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User Manual

Closed-Loop Stepper System

AiC-CL Series

MMD-AiC-CLU1-V1.1-2004US

Thank you for purchasing an Autonics product.
This user manual contains information about the product and its proper 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 user 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.
- A user 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 our website.
- We contrived to describe this manual more easily and correctly. However, if there are any corrections or questions, please notify us through our website.

User Manual Symbols

Symbol	Description
 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.
- Install the unit after considering counter plan against power failure.
Failure to follow this instruction may result in personal injury, or economic loss or fire.
- Check 'Connections' before wiring.
Failure to follow this instruction may result in fire.
- Do not disassemble or modify the unit.
Failure to follow this instruction may result in fire or electrical shock.
- Install the driver in the grounded 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 burn or electric shock due to high temperature of the surface.
- Emergency stop directly when error occurs.
Failure to follow this instruction may result in personal injury or fire.



Caution

- When connecting the power input, use AWG 18(0.75mm²) cable or over.
- Brake is non-polar. When connecting the brake, use AWG 24 (0.2mm²) cable or over.
Failure to follow this instruction may result in fire or malfunction due to contact failure.
- To use the motor safely, do not apply external force to the motor.
- It is recommended to use STOPPER for the vertical load.
- Install over-current 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 unexpected signal.
- 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 damage 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 dry cloth to clean the unit, and do not use water or organic solvent.
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 the product away from metal chip, dust, and wire residue which 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 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.
- 24VDC power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
- Re-supply power after min. 1 sec from disconnected power.
- In case communication is unstable due to the noise generated by supplied power or peripheral device, use ferrite core at communication line.
- It is recommended to use 485 converter with the separate power.
(Autonics product, SCM-38I, recommended)
- The thickness of cable should be same or thicker than the motor cable's when extending the motor cable.
 - ① CN1 (power connector): AWG18
 - ② CN2 (motor+encoder connector): AWG22, AWG24
 - ③ CN3 (I/O connector): AWG28
- RS485 communication is for parameter setting and operation test instead of driver operation. When operating with CC-Link, disconnect the RS485 communication from the device.
- CC-Link dedicated cable must be used. The performance cannot be guaranteed in case of using other cable.
- Keep the distance between power cable and signal cable more than 10cm.
- Motor vibration and noise can occur in specific frequency period
 - ① Change motor installation method or attach the damper.
 - ② Use the unit out of the dedicated frequency range when vibration and noise occurs due to changing motor RUN speed.
- 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

- ※ Please refer to the communication manual for CC-Link communication.

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1 Product Overview

1.1 Features

AiC-CL Series is 2-phase closed-loop stepper motor driver built-in motion controller function.

This unit is stand alone type and it drives through I/O with/without PC.

There are settings; PI-Gain, Speed Filter, In-Position and 4 modes.

It minimizes motor heat generation due to current setting during home search drive, stop.

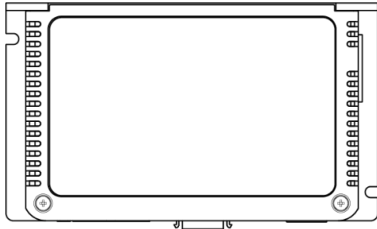
It controls up to 31-axis via RS485 communication.

- Brake operation for safe control of vertical load at power OFF and alarm occur. (built-in brake type)
- Motor driver and controller integral type
- CC-Link supported Remote Device station
- CC-Link occupied stations: 1 station occupied, 2 stations occupied
- CC-Link Version 1.10
- Competitive price compared to the servo motor and closed-loop function and fast response for short-distance continuous drive
- Realizing a wide variety of operation up to 256 steps using 13 control commands combination
- Improved user convenience with providing 20 I/O pins
- Dedicated Windows program (atMotion) provided for parameter setting and test
- Low vibration operation at low speed area and maintaining high torque at high speed area available
- Easy to use without tuning (various gain settings via programming)
- 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 level resolutions available
- Various alarm functions
- : 22 alarms; over current, over speed, over heat, motor connection error, encoder connection error and etc.
- Frame size 20 mm, 28 mm, 35 mm, 42 mm, 56 mm, 60 mm motor supported

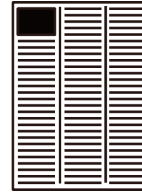
1.2 Configuration Diagram and Components

1.2.1 Components

1.2.1.1 Driver

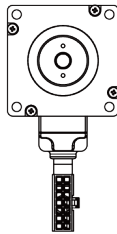


AiC-D-CL Series

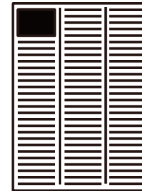


Instruction manual

1.2.1.2 Motor



Ai-M Series



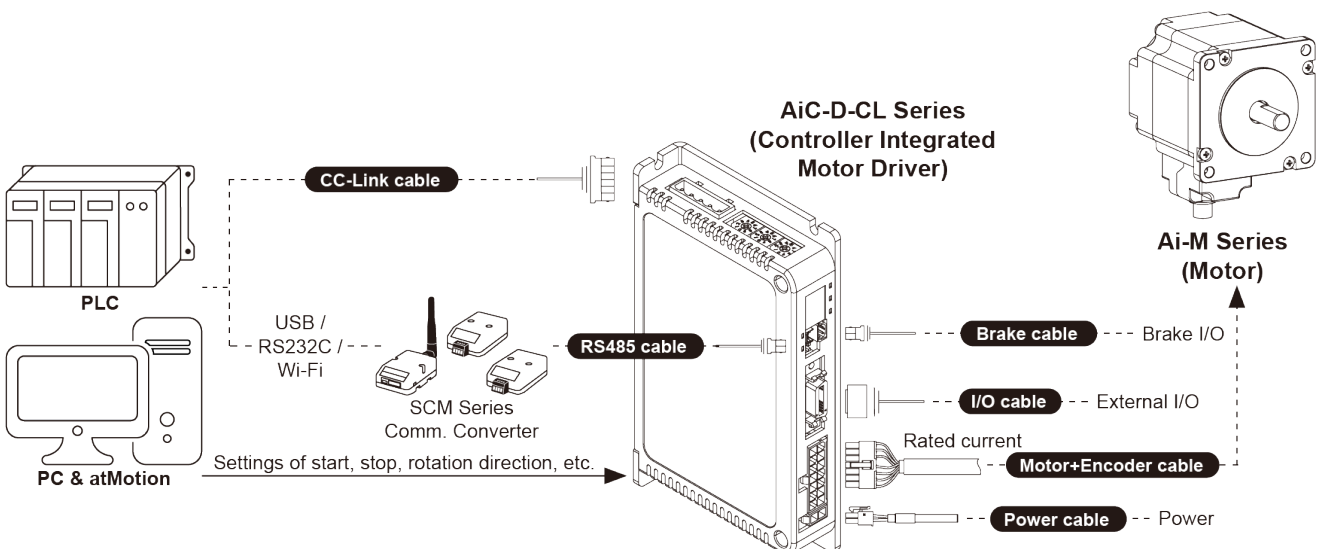
Instruction manual



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 or the distributor.

1.2.2 Configuration Diagram



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

1.3 Ordering Information

1.3.1 Driver

(1) Standard type

Ai	C	-	D	-	35	L	-	B	-	CL
①	②		③		④	⑤		⑥		⑦

Item	Description	
① Series	Ai	Artificial intelligent
② Category	C	Controller
③ Item	D	Driver
④ Motor frame size	20	20×20 mm
	28	28×28 mm
	35	35×35 mm
	42	42×42 mm
	56	57.2×57.2 mm
	60	60×60 mm
⑤ Motor length	S	Short - Frame size 28 mm: 46 mm, Frame size 35 mm: 41.5 mm Frame size 42 mm: 67.5 mm, Frame size 56 mm: 77.3 mm, Frame size 60 mm: 81.9 mm
	M	Middle - Frame size 20 mm: 41.2 mm, Frame size 28 mm: 59 mm, Frame size 35 mm: 52 mm Frame size 42 mm: 73.5 mm, Frame size 56 mm: 90.3 mm, Frame size 60 mm: 102.8 mm
	L	Long - Frame size 20 mm: 53.1mm, Frame size 28 mm: 65 mm, Frame size 35 mm: 68.5 mm Frame size 42 mm: 81.5 mm, Frame size 56 mm: 111.3 mm, Frame size 60 mm: 119.8 mm
⑥ Encoder resolution	A* ¹	4,000 PPR (1,000 PPR x 4-multiply)
	B* ²	16,000 PPR (4,000 PPR x 4-multiply)
	A* ³	10,000 PPR (2,500 PPR x 4-multiply)
⑦ Comm. Method	CL	CC-Link communication

※1. Encoder resolution for frame size 20 mm motors.

※2. Encoder resolution for frame size 28, 35 mm motors.

※3. Encoder resolution for frame size 42, 56, 60 mm motors.

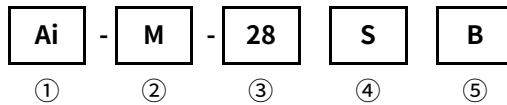
(2) Built-in brake type

Ai	C	-	D	-	60	L	-	A	-	B	-	CL
①	②		③		④	⑤		⑥		⑦		⑧

Item	Description	
① Series	Ai	Artificial intelligent
② Category	C	Controller
③ Item	D	Driver
④ Motor frame size	42	42×42 mm
	56	57.2×57.2 mm
	60	60×60 mm
⑤ Motor length	S	Short - Frame size 42 mm: 102.3 mm, Frame size 56 mm: 112.1 mm, Frame size 60 mm: 116.7 mm
	M	Middle - Frame size 42 mm: 108.3 mm, Frame size 56 mm: 125.1 mm, Frame size 60 mm: 137.6 mm
	L	Long - Frame size 42 mm: 116.3 mm, Frame size 56 mm: 146.1 mm, Frame size 60 mm: 154.6 mm
⑥ Encoder resolution	A	10,000 PPR (2,500 PPR x 4-multiply)
⑦ Brake	B	Built-in Brake type
⑧ Comm. Method	CL	CC-Link communication

1.3.2 Motor

(1) Standard type



Item	Description	
① Series	Ai	Artificial intelligent
② Item	M	Motor
③ Motor frame size	20	20×20 mm
	28	28×28 mm
	35	35×35 mm
	42	42×42 mm
	56	57.2×57.2 mm
	60	60×60mm
④ Motor length	S	Short - Frame size 28 mm: 46 mm, Frame size 35 mm: 41.5 mm Frame size 42 mm: 67.5 mm, Frame size 56mm: 77.3mm, Frame size 60mm: 81.9mm
	M	Middle - Frame size 20 mm: 41.2 mm, Frame size 28 mm: 59 mm Frame size 35 mm: 52 mm Frame size 42 mm: 73.5 mm, Frame size 56 mm: 90.3 mm, Frame size 60 mm: 102.8 mm
	L	Long - Frame size 20 mm: 53.1 mm, Frame size 28 mm: 65 mm, Frame size 35 mm: 68.5 mm Frame size 42 mm: 81.5 mm, Frame size 56 mm: 111.3 mm, Frame size 60 mm: 119.8 mm
⑤ Encoder resolution	A* ¹	4,000 PPR (1,000 PPR x 4-multiply)
	B* ²	16,000 PPR (4,000 PPR x 4-multiply)
	A* ³	10,000 PPR (2,500 PPR x 4-multiply)

※1. Encoder resolution for frame size 20 mm motors.

※2. Encoder resolution for frame size 28, 35 mm motors.

※3. Encoder resolution for frame size 42, 56, 60 mm motors.

(2) Built-in brake type

Ai	-	M	-	60	-	L	-	A	-	B
①		②		③		④		⑤		⑥

Item	Description	
① Series	Ai	Artificial intelligent
② Item	M	Motor
③ Motor frame size	42	42×42 mm
	56	57.2×57.2 mm
	60	60×60mm
④ Motor length	S	Short - Frame size 42 mm: 102.3 mm, Frame size 56 mm: 112.1 mm, Frame size 60 mm: 116.7 mm
	M	Middle - Frame size 42 mm: 108.3 mm, Frame size 56 mm: 125.1 mm, Frame size 60 mm: 137.6 mm
	L	Long - Frame size 42 mm: 116.3 mm, Frame size 56 mm: 146.1 mm, Frame size 60 mm: 154.6 mm
⑤ Encoder resolution	A	10,000 PPR (2,500 PPR x 4-multiply)
⑥ Brake	B	Built-in Brake type

1.4 Models

1.4.1 Standard Type

Set	Driver	Motor
AiC-20MA-CL	AiC-D-20MA-CL	Ai-M-20MA
AiC-20LA-CL	AiC-D-20LA-CL	Ai-M-20LA
AiC-28SB-CL	AiC-D-28SB-CL	Ai-M-28SB
AiC-28MB-CL	AiC-D-28MB-CL	Ai-M-28MB
AiC-28LB-CL	AiC-D-28LB-CL	Ai-M-28LB
AiC-35SB-CL	AiC-D-35SB-CL	Ai-M-35SB
AiC-35MB-CL	AiC-D-35MB-CL	Ai-M-35MB
AiC-35LB-CL	AiC-D-35LB-CL	Ai-M-35LB
AiC-42SA-CL	AiC-D-42SA-CL	Ai-M-42SA
AiC-42MA-CL	AiC-D-42MA-CL	Ai-M-42MA
AiC-42LA-CL	AiC-D-42LA-CL	Ai-M-42LA
AiC-56SA-CL	AiC-D-56SA-CL	Ai-M-56SA
AiC-56MA-CL	AiC-D-56MA-CL	Ai-M-56MA
AiC-56LA-CL	AiC-D-56LA-CL	Ai-M-56LA
AiC-60SA-CL	AiC-D-60SA-CL	Ai-M-60SA
AiC-60MA-CL	AiC-D-60MA-CL	Ai-M-60MA
AiC-60LA-CL	AiC-D-60LA-CL	Ai-M-60LA

1.4.2 Built-in Brake Type

Set	Driver	Motor
AiC-42SA-B-CL	AiC-D-42SA-B-CL	Ai-M-42SA-B
AiC-42MA-B-CL	AiC-D-42MA-B-CL	Ai-M-42MA-B
AiC-42LA-B-CL	AiC-D-42LA-B-CL	Ai-M-42LA-B
AiC-56SA-B-CL	AiC-D-56SA-B-CL	Ai-M-56SA-B
AiC-56MA-B-CL	AiC-D-56MA-B-CL	Ai-M-56MA-B
AiC-56LA-B-CL	AiC-D-56LA-B-CL	Ai-M-56LA-B
AiC-60SA-B-CL	AiC-D-60SA-B-CL	Ai-M-60SA-B
AiC-60MA-B-CL	AiC-D-60MA-B-CL	Ai-M-60MA-B
AiC-60LA-B-CL	AiC-D-60LA-B-CL	Ai-M-60LA-B

2 Specification

2.1 Driver

Model ^{※1}		-	AiC-D-28SB-CL	AiC-D-35SB-CL	AiC-D-42SA(-B)-CL	AiC-D-56SA(-B)-CL	AiC-D-60SA(-B)-CL
		AiC-D-20MA-CL	AiC-D-28MB-CL	AiC-D-35MB-CL	AiC-D-42MA(-B)-CL	AiC-D-56MA(-B)-CL	AiC-D-60MA(-B)-CL
		AiC-D-20LA-CL	AiC-D-28LB-CL	AiC-D-35LB-CL	AiC-D-42LA(-B)-CL	AiC-D-56LA(-B)-CL	AiC-D-60LA(-B)-CL
Power supply		24 VDC \equiv					
Allowable voltage range		90 to 110% of the rated voltage					
Power Consumption	STOP ^{※2}	Max. 10 W			Max. 10 W	Max. 12 W	Max. 15 W
	Max. during operation ^{※3}	Max. 60 W			Max. 60 W	Max. 120 W	Max. 240 W
Max. RUN current ^{※4}		0.6 A/Phase	1.0 A/Phase	1.2 A/Phase	1.7 A/Phase	3.5 A/Phase	
STOP current ^{※5}		20 to 100% of max. RUN current (factory default: 50%)					
Rotation speed		0 to 3000 rpm					
Resolution ^{※5}		500 (factory default), 1000, 1600, 2000, 3600, 4000, 5000, 6400, 7200, 10000 PPR	500 (factory default), 1000, 1600, 2000, 3600, 5000, 6400, 7200, 10000, 16000 PPR		500 (factory default), 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000 PPR		
Applied motor ^{※1}		-	Ai-M-28SB	Ai-M-35SB	Ai-M-42SA(-B)	Ai-M-56SA(-B)	Ai-M-60SA(-B)
		Ai-M-20MA	Ai-M-28MB	Ai-M-35MB	Ai-M-42MA(-B)	Ai-M-56MA(-B)	Ai-M-60MA(-B)
		Ai-M-20LA	Ai-M-28LB	Ai-M-35LB	Ai-M-42LA(-B)	Ai-M-56LA(-B)	Ai-M-60LA(-B)
Speed filter ^{※5}		0 (disable), 2, 4, 6, 8, 10, 20, 40, 60 (factory default), 80, 100, 120, 140, 160, 180, 200 ms					
Positioning Gain ^{※5}		(P Gain, I Gain)= (1, 1), (2, 1), (3, 1), (4, 1), (5, 1), (1, 2), (2, 2), (3, 2), (4, 2), (5, 2), (1, 3), (2, 3), (3, 3), (4, 3), (5, 3), user setting					
Positioning range		-2,147,483,648 to +2,147,483,647					
In-Position		Fast Response: 0 (factory default) to 7, Accurate Response: 0 to 7					
Motor rotation direction ^{※5}		CW, CCW					
Status indicator		<ul style="list-style-type: none"> Power/Alarm indicator: green/red LED Servo On/Off indicator: orange LED Alarm/Warning status indicator: red LED 7 segment 				<ul style="list-style-type: none"> In-Position indicator: yellow LED CC-Link indicator: red/green LED 	
I/O voltage level		[H]: 5-30 VDC \equiv , [L]: 0-2 VDC \equiv					
I/O	Input	Exclusive input: 3, general input: 8					
	Output	General output: 7					
External power supply		VEX (recommended: 24 VDC \equiv), GEX (GND)					
Operation mode		Jog, Continuous, Index, Program mode					

Index step numbers		64 steps
Program function	Step	256 steps
	Control command	ABS (move absolute position), INC (move incremental position), HOM (home search), ICJ (jump input condition), IRD (waiting input), OPC (on/off of output port), OPT (on pulse from output port), JMP (jump), REP (start repetition), RPE (end repetition), END (end program), POS (position set), TIM (timer)
	Start	Power On Program auto-start function
	Home search	Power On Home Search auto-start function
Home search mode		Home, limit home, zero home, torque home
RS485 comm.	Comm. speed ^{※5}	9600, 19200, 38400, 57600, 115200 (factory default) bps
Alarm output		Overcurrent, overspeed, position tracking, overload, overheat, motor connection, encoder connection, regenerative voltage, motor misalignment, command speed, input voltage, in-position, memory, emergency stop, program mode, index mode, home search mode, comm. station setting, comm. mode setting, comm. station setting change, comm. mode setting change, comm. failure
Warning output		± software limit, ± hardware limit, overload
Insulation resistance		Over 100 MΩ (500 VDC= megger)
Dielectric strength		1,000 VAC~ 60 Hz for 1 min
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		<ul style="list-style-type: none"> • Power cable: CJ-PW-□^{※6} • I/O cable: CO20-MP□-R^{※7} (standard: AiC-CL TAG) • Motor+encoder cable - normal: C1D14M(B)-□ / moving: C1DF14M(B)-□^{※8}
Approval		CE
Weight ^{※9}		Approx. 470 g (approx. 320 g)

※1: The model name indicates driver type. (none: standard type, B: built-in brake type)

E.g.) AiC-D-42LA-B-CL: built-in brake type stepping motor driver.

