5-PHASE STEPPING MOTOR AND MICROSTEP DRIVER PACKAGE

NanoStep™ RFK

NanoStep™ RFK

EASY WIRING | PLC DIRECT | RE-GENER-ATION | PACK-AGE | DC INPUT

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

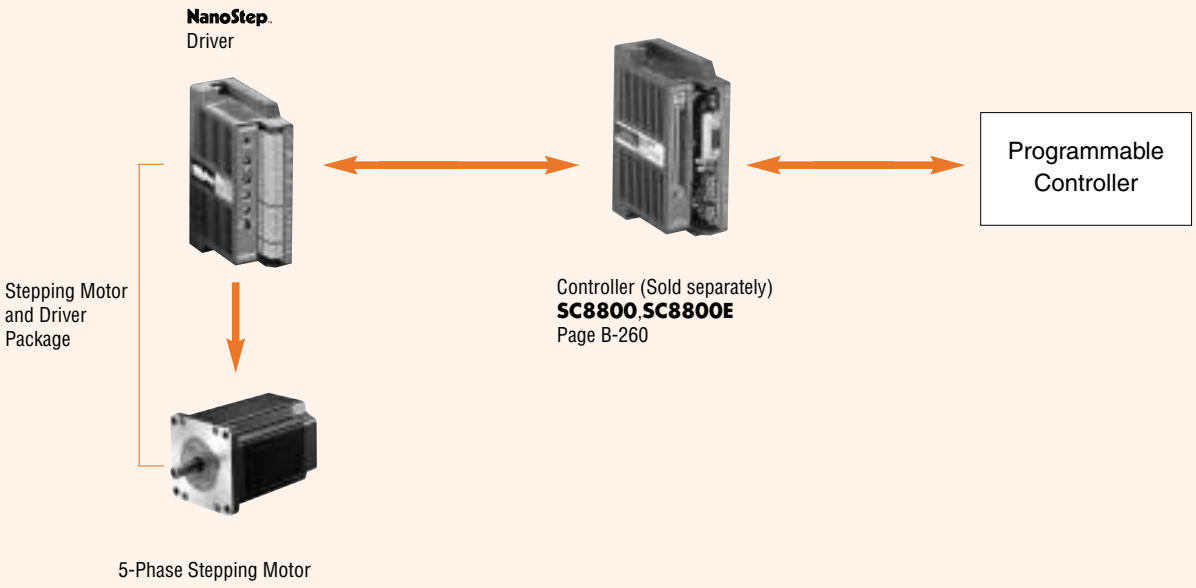
The gate array and dual surface mount technologies utilized in this New Pentagon microstep driver have resulted in a driver that is only W 1.57in. (40mm) × H 4.72in. (120mm) × D 3.35in. (85mm).

Phoenix Connectors

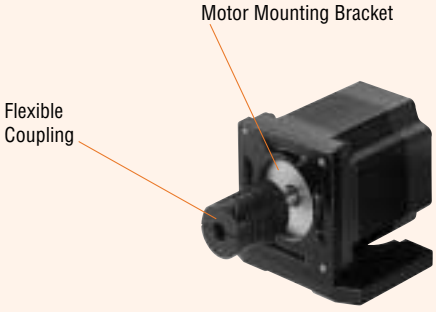
Phoenix connectors are used for easy and secure attachment of the driver's input/output signal lines, motor lead wires and input power line.

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-298

- Flexible Couplings
  Page B-301

MC Motor Couplings

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

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

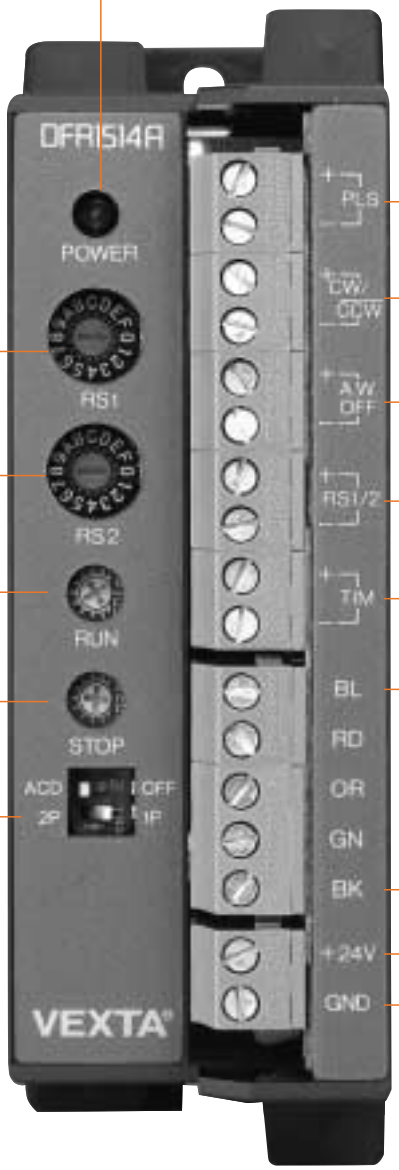
Signal Monitor Indicator

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 A

- USA Version
- Shaft Type **A**: Single Shaft, **B**: Double Shaft
- Motor Case Length
- Motor Frame Size **4**: 1.65in. (42mm) sq., **6**: 2.36in. (60mm) sq.
- NanoStep **RFK** 5-phase

