VEXTA®

HP-4164-2

5-Phase Stepping Motor Unit

CFK II Series

●Photocoupler Input

OPERATING MANUAL

Table of Contents

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 using the motor unit

Only qualified personnel should work with the product.
Use the product correctly after thoroughly reading the section “Safety precautions.”
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 **CFKII** series is a unit comprising of an open-case, high-performance micro-step driver and high-torque, low-vibration design 5-phase stepping motor. The use of micro-stepping, which gives the basic step angle of the motor greater precision, electrically provides lower vibration and lower noise with accurate angle operation without the need for a speed-reduction mechanism.

Conformance with EC directives

Take the following measures to ensure conformance with the EC’s low voltage directive and EMC directive.

■For low voltage directive

This product is not subject to the EC’s low voltage directive because its input power supply voltage is 24 VDC. However, the user is advised to perform the following actions when conducting product installation and connection.

- This product is designed for use within machinery, so it should be installed within an enclosure.
- For the driver’s power supply, use a DC power supply with reinforced insulation on its primary and secondary sides.

■For EMC directive

The EMC measurement is not performed on the individual motor or driver. The customer is required to conduct the EMC measures on the final product incorporating the unit.

■**Applicable standards (Recognized by UL for CSA standards)**

	Applicable standards	Certification body	Standard file No.
Stepping motor	UL1004, UL519 CSA C22.2 No.77 CSA C22.2 No.100	UL	File No. E64199
Driver	–	–	–

- PK513, PMM3□H, PK54□, PK56□H and PK59□ do not comply with CSA standards.
- PK513, PMM3□H, PK56□H and PK59□ are not recognized by UL.

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 input-power 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 lead wire. Doing so may result in fire.

Operation

- Turn off the driver power 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 is turned off. Failure to provide such a measure may cause the moving parts to fall off, resulting in injury or damage to the equipment.
- Do not turn the A.W.OFF (All Windings 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's heat sink during operation or immediately after stopping. The surfaces are hot and may cause a burn.

Transportation

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

Installation

- Keep the area around the motor and driver free of combustible materials in order to prevent fire or a burn.
- 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.
- To avoid injury, remain alert during operation so that the motor can be stopped immediately in an emergency.
- 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 (All Windings Off) input is "ON" to prevent injury.
- When an abnormality is noted, stop the operation immediately, or fire or injury may occur.

Disposal

- When disposing of the motor or driver, treat them as industrial waste.

Preparation

This section covers the points to be checked along with the names, functions and main specifications of the respective parts.

Checking the product

Upon opening the package, 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.

- Motor 1 unit
- Driver 1 unit
- Motor cable 24 in. (600 mm) 1 piece (**CFK513**-type only)
- Operating manual 1 copy

Combinations of motors and drivers

Standard type

Motor rated current	Unit model		Motor model		Driver model
	Single shaft	Double shaft	Single shaft	Double shaft	
0.35 A/phase	**CFK513PAT**	**CFK513PBT**	PK513PA	PK513PB	DFC5103T
0.75 A/phase	**CFK533AT**	**CFK533BT**	PMM33AH2	PMM33BH2	DFC5107T
	CFK535AT	**CFK535BT**	PMM35AH2	PMM35BH2	
	CFK543AT	**CFK543BT**	PK543NAWA	PK543NBWA	
	CFK544AT	**CFK544BT**	PK544NAWA	PK544NBWA	
	CFK545AT	**CFK545BT**	PK545NAWA	PK545NBWA	
1.4 A/phase	**CFK564AT**	**CFK564BT**	PK564NAWA	PK564NBWA	DFC5114T
	CFK566AT	**CFK566BT**	PK566NAWA	PK566NBWA	
	CFK569AT	**CFK569BT**	PK569NAWA	PK569NBWA	

High-speed type

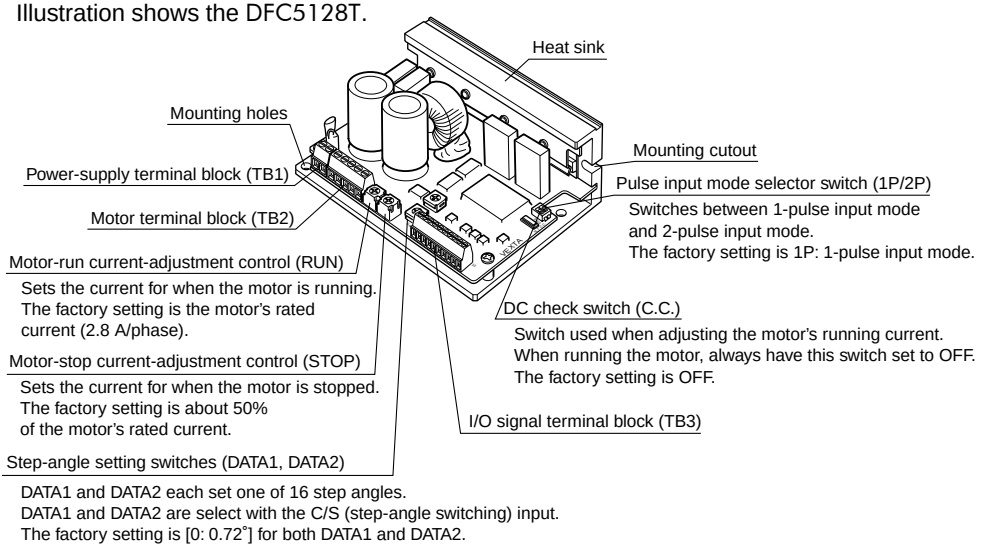
Motor rated current	Unit model		Motor model		Driver model
	Single shaft	Double shaft	Single shaft	Double shaft	
2.8 A/phase	**CFK566HAT**	**CFK566HBT**	PK566H-NAA	PK566H-NBA	DFC5128T
	CFK569HAT	**CFK569HBT**	PK569H-NAA	PK569H-NBA	
	CFK596HAT	**CFK596HBT**	PK596-NAA	PK596-NBA	
	CFK599HAT	**CFK599HBT**	PK599-NAA	PK599-NBA	
	CFK5913HAT	**CFK5913HBT**	PK5913-NAA	PK5913-NBA	

Names and functions of parts

This section covers the names and functions of parts in the driver and motor.