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

※3: 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.

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

※5: Settable with the dedicated program (atMotion).

※6: □ of model name indicates cable length (010, 020). E.g.) CJ-PW-010: 1 m power cable.

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

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

- ※8: □ of model name indicates cable length (1, 2, 3, 5, 7, 10, 15, 20).
 (B) of model name indicates the built-in brake type, none indicates the standard type.
 E.g.) C1DF14MB-10: 10 m moving type, built-in brake type motor+encoder cable.
- ※9: The weight includes packaging. The weight in parenthesis is for unit only.
- ※ Environment resistance is rated at no freezing or condensation.

2.2 CC-Link Communication

Comm. standard	CC-Link Ver.1.10
Station type	Remote Device station
Connection cable	CC-Link dedicated cable
Comm. speed	156k, 625k, 2.5M, 5M, 10M bps
Station number	01 to 64
Number of occupied stations	1 station occupied, 2 stations occupied
Max. transmit distance	Depend on comm. speed
Remote I/O	<ul style="list-style-type: none"> • 1 station occupied: Ryn/RXn 32 points each • 2 stations occupied: Ryn/RXn 64 points each
Remote register	<ul style="list-style-type: none"> • 1 station occupied: RWrn/RWwn 4 words each • 2 stations occupied: RWrn/RWwn 8 words each
Command	Point table read/write, parameter read/write, read only, special command monitor only, network connection, drive control, motion control, drive status
Comm. setting switch	10 bit rotary switch (0 to 9): 3, 1 bit DIP switch (ON/OFF)

- ※ It is for parameter setting and monitoring via external devices (PC, PLC, etc.).
- ※ In CC-Link setting, the communication speed must be same between PLC and the driver.
- ※ The settable station number is 01 to 64, the station number must not be overlapped.
 (65 to 99 is not available)

2.3 Motor

2.3.1 Frame Size 20 mm

Model	Ai-M-20MA	Ai-M-20LA
Max. stop torque ^{*1}	0.183 kgf·cm (0.018 N·m)	0.357 kgf·cm (0.035 N·m)
Rotor moment of inertia	2 g·cm ² (2 x 10 ⁻⁷ kg·m ²)	
Rated current	0.6 A/Phase	
Resistance	6.6 Ω/Phase ± 10%	10.5 Ω/Phase ± 10%
Inductance	2.1 mH/Phase ± 20%	4.0 mH/Phase ± 20%
Weight ^{*2}	Approx. 0.192 kg (approx. 0.092 kg)	Approx. 0.219 kg (approx. 0.120 kg)

2.3.2 Frame Size 28 mm

Model	Ai-M-28SB	Ai-M-28MB	Ai-M-28LB
Max. stop torque ^{*1}	0.51 kgf·cm (0.05 N·m)	1.42 kgf·cm (0.14 N·m)	1.63 kgf·cm (0.16 N·m)
Rotor moment of inertia	9 g·cm ² (9 x 10 ⁻⁷ kg·m ²)	12 g·cm ² (12 x 10 ⁻⁷ kg·m ²)	18 g·cm ² (18 x 10 ⁻⁷ kg·m ²)
Rated current	1.0 A/Phase		
Resistance	5.78 Ω/Phase ± 10%	8.8 Ω/Phase ± 10%	10.1 Ω/Phase ± 10%
Inductance	3.2 mH/Phase ± 20%	6.0 mH/Phase ± 20%	6.2 mH/Phase ± 20%
Weight ^{*2}	Approx. 0.260 kg (approx. 0.162 kg)	Approx. 0.318 kg (approx. 0.222 kg)	Approx. 0.342 kg (approx. 0.248 kg)

2.3.3 Frame Size 35 mm

Model	Ai-M-35SB	Ai-M-35MB	Ai-M-35LB
Max. stop torque ^{*1}	0.714 kgf·cm (0.07 N·m)	1.326 kgf·cm (0.13 N·m)	3.162 kgf·cm (0.31 N·m)
Rotor moment of inertia	8 g·cm ² (8 x 10 ⁻⁷ kg·m ²)	14 g·cm ² (14 x 10 ⁻⁷ kg·m ²)	22 g·cm ² (22 x 10 ⁻⁷ kg·m ²)
Rated current	1.2 A/Phase		
Resistance	2.1 Ω/Phase ± 10%	3.25 Ω/Phase ± 10%	5.0 Ω/Phase ± 10%
Inductance	1.25 mH/Phase ± 20%	2.85 mH/Phase ± 20%	5.6 mH/Phase ± 20%
Weight ^{*2}	Approx. 0.278 kg (approx. 0.180 kg)	Approx. 0.347 kg (approx. 0.250 kg)	Approx. 0.456 kg (approx. 0.366 kg)

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

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

2.3.4 Frame Size 42 mm

Model		Ai-M-42SA-□	Ai-M-42MA-□	Ai-M-42LA-□
Max. stop torque ^{※1}		2.55 kgf·cm (0.25 N·m)	4.08 kgf·cm (0.4 N·m)	4.89 kgf·cm (0.48 N·m)
Rotor moment of inertia		35 g·cm ² (35 x 10 ⁻⁷ kg·m ²)	54 g·cm ² (54 x 10 ⁻⁷ kg·m ²)	77 g·cm ² (77 x 10 ⁻⁷ kg·m ²)
Rated current		1.7 A/Phase		
Resistance		1.7 Ω/Phase ± 10%	1.85 Ω/Phase ± 10%	2.1 Ω/Phase ± 10%
Inductance		1.9 mH/Phase ± 20%	3.5 mH/Phase ± 20%	4.4 mH/Phase ± 20%
Weight ^{※2}	Standard type	Approx. 0.45 kg (approx. 0.34 kg)	Approx. 0.52 kg (approx. 0.41 kg)	Approx. 0.59 kg (approx. 0.48 kg)
	Built-in brake type	Approx. 0.77 kg (approx. 0.67 kg)	Approx. 0.83 kg (approx. 0.73 kg)	Approx. 0.90 kg (approx. 0.80 kg)

2.3.5 Frame Size 56 mm

Model		Ai-M-56SA-□	Ai-M-56MA-□	Ai-M-56LA-□
Max. stop torque ^{※1}		6.12 kgf·cm (0.6 N·m)	12.24 kgf·cm (1.2 N·m)	20.39 kgf·cm (2.0 N·m)
Rotor moment of inertia		140 g·cm ² (140 x 10 ⁻⁷ kg·m ²)	280 g·cm ² (280 x 10 ⁻⁷ kg·m ²)	480 g·cm ² (480 x 10 ⁻⁷ kg·m ²)
Rated current		3.5 A/Phase		
Resistance		0.55 Ω/Phase ± 10%	0.57 Ω/Phase ± 10%	0.93 Ω/Phase ± 10%
Inductance		1.05 mH/Phase ± 20%	1.8 mH/Phase ± 20%	3.7 mH/Phase ± 20%
Weight ^{※2}	Standard type	Approx. 0.76 kg (approx. 0.62 kg)	Approx. 0.99 kg (approx. 0.85 kg)	Approx. 1.36 kg (approx. 1.22 kg)
	Built-in brake type	Approx. 1.30 kg (approx. 1.15 kg)	Approx. 1.52 kg (approx. 1.38 kg)	Approx. 1.90 kg (approx. 1.75 kg)

2.3.6 Frame Size 60 mm

Model		Ai-M-60SA-□	Ai-M-60MA-□	Ai-M-60LA-□
Max. stop torque ^{※1}		11.22 kgf·cm (1.1 N·m)	22.43 kgf·cm (2.2 N·m)	29.57 kgf·cm (2.9 N·m)
Rotor moment of inertia		240 g·cm ² (240 x 10 ⁻⁷ kg·m ²)	490 g·cm ² (490 x 10 ⁻⁷ kg·m ²)	690 g·cm ² (690 x 10 ⁻⁷ kg·m ²)
Rated current		3.5 A/Phase		
Resistance		1.0 Ω/Phase ± 10%	1.23 Ω/Phase ± 10%	1.3 Ω/Phase ± 10%
Inductance		1.5 mH/Phase ± 20%	2.6 mH/Phase ± 20%	3.8 mH/Phase ± 20%
Weight ^{※2}	Standard type	Approx. 0.89kg (approx. 0.75kg)	Approx. 1.27kg (approx. 1.13kg)	Approx. 1.58kg (approx. 1.44kg)
	Built-in brake type	Approx. 1.53kg (approx. 1.36kg)	Approx. 1.90kg (approx. 1.74kg)	Approx. 2.23kg (approx. 2.07kg)

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

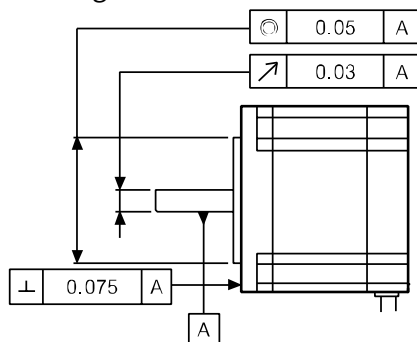
※2: The weight includes packaging. The weight in parenthesis is for unit only.

2.3.7 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 100 MΩ (at 500 VDC≡ megger) between motor coil-case
Dielectric strength		500 VAC≡ 50/60 Hz for 1 min between motor coil-case
Vibration		1.5 mm amplitude at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours
Shock		Approx. max. 50G
Environ ment	Ambient temperature	0 to 50°C, storage: -20 to 70°C
	Ambient humidity	20 to 85%RH, storage: 15 to 90%RH
Approval		CE
Protection structure		IP30 (IEC34-5 standard)
Stop angle error*1		±0.09°
Shaft vibration*2		0.03mm T.I.R.
Radial movement*3	Frame size 20 / 28 / 35 mm	Max. 0.025mm (load 450g)
	Frame size 42 / 56 / 60 mm	Max. 0.025mm (load 25N)
Axial movement*4	Frame size 20 / 28 / 35 mm	Max. 0.005mm (load 920g)
	Frame size 42 / 56 / 60mm	Max. 0.01mm (load 50N)
Concentricity for shaft of setup in-low		0.05 mm T.I.R.
Perpendicularity of set-up plate shaft		0.075 mm 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

(450g – frame size 20 / 28 / 35mm, 25N – frame size 42 / 56 / 60mm) to the tip of the motor shaft.

※4: Amount of axial shaft displacement when adding an axial load

(920g – frame size 20 / 28 / 35mm, 50N – frame size 42 / 56 / 60mm) to the shaft.

※Environment resistance is rated at no freezing or condensation.

2.3.8 Brake

Model	Frame size 42 mm	Frame size 56 mm	Frame size 60 mm
Rated excitation voltage ^{※1}	24 VDC \pm 10%		
Rated excitation current	0.208 A	0.275 A	
Static friction torque	Min. 1.8 kgf·cm	Min. 8.0 kgf·cm	
Rotation part inertia	6 g·cm ²	19 g·cm ²	
Insulation class	B type (130°C)		
B type brake	Power ON: brake is released, Power OFF: brake is operating		
Operating time	Max. 25 msec	Max. 30 msec	
Releasing time	Max. 10 msec	Max. 20 msec	

※1: Driver reduces power voltage from 24 VDC \pm to 11.5 VDC \pm and control the motor to reduce heat generation in the brake which is connected with the motor.

2.3.9 Encoder

(1) Frame size 20 / 28 / 32 mm

Item		Magnetic INCREMENTAL rotary encoder	
Resolution	Frame size 20mm	4,000 PPR (1,000 PPR x 4-multiply)	
	Frame size 28 / 35mm	16,000 PPR (4,000 PPR x 4-multiply)	
Electrical specification	Output phase		A, \bar{A} , B, \bar{B} , Z, \bar{Z}
	Output duty ratio		$\frac{T}{2} \pm \frac{T}{3}$ (T = 1 cycle of A phase)
	Phase difference of output		Output between A and B phase: $\frac{T}{4} \pm \frac{T}{4}$ (T = 1 cycle of A phase)
	Control output	Line driver output	<ul style="list-style-type: none"> [Low] – Load current: max. 20 mA, Residual voltage: max. 0.5 VDC [High] – Load current: max. -20 mA, Output voltage: max. 2.5 VDC
	Response time (rise, fall)	Frame size 20 mm	Max. 1.5 μ s (cable length: 2 m, I sink = 20 mA)
		Frame size 28 / 35 mm	Max. 1 μ s (cable length: 2 m, I sink = 20 mA)
	Max. response frequency	Frame size 20 mm	200 kHz
		Frame size 28 / 35 mm	1,000 kHz
	Power supply		5 VDC \pm 5% (ripple P-P: max. 5%)
Current consumption		Max. 50 mA (disconnection of the load)	

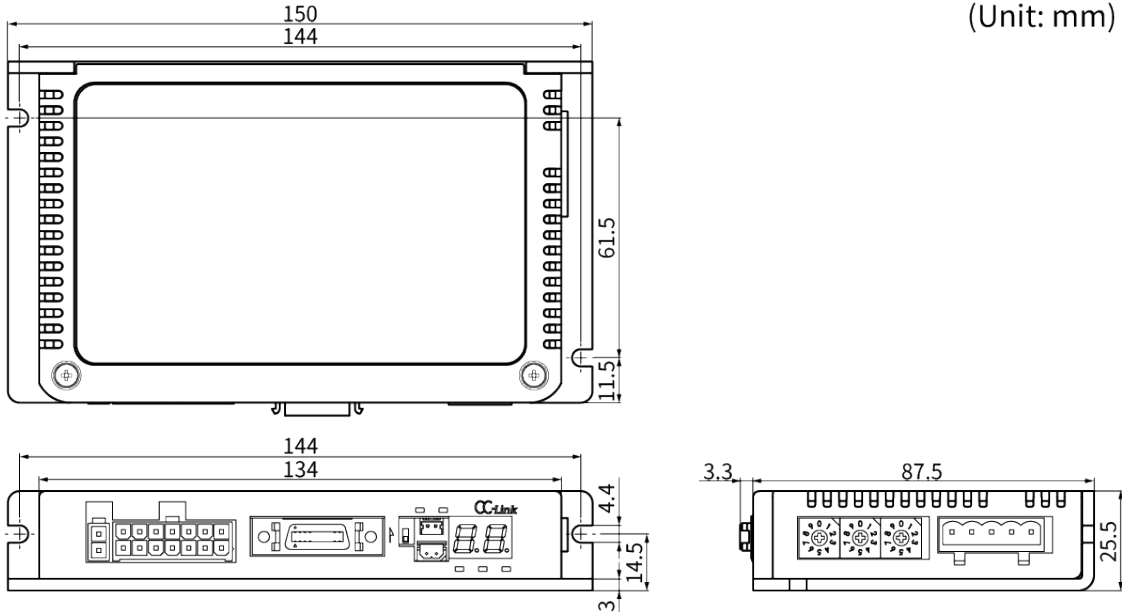
(2) Frame size 42 / 56 / 60 mm

Item		INCREMENTAL rotary encoder	
Resolution		10,000 PPR (2,500 PPR x 4 -multiply)	
Electrical specification	Output phase		A, \bar{A} , B, \bar{B} , Z, \bar{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	<ul style="list-style-type: none"> [Low] – Load current: max. 20 mA, Residual voltage: max. 0.5 VDC [High] – Load current: max. -20 mA, Output voltage: max. 2.5 VDC
	Response time (rise, fall)		Max. 0.5 μ s (cable length: 2 m, I sink = 20 mA)
	Max. response frequency		300 kHz
	Power supply		5 VDC \pm 5% (ripple P-P: max. 5%)
	Current consumption		Max. 50 mA (disconnection of the load)

3 Dimensions

3.1 Driver

(Unit: mm)



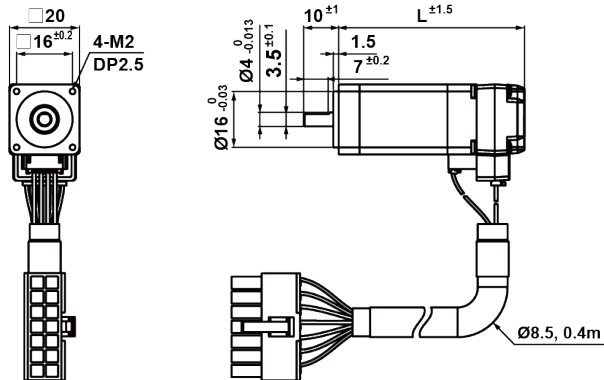
Note

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

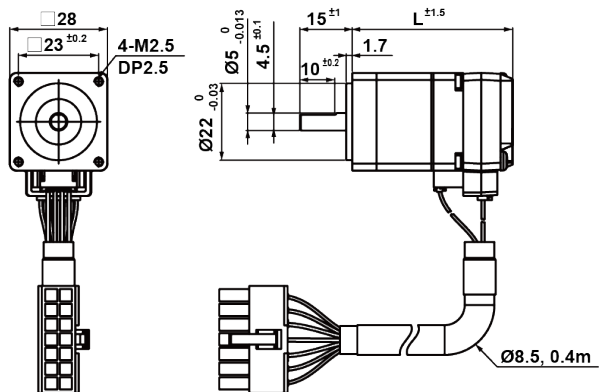
3.2 Motor

3.2.1 Standard Type

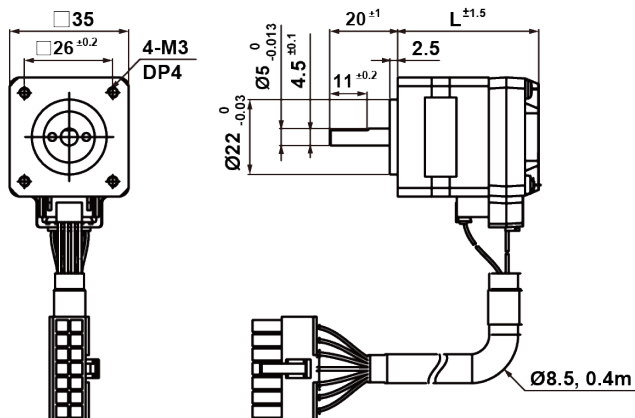
3.2.1.1 Frame Size 20 mm



3.2.1.2 Frame Size 28 mm



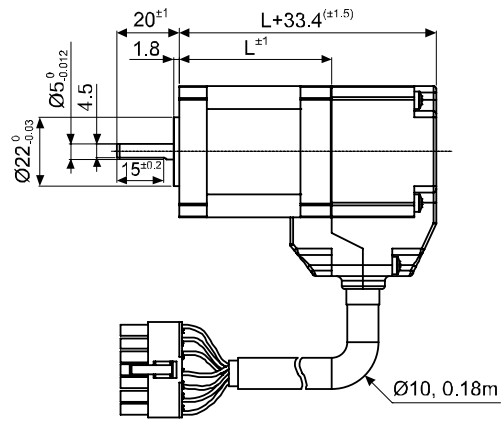
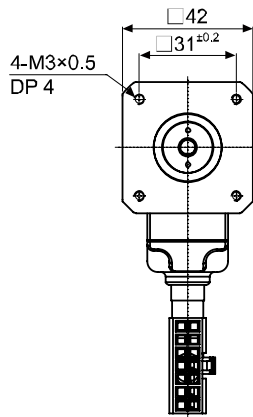
3.2.1.3 Frame Size 35 mm



