A

Stepper Motors

Stepper Motors

Product Series of Stepper Motors

The types of stepper motors by category and series are shown below.
Refer to this page when you select a series.
Refer to "Stepper Motor and Driver Packages Product Line" on page A-4 for a comparison of all the series.

Stepper Motor and Driver Packages

0.36° Stepper Motor and Driver Packages α_{STEP}

These products use our closed loop control to maintain positioning operation even during abrupt load fluctuations and accelerations. The rotor position detection sensor monitors the rotation speed and amount. When an overload condition is detected, it will instantaneously regain control using the closed loop mode. When an overload condition continues it will output an alarm signal, thereby providing reliability equal to that of a servo motor.

AC Power Supply Input

FLEX Built-in Controller Type　Pulse Input Type

AR Series AC Power Supply Input

AC Power Supply Input

Heat generation by the motor has been significantly reduced through higher efficiency. Stepper motors are suitable for short distance, quick, repetitive positioning operations.
The **AR** Series and **AZ** Series offer continuous duty operation due to their design and construction.
List Price starting from $727.00

Page A-20

Built-in Absolute Sensor

Absolute position detection at the motor shaft with ±900 rotations

FLEX Built-in Controller Type　Pulse Input Type

AZ Series AC Power Supply Input

AC Power Supply Input

By incorporating the newly developed absolute sensor, absolute-type positioning is now possible without a battery.
List Price starting from $937.00

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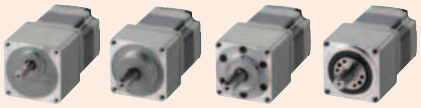
Wide Variety of Geared Types



0.72° Stepper Motor and Driver Packages

This series combines a 0.72° stepper motor, 500 steps per revolution (0.72°/step) and a driver. A wide variety of motors is available, such as geared types, high-torque types, high-resolution types (0.36°/step), etc.

FLEX Built-in Controller Type　Pulse Input Type

RK II Series AC Power Supply Input

Basic performance and ease of use have both been improved in combination with a microstep driver with fully digital control.
List Price starting from $461.00

Page A-84

Wide Variety of Geared Types

Product Line of Geared Motors ▶ Page A-90

1.8° Stepper Motor and Driver Packages

This series combines a 1.8° stepper motor with a resolution of 200 steps per revolution (1.8°/step) and a driver.

Stepper Motors (Motor only)

1.8° Stepper Motors

PKP Series

These products are high-torque stepper motors with a resolution of 200 steps per revolution (1.8°/step). There is also a wide variety of motor current specifications.
(A dedicated driver is required to operate the motor.)

Page A-234

0.72° Stepper Motors

PKP Series

These products are high-torque and low-vibration stepper motors with a resolution of 500 steps per revolution (0.72°/step).
(A dedicated driver is required to operate the motor.)

Page A-266

FLEX What Is FLEX?

FLEX is the collective name for products that support I/O control, Modbus (RTU) control, and FA network control via network converters.
These products enable simple connection and simple control, shortening the total lead time for system construction.

Stepper Motor and Driver Packages Product Line Page A-4

DC Power Supply Input

Standard Models

FLEX Built-in Controller Type

Pulse Input Type

AR Series DC Power Supply Input

DC Power Supply Input

Heat generation by the motor has been significantly reduced through higher efficiency. Stepper motors are suitable for short-distance, quick, repetitive positioning operations, so these operations can be used with these stepper motors without having to worry about the duty cycle.
A compact and lightweight DC input driver is included.
List Price starting from $485.00

Page A-136

Built-in Absolute Sensor

Absolute position detection at the motor shaft with ±900 rotations

FLEX Built-in Controller Type

Pulse Input Type

AZ Series DC Power Supply Input

DC Power Supply Input

By incorporating the newly developed absolute sensor, absolute-type positioning is now possible without a battery.
A compact and lightweight DC input driver is included.
List Price starting from $762.00

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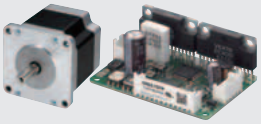


CRK Series DC Power Supply Input

The **CRK** Series is a motor and driver package combining a 0.72°/0.36° stepper motor with a compact and low-vibration board driver offering Oriental Motor's proprietary Smooth Drive Function. High-torque types and compact geared motors are available.
List Price starting from $325.00

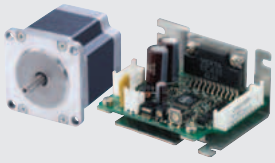
Page A-206

FLEX Built-in Controller Type

PKA Series DC Power Supply Input

An all-in-one 0.72° stepper motor with the driver integrated into the motor. This contributes to space saving and size reduction of the equipment.
List Price starting from $415.00

Page A-226



CMK Series DC Power Supply Input

This package consists of a 1.8°/0.9° stepper motor and a 24 VDC input microstep board driver. This contributes to a reduction in the size and vibration of the equipment.
List Price starting from $241.00

Page A-220

RBK Series DC Power Supply Input

The **RBK** Series is a motor and driver package consisting of a 1.8° step angle stepper motor and DC input microstep driver.
It includes Oriental Motor's proprietary Smooth Drive Function to easily achieve low vibration operation.
List Price starting from $387.00

Page A-214

Overview, Product Series
AC Input Motor & Driver
0.36°/Geared αSTEP AR
0.36°/Geared αSTEP Absolute AZ
0.72°/Geared RKII
DC Input Motor & Driver
0.36°/Geared αSTEP AR
0.36°/Geared αSTEP Absolute AZ
0.72°/0.36°/Geared CRK
1.8°/Geared RBK
1.8°/0.9°/Geared CMK
0.72° All-in-One PKA
Motor Only
1.8°/0.9° PKP/PK
Geared PKP
0.72°/0.36° PKP
Accessories

Stepper Motor and Driver Packages Product Line

One feature of stepper motors is that they can perform accurate positioning operations with ease.
So that more users can enjoy the benefits of stepper motors, Oriental Motor has many different product series designed with different power supply specifications and different functions. There is also a wide spectrum of variations within each series, as products come in different frame sizes and with or without an electromagnetic brake and different gear types.

