

0.36° Closed Loop Stepping Motor and Driver Package α STEP AS Series Built-In Controller Package

For details on this product please refer to our website, contact technical support or your nearest Oriental Motor sales office.
www.orientalmotor.com

The **AS** Series is a motor and driver package offering the user-friendliness of a stepping motor combined with improved response and reliability of our unique α STEP closed loop technology.



For detailed product safety standard information including standards, file number and certification body, please visit www.orientalmotor.com.



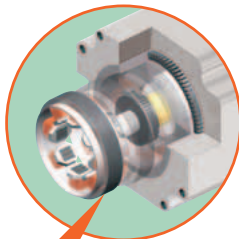
Features

● Incorporating Our Unique Closed Loop Control

This product uses our closed loop control to maintain positioning operation even during abrupt load fluctuations and accelerations. The rotor position detection sensor monitors the rotation. When an overload condition is detected, it will instantaneously regain control using the closed loop mode.

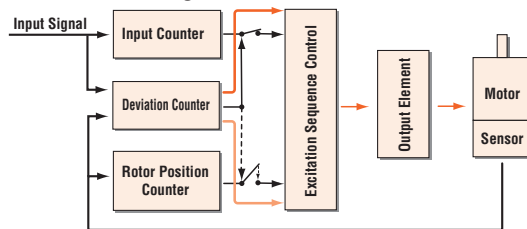
When an overload condition continues it will output an alarm signal, thereby providing reliability equal to that of a servo motor.

α STEP is designed as a "package" consisting of a motor and a driver.



Sensor detects rotor position

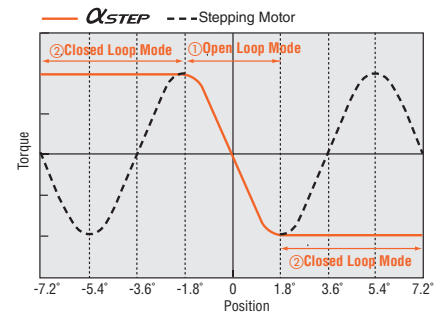
◇ α STEP Control Diagram



Normal (Positioning deviation is less than $\pm 1.8^\circ$)
Motor runs in open loop mode like a stepping motor.

During Overload Condition (Positioning deviation is $\pm 1.8^\circ$ or more)
The closed loop mode is engaged to maintain the positioning operation.

◇ α STEP Angle – Torque Characteristics



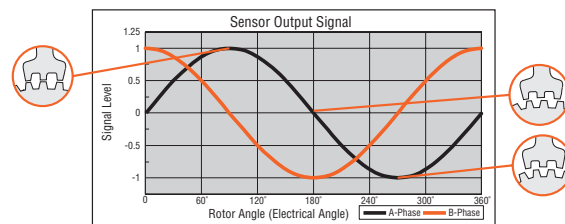
- ① If the positioning deviation is less than $\pm 1.8^\circ$, the motor runs in open loop mode like a stepping motor.
- ② If the positioning deviation is $\pm 1.8^\circ$ or more, the motor runs in closed loop mode and the position is corrected by exciting the motor windings to generate maximum torque based on the rotor position.

◇ The Sensor to Detect Rotor's Position

The α STEP rotor position detection sensor uses the change in inductance caused by change in the distance between the stator teeth and the teeth on the sensor rotor to detect rotor position.

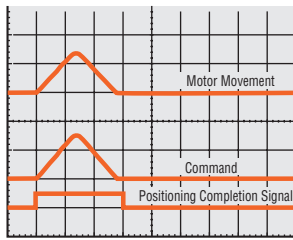
Features

- This structure can be made small and thin, so the overall size of the motor can be reduced
- High resolution
- This structure does not use electronic parts, so it is not affected by heat or vibration



● High Response

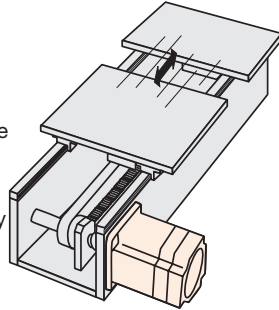
Like conventional stepping motors, **αSTEP** operates in synchronism with the command input. This makes short stroke positioning possible in a short time.



