HP-4130

VEXTA®

5-Phase Stepping Motor Units

CFK Series

CFK543A, CFK544A, CFK545A, CFK564A, CFK566A and **CFK569A**
CFK543B, CFK544B, CFK545B, CFK564B, CFK566B and **CFK569B**

OPERATING MANUAL

Table of Contents

Thank you for purchasing ORIENTAL MOTOR products.
Please read this operating manual thoroughly before installing and operating products, and always keep the manual where it is readily accessible.

1. Introduction

The Oriental Motor (OM) **CFK** Series is a family of 5-Phase Stepping Motor Units which are available in single and double shaft versions. This manual describes the installation and use of the motors in the **CFK** Series, and instructs you in the precautions you should take when using these devices.

There are two frame sizes : **CFK54** □□ and **CFK56** □□

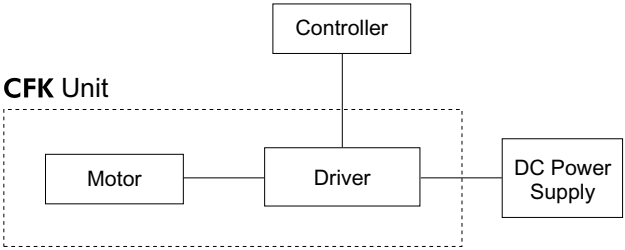
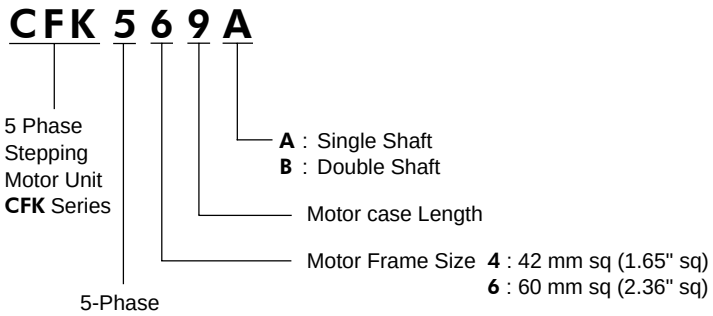


Figure 1 System Block Diagram

All **CFK** units consist of a motor and an electronic driver. The separately purchased power supply, and the digital Controller, complete the system (Figure 1).
A comprehensive Troubleshooting Table on page 16 and 17 lists the symptoms, check points, and action steps related to problems you may encounter using this device. If you require further assistance, contact your local sales office.

CFK Motor Product Number Codes



2. Unit Components

CFK Units include a matched motor and driver, connectors and operating manual.

Table 1 **CFK** Series

Unit Model		Motor Model		Driver Model
Single Shaft	Double Shaft	Single Shaft	Double Shaft	
CFK543A	**CFK543B**	PK543-NA	PK543-NB	DFC1507
CFK544A	**CFK544B**	PK544-NA	PK544-NB	
CFK545A	**CFK545B**	PK545-NA	PK545-NB	
CFK564A	**CFK564B**	PK564-NA	PK564-NB	DFC1514
CFK566A	**CFK566B**	PK566-NA	PK566-NB	
CFK569A	**CFK569B**	PK569-NA	PK569-NB	
Connector Housing		171822 - 5 (AMP)		1 piece
		171822 - 6 (AMP)		1 piece
		1-171822 - 2 (AMP)		1 piece
Contacts		170204 - 2 (AMP)		30 pieces

PRECAUTIONS

Motor/Driver Combinations

Do not use a motor with any driver other than that listed in Table 1. Other combinations may cause damage to a component and improper or unsafe operation of the motor, both of which will void your OM warranty.

Maintaining Motor Integrity

Never disassemble the motor or loosen its assembly screws. These activities will cause significant performance drop and void your OM warranty.

Heat Generation

Do not touch the motor or driver during operation as both components generate high temperatures. Do not allow the motor case to exceed 100**°C**. Motor temperature can be lowered by reducing operating RUN current, STOP current at motor standstill, speed, and duty cycle.

Before touching the motor or the driver, turn the power off allowing ample time for the unit to cool down.

3. Installation

Installation areas for the motors and drivers should :

- Be free from water, dust, oil mist, salt or corrosive gas.
- Be free from excessive vibration or shock.
- Have good ventilation.
- Have ambient temperature for:
  - Motor : between -10℃ to +50℃, noncondensing.
  - Driver : between 0℃ to +40℃, noncondensing.
- Have at least 25 mm of open space between the driver and adjacent items.

Special considerations :

- Prevent contact between the driver and pieces of conductive material such as metal filings or pins.
- Install motors on strong, heat-conducting metal plates such as steel or aluminum.
- If the temperature of the driver heat sink exceeds 85℃, force cool with a fan or attach to a good heat conducting metal plate.
- Do not store or use in direct sunlight.

