User Manual

Closed-Loop Stepper System

AiCA-D Series

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

User Manual Guide

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

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

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

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

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

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

User Manual Symbols

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

Safety Considerations

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

- Safety precautions 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, 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.
- Re-supply power after min. 20 sec from disconnected power.
  Failure to follow this instruction may result in product damage or malfunction.
- Check 'Connections' before wiring.
  Failure to follow this instruction may result in fire.
- For installing the unit, ground it exclusively and use over AWG 18 (0.75mm^2) ground cable.
  Failure to follow this instruction may result in electric shock.
- Do not disassemble or modify the unit.
  Failure to follow this instruction may result in fire or electric shock.
- Insulate the connector not to be exposed.
  Failure to follow this instruction may result in electric shock.
- Install the driver in the grounded housing or ground it.
  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.
- Do not remove the connector during or after operation for a while.
  Failure to follow this instruction may result in electric shock or product damage.
- Emergency stop directly when error occurs. Failure to follow this instruction may result in personal injury or fire.

⚠ Caution

- When connecting the power input, use AWG 18 (0.75mm^2) cable or over.
- Install overcurrent prevention device (e.g. the current breaker, etc) to connect the driver with power.
  Failure to follow this instruction may result in fire.
- Check the control input signal before supplying power to the driver.
  Failure to follow this instruction may result in personal injury or product damage by 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 and degradation by heat.
- Keep metal chip, dust, and wire residue from flowing into the unit.
  Failure to follow this instruction may result in fire or product damage.
- Use the designated motor only.
  Failure to follow this instruction may result in fire or product damage.

Cautions during Use

- Follow instructions in 'Cautions during Use'.
  Otherwise, it may cause unexpected accidents.
- It is recommended to use 485 converter with the separate power.
  (Autonics product, SCM-38I, recommended)
- 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 and set the gain value.
- For using motor, it is recommended to maintenance and inspection regularly.
  ① Unwinding bolts and connection parts for the unit installation and load connection
  ② Strange sound from ball bearing of the unit
  ③ Damage and stress of lead cable of the unit
  ④ Connection error with motor
  ⑤ Inconsistency between the axis of motor output and the center,
     concentric (eccentric, declination) of the load, etc.
- This product does not prepare protection function for a motor.
- This unit may be used in the following environments.
  ① Indoors (in the environment condition rated in 'Specifications')
  ② Altitude max. 2,000m
  ③ Pollution degree 2
  ④ Installation category II

Table of Contents

1   Product Overview

1.1   Features

AiC Series is a closed- loop stepper motor driver with integrated stepping motor driver and motion controller, which is able to control up to 31-axis through network communication. In addition, it supports Automatic Current Down mode to adjust the current supplied to the motor according to the load during stop, thus minimizing the heat generation of the motor.

- Real-time position controllable with closed-loop system
- Motor driver and controller integral type
- As AC power type, possible to omit SMPS and perform higher torque than DC power type
- Able to check alarm and status with Alarm/Warning display (7 segment)
- Controllable maximum 31 axis with RS485 communication
- Auto Current Down Mode available
- C language library provided (32-bit, 64-bit)
- Dedicated Windows program (atMotion) provided
- Easy to set various Gain with program (GUI)
- Applicable to the precision equipment such as optical inspection equipment with the features of maintaining torque in stop and having no micro vibration (hunting)
- 10-levels of resolutions available
- Frame size 42mm, 56mm, 60mm motor supported (Applied motor: AiA-M Series)

1.2   Components and Accessories

1.2.1   Driver
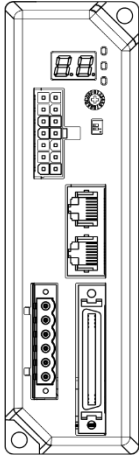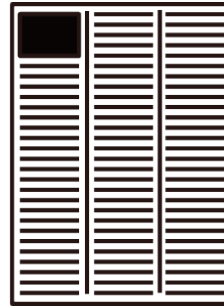
AiCA-D Series   **Instruction manual**

1.2.2   Motor
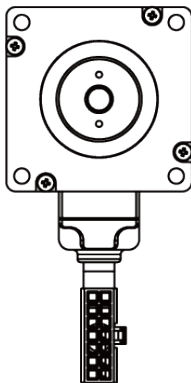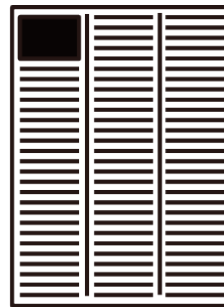
AiA-M Series   **Instruction manual**

📝 **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 orthe product distributor.

※ 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

Ai	C	A	-	D	-	60	M	A
①	②	③		④		⑤	⑥	⑦
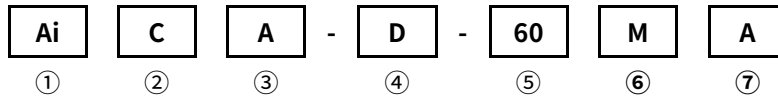
Item	Description	
① Series	Ai	Artificial intelligent
② Category	C	Controller
③ Power	A	AC Power
④ Item	D	Driver
⑤ Motor frame size	60	60 x 60mm
	86	86 x 86mm
⑥ Motor length	M	Middle – Frame size 60mm: 82.8mm, Frame size 86mm: 94.9mm
	L	Long – Frame size 60mm: 103.8mm, Frame size 86mm: 109.4mm
⑦ Encoder resolution	A	10,000PPR (2,500PPR x 4-multiply)

1.3.2 Motor

Ai	A	-	M	-	60	L	A
①	②		③		④	⑤	⑥
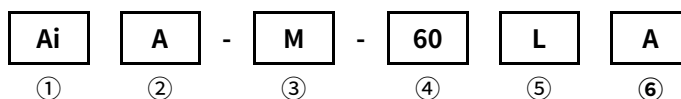
Item	Description	
① Series	Ai	Artificial intelligent
② Power	A	AC power
③ Item	M	Motor
④ Motor frame size	60	60 x 60mm
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	L	Long – Frame size 60mm: 103.8mm, Frame size 86mm: 109.4mm
⑥ Encoder resolution	A	10,000PPR (2,500PPR x 4-multiply)

1.4 Models

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

1.5 Configuration Diagram
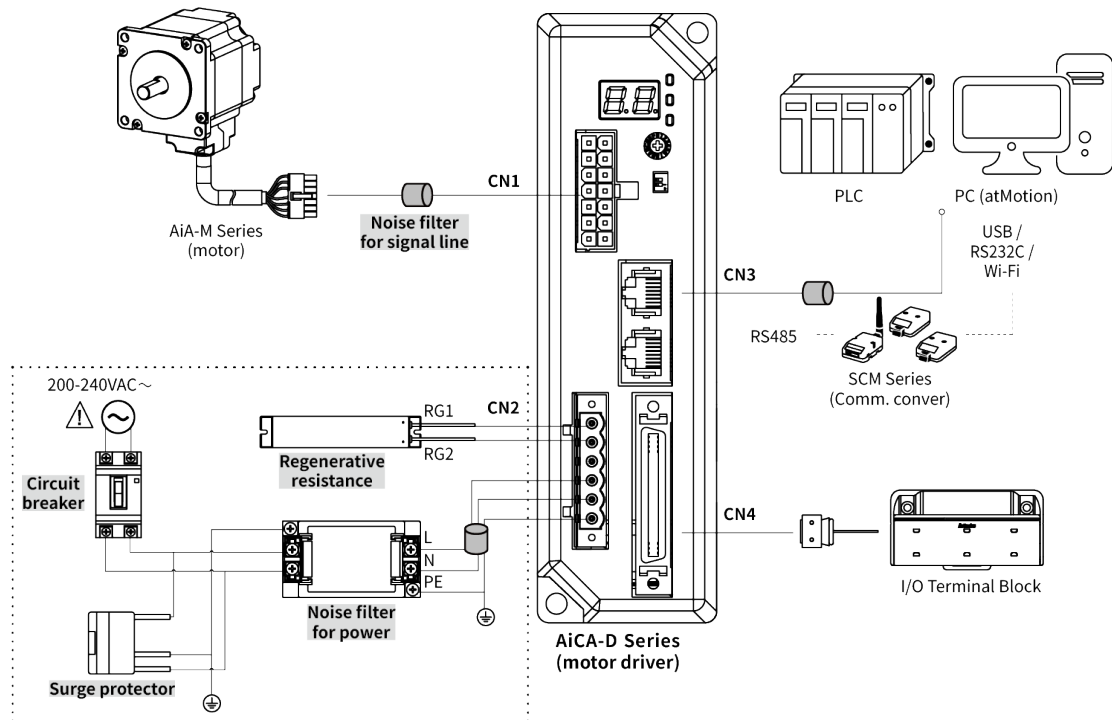
Note

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

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

② CN2 (power connector): AWG18

③ CN3 (communication cable connector): AWG28

④ CN4 (I/O connector): AWG28

※2: In case communication is unstable due to the noise generated by supplied power or peripheral device, use ferrite core at communication line.

※3: Sold separately.

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

- Regenerative resistance

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

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

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

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

- Noise fliter for power

Connect the power to suppress external noise.

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

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

- Surge protector

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

Note

※ Be sureto disconnect the surge protector when testing internal pressure.

It may result in product damage.

Model	Specifications	Manufacture
LT-C12G801W	-	OTOWA Electric CO. Ltd

- Noise filter for signal line

Connect to wiring to suppress external noise.

- Depending on frequency, filtered noise may different.

Applications	Specifications	Manufacture
Comm. wire	28A2025-0A2	Lairdtech
Motor wire	28A5776-0A2	
Power wire	28A5131-0A2	

2 Specifications

2.1 Driver

Model		AiCA-D-60MA	AiCA-D-60LA	AiCA-D-86MA	AiCA-D-86LA
Power supply		200-240VAC∼			
Power consumption	STOP[1]	Max. 60W		Max. 65W	
	Max. during operation	Max. 160W	Max. 220W	Max. 250W	Max. 300W
Max. RUN current[2]		2.0A/Phase			
STOP current		20% of max. RUN current			
Rotation speed		0 to 3000rpm			
Resolution[3]		500 (factory default), 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000 PPR			
Motor GAIN		Setting range among 0 to 30 or Fine Gain			
Positioning range		-2,147,483,648 to +2,147,483,647			
In-Position		Fast Response: 0 to 7 or Accurate Response: setting range among 0 to 7			
Motor rotation direction[3]		CW, CCW			
Status indicator		• Power/Alarm indicator: green/red LED • In-Position indicator: orange LED • Servo On/Off indicator: blue LED • Alarm/Status display part: orange LED 7seg.			
I/O voltage level		[H]: 15-30VDC⎓, [L]: 0-2VDC⎓			
I/O	Input	Exclusive input: 20, general input: 9			
	Output	Exclusive output: 4, general output: 10			
External power supply		VEX (recomended: 24VDC⎓): 2, GEX (GND): 2			
Operation mode		Jog / Continuous / Index / Program / Position / Torque mode			
Index step numbers		64 steps			
Program function	Steps	256 steps			
	Control command	ABS (move absolute position), INC (move relative 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), CMP (compare output), TOQ (torque control)			
	Start	Power On program auto-start function			
	Home search	Power On home search auto-start function			
Communication		RS485 Speed[3]: 9600, 19200, 38400, 57900, 115200 (factory default) [bps]			
Multiaxial control		31-axis			
ID setting switch		16-bit rotary switch (0 to F), 1-bit DIP switch			
Alarm output		Over current, over speed, position tracking, over load, over heat, motor connection, encoder connection, over voltage, under voltage,			

Model	AiCA-D-60MA	AiCA-D-60LA	AiCA-D-86MA	AiCA-D-86LA
	motor misalignment, command speed, In-Position, memory, emergency stop, program mode, index mode, home search mode			
Warning output	±Software limit, ±hardware limit, over load			
Input resistance	4.7kΩ (Anode Pull-up)			
Insulation resistance	Over 200MΩ (at 500VDC megger)			
Dielectric strength	1,500VAC 60Hz for 1min			
Vibration	1.5mm amplitude at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours			
Shock	300m/s^2 (approx. 30G) in each X, Y, Z direction for 3 times			
Environment — Ambient temp.	0 to 50°C, storage: -10 to 60°C			
Environment — Ambient humi.	35 to 85%RH, storage: 10 to 90%RH			
Sold separately	• I/O cable: CO50-MP□-R[4] (standard: AiC TAG) • Motor+Encoder cable – normal: C1D14M-□[5] / moving: C1DF14M-□[5] • Communication converter: SCM-WF48, SCM-US48I, SCM-38I			
Protection structure	IP20 (IEC standard)			
Approval	C€			
Weight[6]	Approx. 1,080g (approx. 800g)			

※1: Based on the ambient temperature 25°C, ambient humidity 55%RH, and STOP current 20%.

