


# AiA-M Series

## 2-Phase Closed-Loop Stepper Motor (for AC driver)

### ■ Features

- Minimal heat generating, high torque motor
- Higher cost-efficiency compared to servo motors
- Frame size 60mm, 86mm supported
- Applied driver: AiSA-D series

 Please read "Safety Considerations" in operation manual before using.



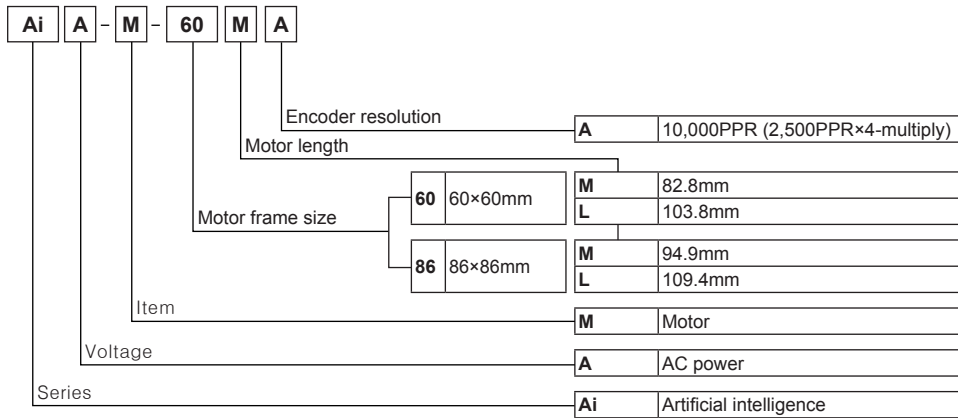
[Frame size 60mm]



[Frame size 86mm]

**NEW**

### ■ Ordering Information



### ◎ AiS-B Series

Set	Driver	Motor
AiSA-60MA	AiSA-D-60MA	AiA-M-60MA
AiSA-60LA	AiSA-D-60LA	AiA-M-60LA
AiSA-86MA	AiSA-D-86MA	AiA-M-86MA
AiSA-86LA	AiSA-D-86LA	AiA-M-86LA

# 2-Phase Closed-Loop Stepper Motor

## ■ Specifications

### ⊙ Motor

Model	AiA-M-60MA	AiA-M-60LA	AiA-M-86MA	AiA-M-86LA
Max. holding torque <sup>※1</sup>	11.22kgf·cm (1.1N·m)	22.43kgf·cm (2.2N·m)	28.56kgf·cm (2.8N·m)	40.8kgf·cm (4.0N·m)
Rotor moment of inertia	240g·cm <sup>2</sup> (240×10 <sup>-7</sup> kg·m <sup>2</sup> )	490g·cm <sup>2</sup> (490×10 <sup>-7</sup> kg·m <sup>2</sup> )	1,100g·cm <sup>2</sup> (1,100×10 <sup>-7</sup> kg·m <sup>2</sup> )	1,800g·cm <sup>2</sup> (1,800×10 <sup>-7</sup> kg·m <sup>2</sup> )
Rated current	2.0A/Phase			
Resistance ±10%	1.5Ω/Phase	2.4Ω/Phase	2.3Ω/Phase	1.9Ω/Phase
Inductance ±20%	3.9mH/Phase	8.5mH/Phase	11.5mH/Phase	16.2mH/Phase
Weight <sup>※2</sup>	Approx. 0.95kg (approx. 0.75kg)	Approx. 1.35kg (approx. 1.15kg)	Approx. 2.00kg (approx. 1.70kg)	Approx. 2.60kg (approx. 2.30kg)

※1: Max. holding torque is maintenance torque of stopping the motor when supplying the rated current (2-phase excitation) and is the standard for comparing the performance of motors.

※2: The weight includes packaging. The weight in parenthesis is for unit only.

