

*Bipolar micro step driver for 2-phase stepping motor*

# SD4015B3

*Instruction manual*



Low cost  
Low vibration



***HPtec***



Thank you for purchasing SD4015B3. This manual describes on the specification and the usage of SD4015B3. Please review the material in this manual thoroughly before using SD4015B3.

## — Warranty —

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•The product is guaranteed against functional failure in the case it occurs during one (1) year from the date of the original delivery, and in spite of your correct usage. In such case we will supply replacement unit free of charge.

## — Cautions for Proper Use —

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- Please use the product under the absolute maximum ratings and the environment recommendation.
- This product is neither designed nor manufactured to be used in a machine or system that may cause death or injury of person when it is failed.

Consult us in advance if you are planning to use this product for applications under such special conditions and environments.

- We are making best efforts on to ensure the highest quality of the products. However, it is highly recommended that you should make enough safety design such as a redundant design, an anti-fire design or a fail-safe design in order to avoid an accident causing injury or death of person, fire accident, or damage of social.
- Contents of this manual are subject to change without prior notice for functional improvement and other purpose.

## — Product lifetime —

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•Please recognize that some parts has product lifetime due to aging degradation. Be sure to change the following parts when the product lifetime is expired.


No.	Parts name	Product lifetime	Conditions of use
1	Electrolytic capacitor in main circuit	5 years	Load factor: less than 50% of rating. Ambient temp: less than 40 C in average.


## — Safety Precautions —

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For safe use of SD4015B3, following icons and messages are used in this manual to indicate safety precautions. The precautions given here indicates serious safety contents. You are recommended to observe the safety precautions fully.

	<b>Danger</b>	In case of incorrect handling, it indicates possibility of dangerous situation could arise and that the possibility of death or serious illness of a person is assumed.
	<b>Caution</b>	In case of incorrect handling, it indicates possibility of dangerous situation could arise and that the possibility of personal injury or property damage is assumed.
	<b>Inhibition</b>	This symbol is used to indicate a practice that shall not be attempted
	<b>Imposition</b>	This symbol is used to indicate a practice that shall be done.

	<b>Danger</b>
<ul style="list-style-type: none"><li>● Never touch any terminals and internal parts that is in active status. Could cause electric shocks.</li><li>● Do not pull or bend the cable, or place heavy objects on it. Could cause electric shocks or a fire.</li><li>● Never touch part of rotating. Could cause personal injury by involving to the rotor.</li><li>● Never touch surface of motors or power elements because those are may become abnormally high temperature while driving. Could cause burns.</li></ul>	

	<b>Caution</b>
<ul style="list-style-type: none"><li>● Don't use in the place where water, oil, or chemicals is splashed, or in the place where is corrosive environment or flammable gas.</li><li>● Use the rated power supply voltage. Could cause a fire.</li><li>● Do not touch the surface-mounted component on the board, as it may be hot while turning on the power or while after just shutting off the power. Could cause burn injury.</li><li>● Wiring work should be done correctly.</li></ul>	

## **Inhibition**

- Don't use or store in the place under direct sunshine.
- Don't use or store in the place where may be beyond the range of ambient temperature and relative humidity specification.
- Do not use or store in the place with many dust, dirt and others.
- Do not use or store in the place subject to direct vibration or shock.
- Never attempt to perform repair and modification by yourself.

## **Imposition**

- Install an emergency stop circuit outside to be able to stop the system operation immediately.

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# 1. Notes (Please be sure to read before using)

## 1-1 Installation

You shall observe the following installation method when installing this driver.

- Please install the driver in the place where **the air around the driver within 5 cm has air convection with a rated temperature (40 ° C or lower temperature)**.
- When using multiple axes please leave a space of **10 mm** or more between each driver.

## 1-2 Connection of Connector

In particular, please pay attention to power wiring. This driver has a power circuit configuration that resists breaking even with the incorrect polarity of the power supply, but the driver will be **damaged** if you wire the power supply to the motor output terminal.

Please observe the instruction about wire materials and a length of stripped bare wire that is shown in the section [3](#). Also, tighten the terminal block screw with a torque of **0.22 to 0.24 Nm**. This prevents loosening of screws and disconnection of wires.

## 1-3 Division of Micro step

Since a Division of Micro Step is performed by vector splitting currents of Phase A and Phase B of a stepping motor by approximate sinusoidal wave electrically, a divided one-step-angle does not guarantee a mechanical position accuracy as is.

The mechanical positional accuracy depends upon the machine accuracy of a motor's own and a driven device.

## 1-4 Heat generation of a motor

Since surface of a motor may become extremely high temperature while driving, please care burns.

If a surface temperature of a motor **exceeds 100°C**, the motor may be **damaged**. So then reduce the current value with "RUN" potentiometer or cool the motor by forced air cooling to not exceed 100 °C.

It also can prevent heat generation by enabling Auto Current Down function and reducing a current during stop.

## 1-5 Electric current value of Micro Step

A setting electric current value by "RUN" potentiometer is a peak value of approximate sinusoidal current.

## 1-6 Unipolar type motor drive

Although this driver is mainly designed for bipolar type motors, it can also drive unipolar type motors.

Please refer to the section [6-2](#) for wire connection method.