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

※3: Settable with the dedicated program.

※4: □ of model name indicates cable length (010, 020, 030, 050, 070, 100, 150, 200).
For corresponding EMC standard, cable length should be below 2m.
E.g.) CO50-MP070-R: 7m I/O cable.

※5: □ of model name indicates cable length (1, 2, 3, 5, 7, 10,15, 20).
E.g.) C1DF14M-10: 10m moving type motor+encoder cable.

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

※Environment resistance is rated at no freezing or condensation.

2.1.1   Factory Default

Function		Factory default
Resolution		500PPR
Motor GAIN		0
In-Position		0
Communication speed		115,200bps
Communication ID setting switch (ID Sel)		1
Communication ID setting / Terminating resistance setting DIP switch (ID, TERM)	Communication ID setting (ID)	OFF
	Terminating resistance setting (TERM)	OFF

2.1.2   Communication Output

It is for parameter setting and monitoring via external devices (PC, PLC, etc.)

2.1.2.1   Interface

Comm. Protocol	Modbus RTU	Comm. Speed	9600, 19200, 38400, 57600, 115200 bps
Connection type	RS485	Comm. Response wait time	5 to 99 msec
Application standard	Compliance with EIA RS485	Start bit	1-bit (fixed)
Max. connection	31units (address: 01 to 31)	Data bit	8-bit (fixed)
Synchronous method	Asynchronous	Parity bit	None, Even, Odd
Comm. Method	Two-wire half duplex	Stop bit	1-bit, 2-bit
Comm. distance	Max. 800m		

⚠ **Caution**

It is not allowed to set overlapping communication address at the same communication line.

Use twisted pair wire for RS485 communication.

2.1.2.2   Application of System organization
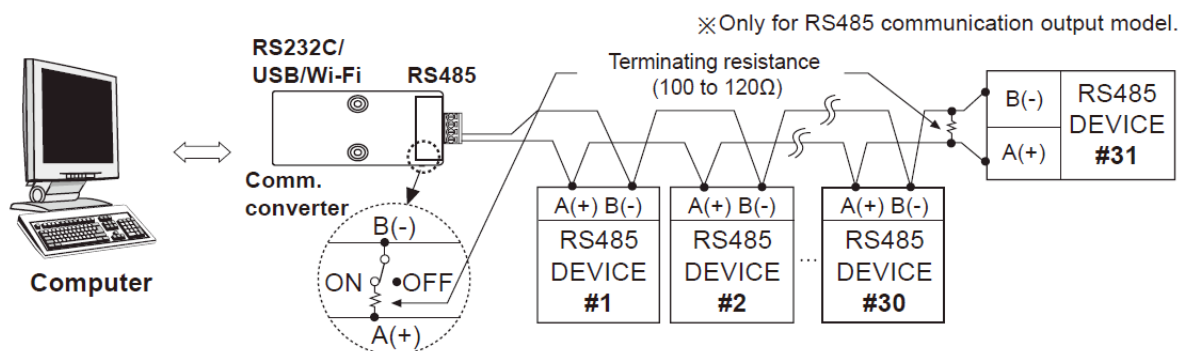
It is recommended to use Autonics communication converter;

SCM-WF48 (Wi-Fi to RS485·USB wireless communication converter, sold separately),

SCM-US48I (USB to RS485 converter, sold separately),

SCM-38I (RS232C to RS485 converter, sold separately).

⚠ **Caution**

Please use twisted pair wire, which is suitable for RS485 communication, for SCM-WF48, SCM-US48I and SCM-38I.

2.2   Motor

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

※1: Max. holding torque is 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.

2.2.1   Common Specifications

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

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

※2: T.I.R. (Total Indicator Reading): Indicate total dial gauge quantity in case of one complete rotating monitored reference around a base point.
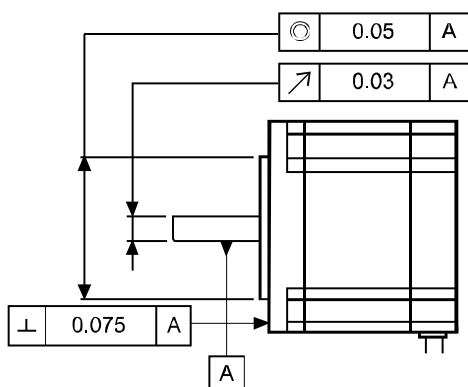
※3: Amount of radial shaft displacement when adding a radial load (25N) to the tip of the motor shaft.

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

※Environment resistance is rated at no freezing or condensation.

2.2.2   Encoder

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

3 Dimensions

3.1 Driver

(unit: mm)
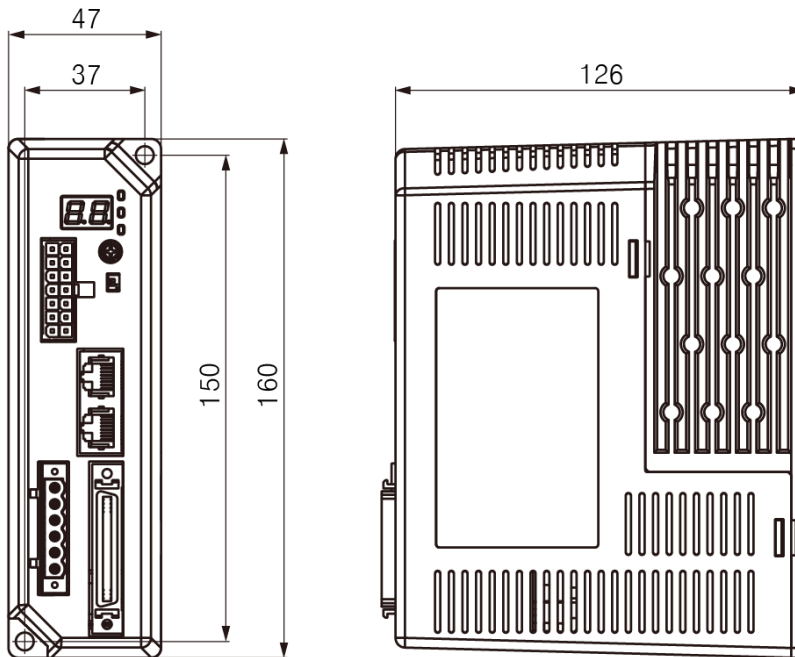
3.1.1 Panel Cut-out
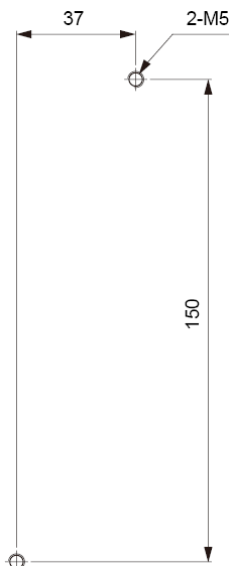
📝 **Note**

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

3.2 Motor

3.2.1 Frame Size 60mm
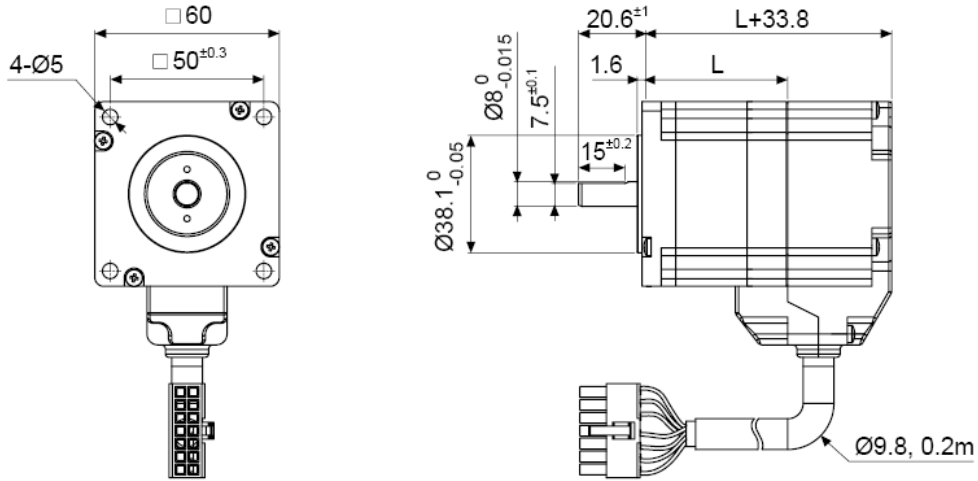
3.2.2 Frame Size 86mm
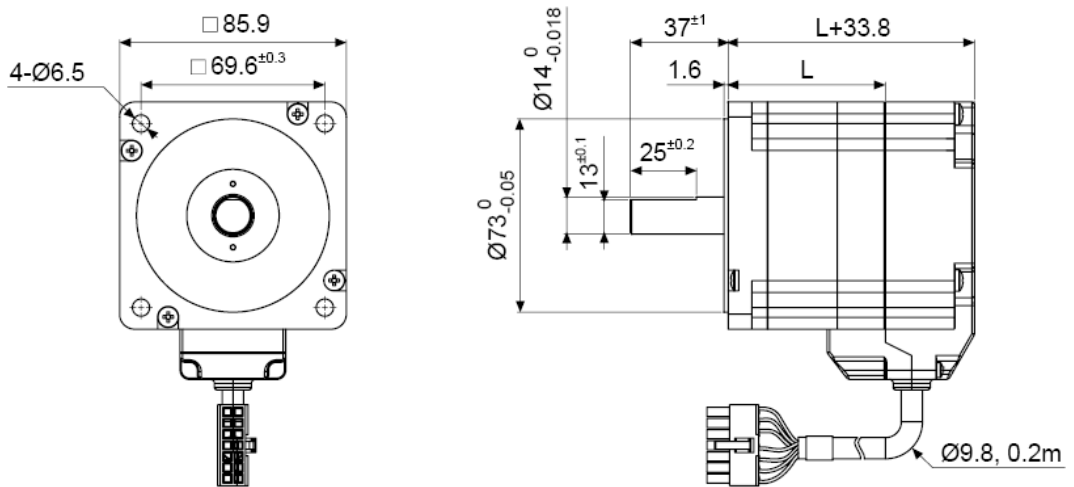
Note

Model	L	Model	L
AiA-M-60MA	47.4	AiA-M-86MA	59.5
AiA-M-60LA	68.3	AiA-M-86LA	74

4 Installation

4.1 Installation of Driver

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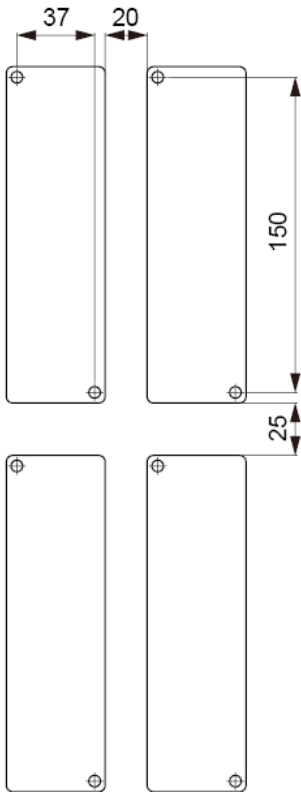
※ Install on the metal plate with high thermal conductivity for heat dissipation of the driver.