AC Input Stepper Motor and Driver Packages

Classification		AC Input Stepper Motor and Driver Packages		
Series		Standard Package 0.36° α_{STEP} **AR** Series 	Built-in Absolute Sensor 0.36° α_{STEP} Absolute **AZ** Series 	Standard Package 0.72° **RK II** Series 
Reference Page		▶ Page A-20	▶ Page A-74	▶ Page A-84
Key Features		● High efficiency and low heat generation ● Continuous operation and extended function ● Conforms to international standards	● Reduced wiring and reduced system cost ● Uses multiple rotation absolute sensor ● No battery required	● High efficiency, low heat generation, low vibration ● Space saving and features simplified wiring and protective function ● Low cost of entry
Control Method		Closed Loop	Closed Loop	Open Loop
Basic Step Angle		0.36° (Resolution setting: 1000 P/R)	0.36° (Resolution setting: 1000 P/R)	0.72°
Excitation Mode		Microstep	Microstep	Microstep
Step Angle		3.6°~0.036°	3.6°~0.036°	0.72°~0.00288° (16 steps) 1.8°~0.0018° (16 steps)
Driver Product Line	Built-in Controller	●	●	●
	Pulse Input	●	●	●
	Network Compatible	Modbus (RTU)	Modbus (RTU)	Modbus (RTU)
Motor Frame Size	□20 mm (0.79 in.)	–	–	–
	□28/30 mm (1.1/1.18 in.)	–	–	–
	□42 mm (1.65 in.)	●	●	●
	□60 mm (2.36 in.)	●	●	●
	□85/90 mm (3.35/3.54 in.)	●	–	●
Additional Functions	Electromagnetic Brake	●	●	●
Geared Types	**TH** (Spur gear mechanism)	●	–	–
	TS (Spur gear mechanism)	–	●	●
	PS (Planetary gear mechanism)	●	●	●
	PN (Planetary gear mechanism)	●	–	–
	HPG (Planetary gear mechanism)	–	●	–
	Harmonic	●	●	●
Driver Functions	Push-Motion Operation	●	●	–
	Extended Functions	●	●	●
	Waveform Monitoring Function	●	●	●
Power Supply Input		Single-Phase 100-115 (120) VAC Single-Phase 200-230 (240) VAC Three-Phase 200-230 VAC*	Single-Phase 100-120 VAC Single-Phase/Three-Phase 200-240 VAC	Single-Phase 100-120 VAC Single-Phase 200-240 VAC
Standards		cULus CE	CE	cULus CE
Price Range		$727.00~$2,057.00	$937.00~$1,861.00	$461.00~$2,006.00

*Pulse input type only

Stepper Motors (Motor only)

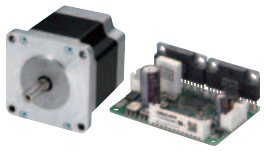
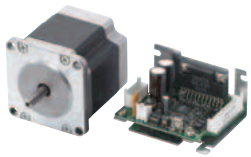
Classification	Stepper Motors (Motor only)	
	1.8° Stepper Motors	0.72° Stepper Motors
Series	**PKP** Series   1.8°/0.9° Motor Type **SH** Geared Type	**PKP** Series  0.72°/0.36° Motor Type
Reference Page	▶ Page A-234	▶ Page A-266
Key Features	● 200 Microsteps/Step (1.8°/step) ● 400 Microsteps/Step (0.9°/step) High-Resolution Type ● High Torque	● 500 Microsteps/Step (0.72°/step) ● 1000 Microsteps/Step (0.36°/step) High-Resolution Type ● Low Vibration

DC Input Stepper Motor and Driver Packages

Classification		DC Input Stepper Motor and Driver Packages		
Series		Standard Package 0.36° αSTEP **AR** Series	Built-in Absolute Sensor 0.36° αSTEP Absolute **AZ** Series	High Torque, Low Vibration 1.8° **RBK** Series
				
Reference Page		▶ Page A-136	▶ Page A-196	▶ Page A-214
Key Features		● High efficiency and low heat generation ● Continuous operation and extended function ● Conforms to international safety standards	● Reduced wiring and reduced system cost ● Uses multiple rotation absolute sensor ● No battery required	● Low vibration, low noise ● Highest torque for entire speed range ● Wide variety of motors
Control Method		Closed Loop	Closed Loop	Open Loop
Basic Step Angle		0.36° (Resolution setting: 1000 P/R)	0.36° (Resolution setting: 1000 P/R)	1.8°
Excitation Mode		Microstep	Microstep	Microstep
Step Angle		3.6°~0.036°	3.6°~0.036°	1.8°~0.0140625° (16 steps)
Driver Product Line	Built-in Controller	●	●	–
	Pulse Input	●	●	●
	Network Compatible	Modbus (RTU)	Modbus (RTU)	–
Motor Frame Size	□20 mm (0.79 in.)	●	–	–
	□28/30/35 mm (1.1/1.18/1.38 in.)	●	–	●
	□42 mm (1.65 in.)	●	●	●
	□50 mm (1.97 in.)	–	–	–
	□56.4/60 mm (2.22/2.36 in.)	●	●	●
	□85/90 mm (3.35/3.54 in.)	●	–	●
Additional Functions	Electromagnetic Brake	●	●	–
Geared Types	**SH** (Spur gear mechanism)	–	–	–
	TH (Spur gear mechanism)	●	–	–
	TS (Spur gear mechanism)	–	●	–
	PL/PS (Planetary gear mechanism)	●	●	●
	PN (Planetary gear mechanism)	●	–	–
	HPG (Planetary gear mechanism)	–	●	–
	Harmonic	●	●	–
Power Supply Input		24 VDC/48 VDC	24 VDC/48 VDC	Standard Type: 20~75 VDC High-Torque Type, **PS/PL** Geared Type: 20~40 VDC
Standards		UL*1 CE	CE	cULus*2 CE*2
Price Range		$485.00~$1,865.00	$762.00~$1,686.00	$387.00~$986.00

*1 28 mm (1.10 in.) frame size excluded
*2 Terminal box type only

DC Input Stepper Motor and Driver Packages

Classification		DC Input Stepper Motor and Driver Packages		
Series		Wide Variety of Motors 0.72°/0.36° **CRK** Series 	Reduced Vibration and Compact, Lightweight Drivers 1.8°/0.9° **CMK** Series 	Integrated Driver 0.72° **PKA** Series 
Reference Page		▶ Page A-206	▶ Page A-220	▶ Page A-226
Key Features		● Wide variety of motors ● Low vibration and low noise ● Compact, lightweight drivers	● Significantly reduced vibration of 1.8°/0.9° stepper motor ● Compact, lightweight drivers	● Space saving, reduced wiring ● 3 types of control including I/O control and network control
Control Method		Open Loop	Open Loop	Open Loop
Basic Step Angle		0.36°/0.72°	1.8°	0.72°
Excitation Mode		Microstep	Microstep	Microstep
Step Angle		0.72°～0.00288° (16 steps) 1.8°～0.00703125° (16 steps)	1.8°～0.1125° (5 steps)	0.72°～0.00288°
Driver Product Line	Built-in Controller	●	–	●
	Pulse Input	●	●	–
	Network Compatible	RS-485	–	Modbus (RTU)
Motor Frame Size	□20 mm (0.79 in.)	●	–	–
	□28/30/35 mm (1.1/1.18/1.38 in.)	●	●	–
	□42 mm (1.65 in.)	●	●	●
	□50 mm (1.97 in.)	–	●	–
	□56.4/60 mm (2.22/2.36 in.)	●	●	●
	□85/90 mm (3.35/3.54 in.)	–	–	–
Additional Functions	Electromagnetic Brake	–	–	–
Geared Types	**SH** (Spur gear mechanism)	–	●	–
	TH (Spur gear mechanism)	●	–	–
	TS (Spur gear mechanism)	–	–	–
	PS (Planetary gear mechanism)	●	–	–
	PN (Planetary gear mechanism)	●	–	–
	HPG (Planetary gear mechanism)	–	–	–
	Harmonic	●	–	–
Power Supply Input		24 VDC	24 VDC	24 VDC
Standards		c UL us * CE	CE	CE
Price Range		$325.00～$1,412.00	$241.00～$435.00	$415.00～$432.00

*Pulse type only

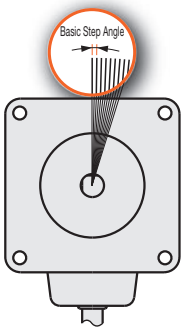
Overview of Stepper Motors

Stepper motors enable accurate positioning operation with ease.
They are used in various types of equipment for accurate rotation angle and speed control using pulse signals.