## 1-7 Compatibility notice to the customers using SD4015B2.

This driver is upward compatible with SD4015B2, but Mix Decay setting has been changed from a potentiometer to a switch. For more detailed information, Refer to the section [18](#).

Outer form size and installation mounting pitch has not be changed.

## 2.Specifications

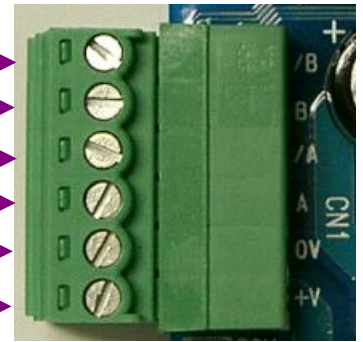
Item		Definition	Note
Model		SD4015B3	
Input power supply voltage		+ 18V to 36V	
Supply current		2A(MAX)	When the output current is set to 1.5 A
Applicable motor		2-phase stepping motors (bipolar type)	Unipolar type motors also can be driven.
Output current		0.25 to 1.5A <sub>o-p</sub> (±5%)/phase	
Driving method		Bipolar constant current chopper method	
Current Down function		Auto Current Down Reduce current to the current value set by "STOP" potentiometer in 0.25 to 1 second after stopping the pulse.	Function is selectable by the switch
Maximum input pulse frequency		200Kpps	
Adjustment by the trimmer	RUN	Set the excitation current (0.25 to 1.5A)	The factory setting is 1A
	STOP	Set the current of Current Down mode	10% to 60% of the RUN current
	JOG	Set the speed of JOG	300pps to 14Kpps
Function select by the switch	SW-1,2,3	Select of division number	1/2,1/8,1/10,1/16,1/20,1/32,1/40,1/64
	SW-4	Enable/disable Auto Current Down	ON: Enable, OFF: Disable The factory setting is Enable.
	SW-5,6	Select of JOG function	SW-5 ON: Enable JOG SW-6 ON: CW, OFF: CCW
	SW3	Select Mix Decay ratio	
	JP1	Select 1-pulse, 2-pulses	
Input signal	P+,P-	Command pulse or Command CW pulse	1-pulse or 2-pulses is selectable as command pulse Inputs are isolated by photo couplers
	D+,D-	Command pulse or Command CCW pulse	
	OFF+,OFF-	Excitation OFF	
Output signal	ALM+,ALM-	Alarm (Power elements overheat detection) The signal outputs when the temperature of inside power elements reach to 170°C (Typ).	Output are isolated by photo couplers ON: Normal, OFF: Alarm
Dimension		W72xD50xH21	
Wight		40g	Including the terminal block socket
Operating temperature, humidity		0 to 40°C, 35 to 80%	No condensation
Storage temperature, humidity		-20 to + 85 C, 35 to 80%	No condensation
CE Marking		Self-declaration	GATEGORY 9



### 3.Connector pin assignment

#### 3-1 CN1

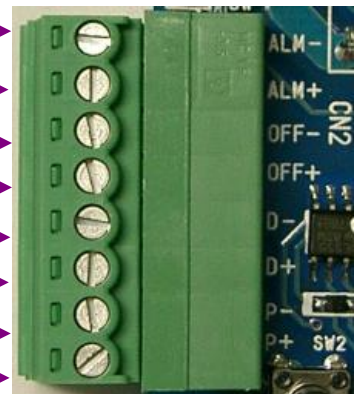
No.	Signal name	Definition	IN/OUT
6	/B	Motor Phase /B	OUT
5	B	Motor Phase B	OUT
4	/A	Motor Phase /A	OUT
3	A	Motor Phase A	OUT
2	0V	Input Power supply 0V	IN
1	+V	Power supply plus input (18V to 36V)	IN



Applicable terminal block: MC1.5/6-ST-3.5 (Phoenix contact)

#### 3-2 CN2

No.	Signal name	Definition	IN/OUT
8	ALM-	Power element overheat alarm. (OFF at Alarm)	OUT
7	ALM+		OUT
6	OFF-	Input Excitation OFF	IN
5	OFF+		IN
4	D-	Input Direction Command or CCW pulse	IN
3	D+		IN
2	P-	Input Command pulse or CW pulse	IN
1	P+		IN

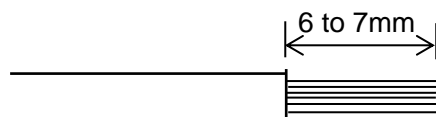


Applicable terminal block: MC1.5/8-ST-3.5 (Phoenix contact)

Note 1) Be careful not to mistake the pin number especially for power supply and motor wiring.

Note 2) Applicable wire size: AWG 28 to AWG 16 (stranded wire)

The length of the stripped bare wire: 6 to 7mm

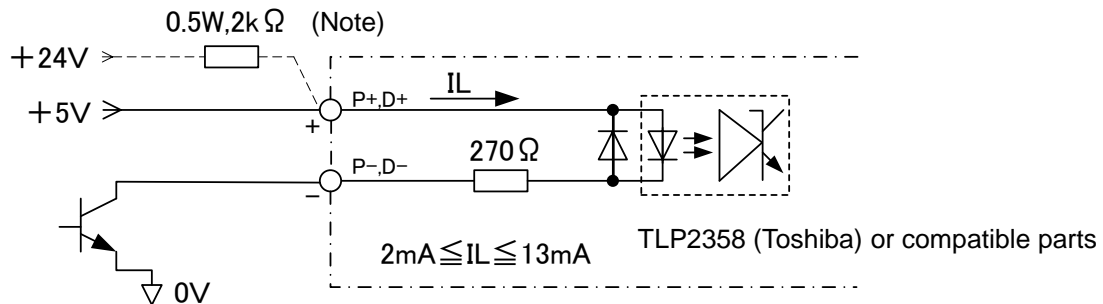


← Do not pre-solder to the wire tip!  
(You will not be able to wire connection correctly.)