■ SPECIFICATIONS

Package Model		Single Shaft	RFK543AA	RFK544AA	RFK545AA	RFK564AA	RFK566AA	RFK569AA
		Double Shaft	RFK543BA	RFK544BA	RFK545BA	RFK564BA	RFK566BA	RFK569BA
Maximum Holding Torque		oz-in	18	24.9	33.3	58.3	115	230
		N · m	0.13	0.18	0.24	0.42	0.83	1.66
Rotor Inertia		oz-in^2	0.192	0.296	0.372	0.96	1.53	3.06
		kg· m^2	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 [266°F (130°C)]					
Power Source			DC 24V±10% 1.1A maximum			DC 24V±10% 1.7A maximum		
Output Current		A/phase	0.75			1.4		
Excitation Mode			Microstep					
Input Signals	Input Signal Circuit		Photocoupler input, Input resistance 220Ω, Input current 20mA maximum Signal voltage Photocoupler ON: +4~+5V, Photocoupler OFF: 0~+0.5V					
	● Pulse Signal (CW Pulse Signal)		Step command pulse signal (CW step command signal at 2-pulse input mode) Pulse width: 1μs minimum, Pulse rise/fall: 2μs maximum Motor moves when the photocoupler state changes from ON to OFF.					
	● Rotation Direction Signal (CCW Pluse Signal)		Rotation direction signal, Photocoupler ON: CW, Photocoupler OFF: CCW (CCW step command signal at 2-pulse input mode, Pulse width: 1μs minimum, Pulse rise/fall: 2μs maximum Motor moves when the photocoupler state changes from ON to OFF.)					
	● 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.					
	● Resolution Select Signal (RS1/2)		When in the "photocoupler ON" state, a step angle is selected between 0.72° and 0.00288° as preset by step angle setting switch RS1. When in the "photocoupler OFF" state, a step angle is selected between 0.72° and 0.00288° as preset by step angle setting switch RS2.					
Output Signals	Output Signal Circuit		Photocoupler· open collector output (emitter common) External use condition DC24V maximum, 10mA minimum					
	● 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, All windings off					
Driver Cooling Method			Natural Ventilation					
Weight (Mass)		Motor lb. (kg)	0.56 (0.25)	0.67 (0.3)	0.89 (0.4)	1.33 (0.6)	1.77 (0.8)	2.87 (1.3)
		Driver lb. (kg)	0.8 (0.36)					
Insulation Resistance		Motor	100MΩ minimum under normal temperature and humidity, when measured by a DC500V megger between the motor coils and the motor casing.					
Dielectric Strength		Motor	Sufficient to withstand 1.0kV (0.5kV for **RFK54**□ type), 60Hz applied between the motor coils and casing for one minute, under normal temperature and humidity.					
Ambient Temperature Range		Motor	+14°F~+122°F (−10°C~+50°C)					
		Driver	+32°F~+104°F (0°C~+40°C)					

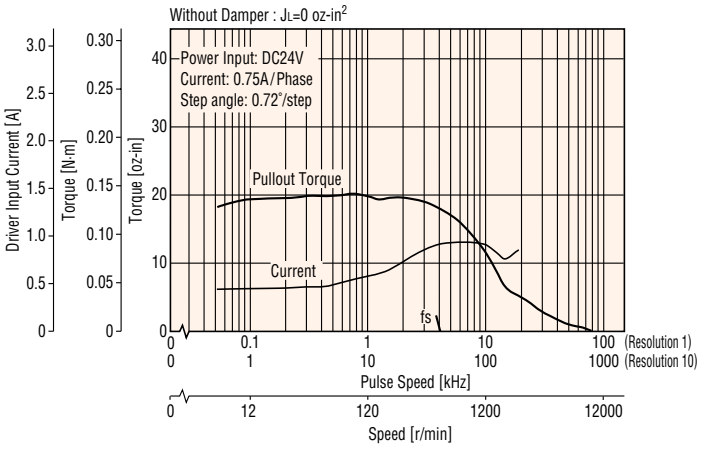
- Maximum holding torque refers to the holding torque at motor standstill when the rated current is supplied to the motor (5 phase excitation). Use this value to compare motor torque performance. When using the motor with the included driver, the driver's "Automatic Current Cutback" function at motor 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.