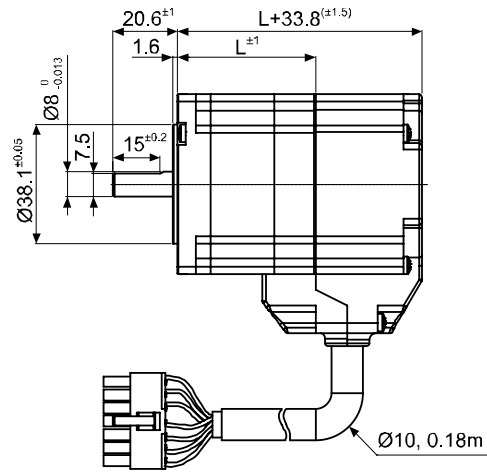
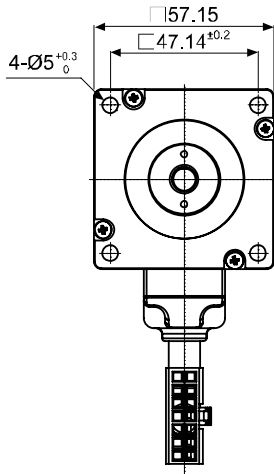
**Note**

Model	L	Model	L	Model	L
—		Ai-M-28SB	46	Ai-M-35SB	41.5
Ai-M-20MA	41.2	Ai-M-28MB	59	Ai-M-35MB	52
Ai-M-20LA	53.1	Ai-M-28LB	65	Ai-M-35LB	68.5

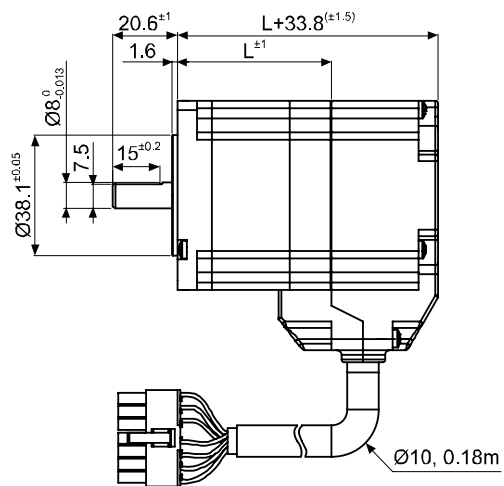
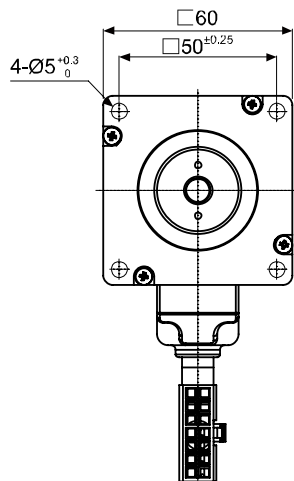
3.2.1.4 Frame Size 42 mm



3.2.1.5 Frame Size 56 mm



3.2.1.6 Frame Size 60 mm

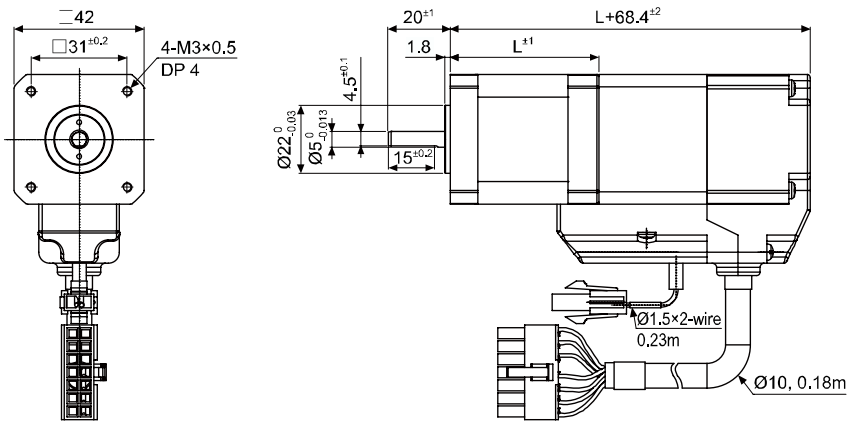


**Note**

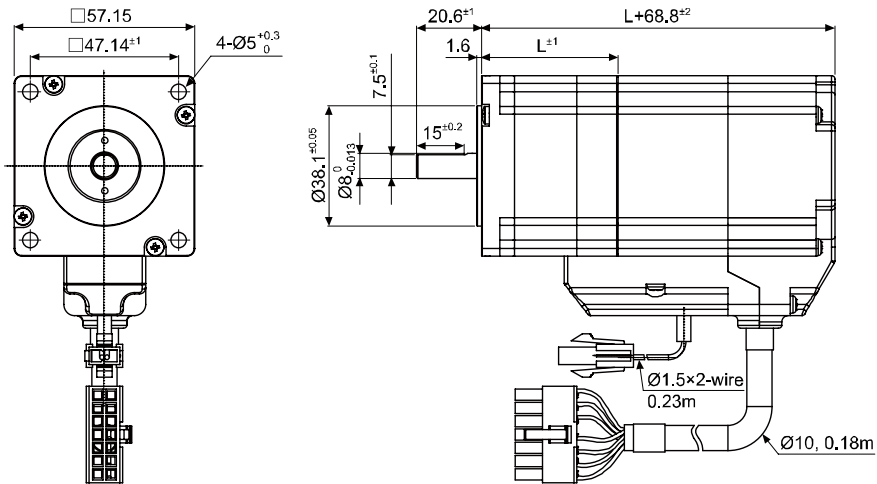
Model	L	Model	L	Model	L
Ai-M-42SA	34.1	Ai-M-56SA	43.5	Ai-M-60SA	48.1
Ai-M-42MA	40.1	Ai-M-56MA	56.5	Ai-M-60MA	69
Ai-M-42LA	48.1	Ai-M-56LA	77.5	Ai-M-60LA	86

3.2.2 Built-in Brake Type

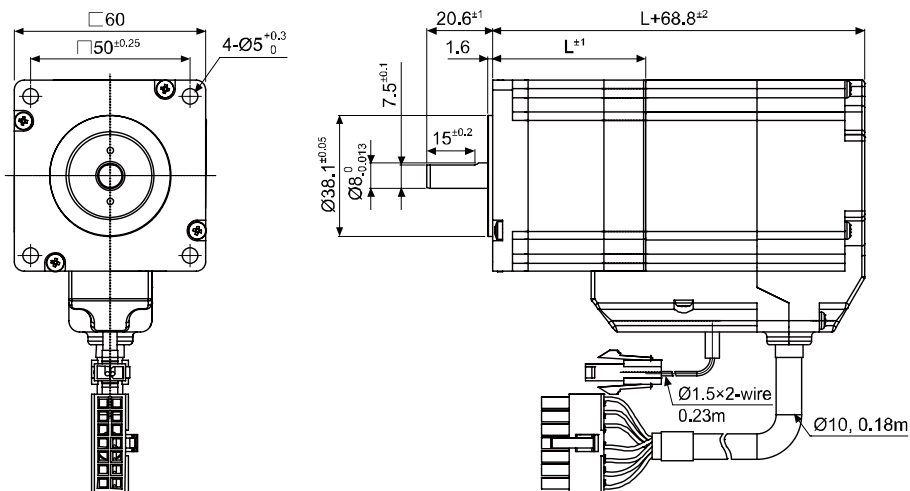
3.2.2.1 Frame Size 42 mm



3.2.2.2 Frame Size 56 mm



3.2.2.3 Frame Size 60 mm



**Note**

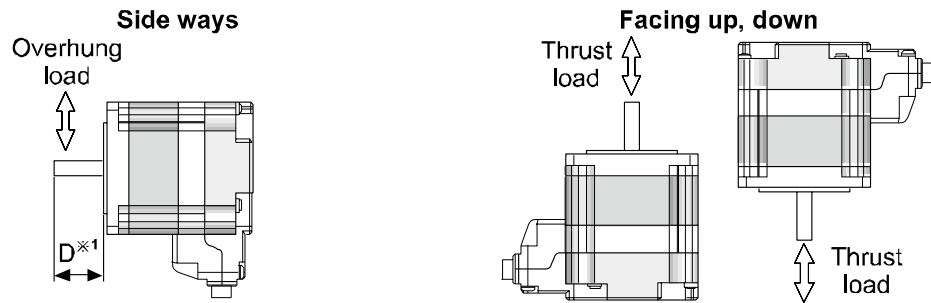
Model	L	Model	L	Model	L
Ai-M-42SA-B	33.9	Ai-M-56SA-B	43.3	Ai-M-60SA-B	47.9
Ai-M-42MA-B	39.9	Ai-M-56MA-B	56.3	Ai-M-60MA-B	68.8
Ai-M-42LA-B	47.9	Ai-M-56LA-B	77.3	Ai-M-60LA-B	85.8

4 Installation of Motor

4.1 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.



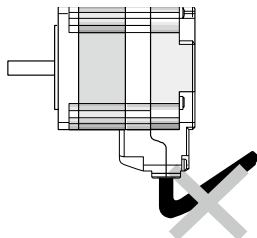
※1: The distance from the shaft in front (mm)

Motor size	The distance from the shaft in front (mm), Allowable overhung load [kgf (N)]				Allowable thrust load
	D = 0	D = 5	D = 10	D = 15	
Frame size 20 mm	1.22 (12)	1.53 (15)	—	—	Below motor weight
Frame size 28 mm	2.55 (25)	3.46 (34)	5.3 (52)	—	
Frame size 35 mm	2 (20)	2.55 (25)	3.46 (34)	5.3 (52)	
Frame size 42 mm	2 (20)	2.6 (25)	3.5 (34)	5.3 (52)	
Frame size 56 mm	5.5 (54)	6.8 (67)	9.1 (89)	13.3 (130)	
Frame size 60 mm					

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

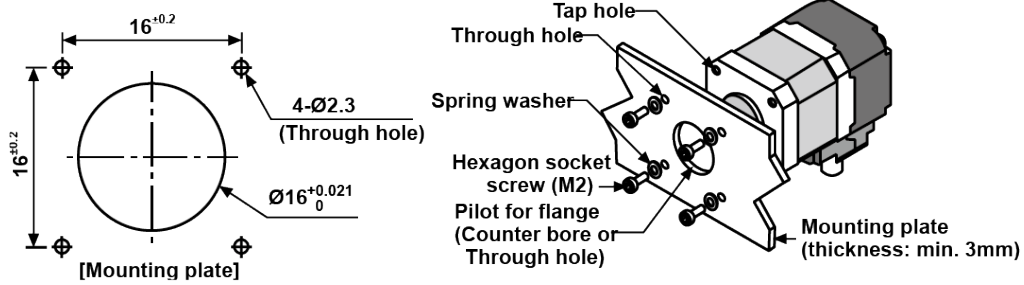
Do not forcibly pull or insert the cable. It may cause poor connection or disconnection of the cable.

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

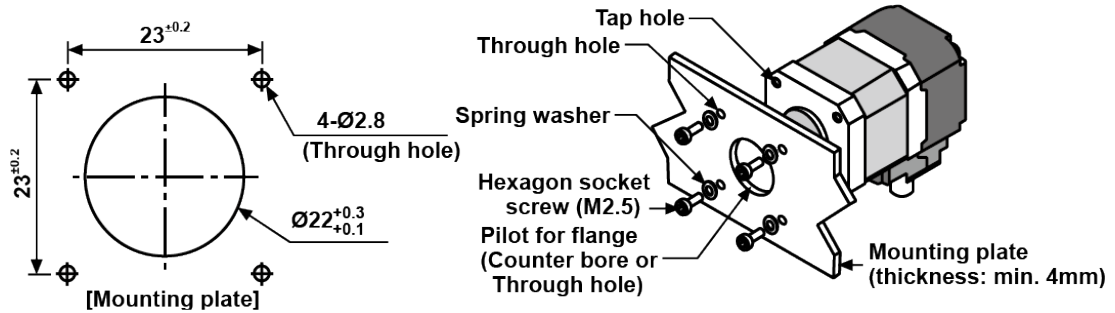


4.2 Mounting of Motor

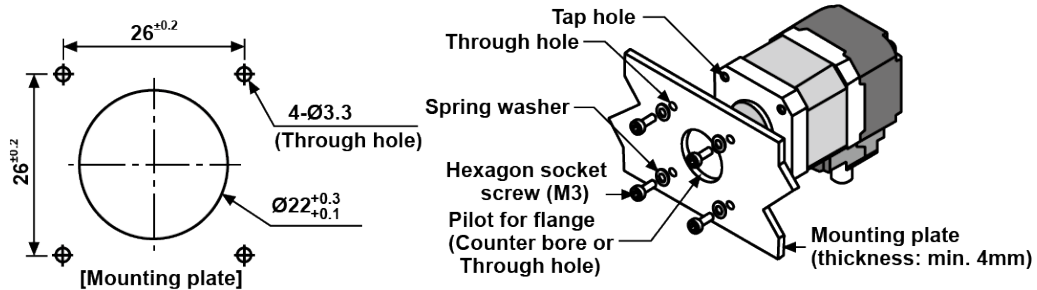
4.2.1 Frame Size 20 mm



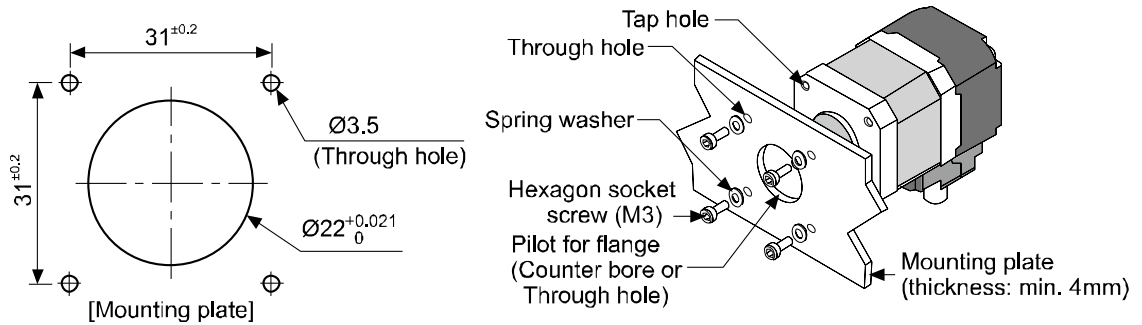
4.2.2 Frame Size 28 mm



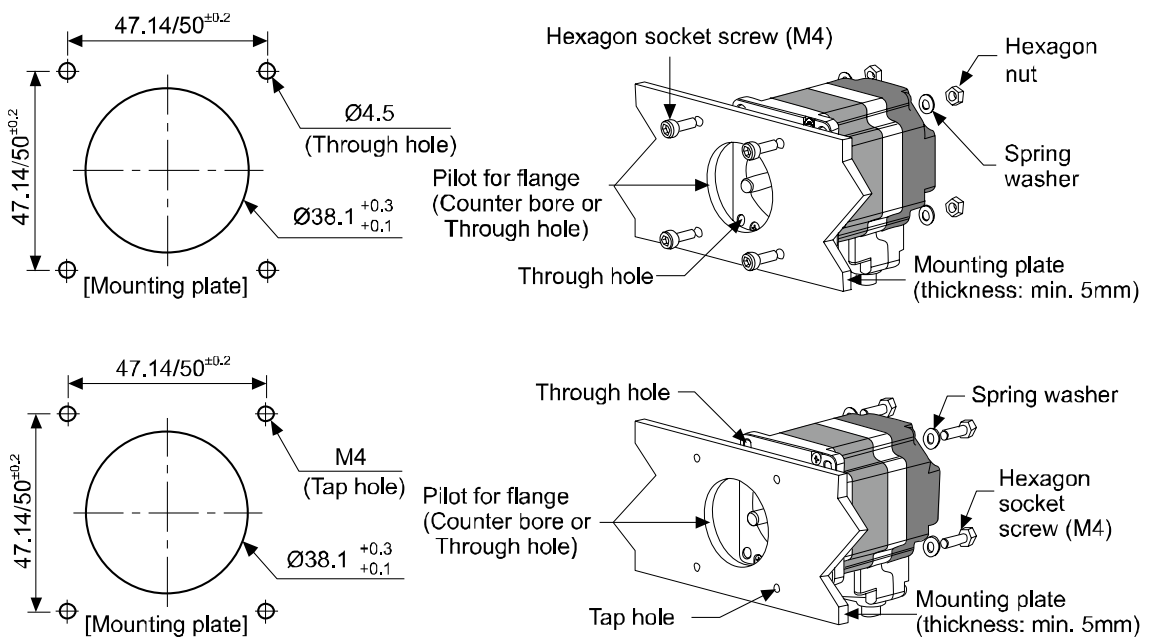
4.2.3 Frame Size 35 mm



4.2.4 Frame Size 42 mm



4.2.5 Frame Size 56 mm/Frame Size 60 mm



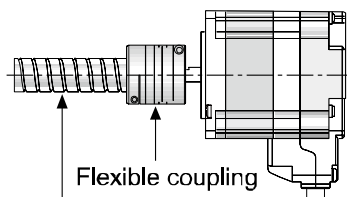
With considering heat radiation and vibration isolation, mount the motor as tight as possible against a metal panel having high thermal conductivity such as iron or aluminum. When mounting motors, use hexagon socket screws, spring washers and flat washers. Do not draw the wire with over strength 30N after wiring the encoder.

4.3 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.

4.3.1 Direct Load Connection with Coupling

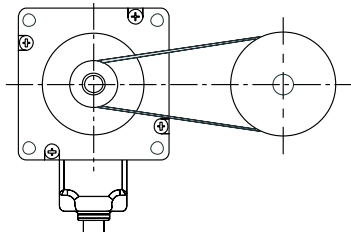


Ball screw or TM screw

※Use Autonics flexible coupling (ERB Series).