Features

Accurate Positioning in Fine Steps

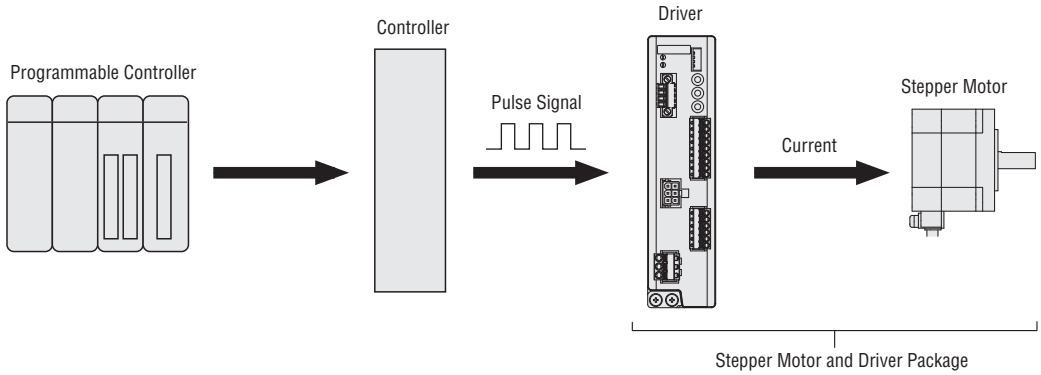
A stepper motor rotates with a fixed step angle, just like the second hand of a clock. This angle is called "basic step angle." Oriental Motor offers four basic step angles (0.36°, 0.72°, 0.9°, 1.8°).



Four Basic Step Angles
- 0.36°
- 0.72°
- 0.9°
- 1.8°

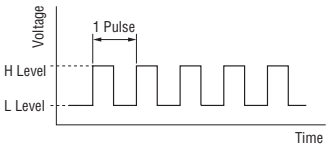
Easy Control with Pulse Signals

A system configuration for high accuracy positioning is shown below. The rotation angle and speed of the stepper motor can be controlled accurately using pulse signals from the controller.



◇What is a Pulse Signal?

A pulse signal is an electrical signal whose voltage level changes repeatedly between ON and OFF. Each ON/OFF cycle is counted as one pulse. A command with one pulse causes the motor output shaft to turn by one step.
The signal levels corresponding to voltage ON and OFF conditions are referred to as "H" and "L", respectively.

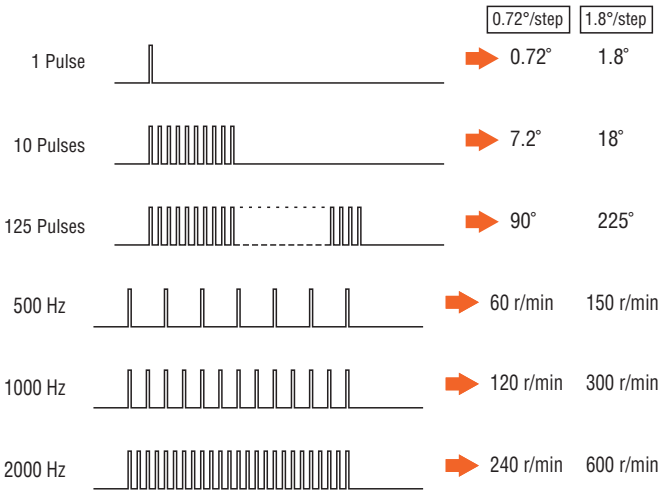


◇The Amount of Rotation is Proportional to the Number of Pulses

The amount of rotation of the stepper motor is proportional to the number of pulse signals (pulse number) given to the driver.
The relationship of the stepper motor's rotation (rotation angle of the motor output shaft) and pulse number is expressed as follows:

$\theta = \theta s \times A$

- θ : Rotation angle of the motor output shaft [deg]
- θs: Step angle [deg/step]
- A : Pulse number [pulses]



◇The Speed is Proportional to the Pulse Speed

The speed of the stepper motor is proportional to the speed of pulse signals (pulse frequency) given to the driver.
The relationship of the pulse speed [Hz] and motor speed [r/min] is expressed as follows:

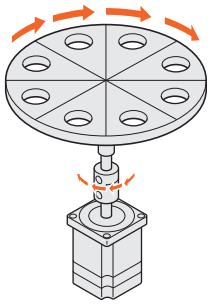
$N = \frac{\theta s}{360} \times f \times 60$

- N : Speed of the motor output shaft [r/min]
- θs : Step angle [deg/step]
- f : Pulse speed [Hz] (Number of pulses input per second)

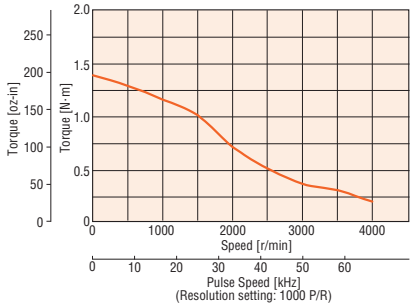
●Generating High Torque with a Compact Body

Stepper motors generate high torque with a compact body. These features give them excellent acceleration and response, which in turn makes these motors well-suited for torque-demanding applications where the motor must be started and stopped frequently. To meet the need for greater torque at low speed, Oriental Motor also has geared motors combining compact design and high torque.

◇Frequent Starting/Stopping is Possible

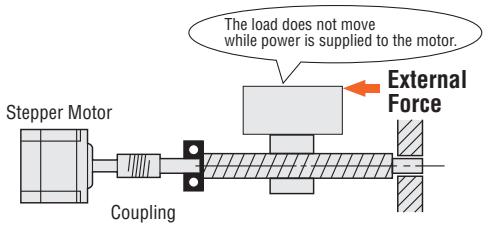


◇Speed – Torque Characteristics [Motor frame size 60 mm (2.36 in.)]



●The Motor Holds Itself at a Stopped Position

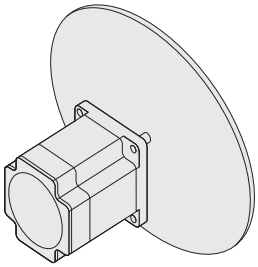
Stepper motors continue to generate holding torque even at standstill. This means that the motor can be held at a stopped position without using a mechanical brake.



●Capable of Driving Large Inertial Loads

Stepper motors can drive larger inertial loads than servo motors of equivalent frame sizes.

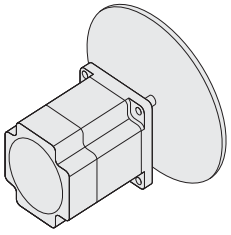
•Comparison at 30 times of the rotor inertia



Stepper Motors

Load Inertia 22.4×10^{-4} kg·m^2 (123 oz-in^2)
(30 times the rotor inertial moment)

Load Inertia:	Diameter: 169 mm (6.65 in.)
	Thickness: 10 mm (0.39 in.)
	Material: Aluminum
Motor:	Frame size 60 mm (2.36 in.)
	Length 90 mm (3.54 in.)



