Oriental motor

HM-60042

OPERATING MANUAL

5-phase Stepping Motor Unit

CSK Series

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

The product described in this manual has been designed and manufactured for use in general industrial machinery, and must not be used for any other purpose. For the driver's power supply, use a DC power supply with reinforced insulation on its primary and secondary sides.
Oriental Motor Co., Ltd. is not responsible for any damage caused through failure to observe this warning.

■ Overview of the product

The driver, which adopts a bipolar constant-current chopper drive and new 5-phase pentagonal connection, is designed to maximize motor characteristics.

■ CE Marking

This product has been certified under the CE Marking requirements (EMC directive) based on the EN Standard.
∗ USA unit model and EUROPA unit model only.

EMC Directive (2004/108/EC)

The compliance of the final machinery with the EMC Directive will depend on such factors as the configuration, wiring, layout and risk involved in the control-system equipment and electrical parts. It therefore must be verified through EMC measures by the customer of the machinery.

Safety precautions

The precautions described below are intended to prevent danger or injury to the user and other personnel through safe, correct use of the product. Use the product only after carefully reading and fully understanding these instructions.

⚠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 safe use of the product.

⚠Warning

General

- Do not use the product in explosive or corrosive environments, in the presence of flammable gases, locations subjected to splashing water, or near combustibles. Doing so may result in fire or injury.
- Assign qualified personnel the task of installing, wiring, operating/controlling, inspecting and troubleshooting the product. Failure to do so may result in fire or injury.

Installation

- Install the motor and driver in their enclosures in order to prevent injury.

Connection

- Keep the driver's power supply input voltage within the specified range to avoid fire.
- For the driver's 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 in order to prevent fire.
- Do not forcibly bend, pull or pinch the power cable or motor leads. Doing so may result in fire.

Operation

- Turn off the driver power supply in the event of a power failure, or the motor may suddenly start when the power is restored and may cause injury or damage to equipment.
- If this product is used in an elevator application, be sure to provide a measure for the position retention of moving parts. The motor loses its holding torque when the power supply is turned off. Failure to provide such a measure may cause the moving parts to fall, resulting in injury or damage to the equipment.
- Do not turn the A.W.OFF input to ON while the motor is operating. The motor will stop and lose its holding ability, which may result in injury or damage to the equipment.

Repair, disassembly and modification

- Do not disassemble or modify the motor or driver. This may cause injury. Refer all such internal inspections and repairs to the branch or sales office from which you purchased the product.

⚠Caution

General

- Do not use the motor and driver beyond their specifications, or injury or damage to equipment may result.
- Do not touch the motor or driver during operation or immediately after stopping. The surfaces are hot and may cause a skin burn(s).

Transportation

- Do not hold the motor output shaft or motor leads. This may cause injury.

Installation

- Keep the area around the motor and driver free of combustible materials in order to prevent fire or a skin burn(s).
- To prevent the risk of damage to equipment, leave nothing around the motor and driver that would obstruct ventilation.
- Provide a cover over the rotating parts (output shaft) of the motor to prevent injury.

Operation

- Use a motor and driver only in the specified combination. An incorrect combination may cause a 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. Otherwise, the motor may start suddenly and cause injury or damage to equipment.
- Before moving the motor directly with the hands (as in the case of manual positioning), confirm that the driver A.W.OFF input is ON to prevent injury.
- Immediately when trouble has occurred, stop running and turn off the driver power. Failure to do so may result in fire or injury.

Disposal

- To dispose of the motor or driver, disassemble it into parts and components as much as possible and dispose of individual parts/components as industrial waste.

Preparation

■ Checking the product

Verify that the items listed below are included. Report any missing or damaged items to the branch or sales office from which you purchased the product.
See table below for the motor and driver combinations.

- Motor ..... 1 unit
- Driver..... 1 unit
- Connector housing/contact..... 1 set
- Motor mounting screws ..... 4 pcs. (supplied with **TH** geared type)
- Operating manual (this manual)..... 1 copy

■ Combinations of motors and drivers

□ within the model name represents the **A** (single shaft) or **B** (double shaft).