Electrical Noise

If the driver is located near significant sources of electrical noise such as high voltage lines, high voltage machines or switched power units, insert noise filters in the source power line or connect the driver to a separate circuit.

Mounting the Motor

There are two motor frame sizes as seen in Figure 2 : **CFK54 □ A(B)** and **CFK56 □ A(B)**. Panel cutout requirements are shown in Figure 3 and corresponding dimensions and angles are detailed in Table 2. Motors are supplied with single or double shafts.

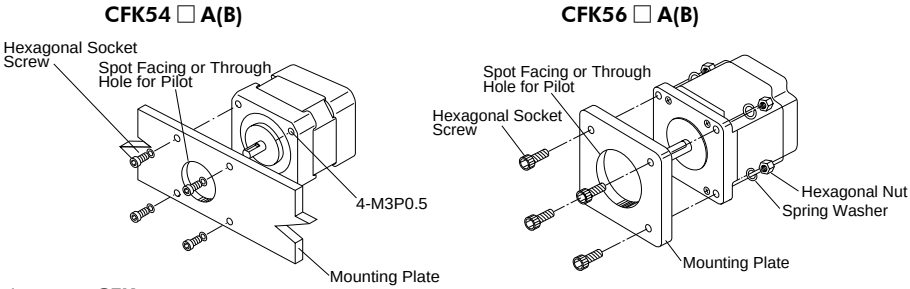


Figure 2 **CFK** Motors

Units=mm (in)

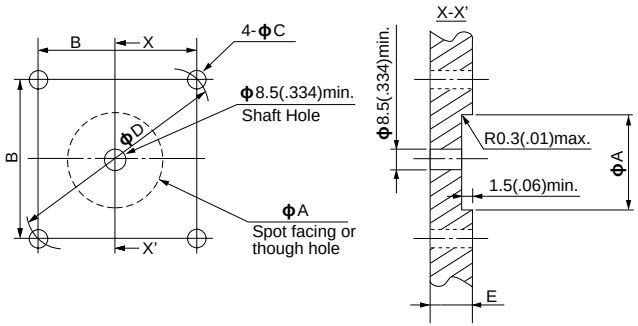


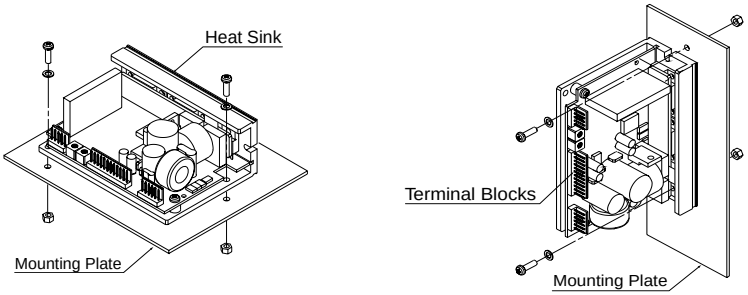
Figure 3 **CFK** Panel Cutout for Motor Mounting

Table 2 **CFK** Motor Mounting Dimensions - mm (in)

	ϕ A	B	ϕ C	ϕ D	E
CFK543A(B) **CFK544A(B)** **CFK545A(B)**	22H8 (ϕ 0.866 $\pm^{0.0015}_{0}$)	31 ± 0.1 (1.22 ± 0.004)	3.5 (ϕ 0.138)	43.8 ± 0.2 (ϕ 1.724 ± 0.079)	4 min. (0.16 min.)
CFK564A(B) **CFK566A(B)** **CFK569A(B)**	36H8 (ϕ 1.417 $\pm^{0.0015}_{0}$)	50 ± 0.35 (1.97 ± 0.014)	4.5 (ϕ 0.177)	70.7 ± 0.3 (ϕ 2.873 ± 0.012)	5 to 10 (0.2 to 0.39)

Mounting the Driver

Figure 4 shows the proper mounting of the driver for horizontal and vertical installation. When mounted horizontally, the heat sink should face upward. A vertical mounting requires that the terminal blocks face upward. For heat sink attachment, use M3-P 0.5 screws. The screw length is 5 mm plus the thickness of the mounting plate.



Horizontal Installation Vertical Installation

Figure 4 Driver Orientations

The driver can be attached to its mounting plate (or chassis) with screws through the driver circuit board (Figure 5), or with screws through the heat sink (Figure 6).