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

※ Failure to heat dissipation may result in damage or malfunction due to the stress on the product.

※ Check the environment of use within the rated specifications and install on the well-heat dissipated area.

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

4.2   Installation of Motor

4.2.1   Mounting Direction of Motor

Motor can be mounted in any directions-facing up, facing down and side ways. No matter which

direction motors to be mounted, be sure not to apply overhung or thrust load on the shaft.

Refer to the table below for allowable shaft overhung load / thrust load.
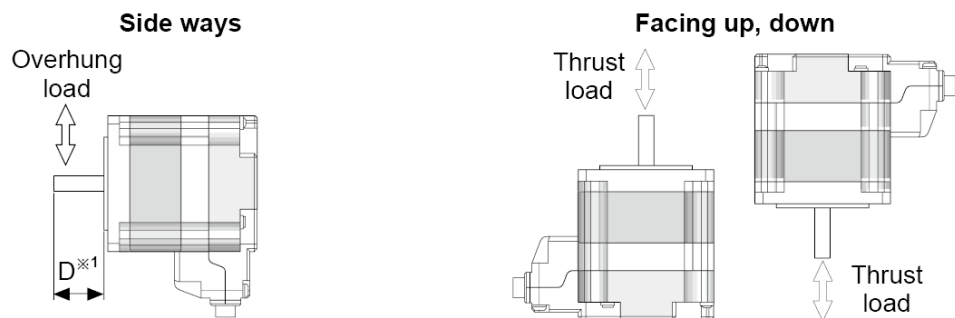
※1: The distance from the shaft in front (mm)

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 60mm	5.5 (54)	6.8 (67)	9.1 (89)	13.3 (130)	Below motor weight
Frame size 86mm	26.5 (260)	29.5 (290)	34.6 (340)	39.7 (390)	

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

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

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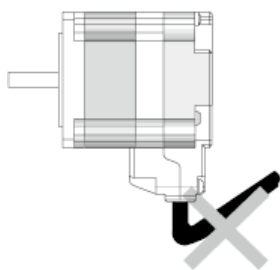
4.2.2   Mounting of Motor

4.2.2.1   Frame Size 60mm / Frame Size 86mm
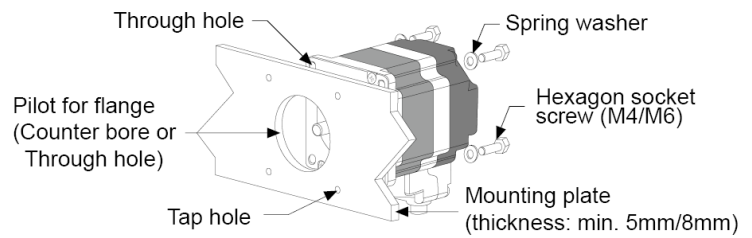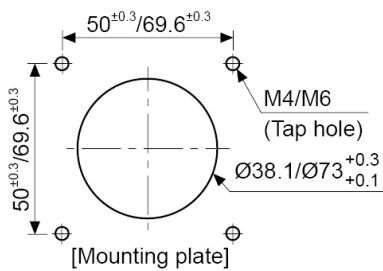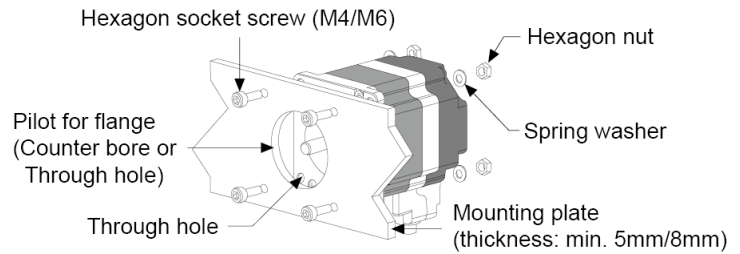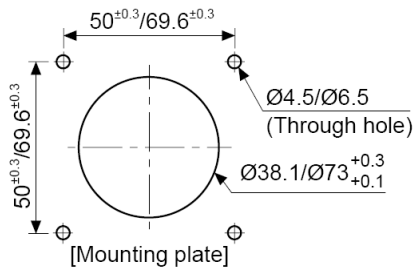
With considering heat radiation and vibration isolation, mount the motor as tight as possible against a metal panel having high thermal conductivity such as iron or aluminum.

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

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

4.2.3   Connection with Load

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

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

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

4.2.3.1   Direct Load Connection with Coupling
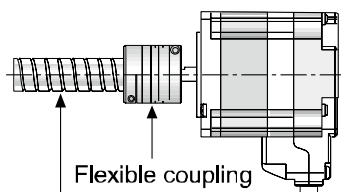
Flexible coupling
Ball screw or TM screw
※Use Autonics flexible coupling (ERB Series).

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

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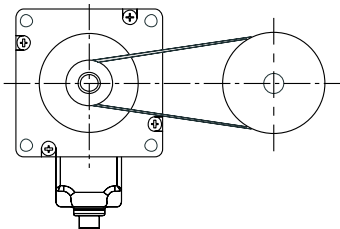
The motor shaft and the load shaft should be parallel. Connect the motor shaft and the line which connects the center of two pulleys to a right angle.

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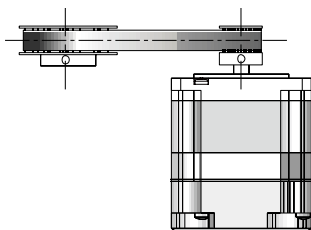
The motor shaft and the load shaft should be parallel. Connect the motor shaft to the center of gear teeth side to be interlocked.

4.2.4 Installation Conditions

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

It may cause product damage if instructions are not following.

① The inner housing installed indoor
(This unit is manufactured and designed for attaching to equipment.
Install a ventilation device.)

② Within 0 to 50℃ (at non-freezing status) of ambient temperature

③ Within 20 to 85%RH (at non-dew status) of ambient humidity

④ The place without explosive, flammable and corrosive gas

⑤ The place without direct ray of light

⑥ The place where dust or metal scrap does not enter into the unit

⑦ The place without contact with water, oil, or other liquid

⑧ The place without contact with strong alkali or acid material

⑨ The place where easy heat dissipation could be made

⑩ The place where no continuous vibration or severe shock

⑪ The place with less salt content

⑫ The place with less electronic noise occurs by welding machine, motor, etc.

⑬ The place where radioactive substances and magnetic fields does not exist and is not in the vacuum status