• USA unit model

Standard type

Unit model	Motor model	Driver model
CSK543-N□TA2	PK543N□WA	CSD5807N2-T
CSK544-N□TA2	PK544N□WA	
CSK545-N□TA2	PK545N□WA	
CSK564-N□TA2	PK564N□WA	CSD5814N2-T
CSK566-N□TA2	PK566N□WA	
CSK569-N□TA2	PK569N□WA	

TH geared type

Unit model	Motor model	Driver model
CSK543□A2-TG3.6	PK543N□WA-T3.6	CSD5807N2-T
CSK543□A2-TG7.2	PK543N□WA-T7.2	
CSK543□A2-TG10	PK543N□WA-T10	
CSK543□A2-TG20	PK543N□WA-T20	
CSK543□A2-TG30	PK543N□WA-T30	
CSK564□A2-TG3.6	PK564N□WA-T3.6	CSD5814N2-T
CSK564□A2-TG7.2	PK564N□WA-T7.2	
CSK564□A2-TG10	PK564N□WA-T10	
CSK564□A2-TG20	PK564N□WA-T20	
CSK564□A2-TG30	PK564N□WA-T30	

• EUROPA unit model

Standard type

Unit model	Motor model	Driver model
CSK543-N□TE2	PK543N□W	CSD5807N2-T
CSK544-N□TE2	PK544N□W	
CSK545-N□TE2	PK545N□W	
CSK564-N□TE2	PK564N□WE	CSD5814N2-T
CSK566-N□TE2	PK566N□WE	
CSK569-N□TE2	PK569N□WE	

TH geared type

Unit model	Motor model	Driver model
CSK543AE2-TG7.2	PK543NAW-TG7.2	CSD5807N2-T
CSK543AE2-TG10	PK543NAW-TG10	
CSK543AE2-TG20	PK543NAW-TG20	
CSK543AE2-TG30	PK543NAW-TG30	
CSK564AE2-TG7.2	PK564NAW-TG7.2	CSD5814N2-T
CSK564AE2-TG10	PK564NAW-TG10	
CSK564AE2-TG20	PK564NAW-TG20	
CSK564AE2-TG30	PK564NAW-TG30	

• Asia unit model

Standard type

Unit model	Motor model	Driver model
CSK543-N□P2	PK543-N□	CSD5807N2-P
CSK544-N□P2	PK544-N□	
CSK545-N□P2	PK545-N□	
CSK564-N□P2	PK564-N□	CSD5814N2-P
CSK566-N□P2	PK566-N□	
CSK569-N□P2	PK569-N□	

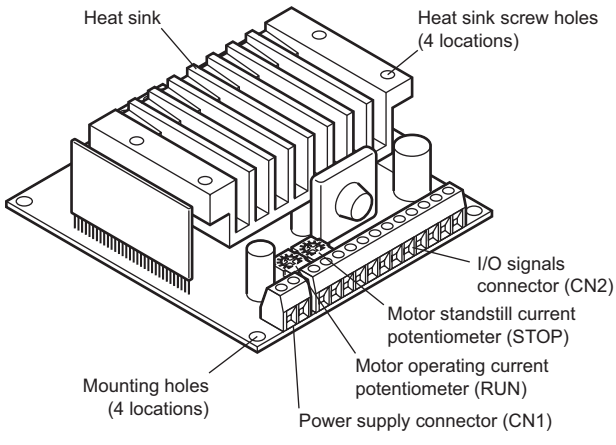
TH geared type

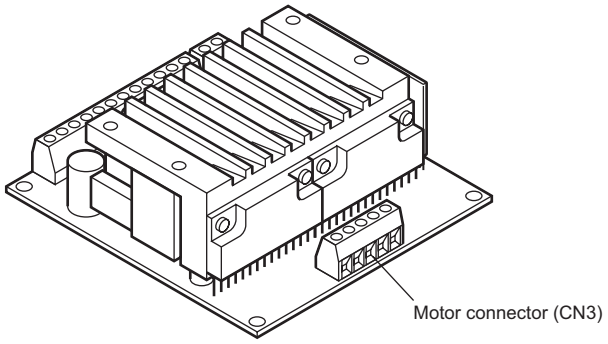
Unit model	Motor model	Driver model
CSK543□P2-TG7.2	PK543□N-TG7.2	CSD5807N2-P
CSK543□P2-TG10	PK543□N-TG10	
CSK543□P2-TG20	PK543□N-TG20	
CSK543□P2-TG30	PK543□N-TG30	
CSK564□P2-TG7.2	PK564□N-TG7.2	CSD5814N2-P
CSK564□P2-TG10	PK564□N-TG10	
CSK564□P2-TG20	PK564□N-TG20	
CSK564□P2-TG30	PK564□N-TG30	