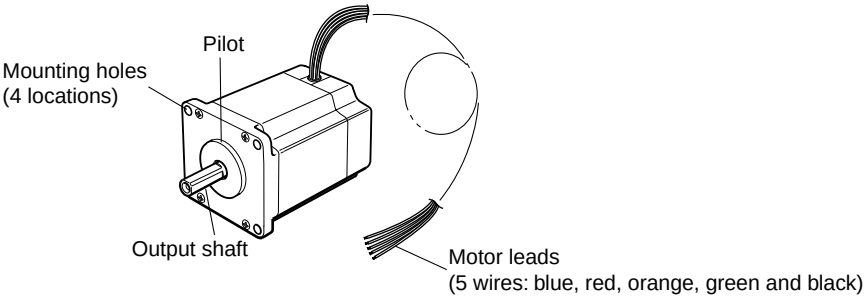
Driver

Illustration shows the DFC5128T.



Motor

Illustration typical for the PK56□ and PK59□.



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-stop current-adjustment control (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-stop current-adjustment control (STOP) setting to ensure the necessary load-holding torque.

Main specifications

This section covers the main specifications.
Refer to the catalog for detailed specifications and torque characteristics.

■Motor specifications

Standard type

Motor model	Single shaft	PK513PA	PMM33AH2	PMM35AH2	PK543NAWA	PK544NAWA
	Double shaft	PK513PB	PMM33BH2	PMM35BH2	PK543NBWA	PK544NBWA
Maximum holding torque oz-in (N·m)		3.12 (0.022)	4.6 (0.033)	8.5 (0.06)	18.4 (0.13)	25 (0.18)
Rotor inertia oz-in^2 (kg·m^2)		0.014 (2.6×10^{-7})	0.049 (9×10^{-7})	0.098 (18×10^{-7})	0.191 (35×10^{-7})	0.3 (54×10^{-7})
Basic step angle		0.72°				
Rated current A/phase		0.35	0.75			
Mass lb. (kg)		0.11 (0.05)	0.22 (0.1)	0.374(0.17)	0.462 (0.21)	0.594 (0.27)
Insulation class		Class B [266°F(130°C)]			Class B [266°F (130°C)] UL/CSA: Class A [221°F (105°C)]	
Ambient temperature range		+14°F to +122°F (−10°C to +50°C)				

Motor model	Single shaft	PK545NAWA	PK564NAWA	PK566NAWA	PK569NAWA
	Double shaft	PK545NBWA	PK564NBWA	PK566NBWA	PK569NBWA
Maximum holding torque oz-in (N·m)		34 (0.24)	59 (0.42)	117 (0.83)	230 (1.66)
Rotor inertia oz-in^2 (kg·m^2)		0.37 (68×10^{-7})	0.96 (175×10^{-7})	1.53 (280×10^{-7})	3.1 (560×10^{-7})
Basic step angle		0.72°			
Rated current A/phase		0.75	1.4		
Mass lb. (kg)		0.77 (0.35)	1.32 (0.6)	1.76 (0.8)	2.86 (1.3)
Insulation class		Class B [266°F (130°C)] UL/CSA: Class A [221°F (105°C)]			
Ambient temperature range		+14°F to +122°F (−10°C to +50°C)			

- The maximum holding torque represents the value of 5-phase excitation at the rated current of the motor.
  When the motor is combined with a dedicated driver, the value will decrease in proportion to the motor's stopped-state current setting.

High-speed type

Motor model	Single shaft	PK566H-NAA	PK569H-NAA	PK596-NAA	PK599-NAA	PK5913-NAA
	Double shaft	PK566H-NBA	PK569H-NBA	PK596-NBA	PK599-NBA	PK5913-NBA
Maximum holding torque oz-in (N·m)		117 (0.83)	230 (1.66)	290 (2.1)	580 (4.1)	890 (6.3)
Rotor inertia oz-in^2 (kg·m^2)		1.53 (280 × 10^{-7})	3.1 (560 × 10^{-7})	7.7 (1400 × 10^{-7})	14.8 (2700 × 10^{-7})	22 (4000 × 10^{-7})
Basic step angle		0.72°				
Rated current A/phase		2.8				
Mass lb. (kg)		1.76 (0.8)	2.83 (1.3)	3.74 (1.7)	6.16 (2.8)	8.36 (3.8)
Insulation class		Class B [266°F (130°C)]				
Ambient temperature range		+14°F to +122°F (−10°C to +50°C)				

- The maximum holding torque represents the value of 5-phase excitation at the rated current of the motor.
  When the motor is combined with a dedicated driver, the value will decrease in proportion to the motor's stopped-state current setting.

■**Driver specifications**

Driver model	DFC5103T	DFC5107T	DFC5114T	DFC5128T
Power input voltage	24 VDC ±10%			
Excitation mode	Microstep (Maximum 250 divisions)			
Input signal	Photocoupler input Signal voltage Photocoupler ON: +4.5 to +5 V Photocoupler OFF: 0 to +1 V PLS, DIR: 5 VDC, 20 mA maximum, Input resistance 220 Ω A.W.OFF, C/S: 5 VDC, 15 mA maximum, Input resistance 470 Ω			
Output signal	Open-collector output TIMING: 24 VDC maximum, 10 mA maximum The signal is output when the excitation sequence is in step “0”. (Photocoupler ON) Division of 1: The signal is output once every 10 pulses. Division of 10: The signal is output once every 100 pulses.			
Driver cooling method	Natural ventilation			
Mass lb. (kg)	0.44 (0.2)			0.484 (0.22)
Ambient temperature range	+32°F to +104°F (0°C to +40°C)			

- The input-power current supplied to the driver represents the maximum input value (which varies with pulse speed).