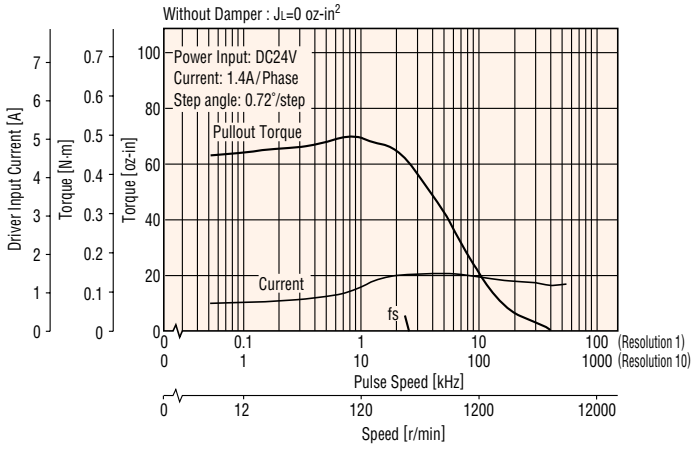
■ SPEED vs. TORQUE CHARACTERISTICS

fs: Maximum Starting Pulse Rate

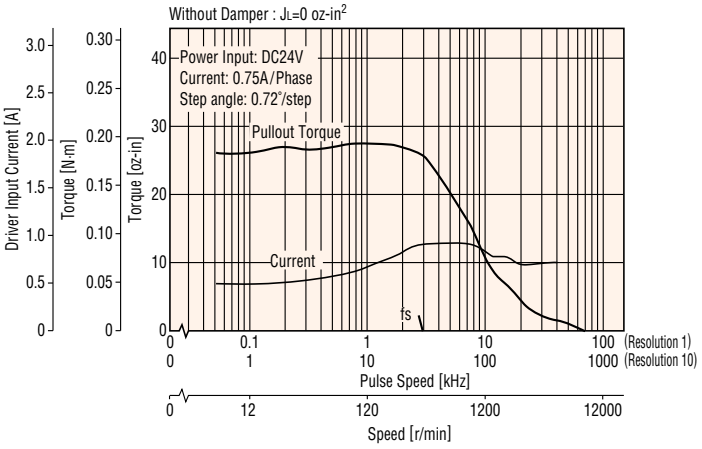
RFK543AA
RFK543BA



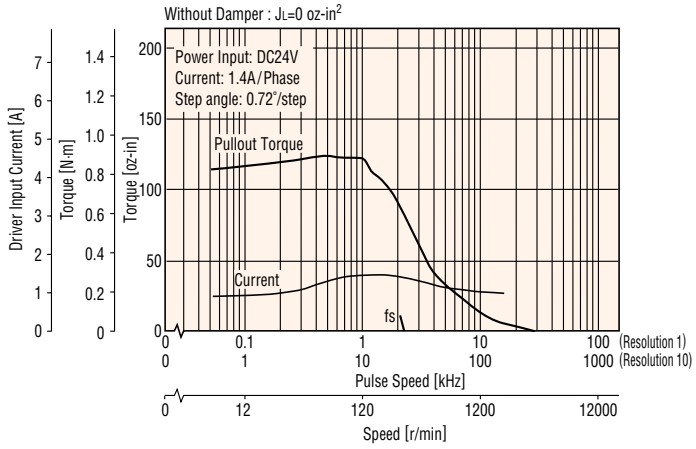
RFK564AA
RFK564BA



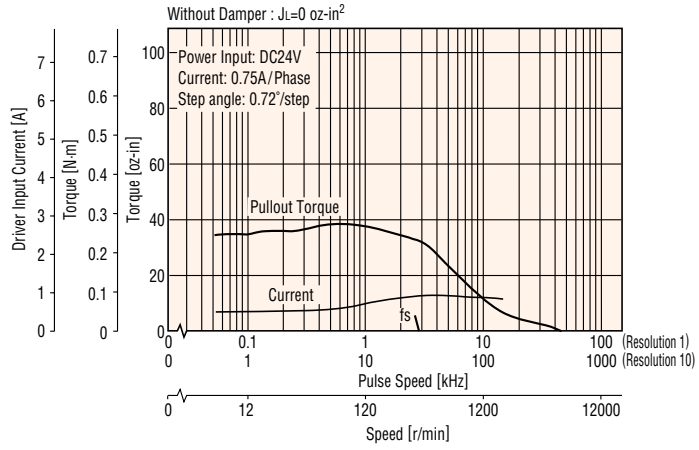
RFK544AA
RFK544BA



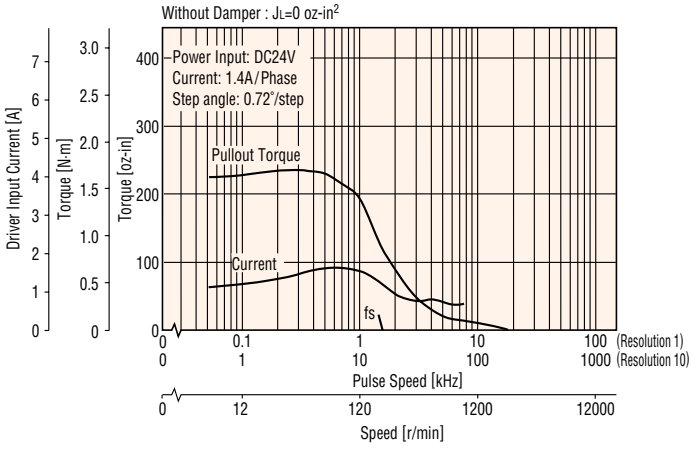
RFK566AA
RFK566BA



RFK545AA
RFK545BA



RFK569AA
RFK569BA



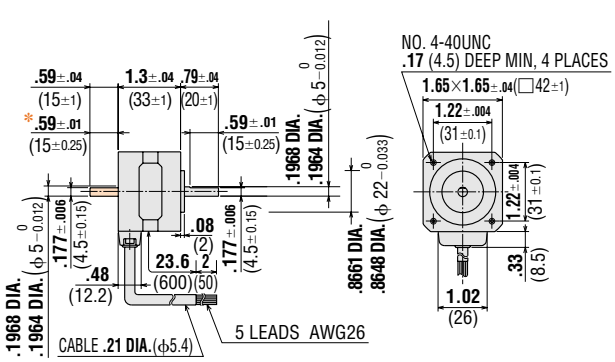
Note:

- 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 212°F (100°C).
- 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%.

■ DIMENSIONS Scale 1/4, Unit = inch (mm)

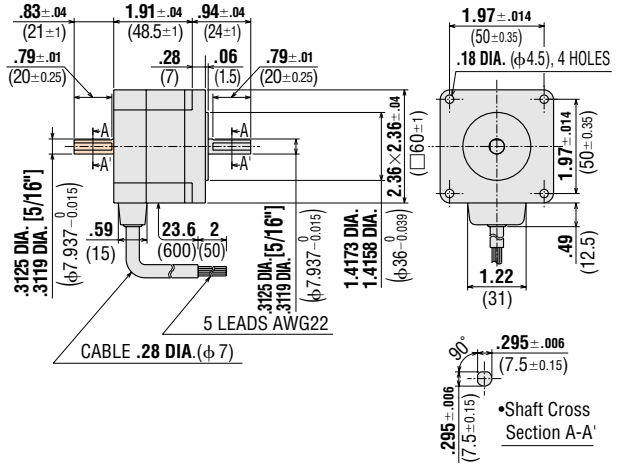
●Motor

RFK543AA (Single shaft)
Motor Model: PK543AUA Weight 0.56lb. (Mass 0.25kg)
RFK543BA (Double shaft)
Motor Model: PK543BUA Weight 0.56lb. (Mass 0.25kg)

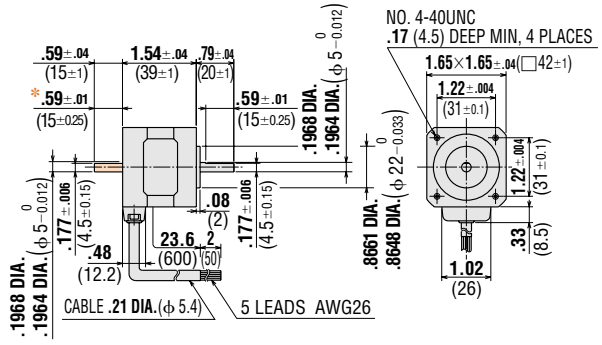


*.59±.01(15±0.25) indicates the length of milling on motor shaft.

