

An Introduction to Stepping Motors

Introduction

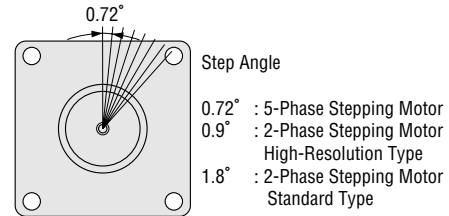
Stepping motors are digitally controlled motors used for precise positioning. They enable simple, accurate control of angle of rotation and rotation speed, so they are suitable to a wide variety of applications. Oriental Motor has brought hybrid stepping motors into its line-up to provide levels of precision and performance better than other stepping motors. These motors have been used in many applications ranging from industrial equipment to office automation.

Oriental Motor also provides a complete line with every form of product and optional equipment that a stepping motor might need, from dedicated drivers that get the most out of the motors, to controllers, precision gears and more.

Features

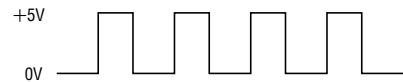
1. Easy Angle and Speed Control

Stepping motors move by rotating in steps of predetermined degrees called the step angle. The degrees rotated and the speed of rotation are easily controlled using electrical signals called pulses.



Pulses

A pulse is an electrical signal that repeats ON and OFF voltages as shown in the illustration below. Each cycle of ON and OFF (1 cycle) is called a "pulse." Normally, a 5 volts is used. ON is high and OFF is low.



2. High Torque/Good Response

Stepping motors are compact, but produce high torque. This provides excellent acceleration and fast movement.

3. High Resolution/High Positioning Precision

There are two types of stepping motors: the 5-phase stepping motor, which rotates 0.72° for each pulse, and the 2-phase stepping motor, which rotates 1.8° for each pulse. The angular distance moved corresponds to the number of pulses input, with a stopping accuracy of $\pm 0.05^\circ$ * with no load.

* $\pm 0.034^\circ$ for the 2-phase **PK-J** type with no load.
 $\pm 0.08^\circ$ for the **PMC** series with no load.

4. Holding Torque

Stepping motors produce high holding torque even while stopped. The stop position can be held without relying on a mechanical brake.

Applications

Factory Automation:

X-Y plotters, laser processors, electric discharge processors, NC machines, sewing machines, etc.

Semiconductor fabrication equipment:

Wafer processing devices, wafer conveyors, IC bonders, dicing machines, IC inspection devices, etc.

Automation and labor-saving devices:

ATMs, ticket machines, postal sorters, laboratory systems, bill counters, vending machines, etc.

Medical equipment:

Analytical instruments, blood pumps, centrifuges, spectrographs, etc.

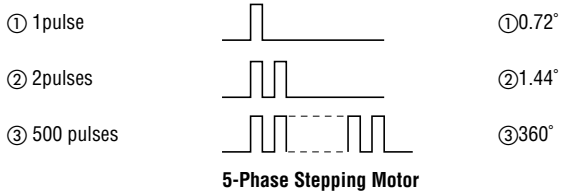
Office automation:

Copiers, faxes, word processors, printers, optical and magnetic disk devices, etc.

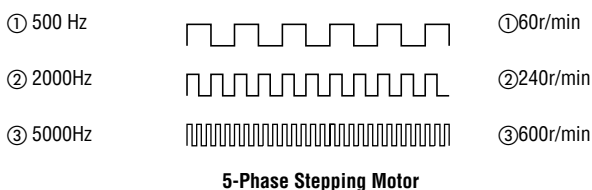
Using Stepping Motors

Stepping motors rotate according to the number of pulse signals, so speed of rotation can be controlled by the speed (frequency) of the pulse signal.

Degrees rotated



Speed of rotation



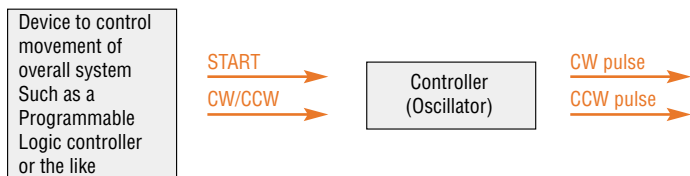
A specialized driver circuit is needed to run the stepping motor. Oriental Motor's drivers are designed for easy connection.