Units= mm (in)

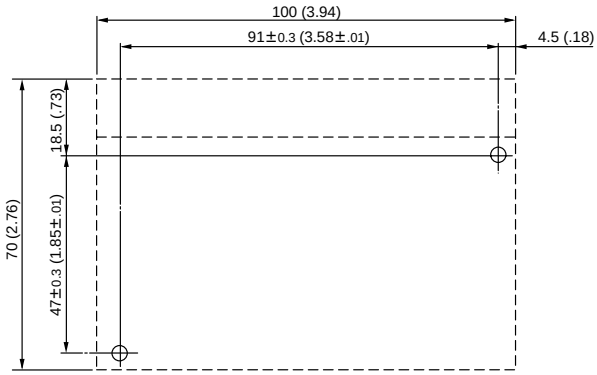


Figure 5 Flat Mounting

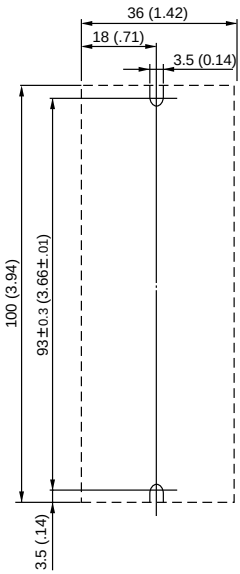


Figure 6 Upright Mounting

4. Wiring

Wiring of the **CFK** motors consists of interconnecting the Driver to the Power Supply via CN1, to the Controller via CN2, and to the Motor via CN3.
The Wiring diagram for all connectors is shown in Figure 7. The power and signal connections are detailed in Table 3 on page 8 and Table 4 on page 9.

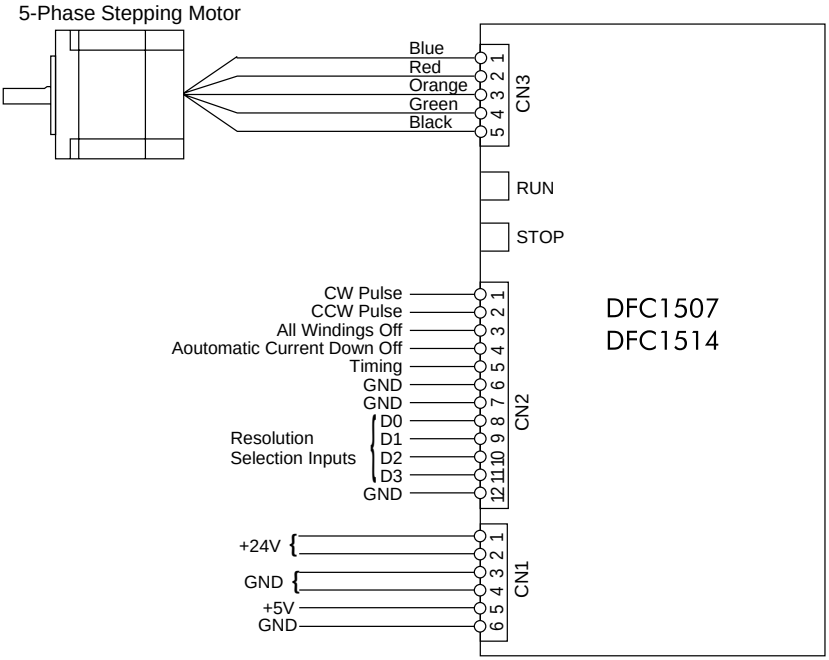


Figure 7 Connections between Terminal Block, Motor, Power Supply, and Controller

Wire Requirements for the CFK

- Use twisted pair hookup wire of minimum diameter 24 AWG for all signal control lines, and 20 AWG for all power lines.
- Strip no more than 5.5 mm of insulation from the end of the lead wires to minimize the possibility of short circuits.

Note

- Keep signal lines as short as possible.
- Keep signal lines as far away as possible from power supply and motor lines.
- If noise generated on the motor lead wires causes interference with signal lines, shield the motor lead wires with conductive tape or wire mesh.
- Before turning on the power, always check the polarity of the power line which is arranged +24V, +24V, GND, GND, +5V, GND from the left facing CN1.
- Make sure the housing and pin do not slip and get stuck when the connector is connected.

Table 3 Terminal CN1 Power Connections and Signal Descriptions

Connector No.	Pin No.	Signal Description	Function	Electrical Characteristics
CN1	1	+24 VDC	Connect + and GND wires of the +24 VDC power supply	24 VDC ± 10% DFC1507, 1.1 A max. DFC1514, 1.5 A max. Ripple Voltage, 5 Vp-p max.
	2			
	3	GND		
	4			
	5	+5V DC	Connect + and GND wires of 5 VDC stabilized power supply	5 VDC ± 5%, 0.1 A min.
	6	GND		

24V type GND, 5V type GND, and GND are used for signal input and are all connected internally.