■ Names of parts

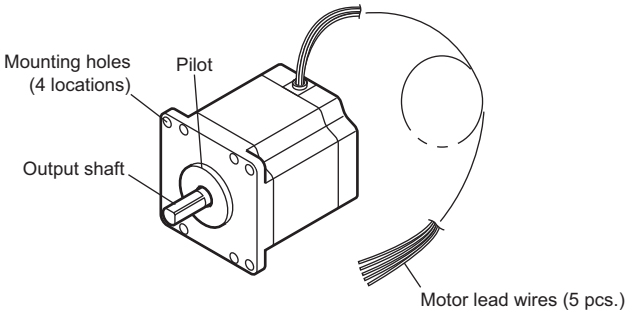
• Driver

Illustration shows the CSD5814N2-T.





- **Motor**



Note
- Even when the motor is stopped, the current remains on and the motor continues to generate heat.
- While the motor is in the stopped state, the current is automatically reduced to a value preset by the motor standstill current potentiometer (STOP) to limit the generation of heat. The motor's holding torque is also reduced in proportion to the stopped-state current. Adjust the motor standstill current potentiometer (STOP) setting to ensure the necessary load-holding torque.

Installation

■ Location for installation

The motor and driver are designed and manufactured for installation in equipment. Install them 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
  Motor: −10 to +50 °C (+14 to +122 °F) [non-freezing]
  Driver: 0 to +40 °C (+32 to +104 °F) [non-freezing]
- Operating ambient humidity 85% or less (non-condensing)
- Area that is free of explosive atmosphere or 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 vibration or excessive shocks
- Area free of excessive electromagnetic noise (from welders, power machinery, etc.)
- Area free of radioactive materials, magnetic fields or vacuum

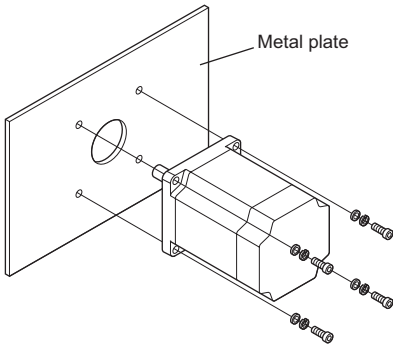
■ Installing the motor

• Installation direction

The motor can be installed in any direction.

• Installation method

Install the motor onto an appropriate flat metal plate having excellent vibration resistance and heat conductivity.
When installing the motor, secure it with four bolts (not supplied) through the four mounting holes provided. Do not leave a gap between the motor and plate.



Note Insert the pilot located on the motor's installation surface into the mounting plate's.

Bolt size and tightening torque

Type	Frame size [mm (in.)]	Bolt size	Tightening torque [N·m (oz-in)]	effective screw depth [mm (in.)]
Standard	42 (1.65)	M3	1 (142)	4.5 (0.177)
	60 (2.36)	M4	2 (280)	–
TH geared	42 (1.65) 60 (2.36)	M4	2 (280)	8 (0.315)

■ Overhung load and thrust load

The overhung load on the motor's output shaft must be kept under the permissible values listed on below. The thrust load must not exceed the motor's mass.

Motor model	Permissible overhung load [N (lb.)] Distance from the tip of motor's output shaft [mm (in.)]					Permissible thrust load [N (lb.)]
	0 (0)	5 (0.20)	10 (0.39)	15 (0.59)	20 (0.79)	
PK543	20 (4.5)	25 (5.6)	34 (7.6)	52 (11.7)	–	0.21 (0.46)
PK544						0.27 (0.59)
PK545						0.35 (0.77)
PK564	63 (14.1)	75 (16.8)	95 (21)	130 (29)	190 (42)	0.6 (1.32)
PK566						0.8 (1.76)
PK569						1.3 (2.9)
PK543-TG	10 (2.2)	14 (3.1)	20 (4.5)	30 (6.7)	–	15 (3.3)
PK564-TG	70 (15.7)	80 (18)	100 (22)	120 (27)	150 (33)	40 (9)

Note Failure due to fatigue may occur when the motor bearings and output shaft are subject to repeated loading by an overhung or thrust load that is in excess of the permissible limit.

