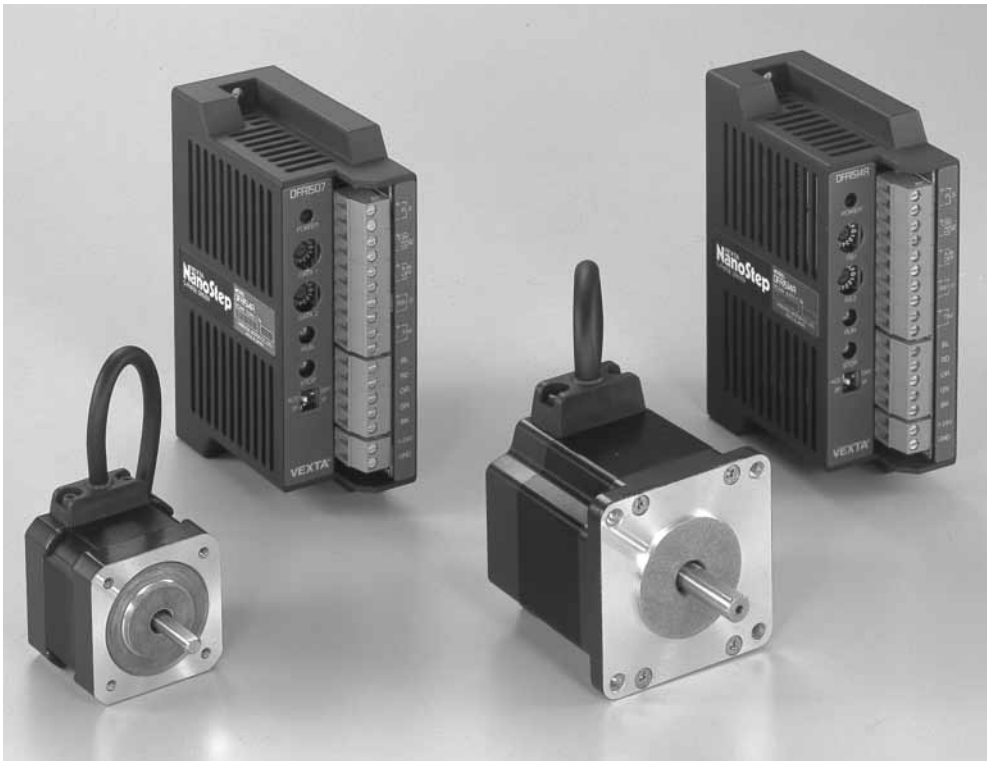


5-Phase Stepping Motor and Microstep Driver Package

NanoStep™ RFK

5-Phase Stepping Motor and Microstep Driver Package

NanoStep™ RFK

The NanoStep™ RFK uses 5-phase microstepping, the most advanced stepping motor drive technology available. It takes the basic 5-phase stepping motor angle of 0.72˚ and divides it electrically into smaller step angles, providing up to 125,000 steps per revolution.

What is NanoStep™?

NanoStep™ is a series of stepping motor and driver package that combines high-performance 5-phase microstep drivers with high-torque/low-vibration 5-phase stepping motors. They provide smoother and more precise operation than any stepping motor previously available.

5-phase Microstep Drive Technology

The primary features of stepping motors are the ability to obtain precise positioning and the simplicity of design. They achieve this by rotating and stopping at step angle increments that are determined by the pole structure of the rotor and stator. Rotating in step angle increments, however, also produces changes in rotor speed and resonance at certain speeds that can cause vibration.
Microstep driving provides a finer degree of control of the basic motor step angle by regulating the current sent to the motor coils, resulting in slow speeds, low-vibration and low-noise operation.

- Since the basic motor step angle (0.72˚/full step) can be divided into proportions ranging from 1/1 to 1/250, smooth operation in fine increments is possible.
- Technology that changes the motor drive current smoothly suppresses motor vibration and makes operation quieter.

Microstepping Divides Steps Into as many as 250 Units

NanoStep™ RFK enables step angles to be set independently on two resolution selection switches (16 resolutions, dividing into as many as 250 parts), it allows switching of the step angles by manipulating the external input step angle. Changing resolution can occur without any error when the motor is at rest .