Table 4 Terminal CN2 Signal Connections and Descriptions

Connector No.	Pin No.	Signal Description		Function	Electrical Characteristics
CN 2	1	CW Pulse		Movement occurs with a rising pulse if pulse is input when either side is at L level, the motor may not run normally.	L: 0 to 0.6 VDC, H: 4 to 5 VDC Pulse width: 1 μsec min., Duty 50% max.
	2	CCW Pulse			
	3	All Windings Off		Turn motor output current off at L level and the motor rotate freely. H level is when nothing is connected, and the motor will run normally.	L: 0 to 0.6 VDC, H: 4 to 5 VDC
	4	Automatic Current Down Off		At L level, the automatic current down function is cancelled. H level results when nothing is connected. There is an approximate 50% automatic current down on output current when the motor is stopped at H level (no connection).	L: 0 to 0.6 VDC, H: 4 to 5 VDC
	5	Timing		A signal is output whenever the motor excitation sequence returns to step 0 in synchronization with the input pulse signal. e.g., ·Every 10 pulses when 0.72 ° STEP ·Every 100 pulses when 0.072 °STEP	30 VDC max. 15 mA max. Open-collector output
	6	GND		GND terminal used for signal input	L: 0 to 0.6 VDC H: 4 to 5 VDC
	7	GND			
	8	D0	Resolution Selection Inputs	A 4-bit signal input allows a 16-step change in motor resolution. Points inputted in bits are active at L level. Please refer to Table 5 on page 12 for the number of divisions arising from each bit combination.	
	9	D1			
	10	D2			
	11	D3			
	12	GND		GND terminal used for signal input	

5. I/O Schematics

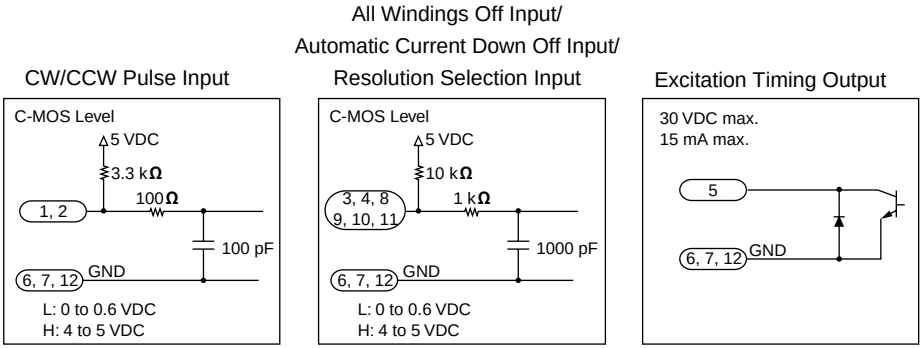
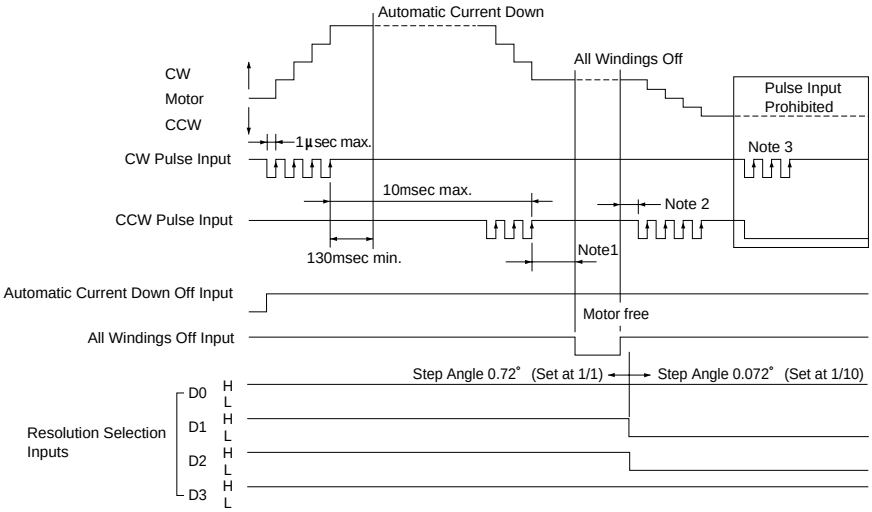


Figure 8 Input/Output Signal Circuits



Note 1 : This will vary according to the inertial load, torque load, self-starting frequency and the like. Please do not input a signal into the all windings off input before the motor is stopped.

Note 2 : Do not input a pulse signal directly after the all windings off input signal has been switched to H level, as this will affect the motor's starting characteristics. Usually a delay of 100msec. is sufficient.

Note 3 : If a pulse is input when either side of the CW pulse input or CCW pulse input is at L level, the motor may not run normally.

Figure 9 Timing Chart

All Windings Off Input

The stepping motor comes to rest after oscillating around its final rest position. Oscillation time varies with the inertial load, friction load, self-starting frequency and motor type. Be sure that the motor has come to a complete stop before inputting the All Windings Off Input signal. Activating the All Windings Off Input prior to the completion of motor oscillation may make the motor lose its resting position.

The All Windings Off Input signal affects the starting characteristics of the motor. After the All Windings Off Input signal has been switched to HIGH, wait 100 msec. before inputting a pulse signal.

Resolution Selection

Motor resolution can be set to 16 values by varying the connections to the Resolution Selection inputs D0 through D3. Therefore, the speed of the motor and the size of a step may be changed by modifying the microstep resolution, without changing the input pulse frequency.
Do not change the resolution unless the pulse signal has stopped and the motor is stationary.