RFK564AA (Single shaft)
Motor Model: PK564AUA Weight 1.33lb. (Mass 0.6kg)
RFK564BA (Double shaft)
Motor Model: PK564BUA Weight 1.33lb. (Mass 0.6kg)

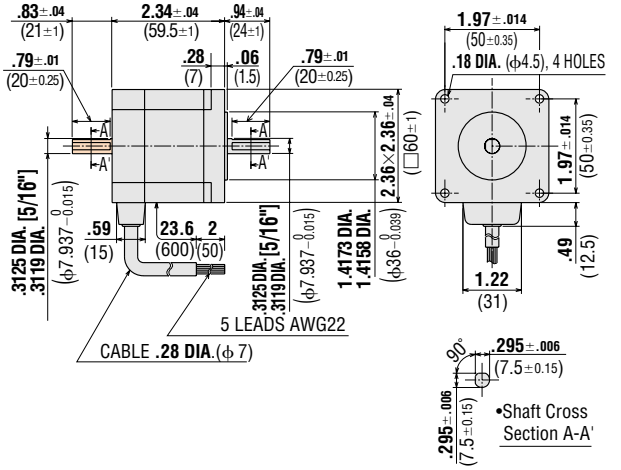


RFK544AA (Single shaft)
Motor Model: PK544AUA Weight 0.67lb. (Mass 0.3kg)
RFK544BA (Double shaft)
Motor Model: PK544BUA Weight 0.67lb. (Mass 0.3kg)

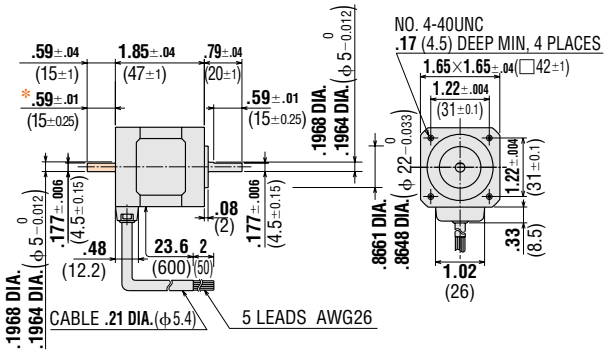


*.59±.01(15±0.25) indicates the length of milling on motor shaft.

RFK566AA (Single shaft)
Motor Model: PK566AUA Weight 1.77lb. (Mass 0.8kg)
RFK566BA (Double shaft)
Motor Model: PK566BUA Weight 1.77lb. (Mass 0.8kg)



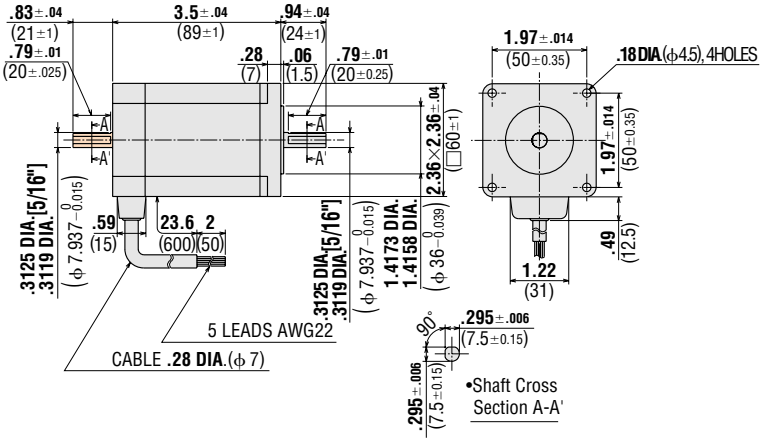
RFK545AA (Single shaft)
Motor Model: PK545AUA Weight 0.89lb. (Mass 0.4kg)
RFK545BA (Double shaft)
Motor Model: PK545BUA Weight 0.89lb. (Mass 0.4kg)



*.59±.01(15±0.25) indicates the length of milling on motor shaft.

●These external appearance drawings are for double shaft models. For a single shaft, ignore the colored areas.

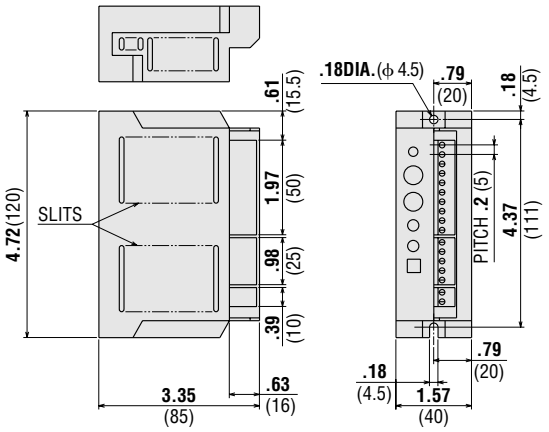
RFK569AA (Single shaft)
Motor Model: PK569AUA Weight 2.87lb. (Mass 1.3kg)
RFK569BA (Double shaft)
Motor Model: PK569BUA Weight 2.87lb. (Mass 1.3kg)



See page B-36 for information on motor installation.

