Oriental motor

HM-7450-6

OPERATING MANUAL

For 2-phase Stepping Motor
CMD Driver

CE

Thank you for purchasing an Oriental Motor product.
This Operating Manual describes product handling procedures and safety precautions.

- Please read it thoroughly to ensure safe operation.
- Always keep the manual where it is readily available.

Introduction

■ Before use

Only qualified personnel of electrical and mechanical engineering should work with the product.
Use the product correctly after thoroughly reading the "Safety precautions." In addition, be sure to observe the contents described in warning, caution, and note in this manual.
The product described in this manual is designed and manufactured to be incorporated in general industrial equipment. Do not use for any other purpose. Oriental Motor Co., Ltd. is not responsible for any compensation for damage caused through failure to observe this warning.

■ Overview of the product

The products described in this manual are open frame type microstep drivers to drive unipolar-connection stepping motors.

Safety precautions

The precautions described below are intended to ensure the safe and correct use of the product, and to prevent the customer and others from exposure to the risk of injury. Use the product only after carefully reading and fully understanding these instructions.

Description of signs

⚠WARNING	Handling the product without observing the instructions that accompany a "WARNING" symbol may result in serious injury or death.
⚠CAUTION	Handling the product without observing the instructions that accompany a "CAUTION" symbol may result in injury or property damage.
Note	The items under this heading contain important handling instructions that the user should observe to ensure the safe use of the product.
memo	The items under this heading contain related information and contents to gain a further understanding of the text in this manual.

Description of graphic symbols

⃠	Indicates "prohibited" actions that must not be performed.
❗	Indicates "compulsory" actions that must be performed.

⚠WARNING

- Do not use the product in explosive or corrosive environments, in the presence of flammable gases, in places subjected to splashing water, or near combustibles. Doing so may result in fire or injury.
- Do not forcibly bend, pull or pinch the cable. Doing so may result in fire.
- Do not remove the motor excitation during operation. Doing so may cause the motor to stop and lose the holding force, resulting in injury or damage to equipment.
- Do not disassemble or modify the product. Doing so may result in injury.

⚠WARNING

- Assign qualified personnel to the task of installing, wiring, operating/controlling, inspecting and troubleshooting the product. Handling by unqualified personnel may result in fire or injury.
- If this product is used in a vertical application, be sure to provide a measure for the position retention of moving parts. Failure to do so may result in injury or damage to equipment.
- Install the product inside an enclosure. Failure to do so may result in injury.
- Always keep the power supply voltage of the driver within the specified range. Failure to do so may result in fire.
- For the driver power supply use a DC power supply with reinforced insulation on its primary and secondary sides. Failure to do so may result in electric shock.
- Connect the cables securely according to the wiring diagram. Failure to do so may result in fire.
- Turn off the driver power supply in the event of a power failure. Failure to do so may result in injury or damage to equipment.

⚠CAUTION

- Do not use the product beyond its specifications. Doing so may result in injury or damage to equipment.
- Keep your fingers and objects out of the openings in the product. Failure to do so may result in fire or injury.
- Do not touch the product during operation or immediately after stopping. Doing so may result in a skin burn(s).
- Do not forcibly bend or pull the cable that was connected to the driver. Doing so may result in damage to product.
- Keep the area around the product free of combustible materials. Failure to do so may result in fire or a skin burn(s).
- Leave nothing around the product that would obstruct ventilation. Failure to do so may result in damage to equipment.
- Do not touch the rotating part (output shaft) while operating the motor. Doing so may result in injury.

- Use a motor and driver only in the specified combination. Failure to do so may result in fire.
- Provide an emergency stop device or emergency stop circuit external to the equipment so that the entire equipment will operate safely in the event of a system failure or malfunction. Failure to do so may result in injury.
- Before supplying power to the driver, turn all input signals to the driver to OFF. Failure to do so may result in injury or damage to equipment.
- When moving the moving part manually, put the motor into a non-excitation state. Continuing the work while the motor is in an excitation state may result in injury.
- When an abnormal condition has occurred, immediately stop operation to turn off the driver power. Failure to do so may result in fire or injury.
- Dispose the product correctly in accordance with laws and regulations, or instructions of local governments.

Precautions for use

- **When conducting the insulation resistance measurement or the dielectric strength test, be sure to separate the connection between the motor and the driver.**

Conducting the insulation resistance measurement or dielectric strength test with the motor and driver connected may result in damage to the product.

- **Regeneration**

When a large inertia load is operated at high speed, regenerative energy will generate and increase the power supply voltage, which may damage the driver. Check the operating condition so that regeneration voltage will not generate.

General specifications

Operation environment

Ambient temperature	0 to +40 °C (+32 to +104 °F) (non-freezing)
Humidity	85 % or less (non-condensing)
Altitude	Up to 1,000 m (3,300 ft.) above sea level
Surrounding atmosphere	No corrosive gas, dust, water or oil

Regulations and standards

■ CE Marking

● Low Voltage Directive

The input power supply voltage of this product is 24 VDC. Therefore this product is not subject to the Low Voltage Directive, but install and connect it as follows.

- This product is designed and manufactured to be incorporated in equipment. Be sure to install the product inside an enclosure.
- For the driver power supply, use a DC power supply with reinforced insulation on its primary and secondary sides.

● EMC Directive

The EMC testing is conducted on this product under the conditions specified in "Example of motor and driver installation and wiring" p.7.
The conformance of your mechanical equipment to the EMC Directive will vary depending on such factors as the control system equipment used with this product, configuration of electrical parts, wiring, and layout. It therefore must be verified through conducting EMC testing in a state where all parts including this product have been installed in the equipment.

- **Applicable standards**

EMI	EN 55011 group 1 class A, EN 61000-6-4
EMS	EN 61000-6-2

⚠CAUTION This equipment is not intended for use in residential environments nor for use on a low-voltage public network supplied in residential premises, and it may not provide adequate protection to radio reception interference in such environments.

- **Combinations of motors and drivers in compliance with EMC Directive**

Check "Motors for possible combinations" for the combinations of motors and drivers in compliance with EMC Directive.

■ RoHS Directive

The products do not contain the substances exceeding the restriction values of RoHS Directive (2011/65/EU).

Preparation

■ Motors for possible combinations

Use the drivers in combination with the motors shown in the table. Match the driver operating current with the motor rated current before use.

Driver model	Motor model *	Motor rated current (A/Phase)
CMD2109P	**PKP213U05□**	0.5
	PKP214U06□	0.6
	PKP22□U09□ **PKP22□MU09□**	0.95
	PKP24□U08□	0.8
	PKP243U09□ **PKP243MU09□**	0.95
CMD2112P	**PKP23□U12□** **PKP24□MU12□** **PKP24□U12□**	1.2
CMD2120P	**PKP246U16□**	1.6
	PKP25□U20□	2
	PKP26□U10□	1
	PKP26□U20□ **PKP26□MU20□**	2

* The motor model column in the table describes part of the entire name of models. Drivers can be combined with motors that include the model names listed here.