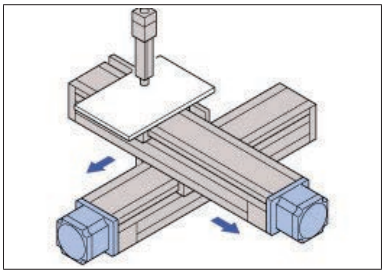
Conventional Servo Motor

Load Inertia 4.0×10^{-4} kg·m^2 (22 oz-in^2)
(30 times the rotor inertia)

Load Inertia:	Diameter: 110 mm (4.33 in.)
	Thickness: 10 mm (0.39 in.)
	Material: Aluminum
Motor:	Frame size 60 mm (2.36 in.)
	Length 96.5 mm (3.8 in.)

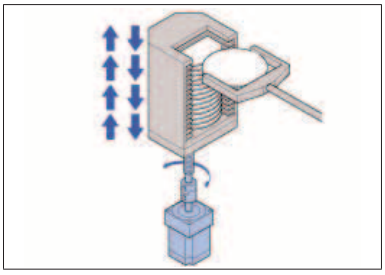
■Applications

●Table Drive for X-Y Axes



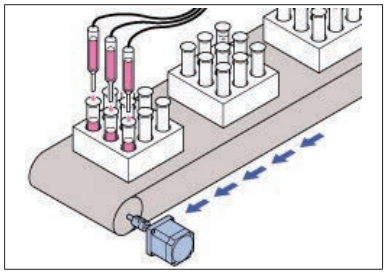
Highly accurate positioning at high speed is possible.

●Vertical Operation of Stocker



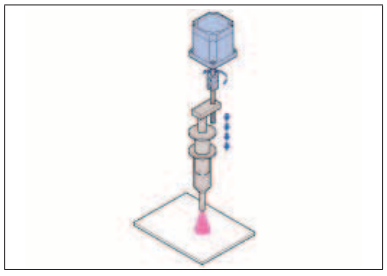
Stable positioning at vertical operation is possible.

●Feeding of Quantitative Dispenser



Stable positioning is possible even on mechanisms with low rigidity, such as a belt mechanism.

●Application of Fixed Amount



The amount applied can be adjusted accurately.

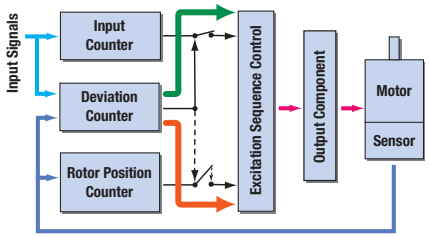
Overview of Closed Loop Stepper Motor and Driver Packages α_{STEP}

Oriental Motor's unique closed loop control α_{STEP} has been integrated.
This is a motor and driver package offering the user-friendliness of a stepper motor with improved response and reliability.

●High Reliability through Closed Loop Control

◇Continues Operation Even with Sudden Load Fluctuation and Sudden Acceleration

It operates synchronously with commands using open loop control during normal conditions. In an overload condition, it switches immediately to closed loop control to correct the position.



Normal Condition

Motor runs in open loop mode like a stepper motor.

Overload Condition

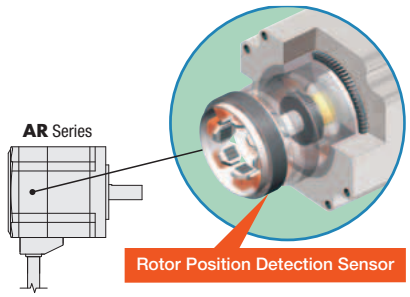
The closed loop mode is engaged to maintain the positioning operation.

◇Alarm Signal Output in Case of Abnormality

If an overload is applied continuously, an alarm signal is output. When the positioning is complete, an END signal is output. Like a servo motor, this ensures the same level of reliability is achieved.

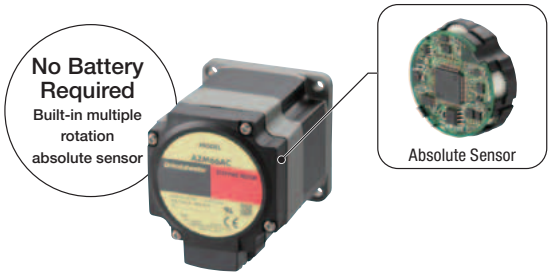
◇**AR** Series with Rotor Position Detection Sensor (Resolver)

- Because the sensor is compact and slim, the overall length of the motor has been reduced.
- Performance such as heat resistance and vibration resistance is better than with regular optical encoders.
- Because an encoder cable is not necessary, the motor and driver can be connected with just 1 cable.



◇**AZ** Series with Absolute Sensor

- Mechanical Multi-Turn Absolute Sensor
  Absolute position detection is possible with ±900 rotations (1800 rotations) of the motor shaft from the home reference.
- No Battery Required
  Because positioning information is managed mechanically by the absolute sensor, the positioning information can be preserved, even if the power turns off or if the cable between the motor and the driver is disconnected.

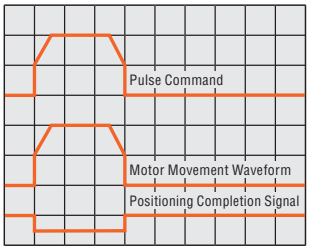


●Unique Advantages of Stepper Motors

◇Excellent Synchronization, High-Response Operation

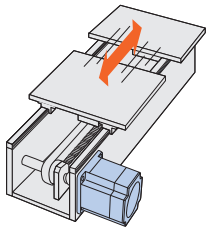
•Frequent Starting and Stopping is Possible

Stepper motors operate synchronously with pulse commands and generate high torque with a compact body, and offer excellent acceleration performance and response.
They are ideal for applications requiring frequent starting and stopping.



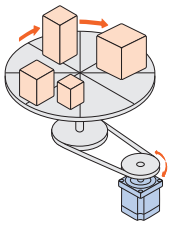
◇Tuning-Free

Positioning is still possible without gain tuning even when the load fluctuates when using a belt mechanism, cam or chain drive, etc.



◇Holding the Stop Position

During positioning, the motor stops with its own holding force without hunting. Because of this, it is ideal for applications where the low rigidity of the mechanism requires absence of vibration upon stopping.

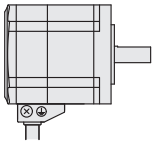


Motor Types

Stepper motors come in several different types including the standard type, electromagnetic brake type and various geared types. The availability of such a wide selection means that you can choose an optimal type according to the function and performance required in your specific application.
Typical examples are introduced below.

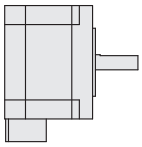
Standard Type

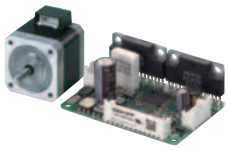
A basic model that is easy to use and designed with a balanced set of functions and characteristics.