Installation

This section covers the environment and method of installing the motor and driver, along with load 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: +14°F to +122°F (-10°C to +50°C) (non-freezing)
  Driver: +32°F to +104°F (0°C to +40°C) (non-freezing)
- Operating ambient humidity 85%, maximum (no condensation)
- 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 (storms, 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

■Direction of installation

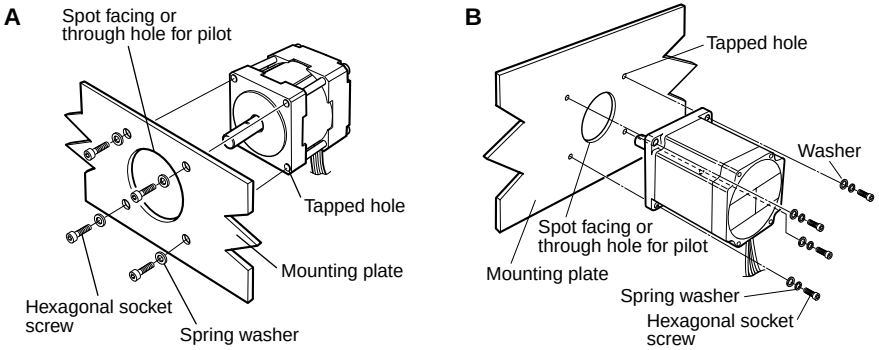
The motor can be installed in any direction.

■How to install the motor

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.

- **Types of installation**



Motor model		Bolt size	Tightening torque	Effectine depth of bolt	Type of installation
PK513PA	PK513PB	M2	2.3 lb-in (0.25 N·m)	0.1 in. (2.5 mm)	A
PMM33AH2	PMM33BH2	M2.5	4.4 lb-in (0.5 N·m)	0.1 in. (2.5 mm)	A
PMM35AH2	PMM35BH2				
PK543NAWA	PK543NBWA	M3	8.8 lb-in (1 N·m)	0.17 in. (4.5 mm)	A
PK544NAWA	PK544NBWA				
PK545NAWA	PK545NBWA				
PK564NAWA	PK564NBWA	M4	17.7 lb-in (2 N·m)	–	B
PK566NAWA	PK566NBWA				
PK569NAWA	PK569NBWA				
PK566H-NAA	PK566H-NBA				
PK569H-NAA	PK569H-NBA				
PK596-NAA	PK596-NBA	M5	26 lb-in (3 N·m)	–	B
PK599-NAA	PK599-NBA				
PK5913-NAA	PK5913-NBA				

Note

Insert the pilot located on the motor's installation surface into the mounting plate's countersunk or through hole.

Installing a load

When connecting a load to the motor, align the centers of the motor's output shaft and load shaft.

■Direct coupling

Align the centers of the motor's output shaft and load shaft in a straight line.

■Using a belt drive

Align the motor's output shaft and load shaft in parallel with each other, and position both pulleys so that the line connecting their centers is at a right angle to the shafts.

■Using a gear drive

Align the motor's output shaft and gear shaft in parallel with each other, and let the gears mesh at the center of the tooth widths.

Note

- When coupling the load to the motor, pay attention to the centering of the shafts, belt tension, parallelism of the pulleys, and so on.
  Securely tighten the coupling and pulley set screws.
- Be careful not to damage the output shaft or bearings when installing a coupling or pulley to the motor's output shaft.
- Do not modify or machine the motor's output shaft.
  Doing so may damage the bearings and destroy the motor.

Overhung load and thrust load

The overhung load on the motor's output shaft must be kept under the permissible values listed below.

The thrust load must not exceed the motor's mass.

[Unit: lb. (N)]

Motor model		Overhung load				
		Distance from the tip of motor's output shaft [inch (mm)]				
		0 (0)	0.2 (5)	0.39 (10)	0.59 (15)	0.79 (20)
PK513PA	PK513PB	2.6 (12)	3.3 (15)	–	–	–
PMM33AH2	PMM33BH2	5.6 (25)	7.6 (34)	11.7 (52)	–	–
PMM35AH2	PMM35BH2					
PK543NAWA	PK543NBWA	4.5 (20)	5.6 (25)	7.6 (34)	11.7 (52)	–
PK544NAWA	PK544NBWA					
PK545NAWA	PK545NBWA					
PK564NAWA	PK564NBWA	14.1 (63)	16.8 (75)	21 (95)	29 (130)	42 (190)
PK566NAWA	PK566NBWA					
PK569NAWA	PK569NBWA					
PK566H-NAA	PK566H-NBA					
PK569H-NAA	PK569H-NBA					
PK596-NAA	PK596-NBA	58 (260)	65 (290)	76 (340)	87 (390)	108 (480)
PK599-NAA	PK599-NBA					
PK5913-NAA	PK5913-NBA					

Note

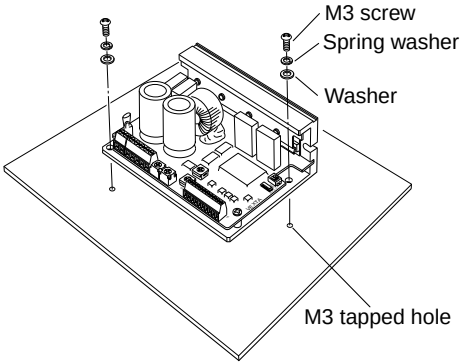
Failure due to fatigue may occur when the motor bearings and output shaft are subject to repeated loading by an overhung or thrust load that is in excess of the permissible limit.