Measurement Condition:
 Feed 1/5 rotation
 Load inertia $250 \times 10^{-7} \text{ kg}\cdot\text{m}^2$ (J)
 (1.365 oz-in²)

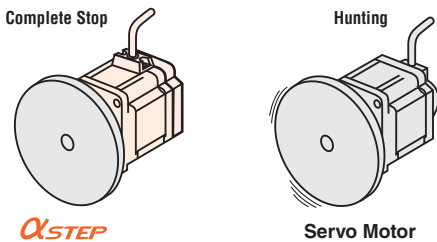
● No Gain Tuning

Gain tuning for servo motors is critical, troublesome and time-consuming. Since the **αSTEP** operates like a stepping motor, there are no gain tuning requirements. **αSTEP** is ideal for low rigidity applications, such as belt and pulley system.



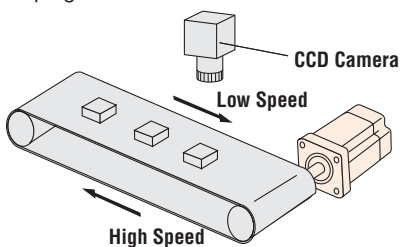
● No Hunting

Since **αSTEP** is a stepping motor, it has no hunting problem. Therefore, when it stops, its position is completely stable and does not fluctuate. **αSTEP** is ideal for applications in which hunting would be a problem.



● Low Vibration at Low Speed

The driver employs advanced technology that produces smoothness comparable to a microstep driver. Its vibration level is incredibly low, even when operating in the low speed range. When frequent changes from low to high (or vice versa) speed operations are required, the use of the Resolution Select Function solves the problem. **αSTEP** provides resolution as high as 0.036° per step without any damping mechanism or other mechanical device.



αSTEP is well-suited to applications where smooth movement or stability is required, such as where a camera is used to monitor the quality of a product.

● Motor/Driver Connection with a Single Cable

αSTEP requires only one cable for connection between the motor and the driver. Wiring is much simpler compared with conventional servo motors requiring two cables, one for motor and the other for encoder. The cable can be extended to a maximum of 20 m (65.6 ft.) [10 m (32.8 ft.) for flexible extension cable], so the motor and the driver can be installed in locations far apart.

● A Full Lineup including Geared Types and Industrial Connector Type

The geared types enable driving of large inertial loads and positioning at higher accuracy, while the industrial connector type provides IP65 level of ingress protection against dust and water. The **αSTEP** offers a wide range of models meeting the needs of various applications.



Standard Type Industrial Connector

● A dedicated motor cable for industrial connector type (sold separately) is needed to connect the industrial connector type motor and driver.

● Improved Motor

- Protective Earth Terminal

[Excluding motors with a frame size of 42 mm (1.65 in.)]








- Twice the Motor Life (compared with a conventional model)

The life of a motor is affected by its bearing.

The **αSTEP** achieves approximately twice the life of a conventional motor by adopting a modified bearing. [Available only with the standard type and standard electromagnetic brake type with a frame size of 60 or 85 mm (2.36 or 3.35 in.).]

Introduction	AC Input Motor & Driver	DC Input Motor & Driver
AR	0.36° / Geared	0.36° / Geared
AS	0.72° / Geared	0.9° / 1.8° / Geared
UMK	0.9° / 1.8°	1.8° / Geared
AR	0.36° / Geared	0.36° / Geared
ASX	0.36° / Geared	0.9° / 1.8° / Geared
CRK	0.36° / 0.72° / Geared	0.9° / 1.8° / Geared
CMK	0.9° / 1.8° / Geared	1.8° / Geared
RBK	1.8° / Geared	Motor Only
PK	0.36°	0.9°
PK	0.72°	1.8°
PK	0.9°	Geared
PK/PV	1.8°	Controllers
PK	Geared	SCX10
		EMP400
		/SG8030J
		Accessories

Characteristics Comparison for Motors and Geared Motors


Motor Type Geared Type	Features	Permissible Torque/ Maximum Torque [N·m (lb-in)]	Backlash [min (degrees)]	Basic Resolution [deg/step]	Output Shaft Speed [r/min]
Standard 	· Basic model of α STEP motor	Maximum Holding Torque 4 (35)	—	0.36	4000
Standard Type Industrial Connector 	· The industrial connector type motor offering IP65 level of ingress protection against dust and water.	Maximum Holding Torque 4 (35)	—	0.36	4000
Low backlash TH Geared (Parallel shaft) 	· A wide variety of low gear ratios, high-speed operation · Gear ratios: 3.6, 7.2, 10, 20, 30	12 (106)	45 (0.75)	0.012	500
Non-backlash PN Geared (Planetary) 	· High speed (low gear ratios), high accuracy positioning · High permissible/maximum torque · A wide variety of gear ratios for selecting the desired step angle (resolution) · Centered output shaft · Gear ratios: 5, 7.2, 10, 25, 36, 50	Permissible Torque 37 (320) Maximum Torque 60 (530)	3 (0.05)	0.0072	600
Non-backlash Harmonic Geared (Harmonic drive) 	· High accuracy positioning · High permissible/maximum torque · High gear ratios, high resolution · Centered output shaft · Gear ratios: 50, 100	Permissible Torque 37 (320) Maximum 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.