●Driver

Driver: DFR1507A Weight: 0.8lb. (Mass 0.36kg)
DFR1514A



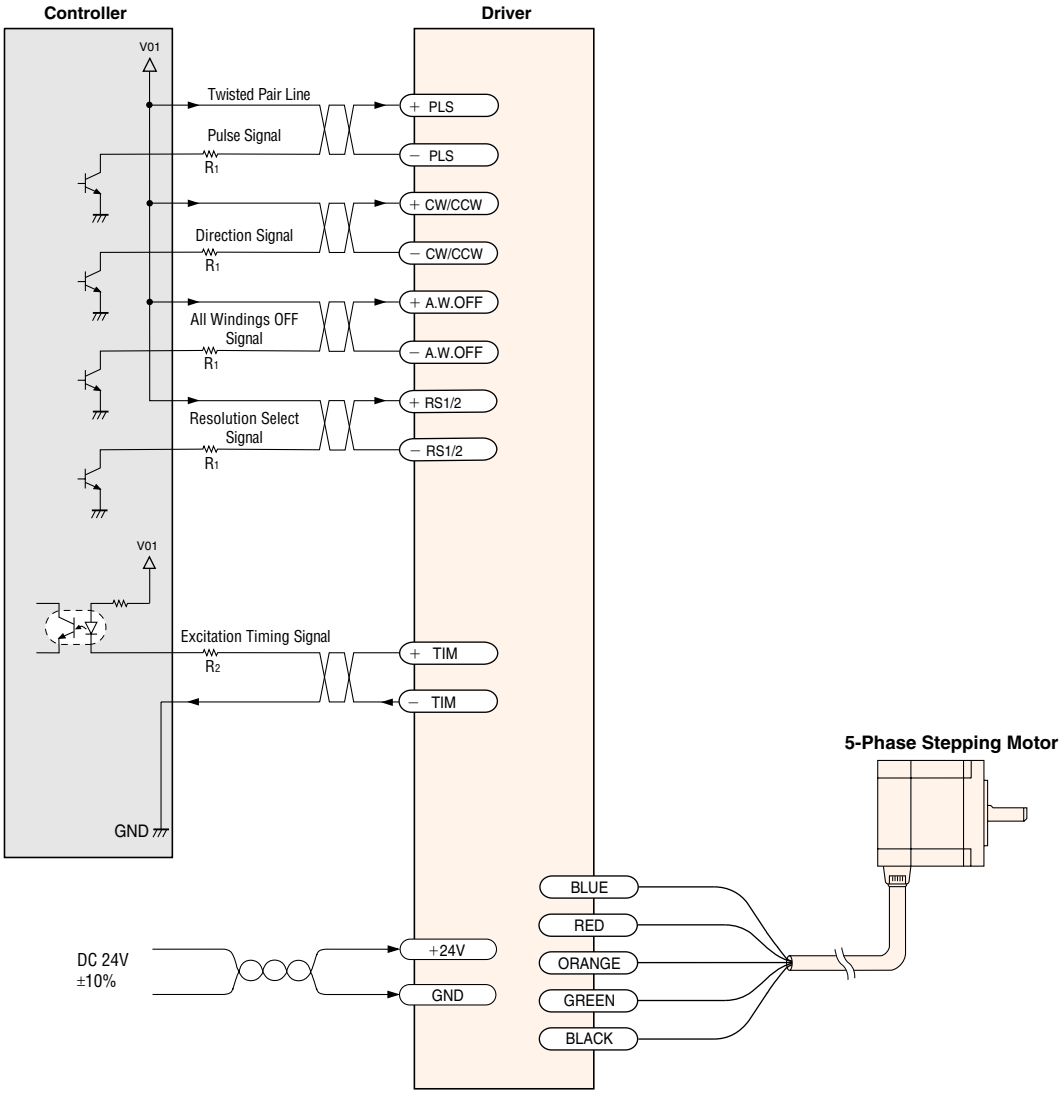
See page B-38 for information on driver installation.

■ LIST OF MOTOR AND DRIVER COMBINATIONS

Type	Package model	Stepping motor		Driver
		Model	Current A/phase	Model
STANDARD	**RFK543□A** **RFK544□A** **RFK545□A**	PK543□UA PK544□UA PK545□UA	0.75	DFR1507A
	RFK564□A **RFK566□A** **RFK569□A**	PK564□UA PK566□UA PK569□UA	1.4	DFR1514A

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

■ WIRING DIAGRAM



■ Power Supply

Use a power supply that can supply sufficient input current.
When power supply capacity is insufficient, a decrease in motor output can cause the following malfunctions:

- Motor does not rotate properly at high-speed (insufficient torque)
- Motor startup and stopping is slow.