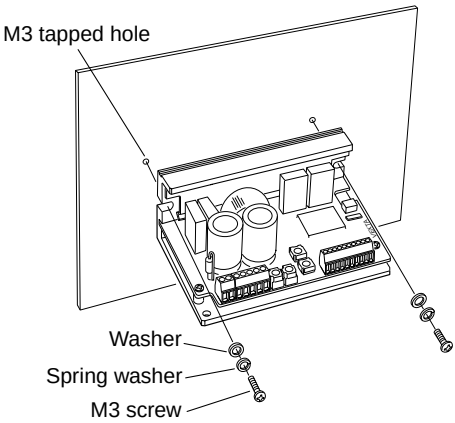
Installing the driver

■Installation method

Install the driver on a flat metal plate having superior capacity to withstand vibration as well as a high heat-conductance effect. Always install the driver using the driver's installation holes and install and fasten it either vertically or horizontally with the two screws (M3; not supplied with unit) so that there is no gap between the driver and the metal plate. Any other installation method will reduce the heat-radiating effect for the driver.

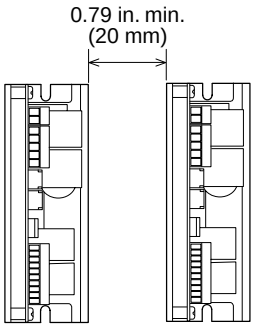
Illustrations show the DFC5128T.





There must be a clearance of at least 0.98 in. (25 mm) and 1.97 in. (50 mm) in the horizontal and vertical directions, between the driver and enclosure or other equipment.

When two or more drivers are to be installed side by side, provide 0.79 in. (20 mm) clearances in the horizontal.



Note

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

Connection

This section covers the methods of connecting the driver, motor, power and controller, as well as the connection examples and I/O interface.

Terminal blocks

Screw terminals are used.
Remove the insulation from the core, then insert the core into the terminal and tighten with terminal screws.
Strip 0.24 to 0.31 in. (6 to 8 mm) of insulation.
Tighten the terminal screw at the specified tightening torque.

Connecting the motor

Connect the motor leads into the driver's motor terminal block (TB2).
The **CFK513** model has a connector with motor leads. Use the supplied motor cable with connector.

Note

If the noise generated from the motor leads becomes a problem, shield the motor leads with electrically conductive tape, wire mesh or the like.

Connecting to the power supply

The input power-supply voltage is 24 VDC ±10%. Use a power supply capable of supplying the power/current capacity as shown below.

Driver model	DFC5103T, DFC5107T	DFC5114T	DFC5128T
	1 A min.	2 A min.	4 A min.

Connecting the power-supply wires into the driver's power-supply terminal blocks (TB1).

Note

- For the power-supply cable, use a cable with a diameter equivalent to AWG20 (0.5 mm^2) for the standard type (DFC5103T, DFC5107T, DFC5114T), and AWG20 to 18 (0.5 to 0.75 mm^2) for the high-speed type (DFC5128T). Be sure to connect the power supply using the correct polarity. If the power supply's polarity is reversed, the driver may be damaged.
- Do not route the power-supply cables in the same conduits as other power-supply lines and motor leads.
- Always wait at least 5 sec. after switching off the power before switching it back on again or connecting/disconnecting the motor-lead connector.

Connecting the I/O signals

Connecting the I/O wires into the driver's I/O signal terminal blocks (TB3).

Note

- For the I/O signal cable, use twisted pair with a diameter equivalent to at least AWG24 to 22 (0.2 to 0.34 mm^2). To suppress the effect of noise, make the cable as short as possible [6.6 ft. (2 m) max.].
- Separate I/O signal cables at least 12 in. (300 mm) from electromagnetic relays and other than inductance loads. Additionally, route I/O signal cables perpendicular to power-supply cables and motor leads, rather than in a parallel fashion.

Terminal blocks pin assignments

	Terminal blocks	Pin No.	I/O	Signal name	Explanation
Power-supply terminal blocks	TB1	1	Input	POWER	+24 VDC ±10%
		2			GND
Motor terminal blocks	TB2	1	Output	MOTOR	Blue motor lead
		2			Red motor lead
		3			Orange motor lead
		4			Green motor l ead
		5			Black motor lead
I/O terminal blocks	TB3	1	Input	PLS+ (CW+)	Pulse (CW pulse) input ∗ photocoupler anode side
		2		PLS− (CW−)	Pulse (CW pulse) input ∗ photocoupler cathode side
		3		DIR+ (CCW+)	Rotational direction (CCW pulse) input ∗ anode side
		4		DIR− (CCW−)	Rotational direction (CCW pulse) input ∗ cathode
		5		A.W.OFF+	All windings off input anode side
		6		A.W.OFF−	All windings off input cathode side
		7	Output	TIMING+	Excitation timing output collector side
		8		TIMING−	Excitation timing output emitter side
		9	Input	C/S+	Step-angle switching input anode side
		10		C/S−	Step-angle switching input cathode side

∗ Depends on the setting of the pulse-input selector switch.

- When this switch is set to 1-pulse input mode, the inputs are the pulse input and the rotation-direction input.
- When this switch is set to 2-pulse input mode, the inputs are CW and CCW.

Connecting the CFK513-type motor

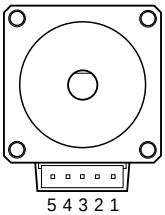
The **CFK513**-type motors are of the connector type having no leads.
To connect these motors, use the supplied motor cable.
The applicable connector housing/contact, crimping tool and connector configuration are shown below.