● **AS Series offers various motor frame sizes in accordance with the motor type and power supply voltage, as shown below.**

[□42 (□1.65): indicates a motor frame size of 42 mm (1.65 in.)]

	Power Supply Voltage	Standard Type	Standard Type Industrial Connector	TH Geared Type	PN Geared Type	Harmonic Geared Type
Built-In Controller Package 	Single-Phase 100-115 VAC	□42 (□1.65) □60 (□2.36) □85 (□3.35)	□60 (□2.36) □85 (□3.35)	□42 (□1.65) □60 (□2.36) □90 (□3.54)	□42 (□1.65) □60 (□2.36) □90 (□3.54)	□42 (□1.65) □60 (□2.36) □90 (□3.54)
	Single-Phase 200-230 VAC	□60 (□2.36) □85 (□3.35)	□60 (□2.36) □85 (□3.35)	□60 (□2.36) □90 (□3.54)	□60 (□2.36) □90 (□3.54)	□60 (□2.36) □90 (□3.54)
	Three-Phase 200-230 VAC	□60 (□2.36) □85 (□3.35)	□60 (□2.36) □85 (□3.35)	□60 (□2.36) □90 (□3.54)	□60 (□2.36) □90 (□3.54)	□60 (□2.36) □90 (□3.54)

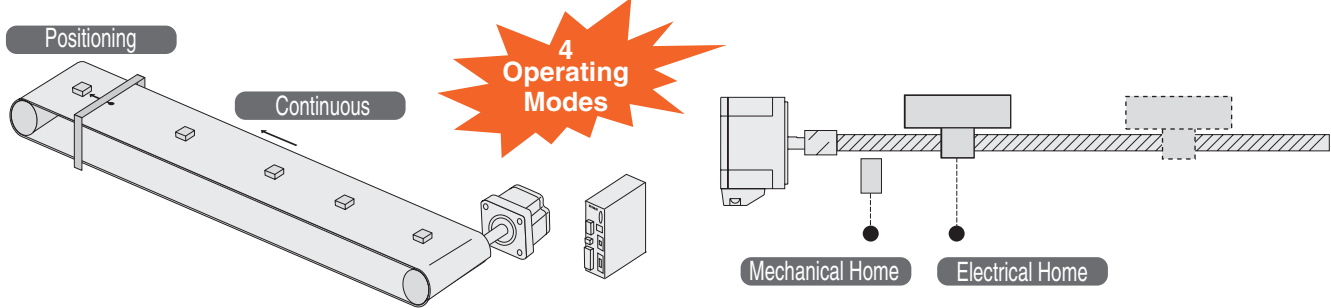
● All the packages can be available with a motor and an electromagnetic brake. (Except for the industrial connector type.)

Features of the Built-In Controller Package

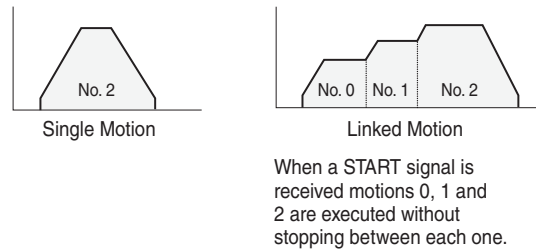
The built-in controller driver has an integrated controller which ensures a simple, efficient solution for stepping motor applications. Intelligent, integrated and ideal for technology's increasing demand on motion control, the built-in controller is computer-programmable via an RS-232C connection.