Note:

- When voltage is above DC 5V, connect external resistance R_1 and keep the input current below 20mA.
- If the current exceeds 10mA, connect external resistance R_2.
- Use twisted-pair wire of 3.1×10^{-4} in^2 (0.2mm^2) or thicker and 6.6 feet (2m) or less in length for the signal line.
- Use wire 7.8×10^{-4} in^2 (0.5mm^2) or thicker for motor lines (when extended) and power supply lines, and use 1.2×10^{-3} in^2 (0.75mm^2) or thicker for the wire for the grounding line.
- Use spot grounding for the grounding of the driver and external controller.
- Signal lines should be kept at least 3.94 inch (10cm) away from power lines (power supply lines and motor lines). Do not bind the signal line and power line together.

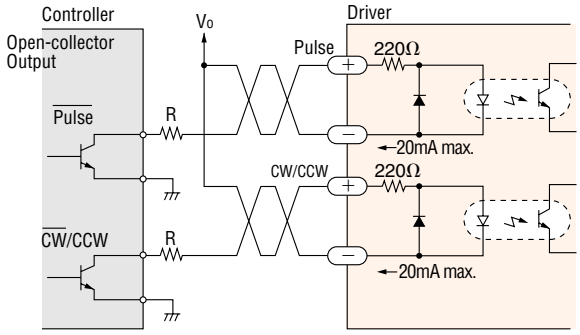
Do not turn on the power or operate the motor until confirming that the auto-diagnosis switch is set to NORM. If it is set to TEST, there is a danger that the motor will start rotating as soon as the power to the driver is turned on.

Use open collector transistors (sink type) for the signal output sections of the controller.

■ DESCRIPTION OF INPUT/OUTPUT SIGNALS

1. Pulse Input

■ Input circuit and sample connection



Keep the voltage between DC 5V and DC 24V.
When voltage is equal to DC 5V, external resistance (R) is not necessary. When voltage is above DC 5V, connect external resistance (R) and keep the input current below 20mA.

1. 1-Pulse Input Mode

Pulse Signal

"Pulse" signal is input to the pulse signal terminal. When the photocoupler state changes from "ON" to "OFF", the motor rotates one step. The direction of rotation is determined by the following rotation direction signal.

Rotation Direction Signal

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

2. 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.

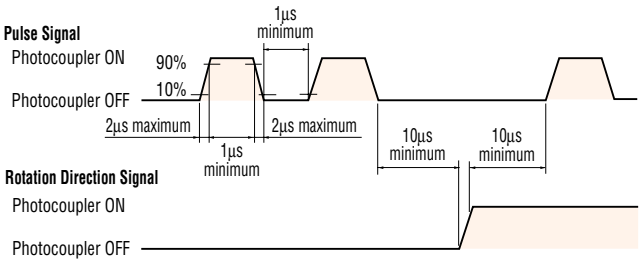
CCW Pulse Signal

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

CW and CCW refer to clockwise and counterclockwise direction respectively, from a reference point of facing the motor output shaft.

■ Pulse Signal Characteristics

Input Pulse characteristics

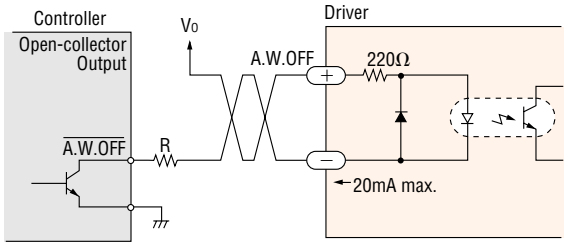


The shaded area indicates when the photocoupler diode is ON. The motor moves when the photocoupler state changes from ON to OFF as indicated by the arrow.

- The pulse voltage is 4~5V in the "photocoupler ON" state, and 0~0.5V in the "photocoupler OFF" state.
- Input pulse signals should have a pulse width over 1µs, pulse rise/fall below 2µs, and a pulse duty below 50%.
- Keep the pulse signal at "photocoupler OFF" when no pulse is being input.
- The minimum interval time when changing rotation direction is 10µs. This value varies greatly depending on the motor type, pulse frequency, and load inertia. It may be necessary to increase this time interval.
- In 1-pulse input mode, leave the pulse signal at rest ("photocoupler OFF") when changing rotation directions.

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

■ Input circuit and sample connection



Keep the voltage between DC 5V and DC 24V.
When voltage is equal to DC 5V, external resistance (R) is not necessary. When voltage is above DC 5V, connect external resistance (R) and keep the input current below 20mA.

When the "All Windings Off" signal is in the "photocoupler ON" state, the current to the motor is cut off and motor torque is reduced to zero. The motor output shaft can then be rotated freely by hand.