Compact Driver

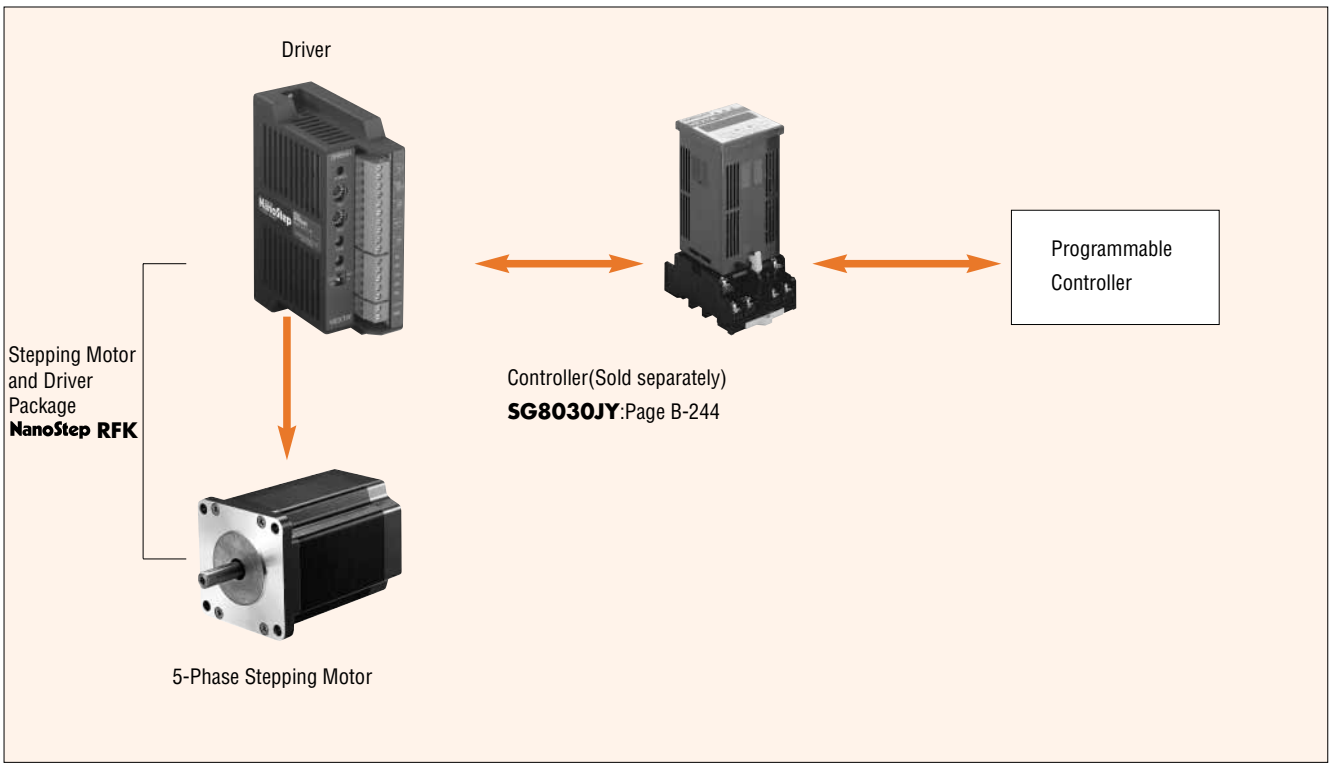
The gate array and dual surface mount technologies utilized in this New Pentagon microstep driver have resulted in a driver that is only 40mm (W) × 120mm (H) × 85mm (D).

Phoenix Connectors

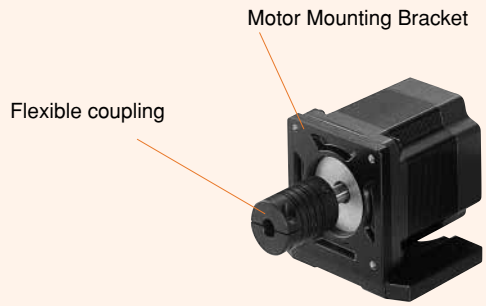
Phoenix connectors are used for easy and secure attachment of the driver's input/output signal lines, motor lead wires and input power line.

NanoStep RFK System Configuration

A high-torque 5-phase stepping motor and NanoStep driver are combined to make high-precision positioning with open loop control possible.



Accessories(Sold separately)

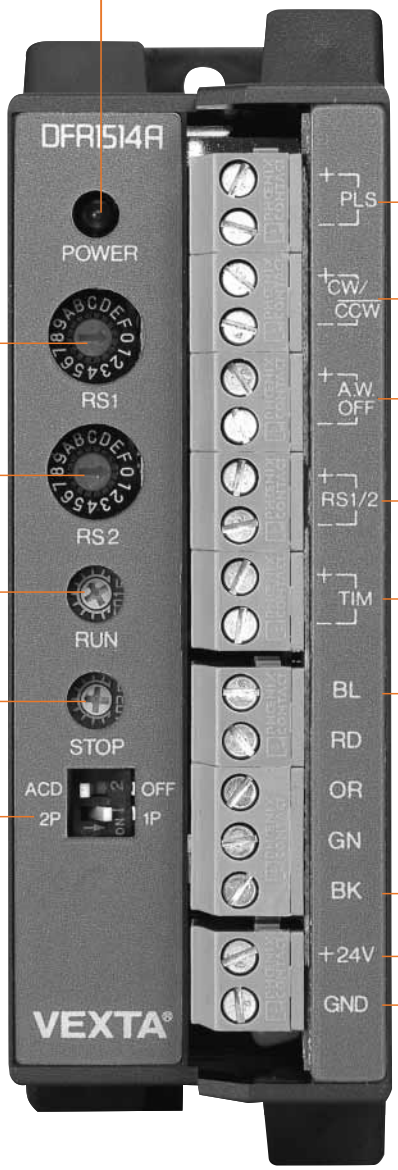


- Motor Mounting Brackets:Page B-248

- Flexible Couplings:Page B-252
  Clamping Type

NanoStep™ RFK dedicated drivers include many functions for easy-of-use.

A full range of driver functions are on the front panel.



Signal monitor indicator

POWER: Power input display

Resolution Select Switch

Use these rotary switches to set the desired resolution from the 16 resolution levels available.

Step Angle	Resolution	Resolution Select Switch	
		RS1	RS2
0.72°	1	0	
0.36°	2	1	
0.288°	2.5	2	
0.18°	4	3	
0.144°	5	4	
0.09°	8	5	
0.072°	10	6	
0.036°	20	7	
0.0288°	25	8	
0.018°	40	9	
0.0144°	50	A	
0.009°	80	B	
0.0072°	100	C	
0.00576°	125	D	
0.0036°	200	E	
0.00288°	250	F	

Pulse Signal input terminals

Rotation Direction Signal input terminals

All Windings Off Signal input terminals

Resolution Select Switching Input Terminal

After setting the two individual step resolutions using the RS1 and RS2 rotary switches, use the RS1/2 terminals to select between the two resolutions.