Operating Modes

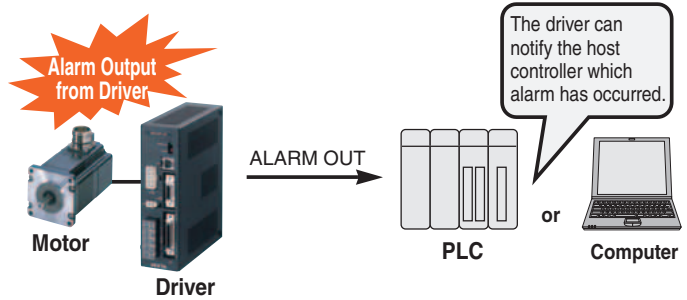


Linked Motion Capability

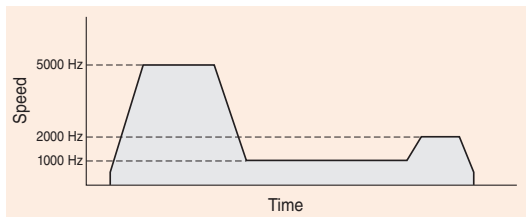


Alarm Functions

The driver can flash LEDs to indicate which alarm has occurred.



Speed Change on the Fly



The running speed of the motor can be changed while the motor is in motion.

Daisy Chain



Up to 36 units can be daisy chained via a customer supplied cable.

Introduction
AC Input Motor & Driver
0.36° / Geared / AR
0.72° / Geared / AS
0.9°/1.8° / Geared / RK
0.9°/1.8° / Geared / UMK
DC Input Motor & Driver
0.36° / Geared / AR
0.36° / Geared / ASX
0.36°/0.72° / Geared / CRK
0.9°/1.8° / Geared / CMK
1.8° / Geared / RBK
0.36° / Geared / PK
0.72° / Geared / PK
Motor Only
0.9° / Geared / PK
1.8° / Geared / PK/PV
Geared / PK
Controllers
SCX10
EMP400
5G8030J
Accessories

● **Position Control**

- Incremental mode (relative distance specification)/Absolute mode (absolute position specification)
- Linked operation (a maximum of four motion profiles may be linked)
- Data range (in pulses): -8 388 608 to +8 388 607
- Operating speed: 10 Hz to 500 kHz (set in 1 Hz increments)

● **Four Operation Modes**

1. Positioning
2. Mechanical return to home (+LS, -LS, HOMELS)
3. Continuous
4. Electrical return to home

● **General Inputs/Outputs**

- 8 programmable inputs
- 8 programmable outputs

● **Daisy Chain Capability**

- Up to 36 units can be daisy chained with unique device ID's.

● **Communication**

- ASCII based commands
- Conforms to RS-232C communication specifications
- Start-stop asynchronous transmission method
- Transmission speed: 9600 bps
- Data length: 8 bits, 1 stop bit, no parity
- Protocol: TTY (CR+LF)
- Modular 4-pin connector

● **Program Memory**

- Maximum number of programs: 14 (including STARTUP)
- Maximum lines per program: 64
- Commands per line: 1
- Program variables: 26 (A to Z)

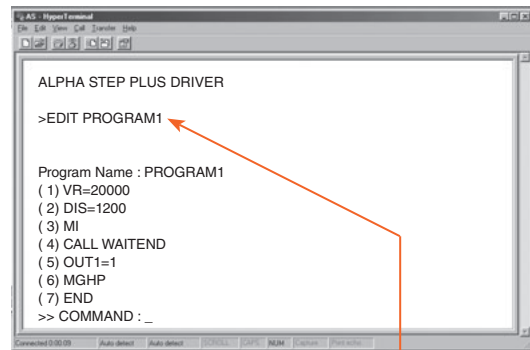
● **Built-In Functions**

- | | | |
|-------------------------------|-----------------------|---------------------|
| ● Selectable motor-resolution | ● Sensor logic | ● Display values |
| ● Run and stop current values | ● Overtravel limits | ● Incremental moves |
| ● Velocity filter set value | ● Software overtravel | ● I/O status |
| ● Motor rotation direction | ● Alarm history | |
| ● External stop | ● Syntax checking | |



Using Windows HyperTerminal®, programming the built-in controller driver is a simple task.

