


# AiS Series

## Pulse Train Input Type, Servo System, DC Type

### ■ Features

- Minimal heat generating, high torque motor (control voltage 55V)
- No tuning necessary, easy operation
- Fast response rate, no hunting and retain torque when stopped
- Various resolutions (electrical gears) and integrated alarm function
- Higher cost-efficiency compared to conventional servo motors
- Available in motor frame size 42mm, 56mm

 Please read "Caution for your safety" in operation manual before using.



NEW



[AiS-42 Series]



[AiS-56 Series]

### ■ Applications

- Semiconductor equipment, 3D printer, Optical inspection equipment, chip mounter, cartesian robot, conveying equipment, alignment stage, etc.

### ■ Ordering Information

AiS	-	42	L	A	
					Encoder resolution
					A 10,000P/R (2,500P/R×4-multiply)
					Motor axis length
					S Short
					M Middle
					L Long
					Motor frame size (width×height)
					42 42mm×42mm
					56 56mm×56mm
					Series
					AiS Artificial Intelligence Standard


### ◎ Model

Set	Driver	Motor
AiS-42SA	AiS-D-42SA	Ai-M-42SA
AiS-42MA	AiS-D-42MA	Ai-M-42MA
AiS-42LA	AiS-D-42LA	Ai-M-42LA
AiS-56SA	AiS-D-56SA	Ai-M-56SA
AiS-56MA	AiS-D-56MA	Ai-M-56MA
AiS-56LA	AiS-D-56LA	Ai-M-56LA

# Closed-Loop Stepper Motor System

## ■ Specifications

### ◎ Driver

Model		AiS-D-42SA	AiS-D-42MA	AiS-D-42LA	AiS-D-56SA	AiS-D-56MA	AiS-D-56LA
Power supply		24VDC					
Allowable voltage range		90 to 110% of the rated voltage					
Current consumption	STOP※ <sup>1</sup>	Max. 6W	Max. 6.5W	Max. 7W	Max. 8W	Max. 9W	Max. 10W
	Max. during operation※ <sup>2</sup>	Max. 60W			Max. 120W		
Max. RUN current※ <sup>3</sup>		1.7A/Phase			3.5A/Phase		
STOP current		25% or 50% of max. RUN current (set by SW3 switch)					
Resolution		500, 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000P/R					
Pulse input method		1 pulse or 2 pulse input method (set by SW3 switch)					
Status indicator		Power indicator: green LED, Alarm indicator: red LED, In-position indicator: Yellow LED					
Input signal		RUN pulse, HOLD OFF, Alarm reset (photocoupler input)					
Output signal		In-position, Alarm output (photocoupler output), Encoder signal (A, $\bar{A}$ , B, $\bar{B}$ , Z, $\bar{Z}$ phase) (line driver output)					
Input pulse specifications	Pulse width	CW, CCW: Input pulse frequency duty 50% (±5%), HOLD OFF: Min. 1ms, ALARM RESET: Min. 20ms					
	Rising/Falling time	CW, CCW: Max. 0.5μs					
	Pulse input voltage	[H]: 4-8VDC, [L]: 0-0.5VDC					
	Max. input pulse freq.※ <sup>4</sup>	CW, CCW: 500kHz					
Input resistance		220Ω (CW, CCW), 270Ω (HOLD OFF, ALARM RESET)					
Insulation voltage		Min. 100MΩ (at 500VDC megger)					
Dielectric strength		1,000VAC 60Hz for 1min.					
Vibration		1.5mm amplitude at frequency of 10 to 55Hz (for 1 min.) in each X, Y, Z direction for 2 hours					
Shock		300m/s <sup>2</sup> (approx. 30G) in each X, Y, Z direction for 3 times					
Environ-ment	Ambient temperature	10 to 50°C, storage: -10 to 60°C					
	Ambient humidity	35 to 85%RH, storage: 35 to 85%RH					
Approval		CE 					
Weight※ <sup>5</sup>		Approx. 400g (approx. 290g)					

※1: Based on the ambient temperature 25°C, ambient humidity 55%RH, and STOP current 50%.

※2: Max. power consumption during operation. When changing the load rapidly, instantaneous peak current may increase. The capacity of power supply should be over 1.5 to 2 times of max. power consumption.

※3: RUN current varies depending on the input RUN frequency and max. RUN current at the moment varies also.

※4: Max. input pulse frequency is max. frequency to be input and does not same as max. pull-out frequency or max. slewing frequency.

※5: The weight includes packaging. The weight in parentheses is for unit only.

※Environment resistance is rated at no freezing or condensation.

### ◎ Motor

Model	Ai-M-42SA	Ai-M-42MA	Ai-M-42LA	Ai-M-56SA	Ai-M-56MA	Ai-M-56LA
Max. holding torque <sup>※1</sup>	2.81kgf-cm (0.275N-m)	4.65kgf-cm (0.45N-m)	5.1kgf-cm (0.5N-m)	7.65kgf-cm (0.75N-m)	12.6kgf-cm (1.23N-m)	23.5kgf-cm (2.3N-m)
Rotor moment of inertia	38g-cm <sup>2</sup> (38 $\times 10^{-7}$ kg-m <sup>2</sup> )	55g-cm <sup>2</sup> (55 $\times 10^{-7}$ kg-m <sup>2</sup> )	80g-cm <sup>2</sup> (80 $\times 10^{-7}$ kg-m <sup>2</sup> )	120g-cm <sup>2</sup> (120 $\times 10^{-7}$ kg-m <sup>2</sup> )	300g-cm <sup>2</sup> (300 $\times 10^{-7}$ kg-m <sup>2</sup> )	520g-cm <sup>2</sup> (520 $\times 10^{-7}$ kg-m <sup>2</sup> )
Weight <sup>※2</sup>	Approx. 0.49kg (approx. 0.3kg)	Approx. 0.56kg (approx. 0.37kg)	Approx. 0.63kg (approx. 0.44kg)	Approx. 0.73kg (approx. 0.55kg)	Approx. 0.92kg (approx. 0.75kg)	Approx. 1.35kg (approx. 1.17kg)

### ● Common specifications

Basic step angle		1.8°/step
Number of phases		2-phase
Operation method		Bipolar
Max. allowable speed		3000rpm
Insulation class		B type (130°C)
Insulation resistance		Min. 100MΩ (at 500VDC megger), between motor coil-case
Dielectric strength		500VAC 50/60Hz for 1 min., between motor coil-case
Environment	Ambient temperature	0 to 50°C, storage: -20 to 70°C
	Ambient humidity	20 to 90%RH, storage: 15 to 95%RH
Radial movement		Max. 0.025mm (load 5N)
Protection structure		IP30 (IEC standards)

※1: Max. holding torque is standard torque when supply the rated current (2-phase holding) and stop the motor for comparing the specifications of motors.

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

※Environment resistance is rated at no freezing or condensation.

