Make Life Easy **:**

User Manual

Closed-Loop Stepper System

AiSA-D Series

MMD-AiSAU1-V1.0-2008US

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This usere manual contains information about the product and its propoer use,

and should be kept in a place where it will be easy to access.

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Preface

Thank you for purchasing Autonics product.

Please familiarize yourself with the information contained in the **Safety Considerations** section before using this product.

This manual contains information about the product and its proper use, and should be kept in a place where it will be easy to access.

User Manual Guide

- Please familiarize yourself with the information in this manual before using the product.

- This manual provides detailed information on the product's features. It does not offer any guarantee concerning matters beyond the scope of this manual.

- This manual may not be edited or reproduced in either part or whole without permission.

- This manual is not provided as part of the product package.
  Visit our website (www.autonics.com) to download a copy.

- The manual's content may vary depending on changes to the product's software and other unforeseen developments within Autonics, and is subject to change without prior notice. Upgrade notice is provided through out the website.

- We contrived to describe this manual more easily and correctly. However, if there are any corrections or questions, please notify us these on our website.

User Manual Symbols

Symbol	Descriptions
Note	Supplementary information for a particular feature.
Warning	Failure to follow instructions can result in serious injury or death.
Caution	Failure to follow instructions can lead to a minor injury or product damage.
Ex.	An example of the concerned feature's use.
※1	Annotation mark.

Safety Considerations

- Following these safety considerations will ensure the safe and proper use of the product and help prevent accidents, as well as minimizing possible hazards.

- Safety considerations are categorized as Warnings and Cautions, as defined below:

⚠ **Warning**	**Warning**	Failure to follow these instructions may result in serious injury or death.
⚠ **Caution**	**Caution**	Failure to follow these instructions may result in personal injury or product damage.

⚠ Warning

- Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime/disaster prevention devices, etc.)
  Failure to follow this instruction may result in personal injury, economic loss or fire.
- Do not use the unit in the place where flammable/explosive/corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact or salinity may be present.
  Failure to follow this instruction may result in explosion or fire.
- Do not connect, repair or inspect the unit while connected to a power source.
  Failure to follow this instruction may result in fire or electric shock.
- Instal the unit after considering counter plan against power failure.
  Failure to follow this instruction may result in personal injury, economic loss or fire.
- Re-supply power after min. 20 sec from disconnected power.
  Failure to follow this instruction may result in product damage or malfunction.
- Check 'Connections' before wiring.
  Failure to follow this instruction may result in fire.
- For installing the unit, ground it exclusively and use over AWG 18 (0.75mm^2) ground cable.
  Failure to follow this instruction may result in electric shock.
- Do not disassemble or modify the unit.
  Failure to follow this instruction may result in fire or electric shock.
- Insulate the connector not to be exposed.
  Failure to follow this instruction may result in electric shock.
- Install the driver in the housing or ground it directly.
  Failure to follow this instruction may result in personal injury, fire or electric shock.
- Do not touch the unit during or after operation for a while.
  Failure to follow this instruction may result in fire or electric shock.
- Do not remove the connector during or after operation for a while.
  Failure to follow this instruction may result in electric shock or product damage.
- Emergency stop directly when error occurs.
  Failure to follow this instruction may result in personal injury or fire.

⚠️ **Caution**

- When connecting the power unit, use AWG 18(0.75mm^2) cable or over.
- Brake is non-polar. When connecting the brake, use AWG 22(0.3 mm^2) cable or over.
  Failure to follow this instruction may result in fire or malfunction due to contact failure.
- Install overcurrent prevention device (e.g. the current breaker, etc) to connect the driver with power.
  Failure to follow this instruction may result in fire.
- Check the control input signal before supplying power to the driver.
  Failure to follow this instruction may result in personal injury or product damage by releasing hoding torque of the motor.
- Install a safety device to maintain the vertical position after turn off the power of this driver.
  Failure to follow this instruction may result in personal injury or product damge by releasing holding torque of the motor.
- Use the unit within the rated specifications.
  Failure to follow this instruction may result in fire or product damage.
- Use a dry cloth to clean the unit and do not use water or organic solvelnt.
  Failure to follow this instruction may result in fire or electric shock.
- The driver may overheat depending on the environment.
  Install the unit in the well ventilated place and forced cooling with a cooling fan.
  Failure to follow this instruction may result in product damage or degradation by heat.
- Keep metal chip, dust and wire residue from flowing into the unit.
  Failure to follow this instruction may result in fire or product damage.
- Use the designated motor only.
  Failure to follow this instruction may result in fire or product damage.

The above specifications, dimensions, etc. are subject to change and some models may be discontinued without notice.

Be sure to follow cautions written in the instruction manual, user manual and the technical descriptions (catalog, website).

Cautions during Use

- Follow instructions in 'Cautions during Use'. Otherwise, it may cause unexpected accidents.
- Do not input CW and CCW signal at the same time in 2-pulse input method.
- When the signal input voltage exceeded the rated voltage, connect additional resistance at the outside.
- To expand the motor+encoder cable, use the designated cable.
- Keep the distance between power cable and signal cable more than 10 cm.
- Install the unit vertically on the alarm/status display part upper side.
- For heat radiation of the driver, install a fan.
- Do not change any setting switches (function, resolution, motor gain, speed filter/limit, in-position switches) during the operation.
  Failure to follow this instruction may result in malfunction.
- Do not input external signal until the driver is initialized (In-Position LED ON) after power is applied.
- Motor vibration and noise can occur in specific frequency period.
  ① Change motor installation method or attach the damper.
  ② Use and set the motor gain value.
- 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 motor
  ⑤ Inconsistency between the axis of motor output and the center, concentric (eccentric, declination) of the load, etc.
- This product does not prepare protection function for a motor.
- 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

Table of Contents

1   Product Overview

1.1   Features

AiSA-D series AC type 2-phase closed loop steper motor drivers offer accurate and precise position control through feedback from the integrated encoder without the hassle of tuning and vibration of conventional servo motors. The encoder feedback provides information of the current position in reference to the input pulse with a high resolution of 10,000 pulses per revoluion, allowing precise and accurate position control down to 0.036°. The series alos features a 7 segment display for easy operation readings and various alarm functions for enhnaced safety.

- Brake operation for safe control of vertical load at power OFF and alarm occur. (Built-in brake type)
- Higher cost-efficiency compared to servo motor drivers
- Torque control mode supported
- Able to check alarm and status with Alarm/Status display part (7 segment)
- Rapid response which is advantageous for the short distance continuous operation
- Able to implement Low frequency operation and high torque in low speed area
- Low current drive at middle high speed area
- Max. stop torque at Current Down Mode (available vertical load attaching)
- Easy to set various Gain with rotary swtich
- Applicable to the precision equipment such as optical inspection equipment with the features of maintaining torque in stop and having no micro vibration (hunting)
- 10-levels of resolution setting
- Frame size 60 mm, 86 mm (Applied Motor: AiA-M Series)

1.2　Components and Configuration Diagram

1.2.1　Components

1.2.1.1　Driver
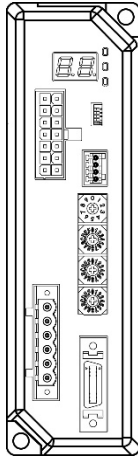
AiSA-D Series
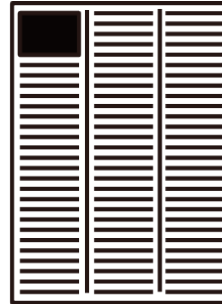
Instruction manual

1.2.1.2　Motor
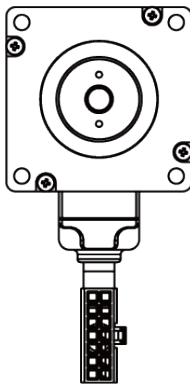
AiA-M Series
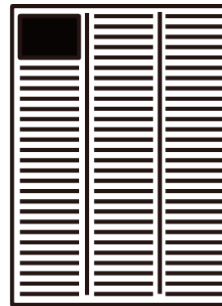
Insturction manual

1.2.1.3　Connectors

- Power connector
- I/O connector
- Brake connector

Note

Make sure all of the above components are included with your product package before use.
If a component is missing or damaged, please contact Autonics orthe product distributor.

※ I/O cable, motor+encoder cable and power cable are sold separately.
For more information, refer to '7.5 Sold Separately'.

1.2.2   Configuration Diagram

※ ⌈▭⌉ is for built-in brake type only.
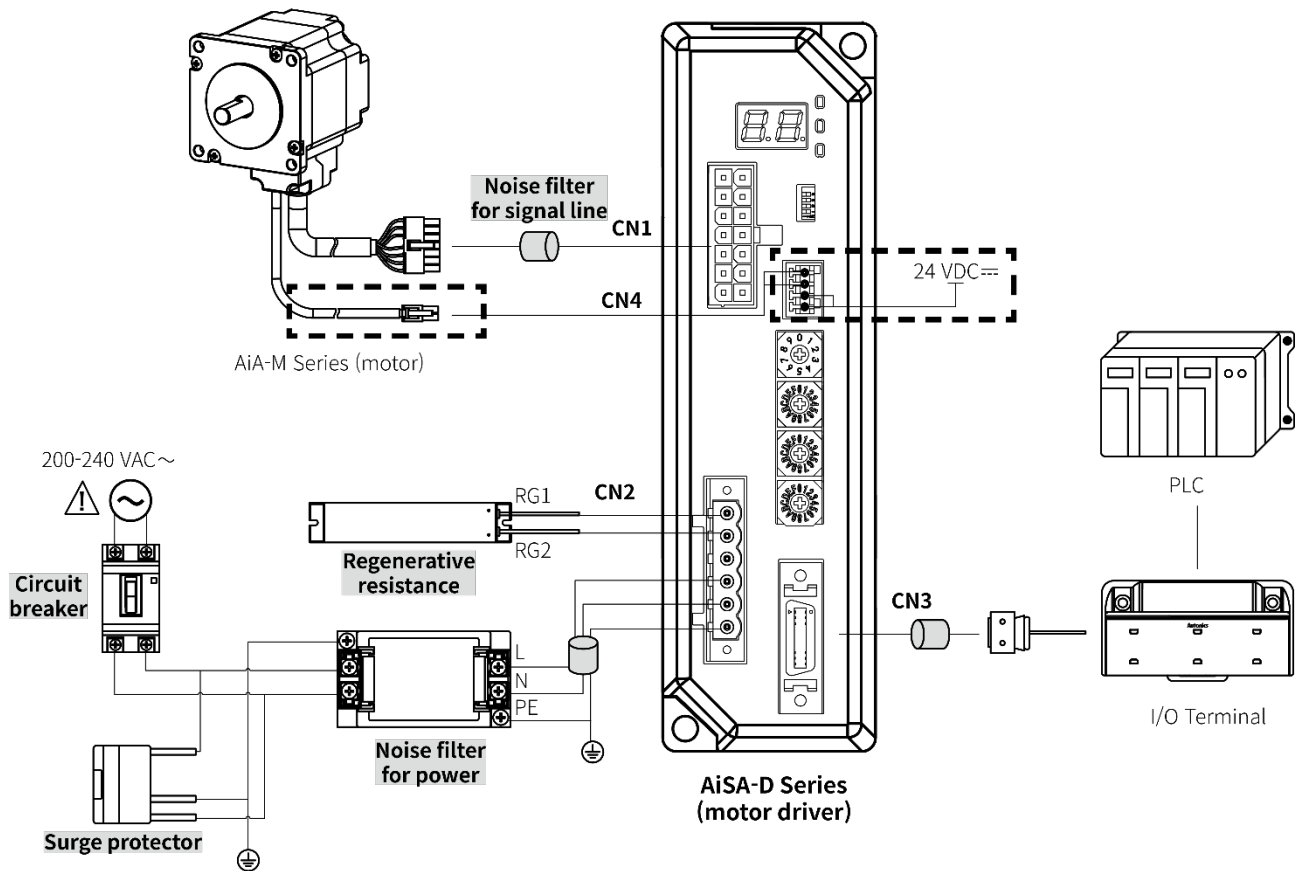
Note

※ The thickness of cable should be same or thicker than the below specifications when connecting the cable for connector.