Example: "PROGRAM1"

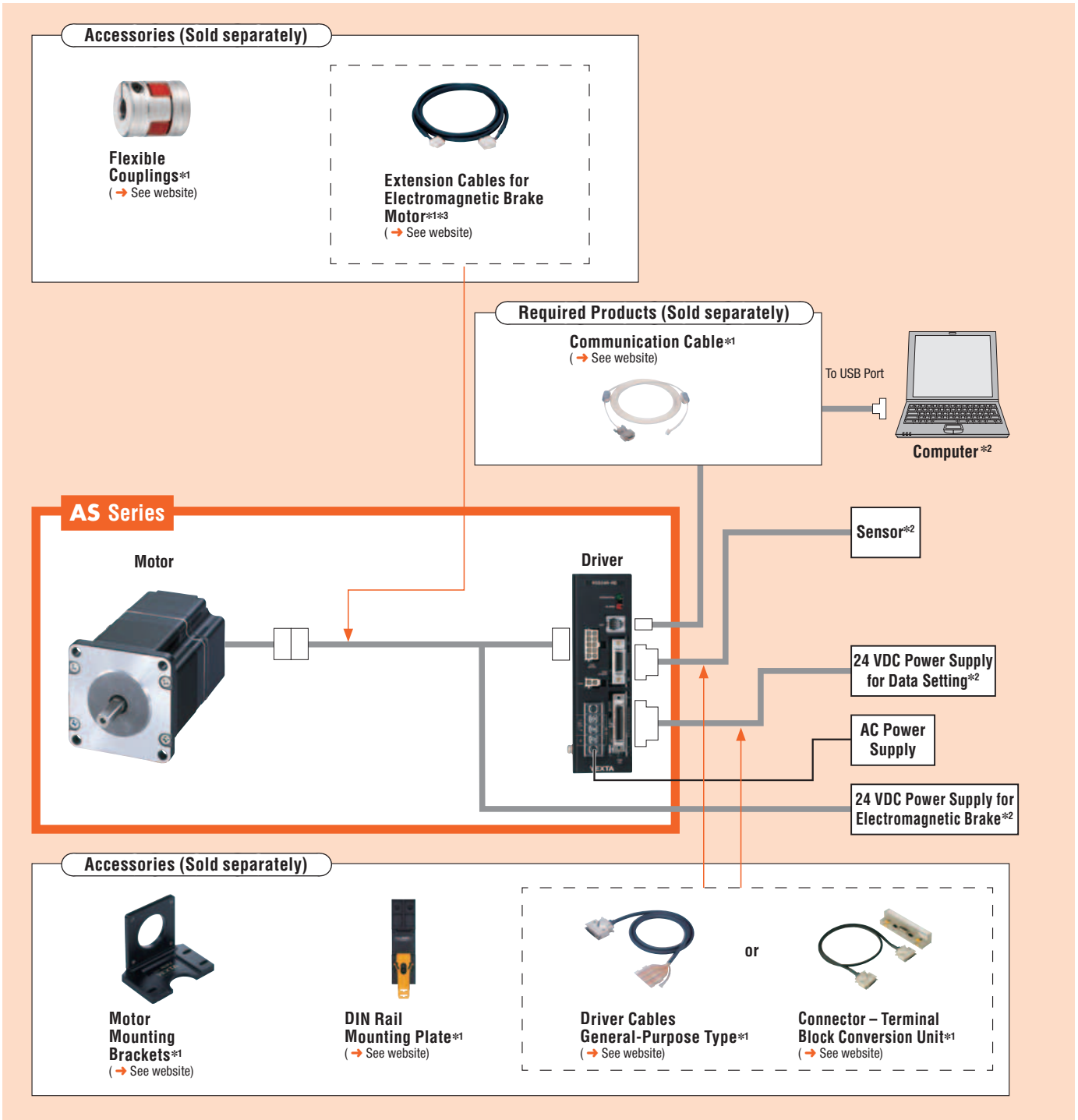


PROGRAM1 Definition

- Operating speed: 20000 Hz
- Make an incremental move of 1200 pulses
- Call a subroutine that waits for the motor to stop before moving on to the next command
- Turn on output #1
- Seek the mechanical home position in the positive direction
- End of program

System Configuration

Standard Type with Electromagnetic Brake



Example of System Configuration

AS Series	Sold Separately		+	Sold Separately				
	Extension Cable for Electromagnetic Brake Motor [3 m (9.8 ft.)]	Communication Cable		Motor Mounting Bracket	Flexible Coupling	DIN Rail Mounting Plate	Connector - Terminal Block For Sensor Input	Conversion Unit [1 m (3.3 ft.)] For Control I/O
AS66MAEP	CC03AIPM	FC04W5		PAL2P-5A	MCS300808	PADPO1	CC20T1	CC36T1

● The system configuration shown above is an example. Other combinations are available.