■ Installing the driver

• Installation method

Install the driver horizontally or vertically on a flat metal plate having excellent vibration resistance and heat conductivity.
Installing the driver under conditions other than this could reduce its radiation effect.
There must be a clearance of at least 25 mm (0.98 in.) and 50 mm (1.97 in.) in the horizontal and vertical directions, respectively, between the driver and enclosure or other equipment.
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.

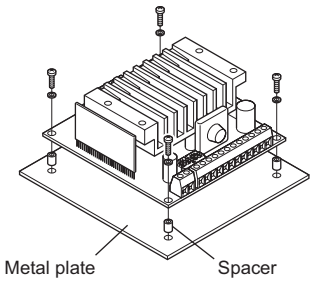
Note
- Do not install any equipment that generates a large amount of heat or noise near the driver.
- Check ventilation if the ambient temperature of the driver exceeds 40 °C (104 °F).

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 screws.....4 pcs.
- M3 spring washers.....4 pcs.
- M3 nuts.....4 pcs.
  (not necessary if screw holes are provided in the metal plate)
- Spacers (see table below).....4 pcs.

Driver model	Spacer size [mm (in.)]
CSD5807N2-T, CSD5814N2-T	10 (0.39) or more
CSD5807N2-P, CSD5814N2-P	5 (0.2) or more

Horizontal installation



Vertical installation

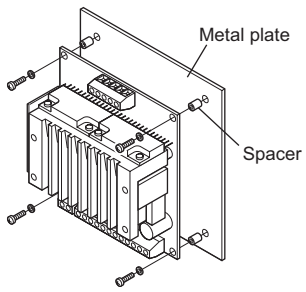


Illustration shows the CSD5814N2-T.

Connection

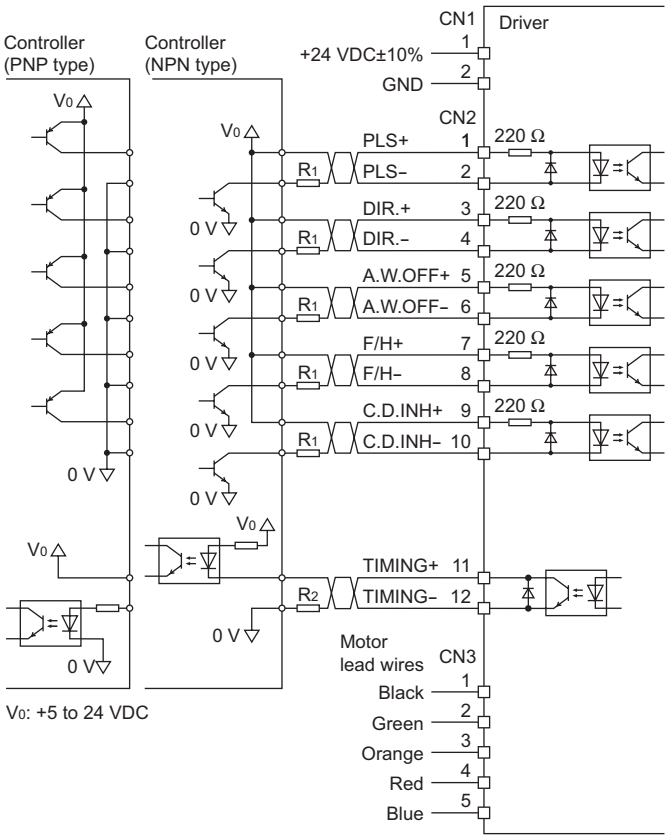
Note
- Have the connector plugged in securely. Insecure connection may cause malfunction or damage to the motor or driver.
- Always wait at least 5 sec. after switching off the power supply before switching it back on again or connecting/disconnecting the motor cables connector.
- Separate I/O cables at least 100 mm (3.94 in.) from electromagnetic relays and other than inductance loads. Additionally, route I/O cables perpendicular to power supply cables and motor cables, rather than in a parallel fashion.
- Do not route the power supply cables in the same conduits as other power supply lines and motor cables.
- If the noise generated from the motor cables becomes a problem, shield the motor cables with electrically conductive tape, wire mesh or the like.
- Use a mounting hole at any of four locations to ground the motor. Use an earth cable with a wire diameter of AWG18 (0.75 mm^2) or larger.

■ Connecting the CSD5807N2-T, CSD5814N2-T

• Connections to the terminal block

- Use electrical wire of AWG18 (0.75 mm^2) or less. Use AWG18 to AWG20 (0.5 to 0.75 mm^2) for the power supply line.
- Remove 5.5 mm (0.2 in.) of the insulation from the end of the lead wires before connecting them. Removing more than the recommended insulation may cause shorting of neighboring leads.