① CN1 (motor+encoder connector): AWG22, AWG24

② CN2 (power connector): AWG18

③ CN3 (I/O connector): AWG28

④ CN4 (brake connector): AWG22

※ In case of unwanted noise generating from peripherals and power, use ferrite core in the wiring.

※　　　　　is sold separately.

※ I/O cable, motor+encoder cable and pwer calbe are sold separately.

For more information, refer to '7.5 Sold Separately'.

■ Regenerative resistance

Connect Pin No. 1, 2 on power connector (CN2).

Use in condition of the high inertia load or the short deceleration time.

Forced cooling is required in condition of high surface temperature of regenerative resistance.

Model	Specifications	Manufacture
IRC100	• Resistance: 100 Ω ±5% • Specified power: 60 W(standby), 100 W(heatsink attached)	RARA Electronics Corp.

■ Noise fliter for power

Connect the power to suppress external noise.

- The wires should be connected as short as possible and grounded.

Model	Specifications	Manufacture
RNS-2006	• Specified power: 250 V • Specified current: 6 A • Max. leakage current: 1 mA	Orient Electronics

■ Surge protector

Protect the product from erxternal nois and surge by connectiong power.

Model	Specifications	Manufacture
LT-C12G801W	• Nominal discharge current: 2500 A • Max. discharge current: 5000 A • Voltage protection level: 1.5 kV	OTOWA Electric Co. Ltd

✎ Note

■ Be sure to disconnect the surge protector when testing internal pressure.

It may result in product damage.

■ Noise filter for signal line

Connect to wiring to suppress external noise.

- Depending on frequency, filtered noise may different.

Applications	Specifications	Manufacture
Motor wire	28A5776-0A2	Lairdtech
Power wire	28A5131-0A2	

1.3 Ordering Information

Ai	S	A	-	D	-	60	M	A	-	
①	②	③		④		⑤	⑥	⑦		⑧
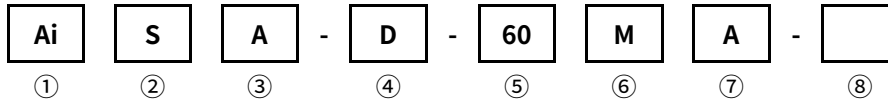
Item	Description	
① Series	Ai	**A**rtificial **i**ntelligent
② Category	No mark	Motor
	S	Standard
③ Power	A	AC Power
④ Item	M	Motor
	D	Driver
⑤ Motor frame size	60	60 x 60mm
	86	86 x 86mm
⑥ Motor axial length	M	Middle – Frame size 60mm: 48mm Frame size: 86mm: 60mm)
	L	Long – Frame size 60mm: 69mm Frame size: 86mm: 75mm)
⑦ Encoder resolution	A	10,000PPR (2,500PPR x 4-multiply)
⑧ Brake	No mark	Standard type
	B	Built-in brake type

1.4 Models

1.4.1 Standard type

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

1.4.2 Built-in Brake Type

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

2 Specifications

2.1 Driver

Model[1]		AiSA-D-60MA(-B)	AiSA-D-60LA(-B)	AiSA-D-86MA(-B)	AiSA-D-86LA(-B)
Power consumption	Power supply	200-240 VAC∼ 50/60 Hz			
	STOP.[2]	Max. 60 W		Max. 65 W	Max. 70 W
	Max. during operation	Max. 160 W	Max.220 W	Max. 250W	Max. 300 W
	Max. Run current[3]	2.0 A/Phase			
Auxiliary power[4]	Power supply	24 VDC⎓			
	Input current	0.3 A		0.5 A	
STOP current		20% ~ 100% of max. RUN current			
Rotation speed		0 to 3000 rpm			
Resolution[5]		500, 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000 PPR			
Speed filter[5]		0, 2, 4, 6, 8, 10, 20, 40, 60, 80, 100, 120, 140, 160, 180, 200 ms			
Motor GAIN[5]		Standard GAIN: 0 to F, Inertia GAIN: 0 to F			
In-Position[5]		Fast Response: 0 to 7, Accurate Response: 0 to 7			
Pulse input method[5]		1-Pulse or 2-Pulse input method			
Motor rotation direction[5]		CW, CCW			
Status indicator		• Alarm/Status display part: orange LED 7 seg. • Power/Alarm indicator: green/red LED • In-Position indicator: orange LED • Servo On/Off indicator: blue LED			
I/O	Input	CW, CCW (Run pulse) Servo On/Off (photocoupler input) input voltage - [H]: 24 VDC⎓, [L]: 0-0.5 VDC⎓ pulse width - min. 1 ms Alarm Reset (photocoupler input) input voltage - [H]: 24 VDC⎓, [L]: 0-0.5 VDC⎓ pulse width - min. 10 ms			
	Output	• Photocoupler: In-Position, Alarm Out • Line driver: encoder signal (A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$)			
Operation mode		Standard/Torque mode			
Input pulse specificatio	Pulse width	CW, CCW: input pulse frequency duty 50 %			
	Rising/Falling time	CW, CCW: max. 0.5 µs			
	Pulse input voltage	CW, CCW-[H]: 4-8 VDC⎓, [L]: 0-0.5 VDC⎓			
	Max. input pulse freq.[6]	CW, CCW: 500 kHz			
Alarm		Overcurrent, overspeed, position tracking, overload, overheat, motor connection, encoder connection, overvoltage, undervoltage, motor misalignment, command pulse, In-Position, brake			
Input resistance		4.7 kΩ (Anode Pull-up)			
Insulation resistance		Over 200 MΩ (500 VDC⎓ megger)			
Dielectric strength		1,500 VAC∼ 60 Hz for 1 min			

Model[1]		AiSA-D-60MA(-B)	AiSA-D-60LA(-B)	AiSA-D-86MA(-B)	AiSA-D-86LA(-B)
Vibration		1.5 mm amplitude at frequency of 10 to 55 Hz (for 1 min) in each X, Y, Z direction for 2 hours			
Shock		300 m/s^2 (approx. 30 G) in each X, Y, Z direction for 3 times			
Environment	Ambient temp.	0 to 50°C, storage: -10 to 60°C			
	Ambient humi.	35 to 85% RH, storage: 10 to 90% RH			
Protection structure		IP20 (IEC standard)			
Sold separately		• I/O cable: CO20-MP□-R[7] (standard: AiS TAG) • Motor+Encoder cable– normal: C1D14M-□[8]/moving: C1DF14M-□[8]			
Approval		CE			
Weight[9]		• Standard type: Approx. 920 g (approx. 800 g) • Built-in brake type: Approx. 1,020 g (approx. 780 g)			

※1: The model name indicates driver type (none: standard type, B: built-in brake type).
　　E.g.) AiSA-D-60MA-B: built-in brake type stepping motor driver
※2: Based on the ambient temperature 25°C, ambient humidity 55%RH, and STOP current 20%.
※3: RUN current varies depending on the input RUN frequency and max. RUN current at the moment varies also.
※4: Auxiliary power is only available in built-in brake type. Corresponding specification is not available
　　in standard type.
※5: Settings are available with the switches located on the front. When setting, the power must not be
　　applied and cannot be set after power is applied.
※6: Max. input pulse frequency is max. frequency to be input and is not the same as max. pull-out
　　frequency or max. slewing frequency.
※7: □ of model name indicates cable length (010, 020, 030, 050, 070, 100, 150, 200).
　　E.g.) CO20-MP070-R: 7m I/O cable.
　　For corresponding EMC Standard, cable length should be below 2 m.
※8: □ of model name indicates cable lenght (1, 2, 3, 5, 7, 10, 15, 20).
　　E.g.) C1DF14M-10: 10m moving type motor+encoder cable.
※9: The weight includes packaging. The weight in parentheses is for unit only.
※ Environment resistance is rated at no freezing or condensation.

2.1.1　Factory Default

Function		Factory default
Function selection DIP switch	DIR	OFF (CW)
	1P/2P	OFF (2-Pulse input)
	GS H/L	OFF (Standard GAIN)
	TM	OFF (Standard mode)
Resolution		0 (500 PPR)
Speed filter		0 (disable)
Motor GAIN		0 (Standard×1)
In-Position		0 (0)

2.2   Motor

Model[1]		AiA-M-60MA	AiA-M-60LA	AiA-M-86MA	AiA-M-86LA
Max. stop torque[2]		1.1N·m	2.2N·m	2.8N·m	4.0N·m
Rotor moment of inertia		240g·cm^2 (240 x 10^{-7}kg·m^2)	490g·cm^2 (490 x 10^{-7}kg·m^2)	1,100g·cm^2 (1,100 x 10^{-7}kg·m^2)	1,800g·cm^2 (1,800 x 10^{-7}kg·m^2)
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[3]	Standard type	Approx. 0.95kg (approx. 0.75kg)	Approx. 1.35kg (approx. 1.15kg)	Approx. 2.00kg (approx. 1.70kg)	Approx. 2.60kg (approx. 2.30kg)
	Built-in brake type	Approx. 1.53 kg (Approx. 1.35 kg)	Approx. 1.90 kg (Approx. 1.75 kg)	Approx. 2.76 kg (Approx. 2.50 kg)	Approx. 3.36 kg (Approx. 3.10 kg)

[1]: The model name indicates driver type (none: standard type, B: built-in brake type)
E.g.) AiCA-D-60MA-B: built-in brake type stepping motor driver.

[2]: Max. holding torque is standard torque when supplying the rated current
(2-phase holding) and stopping the motor for comparing the specifications of motors.

[3]: The weight includes packaging. The weight in parenthesis is for unit only.

2.2.1   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 of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours
Shock		Approx. max. 50G
Environment	Ambient temperature	• Standard type: 0 to 50°C, storage: -20 to 70°C • Built-in brake type: 0 to 40°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[1]		±0.09°
Shaft vibration[2]		0.03mm T.I.R.
Radial movement[3]		Max. 0.025mm (load 25N)
Axial movement[4]		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): Indicate total dial gauge quantity in case of one complete rotating monitored reference around a base point.
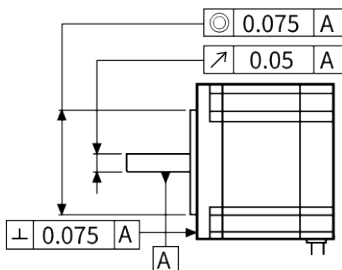
※3: Amount of radial shaft displacement when adding a radial load (25N) to the tip of the motor shaft.

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

※Environment resistance is rated at no freezing or condensation.