■ Checking the product

Verify that the items listed below are included. Report any missing or damaged items to the Oriental Motor sales office from which you purchased the product.

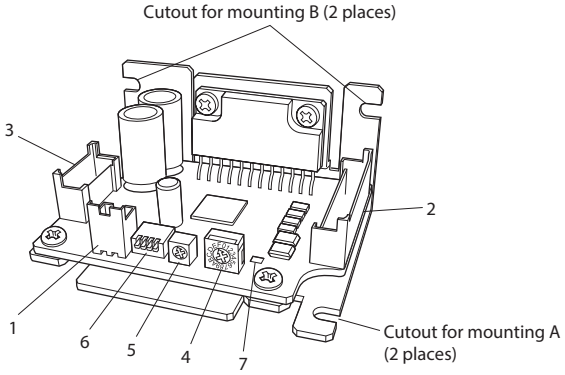
- Driver.....1 unit
- OPERATING MANUAL .....1 copy (this document)
- Connector housing/contact .....1 set (See table next.)

Manufacturer: Molex Incorporated

Application	Housing	Contact
For power supply (CN1)	1 pc. 51103-0200 (2-poles)	35 pcs. 50351-8100 (15 pieces are spare contacts.)
For I/O signals (CN2)	1 pc. 51103-1200 (12-poles)	
For motor (CN3)	1 pc. 51103-0600 (6-poles)	

Note When removing the driver from the ESD protection bag, make sure your hands are not charged with static electricity. This is to prevent damage to the driver due to static electricity.

■ Names of parts



No.	Name	Description
1	Power supply connector (CN1)	Connects the power supply.
2	I/O signal connector (CN2)	Connects the I/O signals.
3	Motor connector (CN3)	Connects the motor.
4	Motor operating current setting switch (RUN)	Sets the operating current of the motor.
5	Motor standstill current potentiometer (STOP)	Sets the current cutback ratio of the motor.
6	Pulse input mode setting switch (SW-1)	Switches the pulse input mode between 1-pulse input mode and 2-pulse input mode. The factory setting of the pulse-input mode depends on the destination country.
	Step angle setting switches (SW-2, SW-3, SW-4)	Sets a step angle by selecting it from among the 5 step angles.
7	POWER LED (Green)	This LED remains lit while the power supply is input.

Installation

■ Installation location

The driver is designed and manufactured to be incorporated in equipment. Install it in a well-ventilated location that provides easy access for inspection. The location must also satisfy the following conditions:

- Inside an enclosure that is installed indoors (provide vent holes)
- Operating ambient temperature 0 to +40 °C (+32 to +104 °F) (non-freezing)
- Operating ambient humidity 85 % or less (non-condensing)
- Area free of explosive atmosphere, toxic gas (such as sulfuric gas), or liquid
- Area not exposed to direct sun
- Area free of excessive amount of dust, iron particles or the like
- Area not subject to splashing water (rain, water droplets), oil (oil droplets) or other liquids
- Area free of excessive salt
- Area not subject to continuous vibrations or excessive shocks
- Area free of excessive electromagnetic noise (from welders, power machinery, etc.)
- Area free of radioactive materials, magnetic fields or vacuum
- 1,000 m (3,300 ft.) or lower above sea level

■ Installation direction

Install the driver on a metal plate having excellent vibration resistance in vertically or horizontally. If the driver is installed under conditions other than vertical or horizontal position, its heat radiation effect will deteriorate.
The items shown below are necessary in order to install the driver. The items are not included and must be provided by the customer.
Torque the mounting screw to 0.5 N·m (71 oz-in).

- M3 screw.....2 pcs.
- M3 spring washer.....2 pcs.
- M3 flat washer.....2 pcs.
- M3 nut.....2 pcs.
  (Not necessary if screw holes are provided in the enclosure.)

There must be a clearance of at least 25 mm (0.98 in.) in the horizontal and 50 mm (1.97 in.) in the vertical directions, between the driver and enclosure or other equipment within the enclosure. When two or more drivers are to be installed side by side, provide 20 mm (0.79 in.) and 50 mm (1.97 in.) clearances in the horizontal and vertical directions, respectively.

memo

- Install the driver inside an enclosure.
- Do not install any equipment that generates a large amount of heat or noise near the driver.
- If the ambient temperature of the driver exceeds 40 °C (104 °F), reconsider the ventilation condition. If the surface temperature of the driver's MOSFET array exceeds 85 °C (185 °F), reconsider the operating conditions.
- The case containing the MOSFET arrays is insulated.

■ Installation method

memo

Install the driver using either of the "cutout for mounting A" or "cutout for mounting B." Do not concurrently use both cutouts.

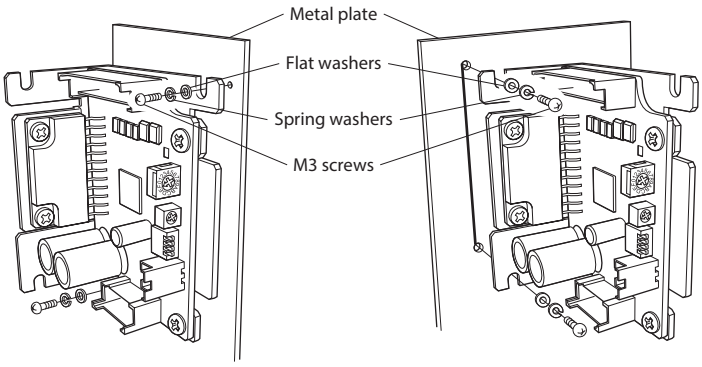
● Vertical installation

Note

When installing the driver vertically, orient the driver so that the power element faces up and the aluminum electrolytic capacitor faces down. If the driver is installed upside down, heat generated by the power element may damage the aluminum electrolytic capacitor.

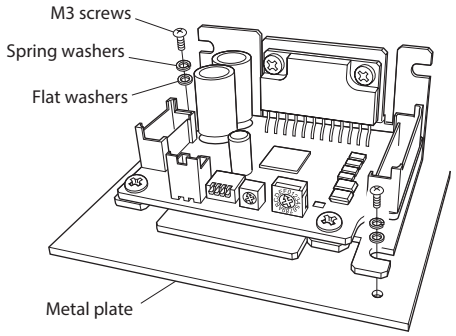
When using the cutout for mounting A

When using the cutout for mounting B

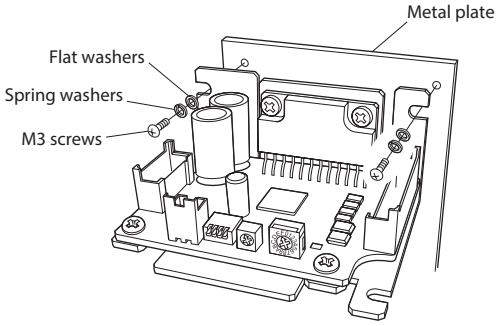


● Horizontal installation

When using the cutout for mounting A



When using the cutout for mounting B



Connection

■ Connection example

Either 5 or 24 VDC can be used as the signal voltage for the AWO input, CS input and ACDOFF input.