5   Connection
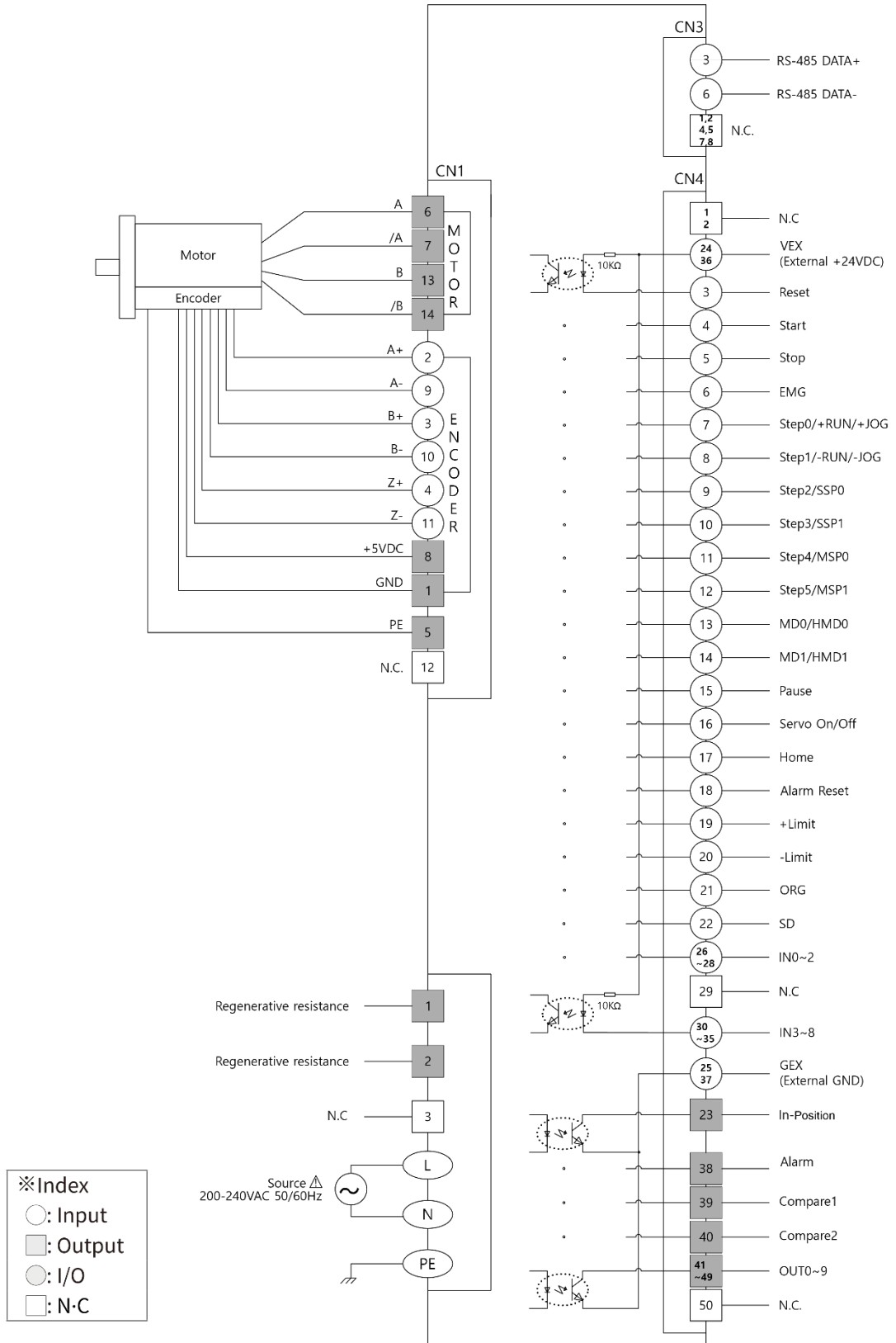
6   Characteristics

6.1   Frame Size 60mm
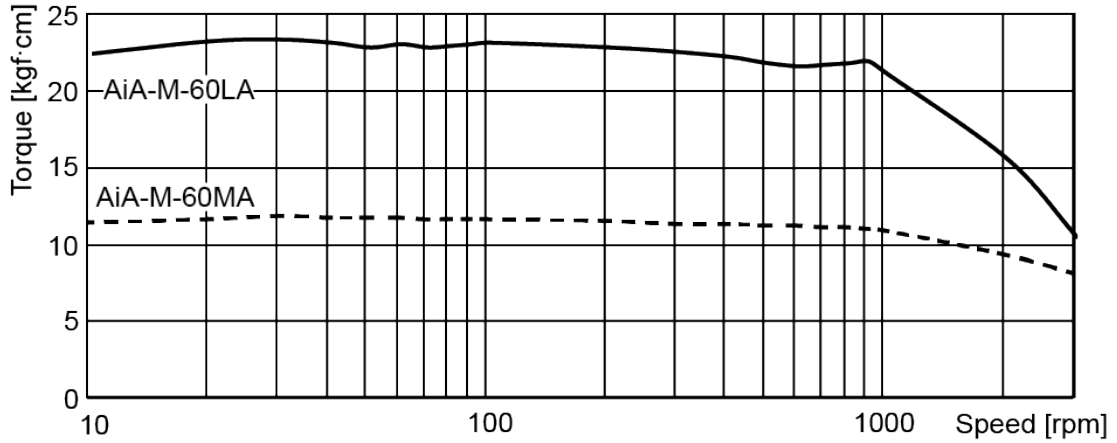
6.2   Frame Size 86mm
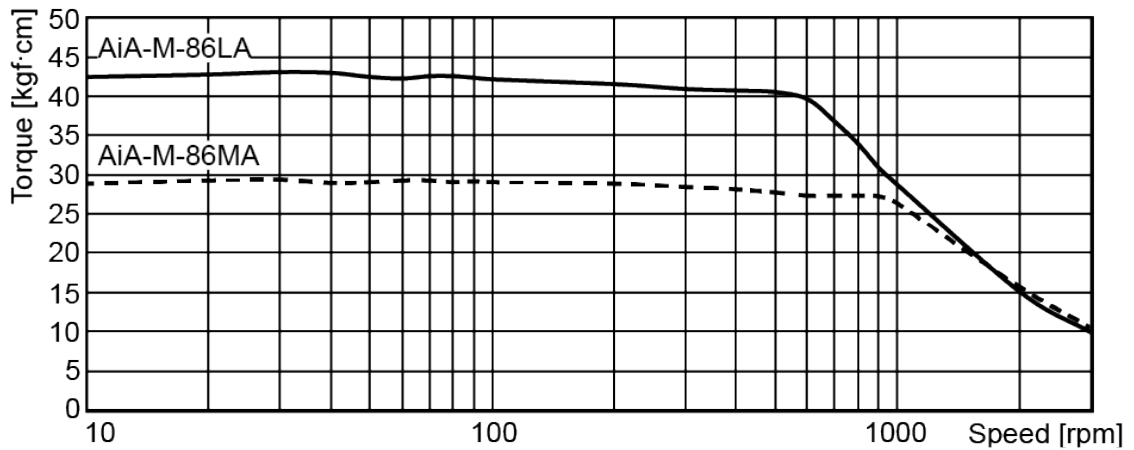
7　Driver Unit Descriptions
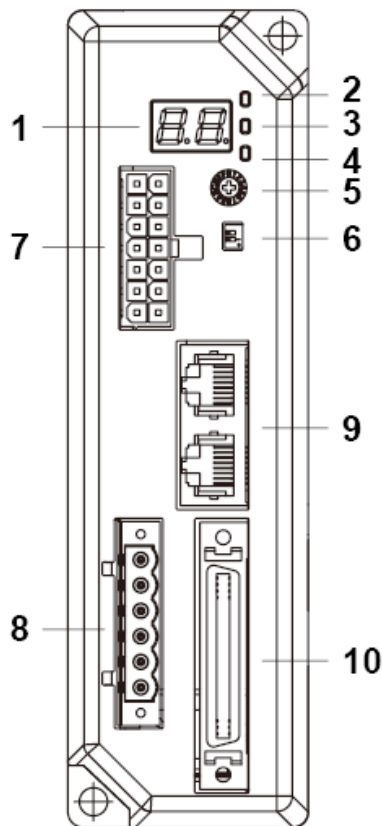
1. Alarm/Status display part (orange)
: Displays the corresponding number and status of operation, model, etc when Alarm occurs.

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

3. In-Position indicator (INP) (orange)
: Turns ON when motor is placed at command position after positioning input.

4. Servo On/Off indicator (SERVO) (blue)
: Turns ON when Servo is operating, turns OFF when servo is not operating.

5. Communication ID setting switch (ID Sel)
: [ID OFF] ID Sel setting 0 to F
　Node ID 0 (disable) to 15
: [ID ON] ID Sel setting 0 to F
　Node ID 16 to 31

6. Communication ID setting/Terminating resistance setting Dip switch (ID, TERM)
: ID – Communication ID setting,
　TERM – Set to use terminating resistance.

7. Motor+Encoder connector (CN1)

8. Power connector (CN2)

9. Communication cable connector (CN3)

10. I/O connector (CN4)

7.1 Driver Status Indicator

Indicator Display part	LED color	Function	Descriptions
PWR/ALM	Green	Power indicator	Turns ON when the unit operates normally after supplying power.
	Red	Alarm indicator	When alarm occurs, it flashes in various ways depending on the situation. Refer to '8.2.2.2 Alarm / Warning'.
INP.	Orange	In-Position indicator	Turns ON when motor is placed at command position after positioning input.
SERVO	Blue	Servo On/Off indicator	Turns ON when servo is operating, turns OFF when servo is not operating.
Alarm/Status display part	Orange	Alarm, status indicator	Displays the corresponding number, status of operation, etc when Alarm occurs.
RXD IN[1]	Yellow	RS485 Data I/O display	Flashes when receiving data.
TXD OUT[1]	Green		Flashes when sending data.

Note

※1: Although RS485 OUT is disconnected, RXD IN/TXD OUT operates normally,
      if RS485 IN is communicating.

7.2   Switches

7.2.1   ID Sel

: Communication ID Setting Switch

Setting switch	Setting	ID		Setting	ID	
		ID OFF	ID ON		ID OFF	ID ON
	0	Disable	16	8	8	24
	1	1 (factory default)	17	9	9	25
	2	2	18	A	10	26
	3	3	19	B	11	27
ID Sel	4	4	20	C	12	28
	5	5	21	D	13	29
	6	6	22	E	14	30
	7	7	23	F	15	31

Note

※Set Node ID of the driver.

※Depending on the ID setting of the ID/TERM switch, it is possible to connect max. 31-axis.

7.2.2   ID, TERM

: Communication ID Setting/Terminating Resistance DIP Switch

No.	Function	Switch position	
		ON	OFF (factory default)
1	ID setting	ID: 16 to 31	ID: 1 to 15
2	Terminating resistance	Use terminating resistance (120Ω)	Do not use terminating resistance

Note
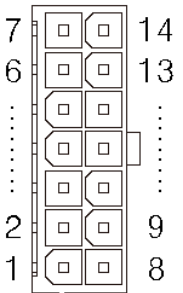
※Set Node ID of the driver.

※Set to use terminating resistance.

7.3 Connectors
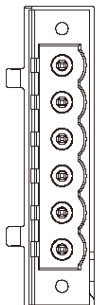
7.3.1 CN1: Motor+Encoder Connector

Connects the motor and the encoder to the driver.
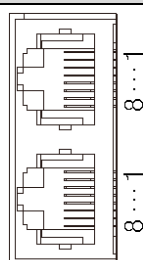
Pin arrangement	Pin no.	Function	Pin no.	Function
	1	GND	8	+5VDC
	2	Encoder A	9	Encoder $\overline{A}$
	3	Encoder B	10	Encoder $\overline{B}$
	4	Encoder Z	11	Encoder $\overline{Z}$
	5	F.G.	12	N.C
	6	Motor A	13	Motor B
	7	Motor $\overline{A}$	14	Motor $\overline{B}$

7.3.2 CN2: Power Connector

Connects with 200-240VAC power.

Pin arrangement	Pin no.	Function
	1	Connect regenerative resistance
	2	
	3	N.C
	4	AC power input
	5	
	6	PE

7.3.3 CN3: RS485 Communication Cable Connector

Pin arrangement	Pin no.	I/O	Function	Pin no.	I/O	Function
	1	-	N.C	5	-	N.C
	2	-	N.C	6	I/O	RS485 DATA-
	3	I/O	RS485 DATA+	7	-	N.C
	4	-	N.C	8	-	N.C

7.3.4 CN4: I/O Connector
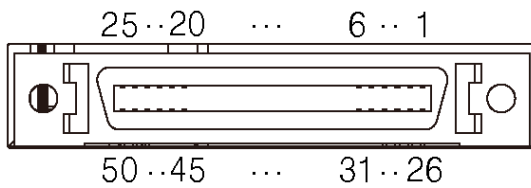
Pin no.	I/O	Signal	Filter※1	Active※2	Function
1	-	N.C	-	-	Disable
2	-	N.C	-	-	Disable
3	Input	Reset	1.5, 10 msec	[L]	Reset
4	Input	Start	1.5, 10 msec	[L], [H]	Start drive
5	Input	Stop	1.5, 10 msec	[L], [H]	Stop drive
6	Input	EMG	1.5, 10 msec	[L], [H]	Emergency stop drive
7	Input	Step0/+Run/+Jog	1.5, 10 msec	[L], [H]	Step designate0/+Continuous/+Jog
8	Input	Step1/-Run/-Jog	1.5, 10 msec	[L], [H]	Step designate1/-Continuous/-Jog
9	Input	Step2/SSP0	1.5, 10 msec	[L], [H]	Step designate2/ Start speed designate 0
10	Input	Step3/SSP1	1.5, 10 msec	[L], [H]	Step designate3/ Start speed designate 1
11	Input	Step4/MSP0	1.5, 10 msec	[L], [H]	Step designate4/ Max. speed designate 0
12	Input	Step5/MSP1	1.5, 10 msec	[L], [H]	Step designate5/ Max. speed designate 1
13	Input	MD0/HMD0	1.5, 10 msec	[L], [H]	Run mode designate0/ Home search mode designate0
14	Input	MD1/HMD1	1.5, 10 msec	[L], [H]	Run mode designate 1/ Home search mode designate 1
15	Input	Pause	1.5, 10 msec	[L], [H]	Pause
16	Input	Servo On/Off	1.5, 10 msec	[L], [H]	Servo On/Off
17	Input	Home	1.5, 10 msec	[L], [H]	Home search
18	Input	Alarm Reset	1.5, 10 msec	[L], [H]	Alarm reset
19	Input	+Limit	1.5 msec	[L], [H]	+ direction limit sensor
20	Input	-Limit	1.5 msec	[L], [H]	- direction limit sensor
21	Input	ORG	1.5 msec	[L], [H]	Home sensor
22	Input	SD	1.5 msec	[L], [H]	deceleration drive signal
23	Output	In-Position	-	-	Drive end pulse
24	Input	VEX	-	-	External input power (24VDC)
25	Input	GEX	-	-	External input GND (0VDC)
26	Input	IN0	1.5, 10 msec	[L], [H]	General input0
27	Input	IN1	1.5, 10 msec	[L], [H]	General input1
28	Input	IN2	1.5, 10 msec	[L], [H]	General input2
29	-	N.C	-	-	Disable
30	Input	IN3	1.5, 10 msec	[L], [H]	General input3

Pin no.	I/O	Signal	Filter※1	Active※2	Function
31	Input	IN4	1.5, 10 msec	[L], [H]	General input4
32	Input	IN5	1.5, 10 msec	[L], [H]	General input5
33	Input	IN6	1.5, 10 msec	[L], [H]	General input6
34	Input	IN7	1.5 msec	[L], [H]	General input7
35	Input	IN8	1.5 msec	[L], [H]	General input8
36	Input	VEX	-	-	External input power (24VDC)
37	Input	GEX	-	-	External input GND (0VDC)
38	Output	Alarm	-	-	Alarm output
39	Output	Compare1	-	-	Comparison output1
40	Output	Compare2	-	-	Comparison output2
41	Output	OUT0	-	-	General output0
42	Output	OUT1	-	-	General output1
43	Output	OUT2	-	-	General output2
44	Output	OUT3	-	-	General output3
45	Output	OUT4	-	-	General output4
46	Output	OUT5	-	-	General output5
47	Output	OUT6	-	-	General output6
48	Output	OUT7	-	-	General output7
49	Output	OUT8	-	-	General output8
50	Output	OUT9	-	-	General output9

※1: It is software input filter to set 10 msec or 1.5 msec of parameter 'Input Filter'.
The filter of +Limit, ORG, SD, IN7 to 9 is fixed as 1.5 msec. 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]: 5-30VDC, [L]: 0-2VDC (however, reset is fixed as [L].)

7.4   Connector Specifications

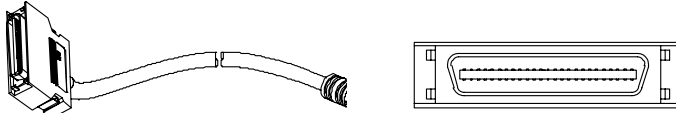| Type		Specifications			Manufacture
		Connector	Connector terminal	Housing	
CN1	Motor+Encoder	5557-14R	5556T	-	Molex
CN2	Power	5ESDVM-06P-OR	-	-	Dinkle
CN3	Communication	RJ45	-	-	-
CN4	I/O connector	10150-3000PE	-	-	KINNEXA

Note

Above connectors are suitable for AiCA-D Series.