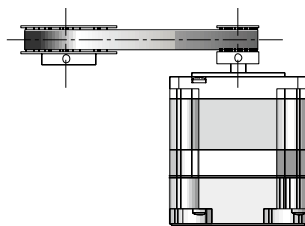
When connecting a load such as Ball screw or Tm screw directly to the shaft of the motor, use flexible coupling as image showing above. If the center of the load and the shaft is not aligned, it may cause severe vibration, damage on shaft or shortened life cycle of bearings.

4.3.2 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.

4.3.3 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.

4.4 Installation Conditions

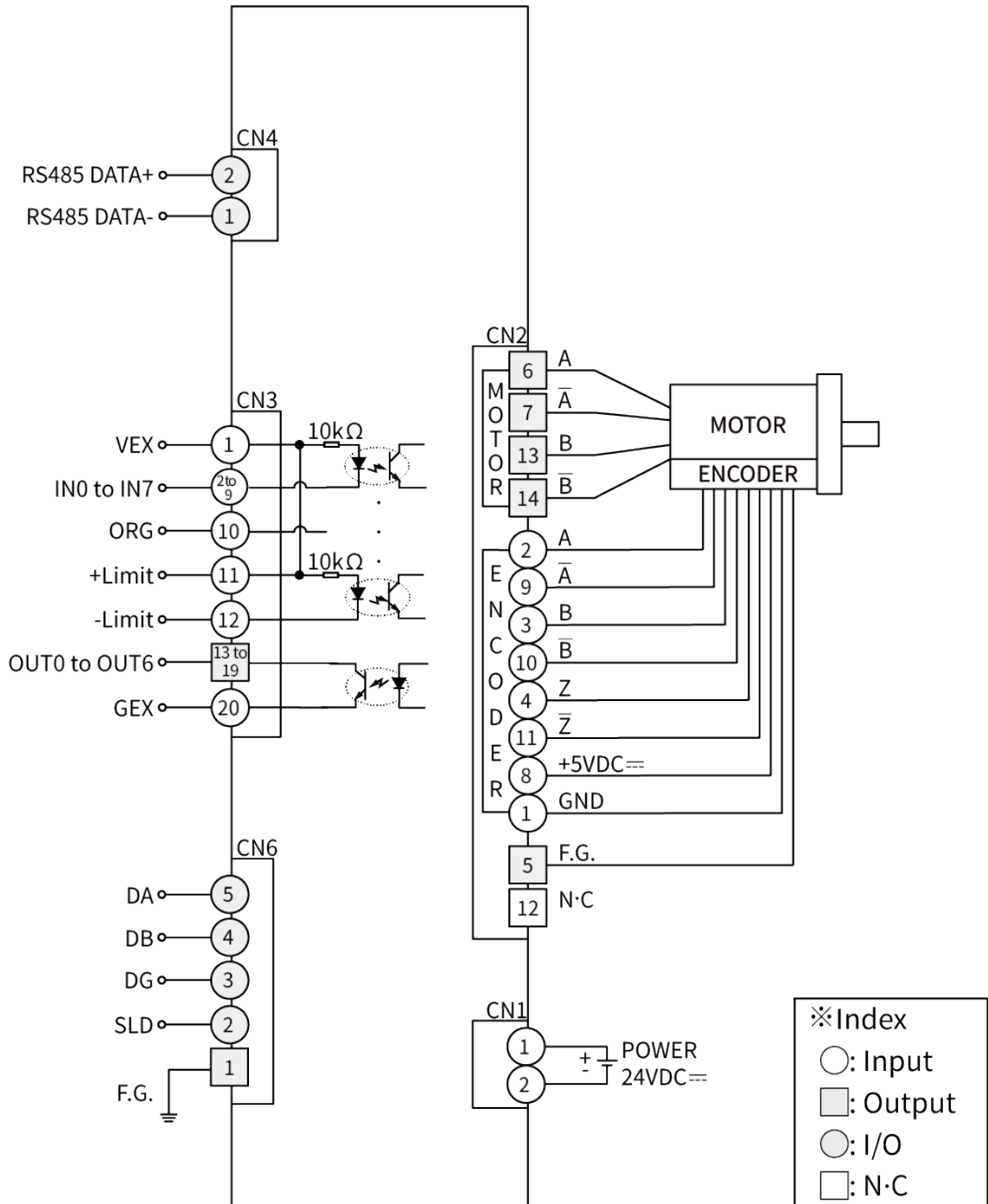
Install the motor in a place that meets certain conditions specified below.

It may cause product damage if instructions are not following.

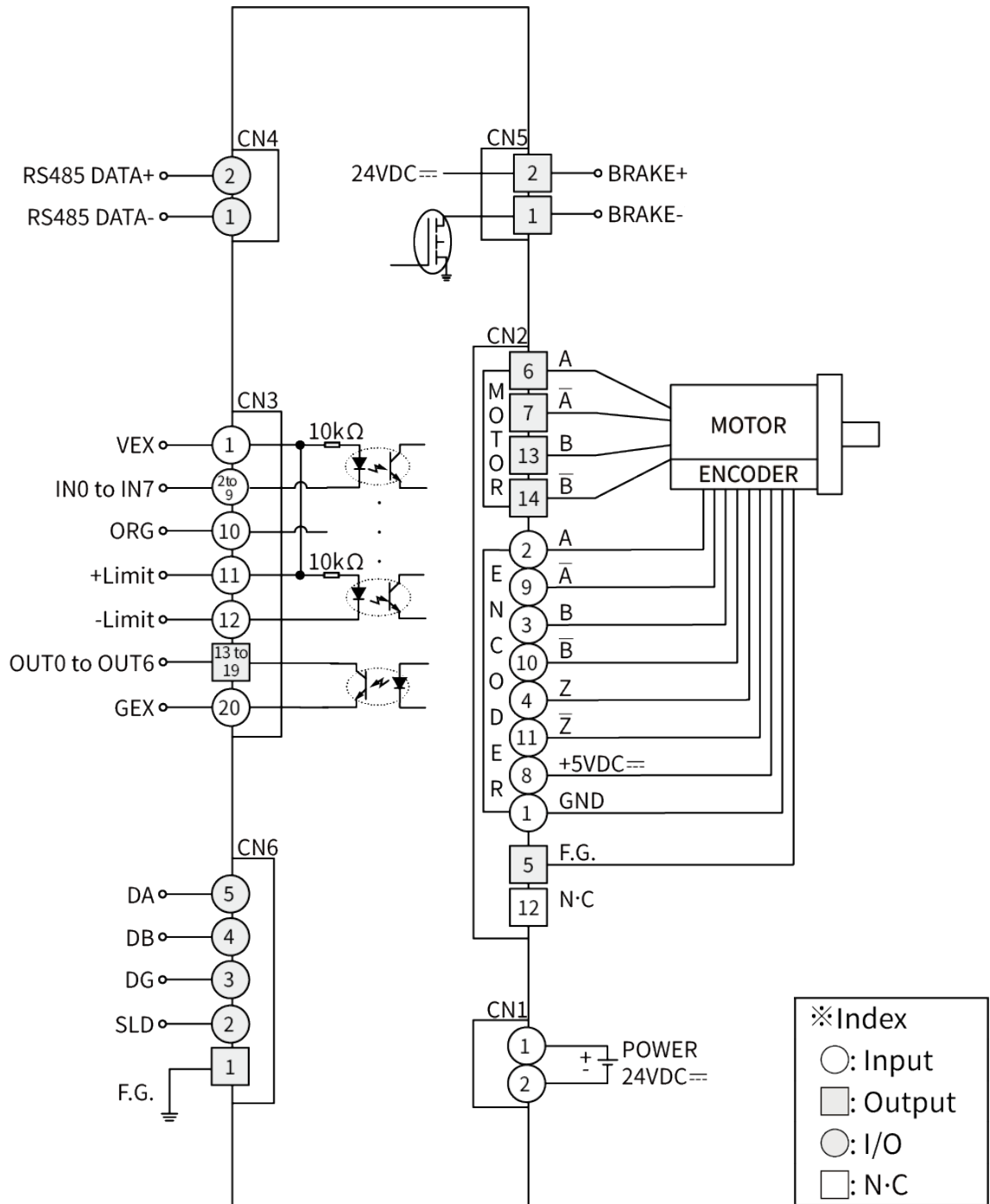
- ① The inner housing installed indoor
(This unit is manufactured and designed for attaching to equipment. Install a ventilation device.)
- ② Within 0 to 50°C (at non-freezing status) of ambient temperature
- ③ Within 35 to 85%RH (at non-dew status) of ambient humidity
- ④ The place without explosive, 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