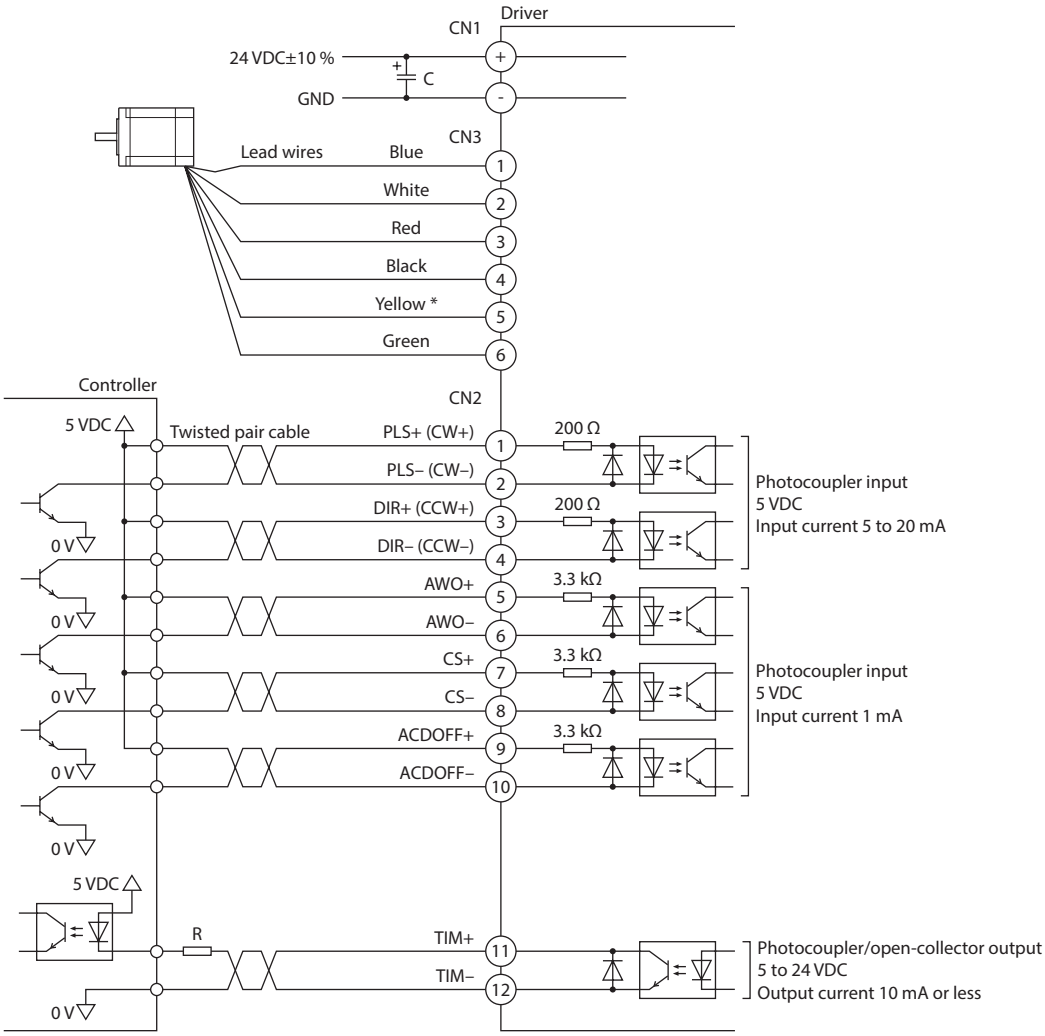
Note

- Check the colors of lead wires and connect them correctly and securely. Wrong connection of lead wires or poor contact may cause damage to the driver.
- Connect the connectors securely. Insecure connection may cause malfunction or damage to the driver.

memo

- When disconnecting the connector, pull out while spreading the latches on the connector a little.
- When turning on the power supply again or connecting/disconnecting the connector, turn off the power and wait for minimum 5 seconds before doing so.
- Be sure to wire the I/O signal cable connecting the driver and controller as short as possible. The maximum input frequency will decrease as the cable length increases.
- Separate an I/O signal cable at least 100 mm (3.94 in.) from inductance loads such as electromagnetic relays, and wire so that it is not in parallel with power supply cables and connection cables.
- If the motor cable or power supply cable generates an undesirable amount of noise depending on the wiring or configuration, shield the cable or install a ferrite core.