• Connection example



Note
- Use 5 to 24 VDC as input signal voltage. If the input signal voltage exceeds 5 VDC, connect an appropriate external resistance R1 in order to keep the input current to 7 to 20 mA.
  Example) When V0 is 24 VDC R1: 1.5 to 2.2 kΩ, 0.5 W or more.
- Use the output signal voltage between 5 VDC and 24 VDC, 10 mA or less. When it is above 10 mA, connect R2 to keep the current below 10 mA or less.

• Connector pin assignments

CN1

Pin No.	Direction	Signal name	Description
1	Input	POWER	24 VDC±10%
2			GND

CN2

Pin No.	Direction	Signal name	Description
1	Input	PLS+ input	Pulse
2		PLS− input	
3		DIR.+ input	Rotation direction
4		DIR.− input	
5		A.W.OFF+ input	All windings off
6		A.W.OFF− input	
7		F/H+ input	Step angle select
8		F/H− input	
9		C.D.INH+ input	Current cutback release
10		C.D.INH− input	
11	Output	TIMING+ output	Excitation timing
12		TIMING− output	

CN3

Pin No.	Direction	Signal name	Description
1	Output	MOTOR	Black motor lead
2			Green motor lead
3			Orange motor lead
4			Red motor lead
5			Blue motor lead

■ Connecting the CSD5807N2-P, CSD5814N2-P

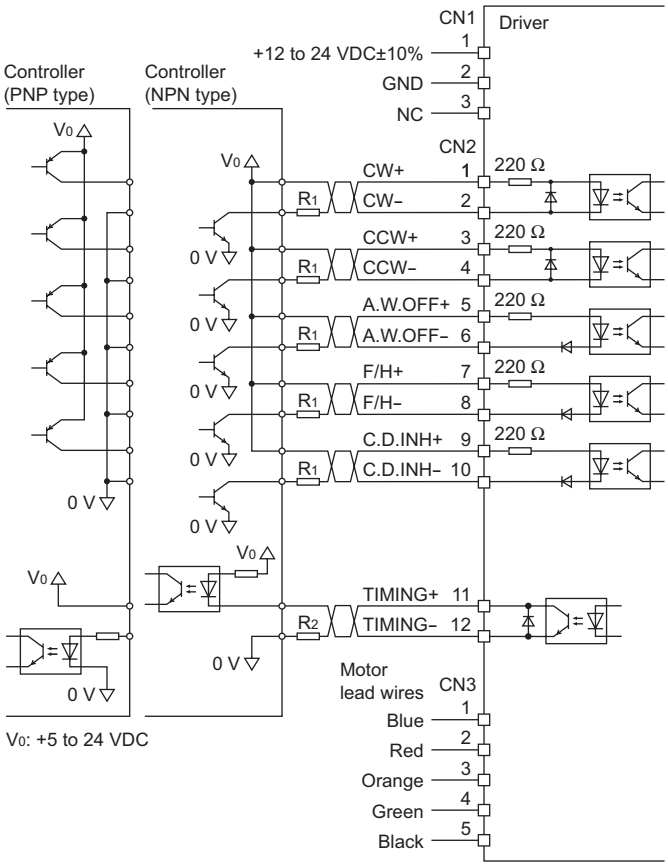
When crimping contacts for connector, be sure to use the crimping tool specified by the connector manufacturer.
Manufacturer: Tyco Electronics AMP

- Applicable contacts and connector housing

Application	Connector housing	Contact	Crimping tool
For power supply	171822-3	170204-2	189509-1
For I/O	1-171822-2		
For motor	171822-5		

- For the power supply and I/O cable, use a cable of AWG22 (0.34 mm^2) and keep the wiring distance as short as possible [less than 2 m (6.6 ft.)] to suppress the effect of noise.
- When connecting the cable, be careful regarding the polarity of the power supply. Incorrect power supply polarity could damage the drivers.

• Connection example



Note

- Use 5 to 24 VDC as input signal voltage. If the input signal voltage exceeds 5 VDC, connect an appropriate external resistance R1 in order to keep the input current to 7 to 20 mA.
  Example) When V0 is 24 VDC R1: 1.5 to 2.2 kΩ, 0.5 W or more.
- Use the output signal voltage between 5 VDC and 24 VDC, 10 mA or less. When it is above 10 mA, connect R2 to keep the current below 10 mA or less.