5.1 Standard Type



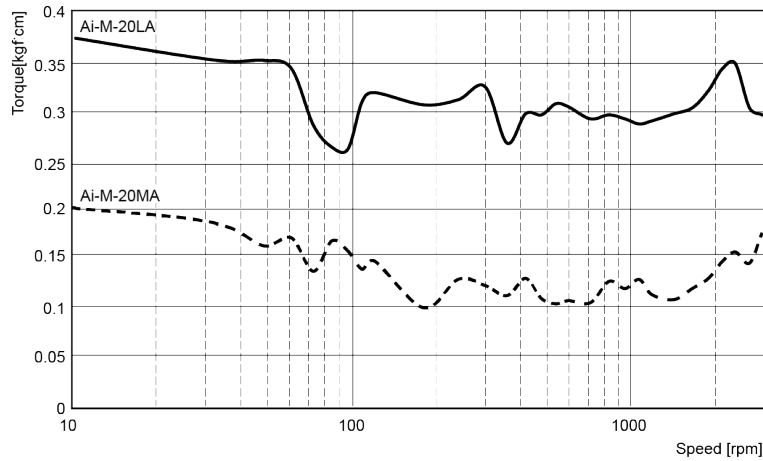
5.2 Built-in Brake Type



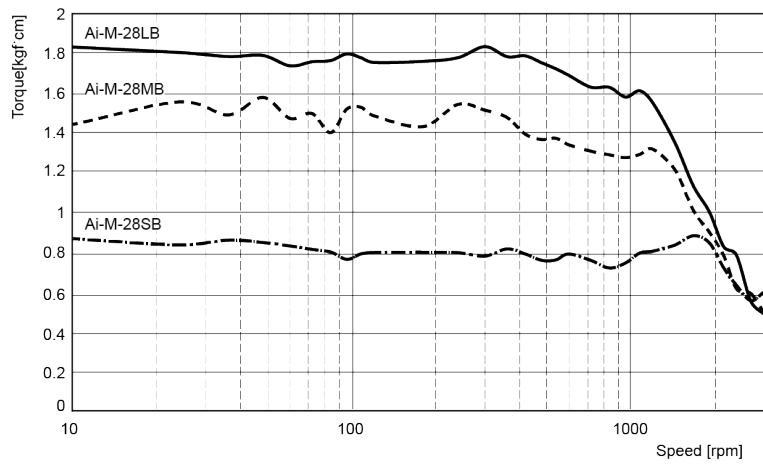
6 Characteristics

6.1 Standard Type

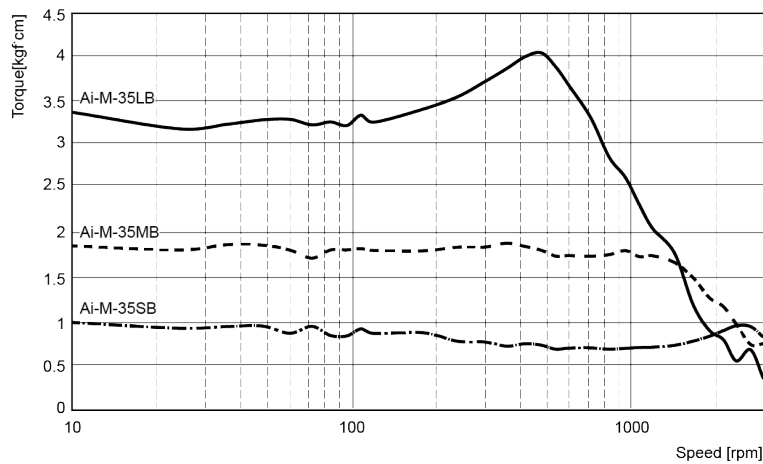
6.1.1 Frame Size 20 mm



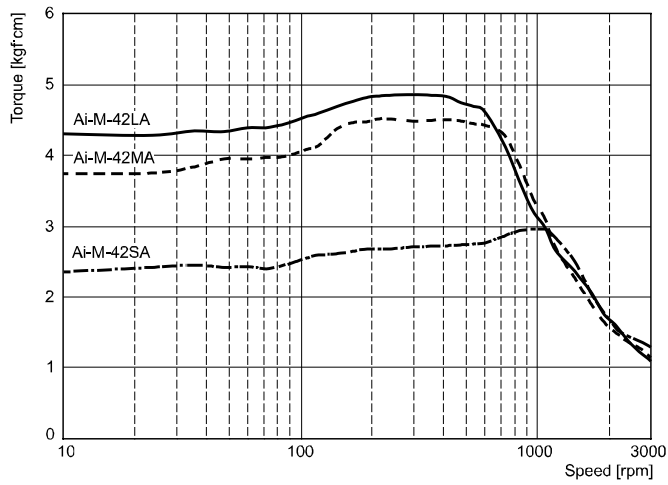
6.1.2 Frame Size 28 mm



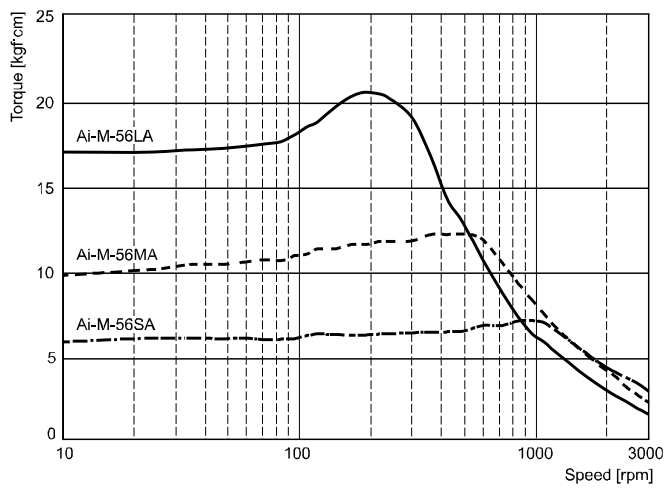
6.1.3 Frame Size 35 mm



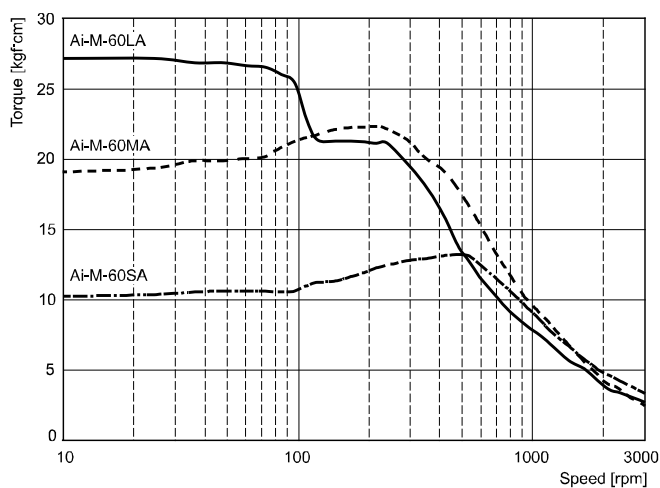
6.1.4 Frame Size 42 mm



6.1.5 Frame Size 56 mm

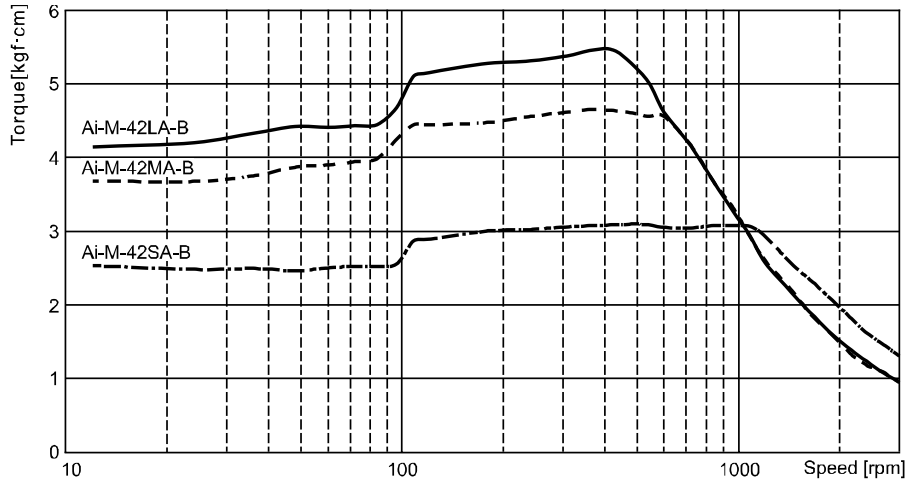


6.1.6 Frame Size 60 mm

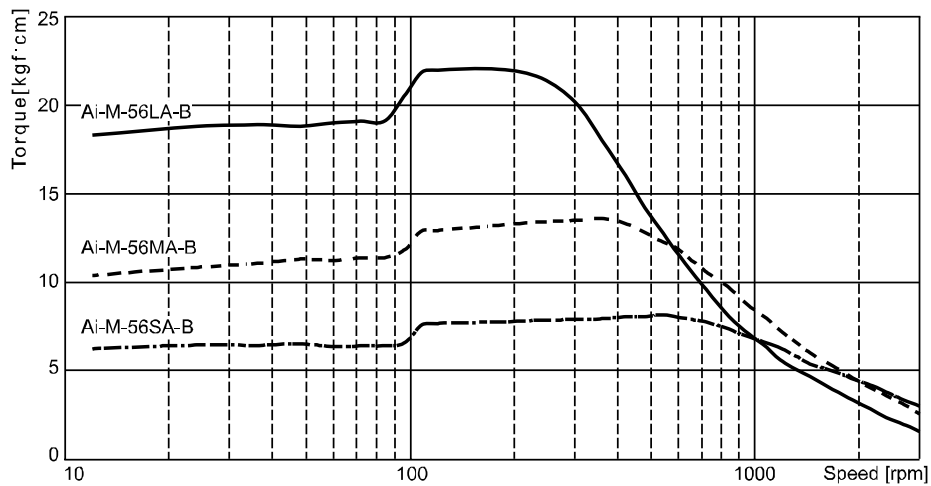


6.2 Built-in Brake Type

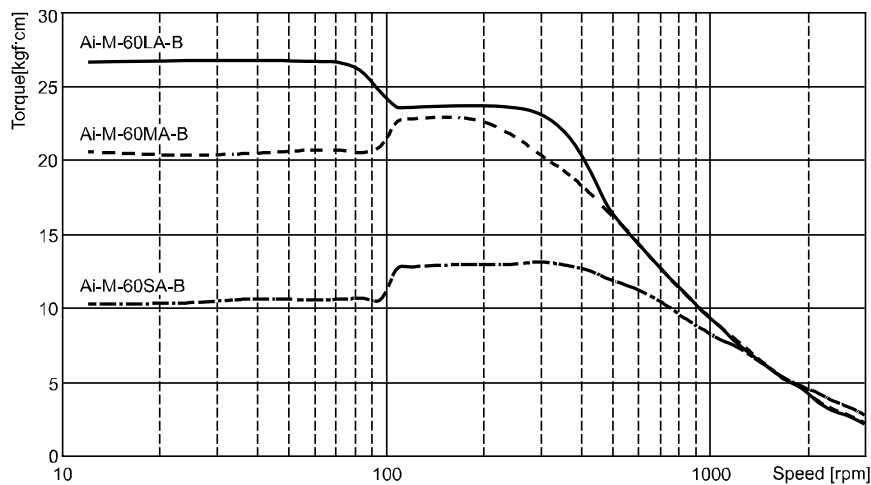
6.2.1 Frame Size 42 mm



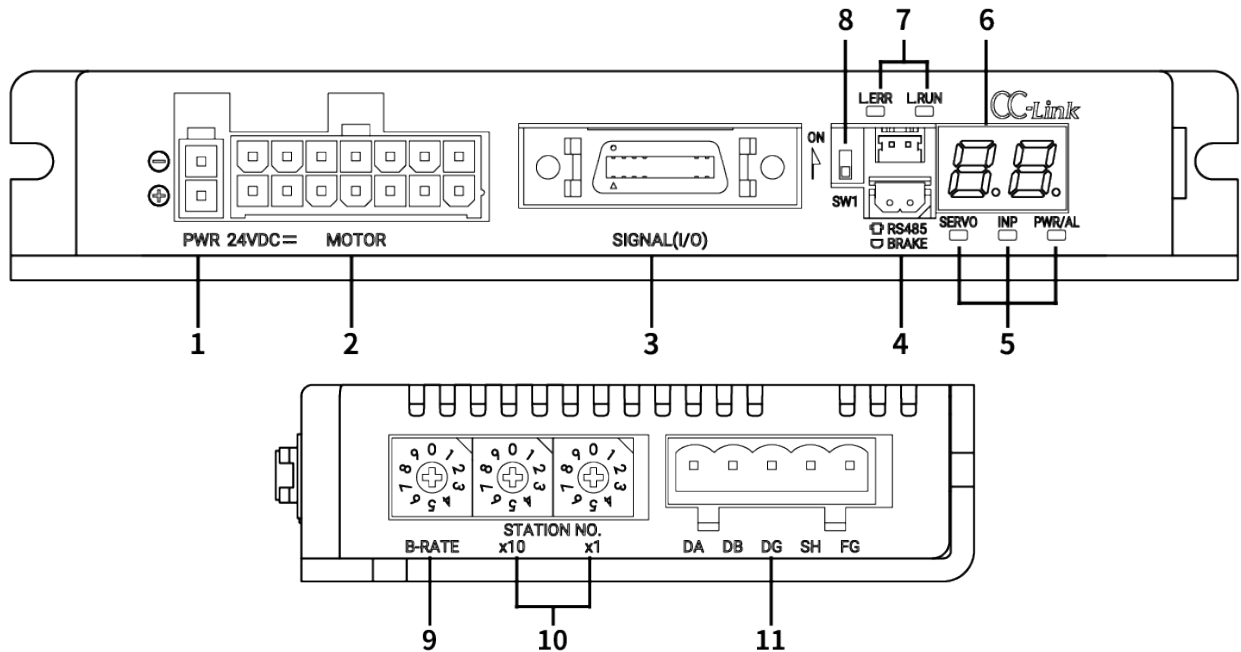
6.2.2 Frame Size 56 mm



6.2.3 Frame Size 60 mm



7 Driver Unit Descriptions




- 1: Power connector (CN1: PWR)
- 2: Motor+Encoder connector (CN2: Motor)
- 3: I/O connector (CN3: Signal I/O)
- 4-1: RS485 communication connector (CN4: RS485)
- 4-2: Brake connector (CN5: BRAKE)
- 5-1: Servo On/Off indicator (SERVO, Orange)
- 5-2: In-Position indicator (INP., Yellow)
- 5-3: Power/Alarm indicator (PWR/AL, Green/Red)
- 6: Alarm/Warning status indicator (7 Segment, Red)
- 7: CC-Link status indicator (L.ERR/L.RUN, Red/Green)
- 8: CC-Link station setting DIP switch (SW1)
- 9: CC-Link comm. speed setting rotary switch (B-RATE)
- 10: CC-Link comm. station setting rotary switch (STATION NO.)
- 11: CC-Link connector (CN6: DA DB DG SH FG)

7.1 Connectors

7.1.1 Power Connector (CN1: PWR)

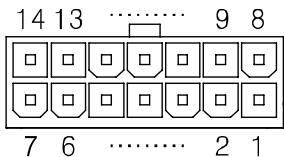
Connects with 24 VDC \equiv power. Be sure to the polarity to correct connection.

When polarity direction is reversed, power is not turned on.

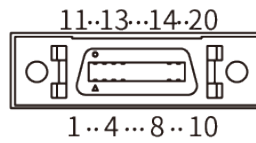
Pin arrangement	Pin no.	Function
	1	24 VDC \equiv
	2	GND

7.1.2 Motor+Encoder Connector (CN2: MOTOR)

Connects the motor and the encoder to the driver.

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

7.1.3 I/O Connector (CN3: SIGNAL I/O)




Pin arrangement	I/O	Signal	Filter ^{※1}	Active ^{※2}	Function
1	-	VEX	-	-	External input power (24 VDC \equiv)
2	Input	IN0	1.5, 10 msec	[L], [H]	General input 0
3	Input	IN1	1.5, 10 msec	[L], [H]	General input 1
4	Input	IN2	1.5, 10 msec	[L], [H]	General input 2
5	Input	IN3	1.5, 10 msec	[L], [H]	General input 3
6	Input	IN4	1.5, 10 msec	[L], [H]	General input 4
7	Input	IN5	1.5, 10 msec	[L], [H]	General input 5
8	Input	IN6	1.5, 10 msec	[L], [H]	General input 6
9	Input	IN7	1.5 msec	[L], [H]	General input 7
10	Input	ORG	1.5 msec	[L], [H]	Home sensor
11	Input	+Limit	1.5 msec	[L], [H]	+ direction limit sensor
12	Input	-Limit	1.5 msec	[L], [H]	- direction limit sensor
13	Output	OUT0	-	-	General output 0
14	Output	OUT1	-	-	General output 1
15	Output	OUT2	-	-	General output 2
16	Output	OUT3	-	-	General output 3
17	Output	OUT4	-	-	General output 4
18	Output	OUT5	-	-	General output 5
19	Output	OUT6	-	-	General output 6
20	-	GEX	-	-	External input GND (0 VDC \equiv)


※1: It is software input filter to set 10 ms or 1.5 ms of parameter 'Input Filter'. The filter of +Limit, ORG, SD, IN7 to 9 is fixed as 1.5ms. When input turns ON over the set time, it recognizes as normal signal input.

※2: It is voltage level to recognize input signal as ON. It is available to set each input. [H]: 5-30 VDC \equiv , [L]: 0-2 VDC \equiv (however, reset is fixed as [L].)

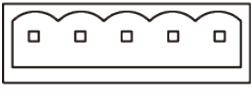
7.1.4 RS485 Comm. Connector (CN4: RS485)

Pin arrangement	Pin no.	Function
	1	RS485 DATA-
	2	RS485 DATA+

7.1.5 Brake Connector (CN5: BRAKE)

Pin arrangement	Pin no.	Function
	1	Brake -
	2	Brake +

7.1.6 CC-Link Connector (CN6: DA DB DG SH FG)

Pin arrangement	Pin no.	Function	Pin no.	Function
	1	F.G.	4	DB
	2	SLD	5	DA
	3	DG	-	

7.2 Connector Specifications

Type		Specifications			Manufacture
		Connector	Connector terminal	Housing	
CN1	Driver	LAD1140-02	-	-	HANLIM
	Power	CHD1140-02	CTD1140	-	
CN2	Driver	35318-1420	-	-	Molex
	Motor+Encoder	5557-14R	5556T	-	
CN3	Driver	10220-52A2 PL	-	-	3M
	I/O connector	10150-3000PE CO20-MP□-R (Sold separately)	-	10350-52F0-008	
CN4	Driver	053254-0270	-	-	Molex
	RS485 connector	51065-0200	50212-8000	-	
CN5	Driver	5268-02A	-	-	Molex
	Brake	5264-02	5263PBT	-	
CN6	Driver	2EHDRC-05P-OR ^{※1}	-	-	Dinkle
	CC-Link connector	2ESDV-05P-OR	-	-	

※4. CC-Link dedicated cable must be used and performance can not be guaranteed when using other cables.

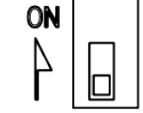


Note

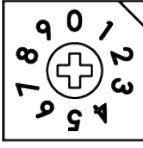
Above connectors are suitable for AiC-D-CL Series. The connectors can be used with equivalent or substitute.

7.3 Switches

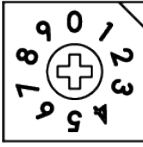
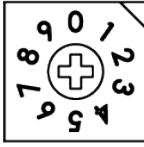
7.3.1 CC-Link Station Setting DIP Switch (SW1)

Setting switch	Setting	CC-Link station setting
	ON	2 stations occupied
	OFF	1 station occupied

7.3.2 CC-Link Comm. Speed Setting Rotary Switch (B-RATE)

Setting switch	Setting	Comm. speed (bps)	Setting	Comm. speed (bps)
	0	156k	5	Disable
	1	625k	6	
	2	2.5M	7	
	3	5M	8	
	4	10M	9	

7.3.3 CC-Link Station Setting Rotary Switch (STATION NO.)

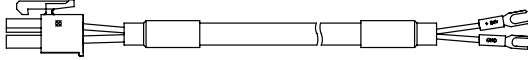
Setting switch	Setting	Station No. ($\times 10$)	Setting switch	Setting	Station No. ($\times 1$)
 $\times 10$	0	0×10	 $\times 1$	0	0
	1	1×10		1	1
	2	2×10		2	2
	3	3×10		3	3
	4	4×10		4	4
	5	5×10		5	5
	6	6×10		6	6
	7	Disable		7	7
	8			8	8
9	9		9		

7.4 Driver Status Indicator

Status indicator	LED color	Function	Descriptions
PWR	Green	Power indicator	Turns ON when the unit operates normally after supplying power.
		Warning indicator	Flashes when limit signal is input or overload, status is maintained.
AL	Red	Alarm indicator	When alarm occurs, it flashes repeat. Refer to '8.2.1.2 Alarm/Warning'.
INP.	Yellow	In-Position indicator	Turns ON when motor is placed at command position after positioning input.
SERVO	Orange	Servo On/Off indicator	Turns ON when Servo is operating, turns off when Servo is not operating
L.RUN	Green	CC-Link status indicator	Flashes when CC-Link status is normal
L.ERR	Red		Flashes when CC-Link is failed

7.5 Sold Separately

7.5.1 Power Cable (CJ-PW-□)



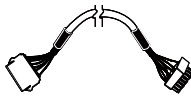
Note

※□ of model name indicates cable length (010, 020).

E.g.)CJ-PW-010: 1 m power cable

※It is recommended to use ferrite core at Power cable.

7.5.2 Motor+Encoder Cable (normal: C1D14M(B)-□/moving: C1DF14M(B)-□)



Note

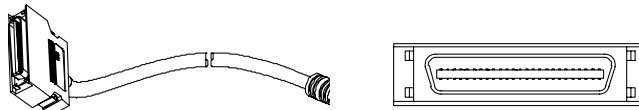
※□ of model name indicates cable length (1, 2, 3, 5, 7, 10, 15, 20).

(B) of model name indicates the built-in brake type, none indicates the standard type.

E.g.)C1DF14MB-10: 10 m moving type, built-in motor+encoder cable

※It is recommended to use ferrite core at Motor+Encoder cable.

7.5.3 I/O Cable (CO20-MP□-R, standard: AiC-CL TAG)



Pin No.	Function (Name TAG)	Cable color	Dot line color-number	Pin No.	Function (Name TAG)	Cable color	Dot line color-number
1	VEX	Yellow	Black-1	11	+Limit	White	Red-1
2	IN0		Red-1	12	-Limit		Black-1
3	IN1		Black-2	13	OUT0		Red-2
4	IN2		Red-2	14	OUT1		Black-2
5	IN3		Black-3	15	OUT2		Red-3
6	IN4		Red-3	16	OUT3		Black-3
7	IN5		Black-4	17	OUT4		Red-4
8	IN6		Red-4	18	OUT5		Black-4
9	IN7		Black-5	19	OUT6		Red-5
10	ORG		Red-5	20	GEX		Black-5



Note

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

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

※It is recommended to use ferrite core at I/O cable.

8 Control Input/Output

Inner signal of all input/output consists of photocoupler.

ON, [H]: photocoupler power ON

OFF, [L]: photocoupler power OFF

8.1 Input

8.1.1 Exclusive Input

Signal name	Descriptions	Pin No.
ORG	Home sensor	10
+Limit	+ direction limit sensor	11
-Limit	- direction limit sensor	12

8.1.1.1 ORG (Origin)

During driving as general home search mode, it is used as home sensor input.

When supplying ORG signal over 1.5 ms, it recognizes as home sensor.

8.1.1.2 \pm Limit

When supplying the \pm limit signal over 1.5 ms, it recognizes as \pm hardware limit input and it decelerates and stops or stops immediately according to the set parameter.

- +Limit = CW direction limit sensor signal
- -Limit = CCW direction limit sensor signal

8.1.2 General Input

List of functions which can be assigned to general input IN0 to IN7.

Signal name	Descriptions
User Input 0	User input
User Input 1	
User Input 2	
User Input 3	
User Input 4	
User Input 5	
User Input 6	
User Input 7	
Reset	Driver reset
Start	Program mode drive start
Start Index	Index drive start
Stop	Driver stop
EMG	Driver emergency stop
+Run	+ continuous drive
-Run	- continuous drive
+Jog	+ jog drive
-Jog	- jog drive
Pause	Pause
Servo ON/OFF	Servo ON/OFF
Home	Home search
Alarm Reset	Alarm reset
SD	Slow Down
Clear Pos.	Clear position, set current position as 0
Step 0	Step number setting (the combination of 6 bit, 0 to 5, selectable 0 to 63)
Step 1	
Step 2	
Step 3	
Step 4	
Step 5	

8.1.2.1 Reset

When driver is reset, it operates same as resupplying the power.

The parameter which is saved at atMotion is not reset.

During motor driving, it stops immediately and the driver is reset.

8.1.2.2 Start

It starts drive as program mode.



Note

- When it stops by stop instruction during driving with program mode, supplying start input, it starts drive from the first step.
- When it pauses by pause instruction during driving with program mode, supplying start input, it starts drive from the next step of the paused one.

8.1.2.3 Start Index

It starts drive as index mode.



Note

- Start 1 step drive which selected by the combination of 6 bit (step 0 to step 5).
- If the step is not selected or operating step without ABS, INC command, index mode error occurs.

8.1.2.4 Stop

During continuous driving, it decelerates and stops the motor according to 'Deceleration Time 1' parameter setting.



Note

- During program mode driving, it stops after complete the current step.
- During home search, it decelerates and stops according to 'Home Search Deceleration Time' parameter setting. In this case, home search mode error alarm occurs.
- During index mode driving, it stops driving and index mode error occurs.

8.1.2.5 EMG (Emergency)

Motor stops immediately, emergency stop alarm occurs.

The current of motor is not blocked.

During motor is stopped, EMG instruction does not run.

8.1.2.6 ±Run

According to the set parameter, it drives to CW(+Run) / CCW(-Run) direction as continuous mode.

8.1.2.7 ±Jog

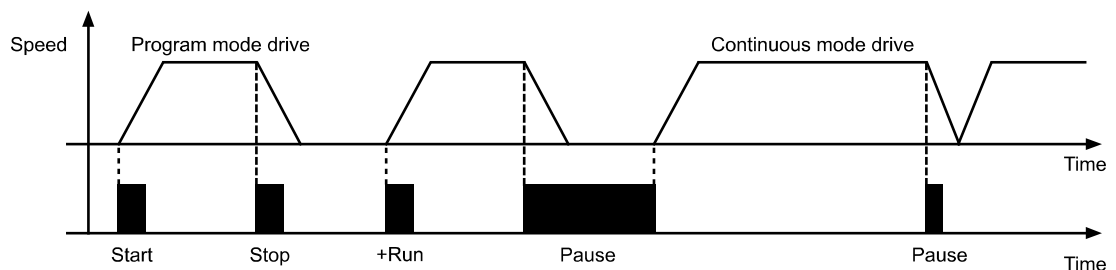
According to the set parameter, it drives to CW(+Jog) / CCW(-Jog) direction during ON jog signal.

**Note**

If +Jog signal and -Jog signal are supplied at the same time, the motor stops.

8.1.2.8 Pause

- When pause signal is ON during program mode drive, it pauses after completing the current step driving.
After start signal is ON, it starts drive from the next step of the paused one.
- During continuous mode driving, it decelerates and stops when pause signal is ON.
When pause signal is OFF, it starts drive.
If pause signal is OFF before stopping the motor, the motor stops and it starts drive as continuous mode.

**8.1.2.9 Servo On/Off**

- It is for adjusting shaft position of motor by external force manually.
- Servo On/Off signal is [H] over 1 msec.
: It recognizes as Servo Off signal and the phase current of motor is blocked and torque is released.
Servo On indicator, In-Position Output and the indicator turns OFF.
- Servo On/Off signal is [L] over 1 msec.
: It recognizes as Servo On signal and the phase current of motor is supplied and torque is return.
Servo On indicator, In-Position Output and the indicator turn ON.

**Note**

Must try when the motor is stop.

8.1.2.10 Home

It drives home search mode.

Home search mode is set at 'Home Search Method' parameter, and settable the value of start speed, max. speed, acceleration time and deceleration time.

8.1.2.11 Alarm Reset

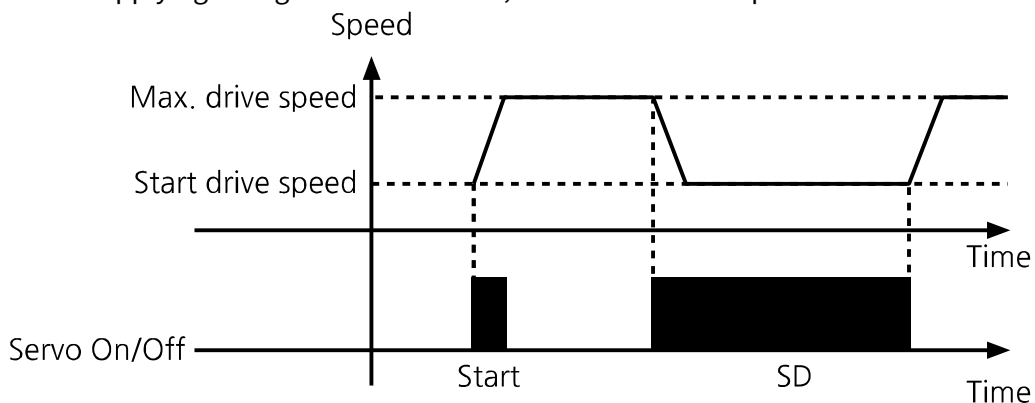
- It is for alarm reset.
- When alarm reset signal is [H] over 10 msec
: alarm is reset and the alarm indicator and alarm output turn OFF then the driver returns to normal status.