High-Resolution Type

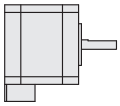
This motor's basic resolution is double that of the standard type. This results in high positioning accuracy and reduced vibration.





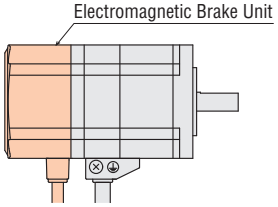
High-Torque Type

A high-torque motor has a higher torque of approximately 1.5 times compared with the conventional standard type motor.
The use of a smaller motor allows for compact equipment design.

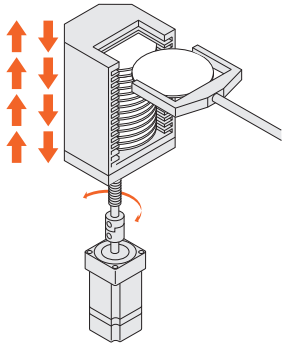


Electromagnetic Brake Type

These motors incorporate a non-excitation type electromagnetic brake. When the power is accidentally cut off due to power outage or other unexpected event, the electromagnetic brake holds the load in position to prevent it from dropping or moving.



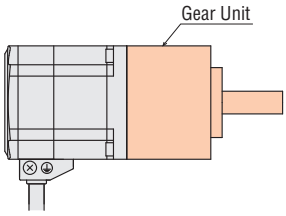
Once the power is cut off, the self-holding torque of the motor is lost and the motor can no longer be held at the stopped position in vertical operations or when an external force is applied. In lift and similar applications, use an electromagnetic brake type.



Geared Type

These motors incorporate a dedicated position-control gearhead with reduced backlash to make the most of the high controllability of the motors. The gearhead ensures highly accurate, smooth operation even in applications where a large torque is received.

Advantages of Geared Motors ➜ Page A-12
Product Line of Geared Motors ➜ Page A-13



◇AR Series Geared Type Typical Characteristics

Geared Type	Permissible Torque [N·m (lb-in)]	Backlash [arcmin]	Resolution [°/pulse]	Speed [r/min]
TH Geared Type	12 (106)	10	0.012	500
PS Geared Type	37 (320)	7	0.0072	600
PN Geared Type	37 (320)	2	0.0072	600
Harmonic Geared Type	37 (320)	0	0.0036	70

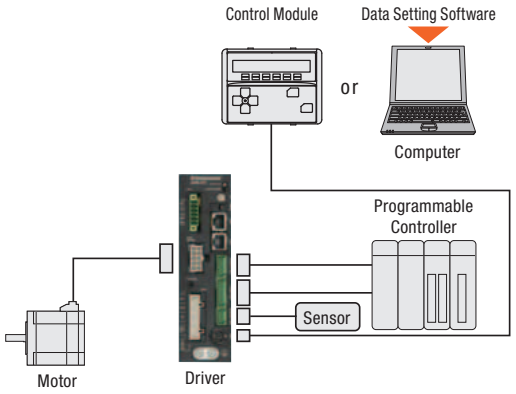
● The values shown above are reference. These values vary depending on the product.

Types of Operation Systems

Stepper motor and driver packages combine a stepper motor selected from various types with a dedicated driver. In addition to the pulse input type, drivers with a built-in controller type and a network-compatible type are also available. You can select a desired combination product according to the required operation system. Representative examples are shown below.

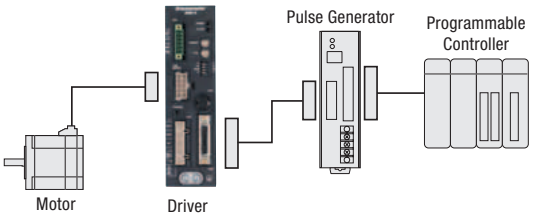
Built-in Controller Type

A built-in pulse generator function allows the motor to be driven via a directly connected programmable controller. Since no separate pulse generator is required, the drivers of this type saves space.



Pulse Input Type

The motor can be controlled using a pulse generator provided by the customer. Operating data is set to the pulse generator beforehand, and you can select the operating data on the programmable controller, then input the operation command.

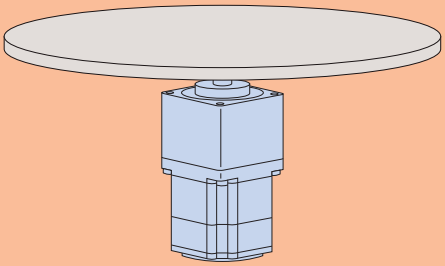


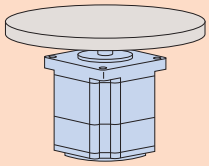
Advantages of Geared Motors

We offer motors pre-assembled with gears, as variations of stepper motors. Geared motors not only achieve deceleration, high torque and high resolution, but they also provide the additional advantages:

Capable of Driving Large Inertial Loads

When a geared motor is used, the inertial load that can be turned increases in comparison with a comparable standard motor in proportion to the square of the gear ratio. This means that larger inertial loads can be driven with geared motors.

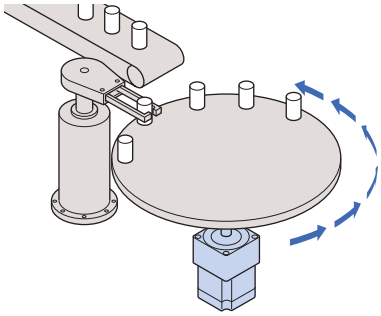


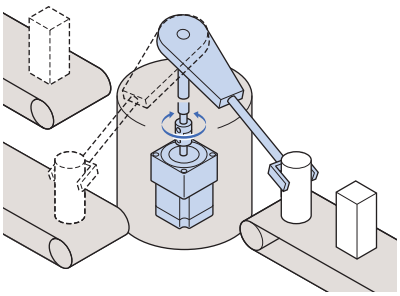


Motor Type	Geared Motor (Gear Ratio: 5)	Standard Motor
Product Name	**AR66AA-N5-3**	**AR66AA-3**
Load Inertia (30 times the rotor inertia)	285×10^{-4} kg·m^2 (1560 oz-in)	11.4×10^{-4} kg·m^2 (62 oz-in)
Diameter of Load Inertia (Thickness: 10 mm (0.39 in.), Material: Aluminum)	319 mm (12.6 in.)	143 mm (5.63 in.)

Improved Damping Characteristics at Start and Stop

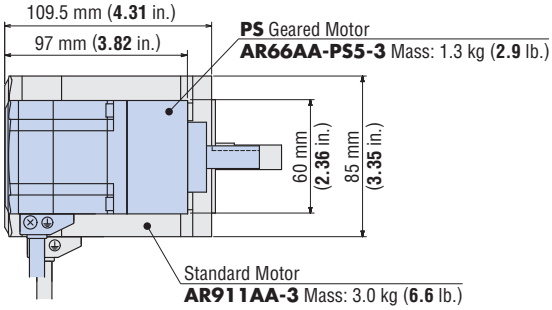
If the inertial load is large or acceleration/deceleration time is short, a geared motor can increase damping more effectively and thereby ensure more stable operation compared to a standard motor. Geared motors are ideal for applications where a large inertia such as an index table or arm must be driven to perform quick positioning.