## 4.I/O circuit diagram

4-1 Command pulse or CW pulse (P+, P-), Direction Command or CCW pulse (D+, D-) Input

### ■ In case of Open collector driven

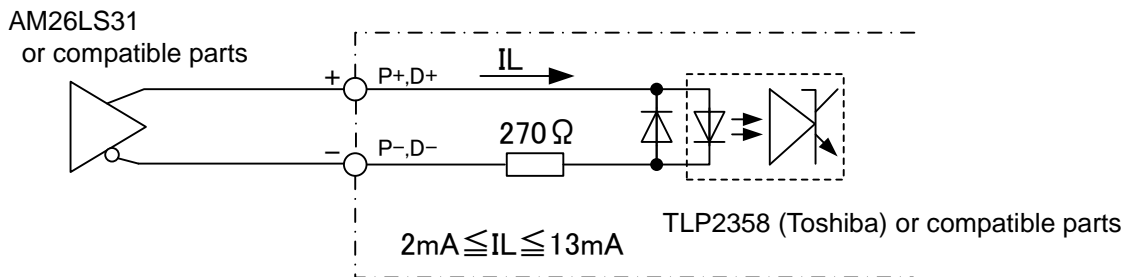


Note 1) When circuit is driven at + 24V, connect a resistor of 1 W, 2 kΩ (recommend) in series.

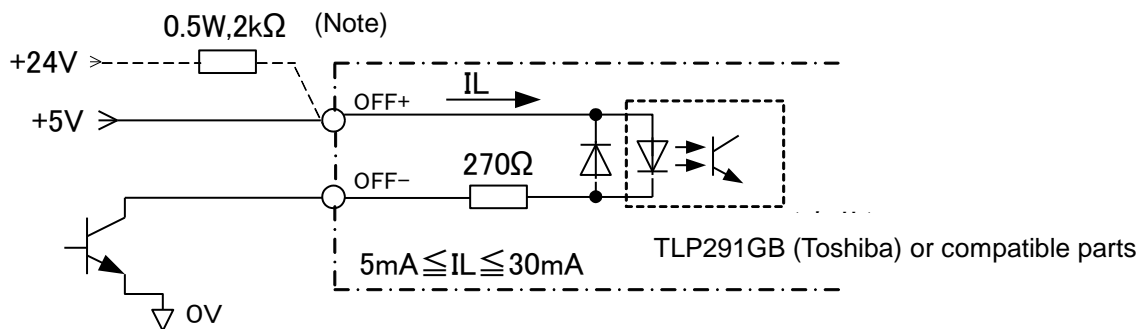
When using a resistor other than 2 kΩ, use the resistance value that satisfies the current value in the figure.

Note 2) In case of Open collector driven, the cable length should be within 1m.

### ■ In case of Line driver driven



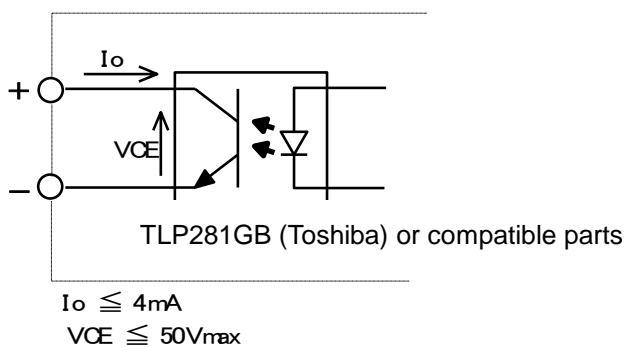
4-2 Excitation off (OFF) input



Note) When circuit is driven at + 24V, connect a resistor of 0.5W, 2 kΩ (recommend) in series.

When using a resistor other than 2 kΩ, use the resistance value that satisfies the current value in the figure.

4-3 Alarm (ALM) Output

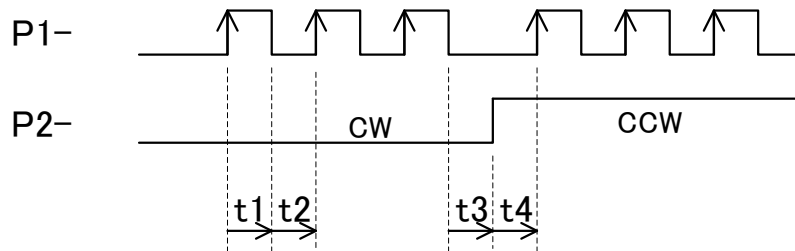


## 5.Logic of Command Input pulse

### 5-1 In case of 1-pulse mode

Command pulse is counted at Up-edge of the internal photo coupler outputs. When a motor is in a normal connection, Command Direction is; CW when the internal photo coupler output is "LOW" and CCW when the internal photo coupler output is "HIGH". Output of the photo coupler is LOW when the primary LED is ON. Please note that direction of motor rotation varies also by wire connection.