● When using the voltage of input signals at 5 VDC

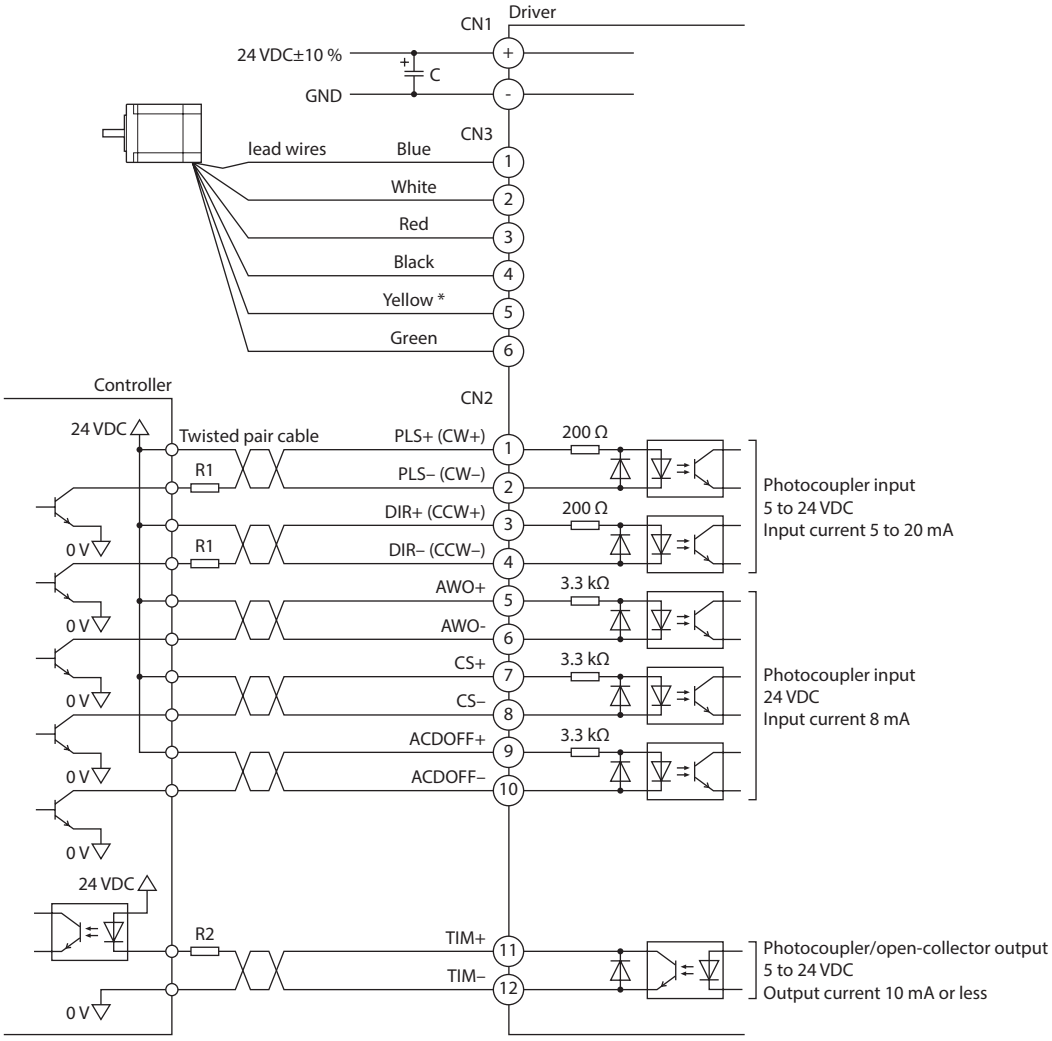


* No lead wire is provided for motors of Model A. Do not connect anything to the pin number 5.

Note

- If the output signal current exceeds 10 mA, connect external resistor R to keep the current to 10 mA or below.
- Driving a large inertia at high speed will generate regenerated energy. This regenerated energy raises the power supply voltage, causing damage to the driver. If such operation is performed, reconsider the operating condition so that the temporary rise of the power supply voltage by the regenerated energy is 8 V or less, or connect an electrolytic capacitor C in parallel to the power line (A rated voltage of 50 V or more and a capacitance of 10,000 µF or more are recommended).

● When using the voltage of input signals at 24 VDC



* No lead wire is provided for motors of Model A. Do not connect anything to the pin number 5.

Note

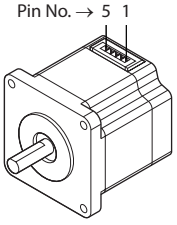
- The PLS (CW) and DIR (CCW) inputs are of the 5 VDC input specification. If input voltage exceeds 5 VDC, connect external resistor R1.
  Example) When input voltage is 24 VDC R1: 1.5 to 2.2 kΩ, 0.5 W or more.
- If the output signal current exceeds 10 mA, connect external resistor R2 to keep the current to 10 mA or below.
- Driving a large inertia at high speed will generate regenerated energy. This regenerated energy raises the power supply voltage, causing damage to the driver. If such operation is performed, reconsider the operating condition so that the temporary rise of the power supply voltage by the regenerated energy is 8 V or less, or connect an electrolytic capacitor C in parallel to the power line (A rated voltage of 50 V or more and a capacitance of 10,000 µF or more are recommended).

■ Connecting the motor

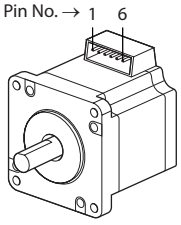
Connector pin assignments vary depending on the motor. Refer to the table.
The pin number is shown in the figure.
"Color" in the table shows the colors of lead wires of our connection cable or motor lead wires.

Note The motors of the model A and model B are different in pin assignments. Wrong connection will not cause the motor to operate properly.

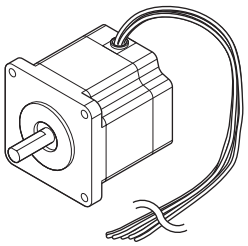
Model A



Model B

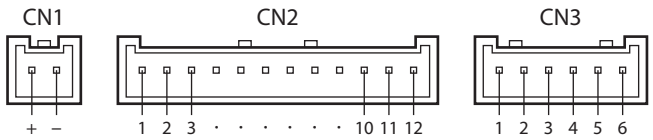


Model C



Driver CN3 Pin No.	Model A		Model B		Model C
	Pin No.	Color	Pin No.	Color	Color
1	4	Blue	1	Blue	Blue
2	3	White	2	White	White
3	5	Red	3	Red	Red
4	1	Black	4	Black	Black
5	–		5	Yellow	Yellow
6	2	Green	6	Green	Green

■ Connector pin assignments



● CN1 (power supply)

Pin No.	Direction	Signal name	Description
+	IN	POWER	+24 VDC
–			GND

● CN2 (I/O signals)

Pin No.	Direction	Signal name		Description
1	IN	PLS (CW)	+	Pulse (CW pulse) input *
2			–	
3		DIR (CCW)	+	Rotation direction (CCW pulse) input *
4			–	
5		AWO	+	All windings off input
6			–	
7		CS	+	Step angle switching input
8			–	
9		ACDOFF	+	Auto current down release input
10			–	
11	OUT	TIM	+	Timing output
12			–	

* When the 1-pulse input mode is set, the signals are the pulse input (PLS) and the rotation direction input (DIR). When the 2-pulse input mode is set, the signals are the CW pulse input (CW) and the CCW pulse input (CCW).

● CN3 (motor)

Pin No.	Direction	Signal name	Description
1	OUT	MOTOR	Blue lead
2			White lead
3			Red lead
4			Black lead
5			Yellow lead *
6			Green lead

* No lead wire is provided for motors of Model A. Do not connect anything to the pin number 5.

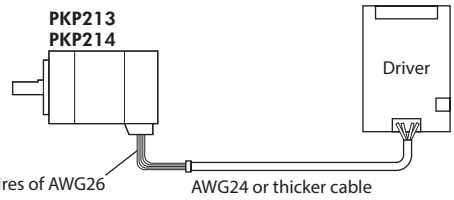
■ Applicable connector

Manufacturer: Molex Incorporated

Type	Application	Model
Connector housing	For power supply (CN1)	51103-0200
	For I/O signals (CN2)	51103-1200
	For motor (CN3)	51103-0600
Contact	–	50351-8100
Applicable crimping tool	–	63811-8100

- For the power supply cable, use a cable of AWG22 (0.3 mm^2).
- For the I/O signal cable, use a twisted pair cable of AWG24 to 22 (0.2 to 0.3 mm^2).
- Keep the wiring distance as short as possible [less than 2 m (6.6 ft.)] to suppress the effect of noise.