Smaller Size

When a standard motor is compared with a geared motor that generates equivalent torque at low speed, the geared motor has a smaller frame size, thus its mass and volume are also smaller.
Geared motors are effective when equipment must be kept small and light.

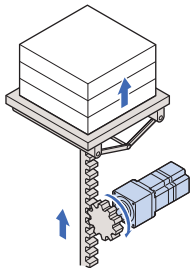


●High Rigidity, Resistant to Torsional Force

Geared motors have high rigidity and are therefore resistant to torsional force. Compared to standard motors, geared motors are less subject to load torque fluctuation. This means that stability and high positioning accuracy can be ensured even when the load size changes.

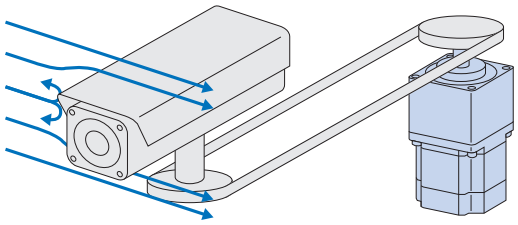
◇Applications: Elevator

The application can be stopped accurately, even with elevators and other mechanisms that perform vertical operations where the number of loads or weight of loads changes.



◇Applications: Security Camera

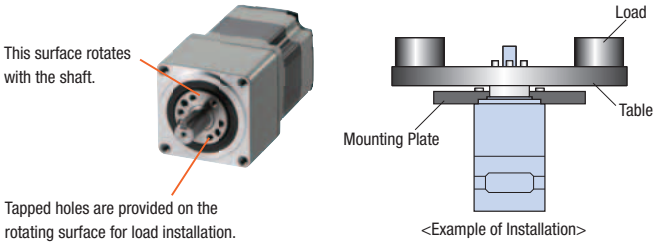
The position can be held securely even when the camera sways due to strong wind.



●Surface Installation of Load (Harmonic geared type)

The harmonic geared type permits installation of a load directly on the rotating surface integrated with the shaft. [Except for geared motors with a frame size of 90 mm (3.54 in.)]

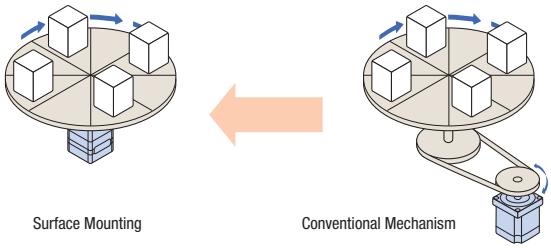
◇Appearance and Installation Example



<Example of Installation>

◇Application: Index Table

This not only reduces the number of parts/processes, but also improves reliability. They are also suitable for operating loads that receive moment loads.



Surface Mounting　　Conventional Mechanism

■Product Line of Geared Motors

Example of **AR** Series

Geared Type	Features	Permissible Torque and Max. Instantaneous Torque [N·m (lb-in)]	Backlash [arcmin (degrees)]	Basic Resolution [deg/step]	Output Shaft Speed [r/min]
Low backlash **TH** Geared Type (Spur Gear Mechanism) 	· A wide variety of low gear ratios, high-speed operations · Gear ratios: 3.6, 7.2, 10, 20, 30	12 (106)	10 (0.17)	0.012	500
Low backlash **PS** Geared Type (Planetary Gear Mechanism) 	· High permissible/max. instantaneous torque · A wide variety of gear ratios for selecting the desired step angle · Centered shaft · Gear ratios: 5, 7.2, 10, 25, 36, 50	Permissible Torque 37 (320) Max. Instantaneous Torque 60 (530)	7 (0.12)	0.0072	600
Non-backlash **PN** Geared Type (Planetary Gear Mechanism) 	· High speed (low gear ratio), high positioning accuracy · High permissible/max. instantaneous torque · A wide variety of gear ratios for selecting the desired step angle · Centered shaft · Gear ratios: 5, 7.2, 10, 25, 36, 50	Permissible Torque 37 (320) Max. Instantaneous Torque 60 (530)	2 (0.034)	0.0072	600
Non-backlash **Harmonic Geared Type** (Harmonic Drive) 	· High positioning accuracy · High permissible/max. instantaneous torque · High gear ratios, high resolution · Centered shaft · Gear ratios: 50, 100	Permissible Torque 37 (320) Max. Instantaneous Torque 55 (480)	0	0.0036	70

Note

- The values shown above must be used as reference. These values vary depending on the frame size and gear ratio.
- For the principle and the structure of each geared type, refer to technical reference.

For stepper motor and servo motor gears ➜ Page H-51

How to Read Specifications

	Product Name	Built-in Controller Type		RKS566□□D□-◇	RKS566□□D-PS5-◇
		Pulse Input Type		RKS566□□-◇	RKS566□□-PS5-◇
①	Maximum Holding Torque		N·m (lb-in.)	0.96 (136 oz-in.)	3.5 (30)
②	Rotor Inertia		J: kg·m^2 (oz-in^2)	270×10^{-7} (1.48) [430×10^{-7} (2.4)] (270×10^{-7} (1.48))	270×10^{-7} (1.48) [430×10^{-7} (2.4)]
③	Rated Current		A/Phase	0.75	
④	Basic Step Angle			0.72°	0.144°
⑤	Gear Ratio			–	5
⑥	Permissible Torque		N·m	–	3.5 (30)
⑦	Maximum Instantaneous Torque		N·m	–	✻
⑧	Holding Torque at Motor Standstill	Power ON	N·m	0.48 (68 oz-in.)	2.7 (23)
		Electromagnetic Brake	N·m	0.48 (68 oz-in.)	2.7 (23)
⑨	Speed Range		r/min	–	0～600
⑩	Backlash		arcmin	–	7 (0.12°)
⑪	Power Supply Input	Voltage and Frequency		Single-Phase 100-120 VAC, Single-Phase 200-240 VAC −15～+10% 50/60 Hz	
		Input Current A	Single-Phase 100-120 VAC	3.8	
			Single-Phase 200-240 VAC	2.4	
⑫	Excitation Mode			Microstep	
	Control Power Supply			24 VDC±5% 0.2 A	
	Electromagnetic Brake	Power Supply Input		24 VDC±5% 0.25 A	

✻For the geared motor output torque, refer to the speed–torque characteristics.

①Maximum Holding Torque

This is the maximum holding torque (holding force) the motor has when power is supplied (at rated current) but the motor is not rotating. (With geared types, the value of holding torque considers the permissible strength of the gear.)

②Rotor Inertia

This refers to the inertia of the rotor inside the motor. This is necessary when the required torque (acceleration torque) for the motor is calculated.

③Rated Current

The rated current is determined by the motor temperature rise. It is the current value that can flow to the motor windings continuously at motor standstill. As a general rule, the current setting must be the rated current.

④Basic Step Angle

The resolution is the angular distance (in degrees) that the motor moves upon input of one pulse signal from the driver. It differs depending on the motor structure and excitation mode.

⑤Gear Ratio

This is the ratio of the rotation speed between the input speed from the motor and the speed of the output gear shaft. For example, a gear ratio of 10 indicates that when the input speed from the motor is 10 r/min, the output gear shaft speed is 1 r/min.