1. Drivers

Drivers are circuits that drive the stepping motor. They supply the optimum current for the number of motor phases.

2. Controller (Oscillators)

Controllers are circuits that control the stepping motor's angular distance of rotation and rotation speed. They create pulse signals according to settings.



Stepping Motor and Driver Packages

To get the most performance out of stepping motors, the best combination of motor and driver are joined in a package. They eliminate cumbersome initialization setups like adjusting the motor's operating current.

Types of Stepping Motor and Driver Packages

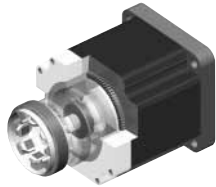
These stepping motor and driver packages deliver optimally matched motors and drivers in sets in order to fully realize the performance potential of the stepping motor. This lineup has a wealth of choices, including AC input and DC input and two-phase and five-phase operation. They can be used without adjustment.

α STEP

New generation stepping motor α STEP.

The newly developed rotor position detection sensor constantly monitors the motor movement. If synchronism is about to be lost, closed loop control is used, so there is no need to worry about loss of synchronism. Also, they provide superior responsiveness and operate synchronized with command pulses. This makes possible positioning with short strokes in a short time. These models have many other superior features as well.

Refer to page B-49 for further detail.



The newly developed sensor to detect rotor's position

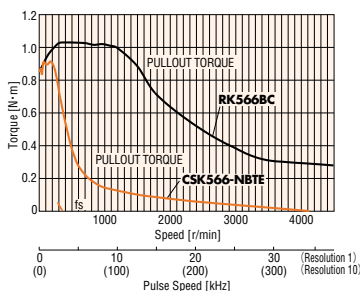
AC Driver & DC Driver

A stepping motor is driven by a DC voltage applied through a driver. In the case of Oriental Motor's DC24V input unit, DC24V is applied to the motor; in the case of AC200V-230V input, the input is rectified to DC and then about DC140V is applied to the motor.

This difference in the voltages applied to the motors appears as a difference in the torque characteristics in the high speed region.

Thus, the AC input unit has superior torque characteristics throughout, from the low speed region to the high speed region, and a large speed ratio can be obtained.

Refer to page B-13 for further detail.



Comparison of characteristics of AC input unit and DC input unit

AC Driver

AS Series Page : B-49



- STEP ANGLE: 0.36°
- NO MISSED STEP
- HIGH RESPONSE



Round Shaft Type with Electromagnetic Brake



TH Geared Type
PL Geared Type
Harmonic Geared Type with Electromagnetic Brake

RK Series Page : B-87

MICROSTEP
SMOOTH DRIVE



Round Shaft Type with Electromagnetic Brake



TH Geared Type
PN Geared Type
Harmonic Geared Type

5-Phase

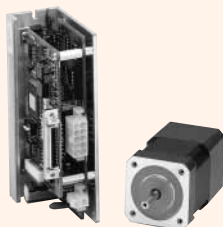
- STEP ANGLE: 0.72°
- COMPACT DRIVER
- HIGH TORQUE

2-Phase

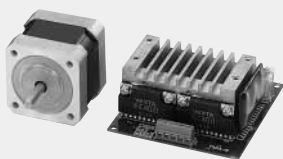
- STEP ANGLE: 1.8° (HIGH RESOLUTION : 0.9°)
- COMPACT DRIVER
- HIGH TORQUE

* The SG8030JY controller is available for controlling stepping motors. Refer to page B-201.

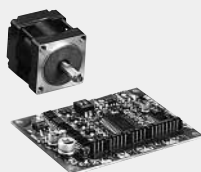
DC Driver

ASC Series Page : B-49

Round Shaft Type
TH Geared Type

CSK Series Page : B-117

Round Shaft Type
TH Geared Type

PMC Series Page : B-139

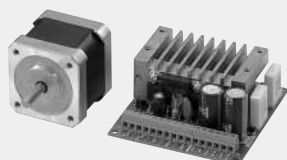
Round Shaft Type
MG Geared Type

NanoStep RFK Page : B-153

MICROSTEP



Round Shaft Type

CSK Series Page : B-173

Round Shaft Type
Round Shaft High Resolution Type
SH Geared Type

Geared Type

If vibration at low speeds is an issue, please consider the geared types. Not only does changing gears increase torque, but also these models improve starting and stopping responsiveness. Refer to page B-18 for further detail.