Excitation Timing Signal output terminals

Motor terminals

Power Supply terminals

Motor operating current potentiometer
Motor resting current potentiometer

The motor current is easy to adjust with the potentiometer. No ammeter is necessary.

Pulse input method switch

Switches between 1-pulse input and 2-pulse input.

Product Number Code

RFK 5 6 9 A E

- RFK: NanoStep RFK
- 5: 5-phase
- 6 9: Motor Frame Size **4**: 42mm sq. **6**: 60mm sq.
- A: Motor Case Length
- A E: Shaft Type **A**: Single Shaft **B**: Double Shaft
- E: Reference Code

Specifications

Package Model		Single Shaft	RFK543AE	RFK544AE	RFK545AE	RFK564AE	RFK566AE	RFK569AE
		Double Shaft	RFK543BE	RFK544BE	RFK545BE	RFK564BE	RFK566BE	RFK569BE
Maximum Holding Torque		N·m	0.13	0.18	0.24	0.42	0.83	1.66
Rotor Inertia		kg·m²	35×10^{-7}	54×10^{-7}	68×10^{-7}	175×10^{-7}	280×10^{-7}	560×10^{-7}
Rated Current		A/phase	0.75			1.4		
Basic Step Angle			0.72°					
Insulation Class			Class B (130°C)					
Power Source			24V DC ±10% 1.1A maximum			24V DC ±10% 1.7A maximum		
Output Current		A/phase	0.75			1.4		
Excitation Mode			Microstep					
Input Signals	Input Signal Circuit		Photocoupler input, input resistance: 220 Ω, input current 20mA maximum. Signal voltage Photocoupler ON H: +4~+5V, Photocoupler OFF: 0~+0.5V					
	● Pulse Signal (CW Pulse Signal)		Step Command Pulse Signal (CW Direction Command Pulse Signal at 2-pulse input mode) Pulse width: 1 μs minimum, Pulse rise/pulse fall time 2 μs maximum Motor moves when the photocoupler state changes from ON to OFF.					
	● Rotation Direction Signal (CCW Pulse Signal)		Rotation Direction Command Pulse Signal Photocoupler ON: CW, Photocoupler OFF: CCW (CCW Direction Command Pulse Signal at 2-pulse input mode) Pulse width: 1 μs minimum, Pulse rise/pulse fall time 2 μs maximum Motor moves when the photocoupler state changes from ON to OFF.					
	● Resolution Select Signal		When in the "Photocoupler ON" state, the step angle will be selected by between 0.72° and 0.00288° as preset by Step Angle Setting Switch RS2. When in the "Photocoupler OFF" state, the step angle will be selected between 0.72° and 0.00288° as preset by Step Angle Setting Switch RS1.					
	● All Windings Off Signal		When in the "Photocoupler ON" state, the current to the motor is cut off and the motor shaft can be rotated manually. When in the "Photocoupler OFF" state, the current level set by the RUN switch is supplied to the motor.					
Output signals	Output Signal Circuit		Photocoupler, Open-Collector Output External use condition: 24 V DC maximum, 10mA maximum					
	● Excitation Timing Signal		The signal is output every time the excitation sequence returns to the initial stage "0". (photocoupler : ON) 0.72°/Step (Resolution 1): signal output every 10 pulses. 0.072°/Step (Resolution 10): signal output every 100 pulses.					
Functions			Automatic current cutback, Pulse input mode switch, Resolution select switch.					
Cooling method (Driver)			Natural Ventilation					
Mass		Motor kg	0.25	0.3	0.4	0.6	0.8	1.3
		Driver kg	0.36					
Insulation resistance		Motor	100M Ω or more under normal ambient temperature and humidity when the megger reading between the windings and frame is DC 500V.					
Dielectric Strength		Motor, Driver	Under normal ambient temperature and humidity, sufficient to withstand 1.0kV (0.5kV for driver) at 50Hz applied between the windings and the case for one minute following a period of continuous operation.					
Ambient temperature		Motor	−10°C ~ +50°C					
		Driver	0°C ~ +40°C					

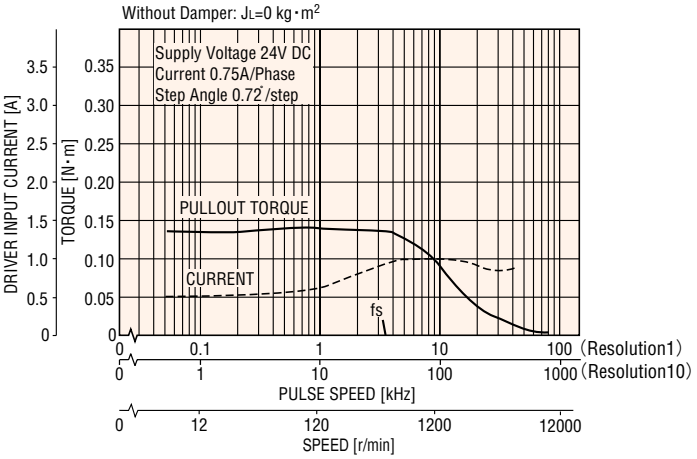
- Maximum holding torque refers to the holding torque at motor standstill when the rated current is supplied to the motor (5 phase excitation). Use this value to compare motor torque performance. When using the motor with the included driver, the driver's "Automatic Current Cutback" function at motor standstill reduces maximum holding torque by approximately 50%.
- The power source input current value represents the maximum current. (The input current varies according to the pulse frequency.)