Table 5 Resolution Selection

D3	D2	D1	D0	Step Angle (Divisions/Step)	D3	D2	D1	D0	Step Angle (Divisions/Step)
H	H	H	H	0.72 ° (1)	L	H	H	H	0.0288 ° (25)
H	H	H	L	0.36 ° (2)	L	H	H	L	0.018 ° (40)
H	H	L	H	0.288 ° (2.5)	L	H	L	H	0.0144 ° (50)
H	H	L	L	0.18 ° (4)	L	H	L	L	0.009 ° (80)
H	L	H	H	0.144 ° (5)	L	L	H	H	0.0072 ° (100)
H	L	H	L	0.09 ° (8)	L	L	H	L	0.00576 ° (125)
H	L	L	H	0.072 ° (10)	L	L	L	H	0.0036 ° (200)
H	L	L	L	0.036 ° (20)	L	L	L	L	0.00288 ° (250)

Switching while in pulse input mode may cause the motor to slip position. Figure 10 illustrates switching the step angle from 0.072 ° to 0.72 °

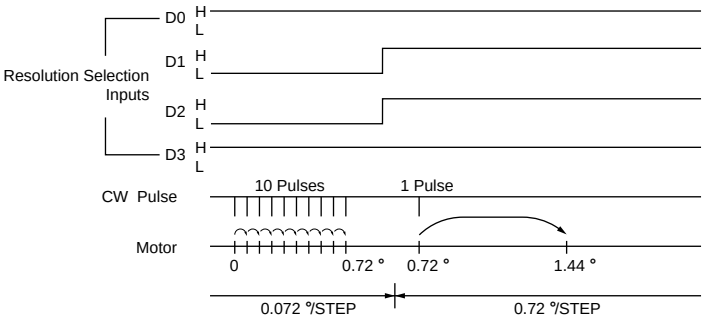


Figure 10 Resolution Selection Inputs of a Step Angle Switched from 0.072 °to 0.72 °

6. Driver Output Current Control

CFK54□□ {Driver : DFC1507} **CFK56**□□ {Driver : DFC1514}

RUN and STOP currents are adjusted before shipment so that matched motor/driver units are ready for immediate use. However, the output current can be lowered to reduce heat generation and vibration. To modify the currents, use the test circuit in Figure 11.

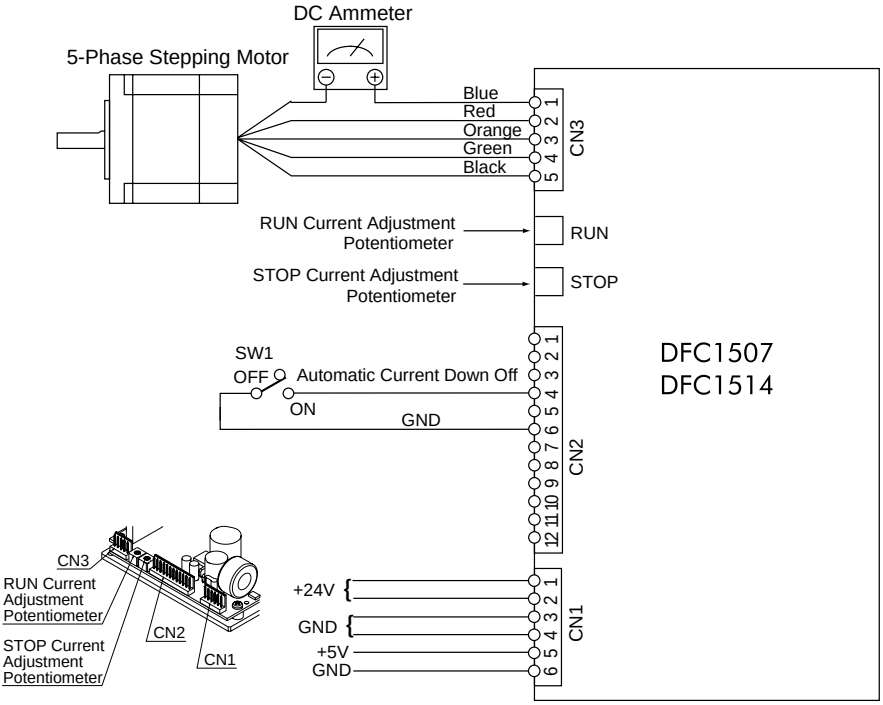


Figure 11 Wiring for Modifying the Driver RUN and STOP Currents

The value measured by the ammeter represents the total current in two phases.

DFC1507 If the ammeter indicates 1.5 A, the motor current has been adjusted to 0.75 A/phase.

DFC1514 If the ammeter indicates 2.8 A, the motor current has been adjusted to 1.4 A/phase.

Adjusting the RUN Current

Your driver is delivered with the RUN current set to the rated operating current. To change this value to reduce heat dissipation at high duty cycles, adjust the RUN potentiometer on the **CFK** driver to the appropriate current value setting shown in Figure 12.