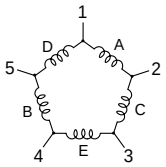
Connector housing/contact, crimping tool

Connector housing	MOLEX 51065-0500
Contact	MOLEX 50212-8xxx
Crimping tool	MOLEX 57176-5000

Connector configuration

Terminal No.	1	2	3	4	5
Motor lead color	Blue	Red	Orange	Green	Black



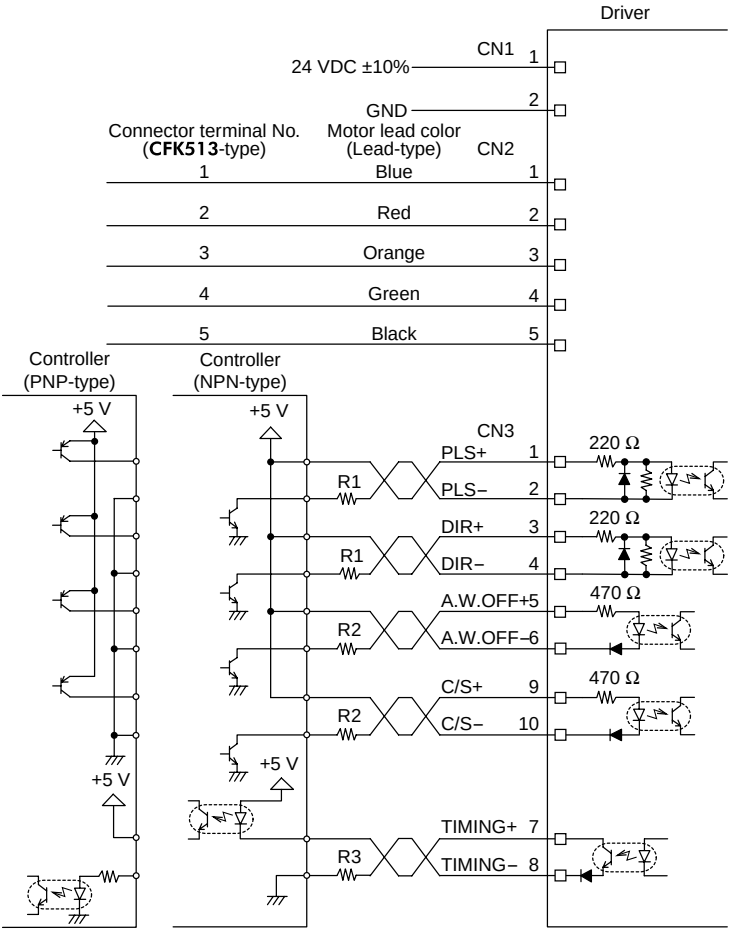


Note

When connecting to the **CFK513**-type motor, arrange the cable at the connector such that the connected part will not be overly stressed as a result of bending of the cable. Set the cable's radius of curvature as large as possible.

Connection examples

Examples of connections with the motor, power supply and controller are shown below.



Note

- Make the input-signal voltage 5 VDC minimum and 24 VDC maximum.
  When the input-signal voltage is 5 VDC, external resistors R1 and R2 in the diagram are not necessary. If the input-signal voltage is greater than 5 VDC, connect external resistors R1 and R2, as shown in the diagram, to restrict the input current as follows:
  PLS, DIR: 20 mA max.
  A.W.OFF, C/S: 15 mA max.
- Use an output-signal voltage of 5 VDC minimum and 24 VDC maximum, and use output-signal current of 10 mA max.
  If the output-signal current is greater than 10 mA, connect external resistor R3, as shown in the diagram, to restrict the current to no more than 10 mA.

Explanation of I/O signals

■Input signals

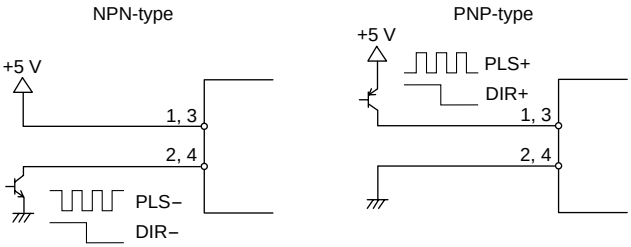
The signal states indicate the state of the internal photocoupler (ON: power conducted; OFF: power not conducted).

◆PLS input and DIR input

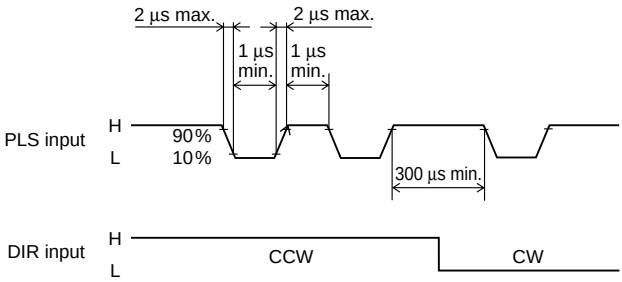
This driver can select either 1-pulse input mode or 2-pulse input mode as the pulse-input mode to match the controller used. For details on how to set the pulse-input mode, see page 29, “Pulse input modes.”

1-pulse input mode (factory setting)

The controller pulses are connected to the PLS+ input (pin No.1) or the PLS− input (pin No.2), and the rotation direction is connected to the DIR+ input (pin No.3) or DIR− input (pin No.4).



1. When the DIR input is “ON,” a fall of the “PLS input” from “ON” to “OFF” will rotate the motor one step in the CW direction.
2. When the DIR input is “OFF,” a fall of the “PLS input” from “ON” to “OFF” will rotate the motor one step in the CCW direction.

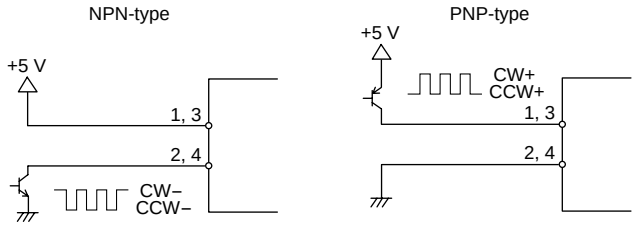


Note

- Do not allow the driver temperature to exceed 158°F (70°C), which is the heat-radiating plate’s saturation temperature during operation.
- The minimum value for the interval time when switching the rotational direction depends on the motor’s size, running speed and load moment of inertia.

