

Ai-M Series

INSTRUCTION MANUAL

Autonics

Follow Autonics website for the latest information.

⚠ Warning Failure to follow instructions may result in serious injury or death.

- Caution** Failure to follow instructions may result in injury or product damage.

- 01. Use the unit within the rated specifications.**
Failure to follow this instruction may result in fire or product damage.
- 02. Brake is non-polar. When connecting the brake, use AWG 24 (0.2 mm²) cable or over.**
Failure to follow this instruction may result in malfunction due to contact failure.
- 03. Use a dry cloth to clean the unit, and do not use water or organic solvent.**
Failure to follow this instruction may result in fire.
- 04. The motor may overheat depending on the environment.**
Install the unit at the well-ventilated environment and forced cooling with a cooling fan.
Failure to follow this instruction may result in product damage or degradation by heat.
- 05. Keep the product away from metal chip, dust, and wire residue which flow into the unit.**
Failure to follow this instruction may result in fire or product damage.

- Follow instructions in 'Cautions during Use'. Otherwise, it may cause unexpected accidents.
- At low temperature, reducing the grease's consistency of ball-bearing and etc. causes the friction torque increment.
- Start the motor gradually since motor's torque is in normal state.
- Encoder shield cable must be connected to F.G. terminal.
- When wiring encoder cable, separate it from high voltage cable, power cable, etc. to prevent surge and inductive noise and keep the cable length as short as possible.
- Failure to follow this instruction may result in raised cable resistance, residual voltage and output waveform noise.

- Maintain and inspect regularly the following lists.
 - Unwinding bolts and connection parts for the unit installation and load connection
 - Abnormal sound from Ball-bearing of the unit
 - Damage and stress of lead cable of the unit
 - Connection error with driver
 - 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.
 - Indoors (in the environment condition rated in 'Specifications')
 - Altitude max. 2,000 m
 - Pollution degree 2
 - Installation category II

- Follow instructions in 'Safety Considerations' and 'Cautions during Use'. Otherwise, it may cause unexpected accidents.
- Install the motor in a place that meets the certain conditions specified below. It may cause product damage if it is used out of following conditions.
 - Inside of the housing which is installed indoors
(This unit is designed/manufactured for the purpose of attaching to equipment.
Install a ventilation device.)
 - The place without contact with water, oil, or other liquid
 - The place without contact with strong alkali or acidity
 - The place with less electronic noise occurs by welding machine, motor, etc.
 - The place where no radioactive substances and magnetic fields exist. It shall be no vacuum status as well.
- Motor can be installed horizontally and vertically. Refer to 'Shaft Allowable Load along Installation Direction'.
- If a force (30 N) exceeding the specification is applied to the motor cable during installation, it may cause the contact failure and disconnection.
If the excessive force or frequent cable movement is required, establish safety measures before use.
- In consideration of heat dissipation and vibration prevention, mount the motor as tight as possible against a metal panel with high thermal conductivity such as iron or aluminum.

- Do not disassemble or modify the motor shaft to connect with the load.
- Tighten the screw not to be unscrewed when connecting with load.
- Refer to 'Shaft Allowable Load along Installation Direction' and take care of potential shock when connecting with load.
- Connect the motor shaft and the load shaft to be parallel.
- If the center with the load is not aligned with the shaft, it may cause unexpected accidents such as severe vibration, shorten life cycle of the shaft bearing and shaft damage.
- When attaching coupling or pulley with motor shaft, be aware of damage on motor shaft and shaft bearing.

Flexible coupling
Ball Screw or TM Screw

When connecting the load directly to the motor shaft, use a flexible coupling (ERE Series).

The diagram illustrates a mechanical system. A motor at the top right drives a pulley. A rope passes over this pulley and under a lower pulley, supporting two masses. The mass on the left is a horizontal arm pivoted at its base, which can swing. The mass on the right is a vertical weight. The motor is connected to a pulley on a fixed base, and the rope is anchored to another pulley on the same base.

Connect the motor shaft and the line which connects the center of two pulleys to be perpendicular.

Connect the motor shaft to the center of gear teeth to be interlocked.

Malfunction	Troubleshooting
When motor does not excite	Check the connection status between controller and driver and pulse input specifications (voltage, width). Check the pulse and direction signal are connected correctly.
When motor rotates to the opposite direction of the designated direction	When the driver's RUN mode is 1-pulse input method, CCW input [H] is for forward, [L] is for backward. When the driver's RUN mode is 2-pulse input method, check CW and CCW pulse input are changed.
When motor drives unstable	Check the driver and motor are connected correctly. Check the driver pulse input specifications (voltage, width).