• Connector pin assignments

CN1

Pin No.	Direction	Signal name	Description
1	Input	POWER	12 to 24 VDC±10%
2			GND
3	−	−	NC

CN2

Pin No.	Direction	Signal name	Description
1	Input	CW+ input	CW pulse
2		CW− input	
3		CCW+ input	CCW pulse
4		CCW− input	
5		A.W.OFF+ input	All windings off
6		A.W.OFF− input	
7		F/H+ input	Step angle select
8		F/H− input	
9		C.D.INH+ input	Current cutback release
10		C.D.INH− input	
11	Output	TIMING+ output	Excitation timing
12		TIMING− output	

CN3

Pin No.	Direction	Signal name	Description
1	Output	MOTOR	Blue motor lead
2			Red motor lead
3			Orange motor lead
4			Green motor lead
5			Black motor lead

■ Connecting the power supply

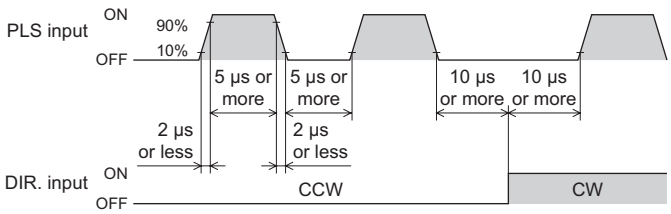
Use a power supply that can supply the following current capacity.

Driver model	CSD5807 N2-T	CSD5814 N2-T	CSD5807 N2-P	CSD5814 N2-P
Input power supply voltage	24 VDC±10%		12 to 24 VDC±10%	
Current capacity	1.3 A or more	2.1 A or more	1.4 A or more	2.5 A or more

■ Pulse waveform

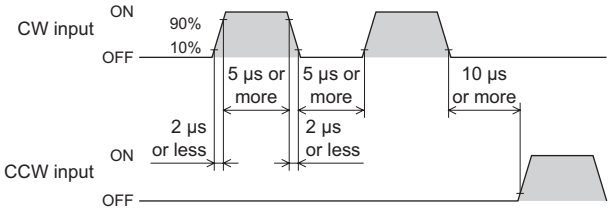
• CSD5807N2-T, CSD5814N2-T

- When the DIR. input is ON, a fall of the pulse input from ON to OFF will rotate the motor one step in the CW direction.
- When the DIR. input is OFF, a fall of the pulse input from ON to OFF will rotate the motor one step in the CCW direction.
- The voltage of the pulse signal is ON: +4 to 5 V, and OFF: 0 to 0.5 V. Input pulse signals should have a pulse width exceeding 5 µs, pulse rise/fall 2 µs or less, and a pulse duty of 50% or less.



• CSD5807N2-P, CSD5814N2-P

- When the CW pulse input changes from the ON state to OFF state, the motor will rotate one step in the CW direction.
- When the CCW pulse input changes from the ON state to OFF state, the motor will rotate one step in the CCW direction.
- The voltage of the pulse signal is ON: +3.6 to 5.25 V, and OFF: 0 to 0.5 V. Input pulse signals should have a pulse width exceeding 5 µs, pulse rise/fall 2 µs or less, and a pulse duty of 50% or less.



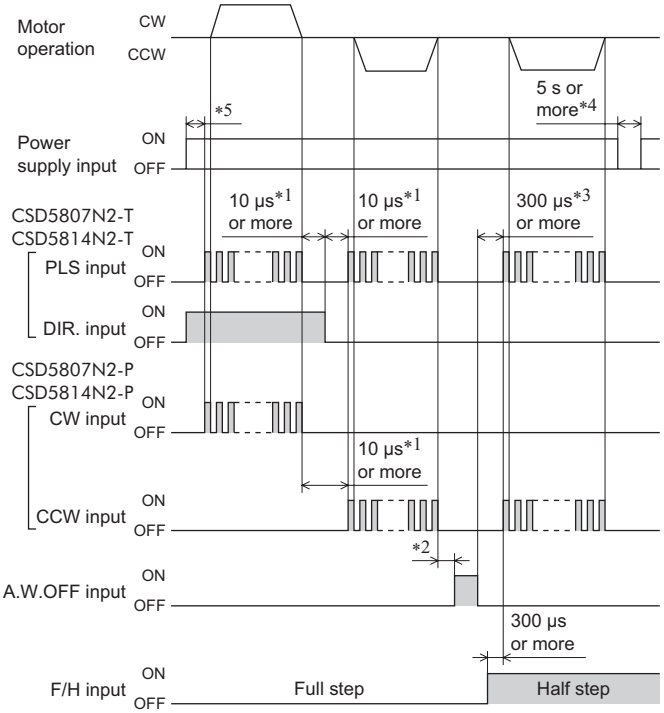
Note
- The interval for switching the motor direction represents the response time of the circuit. Set this interval to an appropriate time after which the motor will respond.
- Always set the photocoupler to OFF when not inputting pulse signals.