### ● Common specifications

Standard step angle	1.8°/0.9° (Full/Half step)	
Motor phase	2-phase	
Run method	Bipolar	
Insulation class	B type (130°C)	
Insulation resistance	Over 100MΩ (at 500VDC megger), between motor coil-case	
Dielectric strength	500VAC 50/60Hz for 1 min between motor coil-case	
Vibration	1.5mm amplitude at frequency 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours	
Shock	Approx. max. 50G	
Environment	Ambient temperature	0 to 50°C, storage: -20 to 70°C
	Ambient humidity	20 to 85%RH, storage: 15 to 90%RH
Approval	CE	
Protection structure	IP30 (IEC34-5 standard)	
Stop angle error <sup>※1</sup>	±0.09°	
Shaft vibration <sup>※2</sup>	0.03mm T.I.R.	
Radial Movement <sup>※3</sup>	Max. 0.025mm (load 25N)	
Axial Movement <sup>※4</sup>	Max. 0.01mm (load 50N)	
Concentricity for shaft of setup in-low	0.05mm T.I.R.	
Perpendicularity of set-up plate shaft	0.075mm T.I.R.	

※1: Specifications are for full-step angle, without load. (values may vary by load size)

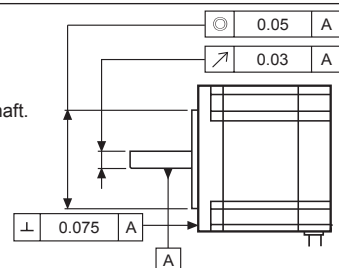
※2: T.I.R. (Total Indicator Reading)

- Indicates total quantity of dial gauge in case of 1 rotation of measuring part around the reference point.

※3: Amount of radial shaft displacement when adding a radial load (25N) to the tip of the motor shaft.

※4: Amount of axial shaft displacement when adding an axial load (50N) to the shaft.

※Environment resistance is rated at no freezing or condensation.



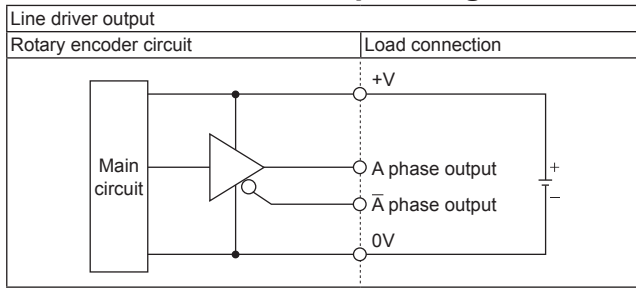
### ⊙ Encoder

Item	Incremental rotary encoder		
Resolution	10,000PPR (2,500PPR×4-multiply)		
Electrical specification	Output phase	A, $\bar{A}$ , B, $\bar{B}$ , Z, $\bar{Z}$ phase	
	Output duty rate	$\frac{T}{2} \pm \frac{T}{4}$ (T=1 cycle of A phase)	
	Phase difference of output	Output between A and B phase: $\frac{T}{4} \pm \frac{T}{8}$ (T=1 cycle of A phase)	
	Control output	Line driver output	• [Low] - Load current: max. 20mA, residual voltage: max. 0.5VDC=
		output	• [High] - Load current: max. -20mA, output voltage: min. 2.5VDC=
	Response time (rise, fall)	Max. 0.5μs (cable length: 2m, I sink = 20mA)	
	Max. response frequency	300kHz	
	Power supply	5VDC= ±5% (ripple P-P: max. 5%)	
	Current consumption	Max. 50mA (disconnection of the load)	

(A)	Photoelectric Sensors
(B)	Fiber Optic Sensors
(C)	Door/Area Sensors
(D)	Proximity Sensors
(E)	Pressure Sensors
(F)	Rotary Encoders
(G)	Connectors/ Connector Cables/ Sensor Distribution Boxes/Sockets
(H)	Temperature Controllers
(I)	SSRs / Power Controllers
(J)	Counters
(K)	Timers
(L)	Panel Meters
(M)	Tacho / Speed / Pulse Meters
(N)	Display Units
(O)	Sensor Controllers
(P)	Switching Mode Power Supplies
(Q)	Stepper Motors & Drivers & Controllers
(R)	Graphic/ Logic Panels
(S)	Field Network Devices
(T)	Software