(A) Photoelectric Sensors

(B) Fiber Optic Sensors

(C) Door/Area Sensors

(D) Proximity Sensors

(E) Pressure Sensors

(F) Rotary Encoders

(G) Connectors/ 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

# Ai Series

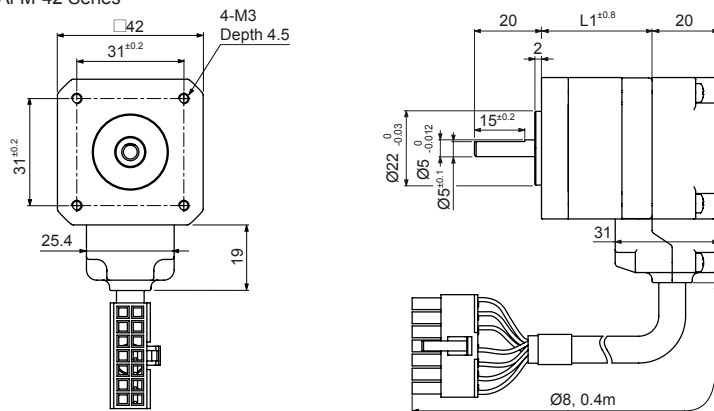
## ■ Dimensions

(unit: mm)

### ◎ Motor

※ For flexible coupling (ERB Series) information, refer to F-64 page.

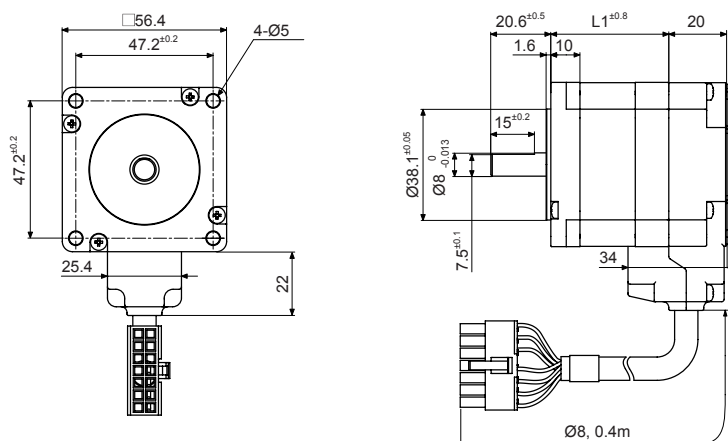
#### ● Ai-M-42 Series



(unit: mm)

Model	L1
Ai-M-42SA	33
Ai-M-42MA	39
Ai-M-42LA	47.5

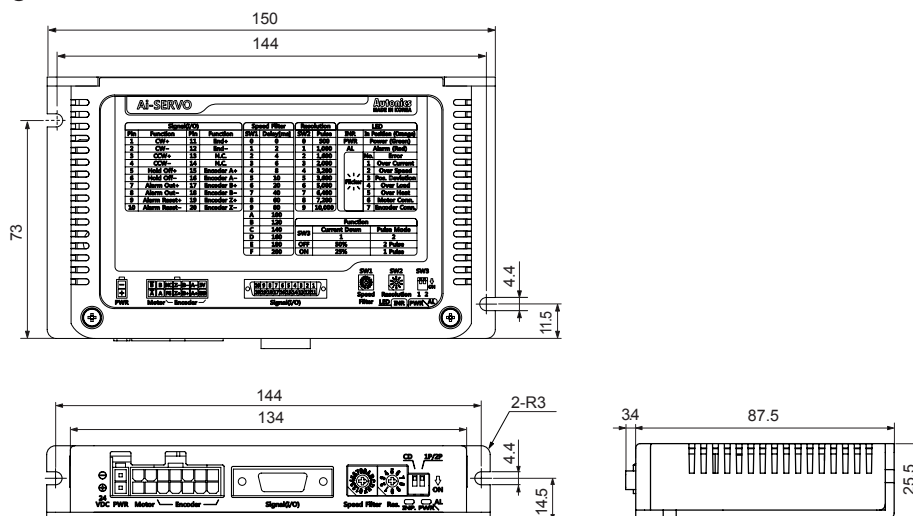
#### ● Ai-M-56 Series



(unit: mm)

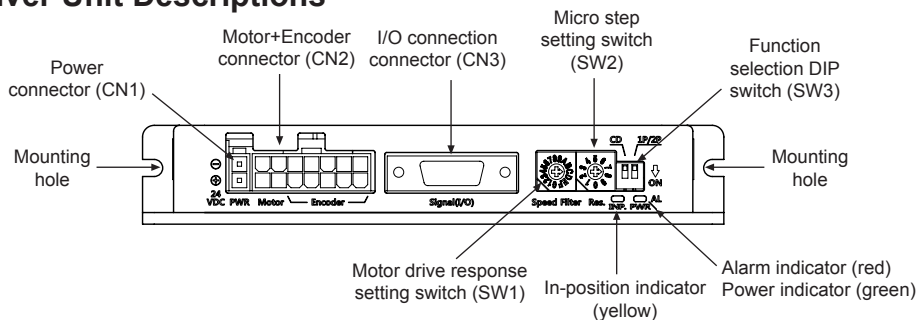
Model	L1
Ai-M-56SA	41
Ai-M-56MA	54.5
Ai-M-56LA	78.5

### ◎ Driver



# Closed-Loop Stepper Motor System

## Driver Unit Descriptions



## Driver Status Indicators

Name	LED Color	Function	Descriptions
PWR	Green	Displays power input	Turns ON when the unit operates normally after supplying power
AL	Red	Displays alarm	Flashes for alarm status.
INP.	Yellow	Displays complete in-position	Turns ON when motor is placed at command position after positioning input.

## Driver Setting

### © SW1: Motor drive response setting switch (speed filter)

※Set motor drive response for input pulse.

※Set the delay time between the position of input pulse and the position of motor to prevent load changing or disturbance with soft operation function.

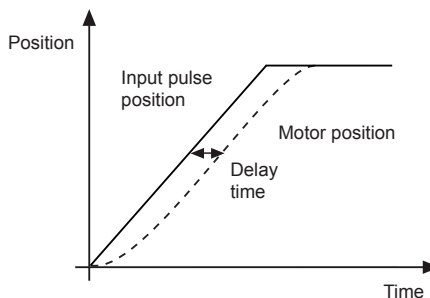
※If the setting value is too high, the synchronous response by command is decreased.

Setting switch	Setting	Delay time
	0	Not used
	1	2ms
	2	4ms
	3	6ms
	4	8ms
	5	10ms
	6	20ms
	7	40ms
	8 (Factory default)	60ms
	9	80ms
	A	100ms
	B	120ms
	C	140ms
	D	160ms
	E	180ms
	F	200ms



Speed Filter

<Graph for input speed and motor response>

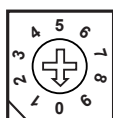


### © SW2: Micro step setting switch (Resolution)

※Set the micro step resolution of driver.

※The number of pulses per 1 rotation by resolution is each 500, 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000.