Note: Do not measure insulation resistance or perform the dielectric strength test while the motor and driver are connected for **RFK54**□ type.

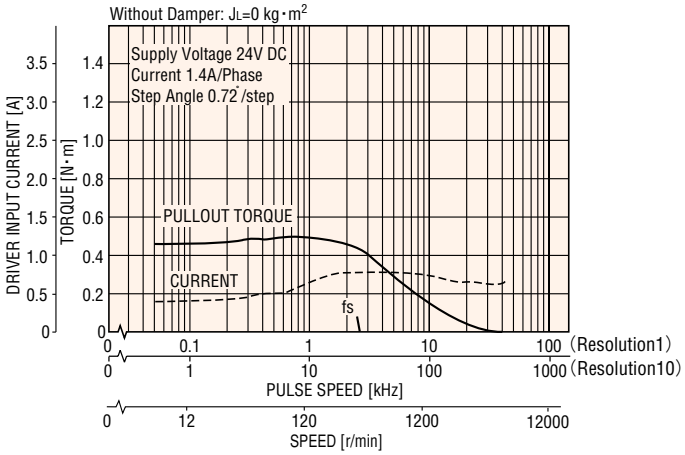
Speed -Torque Characteristics

fs: Maximum Starting Pulse Rate

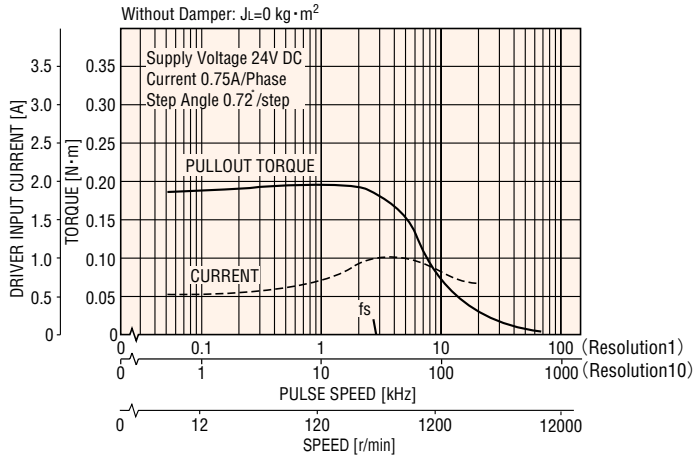
RFK543AE
RFK543BE



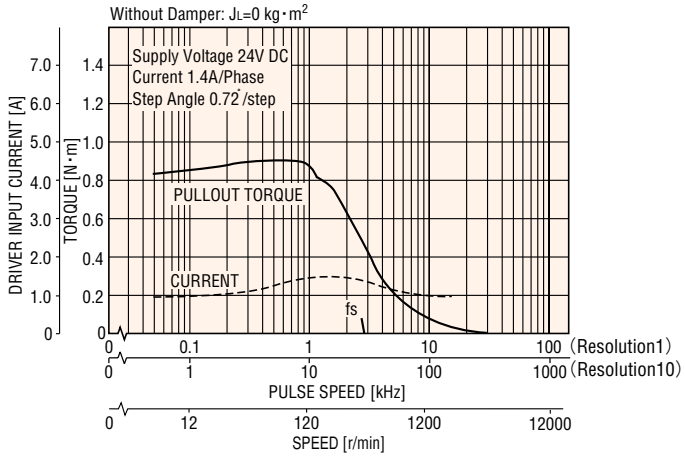
RFK564AE
RFK564BE



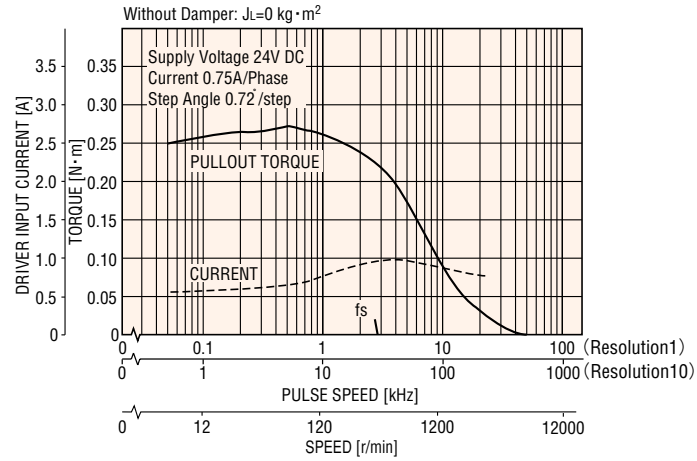
RFK544AE
RFK544BE



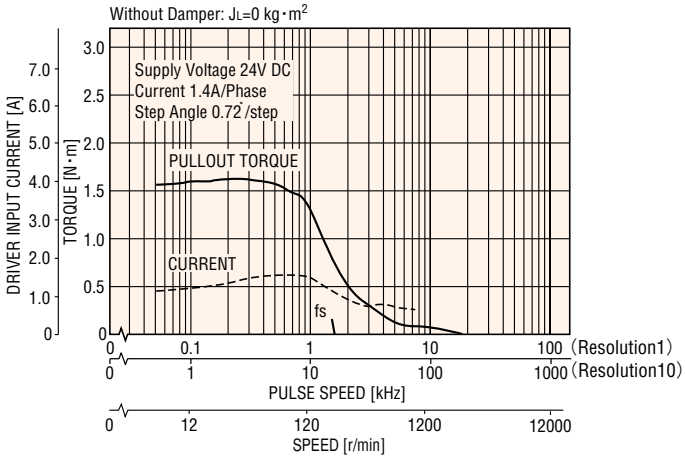
RFK566AE
RFK566BE



RFK545AE
RFK545BE



RFK569AE
RFK569BE



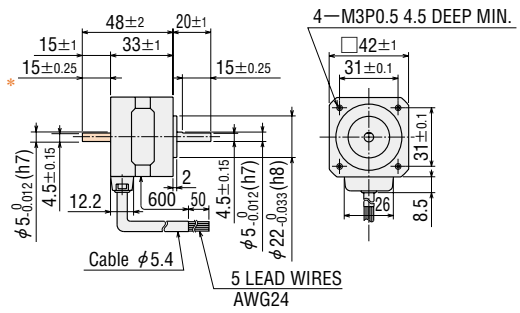
Notes:

1. Pay attention to heat dissipation from the motor and driver. The motor will produce a considerable amount of heat under certain conditions. Be sure to keep the temperature of the motor case under 100°C.
2. When using the motor with the dedicated driver, the driver's "Automatic Current Cutback" function at motor standstill reduces maximum holding torque by approximately 50%.