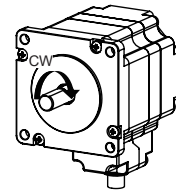
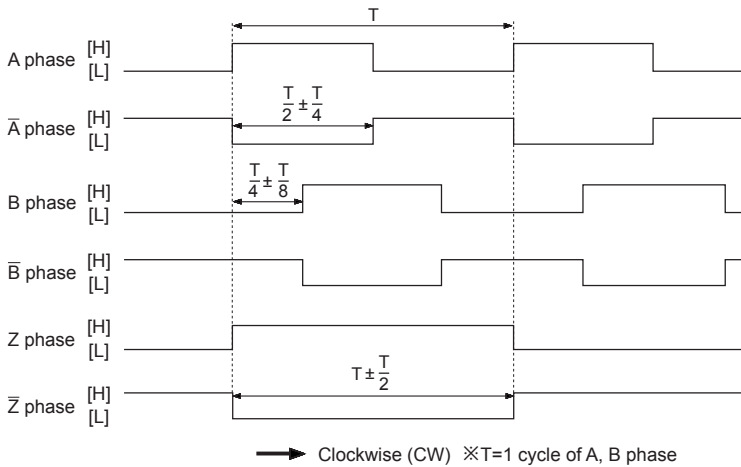
# AiA-M Series

## Encoder Control Output Diagram



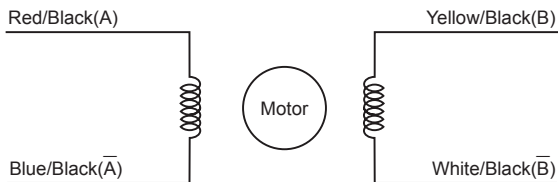
※All output circuits of A,  $\bar{A}$ , B,  $\bar{B}$ , Z,  $\bar{Z}$  phase are the same.

## Encoder Output Waveforms



## Connection Diagram

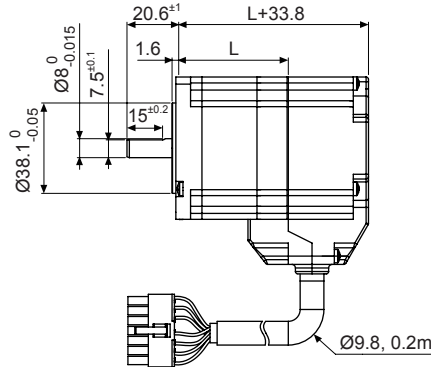
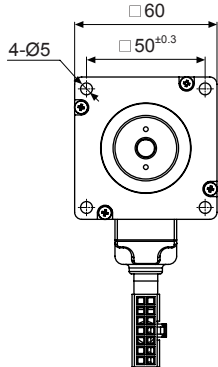
Autonics 2-phase closed-loop stepper motors take bipolar wiring methods. The wiring colors for each phase and lead-wire are as the followings:



# 2-Phase Closed-Loop Stepper Motor

## Dimensions

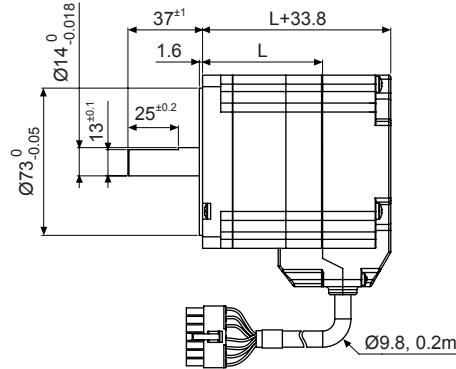
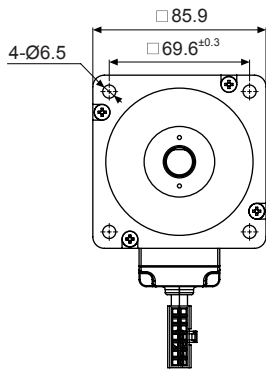
### Frame size 60mm