■ A.W.OFF (all windings off) input

Use this signal only when the motor's shaft must be rotated mechanically for the purpose of position adjustment.

- When the A.W.OFF input is turned ON, the driver stops supplying current to the motor and the motor's holding torque is lost.
- When the A.W.OFF input is turned OFF, the current supply to the motor resumes, thereby restoring the motor's holding torque.

■ Timing chart



∗1 "10 µs or more" indicated in connection with the DIR. input select time (CSD5807N2-T, CSD5814N2-T) or CW/CCW input select time (CSD5807N2-P, CSD5814N2-P) indicates a circuit response time. 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 inertial moment, load torque, self-starting frequency, etc.

∗3 Do not input pulse signals immediately after switching the A.W.OFF input to OFF, given that it will affect the motor's starting characteristics. Ordinarily, the interval should be around 100 ms.

∗4 After turning off the power supply, wait at least 5 sec. before turning the power supply back on.

∗5 Wait at least 2.5 sec after the power is turned on, then input the PLS input (CSD5807N2-T, CSD5814N2-T) or CW/CCW input (CSD5807N2-P, CSD5814N2-P).

Setting

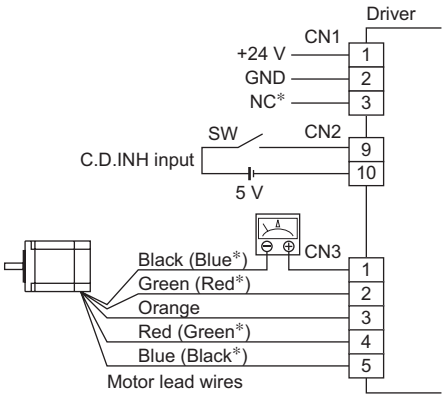
■ Setting the motor current

When the load is light and there is a margin for motor torque, the motor's operating vibration and the temperature increase of the motor and driver can be held down by lowering the motor's operating current and standstill current.

Factory setting RUN: Motor rated current
STOP: About 50% of motor's rated current

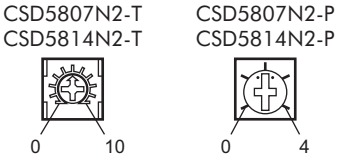
• Setting the motor operating current

1. Connect the motor and DC meter.
2. After connecting the 5 VDC power supply to CN2: pin No.9 and Pin No.10, turn on the 5 VDC.
3. Turn on the power (24 VDC) to the driver.

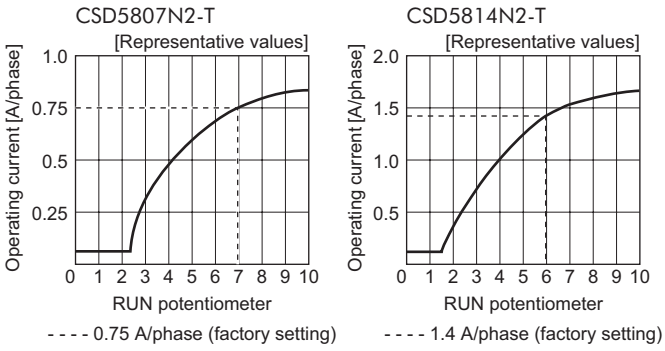


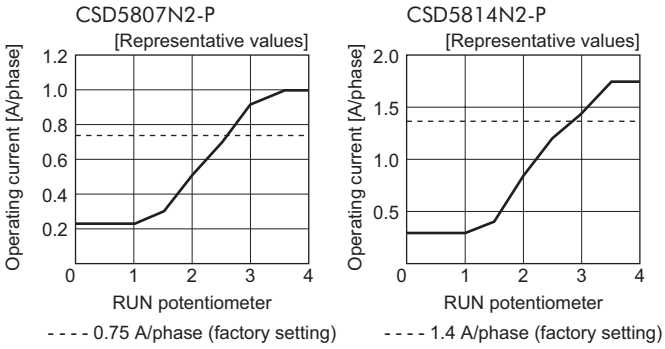
* CSD5807N2-P/CSD5814N2-P only.