2.2.2 Encoder

| Item		INCREMENTAL rotary encoder
Resolution		10,000PPR (2,500PPR x 4 -multiply)
Electrical specification	Output phase	$A, \overline{A}, B, \overline{B}, Z, \overline{Z}$
	Output duty ratio	$\frac{T}{2} \pm \frac{T}{4}$ (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⎓ • [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)

2.2.3 Brake

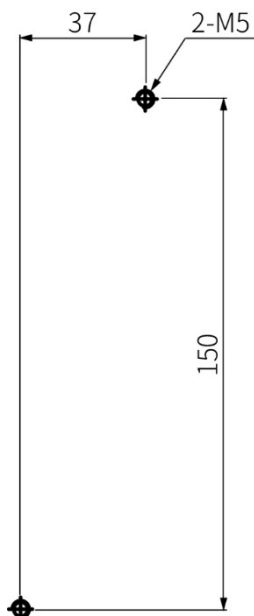| Motor frame size	60 mm	86 mm
Rated excitation voltage	24 VDC⎓ ± 10%	
Rated excitation current	0.275 A	0.479 A
Static friction torque	0.75 N m	2.6 N m
Rotation part inertia moment	19 g·cm² (1.9×10^{-6} kg·m²)	120 g·cm² (12×10^{-6} kg·m²)
Insulation class	B type (130 °C)	
B type brake	Power ON: brake is released, Power OFF: brake is locked	
Operating time	30 ms	40 ms
Releasing time	10 ms	25 ms

3   Dimensions

3.1   Driver

(Unit: mm)
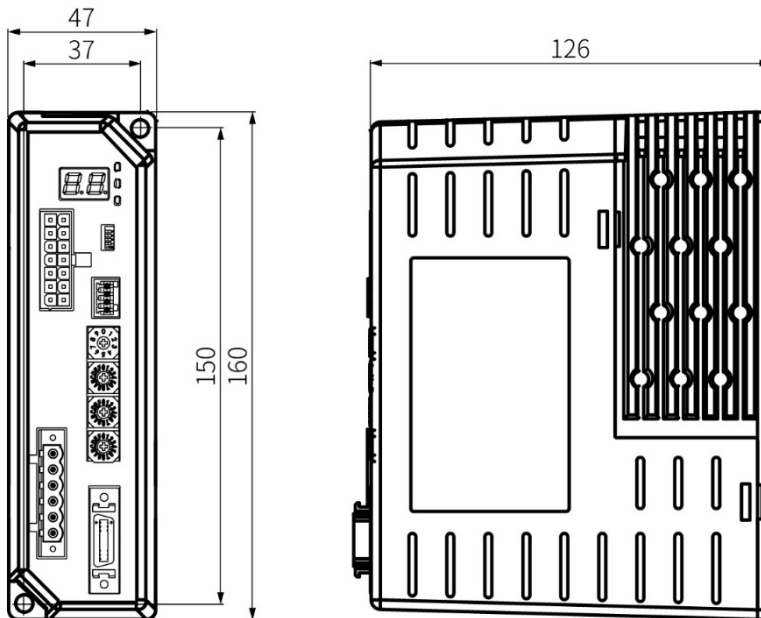
3.1.1   Panel Cut-out
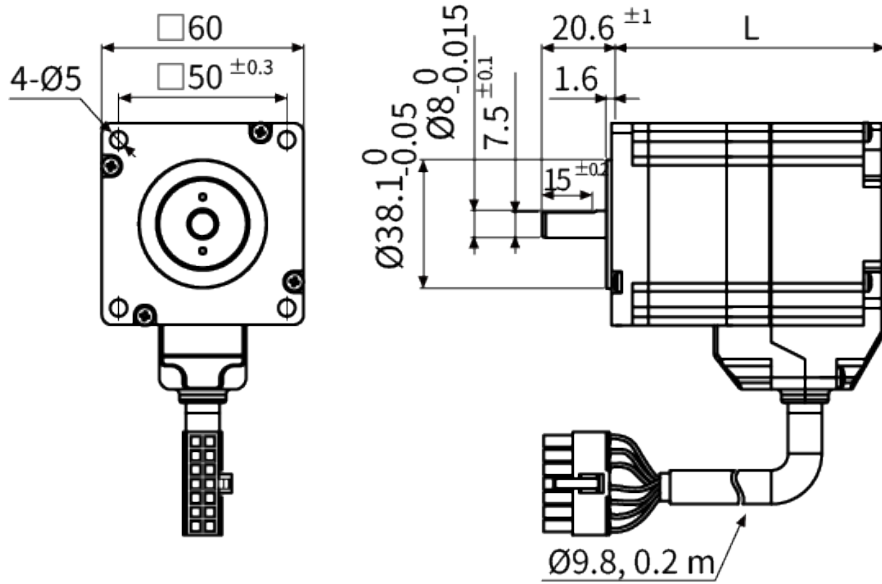

✎ **Note**

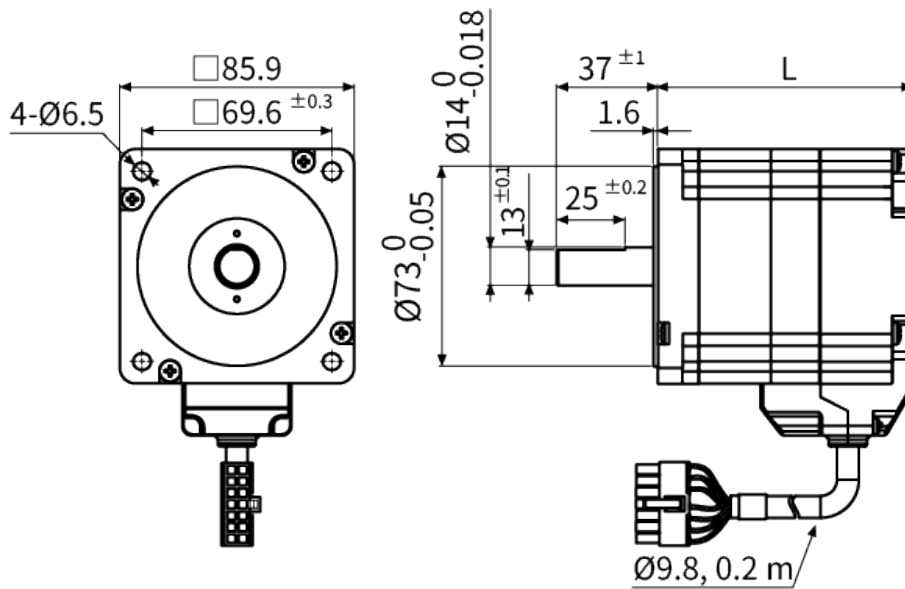Be sure that these figures may differ from the actual units.

3.2 Motor

3.2.1 Standard Type
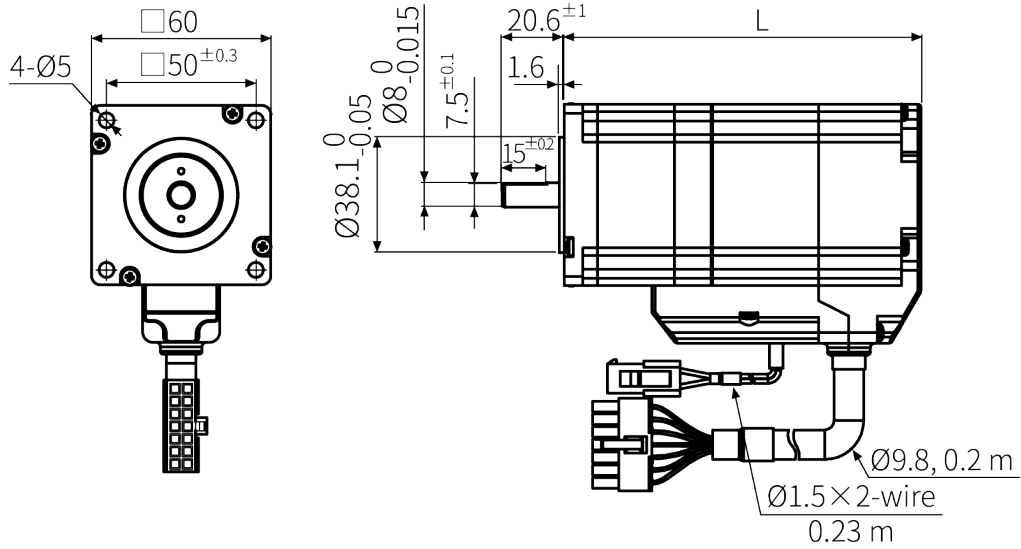
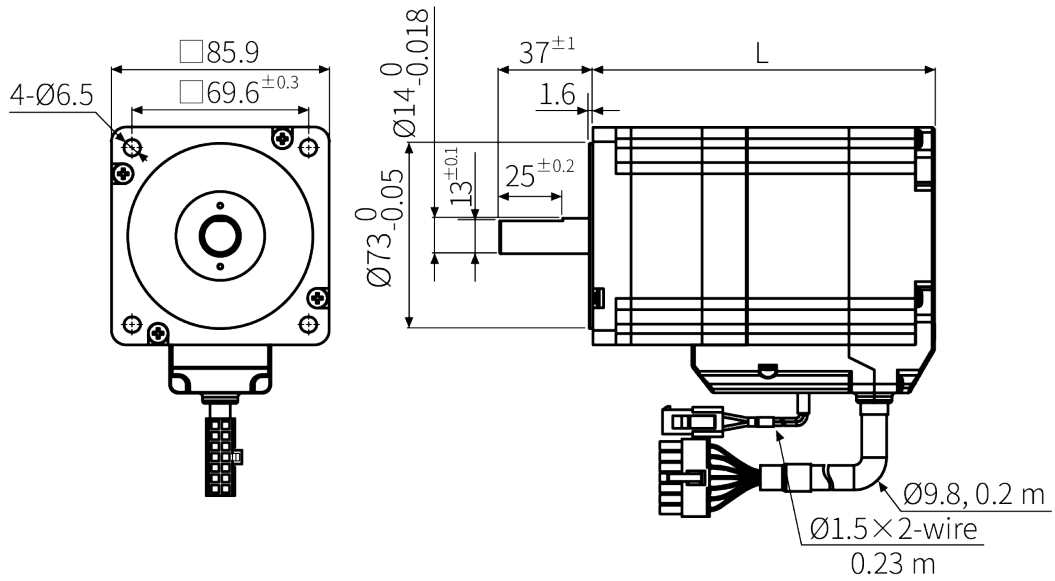#### 3.2.1.1 Frame Size 60 mm

3.2.1.2 Frame Size 86 mm

📝 **Note**

Model	L	Model	L
AiA-M-60MA	81.2	AiA-M-86MA	93.3
AiA-M-60LA	102.1	AiA-M-86LA	107.8

3.2.2   Built-in Brake Type

3.2.2.1   Frame Size 60 mm

3.2.2.2   Frame Size 86 mm

📝 Note

Model	L	Model	L
AiA-M-60MA-B	117.8	AiA-M-86MA-B	134.8
AiA-M-60LA-B	138.8	AiA-M-86LA-B	148.8

4   Installation

4.1   Installation of Driver

(Unit: mm)
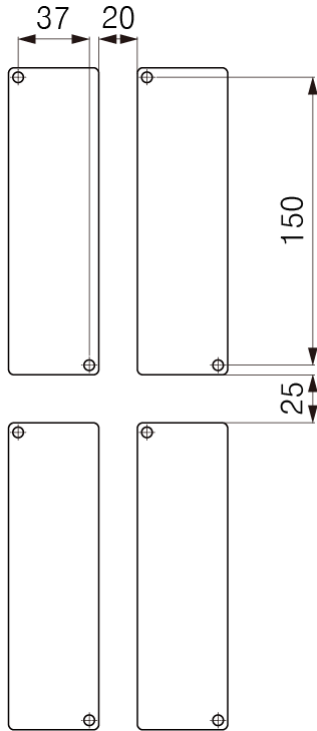
※ Install on the metal plate with high thermal conductivity for heat dissipation of the driver.

※ Install in the well-ventilated area and install the cooling fan in the unventilated environment.

※ Failure to heat dissipation may result in damage or malfunction due to the stress on the product.
Check the environment of use within the rated specifications and install on the well-heat dissipated area.

※ In case of installing the drivers more than two, keep distance at least 20 mm in the horizontal direction and at least 25 mm in the vertical direction.

