specifications ($T_{=}25℃$)

	P403			
Parameters	Min	Typical	Max	Remark
Peak Output Current	1.3A	by user	3.5A	By DIP switch
Supply voltage (DC)	+24V	+32V	+40V	
Logic signal current	6mA	10mA	30mA	
Pulse input frequency	0	By user	300kHz	
Isolation resistance	500MΩ			

Operating Environment and Parameters

Coolant	Natural cooling or forced convection	
Environment	Space	Avoid water, dust, oil, frost and corrosive gases
	Temperature	0° to 50℃
	Humidity	40 to 90%RH
	Vibration	5.9m/s^{2}Max
Storage Temp.	-20℃ to +65℃	
Weight	About 0.35kg	

3. Driver Connectors, P1 and P2

The following is a brief description of the two connectors of the driver. More detailed descriptions of the pins and related issues are presented in sections 4-7.

Control Signal Connector P1 pins

Pin No.	Signal	Functions
1	Pulse	Pulse signal: in single pulse(pulse/direction) mode this input represents pulse signal, effective for each upward rising edge.
2	Direction	Direction signal: in single-pulse mode, this signal has low/high voltage levels, representing two directions of motor rotation; direction of motor rotation is also determined by the connections.
3	Common	Common signal: This should be connected to +5V dc, to provide power. If a higher voltage is used, current should be limited to 15mA.
4	Enable	Enable signal: this signal is used for enable/disable, high level for enabling driver and low level for disabling driver.
5	Reset	Reset signal: A low level signal will reset the driver, but this function is not normally used.
6	Unused	Not connected.

Note: Direction is determined by motor-driver wiring. Exchanging the connection of two wires for a coil to the driver will reverse motion direction. (e.g., reconnecting motor A+ to driver A- and motor A- to driver A+ will reverse motion direction).

Power connector P2 pins

Pin No.	Signal	Functions
1	Gnd	DC power ground
2	+V	DC power supply, +24VDC to +40VDC, Including voltage fluctuation and EMF voltage.
3, 4	Phase A	Motor coil A (leads A+ and A-)
5, 6	Phase B	Motor coil B (leads B+ and B-)

4. Power Supply Selection

It is important to choose the appropriate power supply to make the driver operate properly.

Maximum Voltage Input:

The power Mosfet inside the driver can actually operate within +24V to +40VDC, including power input fluctuation and back EMF voltage generated by motor coils during motor shaft deceleration. Higher voltage will damage the driver. Therefore, it is suggested to use power supplies with theoretical output voltage of no more than +36V, leaving room for power line fluctuation and back EMF.

Regulated or Unregulated Power Supply:

Both regulated and unregulated power supplies can be used to supply DC power to the driver. However, unregulated power supplies are preferred due to their ability to withstand current surge. If a regulated power supply (e.g. switch-mode) is used, it is important to have large current output rating to avoid problems like current clamp, for example using 4A supply for 3A motor-driver operation. On the other hand, 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 driver draws current from the power supply capacitor only during the ON duration of the PWM cycle, but not during 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 Drivers:

It is recommended that multiple drivers share one power supply to reduce cost, provided that the supply has enough capacity. **DO NOT** daisy-chain the power supply input pin of the drivers (connect them to power supply separately) to avoid cross interference.

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 is better to use lower supply voltage to improve noise, heating and reliability.

NEVER connect power and ground in the wrong way, it will damage the driver.

5. Driver Voltage and Current Selection

This driver can match small-medium size step motors (NEMA 17, 23 and 34).

To achieve good driving results, it is important to select supply voltage and output current properly. Generally, supply voltage determines the high-speed performance of the motor, while output current determines the output torque of the motor (particularly at lower speed).

Selecting Supply Voltage:

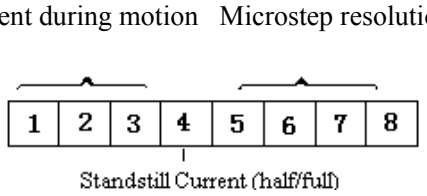
Higher supply voltage can increase motor torque at higher speeds; this is helpful for avoiding losing steps. However, higher voltage may cause more motor vibration at lower speed, and it may also cause over-voltage protection and even driver damage. Therefore, it is suggested to choose only sufficiently high supply voltage for intended applications.