Setting switch	Setting	Pulse/1 Revolution	Resolution
	0 (Factory default)	500	2.5
	1	1000	5
	2	1600	8
	3	2000	10
	4	3200	16
	5	3600	18
	6	5000	25
	7	6400	32
	8	7200	36
	9	10000	50



RES

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# Ais Series

## © SW3: Function selection DIP switch

No.	Name	Function	Switch position	
			ON	OFF (Factory default)
1	CD	STOP current	25% of max. RUN current	50% of max. RUN current
2	1P/2P	Pulse input method	1-pulse input method	2-pulse input method

### ● STOP current

※When it stops (if there is no input during twice of the last input pulse width), set the stop current supplied at the motor phase to decrease motor heat and current consumption.

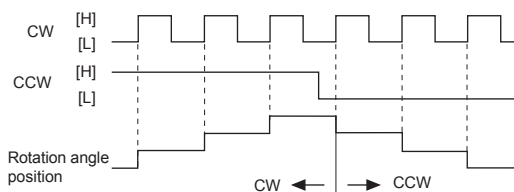
### ● Pulse input method

※1-pulse input method

CW: Rotation operation signal input

CCW: Rotation direction signal input

([H]: Forward rotation, [L]: Reverse rotation)

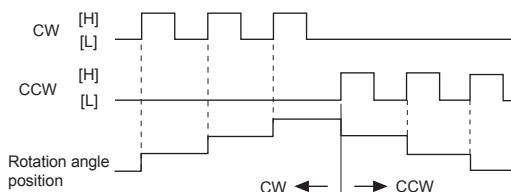


[H]: Photocoupler ON (voltage of both ends 4-8VDC)

※2-pulse input method

CW: Forward rotation signal input

CCW: Reverse rotation signal input



[L]: Photocoupler OFF (voltage of both ends 0-0.5VDC)

## ■ Control Input/Output

Inner signal of all input/output consists of photocoupler.

ON, [H]: photocoupler power ON/ OFF, [L]: photocoupler power OFF.

### © Input

#### 1. HOLD OFF

●This signal is for rotating motor's axis using external force or used for manual positioning.

●When hold off signal maintains over 1ms as [H], motor excitation is released.

●When hold off signal maintains over 1ms as [L], motor excitation is in a normal status.

※When supplying hold off signal, in-position output and LED turn OFF.

※Stop the motor for using this signal.

※Refer to example of input circuit connection.

#### 2. ALARM RESET

●This signal is for clearing the alarm.

●When alarm reset signal maintains over 20ms as [H], alarm is cleared. The alarm LED and alarm output turns OFF and the driver returns to normal status.

※If the alarm causes are not removed clearly and using alarm reset, driver may not be returned at the normal status.

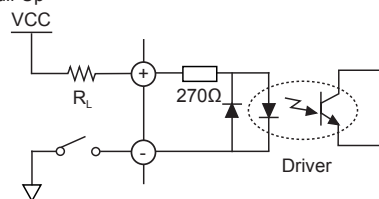
※Refer to example of input circuit connection.

#### 3. Example of input circuit connection

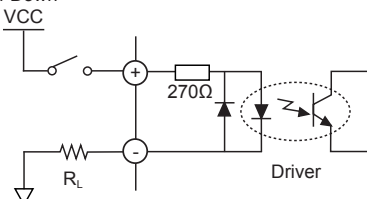
-When using 5VDC for VCC, short the R<sub>L</sub>. In case of over 5VDC (below 30VDC is recommended), use the R<sub>L</sub> for I<sub>F</sub> of photo coupler (forward current of primary LED) to be within 10mA following the below formula.

$$※R_L = \frac{V_{CC} - 1.25V}{0.01A} - 270\Omega$$

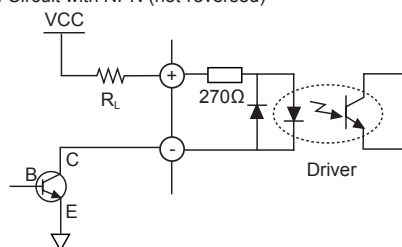
##### A. Pull-Up



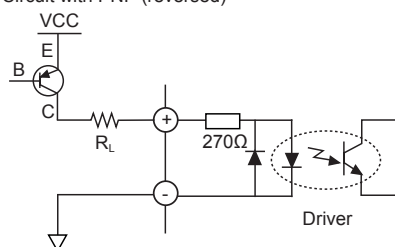
##### B. Pull-Down



##### C. Circuit with NPN (not-reversed)



##### D. Circuit with PNP (reversed)



# Closed-Loop Stepper Motor System

## ◎ Output

### 1. In-Position

In-position output is motor drive complete signal and it is output when drive is complete by command pulses.

- When motor is arrived at the command position, in-position output is [H]. (position error=0)
- When drive is complete and motor rotates by the external force,  
-1.8° ≤ Position error ≤ 1.8° : In-position = [H]

Position error < -1.8°, Position error > 1.8° : In-position = [L]

The in-position LED turns ON/OFF depending on in-position output [H]/[L].

For accurate drive, check the in-position output again and execute the next drive.

※Refer to example of output circuit connection.

### 2. ALARM OUTPUT

When alarm occurs, driver recognizes the alarm. The alarm LED (red) and alarm output represents the errors.

- Alarm output signal
  - In case of normal status, output is [H]. When alarm occurs, output is [L].
  - When supplying alarm reset, output turns [H].

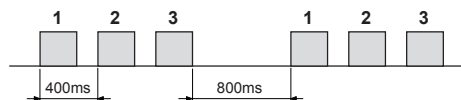
※Refer to example of output circuit connection.

- Alarm indicator

Depending on the number of flashing of alarm indicator, you can check alarm causes.

No. of flashing	Alarm type	Descriptions
1	Over current error	When over current flows at motor RUN element
2	Over speed error	When motor speed is over 4,000rpm
3	Position tracking error	When motor does not track the pulse input normally
4	Over load error	When applying over the rated load for over 1 sec.
5	Over heat error	When driver inner temperature is over 80°C
6	Motor connection error	When supplying power without connecting motor cable to the driver
7	Encoder connection error	When encoder cable connection error occurs at driver

※Depending on alarm type, it flashes the number of flashing with 400ms interval. The waited 800ms signals output repeatedly. Until clearing alarm by alarm reset signal, alarm signal output continuously.



### 3. Example of output circuit connection

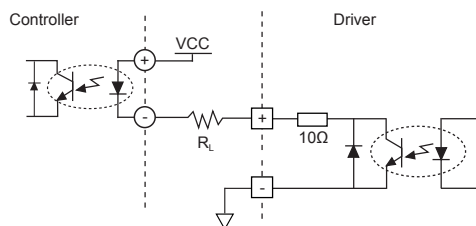
-It is recommended to use below 50VDC at VCC. Use the  $R_L$  for  $I_C$  (collector current of secondary detector) of photo coupler inside the driver to be within 25mA following the below formula.

$$\text{※A: } R_L = \frac{V_{CC} - 0.7V - V_F}{0.025A} - 10\Omega$$

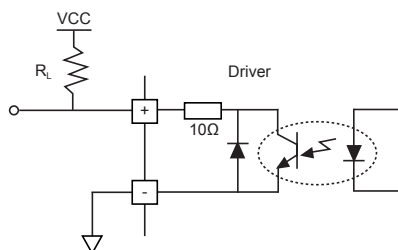
$$\text{※B,C: } R_L = \frac{V_{CC} - 0.7V}{0.025A} - 10\Omega$$

( $V_F$  is LED forward voltage of primary photocoupler.)