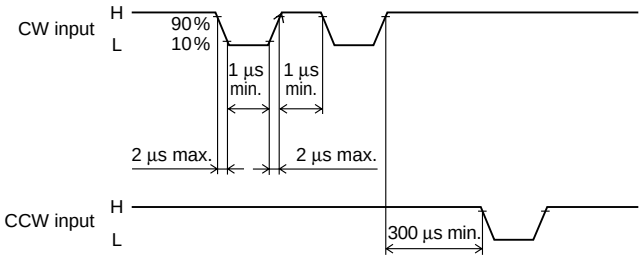
2-pulse input mode

The controller's CW pulses are connected to the CW+ (pin No.1) or the CW− (pin No.2), while the CCW pulses are connected to the CCW+ (pin No.3) or the CCW− (pin No.4).



1. When the CW pulse input changes from the "ON" state to "OFF" state, the motor will rotate one step in the CW direction.
2. When the CCW pulse input changes from the "ON" state to "OFF" state, the motor will rotate one step in the CCW direction.

For the pulse signals use input pulses with sharp rising and trailing edges, as shown in the figure.



Note

- Do not allow the driver's temperature to exceed 158°F (70°C), which is the heat-radiating plate's saturation temperature during operation.
- The minimum value for the interval time when switching the rotational direction depends on the motor's size, running speed and load moment of inertia.
- Always set the photocoupler to "OFF" when not inputting pulse signals. Otherwise, the driver can't shift to the motor-stop setting current.
- Do not input CW input and CCW input at the same time.
  If one of these pulses is input when the other is "ON" the motor will not run properly.

◆A.W.OFF (All Windings Off) input

This is used to rotate the motor's output shaft and adjust its position.

⚠Warning • Do not turn the A.W.OFF (All Windings 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.

⚠Caution • Before moving the motor directly with the hands (as in the case of manual positioning), confirm that the driver A.W.OFF (All Windings Off) input is "ON" to prevent injury.

1. When the A.W.OFF input is turned to "ON," the driver cuts off the current supply to the motor and the motor loses its holding-brake force.
   In this condition the position of the output shaft can be adjusted manually.
2. When the A.W.OFF input is turned to "OFF," the driver resumes the current supply to the motor and restores the motor's holding-torque.
   The A.W.OFF input must be "OFF" when operating the motor.

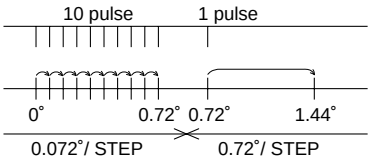
Note

When the A.W.OFF input is not used, keep the A.W.OFF input in the "OFF" or leave it disconnected.

◆C/S (step angle switching) input

This signal selects the step angle set with one of the two step-angle setting switches (DATA1 and DATA2).
For example, when DATA1 is set to [0: 0.72°] and DATA2 is set to [6: 0.072°], this signal can switch between 0.72°-step operation and 0.072°-step operation. For details on setting the step-angle setting switch, see page 25, "Step angle."

1. When the C/S input is turned to "ON," operation switches to the setting for step-angle setting switch DATA2.
2. When the C/S input is turned to "OFF," operation switches to the setting for step-angle setting switch DATA1.



■Output signals

The driver's output signals are photocoupler/opencollector outputs. The signal states indicate the state of the internal photocoupler (ON: power conducted; OFF: power not conducted).

◆Timing (excitation timing) output

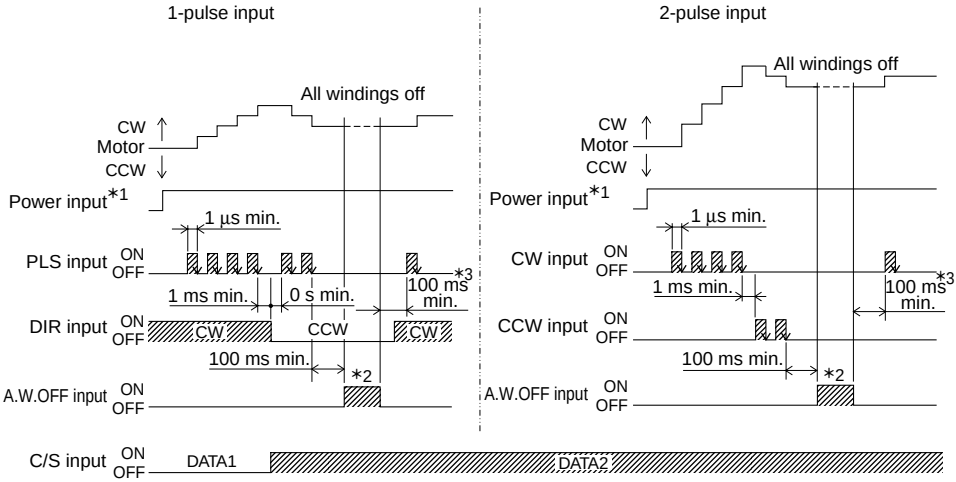
When the motor-excitation state (combined phases of current flowing) is the excitation home position (step [0]), the driver switches on the timing output. The motor-excitation state is reset to the excitation home position when the power supply is switched on.

The timing output comes on every 7.2° of motor rotation, being synchronized with the pulse input. When the pulse signals are input at an integer multiple of the number of pulses required for the motor to rotate 7.2°, then it is possible to check whether or not the driver is operating normally by monitoring the timing output.
Also, when detecting the mechanical home position for a mechanical device, by making an AND circuit for the machine's home-position sensor and the timing output, the variation in the motor-stop position within the machine's home-position sensor can be held down and the machine's home position made more precise.

Note

- When using the timing output, stop the motor's output shaft at an integer multiple of 7.2°.
- When switching the step angle using the C/S (step-angle switch) input, do this with the motor stopped and the timing output on.

Timing chart



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

*1 When switching the power back on again, wait at least 5 sec.

*2 When switching the A.W.OFF input to “ON,” the motor excitation ends and the holding-torque disappears.

*3 The duration here may vary, depending on the motor’s size, running speed and the load’s moment of inertia.

Note

- Do not switch the A.W.OFF input to “ON” while the motor is running.
- Always set the photocoupler to “OFF” when pulse signals are not being input.
- Do not input a CW pulse and CCW pulse simultaneously. If a pulse is input while the other photocoupler is in the “ON” state, the motor will not operate properly.