1. Turn on SW1 to disable the Automatic Current Down at standstill function.
2. Do not input any other signal (i.e., All Winding Off, Pulse, etc.).
3. Connect the motor to CN3 and insert an ammeter in the blue wire between terminal 1 and the motor as shown in Figure 11.
4. Connect the power supplies, turn on the 5 VDC and 24 VDC, and adjust the RUN potentiometer to the RUN current value of the appropriate graph in Figure 12.

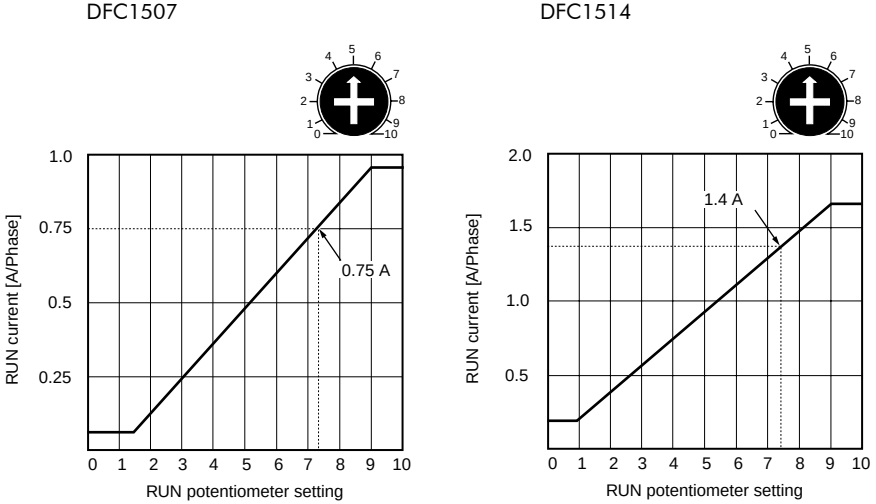


Figure 12 RUN Potentiometer Settings

When the RUN potentiometer is turned clockwise to its internal stop, the output current of the driver will be 0.8 A/phase for the DFC1507 and 1.6 A/phase for the DFC1514.

NOTE

Absolute maximum driver output currents are :
DFC1507 0.75 A/phase
DFC1514 1.4 A/phase

Adjusting the STOP Current

The STOP current has been adjusted at the factory to 50% of the RUN current. To reduce the STOP current to lower the heat dissipation during standstill, use the following procedure.

1. Connect the motor to CN3 and insert an ammeter in the blue wire between terminal 1 and the motor, as shown in Figure 11 on page 13.
2. Turn off SW1 if it is in the circuit to enable the Automatic Current Down at standstill function.
3. Connect the power supplies, turn on the 5 VDC and 24 VDC and adjust the STOP potentiometer to the desired STOP current value of the appropriate graph in Figure 13.

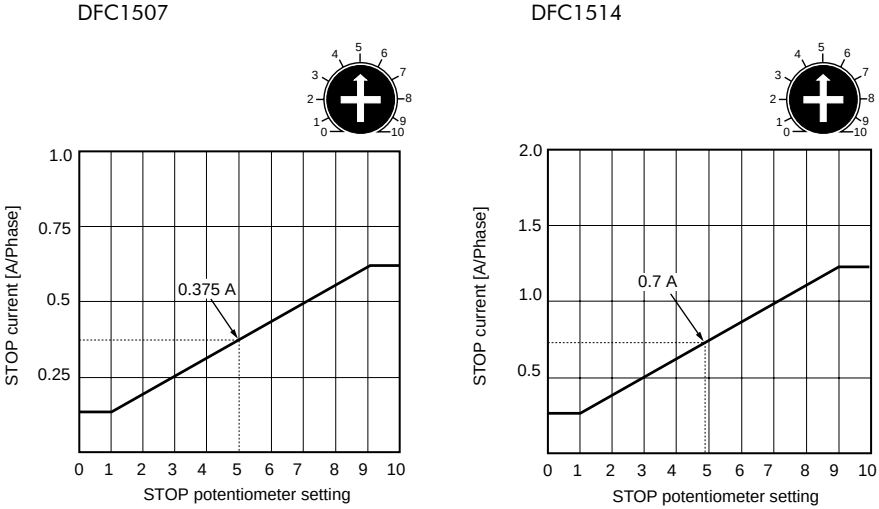


Figure 13 STOP Potentiometer Settings

7. Troubleshooting

If the stepping motor is not functioning properly, perform the following checks and action steps. If the motor continues to malfunction, please contact your local Oriental Motor Sales Office.