**Note**

If the alarm causes are not removed, the driver does not return to normal status even using alarm reset.

8.1.2.12 SD (Slow Down)

When supplying SD signal over 1.5 msec, set the start drive speed decelerates.

**8.1.2.13 Clear Pos**

Set the current position as absolute position 0.

8.1.2.14 Step0 to 5

Set the single step of the index mode for operation.

0 to 63 steps can be set by the combination of 6 bits.

**Note****Program operation mode step address**

Address	Input signal						Address	Input signal					
	Step 5	Step 4	Step 3	Step 2	Step 1	Step 0		Step 5	Step 4	Step 3	Step 2	Step 1	Step 0
0	0	0	0	0	0	0	32	1	0	0	0	0	0
1	0	0	0	0	0	1	33	1	0	0	0	0	1
2	0	0	0	0	1	0	34	1	0	0	0	1	0
3	0	0	0	0	1	1	35	1	0	0	0	1	1
4	0	0	0	1	0	0	36	1	0	0	1	0	0
5	0	0	0	1	0	1	37	1	0	0	1	0	1
6	0	0	0	1	1	0	38	1	0	0	1	1	0
7	0	0	0	1	1	1	39	1	0	0	1	1	1
8	0	0	1	0	0	0	40	1	0	1	0	0	0
9	0	0	1	0	0	1	41	1	0	1	0	0	1
10	0	0	1	0	1	0	42	1	0	1	0	1	0
11	0	0	1	0	1	1	43	1	0	1	0	1	1
12	0	0	1	1	0	0	44	1	0	1	1	0	0
13	0	0	1	1	0	1	45	1	0	1	1	0	1
14	0	0	1	1	1	0	46	1	0	1	1	1	0
15	0	0	1	1	1	1	47	1	0	1	1	1	1
16	0	1	0	0	0	0	48	1	1	0	0	0	0
17	0	1	0	0	0	1	49	1	1	0	0	0	1
18	0	1	0	0	1	0	50	1	1	0	0	1	0
19	0	1	0	0	1	1	51	1	1	0	0	1	1
20	0	1	0	1	0	0	52	1	1	0	1	0	0
21	0	1	0	1	0	1	53	1	1	0	1	0	1
22	0	1	0	1	1	0	54	1	1	0	1	1	0
23	0	1	0	1	1	1	55	1	1	0	1	1	1
24	0	1	1	0	0	0	56	1	1	1	0	0	0
25	0	1	1	0	0	1	57	1	1	1	0	0	1
26	0	1	1	0	1	0	58	1	1	1	0	1	0
27	0	1	1	0	1	1	59	1	1	1	0	1	1
28	0	1	1	1	0	0	60	1	1	1	1	0	0
29	0	1	1	1	0	1	61	1	1	1	1	0	1
30	0	1	1	1	1	0	62	1	1	1	1	1	0
31	0	1	1	1	1	1	63	1	1	1	1	1	1

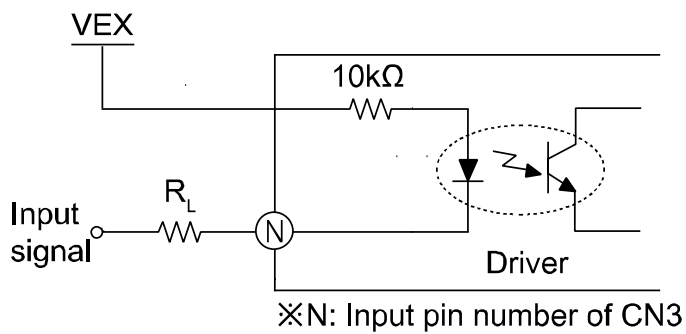
8.1.3 Example of Input Circuit Connection

All input circuits are insulated with photocoupler.

It is recommended to use 24VDC at VEX and short R_L .

In case of using external power over 24 VDC power, select R_L value that I_F (forward current of primary LED) of photocoupler to be around 2.5mA (max. 10 mA).

$$R_L = \frac{VEX - 1.25V}{0.0025A} - 10 \times 10^3 \Omega$$



8.2 Output

8.2.1 General Output

The list of functions below can be assigned to general output OUT0 to OUT6.

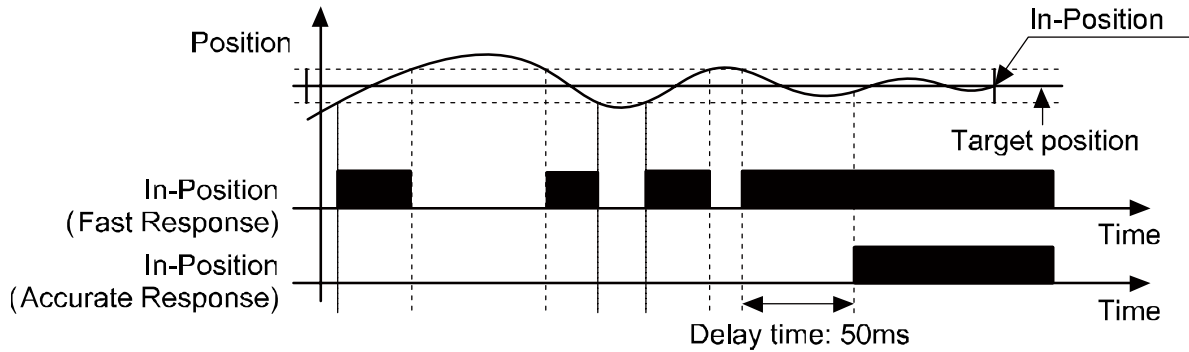
Signal name	Description
User Output 0	User output
User Output 1	
User Output 2	
User Output 3	
User Output 4	
User Output 5	
User Output 6	
In-Position	In-Position output
Alarm	Alarm output
Warning	Warning output

8.2.1.1 In-Position

In-Position output indicates the 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 to [H] and the in-position indicator turns ON.

In reverse, when the gap is over in-position setting value, in-position output turns to [L] and the in-position indicator turns OFF.



Fast Response		Accurate Response	
Setting	Value	Setting	Value
0 (factory default)	0	8	0
1	±1	9	±1
2	±2	10	±2
3	±3	11	±3
4	±4	12	±4
5	±5	13	±5
6	±6	14	±6
7	±7	15	±7



Note

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

- Fast Response: When the deviation of the target position and the current position is smaller than the set value, In-Position signal outputs instantly.
- Accurate Response: When the deviation of the target position and the current position is smaller than the set value and maintains over 50 msec, In-Position signal outputs.

8.2.1.2 Alarm/Warning

(3) Alarm

- This function stops motor to protect driver, depending on the error status such as overcurrent or overspeed.
 - In normal status, output is [H], and in alarm status, output is [L].
 - When alarm occurs, brake operates.
 - When the alarm reset is applied, the driver returns to normal status.
- ※ Refer to '8.2.2 Example of Output Circuit Connection'.

(4) Warning

- This function notices dangers with the alarm indicator prior to motor stop with limit signal or overload alarm.
- When turning out from the alarming condition, driver returns to the normal status automatically.



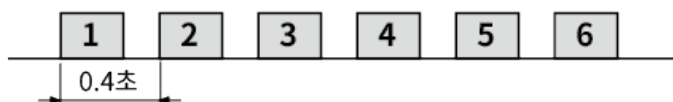
Note

- ※ Even though warning occurs, it drives as normal status and it may cause damage by fire. It is recommended not to use the unit during warning status.
- ※ Depending on the alarm/warning type, it flashes for 0.4 sec interval and it turns OFF repeatedly.



Ex.

In case of alarm/warning



1) In Case of Both Motor and Torque Remains

Alarm status	Alarm type	Descriptions	Causes	Troubleshooting
C.1	Comm. station setting error	When station number is exceeded the range of 1 to 64	1. CC-Link station setting error	1. Select the station number in 1 to 64
C.2	Comm. speed setting error	When comm. speed is exceeded the range of 0 to 4	1. CC-Link speed setting error	1. Select the baud rate in 0 to 4
C.3	Comm. station setting change	When station number is changed while power is ON	1. CC-Link station setting change	1. Re-supply the power
C.4	Comm. speed setting change	When comm. speed is changed while power is ON	1. CC-Link speed setting change	1. Re-supply the power
C.5	Comm. failure	Comm. error	1. Comm. disconnect with CC-Link master	1. Check the connection status of communication cable 2. Check the station number and communication speed in available range

2) In Case of Motor Stops and Torque Releases

Alarm status	Alarm type	Descriptions	Causes	Troubleshooting
E.1	Overcurrent error	When overcurrent flows at motor RUN element	1. Overload 2. Insufficient SMPS capacity	1. Change operation condition or reduce load so that sudden load fluctuation does not occur 2. Check that less than recommended SMPS capacity is used 3. Check driver break
E.2	Overspeed error	When motor speed is over 4,000rpm	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 rotate more than 4,000 rpm
E.3	Position tracking error	When the gap between position command value and current position value is over 90°	1. Overload 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
E.4	Overload error	When applying load over the rated load for 1 sec	1. Overload 2. Insufficient SMPS capacity	1. Change operation condition or reduce load so that sudden load fluctuation does not occur 2. Check the less used than recommended SMPS capacity 3. Check driver break
E.5	Overheat error	When driver inner temperature is over 80°C	1. Installed in an enclosed space	1. Change the installation environment Air flow around driver installation Heat dissipation (heat sink or fan)
E.6	Motor connection error	When motor cable connection error occurs at driver	1. Motor connector and cable connector error 2. Burnout of the inverter in the driver	1. Check motor connector and cable connection 2. Replace burned parts of the inverter in driver
E.7	Encoder connection error	When encoder cable connection error occurs at driver	1. Motor connector and cable connector error 2. Burnout of line driver IC in encoder	1. Check motor connector and cable connection 2. Replace the line driver IC in encoder
E.8	Regenerative voltage error	When regenerative voltage is over 78V	1. Overload 2. Excessive force due to rapid deceleration	1. Change operation condition or reduce load so that sudden load fluctuation does not occur
E.9	Motor misalignment	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 inverter in 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

Alarm status	Alarm type	Descriptions	Causes	Troubleshooting
<i>E.R.</i>	Command speed error	When input pulse is over 3,500 rpm	1. Error of entering user command speed input	<ol style="list-style-type: none"> 1. Use recommended specifications (max. 3,000 rpm input) 2. Enter the speed value (PPS) by checking the resolution
<i>E.b.</i>	Input voltage error	When input voltage is out of 24 VDC $\pm 10\%$	<ol style="list-style-type: none"> 1. Overload 2. Insufficient SMPS capacity 3. Power input over the specification (24 VDC $\pm 10\%$) 	<ol style="list-style-type: none"> 1. Change operation condition or reduce load so that sudden load fluctuation does not occur 2. Check the less used than recommended SMPS capacity 3. Supply power under specification (24 VDC $\pm 10\%$)
<i>E.L.</i>	In-Position error	When position error (In-position setting value) is kept over 3 sec, after motor stopped	<ol style="list-style-type: none"> 1. Overload 2. Stop torque leakage 	<ol style="list-style-type: none"> 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
<i>E.d.</i>	Memory error	When memory error is detected as power supplied	1. EEPROM error	1. Replace EEPROM parts

3) In Case of Motor Stops and Torque Remains

Alarm status	Alarm type	Descriptions	Causes	Troubleshooting
E.E.	Emergency stop	When emergently stopped with emergency stop command	1. When emergency stop enters	1. Check EMG signal 2. Check Active Level Setting of EMG signal
E.F.	Program mode error	When 'END' command does not exist at the last step	1. If there is no 'END' instruction at the last step of the program 2. If there is an empty step in the middle of the program	1. Add 'END' command at last step of program 2. Remove an empty step in middle of a program
E.G.	Index mode error	When other instruction is used but 'INC', 'ABS', When index command is not completed due to the stop command	1. In case of step is not selected 2. When running a step with commands other than 'INC', 'ABS' 3. When entering the stop command during driving on index mode	1. Check where the command of the step is 'INC' or 'ABS' 2. Check that the selected step number is correct
E.H.	Home search mode error	When failed to find home	1. If there is no 'ORG' or '±Limit' input 2. if load above the set value is not applied (torque home search) 3. When stop command is issued during home search operation	1. Check if ORG signal is correctly input (general home search) 2. Check if the ±Limit signal is correctly input (limit home search) 3. Check if the ±Limit signal is correctly set with the motor rotation direction. (CW direction: + Limit, CCW direction: -Limit) 4. Change the value of the home search torque parameter (torque home search)

4) In Case of Motor Stops and Torque Remains

Warning status	Warning type	Descriptions	Causes	Troubleshooting
㉞1	S/W +Limit	When normal direction (CW) S/W limit is ON	1. When the current position reaches the S/W + Limit value	1. Check S/W +Limit parameter value
㉞2	S/W -Limit	When reverse direction (CCW) S/W limit is ON	1. When the current position reaches the S/W - Limit value	1. Check S/W -Limit parameter value
㉞3	H/W +Limit	When normal direction (CW) H/W limit is ON	1. When +Limit signal (I/O pin no. 19) is input	1. Check +Limit signal is input correctly 2. Check if \pm Limit signal is correctly set with the motor rotation direction. (CW direction: +Limit, CCW direction: -Limit)
㉞4	H/W -Limit	When reverse direction (CCW) H/W limit is ON	1. When -Limit signal (I/O pin no. 20) is input	

5) In Case of Both Motor and Torque Remains

Warning status	Warning type	Descriptions	Causes	Troubleshooting
㉞5	Overload warning	When maximum load is kept connected over 10 sec	1. Overload	1. Change operation condition or reduce load so that sudden load fluctuation does not occur

8.2.1.3 User Output

Signal name	Description
User Output 0 to 6	User Output

It is general output at program mode.

It is used with OPC, OPT instruction.



Note

When alarm occurs by Output Mode (Alarm) parameter setting, output can be remained or reset.

Parameter	Settings	Descriptions
Output Mode (Alarm)	Holding	Output remain
	Reset	Output reset

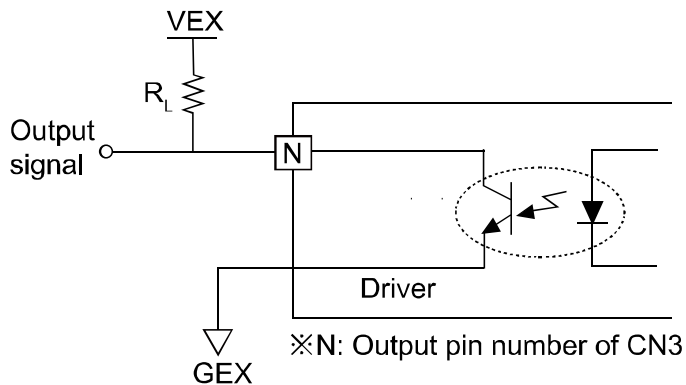
8.2.2 Example of Output Circuit Connection

All output circuits are insulated with photocoupler.

External power input is available from 5 to 80 VDC with the open collector method.

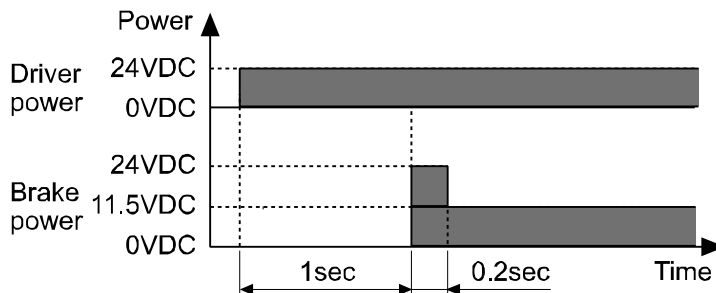
Select R_L value that I_c (collector current of secondary LED) of photocoupler to be around 10mA.

$$R_L = \frac{VEX - 0.7V}{0.01A}$$



8.2.3 Brake Output

In order to reduce heat in the brake, connect to the motor, the driver outputs DC power to turn off the brake.



When supplying power to the driver after connecting the driver and brake, the rated excitation voltage is supplied and the brake power is released after approx. 1 sec.

Then after approx. 0.2 sec, the excitation voltage is decreased to 11.5 VDC and the released brake power is maintained.

※ While power is supplied to the driver, the brake is kept turning on, except in the Servo On status.

9 Drive

As below, AiC Series has 4 drive modes and home search.

It operates each drive mode by I/O.

Drive mode name	Descriptions
Jog mode	Outputs drive while instruction input signal is ON to \pm direction
Continuous mode	Starts drive output when instruction input signal turns ON once to \pm direction. Stops it when the signal turns stop
Program mode	Operates by the designated program
Index mode	Designates and operates the one step among the saved instruction of the program
Home search	Operates home search



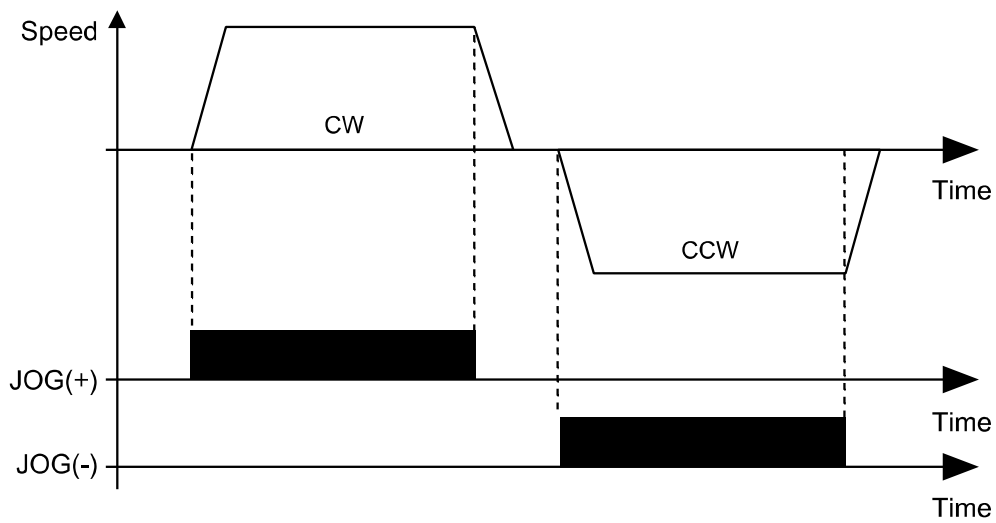
Caution

- Do not operate instructions by I/O during communication between the driver and the PC (atMotion).
(only monitoring is available)
- It may cause malfunction due to double input.