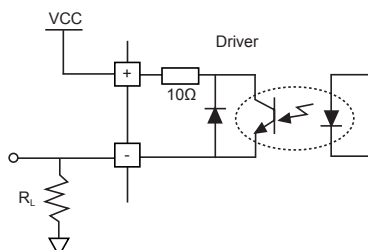
#### A. Circuit with photo coupler



#### B. Circuit with pull up (reversed)



#### C. Circuit with pull down (not-reversed)



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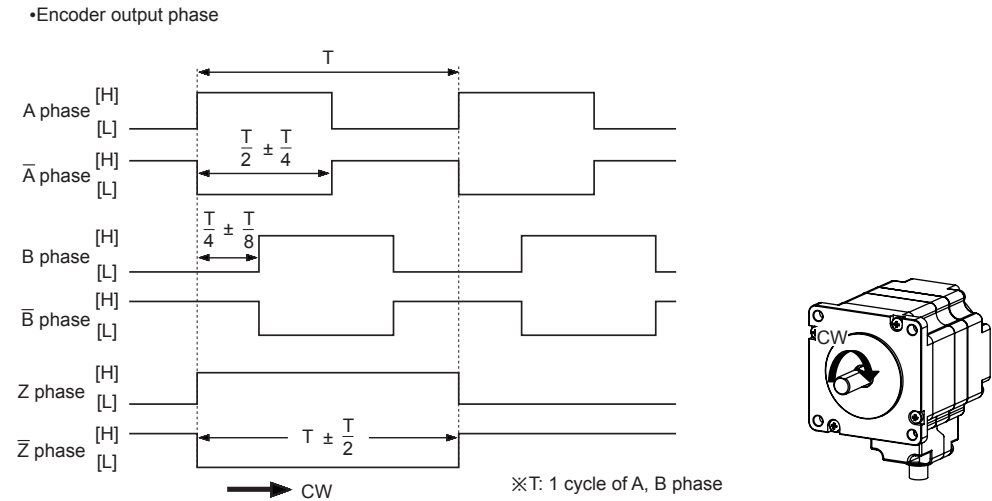
(R) Graphic/ Logic Panels

(S) Field Network Devices

(T) Software

# Ais Series


## 4. Encoder output (line driver output)



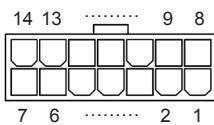
## ■ Connection Connectors of Driver

### ◎ Connector function

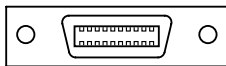
#### ● Power connector (CN1)

Pin arrangement	Pin no.	Function
	2	GND
	1	24VDC

#### ● Motor+Encoder Connector (CN2)

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	GND EARTH	12	N-C
	6	MOTOR A	13	MOTOR B
	7	MOTOR $\bar{A}$	14	MOTOR $\bar{B}$

#### ● I/O connector (CN3)

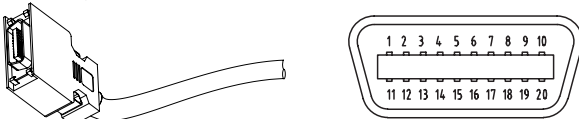
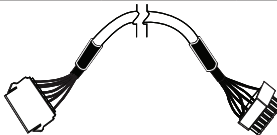
Pin arrangement	Pin no.	Input/Output	Function	Pin no.	Input/Output	Function
	1	Input	CW+	11	Output	END+
	2	Input	CW-	12	Output	END-
	3	Input	CCW+	13	—	N-C
	4	Input	CCW-	14	—	N-C
	5	Input	HOLD OFF+	15	Output	ENCODER A
	6	Input	HOLD OFF-	16	Output	ENCODER $\bar{A}$
	7	Output	ALARM OUT+	17	Output	ENCODER B
	8	Output	ALARM OUT-	18	Output	ENCODER $\bar{B}$
	9	Input	ALARM RESET+	19	Output	ENCODER Z
	10	Input	ALARM RESET-	20	Output	ENCODER $\bar{Z}$

◎ Connector specifications

Type		Specifications			Manufacture
		Connector	Connector terminal	Housing	
CN1	Driver	LAD1140-02(X)	—	—	HANLIM
	Power	CHD1140-02	CTD1140		
CN2	Driver	35318-1420	—	—	Molex
	Motor+Encoder	5557-14R	5556T		
CN3	Driver	10220-52A2 PL	—	—	3M
	I/O connector	10120-3000PE		10320-52F0-008	

※Above connectors are suitable for AiS Series. You can use equivalent or substitute connectors.

◎ Cable (sold separately)

Type	Model					
I/O cable	CJ-MP20-HP□ (sold separately)※ <sup>1</sup>					
						
	Pin No.	Cable color	Dot line color-numbers	Pin No.	Cable color	Dot line color-numbers
	1	Yellow	Black-1	11	White	Black-1
	2		Red-1	12		Red-1
	3		Black-2	13		Black-2
	4		Red-2	14		Red-2
	5		Black-3	15		Black-3
	6		Red-3	16		Red-3
	7		Black-4	17		Black-4
	8		Red-4	18		Red-4
	9		Black-5	19		Black-5
	10		Red-5	20		Red-5
Motor+Encoder cable						
	Normal	C1D14M-□※ <sup>2</sup>				
	Moving	C1DF14M-□※ <sup>2</sup>				

※1: □ indicates cable length (010, 020, 030, 050, 070, 100) E.g.) CJ-MP20-HP070: 7m I/O cable