Table 6 Troubleshooting Chart

Symptom	Check Points	Action Steps
Motor is not receiving power. The shaft is easily rotated by hand.	Power supply	Check that the power supply is properly wired and connected to a power source.
	No All Windings Off input	When the connector is connected, check that the housing has not slipped and become stuck. The motor will not energize when the All Windings Off input signal is at the L level. When the All Windings Off input signal is at L level the motor ceases to be energized. The motor has holding torque.
	Motor and Driver Motor connection	Check that motor and driver are properly wired.
	RUN and STOP potentiometers	Check if the potentiometers have been turned too far down. Return them to their factory settings and recheck the motor operation.
	Connector connection	Check that the housing have not slipped and become stuck.
Motor rotates in the opposite direction.	CW Pulse input	Check the connection polarity, voltage and waveform of pulse signals. Check if the pulse inputs on other sides is at the H level.
Motor is running, but is not functioning properly.	Load	Retighten the shaft coupling screws or check that the load is disengaged. The load may be too large or the motor and load may not be properly centered.
Motor does not move far enough.	Step angle	Verify that the motor's step angle conforms with the step angle required by the device.
	Pulse generator setting	Check that your pulse generator setting for the input pulse number are appropriate for the designated motor movement.

Table 6 Troubleshooting Chart, continued

Symptom	Check Points	Action Steps
Motor loses synchronization.	No All Windings Off input	Disable the input.
	Starting pulse	The rate may be set too high. Lower the rate and check the results.
	Acceleration/ deceleration time	The time may be set too short. Lengthen the time and check the results.
	External electrical noise	Check the motor movement independently without operating any other apparatus which could be a potential source of noise.
There is excessive vibration.	Excessive motor output torque	Reduce the motor RUN current.
	Pulse rate	If the vibration is reduced after a change in the pulse rate, the problem might be in the resonance of the motor. Change the pulse rate or step angle.
Motor or driver is excessively hot. Motor > 100℃ Driver > 85℃	Motor operating time	Shorten the motor operating time or lengthen its rest time. Reduce the duty cycle.
	STOP potentiometer setting	Lower the current setting at 50% of the RUN Current.
Automatic current down function do not work.	STOP potentiometer setting	Adjust to the optimal value. Current cannot be lowered when this potentiometer is in MAX position. Turn this potentiometer to the left after referring to the appropriate graph in Figure 13 on page 15.
	Conclusion of pulse signal	Be sure to return the pulse signal to the H level. When the pulse signal is maintained at the L level, the current cannot be lowered.

8. Specifications

Table 7 **CFK** Series **CFK54**☐☐ Physical Characteristics/Operational Limits

Unit Model		Single Shaft	**CFK543A**	**CFK544A**	**CFK545A**
		Double Shaft	**CFK543B**	**CFK544B**	**CFK545B**
Motor Unit	Motor Model	Single Shaft	PK543-NA	PK544-NA	PK545-NA
		Double Shaft	PK543-NB	PK544-NB	PK545-NB
	Maximum Holding Torque*	Nm (kgcm)	0.13 (1.3)	0.18 (1.8)	0.24 (2.4)
	Rotor Inertia	kgm^2 (gcm^2)	35×10^{-7} (35)	54×10^{-7} (54)	68×10^{-7} (68)
	Resistance per Phase	Ω /phase	2.2	2.5	2.8
	Step Angle		0.72 °		
	Insulation Resistance		100MΩ or more under normal ambient temperature and humidity when the megger reading between the windings and the frame is 500 VDC.		
	Dielectric Strength		Under normal ambient temperature and humidity, sufficient to withstand 0.5 kV at 50 Hz applied between the windings and the frame for one minute following a period of continuous operation.		
	Insulation Class		Class B 130℃		
	Weight		0.21	0.27	0.35
	Ambient Temperature		-10℃ to +50℃		
Driver Unit	Driver Model		DFC1507		
	Voltage		24VDC ± 10%, 1.1A max. ; 5VDC ± 5%, 0.1A max.		
	Output Current		0.15 to 0.75 A/phase		
	Excitation Mode		Microstep		
	Input/Output Signals: CW Pulse input, CCW Pulse input		C-MOS input Maximum response frequency is 500 kHz L : 0 to 0.6 VDC, H : 4 to 5 VDC		
	Input/Output Signals: Excitation Timing Output		Open collector output, 30 VDC, 15 mA maximum		
	Input/Output Signals: Automatic Current Down Off Input		C-MOS input L : 0 to 0.6 VDC, H : 4 to 5 VDC		
	Input/Output Signals: All Windings Off Input		C-MOS input L : 0 to 0.6 VDC, H : 4 to 5 VDC		
	Input/Output Signals: Resolution Selection Input		C-MOS input L : 0 to 0.6 VDC, H : 4 to 5 VDC		
	Weight	kg	0.25		
	Ambient Temperature		0℃ to +40℃		

* Maximum Holding Torque is for operation at rated current and 5-phase excitation.