Setting

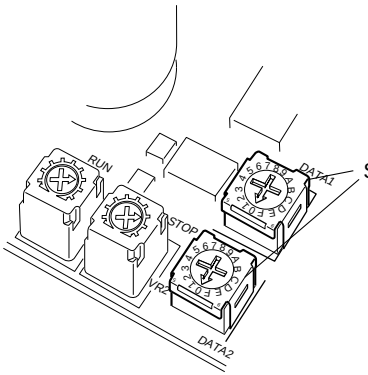
This section describes the methods for setting the step angle and motor's current setting and switching the pulse-input mode.

Step angle

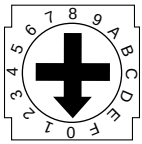
When setting the motor's step angle, use the step-angle setting switches (DATA1 and DATA2).

Factory settings DATA1 [0: 0.72°], DATA2 [0: 0.72°]

- There are 16 settings, ranging from [0] to [F]. The step angle for each setting is given in the table below.
- When changing a step-angle setting, use a precision screwdriver to switch the DATA1 or DATA2 scale.
- The step angle set by DATA1 or by DATA2 is selected with the C/S (step-angle switching) input. For details on C/S (step-angle switching) input, see page 22.



Step-angle setting switch



DATA1, DATA2

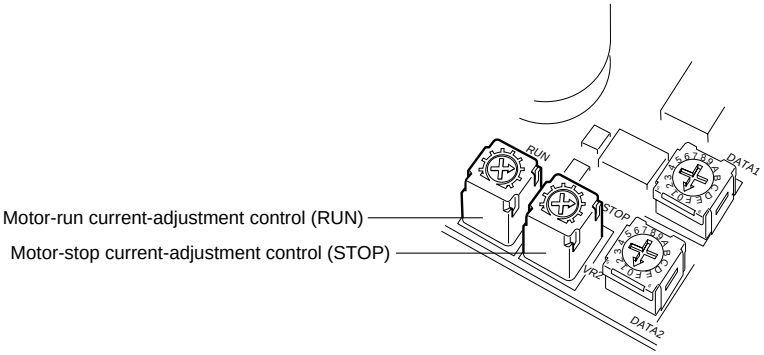
DATA1	DATA2
Dial setting	Step angle
0	0.72°
1	0.36°
2	0.288°
3	0.18°
4	0.144°
5	0.09°
6	0.072°
7	0.036°
8	0.0288°
9	0.018°
A	0.0144°
B	0.009°
C	0.0072°
D	0.00576°
E	0.0036°
F	0.00288°

Motor current

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

When adjusting the motor current, use the motor-run current-adjustment control (RUN) and motor-stop current-adjustment control (STOP).

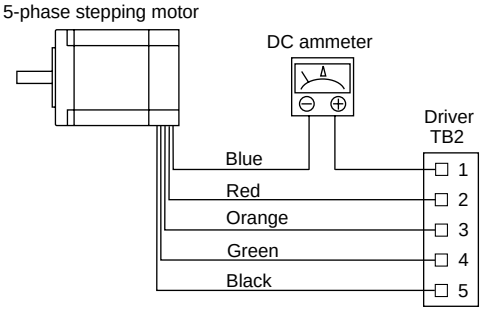
Factory settings RUN: Motor rated current
STOP: About 50% of motor's rated current



⚠Caution • 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.

■Preparations

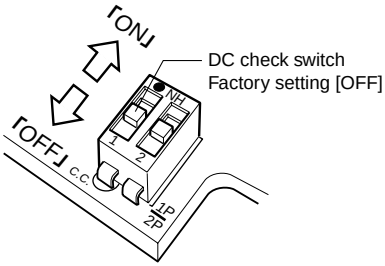
Connect the driver and motor and the power supply and DC ammeter as in the diagram below:



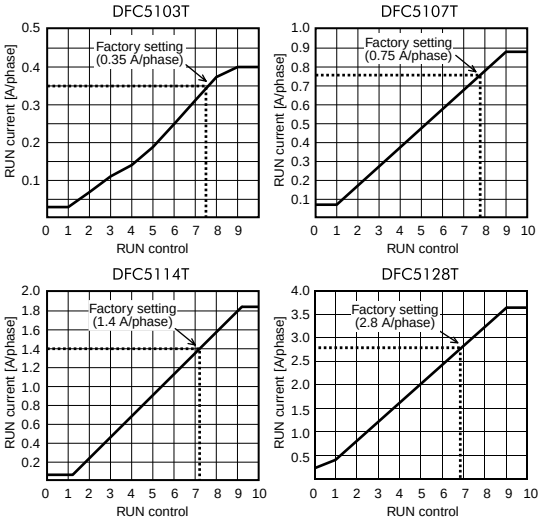
- Connect the − side of the DC ammeter to the motor's blue lead and the + side of the DC ammeter to motor terminal blocks TB2 pin No.1.
- After adjusting the current, disconnect the ammeter and reinsert the motor's blue lead into the motor terminal blocks pin No.1.

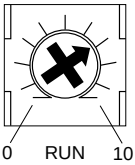
■Adjusting the motor's run current

1. Turn the DC check switch to the "ON."
2. Switch on the driver's power supply.
3. Turning the motor's run-current adjustment control in the counter-clockwise direction reduces the current. One-half the value displayed on the ammeter is the current per phase of the motor.
   (Example: 5.6 A = 2.8 A/phase)



RUN control - output current characteristics (representative values)





The scale values are not displayed on the control.