4. When the motor operating current potentiometer (RUN) is turned counterclockwise, the current decreases.
   Current corresponding to a dual-phase value flows to the ammeter. A value of one-half that which is indicated equals the single-phase current value.



   Example:
   When the indication value on the ammeter shows 1.5 A, it stands for the setting of 0.75 A/phase.
   When the indication value on the ammeter shows 2.8 A, it stands for the setting of 1.4 A/phase.
5. When the setting is complete, turn off the power source.
   Continue setting the motor standstill current.

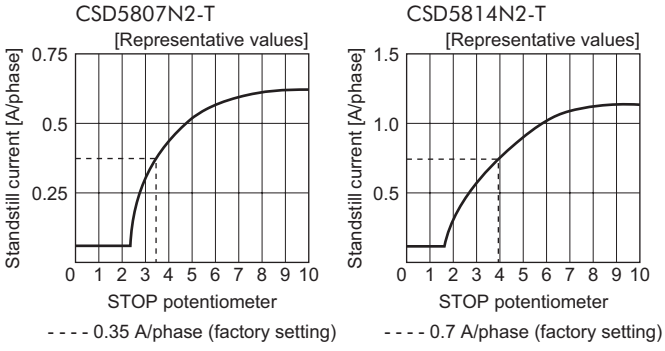


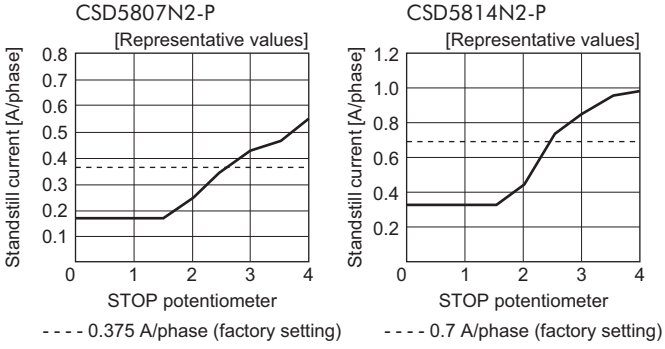


• Setting the motor standstill current

The motor standstill current is factory set so that it will be about 50% of the motor's operating current. This proportion does not change, even if the motor's operating current is changed.
When changing the setting of motor standstill current, use the motor standstill potentiometer volume (STOP).

1. After connecting the motor and DC meter, open the PLS (CW/CCW) input and turn on the power to the driver.
2. When the motor standstill current potentiometer (STOP) is turned counterclockwise, the current at motor standstill decreases.
3. When the setting is complete, turn off the power supply.
   After about 0.1 sec. has passed since the pulse was stopped, the motor's operating current automatically decreases to the set value of motor standstill current.





Note

- Set the motor's operating current within the motor's rated current value range.
- An adjustment range of the motor standstill current is within 50% of motor operating current. When the motor standstill current is too low, motor starting or maintenance of the location may be hindered. Do not reduce it any more than is necessary.
- When operating the volume, use a precision screwdriver.
- When setting the motor standstill current, be sure to do so after setting the motors operating current and turning off the power to the driver. If the motor standstill current is set earlier than the motor operating current, the setting of motor operating current may be changed.

Inspection

It is recommended that periodic inspections be conducted for the items listed below after each operation of the motor.
If an abnormal condition is noted, stop the use and contact your nearest office.

Inspection items

- Are the motor installation screws loose?
- Are there any abnormal sounds from the motor's bearing section (ball bearings) or elsewhere?
- Do any of the motor leads have damage or stress, or is there any play at the section for connection with the driver?
- Is there any deviation between the centers of the motor's output shaft and load shaft?
- Are the driver installation screws or connector sections loose?
- Is there any dust or dirt on the driver?
- Are there any strange smells or other abnormalities at the driver?

Note

- The driver uses semiconductor elements. Handle the driver carefully. There is a danger of the driver being damaged by static electricity, etc.
- Conduct the insulation resistance measurement or withstand voltage test separately on the motor and the driver.

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

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