Setting Proper Output Current

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

6. Microstep Resolution and Driver Current Output

This driver uses an 8-bit DIP switch to set microstep resolution, dynamic current and standstill current, as shown below:



Microstep Resolution Selection

Microstep resolution is set by DIP SW5, 6, 7, 8 as shown in the following table:

Microstep	Step/rev.(for 1.8° motor)	SW5	SW6	SW7	SW8
0	No rotation	off	off	off	off
2	400	on	on	on	on
4	800	on	off	on	on
8	1600	on	on	off	on
16	3200	on	off	off	on
32	6400	on	on	on	off
64	12800	on	off	on	off
128	25600	on	on	off	off
256	51200	on	off	off	off
5	1000	off	on	on	on
10	2000	off	off	on	on
25	5000	off	on	off	on
50	10000	off	off	off	on
125	25000	off	on	on	off
250	50000	off	off	on	off

Current Setting

The first three bits (SW1, 2, 3) of the DIP switch are used to set the current during motion (dynamic current), while SW4 is used to select standstill current.

P403 DIP Selection for current during motion:

Current for P403	SW1	SW2	SW3
1.3A	on	on	on
1.6A	off	on	on
1.9A	on	off	on
2.2A	off	off	on
2.5A	on	on	off
2.9A	off	on	off
3.2A	on	off	off
3.5A	off	off	off

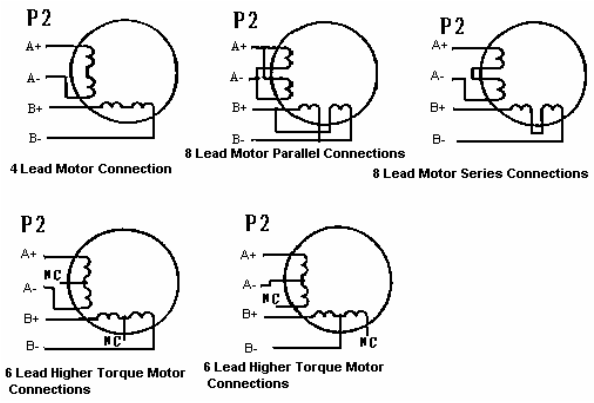
Note: due to motor inductance, actual coil current may be smaller than dynamic current settings, particularly at higher speeds.

DIP Selection for current during standstill:

SW4 is used for this purpose, current setting due to coil inductance. OFF meaning that the standstill current is set to be half of the dynamic current and ON meaning that standstill current is set to be the same as dynamic current.

7. Driver Connection to Stepper Motors

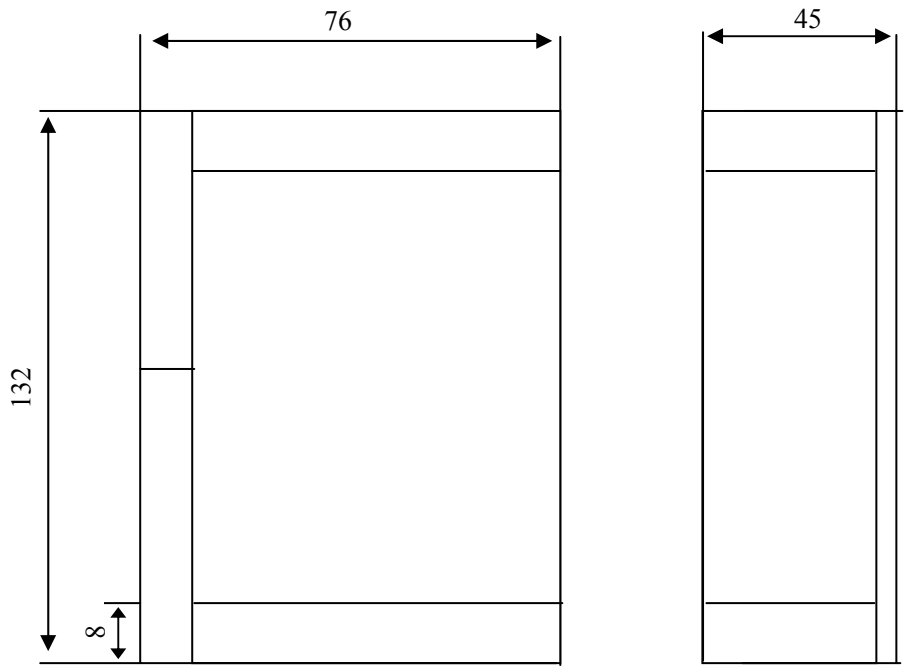
The P403 driver can drive any 4, 6 or 8 lead hybrid stepper motors. The following diagrams illustrate connection to various kinds of motor leads:



Note that when two coils are connected in parallel, coil inductance is reduced by half and motor speed can be significantly increased. Serial connection will lead to increased inductance and thus the motor can be run well only at lower speeds.

8. Dimensions

External dimensions are shown in mm.



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