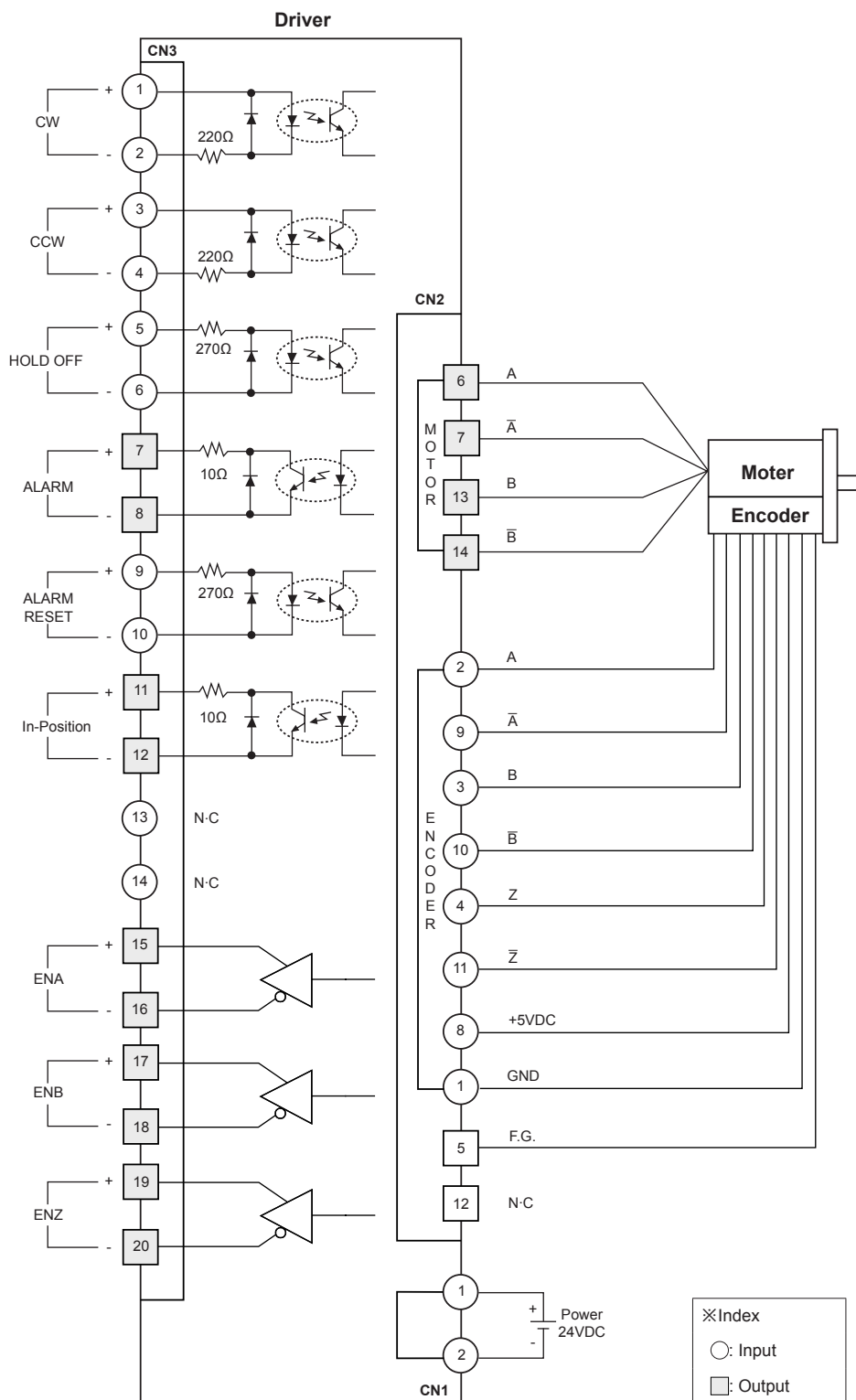
※2: □ indicates cable length (1, 2, 3, 5, 7, 10) E.g.) C1DF14M-10: 10m moving type motor+encoder cable

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# AiS Series

## ■ Connection For Motor And Driver

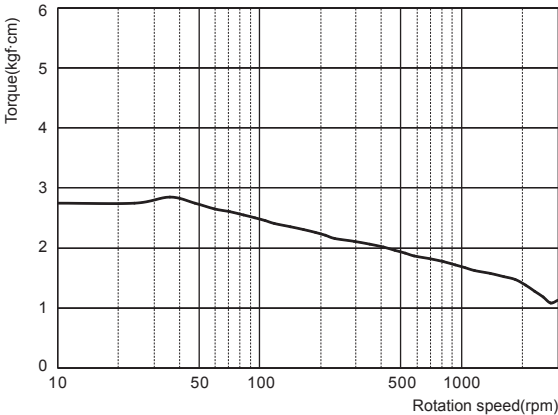


※To input signal over 12VDC, connect external resistance for photocoupler  $I_F$  to be within 10mA.