4.2　　　Installation of Motor

4.2.1　　Mounting Direction of Motor

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

Overhung load

D※1

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

Facing up, down
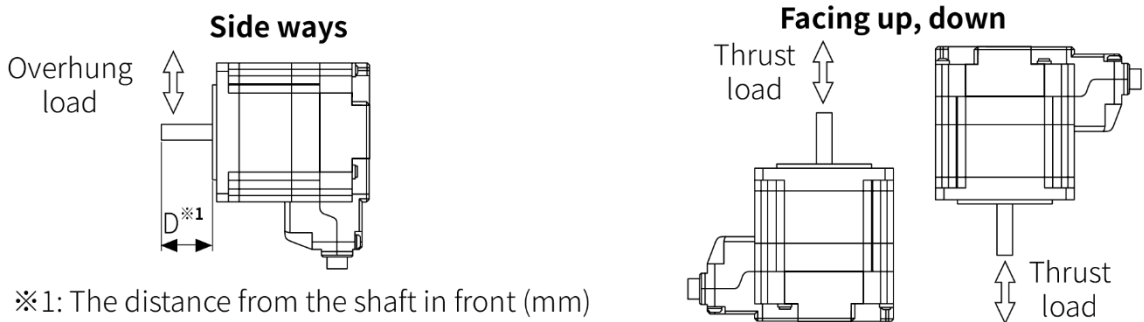
Thrust load

Thrust load

Motor size	The distance from the shaft in front (mm), Allowable overhung load [N]				Allowable thrust load
	D=0	D=5	D=10	D=15	
Frame size 60mm	54	67	89	130	Below motor weight
Frame size 86mm	260	290	340	390	

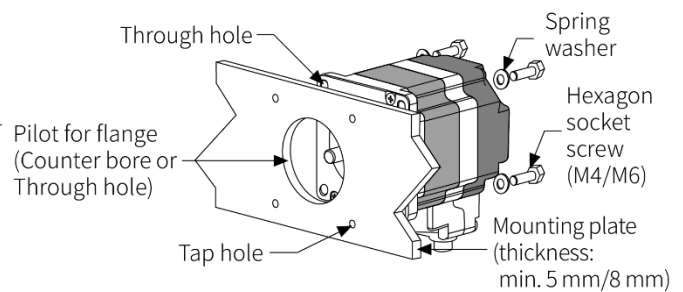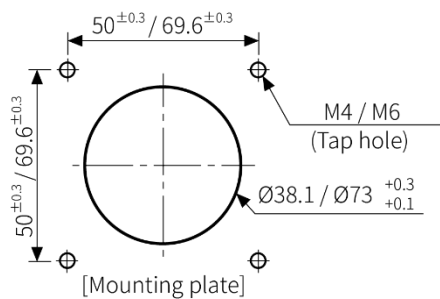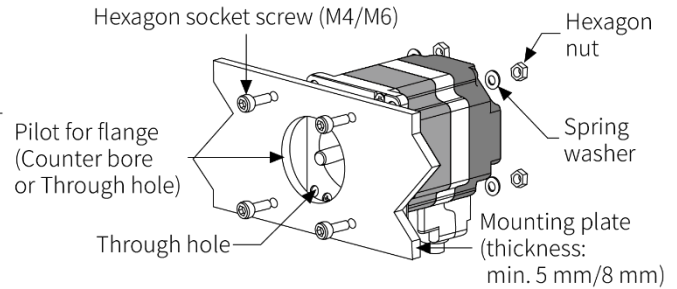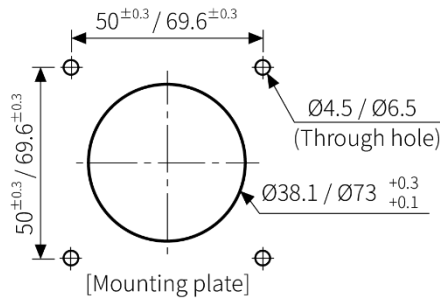Do not apply excessive force on motor cable when mounting motors.

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.
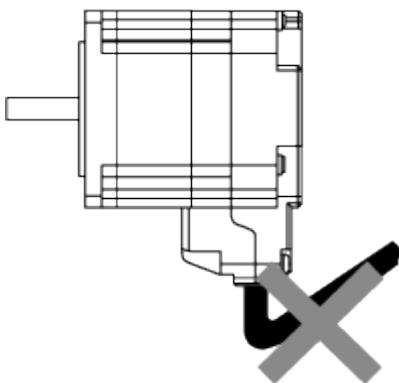
4.2.2   Mounting of Motor

4.2.2.1   Frame Size 60mm / Frame Size 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, spring washers and flat washers.

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

4.2.3 Connection with Load

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

When connecting the load such as a pulley or a belt, be cautious of the allowable thrust load, radial load, and shock, as well as tighten the screw for a coupling or a pulley not to be unscrewed.

When attach a coupling or a pulley to the shaft, be cautious of damage on shaft or bearings and it is banned to disassemble or change structure of the device or the shaft for connecting with a load.

4.2.3.1 Direct Load Connection with Coupling


Flexible coupling
Ball screw or TM screw
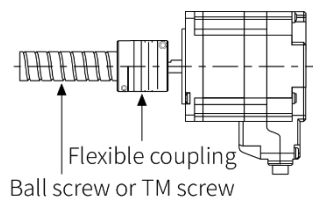
※ Use Autonics flexible coupling (ERB Series)

When connecting a load such as Ball screw or Tm screw directly to the shaft of the motor, use flexible coupling as image showing above.
If the center of the load and the shaft is not aligned, it may cause severe vibration, damage on shaft or shortened life cycle of bearings.

4.2.3.2 Load Connection with Pulley, Belt, and Wire
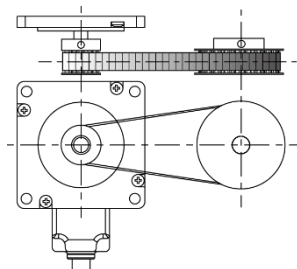
The motor shaft and the load shaft should be parallel. Connect the motor shaft and the line which connects the center of two pulleys to a right angle.

4.2.3.3 Load Connection with Gear
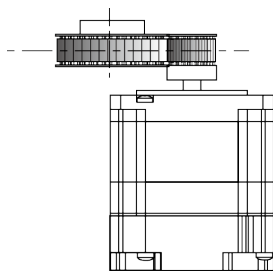
The motor shaft and the load shaft should be parallel. Connect the motor shaft to the center of gear teeth side to be interlocked.

4.2.4   Installation Conditions

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 and designed 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 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 acid material

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 radioactive substances and magnetic fields does not exist and is not in the vacuum status