(unit: mm)

Model	L
AiA-M-60MA	47.4
AiA-M-60LA	68.3

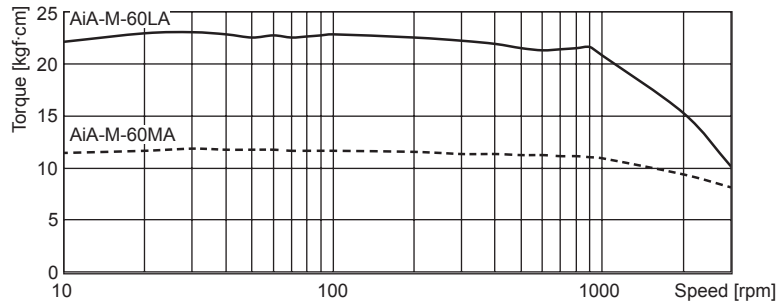
### Frame size 86mm



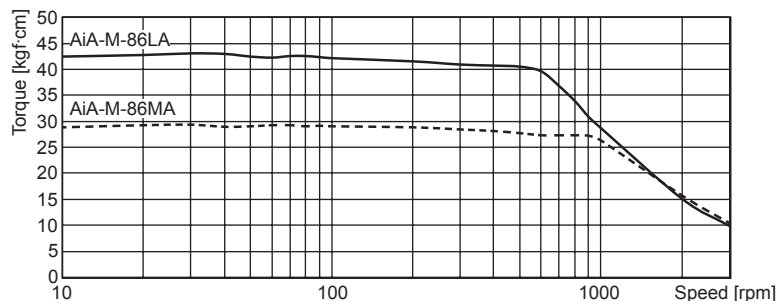
Model	L
AiA-M-86MA	59.5
AiA-M-86LA	74

## Motor Characteristics

### Frame size 60mm



### Frame size 86mm

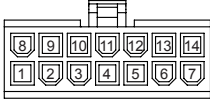


- (A) Photoelectric Sensors
- (B) Fiber Optic Sensors
- (C) Door/Area Sensors
- (D) Proximity Sensors
- (E) Pressure Sensors
- (F) Rotary Encoders
- (G) Connectors/ Connector Cables/ Sensor Distribution Boxes/Sockets
- (H) Temperature Controllers
- (I) SSRs / Power Controllers
- (J) Counters
- (K) Timers
- (L) Panel Meters
- (M) Tacho / Speed / Pulse Meters
- (N) Display Units
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# AiA-M Series

## ■ Connection Connectors of Motor


### ◎ CN1: Motor+Encoder connector

Pin arrangement	Pin No.	Function	Pin No.	Function
	1	GND	8	+5VDC
	2	Encoder A	9	Encoder $\bar{A}$
	3	Encoder B	10	Encoder $\bar{B}$
	4	Encoder Z	11	Encoder $\bar{Z}$
	5	PE	12	N-C
	6	Motor A	13	Motor B
	7	Motor $\bar{A}$	14	Motor $\bar{B}$

Type	Specifications			Manufacture	
	Connector	Connector terminal	Housing		
CN1	Motor+Encoder	5557-14R	5556T	—	Molex

※Above connector is suitable for AiA-M Series.

### ◎ Cable (sold separately)

Type	Model	
Motor+Encoder cable	Normal	Moving
	C1D14M-□※ <sup>1</sup>	C1DF14M-□※ <sup>1</sup>

※<sup>1</sup>: □ indicates cable length (1, 2, 3, 5, 7, 10).