9.1 Jog Mode

The jog mode operates motor to CW direction or CCW direction while “+Jog” or “-Jog” signal is ON.

- Jog mode drive
 - 1st Drive
 - : It drives to CW or CCW direction while “+Jog” or “-Jog” signal inputs.
 - 2nd Emergency stop
 - : It stops emergently, when “EMG” signal inputs.



Note

- It cannot stop by “Stop” signal input.

9.2 Continuous Mode

The continuous mode operates motor continuously when drive signal inputs to the designated direction.

When “STOP” signal inputs or limit signal of the direction inputs, it stops.

- Continuous mode drive

- 1st Drive

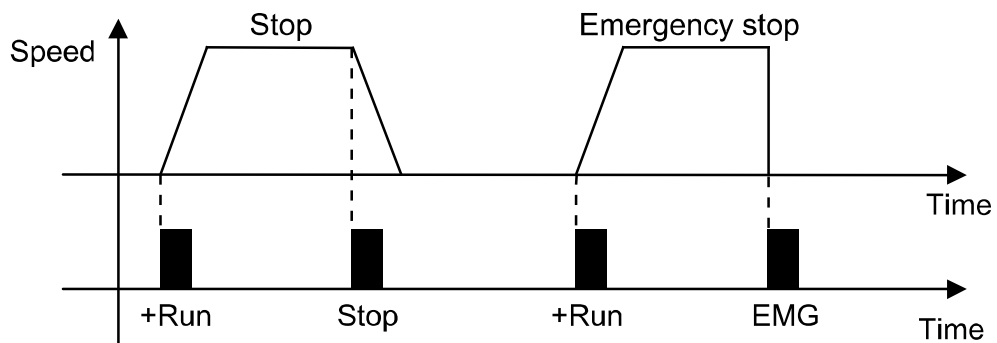
- : It drives to CW or CCW direction when “+Run” or “-Run” signal inputs.

- 2nd Stop

- : It stops when “Stop” signal inputs or limit signal of the direction inputs.

- 3rd Emergency stop

- : It stops emergently when “EMG” signal inputs



9.3 Program Mode

The program mode operates the designated program from 0 to 255 step sequentially.

- Program mode drive

The program must be saved in memory.

1st Drive

: It drives according to the set program when “Start” input signal turns ON.

2nd Pause

: It stops after completing the step when “Pause” signal inputs.

It drives from the completed next step when “Start” signal inputs again.

3rd Stop

: It stops after completing the step, when “Stop” signal inputs.

It drives from the first step, when “Start” signal inputs again.

4th Emergency stop

: It stops emergently when “EMG” signal inputs.

5th Program end

: The program mode drive ends when “END” signal inputs.



Note

- When “Power On Program Start” parameter is enabled, it operates program mode drive when resupplying power.



Caution

- “END” signal must be input to end the program mode.
If there is no “END” instruction input, no. 15 alarm (program mode error) occurs.

9.4 Index Mode

The index mode operates the one step of “ABS” or “INC” instruction from the program.

- Index mode drive

For operating index mode, the designated program step must have the instruction.

When operating the other instruction, error occurs.

1st Select index mode

: It is available to set the step number from 0 to 63 combining with “Step0” to ”Step5”.

2nd Start drive

: The designated one step operates when “Start” input signals turns ON.

3rd Emergency stop

: it stops emergently, when “EMG” signal inputs.



Note

- During the index mode driving, it cannot stop by “Stop” signal or program stop instruction, but only emergency stop is available with “EMG” signal.



Caution

- When it stops by “Stop” signal input, no. 16 alarm (index mode error) occurs.
- When driving the step which does not have “ABS” or “INC” instruction, no. 15 alarm (index mode error) occurs.

9.5 Home Search

The home search operates by “HOME” signal input.

For more information, refer to ‘11.2 Home Search’.

- Home search drive

- 1st Drive

- : It operates home search according to the set mode when “HOME” signal inputs.

- 2nd Stop

- : It stops when “Stop” signal inputs or limit signal of the direction inputs.

- 3rd Emergency stop

- : It stops emergently, when “EMG” signal inputs.



Note

- When “Power On Home Search” parameter is enabled, it operates home search when resupplying power.

10 Program Instructions

There are 13 program instructions as below table.

Type	Instruction	Descriptions
Drive	ABS	Absolute position move
	INC	Incremental position move
	HOM	Home search
Input/Output	ICJ	Input condition jump
	IRD	Input wait
	OPC	Output port ON/OFF
	OPT	Output port ON pulse
Program control	JMP	Jump
	REP	Repeat start
	RPE	Repeat end
	END	Program end
	POS	Position set
Other	TIM	Ready

10.1 Drive Instruction

10.1.1 ABS (Absolute Position Move)

It is for moving to absolute position by a specified distance from home.

Instruction	DATA					
ABS	Instruction	Start speed	Max speed	Acceleration	Deceleration	Position

For more information, refer to '11.1.1 Fixed Pulse and Continuous Pulse Drive'.

- Start speed
 - : Select the start drive speed.
 - Set the start speed from 1 to 5 according to purpose.
 - When selecting 'User Value', it is available to set as the desired value.
- Max speed
 - : Select the max. drive speed during drive.
 - Set the max. speed from 1 to 5 according to purpose.
 - When selecting 'User Value', it is available to set as the desired value.
- Acceleration
 - : Set the acceleration time of drive.
 - Set the acceleration time 1 to 5 according to purpose.
 - When selecting 'User Value', it is available to set as the desired value.
- Deceleration
 - : Set the deceleration time of drive.
 - Set the deceleration time 1 to 5 according to purpose.
 - When selecting 'User Value', it is available to set as the desired value.
- Position
 - : Input the moving position as absolute value.
 - In case of "Present position–Moving position > 2,147,483,647" or "Present position–Moving position < -2,147,483,648", it is out of range to move and program mode error occurs.

10.1.2 INC (Incremental Position Move)

It is for moving to incremental position by a specified distance from current position.

Instruction	DATA					
INC	Instruction	Start speed	Max speed	Acceleration	Deceleration	Position

For more information, refer to the '11.1.1 Fixed Pulse and Continuous Pulse Drive'.

- Start speed
 - : Select the start drive speed.
 - Set the start speed from 1 to 5 according to purpose.
 - When selecting 'User Value', it is available to set as the desired value.
- Max speed
 - : Select the max. drive speed during drive.
 - Set the max. speed from 1 to 5 according to purpose.
 - When selecting 'User Value', it is available to set as the desired value.
- Acceleration
 - : Set the acceleration time of drive.
 - Set the acceleration time 1 to 5 according to purpose.
 - When selecting 'User Value', it is available to set as the desired value.
- Deceleration
 - : Set the deceleration time of drive.
 - Set the deceleration time 1 to 5 according to purpose.
 - When selecting 'User Value', it is available to set as the desired value.
- Position
 - : Input the moving position as absolute value.
 - Available moving range is -2,147,483,648 to 2,147,483,647.

10.1.3 HOM (Home Search)

It is for home search according to the set parameter of Home Search Mode.

Instruction	DATA
HOM	Instruction Home mode

- Home mode: Select home search mode operation setting.
 For more information, refer to the '11.2 Home Search'.
 - 0: General Home Search
 - 1: Limit Home Search
 - 2: Zero Home Search
 - 3: Torque Home Search

10.2 Input/Output Instruction

10.2.1 ICJ (Input Condition Jump)

It is for jumping to the set step (Step No.) when the selected input port is activated.

When the input port is deactivated, it runs the next step.

Instruction	DATA		
ICJ	Instruction	Input port	Step No.

- Input port: Select Input port number.
For more information of input port number, refer to '8.1.2 General Input'.
- Step No.: Set the step number to jump. Setting range is 0 to 255.



Caution

At the loop between REP, RPE instruction, do not use ICJ (Input Condition Jump).

10.2.2 IRD (Input Wait)

It is for moving the next step when the selected input port is activated.

When the input port is deactivated, it waits at the current step until the active status.

Instruction	DATA	
IRD	Instruction	Input port

- Input port: Select the input port number.
For more information of input port number, refer to '8.1.2 General Input'.

10.2.3 OPC (Output Port ON/OFF)

Instruction	DATA		
OPC	Instruction	Output port	ON/OFF

It turns ON/OFF the selected output port.

- Output port: Select the output port number.
For more information of output port number, refer to '8.2.1 General Output'.
- ON/OFF: Set the output port ON/OFF status.
Turn OFF when 0 is set. Turn ON when 1 is set.

10.2.4 OPT (Output Port ON Pulse)

It turns the set output port ON during the set ON time.

Instruction	DATA			
OPT	Instruction	Output port	Next step	On time

- Output port: Select the output port number.
For more information about output port number, refer to '8.2.1 General Output'.
- Next step
 - ON: It moves to the next step regardless of output operation.
 - OFF: It turns the set output port ON during the set On Time. After the time, it moves to the next step.
- On Time: Set the ON time for output port.
Setting range is 1 to 10,000 msec.

10.3 Program Control Instruction

10.3.1 JMP (Jump)

It jumps to the designated step (Step No.).

Instruction	DATA	
JMP	Instruction	Step No.

- Step No.: Set the step number to jump. Setting range is 0 to 255.



Caution

When using JMP instruction, be sure to the position of END instruction.

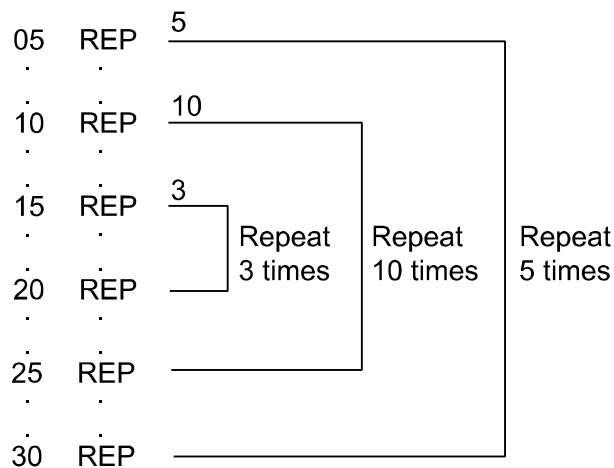
At the loop between REP, RPE instruction, do not use JMP (Jump).

10.3.2 REP (Repeat Start)

It operates repeatedly for the set times from the next step of this instrucion to RPE (repeat end instruction).

Instruction	DATA	
REP	Instruction	Repeat Count

- Repeat Count
: Set the repeat times. Setting range is 1 to 255.
RPE (Repeat End) instruction should be below (higher step number) of the REP (Repeat Start) instruction. The lower nested loops are available up to 3.



10.3.3 RPE (Repeat End)

It is end instruction of REP (Repeat Start).

Instruction	DATA
RPE	Instruction

It operates repeatedly at the set times from REP (Repeat Start) instruction to the RPE (Repeat End) instruction.



Caution

At the loop between REP, RPE instruction, do not use jump instruction (JMP, ICJ).

10.3.4 END (Program End)

It ends program. The instruction must be entered at the end of program.

Instruction	DATA
END	Instruction

10.3.5 POS (Position Setting)

It sets the position value.

Instruction	DATA
POS	Instruction Position

- Position: Set the position value. Setting range is -2,147,483,648 to +2,147,483,647.

10.4 Others

10.4.1 TIM (Ready)

It is ready instruction for the set time.

Instruction	DATA
TIM	Instruction Delay Time

Delay Time: Set the wait time as msec. Setting range is 1 to 10,000 msec.

11 Driver Function

11.1 General Drive

11.1.1 Fixed Pulse and Continuous Pulse Drive

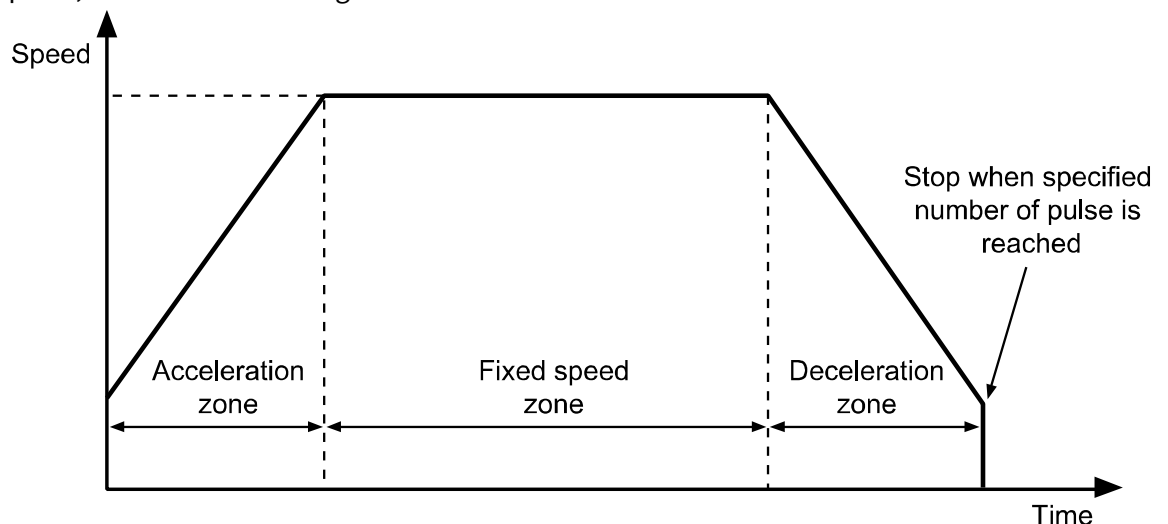
Drive pulse output on each axis is basically in \pm directions by drive instruction of a fixed or continuous pulse.

11.1.1.1 Fixed Pulse Drive

Fixed pulse drive is used to move object a fixed amount.

It operates fixed speed or acceleration/deceleration drive for a specified number of output pulses.

Acceleration/Deceleration fixed pulse drive starts to reduce speed when remaining output pulse is less than the pulse used for acceleration. It ends drive when it finishes generating pulse, as shown in the image below.



- Absolute position moves and incremental position move : There are absolute position move and incremental position move. These are fixed pulse drive.
- Absolute position moves drives from home to position of specified distance. This is only for ABS instruction in program mode.
- Incremental position move sets a distance to drive from present coordinates. INC instruction is corresponding to this program mode.

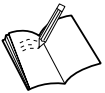
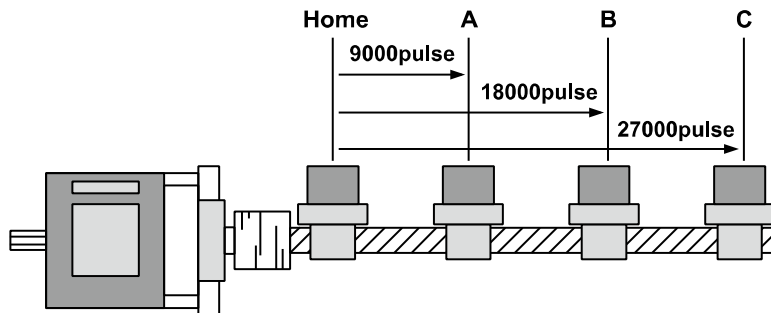
**Ex.**

- Example of Absolute position move

Absolute position move uses home as a base point for move instruction, unlike relative position movement.

For example, if the absolute position move instruction (ABS) is executed for 9,000 pulse 3 times, it moves to A in the image below.

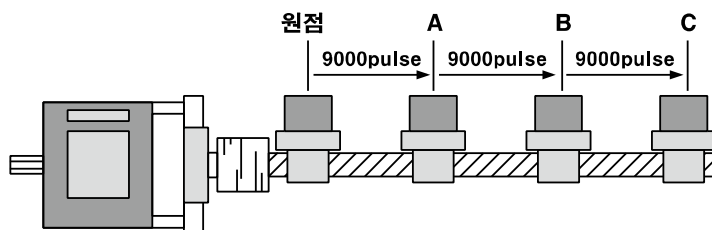
In order to move to points A, B, C, with the absolute position move (ABS), the ABS instruction is required to be set for each of 9,000/18,000/27,000 pulse.

**Ex.**

- Example of incremental position movement

Incremental position move works as shown in the image below.

For example, if the incremental position move (INC) instruction is executed for 9,000 pulse 3 times, it moves to points A -> B -> C.



11.1.1.2 Continuous Drive

Continuous pulse drive outputs the drive pulse sequentially until the stop instruction from the high level or external stop signal becomes active. Continuous mode and home search mode correspond to this category.

Deceleration stop and immediate stop are in stop instruction. Deceleration stop is applied in almost every case except when drive speed is lower than initial speed, reset and emergency stop.

11.1.2 Speed Curve

Drive pulse output of each axis operates by CW direction, CCW direction fixed pulse drive instruction or continuous drive instruction. However, it can operate speed curve of fixed speed, trapezoidal acceleration/deceleration, by operation mode setting or parameter.

11.1.2.1 Constant Speed Drive

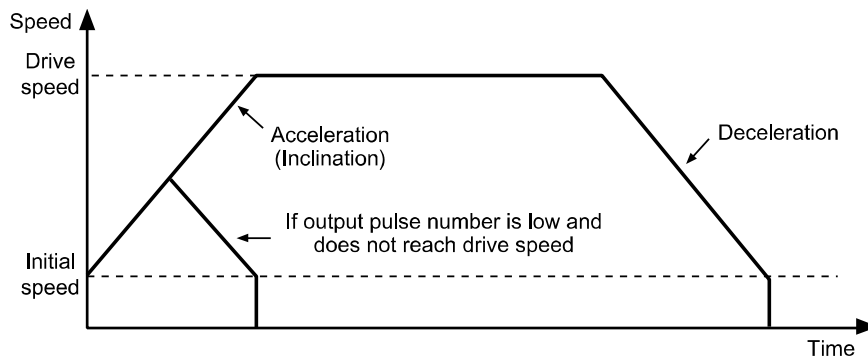
Constant speed drive outputs pulse at a constant speed.

When the start drive speed and the max. drive speed are set as same value or the acceleration or the deceleration time is set as 0, it operates constant speed drive without acceleration/deceleration.

This max. drive speed settings should be higher than or same as start drive speed.

11.1.2.2 Symmetric Trapezoidal Acceleration/Deceleration Drive

- Trapezoidal acceleration/deceleration drive accelerates from initial speed to drive speed trapezoidal with an inclination of the designated acceleration.
- Set acceleration/deceleration time as msec at “Acceleration Time 1 to 5”, “Deceleration Time 1 to 5” parameter.
- It counts the pulses consumed while accelerating to a specified drive speed, and starts decelerating when the remaining output pulse becomes less than accelerating pulse. This decelerating drive reduces speed to initial speed with specified acceleration. In continuous pulse drive, it decelerates to initial speed when the stop signal is activated, and stops immediately when it reaches initial speed.



Note

- When speed override operates during constant speed drive, the set acceleration/deceleration time is changeable.
- For continuous drive or jog drive by I/O, acceleration/deceleration time is set at “Acceleration Time 1”, “Deceleration Time 1”.
- When it does not arrive with the max. drive speed at the target position due to long acceleration time and short command position, acceleration time may be changed.