5 Connection
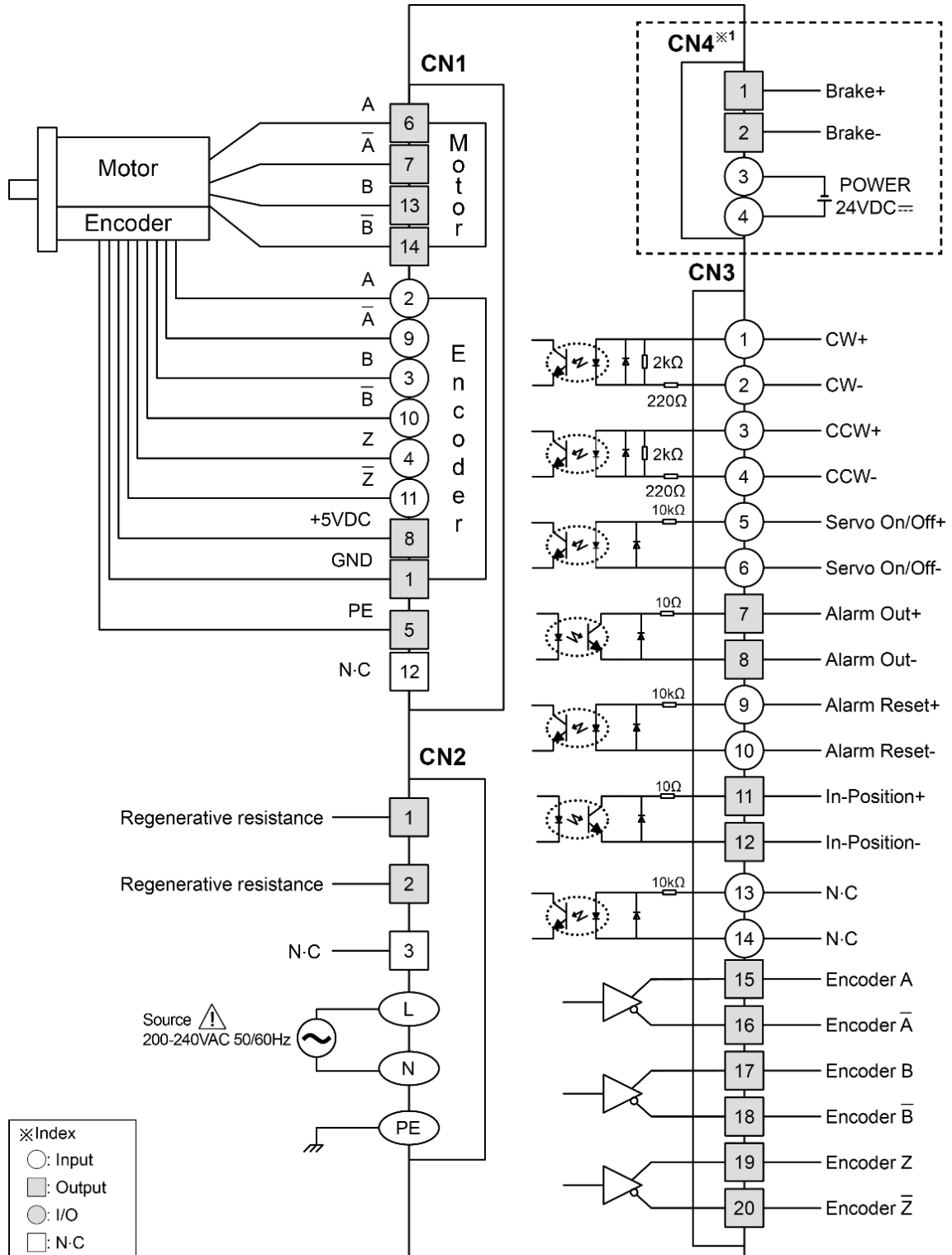
※1. Corresponding connector is for built-in brake type only.

6   Characteristics

6.1   Frame Size 60 mm
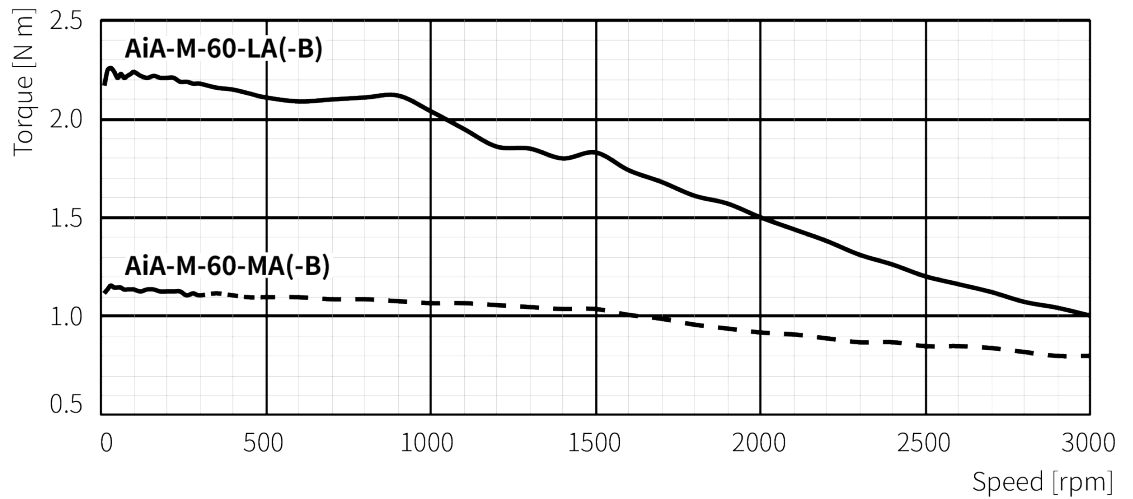
6.2   Frame Size 86mm
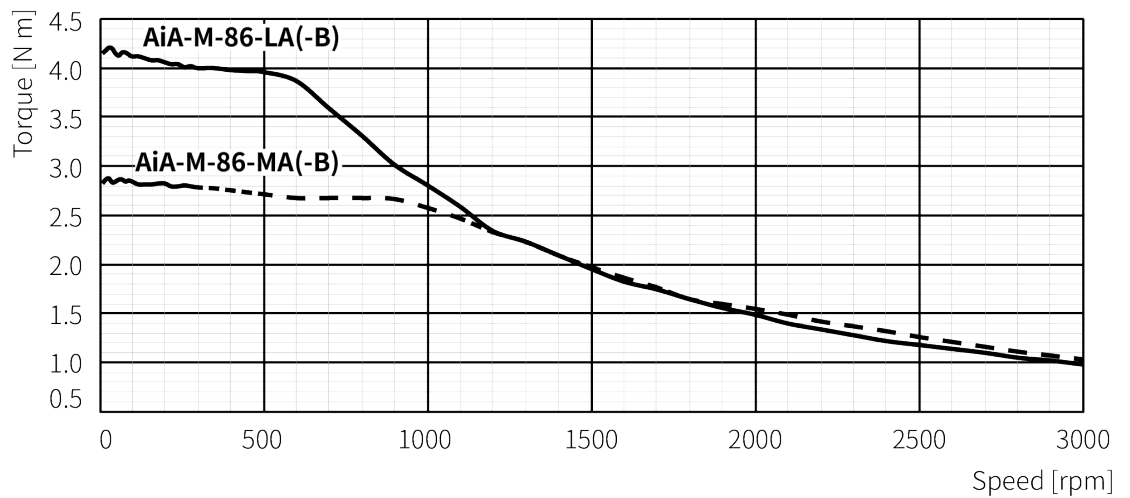
7   Driver Unit Descriptions
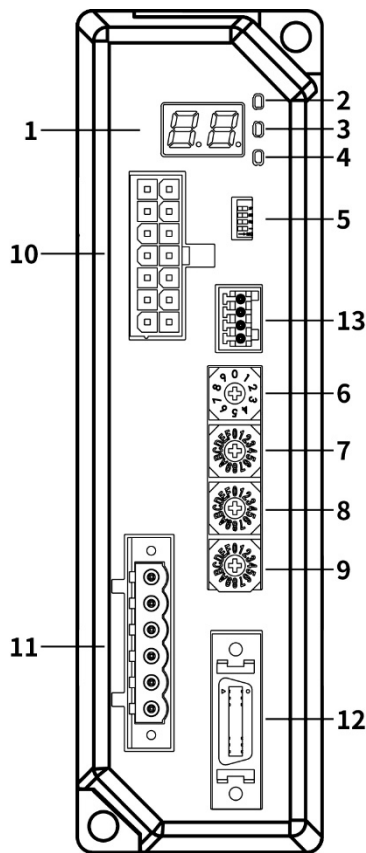
1. **Alarm/Status display part (orange)**

2. **Power/Alarm indicator (PWR/ALM) (green/red)**

3. **In-Position indicator (INP, oragne)**

4. **Servo On/Off indicator (SERVO) (blue)**

5. **Function selection DIP switch**

6. **Resolution rotary switch (RES)**

7. **Motor GAIN setting rotary switch (GAIN)**

8. **Speed filter/limit setting rotary switch (S.F)**

9. **In-Position setting rotary switch (INP)**

10. **Motor+encoder connector (CN1)**

11. **Power connector (CN2)**

12. **I/O connector (CN3)**

13. **Brake connector (CN4)**[1]

※1: Corresponding connector is for built-in brake type only.

7.1   Driver Status Indicator

Indicator & Display part	LED color	Function	Descriptions
Alarm/Status display part	Orange	Alarm, status indicator	Displays the corresponding number, status of operation, etc when Alarm occurs.
PWR/ALM	Green	Power indicator	Turns ON when the unit operates normally after supplying power.
	Red	Alarm indicator	When alarm occurs, it flashes in various ways depending on the situation. Refer to '11.1 Alarm'.
INP.	Orange	In-Position indicator	Turns ON when motor is placed at command position after positioning input. Turns OFF in torque mode.
SERVO	Blue	Servo On/Off indicator	Turns ON when servo is operating, turns OFF when servo is not operating.

7.2 Switches

7.2.1 Function Selection DIP Switch

Set rotation direction, pulse input method, motor gaion and torque mode.

		Function	ON	OFF	Applied setting moment
1	DIR	Rotation direction	CCW	CW	Right after setting ends
2	1P/2P	Pulse input method	1-pulse input method	2-pulse input method	
3	GS H/L	Motor GAIN setting	Inertia GAIN	Standard GAIN	When motor is stopped
4	TM	Torque mode	Torque mode	Standard mode	

Note

- For more information of each function, refer to '10 Driver Function'.

7.2.2 Resolution Setting Switch

Set the resolution of driver.

Setting	PPR	Resolution	Setting	PPR	Resolution
0	500	2.5	5	3600	18
1	1000	5	6	5000	25
2	1600	8	7	6400	32
3	2000	10	8	7200	36
4	3200	16	9	10000	50

Note

- Modified setting values are not applied in the running status and the values will be applied after motor stopped.

7.2.3   Motor GAIN Setting Rotary Switch

Depending on GS H/L switch setting, the motor GAIN sets High or Low.

	GS H/L OFF				GS H/L ON			
	Setting	Standard GAIN	Setting	Standard GAIN	Setting	Inertia GAIN	Setting	Inertia GAIN
	0	×1	8	×9	0	×1	8	×9
	1	×2	9	×10	1	×2	9	×10
	2	×3	A	×11	2	×3	A	×11
	3	×4	B	×12	3	×4	B	×12
	4	×5	C	×13	4	×5	C	×13
	5	×6	D	×14	5	×6	D	×14
	6	×7	E	×15	6	×7	E	×15
	7	×8	F	×16	7	×8	F	×16

Note

- For more information, refer to '10.2.1 Motor GAIN'.

7.2.4   Speed Filter / Limit Setting Rotary Switch

7.2.4.1   Speed Filter Setting Rotary Switch

In standard mode, it sets the delay time between the command position and the motor position.

	Setting	Delay time (ms)	Setting	Delay time (ms)
	0	Disable	8	60
	1	2	9	80
	2	4	A	100
	3	6	B	120
	4	8	C	140
	5	10	D	160
	6	20	E	180
	7	40	F	200

Note

- The corresponding function is only available in standard mode.
- It determines the responsiveness of the motor to the command and smoothly follows the speed even if the load changes or disturbance occurs.
- For more information, refer to '10.2.2 Speed Filter'.

7.2.4.2   Speed Limit Setting Rotary Switch

In torque mode, it sets the speed limit.

Setting	Limit Speed (rpm)	Setting	Limit Speed (rpm)
0	10	8	90
1	20	9	120
2	30	A	150
3	40	B	200
4	50	C	250
5	60	D	300
6	70	E	380
7	80	F	500

Note

- The corresponding function is only avaialbe in torque mode.
- When the rotation speed reaches the speed limit value, the torque control may become unstable. Set value greater than the speed to be limited.

7.2.5   In-Position Setting Rotary Switch

Fast Response		Accurate Response	
Setting	Value	Setting	Value
0	±0	8	±0
1	±1	9	±1
2	±2	A	±2
3	±3	B	±3
4	±4	C	±4
5	±5	D	±5
6	±6	E	±6
7	±7	F	±7

Note

- After position commad pulse has finished, if the gap between target position and real position is under. In-Position setting value, positioning completion pulse is outpu.
- Modified setting values are not applied in the running status, and the values will be aapplied after motor stipped.
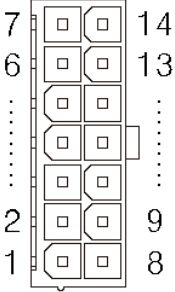
- ▪ For more information, refer to '10.2.3 In-Position'.

7.3 Connectors

7.3.1 CN1: Motor+Encoder Connector
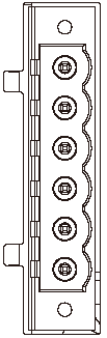
Connects the motor and the encoder to the driver.

Pin no.	Function	Pin no.	Function
1	GND	8	+5 VDC⎓
2	Encoder A	9	Encoder $\overline{A}$
3	Encoder B	10	Encoder $\overline{B}$
4	Encoder Z	11	Encoder $\overline{Z}$
5	PE	12	N·C
6	Motor A	13	Motor B
7	Motor $\overline{A}$	14	Motor $\overline{B}$
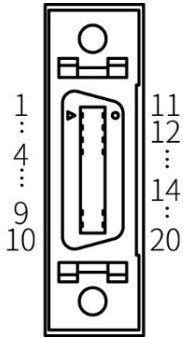
7.3.2 CN2: Power Connector

Connects with 200-240VAC∼ power.

Pin no.	Function
1	Connect regenerative resistance
2	
3	N·C
4	AC power input
5	
6	PE
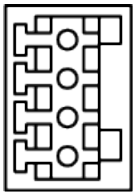
7.3.3   CN3: I/O Connector

Pinno.	I/O	Function	Pinno.	I/O	Function
1	Input	CW+	11	Output	In-Position+
2	Input	CW-	12	Output	In-Position-
3	Input	CCW+	13	-	N·C
4	Input	CCW-	14	-	N·C
5	Input	Servo On/Off +	15	Output	Encoder A
6	Input	Servo On/Off -	16	Output	Encoder $\overline{A}$
7	Output	Alarm Out +	17	Output	Encoder B
8	Output	Alarm Out -	18	Output	Encoder $\overline{B}$
9	Input	Alarm Reset +	19	Output	Encoder Z
10	Input	Alarm Reset -	20	Output	Encoder $\overline{Z}$

7.3.4   CN4: Brake Connector

Corresponding connector is for built-in brake type only.

Pinno.	Function
1	24 VDC⎓
2	GND
3	Brake +
4	Brake -

7.4   Connector Specifications

Type		Specifications			Manufacture
		Connector	Connector terminal	Housing	
CN1	Motor+Encoder	5557-14R	5556T	-	Molex
CN2	Power	5ESDVM-06P-OR	-	-	Dinkle
CN3	I/O connector	10120-3000PE	-	10320-52F0-008	3M
CN4	Brake connector	ESC250V-S2330704P	-	-	Dinkle

✏️ **Note**

Above connectors are suitable for AiSA-D Series.

7.5 Sold Separately

7.5.1 I/O Cable (CO20-MP□-R, standard: AiS TAG)

Pin no.	Function (name tag)	Cable color	Dot line color-numbers	Pin no.	Function (name tag)	Cable color	Dot line color-numbers
1	CW+	Yellow	Black-1	11	In-Position+	White	Black-1
2	CW-		Red-1	12	In-Position-		Red-1
3	CCW+		Black -2	13	N·C		Black-2
4	CCW-		Red -2	14	N·C		Red -2
5	Servo On/Off +		Black -3	15	Encoder A		Black -3
6	Servo On/Off -		Red -3	16	Encoder $\overline{A}$		Red -3
7	Alarm Out +		Black -4	17	Encoder B		Black -4
8	Alarm Out -		Red -4	18	Encoder $\overline{B}$		Red -4
9	Alarm Reset +		Black -5	19	Encoder Z		Black -5
10	Alarm Reset -		Red -5	20	Encoder $\overline{Z}$		Red -5

✎ **Note**

□ of model name indicates the cable length (010, 020, 030, 050, 070, 100, 150, 200).

For corresponding EMC standard, cable length should be below 2 m.

E.g.) CO20-MP070-R: 7m I/O cable

7.5.2 Motor+Encoder Cable (Normal: C1D14M-□/Moving: C1DF14M-□)
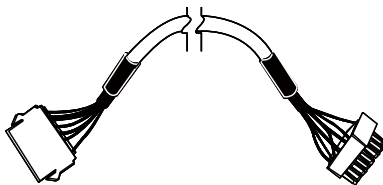
✎ **Note**

□ of model name indicates the cable length (1, 2, 3, 5, 7, 10, 15, 20).