3. Step resolution does not affect torque based on the speed (r/min) of the motor.

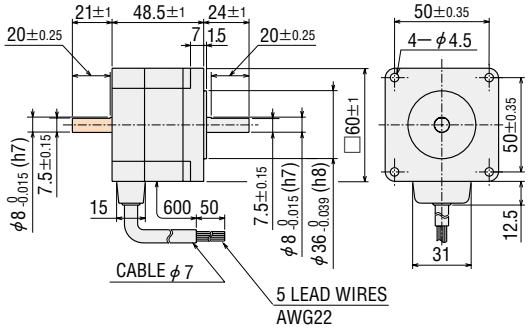
Dimensions

●Motor scale 1/4, unit＝mm

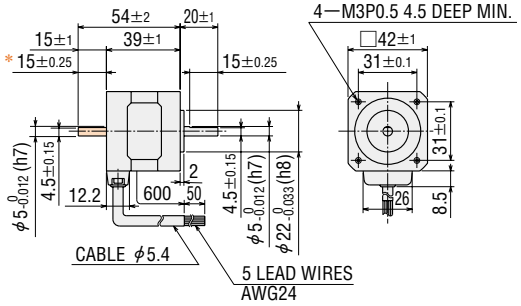
RFK543AE (Single shaft)
Motor Model : PK543-NAC Mass 0.25kg/Driver Model ：DFR1507A
RFK543BE (Double shaft)
Motor Model : PK543-NBC Mass 0.25kg/Driver Model ：DFR1507A



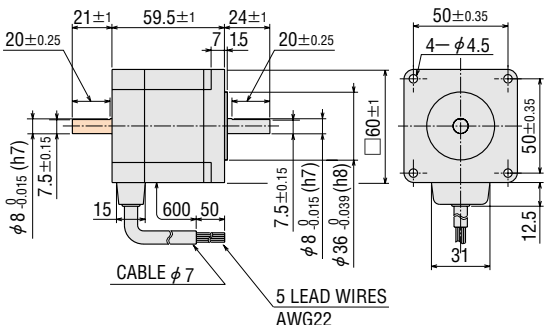
RFK564AE (Single shaft)
Motor Model : PK564AUE Mass 0.6kg/Driver Model ：DFR1514A
RFK564BE (Double shaft)
Motor Model : PK564BUE Mass 0.6kg/Driver Model ：DFR1514A



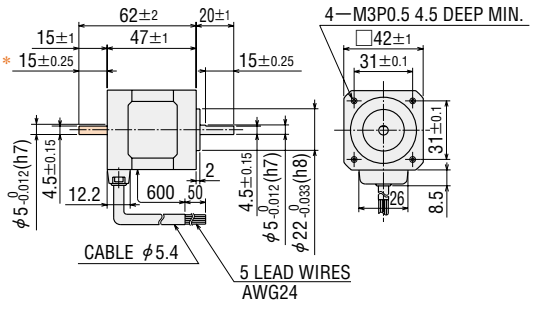
RFK544AE (Single shaft)
Motor Model : PK544-NAC Mass 0.3kg/Driver Model ：DFR1507A
RFK544BE (Double shaft)
Motor Model : PK544-NBC Mass 0.3kg/Driver Model ：DFR1507A



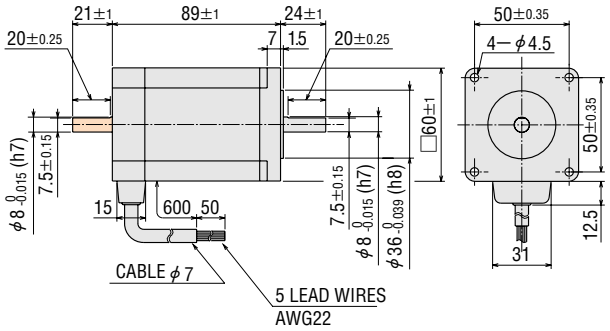
RFK566AE (Single shaft)
Motor Model : PK566AUE Mass 0.8kg/Driver Model ：DFR1514A
RFK566BE (Double shaft)
Motor Model : PK566BUE Mass 0.8kg/Driver Model ：DFR1514A