*1 For accessory details on these products please either refer to our website, contact technical support or your nearest Oriental Motor sale office.
www.orientalmotor.com

*2 Not supplied

*3 When extend the wiring distance of electromagnetic brake type with frame size □42 mm (□1.65 in.), use a standard extension cable.
 (→ See website)

Introduction	AC Input Motor & Driver	DC Input Motor & Driver	Controllers	Accessories
AR	0.36° / Geared	0.36° / Geared	SCX10	
AS	0.72° / Geared	0.36° / Geared	EMP400	
RK	0.9° / 1.8°	0.36° / Geared	5G8030J	
UMK	0.36° / Geared	0.9° / 1.8°		
AR	0.36° / Geared	1.8° / Geared		
ASX	0.36° / Geared			
CRK	0.36°			
CMK	0.72°			
RBK	0.9°			
PK	1.8°			
PK	Motor Only			
PK				
PK				
PK				
PK/PV				
PK				
PK				

Product Number Code

Standard Type

AS 6 6 A A E P

① ② ③ ④ ⑤ ⑥ ⑦

Standard Type Industrial Connector

AS 6 6 A A T P

① ② ③ ④ ⑤ ⑥ ⑦

Geared Type

AS 6 6 A C E P - N 50

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

AS 4 6 A A P 2 - H 100

① ② ③ ④ ⑤ ⑦ ⑩ ⑧ ⑨

①	Series	AS: AS Series
②	Motor Frame Size	4: 42 mm (1.65 in.) 6: 60 mm (2.36 in.) 9: 85 mm (3.35 in.)
③	Motor Case Length	
④	Motor Type	A: Standard (Single shaft) M: Electromagnetic Brake Type
⑤	Power Supply Voltage	A: Single-Phase 100-115 VAC C: Single-Phase 200-230 VAC S: Three-Phase 200-230 VAC
⑥	Motor Classification	
⑦	Driver Type	P: Built-In Controller Package

①	Series	AS: AS Series
②	Motor Frame Size	6: 60 mm (2.36 in.) 9: 85 mm (3.35 in.)
③	Motor Case Length	
④	Motor Type	A: Single Shaft
⑤	Power Supply Voltage	A: Single-Phase 100-115 VAC C: Single-Phase 200-230 VAC S: Three-Phase 200-230 VAC
⑥	Motor Classification	
⑦	Driver Type	P: Built-In Controller Package

①	Series	AS: AS Series
②	Motor Frame Size	4: 42 mm (1.65 in.) 6: 60 mm (2.36 in.) 9: 90 mm (3.54 in.)
③	Motor Case Length	
④	Motor Type	A: Standard (Single shaft) M: Electromagnetic Brake Type
⑤	Power Supply Voltage	A: Single-Phase 100-115 VAC C: Single-Phase 200-230 VAC S: Three-Phase 200-230 VAC
⑥	Motor Classification	
⑦	Driver Type	P: Built-In Controller Package
⑧	Gearhead Type	T: TH Geared Type N: PN Geared Type H: Harmonic Geared Type
⑨	Gear Ratio	
⑩	Reference Number	

Product Line

The product names below are all for single shaft types, but there are also double shaft types available for all products except for those with electromagnetic brakes or industrial connector. Please contact the nearest Oriental Motor sales office for further information on the double shaft types.

Built-In Controller Package

◇ Step Angle 0.36° Standard Type

Power Supply Voltage	Model (Single shaft)
Single-Phase 100-115 VAC	AS46AAP
	AS66AAEP
	AS69AAEP
	AS98AAEP
	AS911AAEP
Single-Phase 200-230 VAC	AS66ACEP
	AS69ACEP
	AS98ACEP
	AS911ACEP
Three-Phase 200-230 VAC	AS66ASEP
	AS69ASEP
	AS98ASEP
	AS911ASEP

◇ Step Angle 0.36° Standard Type Industrial Connector

Always use the motor cable for industrial connector type (sold separately) for connection between the industrial connector type motor and the driver.