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

40

8 Electromagnetic Brake

Electromagnetic brake is a device that helps maintain the position of load in the situation of power failure or alarm occur in vertical load.

⚠️ **Caution**

- Electromagnetic brake does not made for maintaining load compeletly. Do not use as safe brake.

- Do not use electromagnetic brake as brake stop. Brake power will be reduced due to worn brake.

  Make sure to use the exclusive power for electromagnetic brake.

- In case of using auxiliary power supply for electromagnetic brake, do not mix the power with the power supply for I/O signals.

  Failure to follow this instruction may result in electromagnetic brake damage or malfunction due to outer disturbnace.

8.1 Brake Connection

Connect the brake connector (CN4) to motor brake connector and input auxiliary power with 24 VDC⎓.

When connecting the brake, use AWG22 cable or over for connection.

8.2 Brake Operation
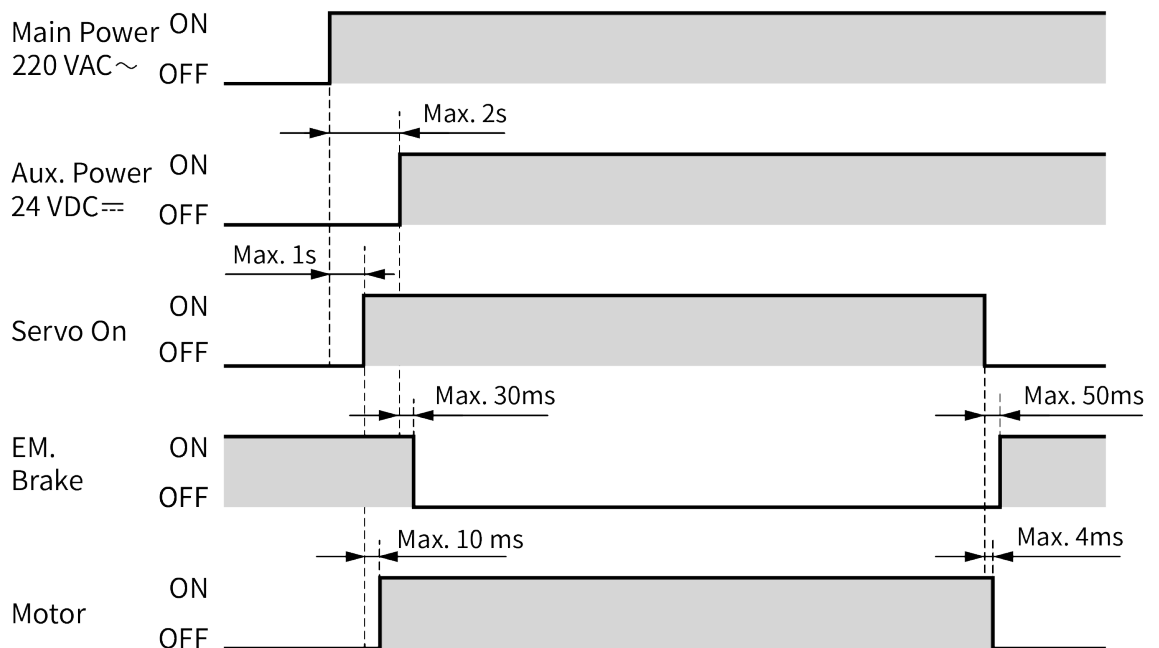
The auxiliary power 24 VDC⎓ input is required to release brake. When the auxiliary power does not input, Brake error (*E d*) alarm occurs. For more information, refer to '11.1 Alarm'.

- When Servo is On, brake is released automatically.
- The brake remains lock inn all status except Servo On status.

Note

※ Brake lock is manually controllable using the Brake ON/OFF input signal.

9   Control Input/Output

Inner signal of all input/output consists of photocoupler.

ON: pohtocoupler power ON

OFF: photocoupler power OFF

9.1   Input

9.1.1   Example of Input Circuit Connection

9.1.1.1   Pulse Input Signal Circuit (CW, CCW)

Use external power (VEX) 5 VDC⎓ in pusle input.

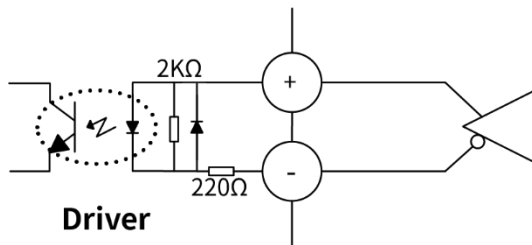When input power is exceedeed, it may result the product damage.

In case the external pulse input power (VEX) is over 5 VDC⎓, use external resistor R_L.

In case the external pulse input power (VEX) isover 12, 24 VDC⎓, refer to R_L as table below.
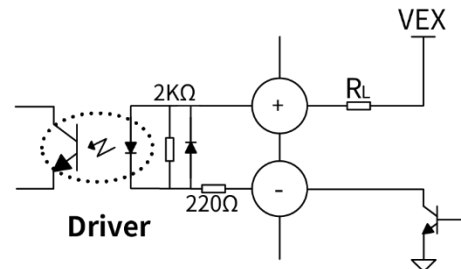
$$R_L = \frac{V_{EX} - 2.17V}{0.011A} - 220\,\Omega$$

VCC	R_L
12 VDC⎓	680 Ω (Min. 0.25W)
24 VDC⎓	1.7 kΩ (Min. 0.5W)

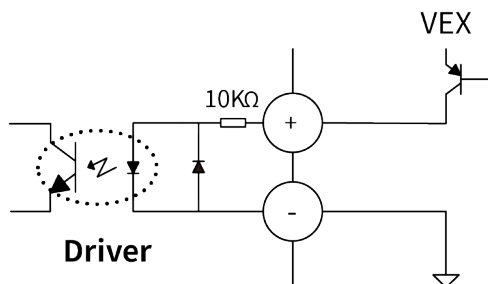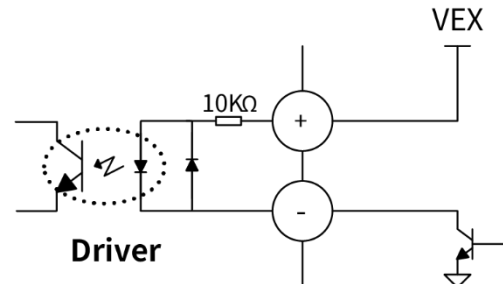**(1) Differential Line Driver**   **(2) Open Collector**

9.1.1.2   External Input (Servo On/Off, Alarm Reset)

Use external power (VEX) 24 VDC⎓ in external input Servo On/Off and Alarm Reset.

**(1) PNP Circuit**   **(2) NPN Circuit**

9.1.2   Exclusive Input

Pin no.	Signal	Descriptions
1	CW +	Rotates CW direction
2	CW -	
3	CCW +	Rotates CCW direction
4	CCW -	
5	Servo On/Off +	Releases motor torque manually
6	Servo On/Off -	
9	Alarm Reset +	Alarm reset
10	Alarm Reset -	

9.1.2.1   Pulse Input (CW, CCW)

Receive pulse input from host controller.

1-Pulse input method and 2-Pulse input method are selectable through the '1P/2P' of Function seleciton DIP switch.
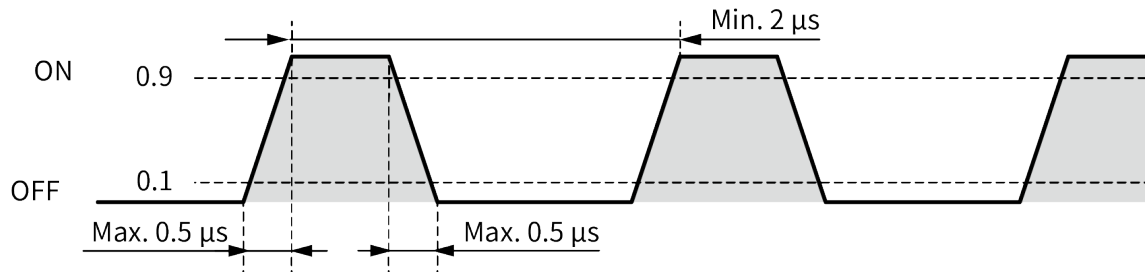
The rotation direction of motor is selectable through the 'DIR' of Function selection DIP switch.

DIR Setting	CW Pulse input	CCW Pulse input
OFF (CW)	Rotate to CW direction Increase position when position setting	Rotate to CCW direction Decrease position when position setting
ON (CCW)	Rotate to CCW direction Decrease position when position setting	Rotate to CW direction Increase position when position setting

- **Pulse Input Method**

(1) 1-Pulse input method
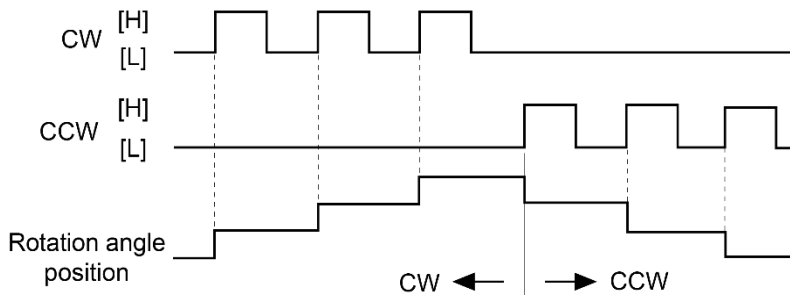
CW: rotation operation signal input

CCW: rotatino direction signal input
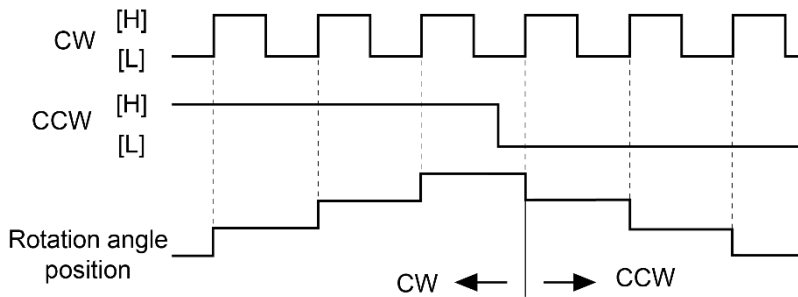
(2) 2-Pulse input method

CW: forward rotation signal input

CCW: reverse rotation signal input

Note

- [H]: photocoupler ON (voltage of both ends 4-8VDC⎓)
- [L]: photocoupler OFF (voltage of both ends 0-0.5VDC⎓)

※ Use noise filter for signal line to avoid disturbance when using extension cable.

9.1.2.2   Servo On/Off

This signal is for rotating axis of motor using external force or used for manual positioning.

Brake is locked in Servo Off status. Connect external switch to change brake as released status manually.

- Servo On/Off signal and phrase current is cut to relase torque

   : Regaraded as Servo Off Signal and phase current is cut to release torque.

   The Servo ON indicator, the In-Poisition output and indicator turns OFF.
- Servo On/Off signal maintains over 1 ms as [L]

   : Regarded as Servo On signal and phase current is supplied to gain torque.

   The Servo On indicator, the In-Position output and indicator turns ON.

📝 Note

For the safety reason, this is not available while motor is in operation.