⑥Permissible Torque

The permissible torque represents the maximum value limited by the mechanical strength of the output gear shaft when operated at a constant speed.
For the types other than the **TS** geared, **PS** geared, **PN** geared, **HPG** geared, and harmonic geared types, the total torque including acceleration and deceleration torque should not exceed the permissible torque.

⑦Maximum Instantaneous Torque (**TS** geared, **PS** geared, **PN** geared, **HPG** geared, and harmonic geared types)

This is the maximum torque that can be applied to the gear output shaft during acceleration/deceleration such when an inertial load is started and stopped.

⑧Holding Torque at Motor Standstill

While Power is ON: Holding torque when the automatic current cutback function is active (factory setting) is shown.
Electromagnetic Brake: Static friction torque when the electromagnetic brake is activated at standstill is shown.
(Electromagnetic brake is power off activated type)

⑨Permissible Speed Range

This is the range for rotation speed on the output gear shaft.

⑩Backlash

This is the play of the output gear shaft when the motor shaft is fixed.
When positioning in bi-direction, the positioning accuracy is affected.

⑪Power Supply Input

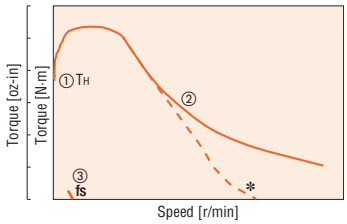
The current value of the power input is the maximum input current value. (The input current varies according to the rotation speed.)

⑫Excitation Mode

The driver has a function that can change the motor's step angle. The step angle value at which the motor can be operated is shown in the table. (The step angle value for microsteps is explained separately.)

How to Read Speed – Torque Characteristics

The characteristics diagram below shows the relationship between the speed and torque when a stepper motor is driven. The required speed and torque is always used when selecting a stepper motor. On the graph of characteristics, the horizontal axis expresses the speed at the motor output shaft while the vertical axis expresses the torque.



The speed – torque characteristics are determined by the motor and driver, so they are greatly affected by the type of driver being used.

①Maximum Holding Torque

This is the maximum holding torque (holding force) the stepper motor has when power is supplied (at rated current) but the motor is not rotating.

②Pullout Torque

The pullout torque is the maximum torque that can be output at a given speed.
When selecting a motor, be sure that the required torque falls within this curve.

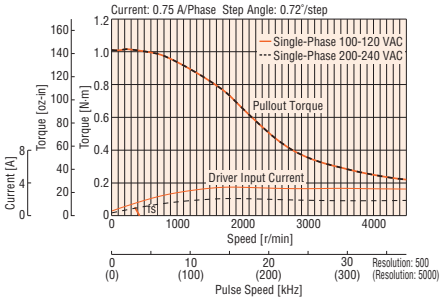
*The figure below shows the pullout torque when no clean damper or inertial load is installed (for reference).

③Maximum Starting Frequency (fs)

This is the maximum pulse speed at which the motor can start and stop instantaneously (without an acceleration or deceleration time) when the frictional load and inertial load of the stepper motor are 0. Driving the motor at a pulse speed in excess of this rate will require a gradual acceleration/deceleration. This frequency drops when there is an inertial load on the motor.

●Inertial Load – Starting Frequency Characteristics ➜ Page H-35

The figure on the right shows the speed – torque characteristics of the 0.72° stepper motor and driver package **RKII** Series.



Common Specifications

Permissible Radial Load and Permissible Axial Load

AR Series

Unit = N (lb.)

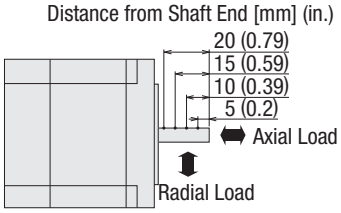
Type	Motor Frame Size mm [in.]	Product Name	Gear Ratio	Permissible Radial Load Distance from Shaft End mm [in.] 0 [0]	5 [0.2]	10 [0.39]	15 [0.59]	20 [0.79]	Permissible Axial Load
Standard Type	28 [1.10]	**AR24**	–	25 (5.6)	34 (7.6)	52 (11.7)	–	–	1.5 (0.33)
		AR26							2.2 (0.49)
	42 [1.65]	**AR46**		35 (7.8)	44 (9.9)	58 (13)	85 (19.1)	–	4.6 (1.03) [6.1 (1.37)]*
	60 [2.36]	**AR66**		90 (20)	100 (22)	130 (29)	180 (40)	270 (60)	8.8 (1.98) [11.8 (2.6)]*
		AR69							13.7 (3) [16.7 (3.7)]*
	85 [3.35]	**AR98**		260 (58)	290 (65)	340 (76)	390 (87)	480 (108)	18 (4) [24 (5.4)]*
		AR911							29 (6.5)
TH Geared Type	28 [1.10]	**AR24**	**7.2**, **10**, **20**, **30**	15 (3.3)	17 (3.8)	20 (4.5)	23 (5.1)	–	10 (2.2)
	42 [1.65]	**AR46**	**3.6**, **7.2**, **10**, **20**, **30**	10 (2.2)	14 (3.1)	20 (4.5)	30 (6.7)	–	15 (3.3)
	60 [2.36]	**AR66**		70 (15.7)	80 (18)	100 (22)	120 (27)	150 (33)	40 (9)
	90 [3.54]	**AR98**		220 (49)	250 (56)	300 (67)	350 (78)	400 (90)	100 (22)
PS Geared Type	28 [1.10]	**AR24**	**5**, **7.2**, **10**	45 (10.1)	60 (13.5)	80 (18)	100 (22)	–	20 (4.5)
	42 [1.65]	**AR46**	**5**, **7.2**, **10**	73 (16.4)	84 (18.9)	100 (22)	123 (27)	–	50 (11.2)
			25, **36**, **50**	109 (24)	127 (28)	150 (33)	184 (41)	–	
	60 [2.36]	**AR66**	**5**	200 (45)	220 (49)	250 (56)	280 (63)	320 (72)	100 (22)
			7.2, **10**	250 (56)	270 (60)	300 (67)	340 (76)	390 (87)	
			25, **36**, **50**	330 (74)	360 (81)	400 (90)	450 (101)	520 (117)	
	90 [3.54]	**AR98**	**5**, **7.2**, **10**	480 (108)	540 (121)	600 (135)	680 (153)	790 (177)	300 (67)
			25	850 (191)	940 (210)	1050 (230)	1190 (260)	1380 (310)	
			36	930 (200)	1030 (230)	1150 (250)	1310 (290)	1520 (340)	
			50	1050 (230)	1160 (260)	1300 (290)	1480 (330)	1710 (380)	
PN Geared Type	28 [1.10]	**AR24**	**5**, **7.2**, **10**	45 (10.1)	60 (13.5)	80 (18)	100 (22)	–	20 (4.5)
	42 [1.65]	**AR46**		100 (22)	120 (27)	150 (33)	190 (42)	–	100 (22)
	60 [2.36]	**AR66**	**5**	200 (45)	220 (49)	250 (56)	280 (63)	320 (72)	
			7.2, **10**	250 (56)	270 (60)	300 (67)	340 (76)	390 (87)	
			25, **36**, **50**	330 (74)	360 (81)	400 (90)	450 (101)	520 (117)	
	90 [3.54]	**AR98**	**5**	480 (108)	520 (117)	550 (123)	580 (130)	620 (139)	300 (67)
			7.2, **10**	480 (108)	540 (121)	600 (135)	680 (153)	790 (177)	
			25	850 (191)	940 (210)	1050 (230)	1110 (240)	1190 (260)	
			36	930 (200)	1030 (230)	1150 (250)	1220 (270)	1300 (290)	
			50	1050 (230)	1160 (260)	1300 (290)	1380 (310)	1490 (330)	
Harmonic Geared Type	30 [1.18]	**AR24**	**50**, **100**	100 (22)	135 (30)	175 (39)	250 (56)	–	140 (31)
	42 [1.65]	**AR46**		180 (40)	220 (49)	270 (60)	360 (81)	510 (114)	220 (49)
	60 [2.36]	**AR66**		320 (72)	370 (83)	440 (99)	550 (123)	720 (162)	450 (101)
	90 [3.54]	**AR98**		1090 (240)	1150 (250)	1230 (270)	1310 (290)	1410 (310)	1300 (290)