Timing chart is shown in the following figure.

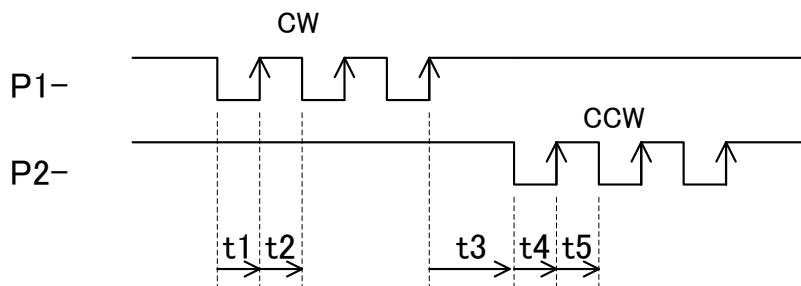


$$T1, t2, t3, t4 \geq 2.5 \mu \text{ sec}$$

### 5-2 In case of 2-pulses mode

Command pulse is counted at Up-edge of photo coupler outputs. Each input becomes stand-by mode at the high level (photo coupler OFF). A motor rotates CW direction by pulses input to P1, or rotates CCW direction by the pulses input to P2. Please note that direction of motor rotation varies also by wire connection.

Timing chart is shown in the following figure.

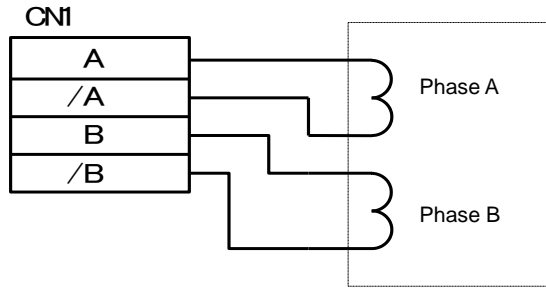


$$T1, t2, t3, t4, t5 \geq 2.5 \mu \text{ sec}$$

## 6.Connection of Motor

6-1 In the case of Bipolar type motor

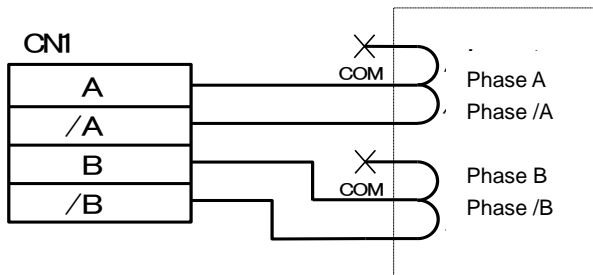
Stepping motor (coil connection)



6-2 In the case of Unipolar type motor

Wiring method 1: With same current settings as a unipolar microstep driver, the torque and heat that is generated by a motor are almost the same. Please use this wiring method in usual.

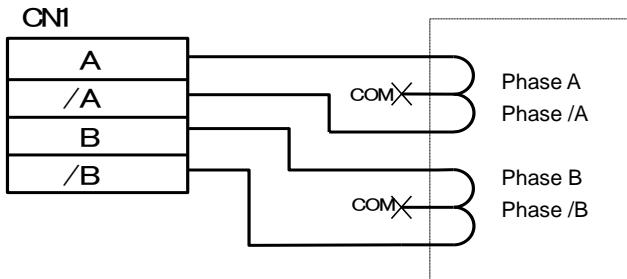
Stepping motor (coil connection)



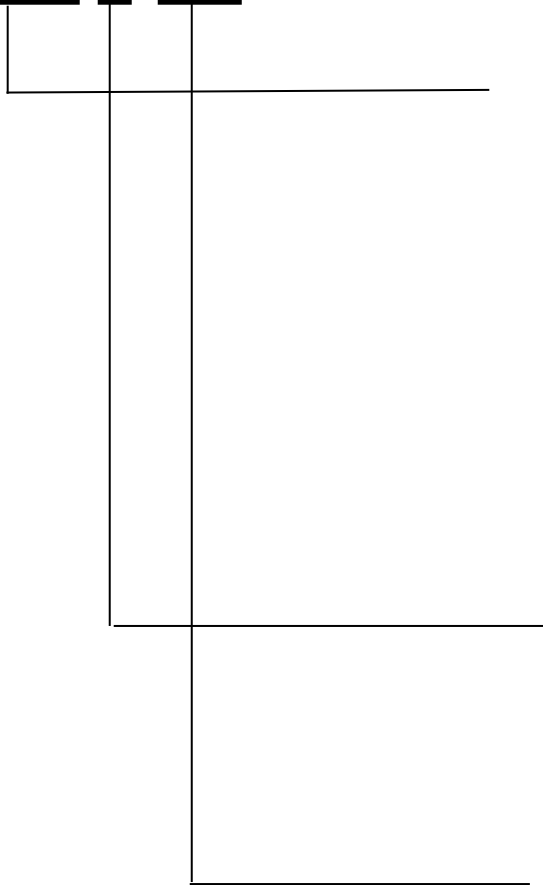
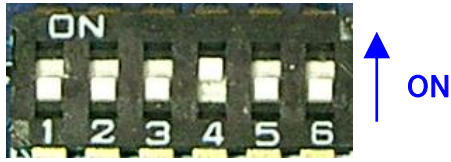
Wiring method 2: It is effective method for using a motor at low speed with high torque. To make motor heat generation equivalent to wiring method 1, please limit the maximum current to 70%.