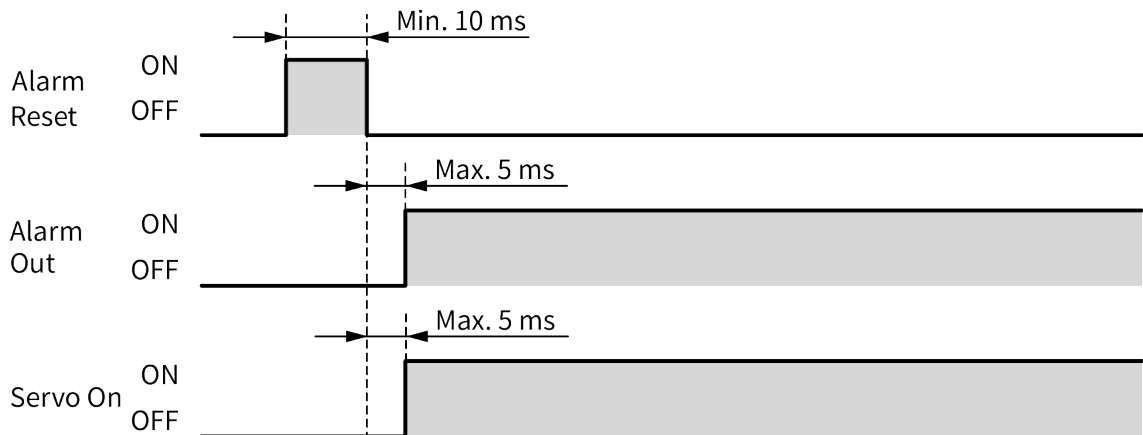Must use when the motor is completely stopped.
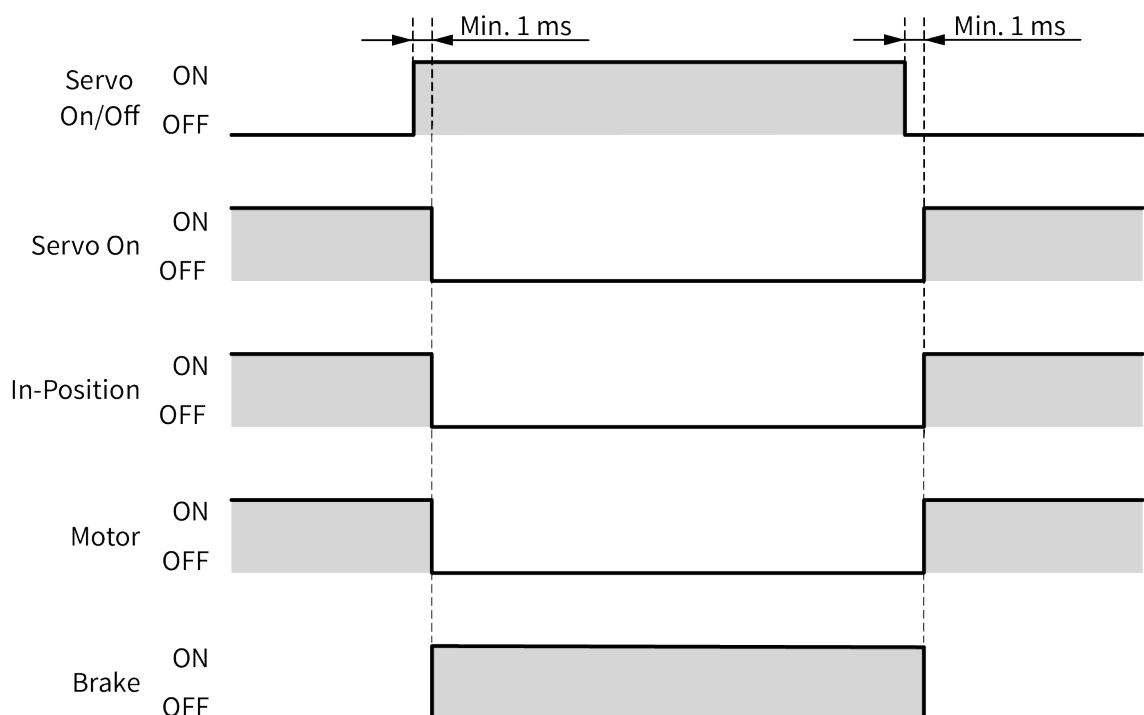
9.1.2.3　Alarm Reset

- It is for alarm reset.
- When alarm reset seignal"Alarm Reset" is [H].

: alarm is reset and the alarm indicator and alarm output turns OFF.

The driver returns to normal status.

Note

If alarm causes are not removed, the diver does not return to normal status.

9.2   Output

9.2.1   Example of Output Circuit Connection

9.2.1.1   External output signal circuit

Use external power (VCC) max. 30 VDC⎓, 10mA for output.

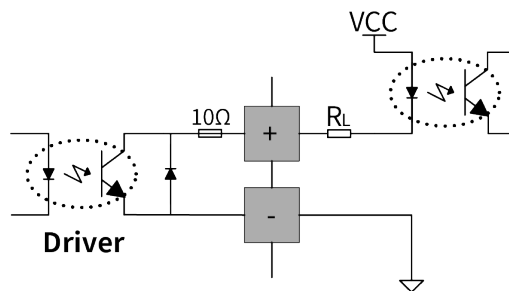When current is over 10mA, use external resistor R_L to control current.

$$R_L \quad = \quad \frac{V_{CC} - 0.7V - V_F}{0.01A} - 10\,\Omega$$

Note

V_F: LED forward voltage of primary photo coupler.

(1) Open Collector

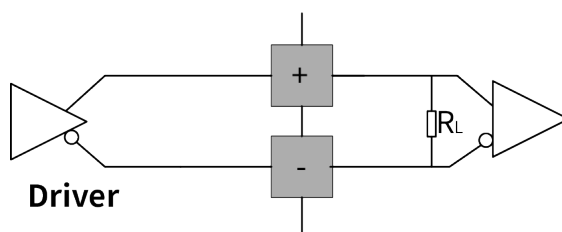#### 9.2.1.2   Encoder Output Signal Circuit

Encoder output signal uses a line driver (26C32).

Connect the terminal resistance R_L of 100 to 150 Ω in parallel to both ends (A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$) of each phase of encoder.

(1) Differential line driver

9.2.2   Exclusive Output

Pin no.	Signal	Descriptions
7	Alarm Out +	Alarm output
8	Alarm Out -	
11	In-Position +	In-Position output
12	In-Position -	
15	Encoder A	Encoder signal output
16	Encoder $\overline{A}$	
17	Encoder B	
18	Encoder $\overline{B}$	
19	Encoder Z	
20	Encoder $\overline{Z}$	

9.2.2.1   Alarm Out

In normal state, output is ON and when alarm occurs, the phase current flowing to motor is cut off and output is OFF.

Depending on the alarm type, it displays the alarm number and flashes as much as the alarm number on the alarm/status display part.

For more information, refer to '11 Protection Function'.

9.2.2.2   In-Position

In-Position output is output dcondition of the positioning complete signal.

When In-Position completes, In-Position output becomes [H] and In-Position indicator turns ON.
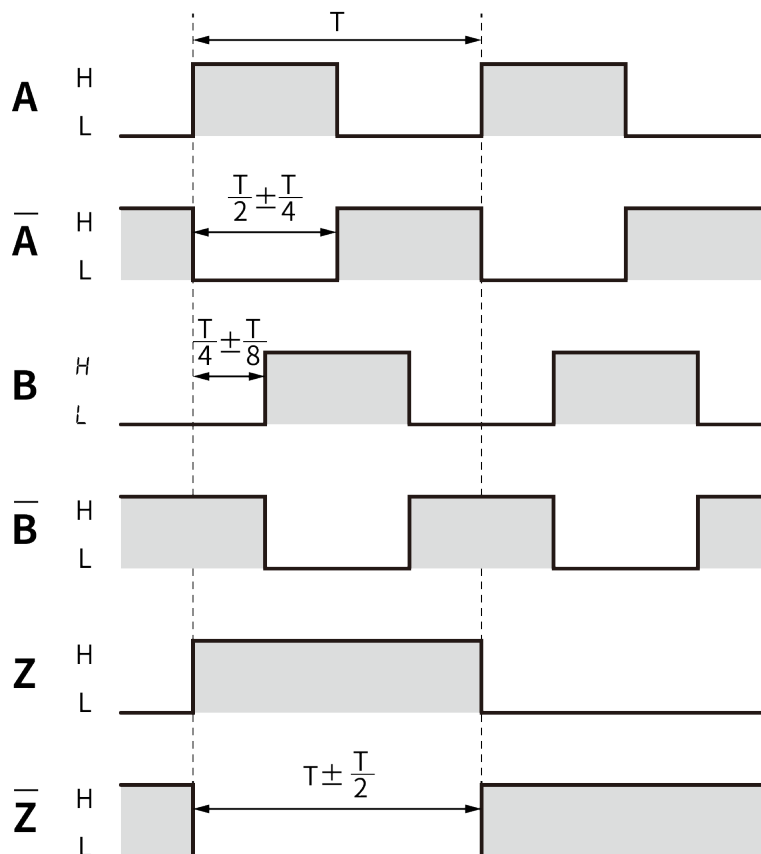
During In-position operation, In-Position output becomes [L] and In-Position indicator turns OFF.

The signal outputs depending on the set In-Position value

For more information, refer to '10.2.3 In-Position'.

9.2.2.3   Encoder A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$

Encoder signals output in each differential line driver.

10 Driver Function

10.1 Torque Mode

Torque mode is used to maintain a constant tension with a constant torque or to change the number of rotatinos depending on the size of the load.

When a constant torque is output from the moter, the speed increases at a constant acceleration and the speed limit must be set.

10.1.1 Torque Mode Setting

It has a 1% torque size of the max. torque of the motor per pulse input from the upper control device.

If a torque greater than 100 Pulse is entered, the torque size will have a max. torque (100%).

Note

- Make sure to use absolute position mode (ABS) in torque mode when input pulse.
- The current torque size can be checked through the alarm/status display part.

Alarm/Status display part	Torque size (%)
1	1
2	2
3	3
4	4
. . .	
97	97
98	98
99	99
A0	100

10.1.2   Torque Mode Drive

10.1.2.1   I/O Signal Control Drive

1st Drive select: Set TM of the function selection DIP switch to ON before applying power.

2nd Power input: Apply power to the driver. In-Position indicator flashes at this point.

3rd Speed limit setting: Set the speed limit value using the speed limit swtich.

4th Torque setting: Set the torque value by assigning pulse of the host controller.

5th Drive: Start drive by input pulse on CW or CCW.

10.1.2.2   Torque Mode Drive through PMC
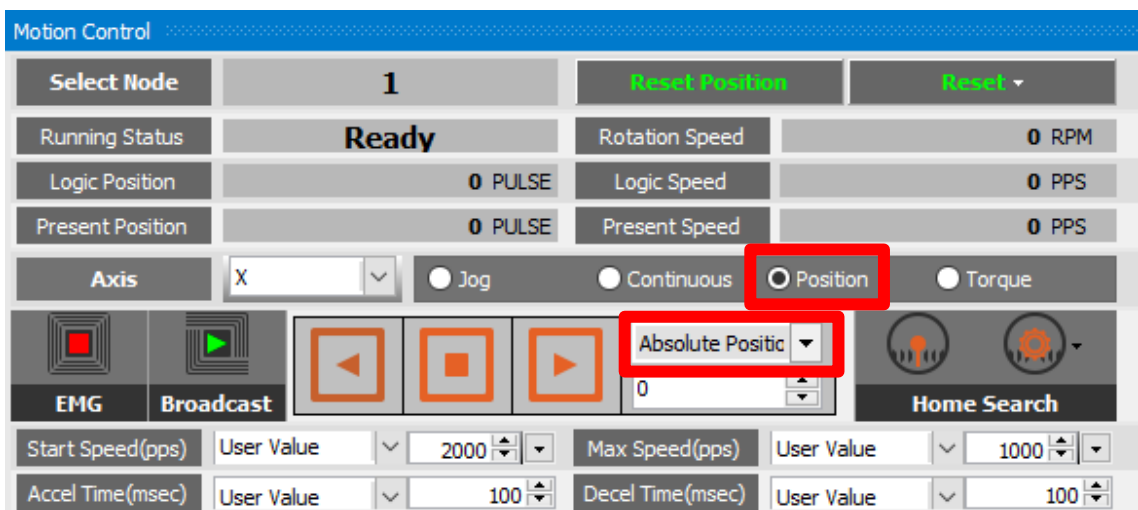
1st Drive select: Set TM of the function selection DIP switch to ON before applying power.