This is only for reference, the actual product does not support all combinations.
For selecting the specified model, follow the Autonics website.

① Frame size Number: frame size (unit: mm)	③ Encoder resolution A: 10,000 PPR (2,500 PPR × 4-multiply)
② Axial length S: Short M: Medium	④ Motor type No mark: standard type B: built-in brake type

- Product
- Instruction manual

- Motor + Encoder cable: C1D14M-□ (fixed type), C1DF14M-□ (flexible type)
- Flexible coupling: ERB Series

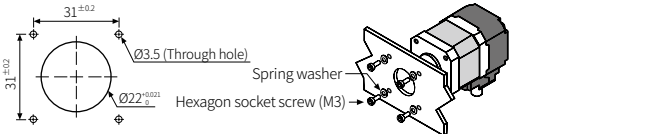
- Unit: mm, For the detailed drawings, follow the Autonics website

- [illegible]

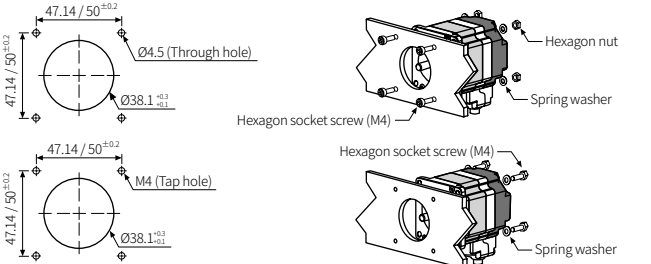
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Panel Cut-out Dimensions

- □ 42 mm • Mounting plate thickness: ≥ 4 mm



- □ 56 mm / □ 60 mm • Mounting plate thickness: ≥ 5 mm



Horizontal installation

Overhung load

Vertical installation

Thrust load

01) D: The distance from the shaft in front end (mm)


Frame size	Horizontal installation: Overhung allowable load [N]				Vertical installation: Thrust allowable load [N]
	D = 0	D = 5	D = 10	D = 15	
□ 42 mm	20	25	34	52	Under load of motor
□ 56 mm / □ 60 mm	54	67	89	130	

Model	Ai-M 42SA-□	Ai-M 42MA-□	Ai-M 42LA-□
Max. stop torque	0.25 N·m	0.4 N·m	0.48 N·m
Rotor inertia moment	35×10^{-4} kg · m ²	54×10^{-4} kg · m ²	77×10^{-4} kg · m ²
Rated current	1.7 A / Phase		
Basic step angle	1.8° / 0.9° (Full / Half step)		
Resistance	1.7 Ω / Phase ± 10%	1.85 Ω / Phase ± 10%	2.1 Ω / Phase ± 10%
Inductance	1.9 mH / Phase ± 20%	3.5 mH / Phase ± 20%	4.4 mH / Phase ± 20%
Unit weight (packaged) ⁽¹⁾	≈ 0.34 kg (≈ 0.45 kg)	≈ 0.41 kg (≈ 0.52 kg)	≈ 0.48 kg (≈ 0.59 kg)
	≈ 0.64 kg (≈ 0.77 kg)	≈ 0.73 kg (≈ 0.83 kg)	≈ 0.80 kg (≈ 0.90 kg)

Model	Ai-M-56SA-□	Ai-M-56MA-□	Ai-M-56LA-□
Max. stop torque	0.6 N·m	1.2 N·m	2.0 N·m
Rotor inertia moment	$140 \times 10^{-3} \text{ kg} \cdot \text{m}^2$	$280 \times 10^{-3} \text{ kg} \cdot \text{m}^2$	$480 \times 10^{-3} \text{ kg} \cdot \text{m}^2$
Rated current	3.5 A/Phase		
Basic step angle	1.8°/0.9° (Full / Half step)		
Resistance	0.55 Ω / Phase ± 10%	0.57 Ω / Phase ± 10%	0.93 Ω / Phase ± 10%
Inductance	1.05 mH / Phase ± 20%	1.8 mH / Phase ± 20%	3.7 mH / Phase ± 20%
Unit weight (packaged) ⁽¹⁾	≈ 0.62 kg (≈ 0.76 kg)	≈ 0.85 kg (≈ 0.99 kg)	≈ 1.22 kg (≈ 1.36 kg)
	≈ 1.65 kg (≈ 1.30 kg)	≈ 1.38 kg (≈ 1.52 kg)	≈ 1.75 kg (≈ 1.90 kg)