However, the torque generated in the low speed range is 1.4 times of usual but an inductance of the coil is four times than the method 1, a torque drops sharply against an increasing rotation speed.

Stepping motor (coil connection)



## 7. Setting of switch SW 1



### ■ Setting of Division Number

1	2	3	Division number
ON	ON	ON	1/2
ON	ON	OFF	1/8
ON	OFF	ON	1/10
ON	OFF	OFF	1/16
OFF	ON	ON	1/20
OFF	ON	OFF	1/32
OFF	OFF	ON	1/40
OFF	OFF	OFF	1/64

☆

### ■ Setting of Auto Current Down

4	
ON	Enable
OFF	Disable

☆

### ■ Setting of JOG operation

5	6	JOG rotation
ON	ON	CW
ON	OFF	CCW
OFF	OFF	JOG disable

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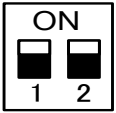

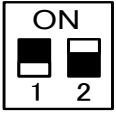
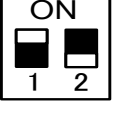
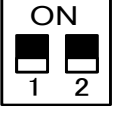
Caution) In case of pulse input operation, be sure to set 5 and 6 to OFF.

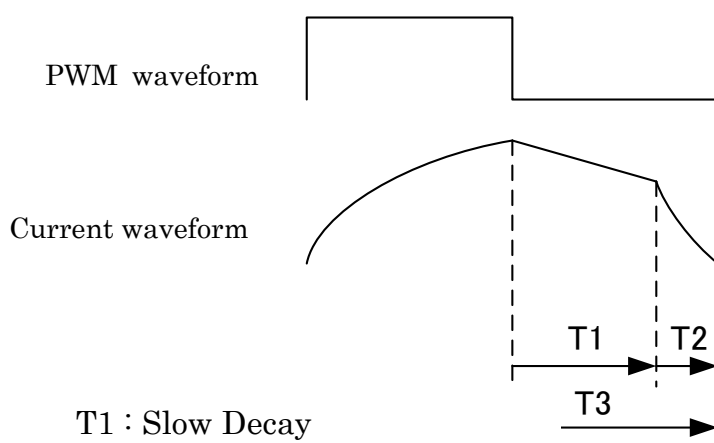
## 8.Setting of switch SW 3(MIX)

Four types of setting are possible with the switch for adjusting Mix Decay function.

Mix Decay function has effect of reducing vibration of a motor by controlling slope of electric current attenuation within a PWM cycle. Since the optimum ratio of Slow Decay setting at each motor rotation speed is different, it is recommended that a customer may select the optimum switch position while checking vibration at the motor speed you need.

In general, vibration declines when a Slow Decay ratio is larger at ultra-low speed area. On the other hand, vibration declines when set a Slow Decay ratio smaller at a faster rotation speed.

SW setting	Slow Decay ratio	Motor rotation speed
ON ON 	80%	Slower  Faster
OFF ON 	40%	
ON OFF 	20%	
OFF OFF 	0%	



T1 : Slow Decay

T2 : Fast Decay

T3 : Decay Cycle

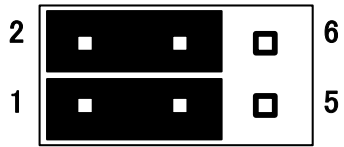
$$\text{Slow Decay Ratio} = T1 / T3 \times 100 (\%)$$

## 9.Settings of Jumper JP1

Set according to Command pulse type. The factory setting is 1-pulse.

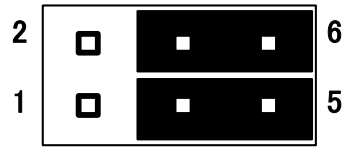
- In case of 1-pulse mode (pulse, direction)

1-3, 2-4 short



- In case of 2-pulses mode (CW pulse, CCW pulse)

3-5, 4-6 short



## 10.LED“POW”

LED lights green when power is turned on. If the LED does not light even when power is turned on, there is a possibility that Polarity of the power supply connected may be reversed, or that the power module may have been damaged by wiring mistake.

Since this driver has a power circuit configuration that resists breaking even with the incorrect polarity of the power supply, please turn the power on again after correcting the connection. If the power module is broken, a whole unit shall be replaced.

Regarding location of the LED, refer layout diagram in the page [14](#).

## 11.JOG operation

JOG operation by PUSH switch becomes enable when SW1-5 is ON.

When performing JOG operation, remove CN2, and set JP1 to 1-pulse mode.

Select Direction of rotation with SW1 - 6, and change a pulse frequency with "JOG" potentiometer.