2nd Power input: Apply power to the driver. In-Position indicator flashes at this point.

3rd Speed limit setting: Set the speed limit value using the speed limit swtich.

4th GUI connect: Execute atMotion by connecting communication on PMC.

5th atMotion setting: Select drive mode as 'Position' then selec 'Absolut Position'.

6th Torque setting: Select the torque size by entering position value 0 to 100. If the position value is 10, the torque size is controlled at 10%. Select ▶, ◀ to rotate the motor in the desired direction.

Note

For more detailed connection information, refer to 'PMC user manual' and 'atMotion user manual'.
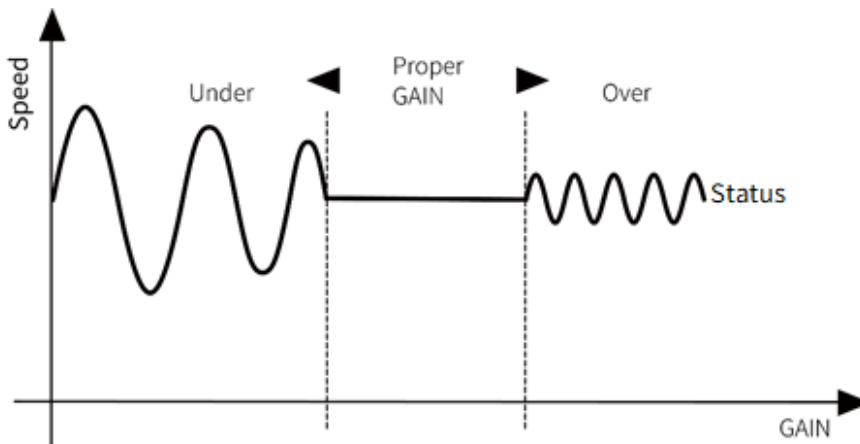
10.2　　Other Functions

10.2.1　　Motor GAIN

The motor response of position command can be changed by parameter setting.

Depending on the load of motor, assign gain value to make faster position decision and smoother movement.

As GAIN gets bigger, the transient response improves and error gets lesser, motor specification gets stable.

Assigned GAIN value is applied when motor stops.

| GS H/L OFF				GS H/L ON			
Setting	Standard GAIN	Setting	Standard GAIN	Setting	Inertia GAIN	Setting	Inertia GAIN
0	×1	8	×9	0	×1	8	×9
1	×2	9	×10	1	×2	9	×10
2	×3	A	×11	2	×3	A	×11
3	×4	B	×12	3	×4	B	×12
4	×5	C	×13	4	×5	C	×13
5	×6	D	×14	5	×6	D	×14
6	×7	E	×15	6	×7	E	×15
7	×8	F	×16	7	×8	F	×16

Note

Rasie the GAIN value until the motor vibrates at the lowest load of the system and then set the GAIN value to 1 to 2 steps lower.

10.2.2 Speed Filter

It is available to set motor drive response according to the swtich setting.

Set the speed filter value for time delay between the command position and motor. It is able to drive softly even though load changing or disturbnace occurs.
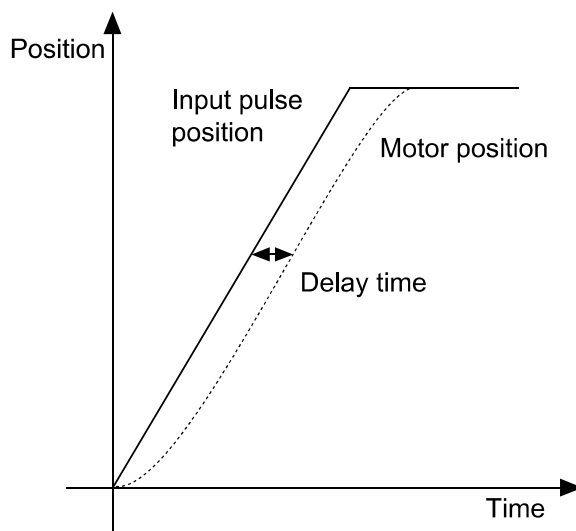
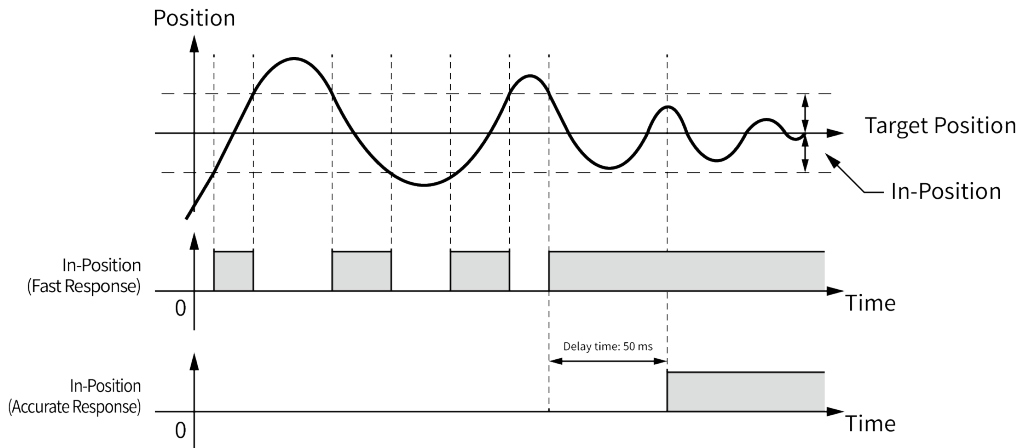| Setting	Value (ms)
0	Disable
1	2
2	4
3	6
4	8
5	10
6	20
7	40
8	60
9	80
A	100
B	120
C	140
D	160
E	180
F	200

10.2.3   In-Position

In-Position output is output condition of positioning completion signal.

If the gap between target position and real position is under in-position setting value after position command pulse has finished, in-position output turns ON and the in-position indicator turns ON.
In reverse, when the gap is over in-position setting value, in-position output turns OFF and the in-position indicator turns OFF.

■   Fast Response: When the gap between the target position and the current position is lower than the setting value, it outputs in-position signal imeediately.

■   Accurate Response: When the gap between the target position and the current position is lower than the setting value and maintains over 50 ms, it outputs in-position signal.

Fast Response		Accurate Response	
Setting	Value	Setting	Value
0	0	8	0
1	±1	9	±1
2	±2	A	±2
3	±3	B	±3
4	±4	C	±4
5	±5	D	±5
6	±6	E	±6
7	±7	F	±7

Note

For accurate control, check the in-position output before the next drive.
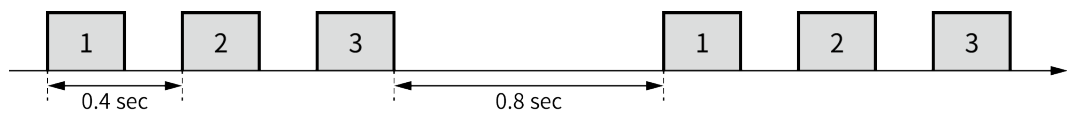
11   Protection Function

11.1   Alarm

- This function stops motor to protect driver, depending on the error status such as over current or over speed.
- After removing the cause of alarm, re-supply power or apply the signal on Alarm Reset, the driver returns to the normal status.

Note

- Depending on the alarm type, it displays as a segment and indicator on the Alarm/Status display part.
- When alarm occurs, indicators flash with interval of 0.4 sec and turn OFF with interval of 0.8 sec until the alarm is cleared

<E.g.: In case of alarm no. 3 >

No. of flashing	Alarm type	Desctiptions	Causes	Troubleshooting
1 (E 1)	Overcurrent error	When over current flows at motor RUN element	1. Over load 2. Insufficient SMPS capacity	1. Change operation condition or reduce load so that sudden load fluctuation does not occur. 2. Check that less than the recommended SMPS capacity is used. 3. Check driver break.
2 (E 2)	Overspeed error	When motor speed is over 3,500rpm	1. When overload is applied and released at a moment. 2. Turning more than 4,000 rpm by external force.	1. Change operation condition or reduce load so that sudden load fluctuation does not occur. 2. Change the operating condition so that the motor does not ratate more than 4,000 rpm.
3 (E 3)	Position tracking error	When the gap between position command value and current position value is over 90°	1. Over load 2. Motor connector and cable connection error 3. Burnout of line driver IC in encoder	1. Change operation condition or reduce load so that sudden load fluctuation does not occur. 2. Check motor connector and cable connection. 3. Replace the line driver IC in encoder.
4 (E 4)	Overload error	When applying load over the rated load for over 1 sec.	1. Over load 2. Insufficient SMPS capacity	1. Change operation condition or reduce load so that sudden load fluctuation does not occur. 2. Check that less than the recommended SMPS capacity is used. 3. Check driver break.
5 (E 5)	Overheat error	When driver inner temperature is over 85°C	1. Installed in an enclosed space	1. Change the installation environment. -Air flow around driver installation. -Heat dissipation (heat sink or fan)
6 (E 6)	Motor connection error	When motor cable connection error occurs at driver	1. Motor connector and cable connection error 2. Burnout of the inverter in the driver	1. Check motor connector and cable connection. 2. Replace burned parts of the inverter in the driver.

No. of flashing	Alarm type	Desctiptions	Causes	Troubleshooting
7 (E 7)	Encoder connection error	When encoder cable connection error occurs at driver	1. Motor connector and cable connection error 2. Burnout of line driver IC in encoder	1. Check motor connector and cable connection. 2. Replace the line driver IC in encoder.
8 (E 8)	Overvoltage error	When input voltage is over 24VAC +10%	1. Over load 2. Counter electromotive force overflow due to rapid deceleration	1. Change operation condition or reduce load so that sudden load fluctuation does not occur.
9 (E 9)	Under-voltage error	When input voltage is under 24VAC-10%	1. Low voltage	1. Change operation condition or reduce load so that sudden load fluctuation does not occur.
10 (E A)	Motor mis-alignment	When motor is in misalignment	1. Motor connector and cable connector error 2. Burnout of line driver IC in driver 3. Burnout of line driver IC in encoder 4. Burnout of the inverter in the driver	1. Check motor connector and cable connection. 2. Replace the line driver IC in driver. 3. Replace the line driver IC in encoder. 4. Replace burned parts of the inverter in the driver.
11 (E b)	Command pulse error	When input pulse is over 3,500rpm When input pulse is input befor initial motor alignment	1. Enter error of user command speed input	1. Use recommended specifications. (max. 3,000rpm input) 2. Enter the speed value (PPS) by checking the resolution.
12 (E C)	In-Position error	When position error (over 1) is kept over 3 sec, after motor stopped.	1. Over load 2. Lack of stop torque.	1. Change operation condition or reduce load so that sudden load fluctuation does not occur. 2. Increase stop torque as 50% or use the other motor with higher torque.
13 (E d)	Brake error	When brake failed to operate	1. If there is no auxiliary power applied. 2. Brake connector or cable connection error 3. Brake is damaged	1. Check auxiliary power 2. Check brake connector and cable 3. Replace brake motor

12   Troubleshooting

Malfunction	Causes	Troubleshooting
When motor does not excite	Servo is not ON.	Check that servo On/Off input signal is [L]. In case of [H], servo is off and excitation of motor is released.
	Alarm occurs.	Check the alarm type and remove the cause of alarm.
When motor rotates to the opposite direction of the designated direction	Rotation direction setting is not correct.	Check the DIR setting in function selection DIP switch.
When motor drive is unstable	Connection between motor and encoder is unstable.	Check the Motor+Encoder connection cable.
	Motor gain value is not correct.	Check motor GAIN setting rotary switch (GAIN) value.

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