RFK545AE (Single shaft)
Motor Model : PK545-NAC Mass 0.4kg/Driver Model ：DFR1507A
RFK545BE (Double shaft)
Motor Model : PK545-NBC Mass 0.4kg/Driver Model ：DFR1507A



RFK569AE (Single shaft)
Motor Model : PK569AUE Mass 1.3kg/Driver Model ：DFR1514A
RFK569BE (Double shaft)
Motor Model : PK569BUE Mass 1.3kg/Driver Model ：DFR1514A

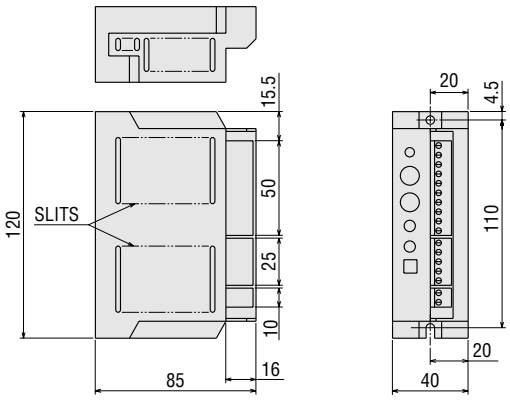


＊ 15±0.25 indicates the length of milling on motor shaft.

●These dimensions are for double shaft models. For single shaft, ignore the colored areas.
●See page B-42 for information on motor installation.

●Driver scale 1/4, unit = mm

Driver Model : DFR1507A Mass: 0.36kg
DFR1514A



●See page B-45 for information on driver installation.

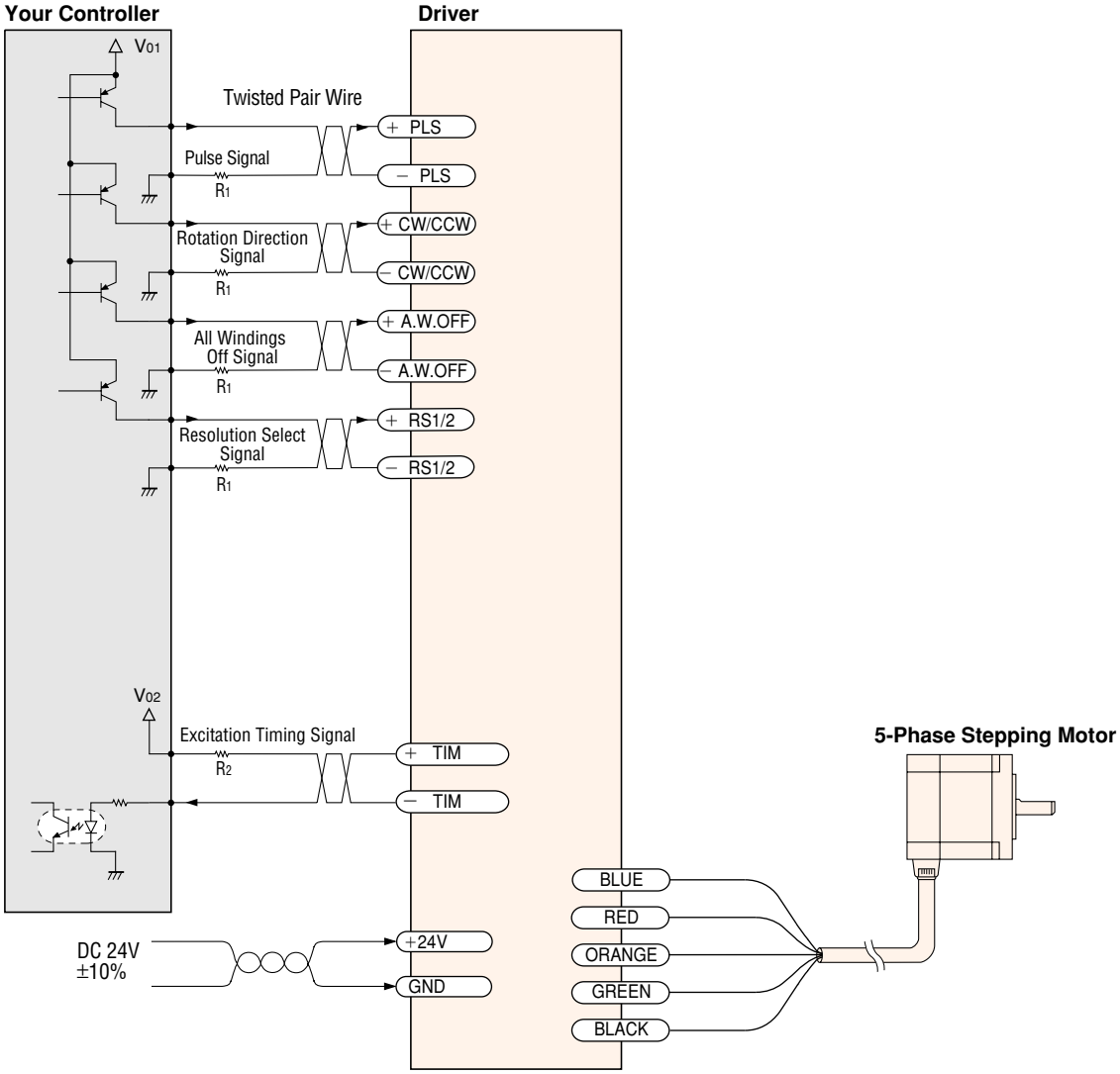
■List of Motor and Driver Combinations

Model numbers for motor and driver combinations are shown below.