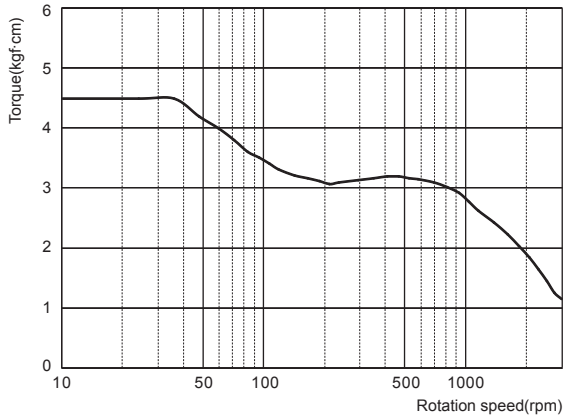
# Closed-Loop Stepper Motor System

## Motor Characteristics

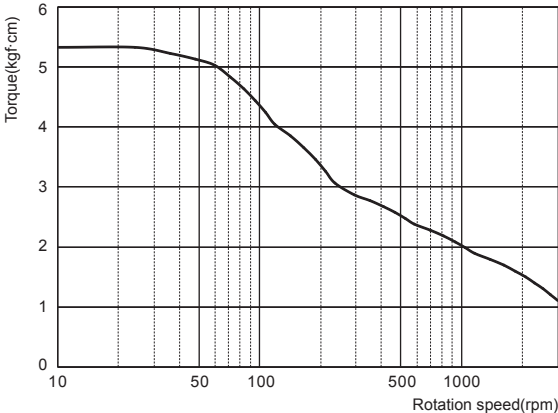
### ● Ai-M-42SA



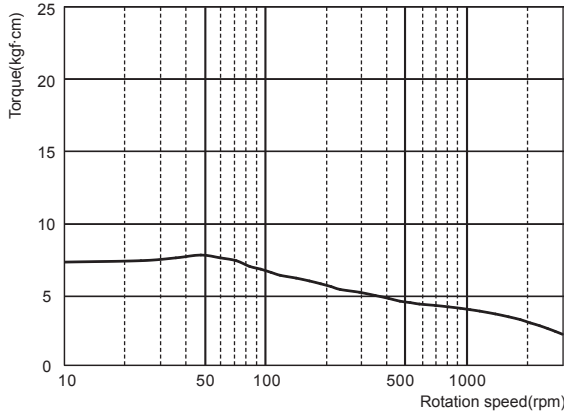
### ● Ai-M-42MA



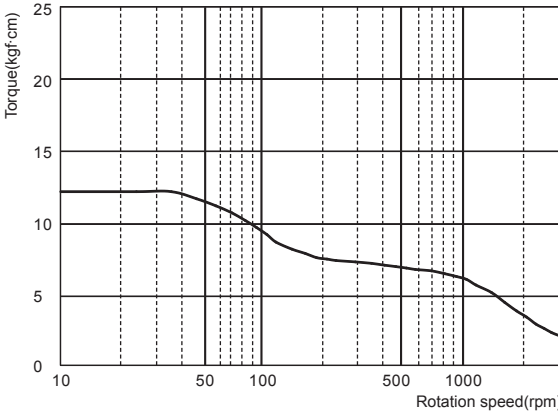
### ● Ai-M-42LA



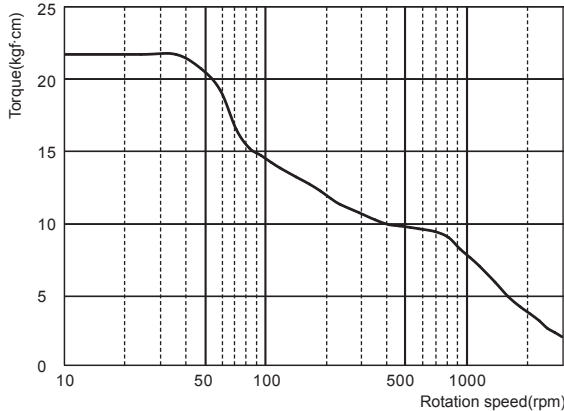
### ● Ai-M-56SA



### ● Ai-M-56MA



### ● Ai-M-56LA



(A)	Photoelectric Sensors
(B)	Fiber Optic Sensors
(C)	Door/Area Sensors
(D)	Proximity Sensors
(E)	Pressure Sensors
(F)	Rotary Encoders
(G)	Connectors/ 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
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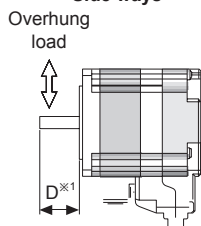
# Ais Series

## Motor Installation

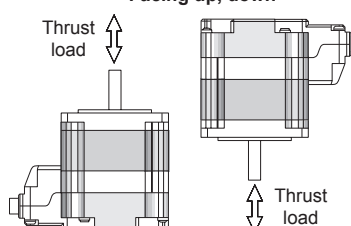
### 1. Mounting direction

Motor can be mounted in any directions-facing up, facing down and side ways. No matter which direction motors to be mounted, be sure not to apply overhung or thrust load on the shaft. Refer to the table below for allowable shaft overhung load / thrust load.

Side ways



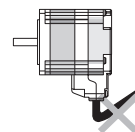
Facing up, down



※1: The distance from the shaft in front (mm)

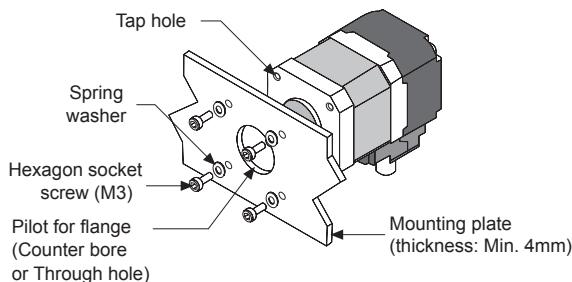
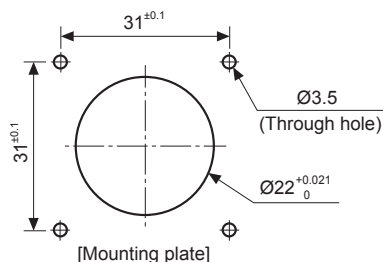
Motor size	Permissible overhung load [kgf(N)] by distance from shaft tip (mm)				Allowable thrust load
	D=0	D=5	D=10	D=15	
Ai-M-42 Series	2 (20)	2.5 (25)	3.5 (34)	5.3 (52)	Under the load of motor
Ai-M-56 Series	5.6 (55)	6.8 (67)	9.1 (89)	13.3 (130)	

Do not apply excessive force on motor cable when mounting motors.  
Do not forcibly pull or insert the cable. It may cause poor connection or disconnection of the cable.  
In case of frequent cable movement required application, proper safety countermeasures must be ensured.



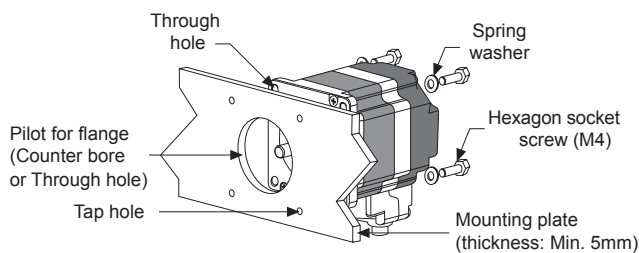
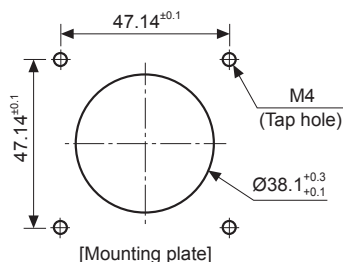
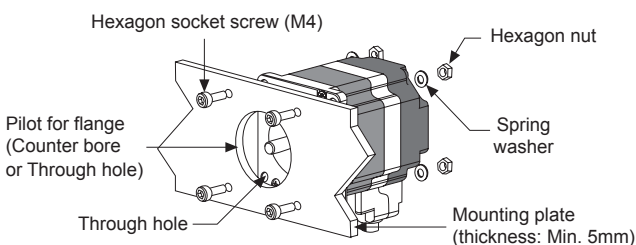
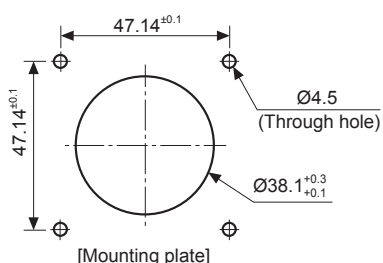
### 2. Mounting method

#### ●Ai-M-42 Series



(unit: mm)

#### ●Ai-M-56 Series

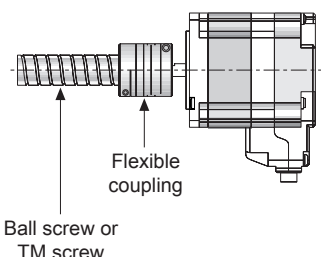
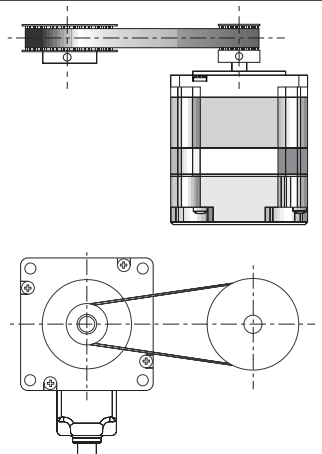
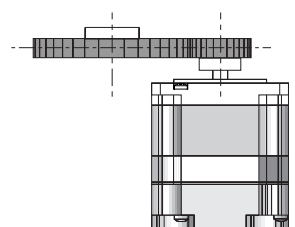


With considering heat radiation and vibration isolation, mount the motor as tight as possible against a metal panel having high thermal conductivity such as iron or aluminum.

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.

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.