7.5 Sold Separately

7.5.1 I/O Cable (CO50-MP□-R, standard: AiC TAG)

Pin no.	Function (name tag)	Cable color	Dot line color-numbers	Pin no.	Function (name tag)	Cable color	Dot line color-numbers
1	BRAKE+	Orange	Black-1	26	IN0	White	Red-3
2	BRAKE-		Red-1	27	IN1		Black-4
3	RESET		Black-2	28	IN2		Red-4
4	START		Red-2	29	N.C		Black-5
5	STOP		Black-3	30	IN3		Red-5
6	EMG		Red-3	31	IN4	Gray	Black-1
7	STEP0/+RUN/+JOG		Black-4	32	IN5		Red-1
8	STEP1/-RUN/-JOG		Red-4	33	IN6		Black-2
9	STEP2/SSP0		Black-5	34	IN7		Red-2
10	STEP3/SSP1		Red-5	35	IN8		Black-3
11	STEP4/MSP0	Yellow	Black-1	36	VEX		Red-3
12	STEP5/MSP1		Red-1	37	GEX		Black-4
13	MD0/HMD0		Black-2	38	ALARM		Red-4
14	MD1/HMD1		Red-2	39	COMPARE1		Black-5
15	PAUSE		Black-3	40	COMPARE2		Red-5
16	SERVO ON/OFF		Red-3	41	OUT0	Pink	Black-1
17	HOME		Black-4	42	OUT1		Red-1
18	ALARM RESET		Red-4	43	OUT2		Black-2
19	+LIMIT		Black-5	44	OUT3		Red-2
20	-LIMIT		Red-5	45	OUT4		Black-3
21	ORG	White	Black-1	46	OUT5		Red-3
22	SD		Red-1	47	OUT6		Black-4
23	IN POSITION		Black-2	48	OUT7		Red-4
24	VEX		Red-2	49	OUT8		Black-5
25	GEX		Black-3	50	OUT9		Red-5

Note

※□ of model name indicates cable length (010, 020, 030, 050, 070, 100, 150, 200). For corresponding EMC standard, cable length should be below 2m.

E.g.) CO50-MP070-R: 7m I/O cable

7.5.2   Motor+Encoder Cable (Normal: C1D14M-☐/Moving: C1DF14M-☐)
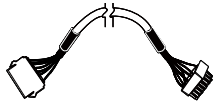
Note

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

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

7.5.3   Communication Converter

7.5.3.1   SCM-WF48 (Wi-Fi to RS485·USB wireless communication converter)

7.5.3.2   SCM-US48I (USB to RS485 converter)

7.5.3.3   SCM-38I (RS232C to RS485 converter)

8   Control Input/Output

Inner signal of all input/output consists of photocoupler.

ON: photocoupler power ON

OFF: photocoupler power OFF

8.1   Input

8.1.1   Example of Input Circuit Connection

Incase of input, use external power (VEX) 24VDC.

8.1.1.1   Pull-up

8.1.1.2   Circuit with NPN (Not-reversed)
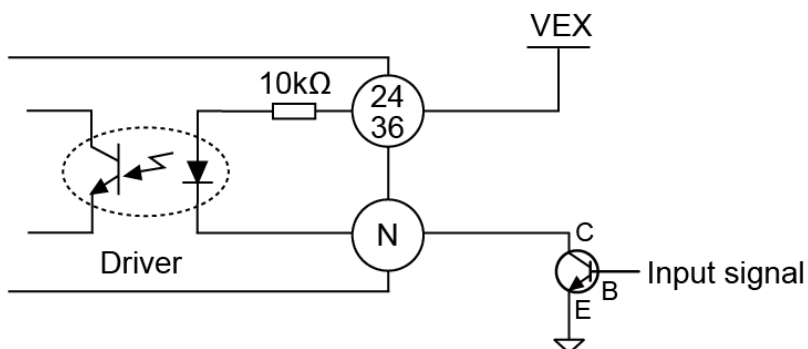
📝 **Note**

N: Input pin number of CN4

8.1.2   Exclusive Input (20)

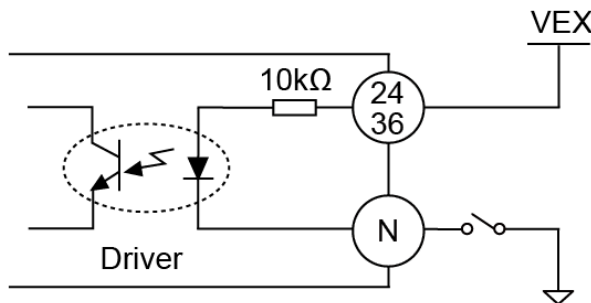| Pin no.	Signal name	Descriptions
3	Reset	Reset command
4	Start	Drive start command
5	Stop	Drive stop command
6	EMG	Drive emergency stop command
7	Step0/+Run/+Jog	Step designate 0/+Continuous/+Jog
8	Step1/-Run/-Jog	Step designate 1/-Continuous/-Jog
9	Step2/SSP0	Step designate 2/ Start speed designate 0
10	Step3/SSP1	Step designate 3/ Start speed designate 1
11	Step4/MSP0	Step designate 4/ Max. speed designate 0
12	Step5/MSP1	Step designate 5/ Max. speed designate 1
13	MD0/HMD0	Operation mode designate 0/Home search mode designate 0
14	MD1/HMD1	Operation mode designate 1/Home search mode designate 1
15	Pause	Pause
16	Servo On/Off	Servo On/Off
17	Home	Home search
18	Alarm Reset	Alarm reset command
19	+Limit	+ direction limit sensor
20	-Limit	- direction limit sensor
21	ORG	Home sensor
22	SD	Deceleration (Deceleration stop) signal

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 the set mode; index mode or 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   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.

8.1.2.4   EMG (emergency)

Motor stops immediately, emergency stop alarm occurs.
The current of motor is not blocked.
During stopping motor, EMG instruction does not run.

📝 **Note**

Program drive mode step address

Address	Input signal						Address	Input signal					
	Step5	Step4	Step3	Step2	Step1	Step0		Step5	Step4	Step3	Step2	Step1	Step0
1	0	0	0	0	0	0	33	1	0	0	0	0	0
2	0	0	0	0	0	1	34	1	0	0	0	0	1
3	0	0	0	0	1	0	35	1	0	0	0	1	0
4	0	0	0	0	1	1	36	1	0	0	0	1	1
5	0	0	0	1	0	0	37	1	0	0	1	0	0
6	0	0	0	1	0	1	38	1	0	0	1	0	1
7	0	0	0	1	1	0	39	1	0	0	1	1	0
8	0	0	0	1	1	1	40	1	0	0	1	1	1
9	0	0	1	0	0	0	41	1	0	1	0	0	0
10	0	0	1	0	0	1	42	1	0	1	0	0	1
11	0	0	1	0	1	0	43	1	0	1	0	1	0
12	0	0	1	0	1	1	44	1	0	1	0	1	1
13	0	0	1	1	0	0	45	1	0	1	1	0	0
14	0	0	1	1	0	1	46	1	0	1	1	0	1
15	0	0	1	1	1	0	47	1	0	1	1	1	0
16	0	0	1	1	1	1	48	1	0	1	1	1	1
17	0	1	0	0	0	0	49	1	1	0	0	0	0
18	0	1	0	0	0	1	50	1	1	0	0	0	1
19	0	1	0	0	1	0	51	1	1	0	0	1	0
20	0	1	0	0	1	1	52	1	1	0	0	1	1
21	0	1	0	1	0	0	53	1	1	0	1	0	0
22	0	1	0	1	0	1	54	1	1	0	1	0	1
23	0	1	0	1	1	0	55	1	1	0	1	1	0
24	0	1	0	1	1	1	56	1	1	0	1	1	1
25	0	1	1	0	0	0	57	1	1	1	0	0	0
26	0	1	1	0	0	1	58	1	1	1	0	0	1
27	0	1	1	0	1	0	59	1	1	1	0	1	0
28	0	1	1	0	1	1	60	1	1	1	0	1	1
29	0	1	1	1	0	0	61	1	1	1	1	0	0
30	0	1	1	1	0	1	62	1	1	1	1	0	1
31	0	1	1	1	1	0	63	1	1	1	1	1	0
32	0	1	1	1	1	1	64	1	1	1	1	1	1

- 0: OFF, 1: ON

8.1.2.5   Step0, 1/±Run/±Jog

Operate according to the mode selection of "MD0", "MD1".

(1) Step0, 1

It is available to set the start address of program mode among 0 to 63 range by 6-digit bit of Step0 to Step5.

- • Refer to 'Program drive mode step address'

(1) ±Run

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

(2) ±Jog

Accoridng 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.

8.1.2.6   Step2, 3/SSP0, 1 (start speed)

(1) Step2, 3

It is available to set the start address of program mode among 0 to 63 range by 6-digit bit of Step0 to Step5.

- • Refer to 'Program drive mode step address'

(2) SSP0, 1

It is available to set the start drive speed of jog mode, continuous mode by 2-digit bit of SSP0, SSP1.

	SSP1	SSP0
Start speed 1	OFF	OFF
Start speed 2	OFF	ON
Start speed 3	ON	OFF
Start speed 4	ON	ON

Note

Start speed 5 is not available.

8.1.2.7   Step4, 5/MSP0, 1 (max speed)

Operate according to the mode selection of "MD0", "MD1".

(1) Step4, 5

It is available to set the start address of program mode among 0 to 63 range by 6-digit bit of Step0 to Step5.

• Refer to 'Program drive mode step address'

(2) MSP0, 1

It is available to set the max. drive speed of jog mode, continuous mode by 2-digit bit of MSP0, MSP1.

	MSP1	MSP0
Max speed 1	OFF	OFF
Max speed 2	OFF	ON
Max speed 3	ON	OFF
Max speed 4	ON	ON

Note

Max speed 5 is not available.

8.1.2.8   MD0, 1/HMD0, 1 (mode/home mode)

Drive mode and home search mode can be selected.

(1) MD0, 1

When it is not home search mode, it is available to set the drive mode among 4 types.

	MD1	MD0
Index mode	OFF	OFF
Jog mode	OFF	ON
Continuous mode	ON	OFF
Program mode	ON	ON

(2) HMD0, 1

When home signal is ON, it is available to set the home search mode among 4 types.

|	HMD1	HMD0
Home search	OFF	OFF
Limit home search	OFF	ON
Zero point home search	ON	OFF
Torque home search	ON	ON

8.1.2.9   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.
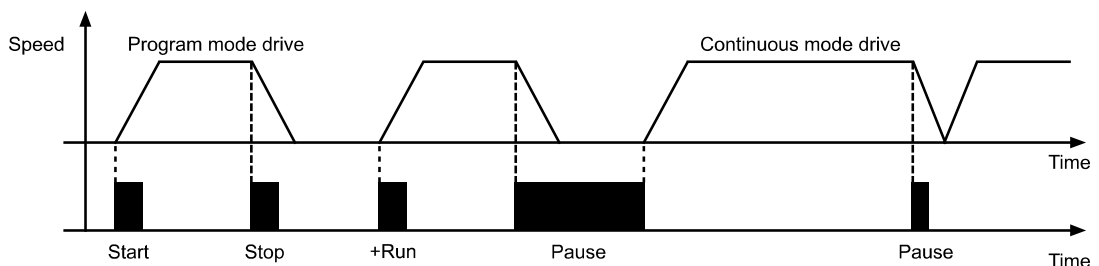
8.1.2.10   Servo On/Off

- 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 turn 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

The motor must stop.

8.1.2.11   Home

Home search mode is set at 'Home Search Method' parameter.
As below 4 parameters, it is avaliable to set home search speed and acceleration/deceleration time.