*The brackets [ ] indicate the value for the electromagnetic brake product.

Note

- With a double shaft product, the output shaft located on the opposite side of the motor output shaft is used to install a slit disk or similar device. Do not apply any load torque, overhung load or thrust load on this output shaft.

Radial Load and Axial Load



●RKII Series, PKP/PK Series Stepper Motor

Unit = N (lb.)

Type	Motor Frame Size mm [in.]	Product Name	Gear Ratio	Permissible Radial Load Distance from Shaft End mm [in.] 0 [0]	5 [0.2]	10 [0.39]	15 [0.59]	20 [0.79]	Permissible Axial Load
High-Resolution Type	42 [1.65]	**PKP243**, **PKP244**		20 (4.5)	25 (5.6)	34 (7.6)	52 (11.7)	–	Less than or equal to motor weight
	56.4 [2.22]	**PKP264**, **PKP266**, **PKP268**		49 (11)	60 (13.5)	79 (17.7)	110 (24)	–	
Standard Type	20 [0.79]	**PKP213**, **PKP214**		12 (2.7)	15 (3.3)	–	–	–	
	28 [1.10]	**PKP223**, **PKP225**		25 (5.6)	34 (7.6)	52 (11.7)	–	–	
	35 [1.38]	**PKP233**, **PKP235**		20 (4.5)	25 (5.6)	34 (7.6)	52 (11.7)	–	
	42 [1.65]	**PKP243**, **PKP244**, **PKP245**, **PKP246**		20 (4.5)	25 (5.6)	34 (7.6)	52 (11.7)	–	
		RKS543, **RKS544**, **RKS545**		35 (7.8)	44 (9.9)	58 (13)	85 (19.1)	–	
	56.4 [2.22]	**PKP264**, **PKP266**, **PKP268**		49 (11)	60 (13.5)	79 (17.7)	110 (24)	–	
	60 [2.36]	**RKS564**, **RKS566**, **RKS569**		90 (20)	100 (22)	130 (29)	180 (40)	270 (60)	
	85 [3.35]	**PK296**, **PK299**, **PK2913**, **RKS596**, **RKS599**, **RKS5913**		260 (58)	290 (65)	340 (76)	390 (87)	480 (108)	
SH Geared Type	28 [1.10]	**PKP223**	**7.2**, **9**, **10**, **18**, **36**	15 (3.3)	17 (3.8)	20 (4.5)	23 (5.1)	–	10 (2.2)
	42 [1.65]	**PKP243**	**3.6**, **7.2**, **9**, **10**, **18**, **36**	10 (2.2)	15 (3.3)	20 (4.5)	30 (6.7)	–	15 (3.3)
	60 [2.36]	**PKP264**	**3.6**, **7.2**, **9**, **10**	30 (6.7)	40 (9)	50 (11.2)	60 (13.5)	70 (15.7)	30 (6.7)
			18, **36**	80 (18)	100 (22)	120 (27)	140 (31)	160 (36)	
TS Geared Type	42 [1.65]	**RKS543**	**3.6**, **7.2**, **10**	20 (4.5)	30 (6.7)	40 (9)	50 (11.2)	–	15 (3.3)
			20, **30**	40 (9)	50 (11.2)	60 (13.5)	70 (15.7)	–	
	60 [2.36]	**RKS564**	**3.6**, **7.2**, **10**	120 (27)	135 (30)	150 (33)	165 (37)	180 (40)	40 (9)
			20, **30**	170 (38)	185 (41)	200 (45)	215 (48)	230 (51)	
	90 [3.54]	**RKS596**	**3.6**, **7.2**, **10**	300 (67)	325 (73)	350 (78)	375 (84)	400 (90)	150 (33)
			20, **30**	400 (90)	450 (101)	500 (112)	550 (123)	600 (135)	
PS Geared Type	42 [1.65]	**RKS545**	**5**, **7.2**, **10**	73 (16.4)	84 (18.9)	100 (22)	123 (27)	–	50 (11.2)
		RKS543	**25**, **36**, **50**	109 (24)	127 (28)	150 (33)	184 (41)	–	
	60 [2.36]	**RKS566**	**5**	200 (45)	220 (49)	250 (56)	280 (63)	320 (72)	100 (22)
			7.2, **10**	250 (56)	270 (60)	300 (67)	340 (76)	390 (87)	
		RKS564	**25**, **36**, **50**	330 (74)	360 (81)	400 (90)	450 (101)	520 (117)	
	90 [3.54]	**RKS599**	**5**, **7.2**, **10**	480 (108)	540 (121)	600 (135)	680 (153)	790 (177)	300 (67)
		RKS596	**25**	850 (191)	940 (210)	1050 (230)	1190 (260)	1380 (310)	
			36	930 (200)	1030 (230)	1150 (250)	1310 (290)	1520 (340)	
			50	1050 (230)	1160 (260)	1300 (290)	1480 (330)	1710 (380)	
Harmonic Geared Type	42 [1.65]	**RKS543**	**50**, **100**	180 (40)	220 (49)	270 (60)	360 (81)	510 (114)	220 (49)
	60 [2.36]	**RKS564**		320 (72)	370 (83)	440 (99)	550 (123)	720 (162)	450 (101)
	90 [3.54]	**RKS596**		1090 (240)	1150 (250)	1230 (270)	1310 (290)	1410 (310)	1300 (290)

Permissible Moment Load (Harmonic Geared Type)

If an eccentric load is applied when attaching an arm or table to the flange face, calculate the moment load with the following formula. The moment load should not exceed the permissible values shown in the table below.

Moment Load: M [N·m (oz-in)] = $F \times L$

Type	Motor Frame Size mm (in.)	Permissible Moment Load N·m (oz-in)
Harmonic Geared Type	20 (0.79)	0.7 (99)
	30 (1.18)	2.9 (410)
	42 (1.65)	5.6 (790)
	60 (2.36)	11.6 (1640)