Table 8 **CFK** Series **CFK56** □□ Physical Characteristics/Operational Limits

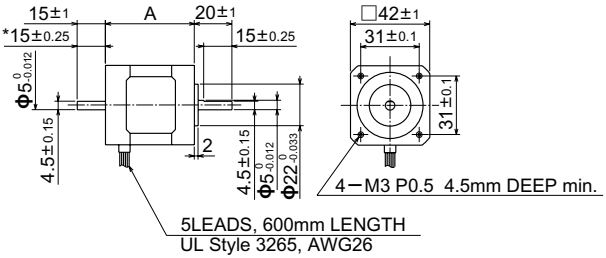
Unit Model		Single Shaft	**CFK564A**	**CFK566A**	**CFK569A**
		Double Shaft	**CFK564B**	**CFK566B**	**CFK569B**
Motor Unit	Motor Model	Single Shaft	PK564-NA	PK566-NA	PK569-NA
		Double Shaft	PK564-NB	PK566-NB	PK569-NB
	Maximum Holding Torque*	Nm	0.42	0.83	1.66
		(kgcm)	(4.2)	(8.3)	(16.6)
	Rotor Inertia	kgm^2	175×10^{-7}	280×10^{-7}	560×10^{-7}
		(gcm^2)	(175)	(280)	(560)
	Resistance per Phase	**Ω** /phase	0.7	1.1	1.7
	Step Angle		0.72 °		
	Insulation Resistance		100M**Ω** or more under normal ambient temperature and humidity when the megger reading between the windings and the frame is 500 VDC.		
	Dielectric Strength		Under normal ambient temperature and humidity, sufficient to withstand 1 kV at 50 Hz applied between the windings and the frame for one minute following a period of continuous operation.		
	Insulation Class		Class B 130℃		
	Weight		0.6	0.8	1.3
	Ambient Temperature		-10℃ to +50℃		
Driver Unit	Driver Model		DFC1514		
	Voltage		24VDC ± 10%, 1.5A max. ; 5VDC ± 5%, 0.1A max.		
	Output Current		0.17 to 1.4 A/phase		
	Excitation Mode		Microstep		
	Input/Output Signals: CW Pulse input CCW Pulse Input		C-MOS input Maximum response frequency is 500 kHz L : 0 to 0.6 VDC, H : 4 to 5 VDC		
	Input/Output Signals: Excitation Timing Output		Open collector output, 30 VDC, 15 mA maximum		
	Input/Output Signals: Automatic Current Down Off Input		C-MOS input L : 0 to 0.6 VDC, H : 4 to 5 VDC		
	Input/Output Signals: All Windings Off Input		C-MOS input L : 0 to 0.6 VDC, H : 4 to 5 VDC		
	Input/Output Signals: Resolution Selection Input		C-MOS input L : 0 to 0.6 VDC, H : 4 to 5 VDC		
	Weight	kg	0.25		
	Ambient Temperature		0℃ to +40℃		

* Maximum Holding Torque is for operation at rated current and 5-phase excitation.

9. Dimensions

Motor

Units = mm

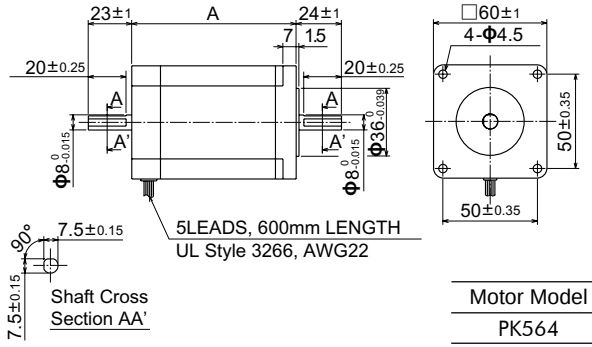


* 15 ± 0.25 indicates the length of milling on motor shaft.

Motor Model	A
PK543	33
PK544	39
PK545	47

Figure 14 Standard Motor Type/PK54 □ -N □ Series

Units = mm



Motor Model	A
PK564	46.5
PK566	57.5
PK569	87

Figure 15 Standard Motor Type/PK56 □ -N □ Series

Driver

Units = mm

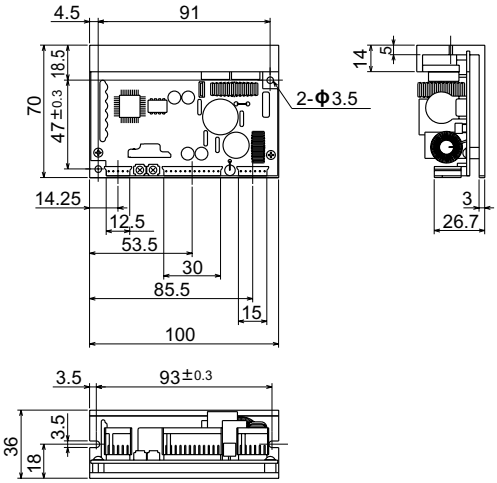


Figure 16 Driver/DFC1507 and DFC1514

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