→Home Search High Speed / Home Search Low Speed

    Home Search Acceleration Time / Home Search Deceleration Time

8.1.2.12   Alarm Reset

- It is for alarm reset.
- When alarm reset signal is [H],

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

    The driver returns to normal status.

Note

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

8.1.2.13   ±Limit

When supplying the ±limit signal over 1.5 msec, it recognizes as ±hardware limit input and it decelerates and stops or stops immediately accoridng to the set parameter.
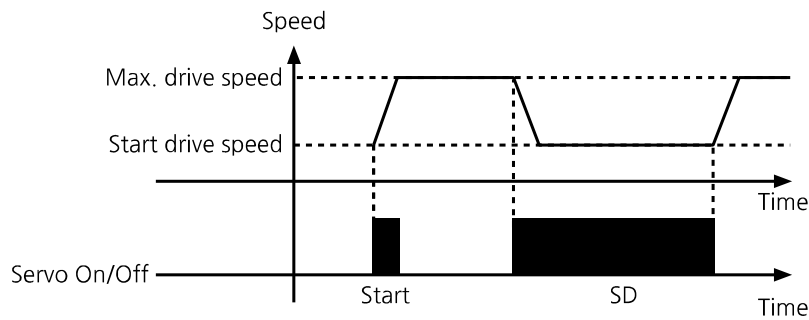
- +Limit=CW direction limit sensor signal
- -Limit=CCW direction limit sensor signal

8.1.2.14   ORG (origin)

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

When suppling ORG signal over 1.5 msec, it recognizes as home sensor.

8.1.2.15   SD (slow down)

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

8.1.3   General Input (9)

Signal name	Descriptions	Pin no.
IN0 to IN2	General input 0 to 2	26 to 28
IN3 to IN8	General input 3 to 8	30 to 35

It is general input at program mode.

It is used with ICJ, IRD instruction.

- IN0 to IN7

  When supplying over 1.5 msec, it recognizes as input

- IN8

  When supplying over 10 msec or 1.5 msec (set at 'Input Filter' parameter), it recognizes as input.

8.2   Output

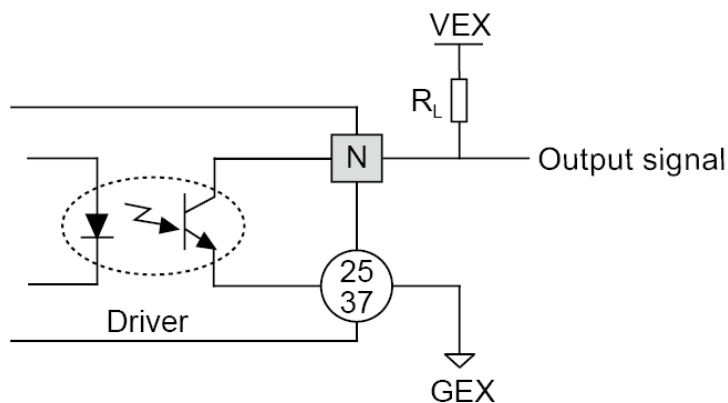### 8.2.1   Example of Output Circuit Connection

In case of output, use external power (VEX) max. 12 to 24VDC, 10mA

When current exceeds 10mA, use an external resistor R_L to adjust the current value.

8.2.1.1   Circuit with photocoupler
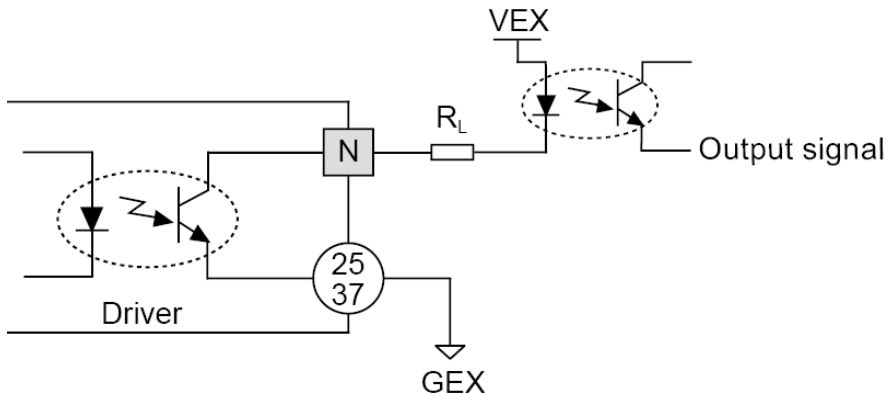
8.2.1.2   Circuit with pull up (reversed)

📝 **Note**

N: Output pin number of CN4

8.2.2   Exclusive Output (4)

| Signal name	Descriptions	Pin no.
In-Position	Drive ending pulse	23
Alarm	Alarm output	38
Compare 1 (Trigger)	Compare output 1	39
Compare 2 (Trigger)	Compare output 2	40

8.2.2.1   In-Position

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

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

- Fast response: When gab between the target position and the current position is lower than the setting value, it outputs in-position signal immediately.
- Accurate response: When gab between the target position and the current position is lower than the setting value and maintains over 50 msec, it outputs in-position signal.
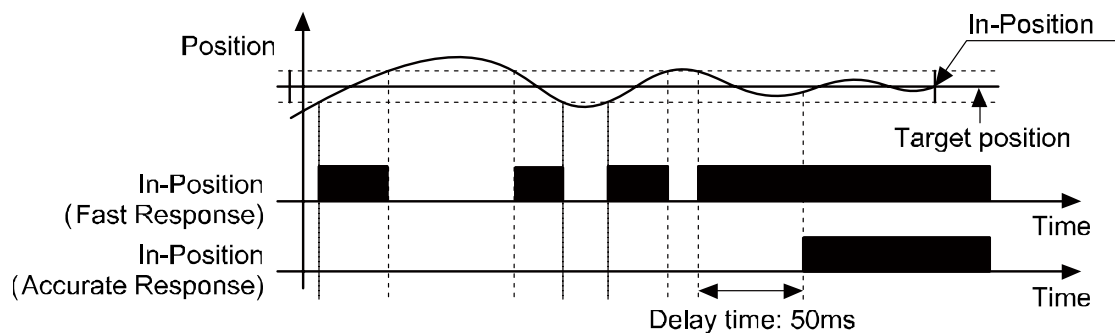
Fast response		Accurate response	
Setting	Value	Setting	Value
0 (factory default)	0	8	0
1	±1	9	±1
2	±2	10	±2
3	±3	11	±3
4	±4	12	±4
5	±5	13	±5
6	±6	14	±6
7	±7	15	±7

Note

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

8.2.2.2   Alarm / Warning

In normal state, output is ON and when alarm occurs, output is OFF.

Depending on the alarm type, it displays on the segment and flashes on the alarm / stauts indicator.

For more information, refer to '12.1 Alarm'.

8.2.2.3

8.2.2.3   Compare1, Compare2

It outputs trigger pulse at the designated cycle.

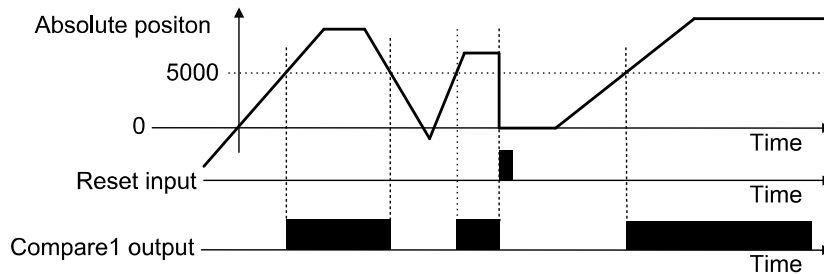| Mode	Description
0	Not use comparison output.
1	Comparison output turns ON when the present absolute position value is same or bigger than the set position value.
2	Comparison output turns ON when the present absolute position value is same or smaller than the set position value.
3	Trigger pulses output with the set interval and width.

Note

※Setting range of Compare 1 Position, Compare 2 Position: -2,147,483,648 to +2,147,483,647

※Setting range of Compare 1 Period, Compare 2 Period: 1 to 2,147,483,648 [pulse]
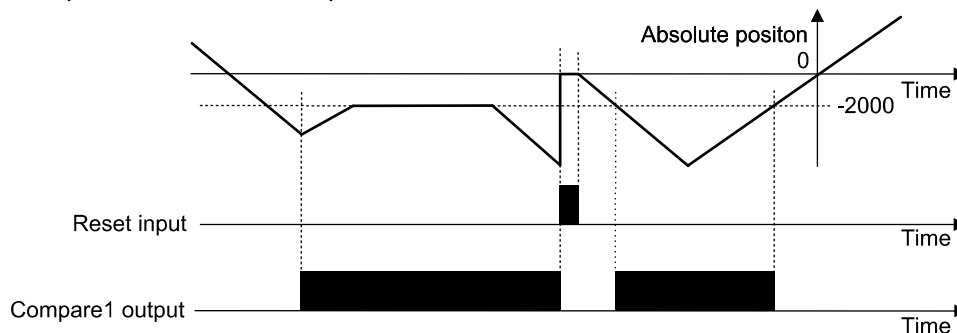
※Setting range of Compare 1 Pulse Width, Compare 2 Pulse Width : 1 to 1,000 [msec]
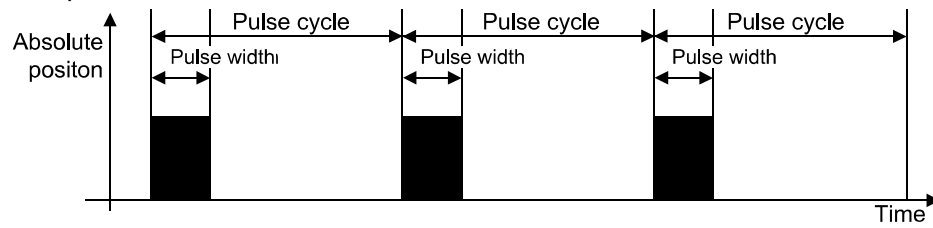
Ex.

- Compare 1 Mode=1 / Compare 1 Position=5000,

- Compare 1 Mode=2 / Compare 1 Position=-2000,

■ Compare 1 Mode=3,

8.2.3 General Output (10)

Signal name	Description	Pin no.
OUT0 to OUT9	General Output 0 to 9	41 to 50

It is general output at program mode.

It is used with OPC, OPT instruction.

Note

By setting the prameter 'Output Mode (Alarm)', the output can be maintained or initialized when the alarm occurs.

Parameter	Setting	Description
Output Mode (Alarm)	Holding	Output maintained
	Reset	Output initialized

9   Drive

As below, AiCA Series has various drive modes and home search.

It operates each drive mode by I/O.

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

⚠ **Caution**

Do not operate instructions by I/O during communication between the driver and the PC (atMotion) (only monitoring is available.)

It may cause malfuncation due to double input.

9.1   I/O Control Drive

9.1.1   Index Mode

At index mode, it operates the one step of "ABS" or "INC" instruction from the program.

- Index mode drive

  For operating index mode drive, the designated program step must have the instruction.
  When operating the other instruction, error occurs.

    1st Drive mode: "MD0"=0, "MD1"=0

    2nd Select Index mode.

        : It is available to set the step number from 0 to 63 combining with "Step0"

        to "Step5".

    3rd Start drive.

        : When "Start" input signal turns ON, the designated one step operates.

    4th Emergency stop

        : When "EMG" signal inputs, it stops emergently.

Note

- For index mode drive by I/O control, "MD0/HMD0", "MD1/HMD1" are turn OFF and it

  selects index drive.

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. 16 alarm

  (Index mode error) occurs.

9.1.2   Jog Mode

At jog mode, it operates motor to CW direction or CCW direction while "+Jog" or "-Jog" signal is   ON.