Power Supply Voltage	Model (Single shaft)
Single-Phase 100-115 VAC	AS66AATP
	AS69AATP
	AS98AATP
	AS911AATP
Single-Phase 200-230 VAC	AS66ACTP
	AS69ACTP
	AS98ACTP
Three-Phase 200-230 VAC	AS66ASTP
	AS69ASTP
	AS98ASTP
	AS911ASTP

◇ TH Geared Type

Power Supply Voltage	Model (Single shaft)	
Single-Phase 100-115 VAC	AS46AAP-T3.6	
	AS46AAP-T7.2	
	AS46AAP-T10	
	AS46AAP-T20	
	AS46AAP-T30	
	AS66AAEP-T3.6	
	AS66AAEP-T7.2	
	AS66AAEP-T10	
	AS66AAEP-T20	
	AS66AAEP-T30	
	AS98AAEP-T3.6	
	AS98AAEP-T7.2	
	AS98AAEP-T10	
	AS98AAEP-T20	
	AS98AAEP-T30	
Single-Phase 200-230 VAC	AS66ACEP-T3.6	
	AS66ACEP-T7.2	
	AS66ACEP-T10	
	AS66ACEP-T20	
	AS66ACEP-T30	
	AS98ACEP-T3.6	
	AS98ACEP-T7.2	
	AS98ACEP-T10	
	AS98ACEP-T20	
	AS98ACEP-T30	
	Three-Phase 200-230 VAC	AS66ASEP-T3.6
		AS66ASEP-T7.2
		AS66ASEP-T10
		AS66ASEP-T20
		AS66ASEP-T30
AS98ASEP-T3.6		
AS98ASEP-T7.2		
AS98ASEP-T10		
AS98ASEP-T20		
AS98ASEP-T30		

The following items are included in each product.
 Motor, Parallel Key*1, Surge Suppressor*2, Driver, Connector for Input/Output Signal, Mounting Bracket for Driver (with screws), Operating Manual
 *1 Only for the products with a key slot on the output shaft
 *2 Only for electromagnetic brake type

◇ Step Angle 0.36° Standard Type with Electromagnetic Brake

Power Supply Voltage	Model (Single shaft)
Single-Phase 100-115 VAC	AS46MAP
	AS66MAEP
	AS69MAEP
	AS98MAEP
Single-Phase 200-230 VAC	AS66MCEP
	AS69MCEP
	AS98MCEP
Three-Phase 200-230 VAC	AS66MSEP
	AS69MSEP
	AS98MSEP

◇ TH Geared Type with Electromagnetic Brake

Power Supply Voltage	Model (Single shaft)	
Single-Phase 100-115 VAC	AS46MAP-T3.6	
	AS46MAP-T7.2	
	AS46MAP-T10	
	AS46MAP-T20	
	AS46MAP-T30	
	AS66MAEP-T3.6	
	AS66MAEP-T7.2	
	AS66MAEP-T10	
	AS66MAEP-T20	
	AS66MAEP-T30	
	AS98MAEP-T3.6	
	AS98MAEP-T7.2	
	AS98MAEP-T10	
	AS98MAEP-T20	
	AS98MAEP-T30	
Single-Phase 200-230 VAC	AS66MCEP-T3.6	
	AS66MCEP-T7.2	
	AS66MCEP-T10	
	AS66MCEP-T20	
	AS66MCEP-T30	
	AS98MCEP-T3.6	
	AS98MCEP-T7.2	
	AS98MCEP-T10	
	AS98MCEP-T20	
	AS98MCEP-T30	
	Three-Phase 200-230 VAC	AS66MSEP-T3.6
		AS66MSEP-T7.2
		AS66MSEP-T10
		AS66MSEP-T20
		AS66MSEP-T30
AS98MSEP-T3.6		
AS98MSEP-T7.2		
AS98MSEP-T10		
AS98MSEP-T20		
AS98MSEP-T30		

◇ PN Geared Type

Power Supply Voltage	Model (Single shaft)		
Single-Phase 100-115 VAC	AS46AAP-N7.2 AS46AAP-N10		
	AS66AAEP-N5 AS66AAEP-N7.2 AS66AAEP-N10 AS66AAEP-N25 AS66AAEP-N36 AS66AAEP-N50		
	AS98AAEP-N5 AS98AAEP-N7.2 AS98AAEP-N10 AS98AAEP-N25 AS98AAEP-N36 AS98AAEP-N50		
	Single-Phase 200-230 VAC	AS66ACEP-N5 AS66ACEP-N7.2 AS66ACEP-N10 AS66ACEP-N25 AS66ACEP-N36 AS66ACEP-N50	
		AS98ACEP-N5 AS98ACEP-N7.2 AS98ACEP-N10 AS98ACEP-N25 AS98ACEP-N36 AS98ACEP-N50	
		Three-Phase 200-230 VAC	AS66ASEP-N5 AS66ASEP-N7.2 AS66ASEP-N10 AS66ASEP-N25 AS66ASEP-N36 AS66ASEP-N50
			AS98ASEP-N5 AS98ASEP-N7.2 AS98ASEP-N10 AS98ASEP-N25 AS98ASEP-N36 AS98ASEP-N50