Note For the motor of the frame size 20 mm (0.79 in.) [**PKP213**, **PKP214** type], since the wire diameter of the motor cable is AWG26 (0.14 mm^2), it is too thin to fit in the included connector for motor. Provide the AWG24 (0.2 mm^2) or thicker cable yourself, and connect by using it.



■ Connecting the power supply

Use a power supply that can supply the following current capacity.
When the power is turned on, the POWER LED will be lit in green.

Driver model	Input power supply voltage	Power supply current capacity
CMD2109P	+24 VDC±10 %	1.5 A or more
CMD2112P		1.7 A or more
CMD2120P		2.9 A or more

Note When connecting, pay attention to the polarity of the power supply. Reverse-polarity connection may cause damage to the driver.

memo Do not wire the power supply cable in the same cable duct with other power lines or motor cables.

■ Noise elimination measures

There are two types of electrical noises: One is a noise to invade into the driver from the outside and cause the driver malfunction, and the other is a noise to emit from the driver and cause peripheral equipment malfunction. For the noise that is invaded from the outside, take measures to prevent the driver malfunction. It is needed to take adequate measures because signal lines are very likely to be affected by the noise.
For the noise that is emitted from the driver, take measures to suppress it.

● Measures against electrical noise

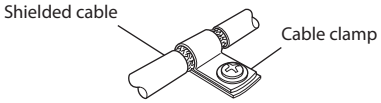
There are the following three methods mainly to take measures against the electrical noise.

• Noise suppression

- When relays or electromagnetic switches are used together with the system, use noise filters and CR circuits to suppress surges generated by them.
- Cover the driver by a metal plate such as aluminum. This is effective in shielding the electrical noise emitted from the driver.

• Prevention of noise propagation

- Place the power lines, such as the motor and power supply cables, keeping a distance of 100 mm (3.94 in.) or more from the signal lines, and also do not bundle them or wire them in parallel. If the power cables and signal cables have to cross, cross them at a right angle.
- Use shielded twisted pair cables of AWG22 (0.3 mm^2) or thicker for power lines and AWG24 (0.2 mm^2) or thicker for signal lines.
- Keep cables as short as possible without coiling and bundling extra lengths.
- Grounding multiple points will increase effect to block electrical noise because impedance on the grounding points is decreased. However, ground them so that a potential difference does not occur among the grounding points. I/O signal cables that include a grounding wire are provided in our product. Check the cable models on p.11.
- To ground a shielded cable, use a metal cable clamp that will maintain contact with the entire circumference of the cable. Ground the cable clamp near the product.



• Suppression of effect by noise propagation

- Loop the noise propagated cable around a ferrite core. Doing so will prevent the propagated noise invades into the driver or emits from the driver. The frequency band in which an effect by the ferrite core can be seen is generally 1 MHz or more. Check the frequency characteristics of the ferrite core used. When increasing the effect of noise attenuation by the ferrite core, loop the cable a lot.
- Use the line driver type, which is less likely to be affected by electrical noise, for the output circuit of pulse signals. If the pulse signal of the controller is of the open collector type, use a pulse signal converter for noise immunity. Check the model name on p.12.

● Our noise suppression products

Check the model name on p.11.

• I/O signal cable

This cable is a shielded twisted pair cable for good noise immunity to connect the driver and controller. The grounding wires useful to grounding are provided at both ends of the cable. The EMC testing is conducted using our I/O signal cable.

• Pulse signal converter for noise immunity

This product converts a pulse signal, which is output from the open collector output, to a pulse signal for good noise immunity by outputting the pulse signal again from the differential output.

• Surge suppressor

This product is effective to suppress the surge which occurs in a relay contact part. Connect it when using a relay or electromagnetic switch. CR circuit for surge suppression and CR circuit module are provided.

■ Conformity to the EMC Directive

Effective measures must be taken against the EMI that the motor and driver may give to adjacent control-system equipment, as well as the EMS of the motor and driver itself, in order to prevent a serious functional impediment in the machinery. The use of the following installation and wiring methods will enable the motor and driver to be compliant with the EMC Directive. Refer to p.2 for the applicable standards.
Oriental Motor conducts EMC testing on its motors and drivers in accordance with the "Example of motor and driver installation and wiring" shown later.
The user is responsible for ensuring the machine's compliance with the EMC Directive, based on the installation and wiring explained below.

• Power supply

The driver is a product of DC power input. Use a DC power supply (switched-mode power supply etc.) that conforms to the EMC Directive.

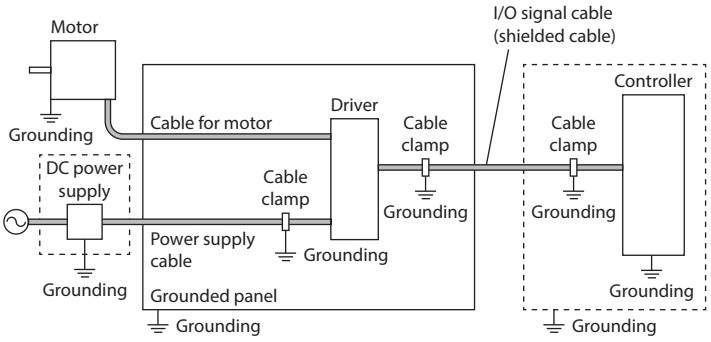
• Connecting the signal cable

Refer to "Prevention of noise propagation" p.6.

• How to ground

- The cable used to ground the motor, driver and noise filter must be as thick and short as possible so that no potential difference is generated.
- Choose a large, thick and uniformly conductive surface for the grounding point.
- Install the motor to the grounded metal plate.

• Example of motor and driver installation and wiring



• Precautions about static electricity

Static electricity may cause the driver to malfunction or suffer damage. While the driver is receiving power, handle the driver with care and do not come near or touch the driver.
Always use an insulated screwdriver to adjust the driver's switches.

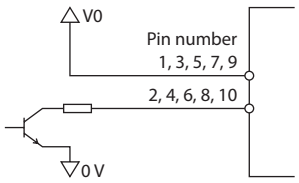
Note The driver uses parts that are sensitive to electrostatic charge. Before touching the driver, turn off the power to prevent electrostatic charge from generating. If an electrostatic charge is impressed on the driver, the driver may be damaged.

Explanation of I/O signals

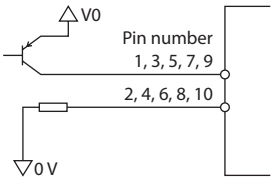
■ Input signals

The signal input state represents "ON: Carrying current" or "OFF: Not carrying current" state of the internal photocoupler.