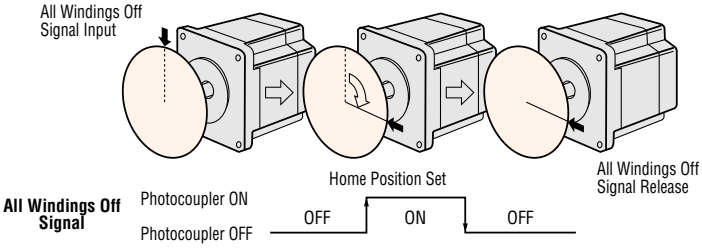
When the "All Windings Off" signal is in the "photocoupler OFF" state, the motor holding torque is proportional to the current set by the current adjustment rotary switches. During motor operation be sure to keep the signal in the "photocoupler OFF" state.

This signal is used when moving the motor by external force or manual home position is desired. If this function is not needed, it is not necessary to connect this terminal.
Switching the "All Windings Off" signal from "photocoupler ON" to "photocoupler OFF" does not alter the excitation sequence.

When the motor shaft is manually adjusted with the "All Windings Off" signal input, the shaft will shift up to ±3.6° from the position set after the "All Windings Off" signal is released.

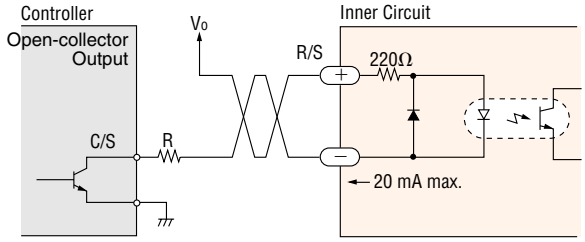
■ Manual Setting of the Home Position

Input the "All Windings Off" signal, set the motor to the desired position, then release the "All Windings Off" signal.



3. R/S (Resolution Select Switching) Input

■ Input circuit and sample connection



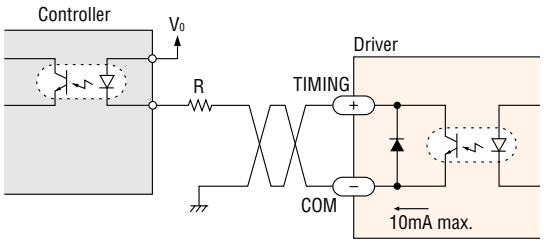
Keep the voltage between DC 5V and DC 24V.
When voltage is equal to DC 5V, external resistance (R) is not necessary. When voltage is above DC 5V, connect external resistance (R) and keep the input current below 20mA.

When the "Resolution Select" signal is in the "photocoupler ON" state, the step angle set by resolution select switch RS1 is selected, and when the "Resolution Select" signal is in the "photocoupler OFF" state, the step angle set by resolution select switch RS2 is selected.
This signal can be used to change the motor speed or amount of rotation without altering the input pulses.

Note: Input the "Resolution Select" signal when the driver power is off, or when pulse signals are not being input. If the "Resolution Select" signal is input at other times, the excitation timing signal output may not function properly.

4. TIMING (Excitation Timing)

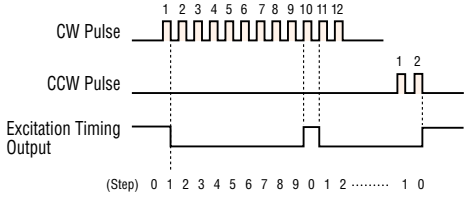
■ Output Circuit and Sample Connection



Keep the voltage between DC 5V and DC 24V.
Keep the current below 10mA. If the current exceeds 10mA, connect external Resistance (R).

The "Excitation Timing" signal is output to indicate when the motor excitation (current flowing through the winding) is in the initial stage (step "0" at power up).
The "Excitation Timing" signal can be used to increase the accuracy of home position detection by setting the mechanical home position of your equipment (for example, a photo-sensor) to coincide with the excitation sequence initial stage (step "0").
The motor excitation stage changes simultaneously with pulse input, and returns to the initial stage for each 7.2˚ rotation of the motor output shaft.
When power is turned ON, the excitation sequence is reset to step "0".

The "Excitation Timing" signal is output once for each number of pulses equivalent to 7.2˚ divided by the step angle setting.
Example: At a step angle setting of 0.72˚/step (Division of 1): The signal is output once every 10 pulses
At a step angle setting of 0.072˚/step (Division of 10): The signal is output once every 100 pulses



When using the "Excitation Timing" signal, set the number of input pulses and the step angle in combinations which allow the motor shaft to stop at positions which are multiples of 7.2˚.
When using the "Resolution Select" signal to change the step angle, be aware that depending on the number of pulses and step angle setting, there are conditions, such as those shown below, in which the "Excitation Timing" signal will not be output.