- Jog mode drive

  1st Dive mode: "MD0"=1, "MD1"=0

  2nd Select start drive speed.
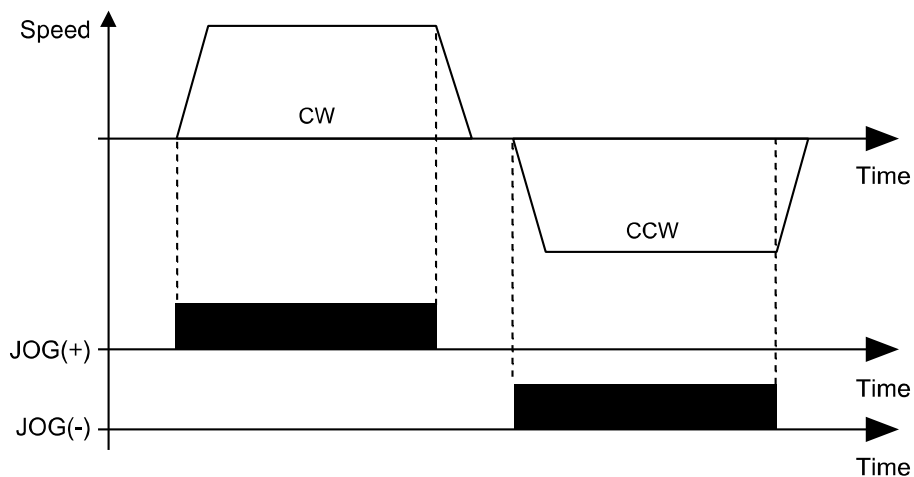   : It is available to set the start drive speed combining with "SSP0", "SSP1".

  3rd Select max. drive speed.
    : It is available to set the max. drive speed combining with "MSP0", "MSP1".

  4th Drive: It drives to CW direction or CCW direction while "+Jog" or "–Jog" signal inputs.

  5th Emergency stop
    : When "EMG" signal inputs, it stops emergently.

Note

- For jog mode drive by I/O control, "MD0/HMD0" turns ON, "MD1/HMD1" turns OFF and it selects jog drive.
- It cannot stop by "Stop" signal input.

9.1.3   Continuous Mode

At continuous mode, it 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 mode: "MD0"=0, "MD1"=1

    2nd Select start drive speed.

    : It is available to set the start drive speed combining with "SSP0", "SSP1".

    3rd Select max. drive speed.

    : It is available to set the max. drive speed combining with "MSP0", "MSP1".

    4th Drive: When "+Run" or "–Run" signal inputs, it drives to CW direction or CCW direction.

    5th Stop: When "STOP" signal inputs or limit signal of the direction inputs, it stops.

    6th Emergency stop: When "EMG" signal inputs, it stops emergently.
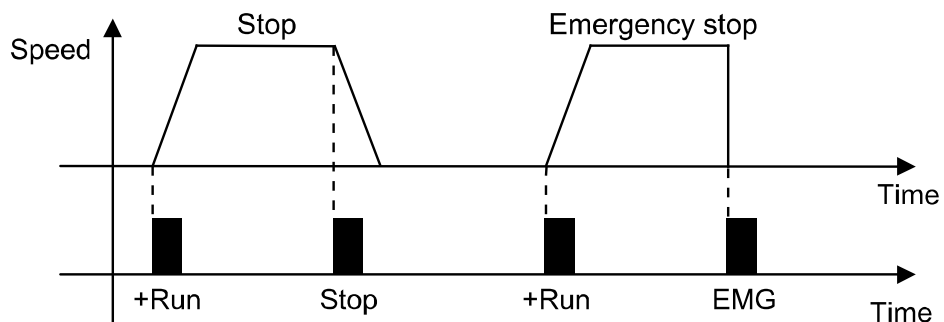
Note

For continuous mode drive by I/O control, "MD0/HMD0" turns OFF, "MD1/HMD1" turns ON, and it selects continuous drive.

9.1.4   Program Mode

At program mode, it operates the designated program from 0 to 255-step sequentially.

- Program mode drive
  The saved program should exist at memory.

    1st Drive mode: "MD0" = 1, "MD1" = 1

    2nd Drive
        : When "Start" input signal turns ON, it drives according to the set program.

    3rd Pause
        : When "Pause" signal inputs, it stops after completing the step.
         When "Start" signal inputs again, it drives from the completed next step.

    4th Stop
        : When "Stop" signal inputs, it stops after completing the step.
         When "Start" signal inputs again, it drives from the first step.

    5th When "EMG" signal inputs, it stops emergently.

    6th Program end: When "END" signal inputs, program mode drive is end.

Note

- For program mode drive by I/O control, "MD0/HMD0" turns OFF, "MD1/HMD1" turns ON, and it selects program mode drive.
- When "Power On Program Start" parameter is Enable, it operates program mode drive when resupplying power.

Caution

- For end of program mode, "END" signal must be input.
  If there is no "END" instruction input, no. 15 alarm (Program mode error) occurs.
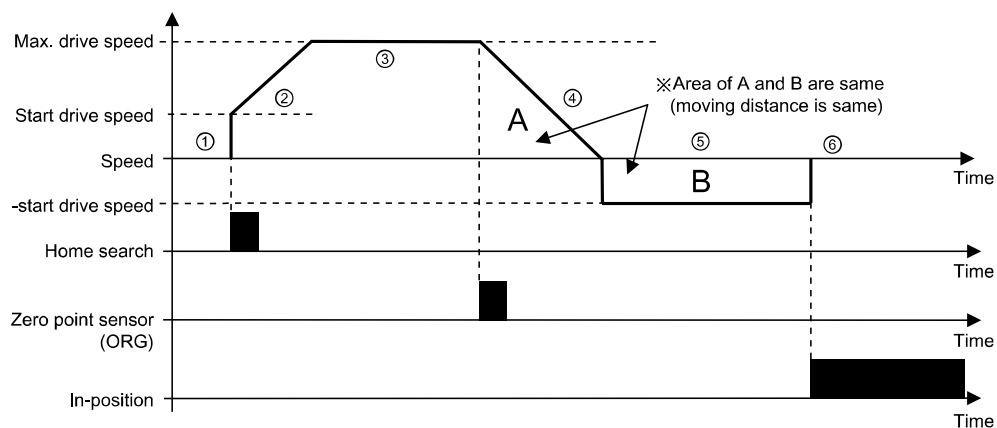
9.1.5   Home Search

According to the setting of "HOME Active Level" parameter, it operates home search drive by [H] or [L] input.

- Home search drive
    1st Drive mode
        : It is available to set the home search mode combining with "HMD0", "HMD1".

    2nd Drive
        : When "HOME" signal inputs, it operates home search according to the set mode.

    3rd Stop
        : When "STOP" signal inputs or limit signal of the direction inputs, it stops.

    4th Emergency stop
        : When "EMG" signal inputs, it stops emergently.

9.1.5.1   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 (orange)" turns ON.

9.1.5.2   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 "±Limit (±direction limit sensor)" signal inputs or it arrives to "Software Limit± (±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 (orange)" 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 (orange)" turns ON.
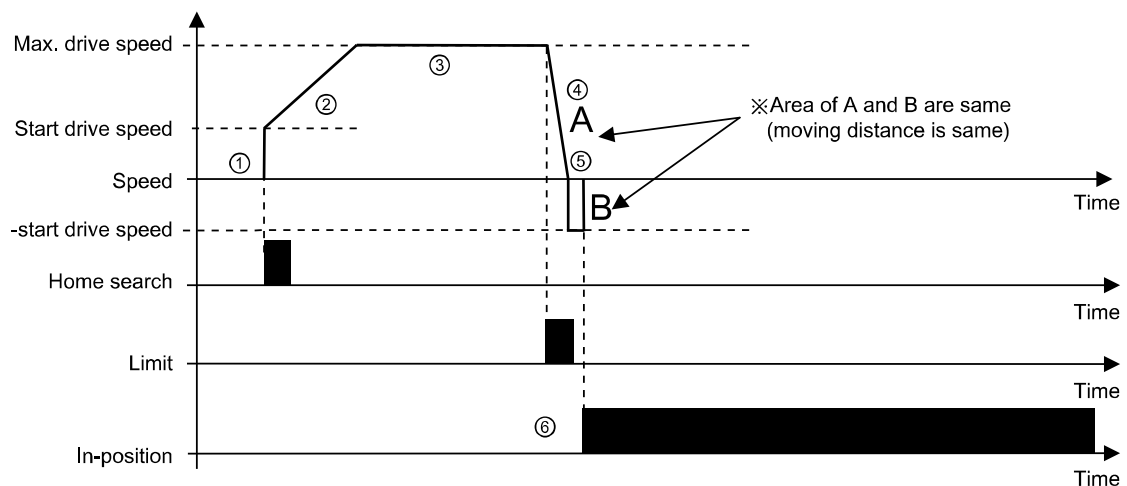
⚠ Caution

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.

9.1.5.3   Zero Point Home Search (home search method=2)

It operates home search by zero point (absolute coordinate=0) when there is no home sensor, 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 it 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 complete, it operates constant speed drive with the set max. drive speed at "Home Search Max speed".

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

6th After finding home, "In-Position" signal utputs and the "INP. indicator (orange)" 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 (orange)" turns ON.
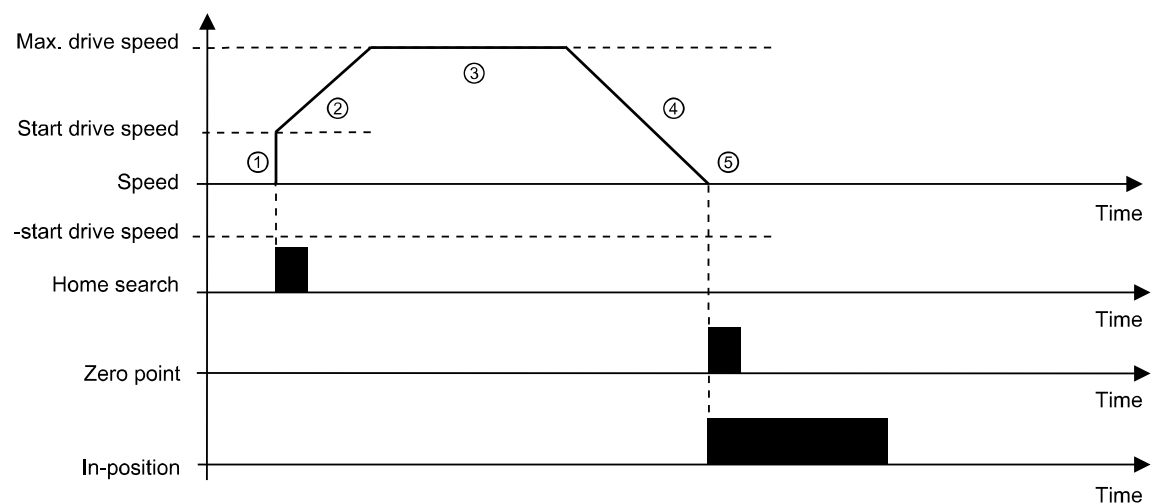
9.1.5.4   Torque Home Search (home search method=3)

It operates home search by contact with the sepcific equipment when there is no home sensor, 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 and stops to the reverse direction with the start drive speed and rotation value set from atMotion.