• Example of connection with a current sink output circuit



• Example of connection with a current source output circuit



Note The PLS (CW) input and DIR (CCW) input are of the 5 VDC input specification. If V0 exceeds 5 VDC, connect an external resistor. The AWO input, CS input and ACDOFF input can be connected directly to 5 VDC or 24 VDC.

● PLS (CW) input, DIR (CCW) input

[ON: 3 to 5.25 V, OFF: 0 to 1 V]
Set a desired pulse input mode of the driver according to the pulse output mode of the controller used with the driver.

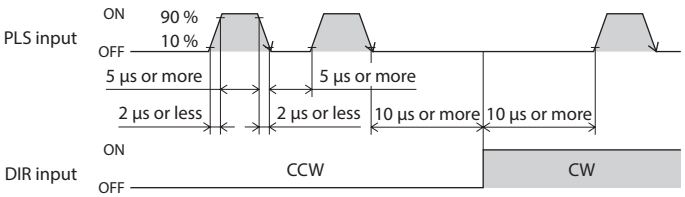
Maximum input pulse frequency: 100 kHz (duty cycle is 50 %)

memo The interval when the rotation direction is switched represents the response time of the driver. Set it to the time required for the motor to respond to the applicable pulse input.

• 1-pulse input mode

When the PLS input is turned from ON to OFF while the DIR input is ON, the motor will rotate by one step in CW direction.
When the PLS input is turned from ON to OFF while the DIR input is OFF, the motor will rotate by one step in CCW direction.

Input pulse signals having pulse waveforms with sharp rising and falling edges, as shown in the figure.

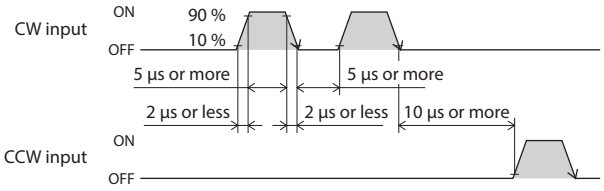


memo When the motor is at standstill, be sure to keep the photocoupler in OFF state.

• 2-pulse input mode

When the CW input is turned from ON to OFF, the motor will rotate by one step in CW direction.
When the CCW input is turned from ON to OFF, the motor will rotate by one step in CCW direction.

Input pulse signals having pulse waveforms with sharp rising and falling edges, as shown in the figure.



memo
- When the motor is at standstill, be sure to keep the photocoupler in OFF state.
- Do not input the CW pulse and CCW pulse simultaneously. If the other pulse is input while one of the pulse is ON, the motor cannot operate normally.

● AWO (all windings off) input

[ON: 4.5 to 26.4 V, OFF: 0 to 1 V]
When the AWO input is turned ON, the motor current will be cut off and the motor will lose its holding torque. The motor output shaft can be turned manually.
When the AWO input is turned OFF, current will be supplied and the holding torque will be restored.

● CS (step angle switching) input

[ON: 4.5 to 26.4 V, OFF: 0 to 1 V]
When the CS input is turned ON, the motor rotates at a basic step angle.
When the CS input is turned OFF, the motor rotates at the step angle set by the driver step angle setting switches (SW-2, SW-3, SW-4).

memo
- Do not change the CS input while operating. The motor may lose its synchronism, causing position deviation or standstill of the motor.
- When changing the step angle using the CS input, do so while the TIM output is ON.

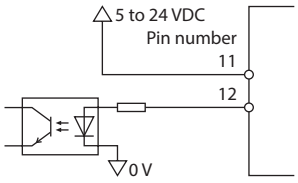
● ACDOFF (auto current down release) input

[ON: 4.5 to 26.4 V, OFF: 0 to 1 V]
When the ACDOFF input is turned OFF, the motor current will automatically drop to the standstill current in approximately 0.1 second after the stopping of pulse output. This mechanism suppresses heat generation from the motor or driver while the motor is at standstill.
Keep the ACDOFF input OFF in normal conditions of use.

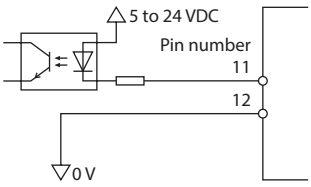
■ Output signals

The driver outputs signals are photocoupler/open-collector output. The signal output state represents "ON: Carrying current" or "OFF: Not carrying current" state of the internal photocoupler.

• Example of connection with a current sink input circuit



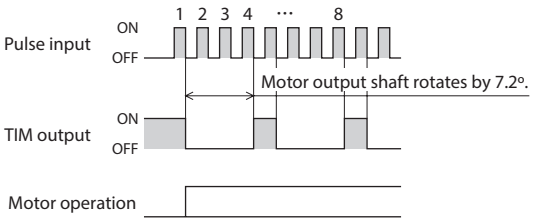
• Example of connection with a current source input circuit



● TIM (timing) output

Every time the motor output shaft rotates by 7.2° (3.6° for high-resolution type), the motor excitation state becomes the initial setting state (step 0), and the TIM output turns ON. If an AND circuit is configured with signals of the home sensor and TIM output when the home in the equipment is detected, the tolerance for the motor stop positions in a detection range of the home sensor can be reduced and the further accurate home can be detected.

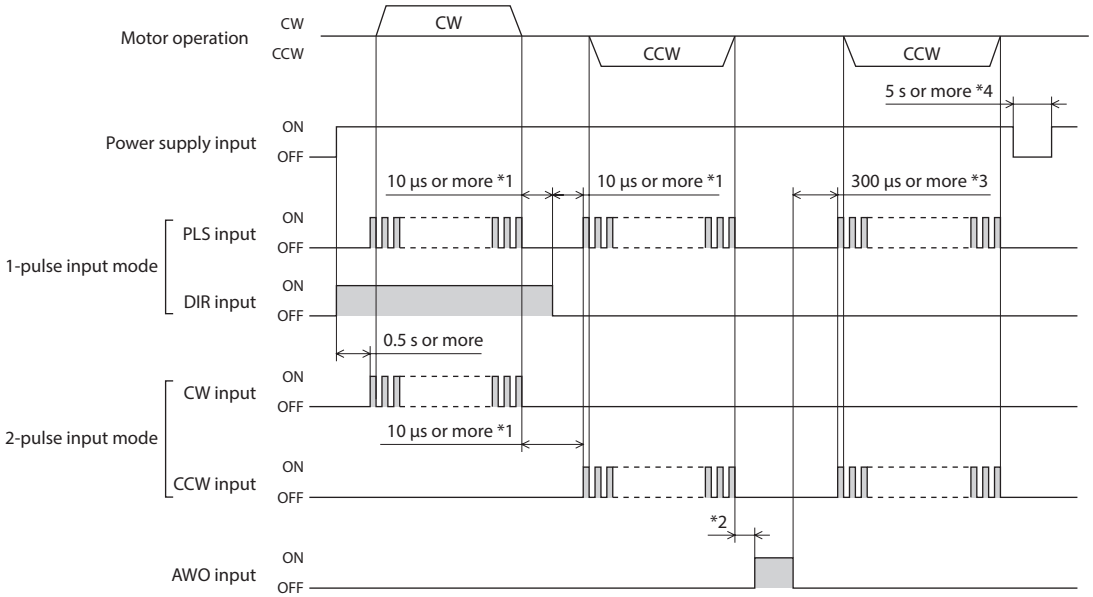
Example of output signal for standard type motor
When the base step angle is 1.8° (resolution 200 P/R)