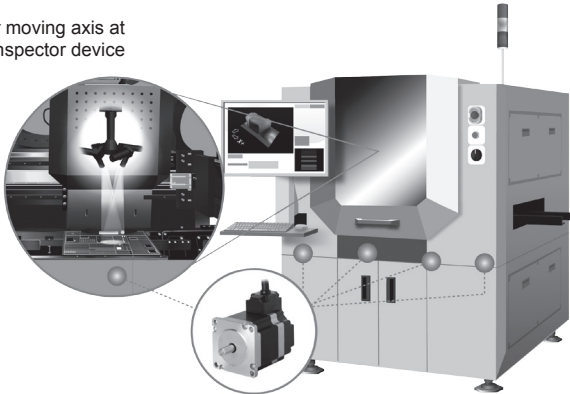
Direct load connection with coupling	Load connection with pulley, belt, and wire	Load connection with gear
 <p>Flexible coupling</p> <p>Ball screw or TM screw</p> <p>※Use Autonics flexible coupling (ERB Series).</p> <p>When connecting the load directly (ball screw, TM screw, etc) to the motor shaft, use a flexible coupling as shown in the above figure. If the center of the load is not matched to that of shaft, it may cause severe vibration, shaft damage or shortened 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 instructions are not following.
- ① The inner housing installed indoor (This unit is manufactured for attaching to equipment. Install a ventilation device.)
  - ② Within 0 to 50°C (at non-freezing status) of ambient temperature
  - ③ Within 20 to 90%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 is not entered into the unit
  - ⑦ The place where water, oil, or other liquid are not touched
  - ⑧ The place where strong alkali or acidity does not exist closely
  - ⑨ The place where easy heat dissipation could be made
  - ⑩ The place where no 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.

■ Applications

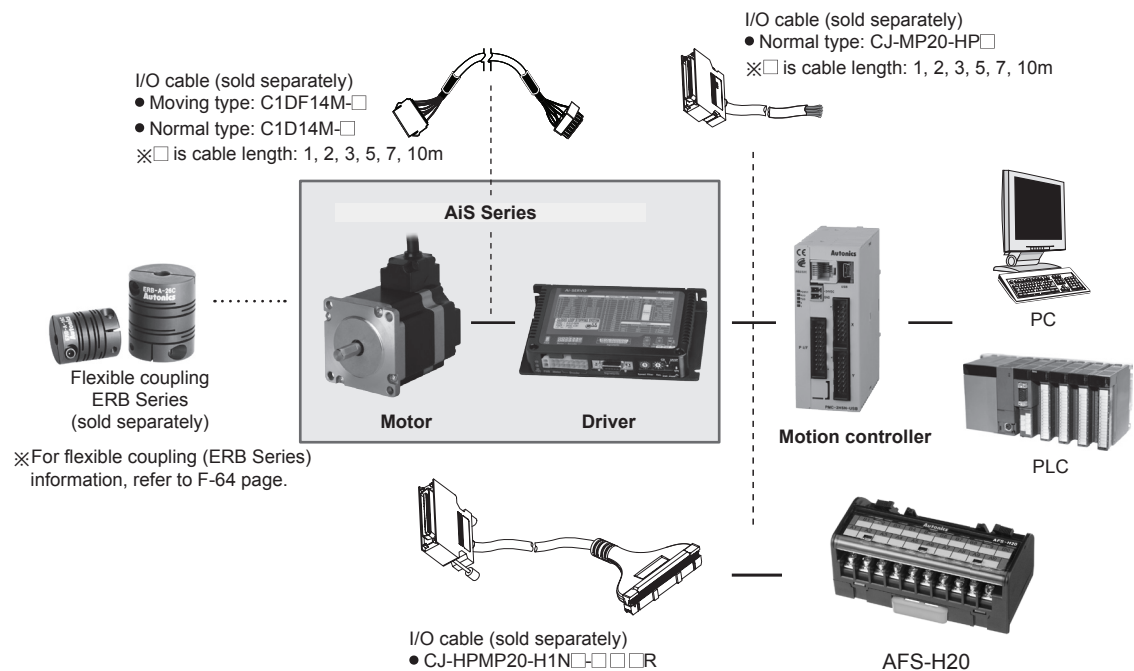
AiS Series for moving axis at 3D inspector device



(A) Photoelectric Sensors
(B) Fiber Optic Sensors
(C) Door/Area Sensors
(D) Proximity Sensors
(E) Pressure Sensors
(F) Rotary Encoders
(G) Connectors/ Sockets
(H) Temperature Controllers
(I) SSRs / Power Controllers
(J) Counters
(K) Timers
(L) Panel Meters
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(N) Display Units
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(Q) Stepper Motors & Drivers & Controllers
(R) Graphic/ Logic Panels
(S) Field Network Devices
(T) Software

# AiS Series

## System Configurations



## AiS-D Series, AFS-H20, and CJ cable Connection

CJ-MP20-HP Series			AiS-D Series		AFS-H20 and CJ-HPMP20-H1N□-1ANR connection	AFS-H20 and CJ-HPMP20-H1N□-3ANR connection
Pin No.	Cable color	Dot color-No. of Dot(s)	Driver function		Terminal No.	Terminal No.
1	Yellow	Black-1	Input	CW+	A1	B1
2	Yellow	Red-1	Input	CW-	B1	A1
3	Yellow	Black-2	Input	CCW+	A2	B2
4	Yellow	Red-2	Input	CCW-	B2	A2
5	Yellow	Black-3	Input	HOLD OFF+	A3	B3
6	Yellow	Red-3	Input	HOLD OFF-	B3	A3
7	Yellow	Black-4	Output	ALARM+	A4	B4
8	Yellow	Red-4	Output	ALARM-	B4	A4
9	Yellow	Black-5	Input	ALARM RESET+	A5	B5
10	Yellow	Red-5	Input	ALARM RESET-	B5	A5
11	White	Black-1	Output	END+	A6	B6
12	White	Red-1	Output	END-	B6	A6
13	White	Black-2	—	N-C	A7	B7
14	White	Red-2	—	N-C	B7	A7
15	White	Black-3	Output	Encoder A	A8	B8
16	White	Red-3	Output	Encoder $\bar{A}$	B8	A8
17	White	Black-4	Output	Encoder B	A9	B9
18	White	Red-4	Output	Encoder $\bar{B}$	B9	A9
19	White	Black-5	Output	Encoder Z	A10	B10
20	White	Red-5	Output	Encoder $\bar{Z}$	B10	A10

# Closed-Loop Stepper Motor System

## ■ Ai-SERVO

### 1) System overview

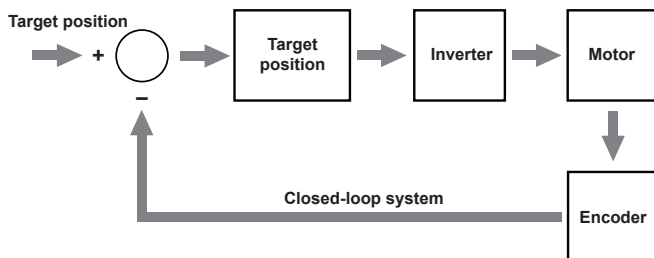
Ai-Servo is a closed-loop stepper motor system that combines the strengths of stepper motor systems and servo motor systems.

The integrated encoder allows accurate motor movement through feedback, a characteristic of servo motors.