Model	Ai-M-60SA-□	Ai-M-60MA-□	Ai-M-60LA-□
Max. stop torque	1.1 N·m	2.2 N·m	2.9 N·m
Rotor inertia moment	$240 \times 10^{-4} \text{ kg} \cdot \text{m}^2$	$490 \times 10^{-4} \text{ kg} \cdot \text{m}^2$	$690 \times 10^{-4} \text{ kg} \cdot \text{m}^2$
Rated current	3.5 A / Phase		
Basic step angle	1.8° / 0.9° (Full / Half step)		
Resistance	1.0 Ω / Phase ± 10%	1.23 Ω / Phase ± 10%	1.3 Ω / Phase ± 10%
Inductance	1.5 mH / Phase ± 20%	2.6 mH / Phase ± 20%	3.8 mH / Phase ± 20%
Unit weight (packaged) ⁽¹⁾	≈ 0.75 kg (≈ 0.89 kg)	≈ 1.3 kg (≈ 1.27 kg)	≈ 1.44 kg (≈ 1.58 kg)
	≈ 0.76 kg (≈ 1.53 kg)	≈ 1.74 kg (≈ 1.90 kg)	≈ 2.07 kg (≈ 2.23 kg)

01) Listed in order of $\frac{\text{Standard type}}{\text{Built-in brake type}}$

Motor phase	2-phase
RUN method	Bipolar
Insulation class	B type (130°C)
Insulation resistance	Between the motor coil and the case: $\geq 100 \text{ M}\Omega$ (500 VDC== megger)
Dielectric strength	Between the all charging part and the case: 500 VAC ~ 50 / 60 Hz for 1 minute
Vibration	1.5 mm double amplitude at frequency 10 to 55 Hz in each X, Y, Z direction for 2 hours
Shock	$\leq 50 \text{ G}$
Ambient temp.	0 to 50°C, storage: -20 to 70°C (no freezing or condensation)
Ambient humi.	20 to 85%RH, storage: 15 to 90%RH (no freezing or condensation)
Protection rating	IP30 (IEC34-5 standard)
Certification	CE  ENEC
Stop angle error	$\pm 0.09^\circ$ (Full step, no load)
Shaft vibration	0.03 mm T.I.R.
Radial movement^(a)	$\leq 0.025 \text{ mm T.I.R.}$
Axial movement^(a)	$\leq 0.01 \text{ mm T.I.R.}$
Shaft concentricity	0.05 mm T.I.R.
Shaft perpendicularity	0.075 mm T.I.R.

01) Amount of radial shaft displacement when applying radial load (25 N) to the end of the shaft

02) Amount of axial shaft displacement when applying axial load (50 N) to the motor shaft.

Encoder type	Incremental rotary encoder
Power supply	5VDC \pm 5% (ripple P-P: \leq 5%)
Current consumption	\leq 50 mA (no load)
Resolution	10,000 PPR (2,500 PPR \times 4)
Control output	Line driver output
Output phase	A, \bar{A} , B, \bar{B} , Z, \bar{Z}
Output waveform	Output duty rate: $\frac{T}{2} \pm \frac{T}{4}$, A-B phase difference: $\frac{T}{4} \pm \frac{T}{8}$ (T = 1 cycle of A)
Inflow current	\leq 20 mA
Residual voltage	\leq 0.5 VDC \pm
Outflow current	\leq -20 mA
Output voltage	\geq 2.5 VDC \pm
Response speed	\leq 0.5 μ s (based on cable length: 2 m, I sink = 20 mA)
Max. response freq.	300 kHz


Built-in brake type frame size	<input type="checkbox"/> 42 mm	<input type="checkbox"/> 56 mm	<input type="checkbox"/> 60 mm
Rated excitation voltage ⁽¹⁾	24 VDC= ± 10%		
Rated excitation current	0.208 A	0.275 A	
Static friction torque	≥ 0.18 N·m	≥ 0.8 N·m	
Rotation part inertia moment	6×10 ⁻⁷ kg · m ²	19×10 ⁻⁷ kg · m ²	
Insulation class	B type (130°C)		
B type brake	Brake is released when power ON, brake is locked when power OFF		
Operating time	≤ 25 ms	≤ 30 ms	
Releasing time	≤ 10 ms	≤ 20 ms	

01) In order to reduce the heat generation of the built-in brake, the voltage drops from 24 VDC to 11.5 VDC to control

■ **Motor + Encoder connector**

Pin	Function	Pin	Function
1	GND	8	+5 VDC
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}

■ Brake connector



Pin	Function
1	24 VDC
2	GND

■ Suitable specifications

Type	Connector specifications	Manufacture
Motor + Encoder connector	5557-14R (connector terminal: 5556T)	Molex
Brake connector	5559-02P (connector terminal: 5558T)	Molex