Harmonic Geared Type (B-20)

By using the elastic characteristics of metals for speed reduction, the impact of pitch errors on the rotation accuracy are well-balanced and equalized. The mechanism is quite different from the one of the ordinary spur gears, thereby creating non backlash.

PL Geared Type (B-18)

Until the planetary gear mechanism was introduced, we needed a very complicated adjusting mechanism to reduce the level of backlash. Now, the **PL** geared type does not only realize less backlash but also contributes to down-sizing.

PN Geared Type (B-19)

A high-strength, high-rigidity planetary gear mechanism is combined with a backlash-eliminating mechanism to keep the backlash to 3 minutes (0.05°) or less.

TH Geared Type (B-18)

For the output stage and gear, we employ the cone-shaped gear (taper gear) to realize high accuracy with low backlash.

A high-strength, high-rigidity planetary gear mechanism is combined with a backlash-eliminating mechanism to keep the backlash to 3 minutes (0.05°) or less.

Electromagnetic Brake Type

The packages with brakes use power off activated electromagnetic brakes that operate when the power is cut off, so they hold the load and prevent crashes even if the power fails.

Microstep

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, low vibration, even at low speed.

Smooth Drive

The new and innovative Smooth Drive function ensures low-vibration, low-noise operation at low speeds by executing microstep drive within the driver yet maintaining the input pulse frequency and resolution. For example, do you want to reduce vibration and noise during low-speed operation in microstep mode without changing the full-step resolution? Or, are you looking for ways to use microstep drive while keeping the pulse frequency low to accommodate the oscillator requirement? If so, the **RK** Series is the answer to your needs.

Product Line

αSTEP

- No Missed Step
- High Response
- No Hunting
- No Parameter Setting
- Low Vibration at Low Speed (Microstep Drive)
- UL Recognized, CSA Certified, CE Marking

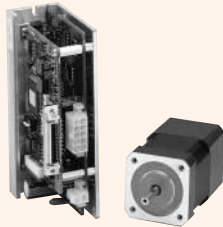
AS Series



Single-Phase 200V-230V

Motor Frame Size [mm]	Step Angle [°]	Holding Torque [N·m]	With Electro-magnetic Brake	Type	Page
60	0.36	1.2	○	Round Shaft	B-49
	0.1 ~ 0.012	1.25 ~ 4	○	TH Geared	
	0.072 ~ 0.0072	3.5 ~ 8	○	PL Geared	
85 (Geared : 90)	0.0072 ~ 0.0036	5.5, 8	○	Harmonic Geared	
	0.36	2	○	Round Shaft	
	0.1 ~ 0.012	4.5 ~ 12	○	TH Geared	
	0.072 ~ 0.0072	9 ~ 37	○	PL Geared	
	0.0072 ~ 0.0036	25, 37	○	Harmonic Geared	

ASC Series



24V DC

Motor Frame Size [mm]	Step Angle [°]	Holding Torque [N·m]	With Electro-magnetic Brake	Type	Page
28	0.36	0.055 ~ 0.12	-	Round Shaft	B-49
	0.0072 ~ 0.0036	1.5 ~ 2	-	Harmonic Geared	
42	0.36	0.3	-	Round Shaft	
	0.1 ~ 0.012	0.35 ~ 1.5	-	TH Geared	
	0.0072 ~ 0.0036	3.5 ~ 5.0	-	Harmonic Geared	
60	0.36	1	-	Round Shaft	
	0.1 ~ 0.012	1.25 ~ 4	-	TH Geared	
	0.0072 ~ 0.0036	5.5 ~ 8.0	-	Harmonic Geared	

5-Phase Motor and AC Driver Package



- Compact Driver
- High Torque
- Low Vibration at Low Speed (Microstep Driver)
- Smooth Drive Function
- Low Noise
- UL Recognized, CSA Certified, CE Marking