4. After adjusting the run control, return the current check switch to the "OFF."

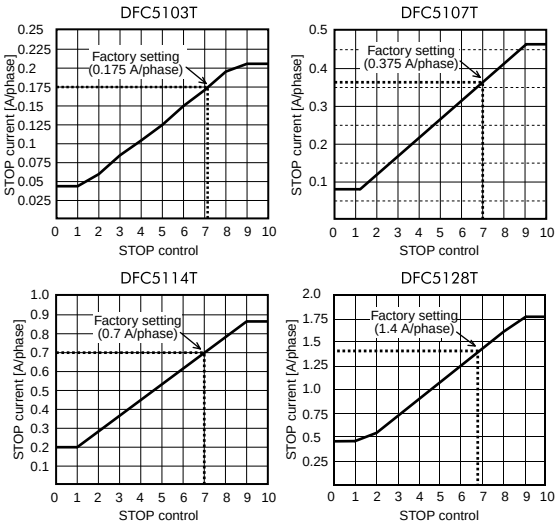
Note

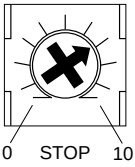
- After adjusting the run current, always return the current check switch to the "OFF." If this switch is set to "ON," when the motor stops the motor current does not decrease to the motor-stop current level.
- Always adjust the run current to no more than value of rated current. Higher current can damage the motor and driver.

■Adjusting the motor's stop current

1. Turn the DC check switch to the "OFF."
2. Switch on the driver's power supply.
3. Turning the motor's stop-current adjustment control in the counter-clockwise direction reduces the current. One-half the value displayed on the ammeter is the current per phase of the motor.
   (Example: 2.8 A = 1.4 A/phase)

STOP control - output current characteristics (representative values)





The scale values are not displayed on the control.

The motor's current will automatically drop to the motor's stop current within approximately 0.1 sec. after the pulse input has stopped.

Note

When adjusting the motor's stop current, set the current to within 50% of the specified motor's running current. Failure to do so may result in damage to the motor and/or driver. On the other hand, setting the motor's stop current too low may cause trouble with the motor's startup or holding torque.

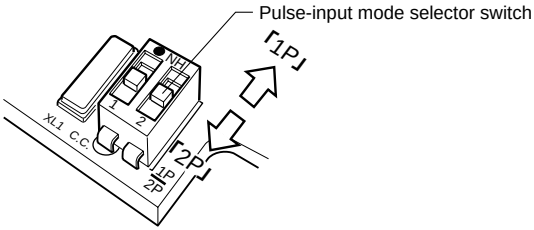
Pulse input modes

Set the pulse-input mode switch to either 1-pulse input mode or 2-pulse input mode, whichever the controller uses.

Note

Set the pulse-input mode switch when the driver power is off.

Factory setting [1P: 1-pulse input mode]



■Setting 1-pulse input mode

When operating the motor with pulse input and rotation-direction input, switch the pulse-input mode selector switch to the “1P”.

■Setting 2-pulse input mode

When operating the motor with two pulses (CW pulse input and CCW pulse input) switch the pulse-input mode selector switch to the “2P”.

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's power transistors or capacitors?

Note

- The driver uses semiconductor elements. Handle the driver carefully. There is a danger of the driver being damaged by static electricity, etc.
- Never measure insulation resistance or withstand voltage with the motor and driver connected.

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 office.

Phenomenon	Possible cause	Remedial action
The motor is not energized. The motor's output shaft can be turned easily with the hands.	Connection error in the motor lead or power cable	Double-check that the connections between the driver, motor and power supply are correct.
	Current-adjustment control incorrectly set If the setting is too low, the motor torque will also be too low and operation will be unstable.	Return the current-adjustment control to its factory setting and check.
	The A.W.OFF input is set to "ON."	Switch the A.W.OFF 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).
	During 1-pulse input, the pulses are connected to the DIR input (pin Nos. 3 and 4).	Connect the pulses to the PLS input (pin Nos.1 and 2).
	During 2-pulse input, 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.	With 1-pulse input selected, the DIR input setting is reversed.	Set the rotation-direction input to "ON" when setting the clockwise direction; set the rotation direction input to "OFF" when setting the counter-clockwise direction.
	With 2-pulse input selected, 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).

Phenomenon	Possible cause	Remedial action
Motor operation is unstable.	Error in the motor's cable connection	Double-check that the driver and motor connections are correct.
	Current-adjustment control incorrectly set If the setting is too low, the motor torque will also be too low and operation will be unstable.	Return the current-adjustment controls to its factory setting and check.
	Pulse-input line connection defect	• Check the controller and driver connections. • Check the pulse-input specifications (voltage and width).
Loss of synchronization during acceleration or running	The centers of the motor's output shaft and load shaft are not aligned.	Check the linkage state for the motor's 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's operating speed to low and high torque eliminates the problem, it is necessary to review the load conditions.
	The speed of the starting pulse is too high.	Lower the speed of the starting pulse and set it again to a speed at which stable starting is possible.
	The acceleration (deceleration) time is too short.	Lengthen the acceleration (deceleration) time in order to reset it to a time at which stable starting is possible.
	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 C/S (step-angle switching) input	Check the step-angle setting switch (DATA1, DATA2) settings and the C/S input switching state.
	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.	Current-check switch to "ON"	Switch the current check switch to "OFF."
	CW input, CCW input or pulse input set to "ON" after pulses have stopped	After the pulses stop, always switch to "OFF."

Phenomenon	Possible cause	Remedial action
Motor vibration too great	The centers of the motor's output shaft and load shaft are not aligned.	Check the linkage state for the motor's output shaft and load shaft.
	Motor resonating	If changing the running pulse speed reduces the vibration, the motor is resonating. Either change the speed setting of the running pulse or reduce the step-angle setting.
	Load too small	Turn the motor-run current-adjustment controls slightly in the counter-clockwise direction in order to lower the current. Vibration will increase if the motor's output torque is too large for the load.
Motor too hot	Motor run time too long	Either shorten the motor's run time or lengthen the stop time. Hold the motor case temperature to a maximum of 212°F (100°C).
	Current check switch switched to "ON"	Switch the current check switch to "OFF."
	Motor-stop current adjustment too high	Adjust the motor stop current to a maximum of one-half the value of the run current.
Timing output not output	C/S (step-angle switching) input switched to "ON" when timing output is not being output	Switch the C/S input to "ON" when timing output is being output.

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