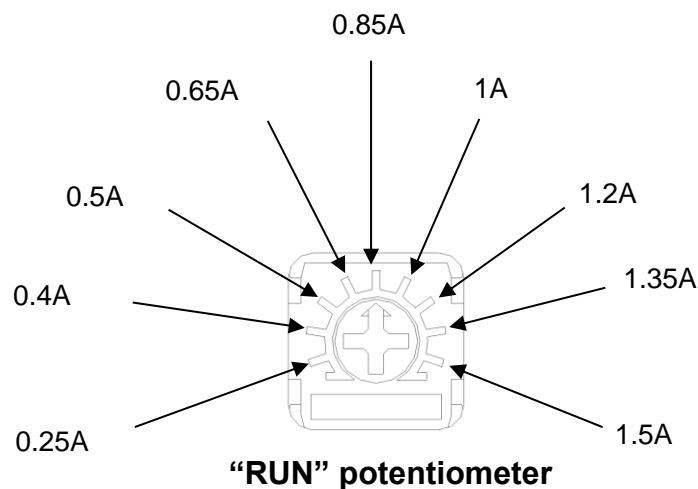
JOG operation should be only used for trial operation of a driver and motor, and please operate with a motor alone. Never use JOG operation after mounting this unit into other equipment, since it is dangerous to use JOG operation then.

Be sure to turn off SW1-5 and 6 for normal Pulse Input operation

## 12.Setting of potentiometers

### 12-1 RUN potentiometer

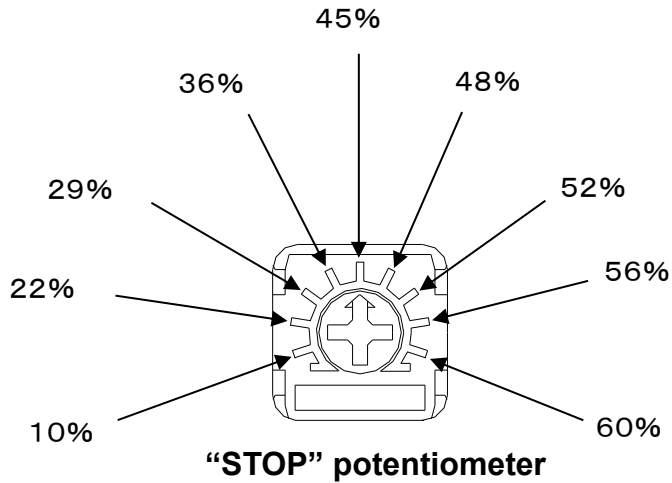
This potentiometer is for setting a peak current value during operation. The factory setting is 1A.





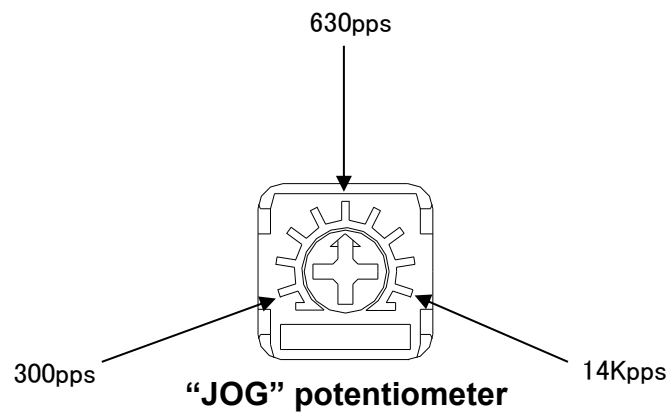
### 12-2 STOP potentiometer

This potentiometer is for setting a current value at the time of Auto Current Down. The setting value is a ratio to the setting value of RUN potentiometer.



### 12-3 JOG potentiometer

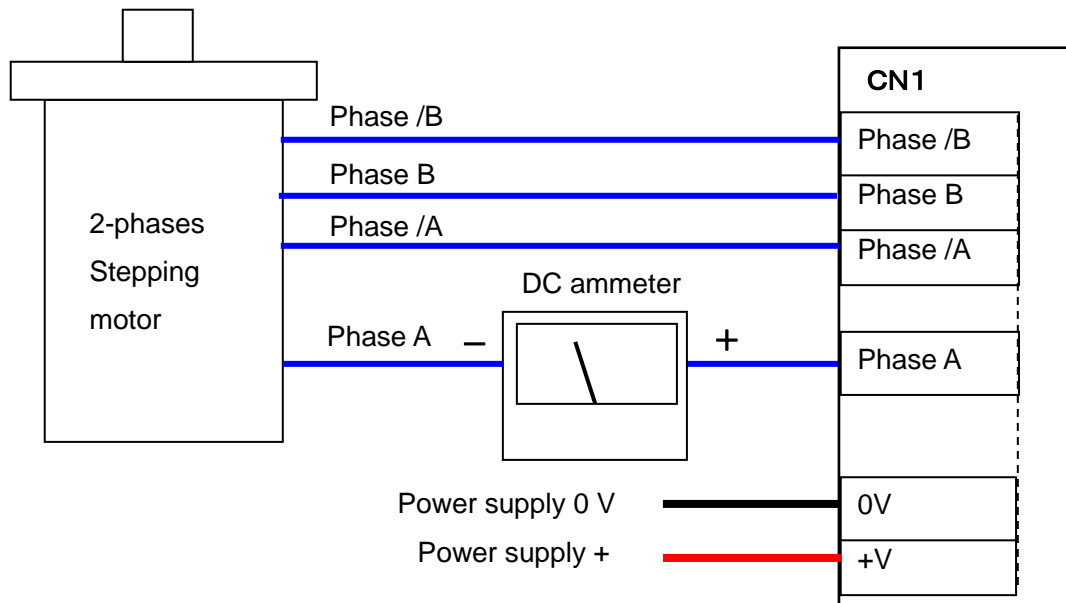
Set a frequency value at JOG operation. The following frequency are only a guide, so please adjust the potentiometer while watching an actual motor rotation speed. Please note that an angle of the potentiometer and a frequency do not change linearly, and it will rise sharply from near the center.