E.g.) C1DF14M-10: 10m moving type motor+encoder cable.

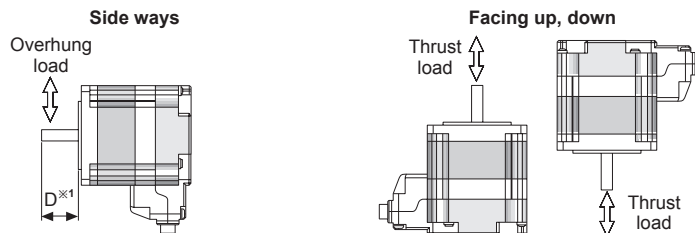
## ■ Motor Installation

### 1. Mounting direction

Motor can be mounted in any directions-facing up, facing down and side ways.

No matter which direction motors to be mounted, make sure not to apply overhung or thrust load on the shaft.

Refer to the table below for allowable shaft overhung load / thrust load.



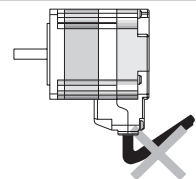
※<sup>1</sup>: The distance from the shaft in front (mm)

Motor size	The distance from the shaft in front (mm), Allowable overhung load [kgf (N)]				Allowable thrust load
	D=0	D=5	D=10	D=15	
Frame size 60mm	5.5 (54)	6.8 (67)	9.1 (89)	13.3 (130)	Under the load of motor
Frame size 86mm	26.5 (260)	29.5 (290)	34.6 (340)	39.7 (390)	

Do not apply excessive force to motor cable when mounting motors.

Do not forcibly pull or insert the cable. It may cause poor connection or disconnection of the cable by force.

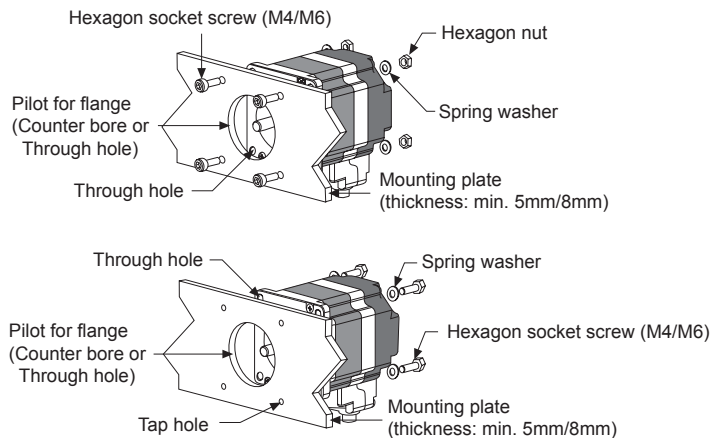
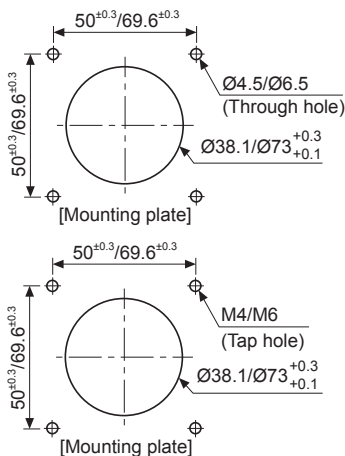
In case of frequent cable movement required application, proper safety countermeasures must be ensured.



# 2-Phase Closed-Loop Stepper Motor

## 2. Mounting method

### ◎ Frame size 60mm/86mm



With considering heat radiation and vibration isolation, mount the motor as tight as possible against a metal panel having high thermal conductivity such as iron or aluminum.

When mounting motors, use hexagon socket screws, hexagon nuts, spring washers and flat washers.

Refer to the table below for allowable thickness of mounting plate and using bolt.

Do not draw the wire with over strength 30N after wiring the encoder.