RK series



Single-Phase 200V-230V

Motor Frame Size [mm]	Step Angle [°]	Holding Torque [N·m]	With Electro-magnetic Brake	Type	Page
60	0.72	0.42 ~ 1.66	○	Standard	B-87
	0.2 ~ 0.024	1.25 ~ 4	-	TH Geared	
	0.144 ~ 0.0144	3.5 ~ 8	-	PN Geared	
	0.0144 ~ 0.0072	5.5 ~ 8	-	Harmonic Geared	
85 (Geared : 90)	0.72	2.1 ~ 6.3	○	Standard	
	0.2 ~ 0.024	4.5 ~ 12	-	TH Geared	
	0.144 ~ 0.0144	14 ~ 37	-	PN Geared	
	0.0144 ~ 0.0072	25 ~ 37	-	Harmonic Geared	

5-Phase Motor

PK type

- High Torque
- Low Vibration
- Low Noise



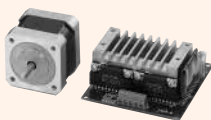
Motor Frame Size [mm]	Step Angle [°]	Holding Torque [N·m]	Type	Page
42	0.72	0.13 ~ 0.24	Standard	B-165
60	0.72	0.42 ~ 1.66		
85	0.72	2.1 ~ 6.3		

5-Phase Motor and DC Driver Packages

CSK series

- Compact Driver
- High Torque
- Low Vibration
- Low Noise

24V DC

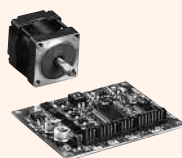


Motor Frame Size [mm]	Step Angle [°]	Holding Torque [N·m]	Type	Page
42	0.72	0.13 ~ 0.24	Round Shaft	B-117
	0.1 ~ 0.024	0.7 ~ 1.5	TH Geared	
60	0.72	0.42 ~ 1.66	Round Shaft	
	0.1 ~ 0.024	2.5 ~ 4	TH Geared	
85	0.72	2.1 ~ 6.3	Round Shaft	

PMC series

- Compact & Light Weight

24V DC (36V DC)



Motor Frame Size [mm]	Step Angle [°]	Holding Torque [N·m]	Type	Page
28	0.72	0.033 ~ 0.06	Round Shaft	B-139
	0.2 ~ 0.024	0.08 ~ 0.51	MG Geared	

NanoStep™

RFK

- Low Vibration at Low Speed (Microstep Drive)
- Low Noise

24V DC



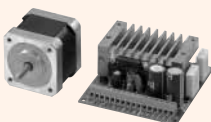
Motor Frame Size [mm]	Step Angle [°]	Holding Torque [N·m]	Type	Page
42	0.72	0.13 ~ 0.24	Round Shaft	B-153
60	0.72	0.42 ~ 1.66		

2-Phase Motor and DC Driver Packages

CSK series

- Compact Driver
- High Torque
- Many Functions

24V DC (36V DC)

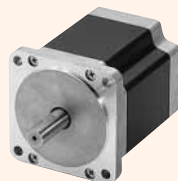


Motor Frame Size [mm]	Step Angle [°]	Holding Torque [N·m]	Type	Page
42	1.8	0.16 ~ 0.32	Round Shaft	B-173
	0.9	0.16 ~ 0.32	High Resolution	
	0.5 ~ 0.05	0.2 ~ 0.8	SH Geared	
60	1.8	0.39 ~ 1.35	Round Shaft	
	0.9	0.39 ~ 1.35	High Resolution	
	0.5 ~ 0.05	1 ~ 4	SH Geared	

2-Phase Motor

PK type

- High Torque
- Low Vibration
- Low Noise



Motor Frame Size [mm]	Step Angle [°]	Holding Torque [N·m]	Type	Page
28	1.8	0.05 ~ 0.11	Round Shaft	B-193
	0.25 ~ 0.05	0.3 ~ 0.4	SH Geared	
35	1.8	0.16 ~ 0.37	Round Shaft	
	1.8	0.16 ~ 0.93	Round Shaft	
42	0.9	0.16 ~ 0.38	Round Shaft High Resolution	
	0.5 ~ 0.05	0.2 ~ 0.8	SH Geared	
56.4 (60)	1.8	0.39 ~ 1.75	Round Shaft	
	1.8	0.75 ~ 3.10	High Inertia Capability	
	0.9	0.39 ~ 1.75	Round Shaft High Resolution	
85 (Geared : 90)	0.5 ~ 0.05	1 ~ 4	SH Geared	
	1.8	2.2 ~ 9.3	Round Shaft, Terminal Box	
	0.5 ~ 0.05	2.5 ~ 12	SH Geared	