◇ Harmonic Geared Type

Power Supply Voltage	Model (Single shaft)	
Single-Phase 100-115 VAC	AS46AAP2-H50 AS46AAP2-H100	
	AS66AAEP-H50 AS66AAEP-H100	
	AS98AAEP-H50 AS98AAEP-H100	
	Single-Phase 200-230 VAC	AS66ACEP-H50 AS66ACEP-H100
		AS98ACEP-H50 AS98ACEP-H100
Three-Phase 200-230 VAC		AS66ASEP-H50 AS66ASEP-H100
		AS98ASEP-H50 AS98ASEP-H100

● Electromagnetic brake models except frame size □42 mm (□1.65 in.) must use an extension cable or flexible extension cable for an electromagnetic brake motor. The frame size □42 mm (□1.65 in.) models can use a standard extension cable even for electromagnetic brake motor models.

● Extension Cables for Electromagnetic Brake Motor

Model	Length m (ft.)
CC01AIPM	1 (3.3)
CC02AIPM	2 (6.6)
CC03AIPM	3 (9.8)
CC05AIPM	5 (16.4)
CC07AIPM	7 (23)
CC10AIPM	10 (32.8)
CC15AIPM	15 (49.2)
CC20AIPM	20 (65.6)

◇ PN Geared Type with Electromagnetic Brake

Power Supply Voltage	Model (Single shaft)		
Single-Phase 100-115 VAC	AS46MAP-N7.2 AS46MAP-N10		
	AS66MAEP-N5 AS66MAEP-N7.2 AS66MAEP-N10 AS66MAEP-N25 AS66MAEP-N36 AS66MAEP-N50		
	AS98MAEP-N5 AS98MAEP-N7.2 AS98MAEP-N10 AS98MAEP-N25 AS98MAEP-N36 AS98MAEP-N50		
	Single-Phase 200-230 VAC	AS66MCEP-N5 AS66MCEP-N7.2 AS66MCEP-N10 AS66MCEP-N25 AS66MCEP-N36 AS66MCEP-N50	
		AS98MCEP-N5 AS98MCEP-N7.2 AS98MCEP-N10 AS98MCEP-N25 AS98MCEP-N36 AS98MCEP-N50	
		Three-Phase 200-230 VAC	AS66MSEP-N5 AS66MSEP-N7.2 AS66MSEP-N10 AS66MSEP-N25 AS66MSEP-N36 AS66MSEP-N50
			AS98MSEP-N5 AS98MSEP-N7.2 AS98MSEP-N10 AS98MSEP-N25 AS98MSEP-N36 AS98MSEP-N50

◇ Harmonic Geared Type with Electromagnetic Brake

Power Supply Voltage	Model (Single shaft)	
Single-Phase 100-115 VAC	AS46MAP2-H50 AS46MAP2-H100	
	AS66MAEP-H50 AS66MAEP-H100	
	AS98MAEP-H50 AS98MAEP-H100	
	Single-Phase 200-230 VAC	AS66MCEP-H50 AS66MCEP-H100
		AS98MCEP-H50 AS98MCEP-H100
Three-Phase 200-230 VAC		AS66MSEP-H50 AS66MSEP-H100
		AS98MSEP-H50 AS98MSEP-H100

● Flexible Extension Cables for Electromagnetic Brake Motor

Model	Length m (ft.)
CC01SARM2	1 (3.3)
CC02SARM2	2 (6.6)
CC03SARM2	3 (9.8)
CC05SARM2	5 (16.4)
CC07SARM2	7 (23)
CC10SARM2	10 (32.8)

For details (specifications, characteristics, dimensions and others) on these products please refer either to our website, contact technical support or your nearest Oriental Motor sales office.
www.orientalmotor.com

Introduction	AC Input Motor & Driver			DC Input Motor & Driver			Motor Only				Controllers SCX10 EMP400 /5G8030J	Accessories
	0.36° /Geared QSTEP AR	0.72° /Geared QSTEP AS	0.9°/1.8° UMK	0.36° /Geared QSTEP AR	0.36° QSTEP ASX	0.36°/0.72° /Geared CRK	0.9°/1.8° /Geared CMK	1.8° /Geared RBK	0.36° PK	0.72° PK		