Package Model	Stepping Motor		Driver
	Model	Current A/phase	Model
RFK543□E	PK543-N□C	0.75	DFR1507A
RFK544□E	PK544-N□C		
RFK545□E	PK545-N□C		
RFK564□E	PK564□UE	1.4	DFR1514A
RFK566□E	PK566□UE		
RFK569□E	PK569□UE		

＊Enter **A**(single shaft)or **B**(double shaft) in the □ within the model numbers.

Wiring Diagram



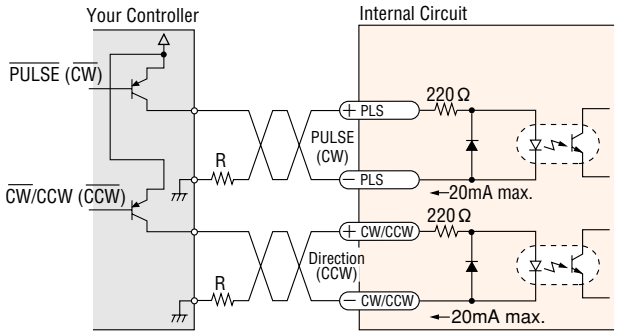
Notes regarding wiring

1. Keep the voltage V_{01} and V_{02} between DC5V and DC24V. When V_{01} is equal to DC5V, the external resistances R_1 is not necessary. When V_{01} is above DC5V, connect R_1 to keep the current below 20mA. When the output current exceeds 10mA, connect the external resistances R_2 to keep the current below 10mA.
2. Use twisted-pair wire for the signal lines and keep them as short as possible.
3. Use AWG14 to 22 wire for the terminals and AWG22 or thicker for the power source line.
4. Signal lines should be kept at least 10cm away from power lines (power supply lines and motor lines). Do not bind the signal line and power line together.
5. If noise generated by the motor lead wire causes problem, try shielding of the motor lead wires with conductive tape or wire mesh.

Description of Input/Output Signals

1. Pulse (Pulse and Direction) signal

Input Circuit and Sample Connection



The characters indicate signals under the 1-pulse input mode, while the characters in parenthesis indicate signals under the 2-pulse input mode. The external resistance R is not needed when V_0 is 5V. When the voltage exceeds 5V, connect the external resistance R to keep input current at 20mA or less.

1-pulse Input Mode

●Pulse Signal

When the photocoupler state changes from "ON" to "OFF", the motor rotates one step.
The direction of the motor's rotation is determined by the following "Rotation Direction" signal.

●Rotation Direction Signal

The "Rotation Direction" signal is input.
A "photocoupler ON" signal input commands a clockwise direction rotation.
A "photocoupler OFF" signal input commands a counterclockwise direction rotation.

2-pulse Input Mode

●CW Pulse Signal

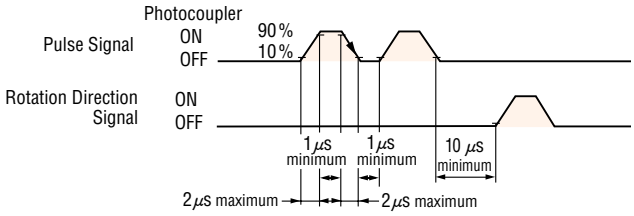
When the photocoupler state changes from "ON" to "OFF" the motor rotates one step in the clockwise direction.

●CCW Pulse Input

When the photocoupler state changes from "ON" to "OFF" the motor rotates one step in the counterclockwise direction.

Pulse Signal Characteristics

Input Pulse characteristics



Shaded area ▭ indicates the radiation of the photocoupler diode. The motor starts at the trailing edge, shown by the arrow.

Pulse Signal Characteristics

- The pulse voltage is 4 ~ 5V in the "photocoupler ON" state, and 0 ~ 0.5V in the "photocoupler OFF" state.
- Input pulses for a pulse width is 1μs or more, the rise/ fall time is 2μs or less and pulse duty is 50% or less.
- 10μs or more is the standard interval time for switching from CW to CCW. Note that the interval time greatly varies according to the motor and load inertia.

Pulse Signal Input Precautions

Be sure to set the signal in the "photocoupler OFF" state when the pulse signal is at rest.
Setting to the signal in the "photocoupler ON" state will not activate the automatic current cutback function.

1-pulse Input Mode

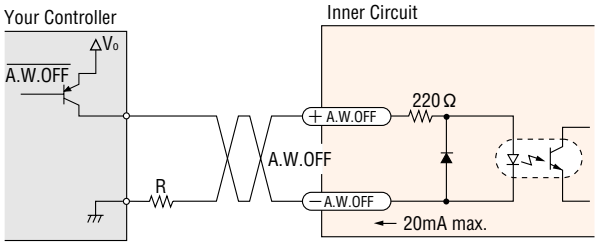
- Be sure to switch the direction of rotation with the pulse signal in the "photocoupler OFF" state.

2-pulse Input Mode

- Do not input CW pulses and CCW pulses at the same time.
- When the CW pulse signal or CCW pulse signal is in the "photocoupler ON" state the input of pulses to the other will not rotate the motor normally.

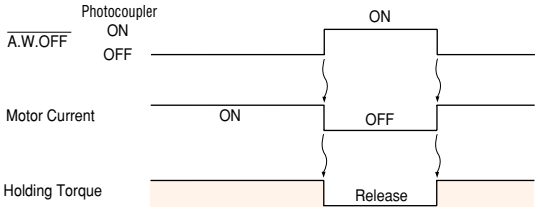
2. A.W.OFF (All Windings Off) Signal

Input Circuit and Sample Connection



The external resistance R is not needed when V_{01} is 5V. When the voltage exceeds 5V, connect the external resistance R to keep input current at 20mA or less.