### 13. How to adjust the RUN potentiometer precisely

Prepare a DC ammeter. Before turning on the power supply, connect the positive side of the ammeter to the phase A of connector CN1, and the negative side of the ammeter to the phase A of a motor. Turn off SW1-4 of the driver.

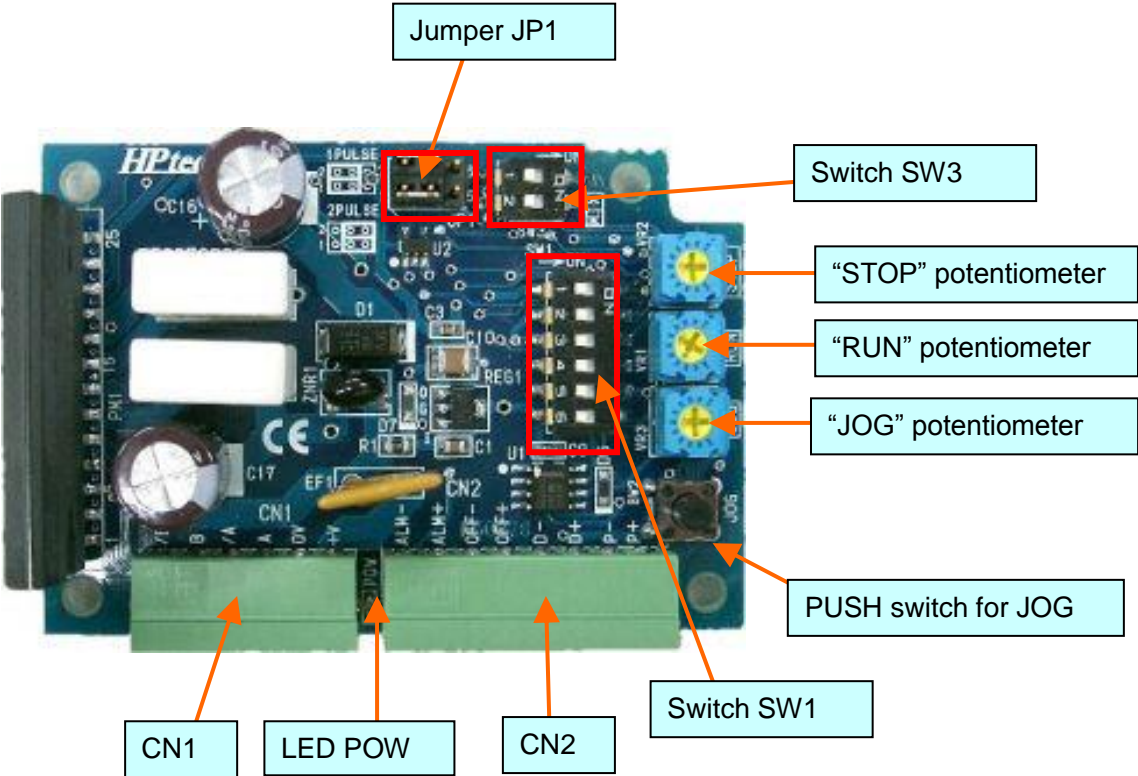
Then turn on the power supply and adjust with the RUN potentiometer to a target current value.



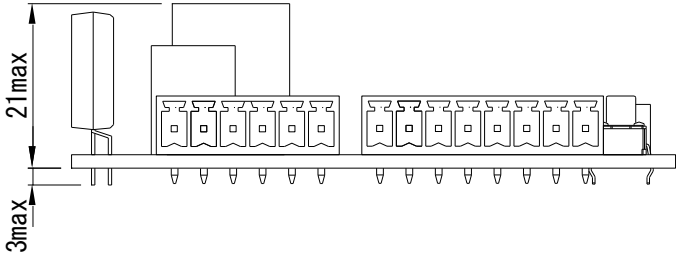
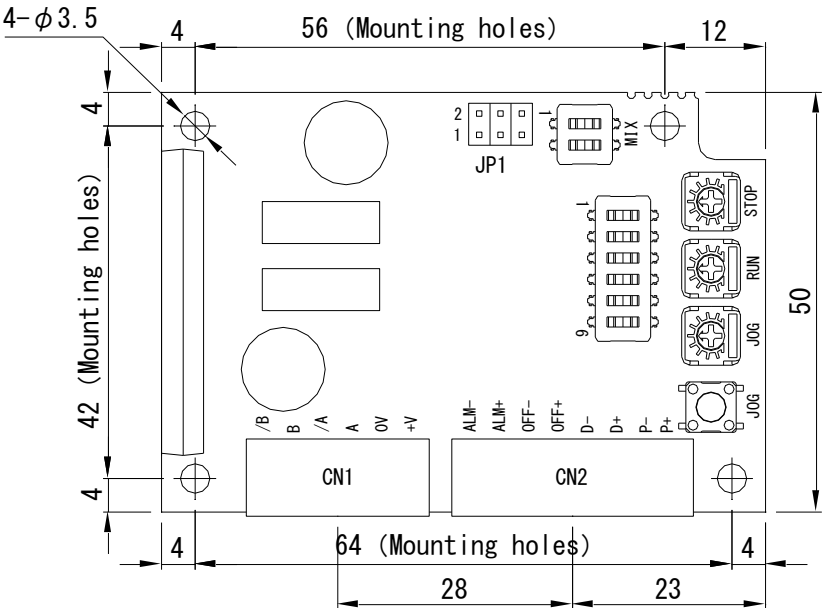
### 14. Troubleshooting