## 3. Connection with load

When connecting the load, be sure of the center, tension of the belt, and parallel of the pulley.

When connecting the load such as a pulley, a belt, be sure of the allowable thrust load, radial load, and shock.

Tighten the screw for a coupling or a pulley not to be unscrewed.

When connecting a coupling or a pulley on the motor shaft, be sure of damage of the motor shaft and the motor shaft bearing.

Do not disassemble or modify the motor shaft to connect with the load.

Direct load connection with coupling	Load connection with pulley, belt, and wire	Load connection with gear
<p>Flexible coupling Ball screw or TM screw ※Use Autonics flexible coupling (ERB Series).</p>		
<p>When connecting the load directly (ball screw, TM screw, etc) to the motor shaft, use a flexible coupling as shown in the above figure. If the center of the load is not aligned with that of shaft, it may cause severe vibration, shaft damage or shorten life cycle of the shaft bearing.</p>	<p>The motor shaft and the load shaft should be parallel. Connect the motor shaft and the line which connects the center of two pulleys to a right angle.</p>	<p>The motor shaft and the load shaft should be parallel. Connect the motor shaft to the center of gear teeth side to be interlocked.</p>

## 4. Installation condition

Install the motor in a place that meets certain conditions specified below.

It may cause product damage if it is used out of following conditions.

- ① Inside of the housing which is installed indoors  
(This unit is manufactured for the purpose of attaching to equipment. Install a ventilation device.)
- ② Within 0 to 50°C (at non-freezing status) of ambient temperature
- ③ Within 20 to 85%RH (at non-dew status) of ambient humidity
- ④ The place without explosive, flammable and corrosive gas
- ⑤ The place without direct ray of light
- ⑥ The place where dust or metal scrap does not enter into the unit
- ⑦ The place without contact with water, oil, or other liquid
- ⑧ The place without contact with strong alkali or acidity
- ⑨ The place where easy heat dissipation could be made
- ⑩ The place without continuous vibration or severe shock
- ⑪ The place with less salt content
- ⑫ The place with less electronic noise occurs by welding machine, motor, etc.
- ⑬ The place where no radioactive substances and magnetic fields exist. It shall be no vacuum status as well.

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## ■ Troubleshooting

### 1. When motor does not rotate

- ① Check the connection status between controller and driver, and pulse input specifications (voltage, width).
- ② Check the pulse and direction signal are connected correctly.

### 2. When motor rotates to the opposite direction of the designated direction

- ① When RUN mode is 1-pulse input method, CCW input [H] is for forward, [L] is for backward.
- ② When RUN mode is 2-pulse input method, check CW and CCW pulse input are changed or not.

### 3. When motor drive is unstable

- ① Check that driver and motor are connected correctly.
- ② Check the driver pulse input specifications (voltage, width).

## ■ Proper Usage

- Follow instructions in 'Proper Usage'.  
Otherwise, it may cause unexpected accidents.
- Using motors at low temperature may cause reducing ball bearing's grease consistency and friction torque is increased.  
Start the motor in a steady manner since motor's torque is not to be influenced.
- If wiring encoder cable, separate it from high voltage line or power cable for preventing surge and inductive noise. The cable length should be as short as possible.  
Failure to follow this instruction may result in raised cable resistance, residual voltage, and output waveform noise.
- Must connect the encoder shield cable to the F.G. terminal.
- For using motor, it is recommended to maintenance and inspection regularly.
  - ① Unwinding bolts and connection parts for the unit installation and load connection
  - ② Strange sound from ball bearing of the unit
  - ③ Damage and stress of lead cable of the unit
  - ④ Connection error with driver
  - ⑤ Inconsistency between the axis of motor output and the center, concentric (eccentric, declination) of the load, etc.
- This unit may be used in the following environments.
  - ① Indoors (in the environment condition rated in 'Specifications')
  - ② Altitude max. 2,000m
  - ③ Pollution degree 2
  - ④ Installation category II