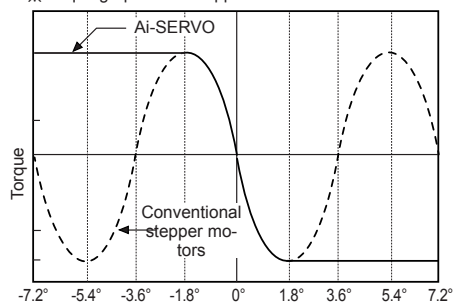
As with stepper motors, Ai-Servo has a fast response rate for continuous short stroke positioning and does not have hunting problem, reducing vibrations.

Ai-Servo does not need to be tuned during initial setup, is equipped with various alarm functions, and boasts higher torque and reduced overheating problems.

### 2) Control properties



※ Torque graph when stopped



When rotating the motor while stopped, the encoder detects the rotation of the motor and controls the motor so that it generates the maximum torque.

### 3) Feature comparison between Ai-SERVO and conventional system

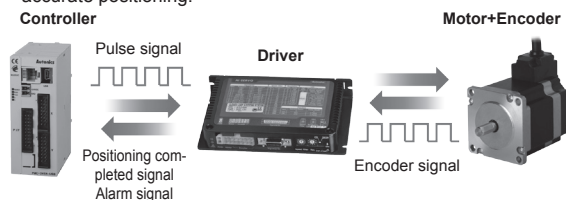
	Stepper system	Ai-SERVO	Servo system
Accuracy	Low position control accuracy	High position control accuracy	High position control accuracy
Hunting	No hunting when stopped	No hunting when stopped	Hunting when stopped
Low speed operation	Vibration in low speed	Low vibrations in low speed	Low vibrations in low speed
Continuous drive	High response rate	High response rate	Slower response rate (correction time)
System setting	Quick and easy setting	Quick and easy setting	Gain tuning required
Applications	Optimized for short continuous high-speed drive	Optimized for lengthy high-speed drive	Optimized for lengthy high-speed drive

## ■ Features

### 1) Fast response rates and accurate position control

The integrated encoder compares the current position with the received command pulse then provides feedback, allowing for accurate positioning.

Controller



### 2) 10-stage resolution

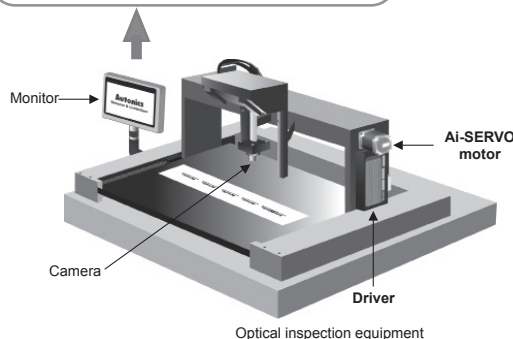
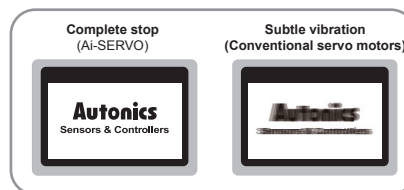
10-stage resolution of up to 10,000 P/R allows highly precise position control (up to 0.036°).

500 1000 1600 2000 3200 3600 5000 6400 7200 10000



### 3) No hunting for accurate stop positioning

Unlike servo systems which require hunting (fine vibration) when stopped, AiS series does not require hunting for stable and accurate stop positioning.



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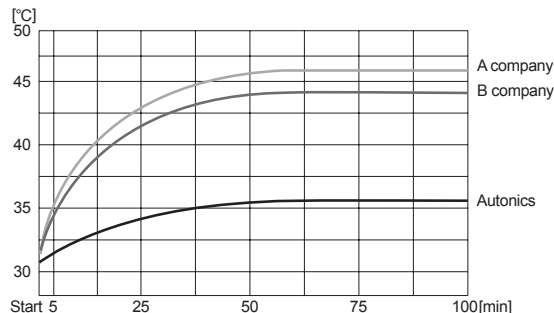
# AIS Series

## 4) Motor temperature chart

Minimized heat generation by managing the current flowing through the motor with load.

※Result of Autonics test  
(Drives 50 times and stops 1 min. repeatedly  
at 29±1°C ambient temperature)

### ●L type of frame size 42mm motor



## 5) Tuning not required

Tuning is unnecessary even with load changes. (no gain tuning)



## ■ Proper usage

### ◎ 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 is connected correctly.

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

- ① When RUN mode is 1-pulse method, CCW input [H] is for forward, [L] is for backward.
- ② When RUN mode is 2-pulse method, check CW and CCW pulse input is changed.

#### 3. When motor drive is unstable

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

### ◎ Caution during use

#### ● Motor

**1. Do not disassemble or modify the product.**  
It may cause malfunction due to small dregs. Once disassembling the motor, its performance would significantly decline.

#### **2. Do not impact the motor.**

The air-gap, the distance between rotator and stator is processed as 0.05mm, but if it is impacted, the balance of air-gap can be broken and it may cause a malfunction.

This encoder consists of precision components. Therefore, if it is dropped or has strong shock, it may lose the function or generates wrong output pulses.

#### **3. Using at low temperature**

Using motors at low temperature may cause reducing maximum starting / driving characteristics of the motor as ball bearing's grease consistency decreases due to low temperature. (Note that the lower the bearing's grease consistency, the higher the bearing's friction torques.) Start the motor in a steady manner since motor's torque is not to be influenced.

#### **4. Temperature rise**

The surface temperature of motor shall be under 100°C and it can be significantly increased by operation conditions. In this case, use the cooling fan to lower the temperature forcibly.

#### **5. Insulation resistance measurement, Dielectric strength test**

When executing insulation resistance measurement or dielectric strength test when motor and driver are connected, it may cause damage to the unit.

#### **6. Maintenance, Inspection**

For using motor, it is recommended to Maintenance and inspection regularly.

If motor has error, do not use the motor. Take maintenance and inspection before using it.

Maintenance and inspection items are as below.

- ① Unwinding bolt 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.

#### ● Driver

##### **1. Caution for signal input**

If the signal input supply is higher than rated supply in the specification, connect the additional resistance to external part. (Connect 3kΩ of resistance when applying 24V of power)

##### **2. Caution for wiring**

(※Autonics product is recommended)

- ① Use twisted pair (over 0.2mm<sup>2</sup>) for the signal cable which should be shorter than 2m.
- ② The thickness of cable should be same or thicker than the motor cable's when extending the motor cable.
- ③ Must separate between the signal cable and the power cable over 10cm.

##### **3. Caution for installation**

For heat radiation when installing this unit, contact this driver base tightly with the metal surface. When using this unit, overheat error occur, install a fan for heat radiation or change the installation placement.

##### **4. Caution for re-supplying power**

Re-supply power after min. 1 sec. from disconnected power.

##### **5. Motor vibration and noise can occur in specific frequency period**

- ① Motor vibration and noise can be lowered by change motor installation or attach damper.
- ② Use the unit in a range without vibration and noise range by RUN speed adjustment.

##### **6. This product may be used in the following environments**

- ① It shall be used indoor
- ② Altitude up to 2,000m
- ③ Pollution degree 2
- ④ Installation category II