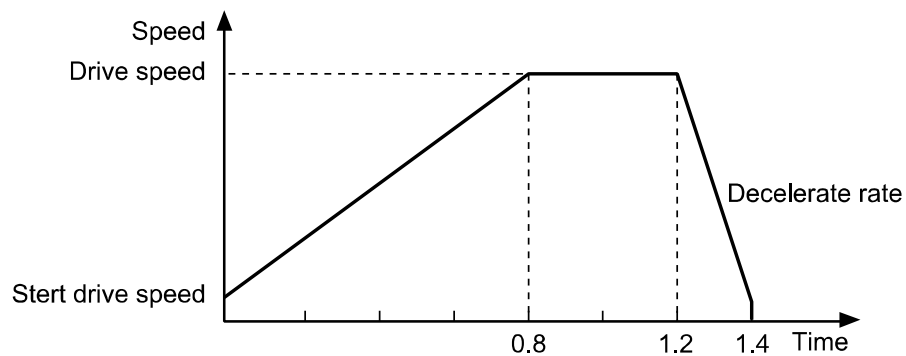
11.1.2.3 Asymmetric Trapezoidal Acceleration/Deceleration Drive

- AiC-D-CL is available as asymmetric trapezoidal acceleration/deceleration drive which is different between acceleration speed and deceleration speed.

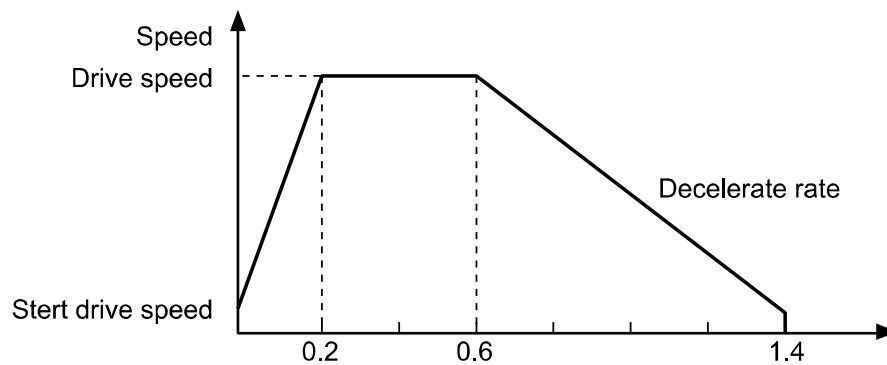
To move the object to the vertical direction such as stacking device of semiconductor wafer, the gravity acceleration speed is added to the object and acceleration speed and deceleration speed for up/down movement should be different.

In this case, it operates asymmetric trapezoidal acceleration/deceleration drive.

- When deceleration speed is higher than acceleration speed,



- When acceleration speed is higher than deceleration speed,



11.2 Home Search

During program mode drive, it operates home search drive by “HOM” instruction.
 Set “Power On Home Search” parameter as Enable and home search drive operates when initial power is ON.



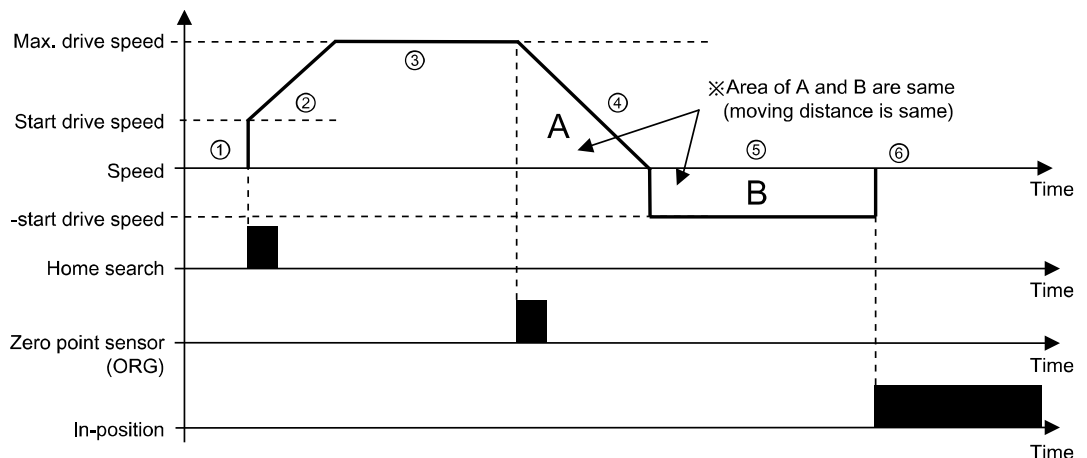
Note

It stops home search by “Stop” or “EMG” instruction.
 When stop, home search drive is cancel.

11.2.1 General Home Search (Home Search Method = 0)

It operates home search by home sensor.

- 1st It operates home search drive to the set direction at “Home Search Direction”.
- 2nd It starts drive with the set start drive speed at “Home Search Start Speed” and operates acceleration drive with the set acceleration time at “Home Search Acceleration Time”.
- 3rd When acceleration drive is completed, it operates constant speed drive until “ORG (home sensor)” signal inputs with the set max. drive speed at “Home Search Max speed”.
- 4th If “±Limit (±direction limit sensor)” signal inputs before “ORG (home sensor)” signal inputs, it decelerates and stops drive to the reverse direction to find home.
- 5th If “ORG (home sensor)” signal inputs, it decelerates with the set deceleration time at the “Home Search Deceleration Time” and stops.
- 6th After stops, it moves home sensor to the reverse direction for the passing distance from home with the set start drive speed at “Home Search Start Speed”, finds home sensor and stops.
- 7th After finding home, “In-Position” signal outputs and the “INP. indicator (yellow)” turns ON.



11.2.2 Limit Home Search (Home Search Method = 1)

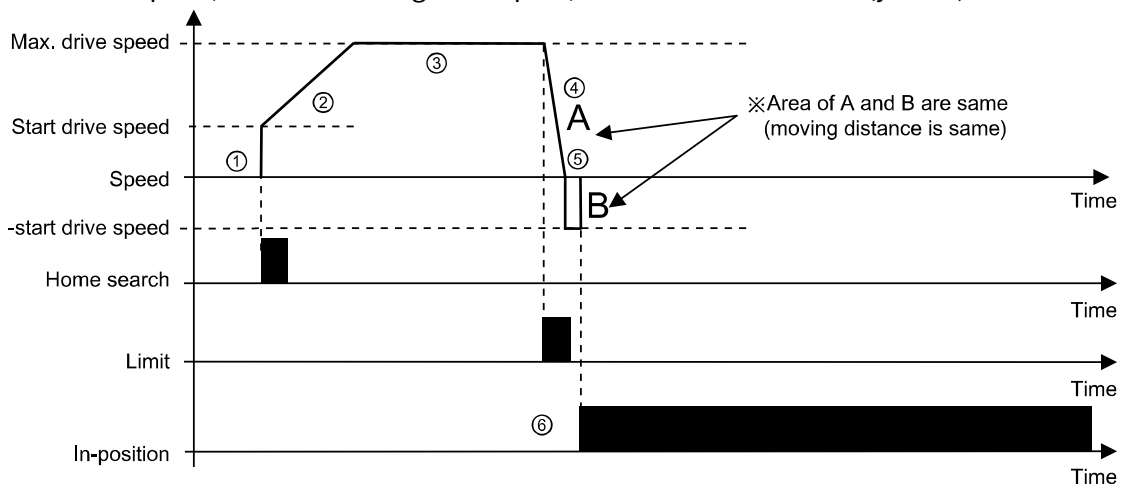
It operates home search by limit sensor.

- 1st It operates home search drive to the set direction at “Home Search Direction”.
- 2nd It starts drive with the set start drive speed at “Home Search Start Speed” and operates acceleration drive with the set acceleration time at “Home Search Acceleration Time”.
- 3rd When acceleration drive is completed, it operates constant speed drive until meeting the limit sensor with the set max. drive speed at “Home Search Max Speed”.
- 4th If “ \pm Limit (\pm direction limit sensor)” signal inputs or it arrives to “ \pm Software Limit (\pm software limit)”, it decelerates with the set deceleration time at “Home Search Deceleration Time” and stops.
- 5th After stops, it moves to the reverse direction for the passing distance from limit sensor with the set start drive speed at “Home Search Start Speed”, finds limit sensor and stops.
- 6th After finding home, “In-Position” signal outputs and the “INP. indicator (yellow)” turns ON.



Note

At “Home Search Offset”, the other value except 0 is set, it moves for the setting value with start drive speed, “In-Position” signal outputs, and the “INP. indicator (yellow)” turns ON.



Caution

For deceleration stop, set the deceleration time shortly. In case of long deceleration time, it may conflict with the structure.

Install the limit sensor with the certain distance from the structure.

11.2.3 Zero Home Search (Home Search Method = 2)

It operates home search by zero point (absolute coordinate = 0) when there is no home sensor and limit sensor.

1st Set the zero (absolute coordinate = 0) as home.

For changing home position, use the position reset.

If changing zero position by I/O, move the zero to the desired position and supply “RESET” signal and resets.



Note

When reset or resupplying power, the zero point is also reset.

2nd The set direction at “Home Search Direction” is ignored and it operates drive at the set home direction.

3rd It starts drive with the set start drive speed at “Home Search Start Speed”, and it operates acceleration drive with the set acceleration time at “Home Search Acceleration Time”.

4th After acceleration drive is completed, it operates constant speed drive with the set max. drive speed at “Home Search Max speed”.

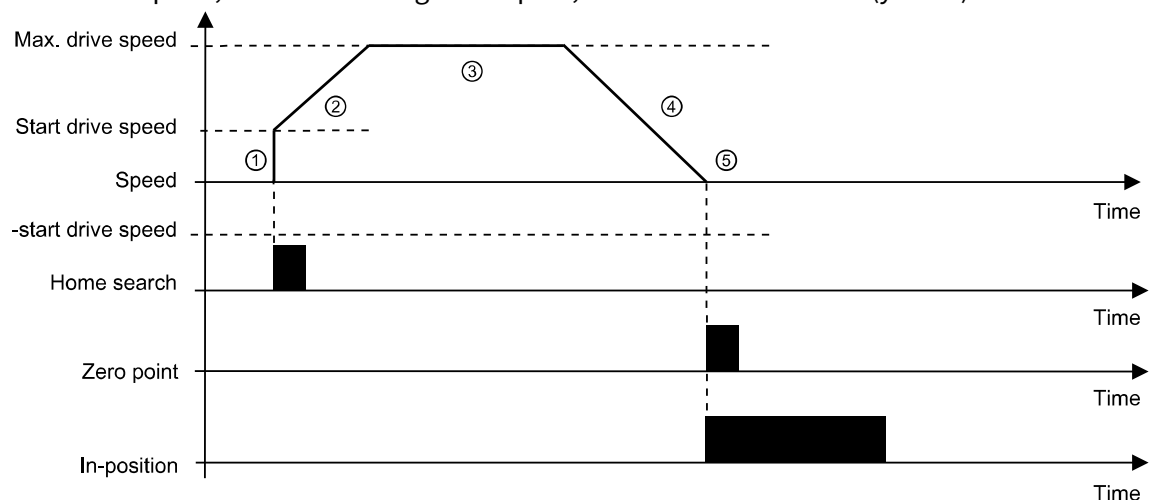
5th When it is closed to home, it decelerates with the set deceleration time at “Home Search Deceleration Time” and it stops.

6th After finding home, “In-Position” signal outputs and the “INP. indicator (yellow)” turns ON.



Note

At “Home Search Offset”, the other value except 0 is set, it moves for the setting value with start drive speed, “In-Position” signal outputs, and the “INP. indicator (yellow)” turns ON.



11.2.4 Torque Home Search (Home Search Method = 3)

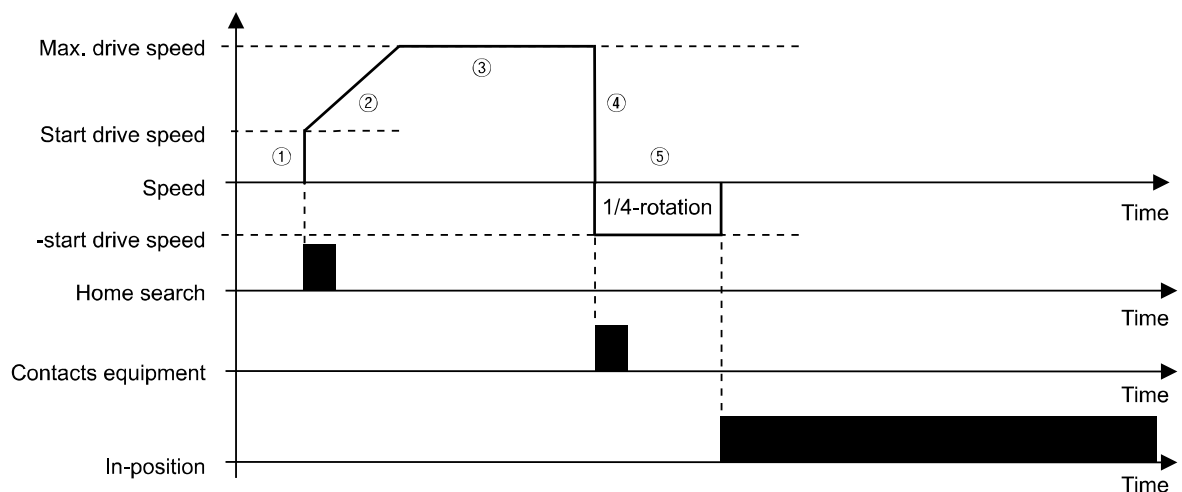
It operates home search by constant with the specific equipment when there is no home sensor and limit sensor.

- 1st It operates home search drive to the set direction at “Home Search Direction”.
- 2nd It starts drive with the set start drive speed at “Home Search Start Speed” and operates acceleration drive with the set acceleration time at “Home Search Acceleration Time”.
- 3rd When acceleration drive is completed, it operates constant speed drive until contacting the specific equipment with the set max. drive speed at “Home Search Max speed”.
- 4th When it contacts with the specific equipment, the current of motor is higher. It stops when the current of motor is same value as the set value at “Home Search Torque”.
- 5th After stops, it rotates 1/4 to the reverse direction with the start drive speed and stops.
- 6th After finding home, “In-Position” signal outputs and the “INP. Indicator (yellow)” turns ON.



Note

At “Home Search Offset”, the other value except 0 is set, it moves for the setting value with start drive speed, “In-Position” signal outputs, and the “INP. indicator (yellow)” turns ON.



11.3 Other Functions

11.3.1 Limit Operation

Hard ware and software limits can be used to stop drive.

- Hardware limit

Install a limit sensor to the machine to monitor system operation directly.

Connect \pm Limit (Pin11, 12) at I/O connector (CN3).

- Set Instant (instant stop)/Slow (deceleration stop) at Limit Stop Mode of Operation Mode.

- Software limit

Unlike the input of hardware limit signal by external sensor, this limit function is set using internal position data. To operate software limit, set software limit (software limit) as Enable.

High and low limit values can be set each axis separately at \pm software limit parameter.

Operation Mode	Setting value	Parameter	Setting value
Software Limit	Enable	+Software Limit	100,000
		-Software Limit	-50,000

When the setting value is as above, the position value operates among -50,000 to 100,000 range. When it is out of the range, the drive decelerates and stops.



Note

Hardware limit operates independently regardless of the software limit settings, and only hardware limit except limit home search is operated during home search.

11.3.2 Stop Current

When it stops, set the stop current supplied at the motor phase to decrease motor heat and current consumption.

- Factory default is 50% of max. run current. It is available to set at the parameter.

Parameter	Setting range	Unit	Unit value	Factory default
Stop Current	20 to 100	%	1	50

11.3.3 Stop Current Fix

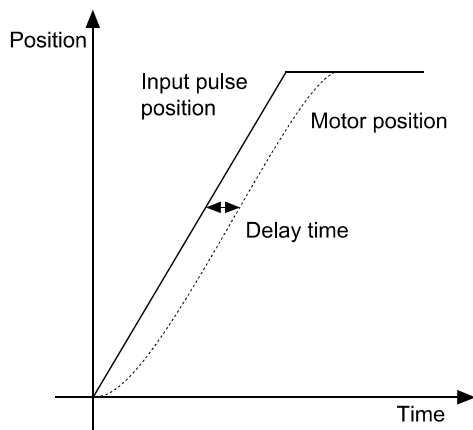
Set the stop current control method; Enable, Disable (factory default).

- Enable: Fixed stop current
: It maintains stop current as the set value at the parameter.
- Disable: Setting stop current
: It adjusts by stop current load and it is able to reduce over heat of motor.

11.3.4 Speed Filter

It is available to set motor drive response according to the instruction at the parameter.

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 disturbance occurs.



Parameter	Setting	Value (msec)
Speed Filter	0	Disable
	1	2
	2	4
	3	6
	4	8
	5	10
	6	20
	7	40
	8 (factory default)	60
	9	80
	10	100
	11	120
	12	140
	13	160
	14	180
15	200	

11.3.5 Position Control Gain Setting

It is available to set responsiveness of motor to position instruction at the parameter. According to the motor load, set the gain for fast positioning and soft movement.

- P Gain: Adjust vibration during drive
- I Gain: Adjust vibration in acceleration/deceleration zone
- The set gain value applies when motor stops.

Parameter	Setting	Value (ratio)	
		P	I
GAIN	0 (factory default)	1	1
	1	2	1
	2	3	1
	3	4	1
	4	5	1
	5	1	2
	6	2	2
	7	3	2
	8	4	2
	9	5	2
	10	1	3
	11	2	3
	12	3	3
	13	4	3
	14	5	3
15	User setting		



Ex.

- When GAIN = 1
P: I = 2:1
The set value is the ratio between P and I.
- When GAIN = 15
each GAIN value can be set by using atMotion.

Parameter	Setting range	Unit
P GAIN	0 to 7	0.001
I GAIN	0 to 4	0.001

11.3.6 In-Position

In-Position output is output condition of the positioning complete 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 to [H] and the in-position indicator turns ON.

In reverse, when the gap is over in-position setting value, in-position output turns to [L] and the in-position indicator turns OFF.

For more accurate control, check the in-position output before operating the next step.

For more information, refer to '8.2.1.1 In-Position'.

12 Troubleshooting

Malfunction	Causes	Troubleshooting
When communication is not connected	The communication cable is not connected.	Check communication cable wiring. Check communication cable connection correctly.
	The communication port or speed settings are not correct.	Check communication port and speed settings are correct.
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	MotorDir parameter setting is not correct.	Check the MotorDir parameter settings.
When motor drive is unstable	Connection between motor and encoder is unstable.	Check the Motor+Encoder connection cable.
	Position control gain value is not correct.	Change the P Gain or I Gain parameter as the certain value.

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* Dimensions or specifications on this manual are subject to change and some models may be discontinued without notice.