1. If the "A.W.OFF" signal is in the "photocoupler ON" state the current does not flow through the motor and the motor shaft can be turned manually. This function can be used when the motor shaft needs external rotation or manual positioning. Be sure to set to the signal in the "photocoupler OFF" state when operating the motor. For regular use, no connections are necessary. The holding torque can be set in proportion to the motor stop current set by the STOP potentiometer.

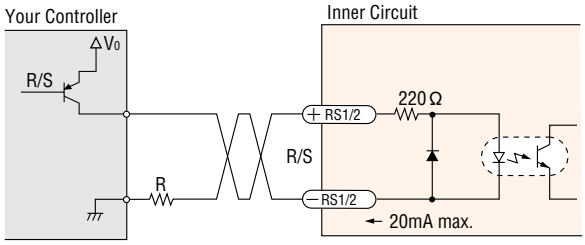


Shaded area indicates that the motor provides holding brake force in proportion to standstill current set by STOP potentiometer.

2. Turning the "A.W.OFF" signal OFF does not change the excitation sequence (phase) of the motor. When the motor shaft is turned manually with "A.W.OFF" input, the shaft may turn ±3.6° from the shaft position when "A.W.OFF" is released.

3. R/S (Resolution Select Switching) Signal

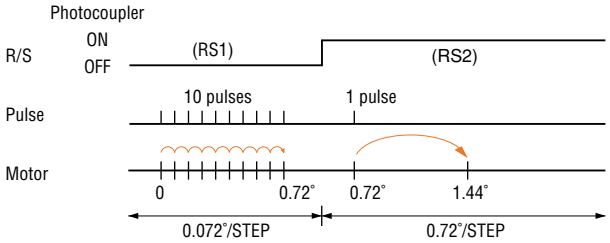
Input Circuit and Sample Connection



The external resistance R is not needed when V_0 is 5V. When the voltage exceeds 5V, connect the external resistance R to keep input current at 20mA or less.

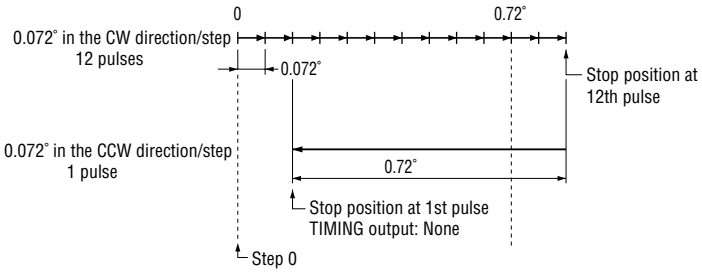
You may preselect two resolutions from 16 available resolutions with the Step Angle Setting Switches RS1 and RS2. When the signal is in the "photocoupler OFF" state a step angle set by RS1 is selected; in the "photocoupler ON" state RS2 is selected.

Example: Changing the step angle from 0.072˚ to 0.72˚.



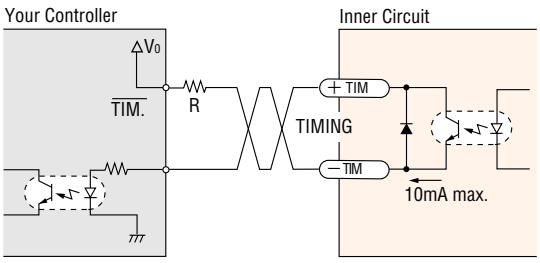
Notes:

(1) Be sure to change step angle setting inputs only when the pulse signals are at rest. Switching while moving may cause a positional error of the motor.
(2) There is no positional error if the step angle setting is changed with the motor at rest.
(3) When the step angle is changed by the "R/S" signal, the "TIMING" signal output shown below may become impossible for some combinations of step angles.
When the "TIMING" signal is used, adjust the number of pulses so that the motor can operate with angles that are multiples of 7.2。



4. TIMING (Excitation Timing) Signal

Input Circuit and Sample Connection

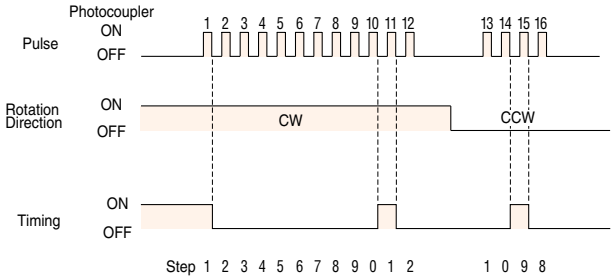


Keep the voltage between 5V and 24V and current at 10mA or less.

1) The "TIMING" signal indicates that the excitation of the motor is in the initial state (STEP 0). Use this signal to detect the home position accurately by matching the mechanical home position of the device and the excitation home position (STEP 0) of the motor.
2) The signal is output once each time the excitation sequence returns to (STEP 0) in synchronization with input pulses. The excitation sequence is designed to complete one cycle as the motor shaft rotates 7.2˚. Output is as follows:
0.72˚/step: 1 output per 10 pulses
0.072˚/step: 1 output per 100 pulses

The timing lamp on the front panel lights up during output.

Timing Chart at Full Step



Notes:

1. When the power is turned ON, the excitation sequence is reset to STEP 0 and the timing lamp light up.
2. The timing lamp flashes quickly while the motor runs appearing continuously lit.