Motor type		Number of divisions		TIM output
	Base step angle	1	4	
Standard	1.8°/step	1.8°	0.45°	Every 7.2°
High-resolution	0.9°/step	0.9°	0.225°	Every 3.6°
Geared	0.1°/step (Gear ratio 18)	0.1°	0.025°	Every 0.4°

memo
- When using the TIM output, set the pulse or step angle so that the motor output shaft stops at an integral multiple of 7.2°.
- When changing the step angle, do so while the TIM output is ON and the motor is at standstill.

■ Timing chart



The ▭ section indicates that the photocoupler diode is emitting light.

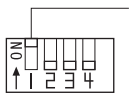
*1 10 µs or more for the switching time of the DIR input (for 1-pulse input mode) and the switching time of the CW input and CCW input (2-pulse input mode) represents the response time of the driver. Set it to the time required for the motor to respond to the applicable pulse input.
*2 The specific duration varies depending on the load inertia moment, load torque, starting frequency, etc.
*3 Do not input pulse signals immediately after switching the AWO input to OFF, given that it will affect the motor starting characteristics.
*4 When turning on the power supply again, turn off the power and turn on the power again after waiting for 5 second or more.

memo The maximum response frequency is 100 kHz at a pulse duty of 50 %.

Setting

■ Pulse input mode

Either the 1-pulse input mode or 2-pulse input mode can be selected in accordance with the controller used.
Sets a desired mode using the pulse input mode setting switch (SW-1).
The factory setting of the pulse-input mode depends on the destination country.

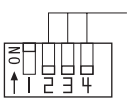


Pulse input mode setting switch (SW-1)
ON: 2-pulse input mode
OFF: 1-pulse input mode

■ Step angle

Sets the motor step angle using the step angle setting switches (SW-2, SW-3, SW-4). See the next table for the step angles that can be set.

Factory setting All OFF



Step angle setting switches
(SW-2, SW-3, SW-4)

When the base step angle is 1.8°/step

SW-2	SW-3	SW-4	Number of divisions	Resolution	Step angle
OFF	OFF	OFF	1	200	1.8°
OFF	OFF	**ON**	2	400	0.9°
OFF	**ON**	OFF	4	800	0.45°
OFF	**ON**	**ON**	8	1,600	0.225°
ON	OFF	OFF	16	3,200	0.1125°

The step angle is calculated by dividing the base step angle by the number of divisions.
If the switches are set to any combination other than those listed in the table, the number of divisions will become one and the motor will operate at the base step angle.

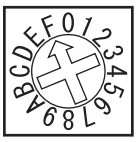
memo
- Step angles are theoretical values.
- The step angle set by the step angle setting switches becomes effective when the CS input is OFF.
- Do not change the CS input or the step angle setting switch while operating. Doing so may cause loss of synchronism of the motor, resulting in the motor standstill. Set the step angle setting switches when the CS input is OFF and TIM output is ON.
- For the high-resolution type, in comparison with the standard type the resolution is twice and the step angle is one-half.
  Example: When SW-2, SW-3, and SW-4 are all OFF
  Resolution of the high-resolution type: 200 × 2 = 400
  Step angle of the high-resolution type: 1.8°/2 = 0.9°
- With the geared motor, the actual step angle is calculated by dividing the step angle by the gear ratio.

■ Motor current

Set the motor current using the motor operating current setting switch (RUN) and motor standstill current potentiometer (STOP).
When the load is light and there is a margin for motor torque, the motor operating vibration and the temperature increase of the motor and driver can be held down by lowering the motor operating current and standstill current.

● Operating current

The motor operating current setting switch (RUN) can be used to set the 16 operating current levels. Set the operating current to less than the motor rated current.



Factory setting F

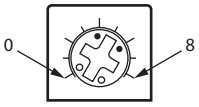
Dial setting	Operating current (A/phase) [Representative values]		
	CMD2109P	**CMD2112P**	**CMD2120P**
0	0.12	0.29	0.58
1	0.15	0.36	0.68
2	0.28	0.41	0.77
3	0.33	0.47	0.87
4	0.38	0.54	0.96
5	0.43	0.59	1.05
6	0.49	0.66	1.15
7	0.54	0.72	1.24
8	0.59	0.78	1.35
9	0.64	0.84	1.44
A	0.7	0.9	1.53
B	0.75	0.96	1.62
C	0.8	1.02	1.71
D	0.85	1.08	1.8
E	0.9	1.14	1.9
F	0.95	1.2	2

Note If the operating current is larger than the motor rated current, the motor generates heat, causing a burnout or a skin burn(s).

memo The actual operating current may vary from the applicable value in the table depending on the motor used.

● Standstill current

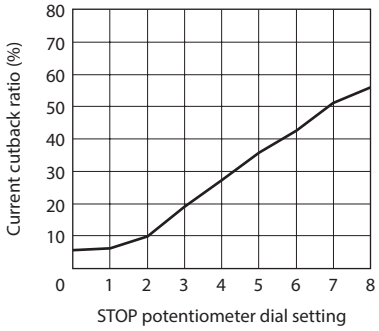
Set the motor standstill current using the motor standstill current potentiometer (STOP). The motor standstill current is the motor operating current multiplied by current cutback ratio.



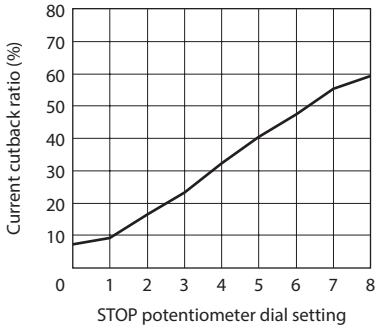
Factory setting 40 % of the operating current

memo
- A range of adjustment of the current at motor standstill is within 40 % of motor operating current. When the current at motor standstill is decreased too much, motor starting or maintenance of the location may be hindered. Do not reduce it any more than is necessary.
- When operating the potentiometer, use a insulated precision screwdriver.
- When setting the current at motor standstill, be sure to do so after setting the motor operating current and turning off the power supply to the driver.