Symptom	Cause	Inspection / Corrective action
Motor does not turn	Command pulse is not input	Please check the host controller side
	Motor does not invert rotate direction even switching CW / CCW pulse input.	Please short 3-5, 4-6 of jumper JP 1
	It is in JOG mode	Please turn off 5, 6 of DIP switch SW1
Motor temperature becomes abnormally high during rotation.	RUN potentiometer setting is too high for the rated current of the motor.	Please reduce down RUN potentiometer.
Motor temperature becomes abnormally high during stop.	Auto Current Down is disabled.	Please turn on SW1-4

15.Component layout



16.Dimension



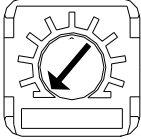
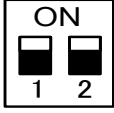
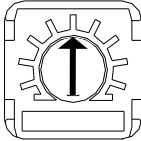
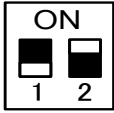
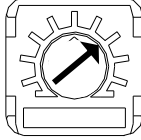
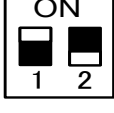

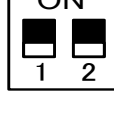
## 17. Difference between SD4015B2 and SD4015B3

### 17-1 Difference in how to set Mix Decay

The Mix Decay setting has been changed from a potentiometer to a switch.

Customers already using SD4015B2 are recommended to refer to the following compatibility chart for setting SD4015B3.

Compatibility table of Mix Decay potentiometer setting and switch setting

Slow Decay ratio	SD4015B2	SD4015B3
	Settings of MIX potentiometer	Position of SW3
80% (Factory setting)	 0	 ON ON
40%	 5	 OFF ON
20%	 7	 ON OFF
0%	 10	 OFF OFF

Note) For Mix Decay, see page 7, section [7](#). Switch SW3 (MIX) setting.

### 17-2 Difference on the maximum frequency of Command pulse

	SD4015B2	SD4015B3
Maximum input pulse frequency	100Kpps	200Kpps

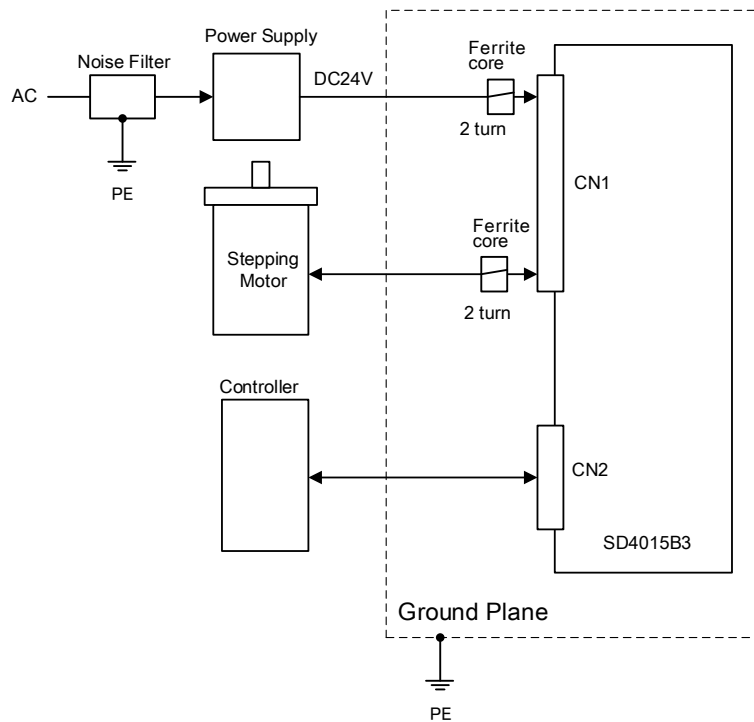
## 18.CE Marking

SD4015B3 had performed tests for a driver and a motor individually that based on the following standards, and had made the self-declaration of CE marking.

As for the EMC directive conformity, hence a condition varies depending on a customer's equipment configuration with this driver and motor installed, so the customer should confirm the conformity of whole devices by your own responsibility.

EMC Directive	Emission	EN61000-6-4:2007+A1:2011
	Immunity	EN61000-6-2:2005
RoHS Directive		EN50581:2012

### Setting example



Ferrite core : KRFC series(KITAGAWA INDUSTRIES CO.,LTD.)

## 19.Caution for ESD damage

ElectroStatic Discharge may cause malfunction of, or damage on the driver.

When the driver power is on, do not touch directly potentiometers and switches with bare hands.

When changing the setting on the potentiometers and switches, use an insulated screwdriver.

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