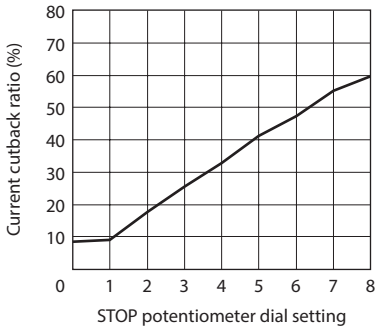
- **CMD2109P [Representative values]**



- **CMD2112P [Representative values]**



- **CMD2120P [Representative values]**



Example:
Use CMD2109P at an operating current of 0.95 A/phase.

- When the motor standstill current potentiometer (STOP) is set to "2," the applicable standstill current is calculated as follows:
  0.95 A/phase × 10 % = Approximately 0.095 A/phase
- When the motor standstill current potentiometer (STOP) is set to "5," the applicable standstill current is calculated as follows:
  0.95 A/phase × 36 % = Approximately 0.35 A/phase

Inspection

It is recommended that periodic inspections are conducted for the items listed below after each operation of the motor. If an abnormal condition is noted, discontinue any use and contact your nearest Oriental Motor sales office.

Inspection item

- Check if the installation place of the driver is loose.
- Check if any of the connection part of the driver is loose.
- Check if dust and others attach on the driver.
- Check if the driver has unusual smells or appearance defects.

Note The driver uses semiconductor components. Static electricity may damage the semiconductor components of the driver, so be extremely careful when handling the driver.

Troubleshooting and remedial actions

During motor operation, the motor or driver may fail to function properly due to an improper speed setting or wiring. When the motor cannot be operated correctly, refer to the contents provided in this section and take appropriate action. If the problem persists, contact your nearest Oriental Motor sales office.

Phenomenon	Possible cause	Remedial action
• The motor is not excited. • The motor output shaft can be turned easily by hand.	Connection error in the motor or power supply.	Check that the connections between the driver, motor and power supply are correct.
	Motor operating current incorrectly set. If the setting is too low, the motor torque will also be too low and operation will be unstable.	Check the setting of the operating current. If the motor current value is low, the torque will also be low and the operation will be unstable.
	The AWO input is being ON.	Switch the AWO input to OFF and confirm that the motor is excited.
The motor does not run.	Pulse input line connection error.	• Check the controller and driver connections. • Check the pulse input specifications (voltage and width).
	The CW input and the CCW input came ON at the same time.	Input either the CW input or the CCW input, and always switch the other terminal to OFF.
The motor rotates in the direction opposite that which is specified.	The CW input and the CCW input are connected in reverse.	Connect the CW pulses to the CW input (pin Nos.1 and 2), and connect the CCW pulses to the CCW input (pin Nos.3 and 4).
Motor operation is unstable.	Motor connection error.	Check that the driver and motor connections are correct.
	Motor operating current incorrectly set. If the setting is too low, the motor torque will also be too low and operation will be unstable.	Check the setting of the operating current. If the motor current value is low, the torque will also be low and the operation will be unstable.
Loss of synchronization during acceleration or running.	The centers of the motor output shaft and load shaft are not aligned.	Check the connection condition of the motor output shaft and load shaft.
	The load or load fluctuation is too high.	Check for large load fluctuations during motor operation. If adjusting the motor operating speed to low and high torque eliminates the problem, it is necessary to reconsider the load conditions.
	The speed of the starting pulse is too high.	Lower the speed of the starting pulse.
	The acceleration (deceleration) time is too short.	Lengthen the acceleration (deceleration) time.
	Effect of electrical noise.	Check running with only the motor, driver and required controller. If the impact of noise is recognized, take countermeasures, such as rewiring for greater distance from the noise source, changing the signal cables to shielded wire, or mounting a ferrite core.
Motor does not move the set amount.	Mistake in switching CS input.	Check the CS input state.
	Wrong step angle settings.	Check the settings of the step angle setting switches.
	Pulse output count is too low or too high.	Check whether or not the number of pulses required for operation at the set step angle are being output.
Current does not drop when the motor stops.	The ACDOFF input is being ON.	Switch ACDOFF input to OFF.
Motor vibration is too loud.	The centers of the motor output shaft and load shaft are not aligned.	Check the connection condition of the motor output shaft and load shaft.
	Motor is resonating.	If the vibration decreases when the operating pulse speed is changed, it means the motor is resonating. Change the operating pulse speed setting or install our clean damper to suppress vibration. Check the model name on p.12.
	Load is too small.	Lower the operating current. Vibration will increase if the motor torque is too large for the load.
Motor is too hot.	Long continuous operation time of the motor.	Decrease the operation time of the motor per session or increase the standstill time. Make sure that the motor case temperature will not exceed 100 °C (212 °F).
	The ACDOFF input is being ON.	Switch ACDOFF input to OFF.
	Motor standstill current is too high.	Lower the standstill current.
TIM output does not work.	CS input switched to ON when TIM output is not being output.	Switch the CS input to ON when TIM output is being output.

Cables

■ Connection cable set

This is a cable set which includes three cables for power supply, for I/O signals, and for motor.

Model: **LCS01CMK2** [0.6 m (2 ft.)]

■ I/O signal cables

This is a shielded twisted pair cable for I/O signals of the driver (12 pins) that has good noise immunity. The grounding wires useful to grounding are provided at both ends of the cable.

Model	Length [m (ft.)]	Conductor
CC12D005-2	0.5 (1.6)	AWG24 (0.2 mm^2)
CC12D010-2	1 (3.3)	
CC12D015-2	1.5 (4.9)	
CC12D020-2	2 (6.6)	

Accessories

■ Pulse signal converter for noise immunity

This product eliminates the noise of the pulse signal, and converts the pulse signal to the line driver type.

Model: **VCS06**

■ CR circuit for surge suppression

This product is effective to suppress the serge which occurs in a relay contact part. Use it to protect the contacts of the relay or switch.

Model: **EPCR1201-2**

■ CR circuit module

This product is effective to suppress the surge which occurs in a relay contact part. Use this product to protect the contacts of the relay or switch.
Four pieces of CR circuit for surge suppression are mounted on the compact circuit, and this product can be installed to the DIN rail. This product can make the wiring easily and securely since it also supports terminal block connection.

Model: **VCS02**

■ Clean dampers

These are mechanical dampers effective in suppressing motor vibration. They can be used with the double shaft motor only.

Model	Frame size of applicable motor [mm (in.)]
D4CL-5.0F	28 (1.10), 35 (1.38), 42 (1.65)
D6CL-6.3F	50 (1.97)
D6CL-8.0F	56.4 (2.22), 60 (2.36)
D9CL-14F	85 (3.35), 90 (3.54)

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• Please contact your nearest Oriental Motor office for further information.

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