6th After finding home, "In-Position" signal utputs and the "INP. indicator (orange)" 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 (orange)" turns ON.
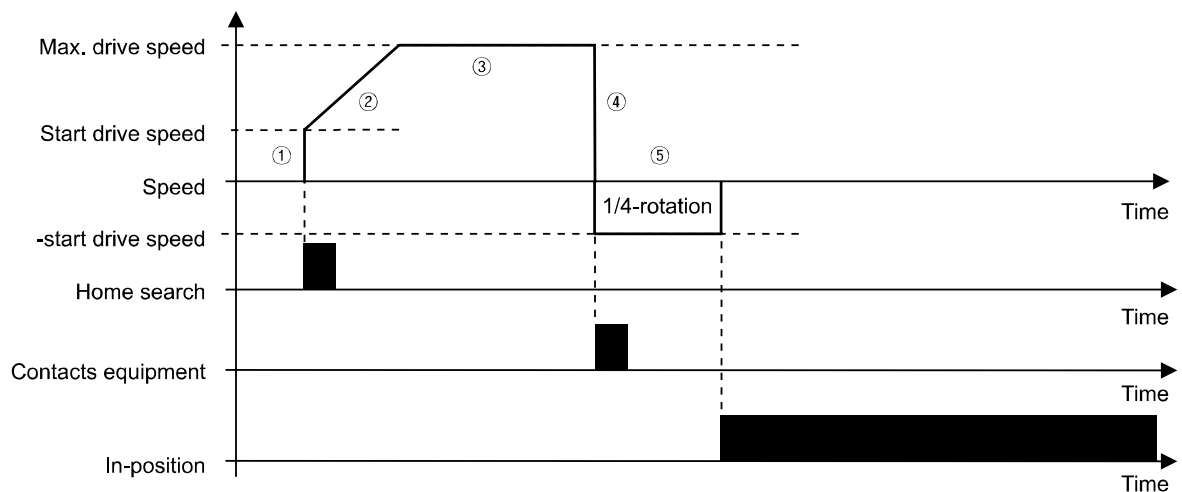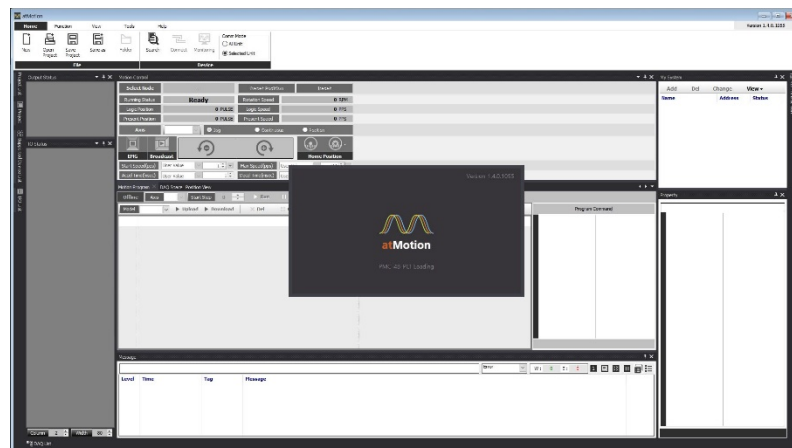
9.2 GUI Control Drive
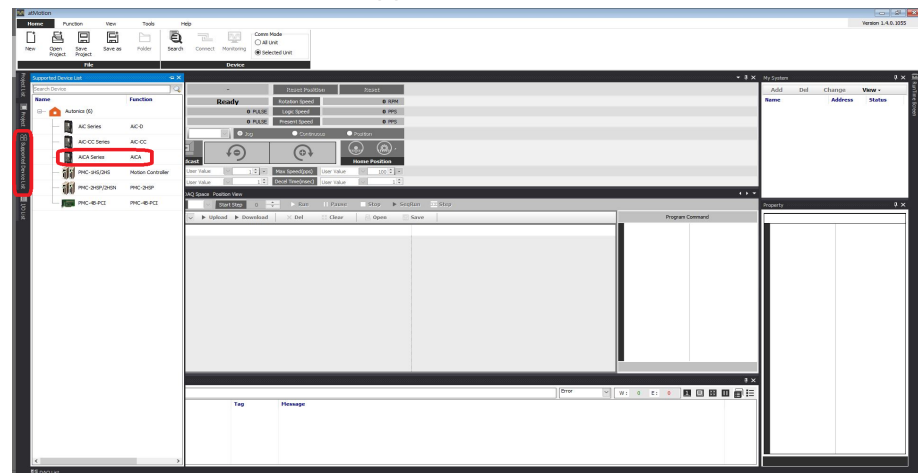
■ GUI run and setting

1st Visit our website (www.autonics.com) to download and install newest version of 'atMotion'.
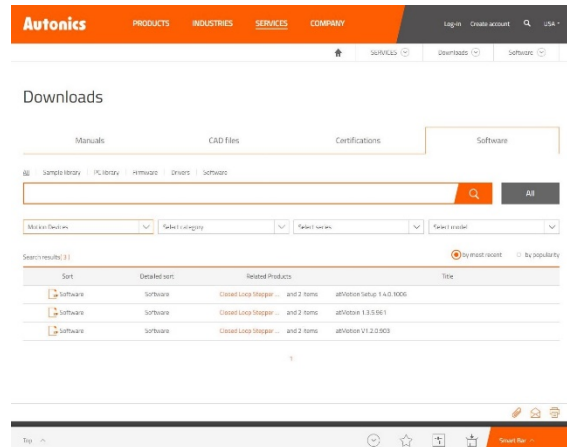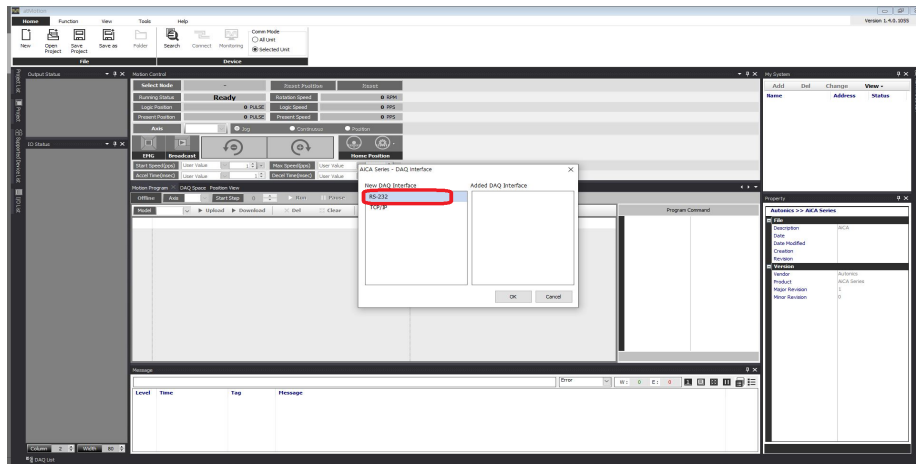

2nd Run 'atMotion' which is installed on PC.

3rd On the left side, select ① 'Supported Device List' - ② 'AiCA Series'.

Autonics

4th Set communication method as 'RS-232' at New DAQ interface


5th Right click the newly added device on 'My System' then click ① 'Add'.

When ② 'Add Unit' window displays, double click the device list or click the arrow, placed in the middle of the widnow, to create node number then select ③ 'OK'.
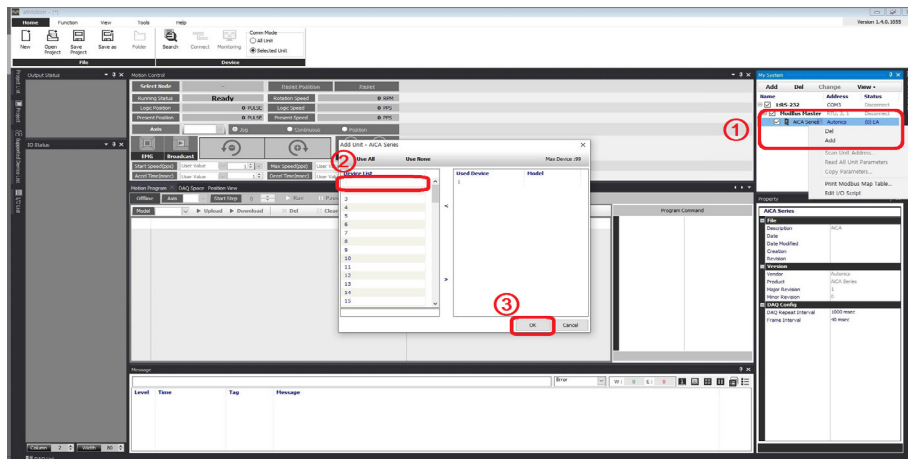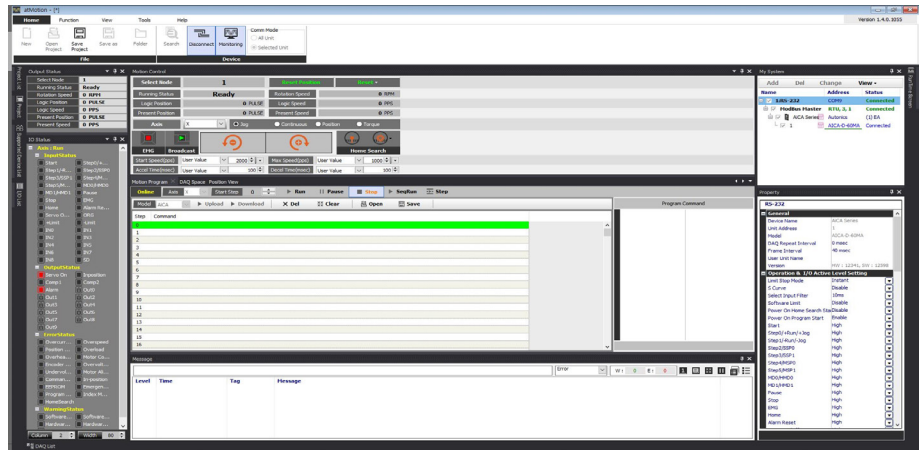

6th Select 'RS-232' on the right side of the window, set the communication port, and baud rate for the connected device.
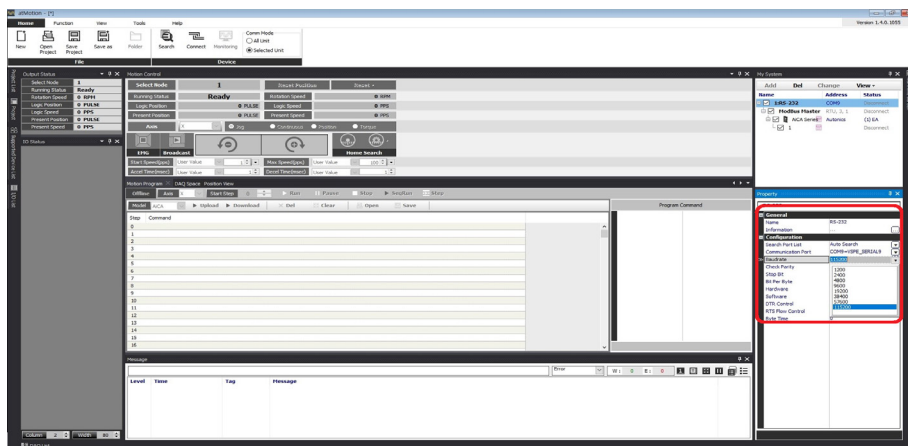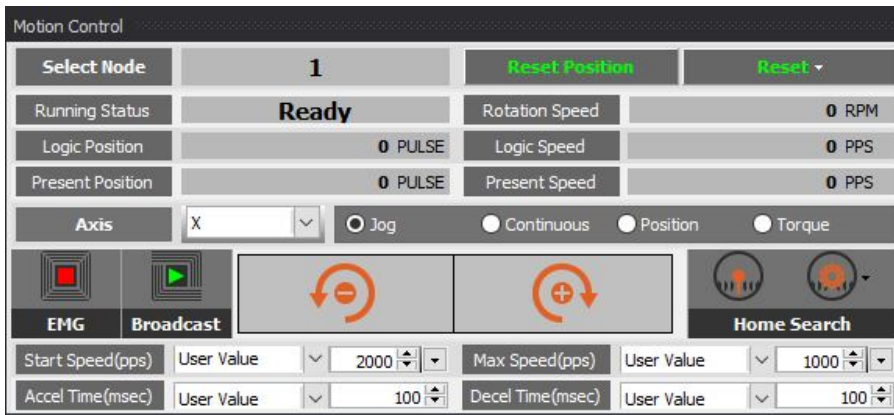
7th Click 'Connect' on the upper side of the window to connect the communication.
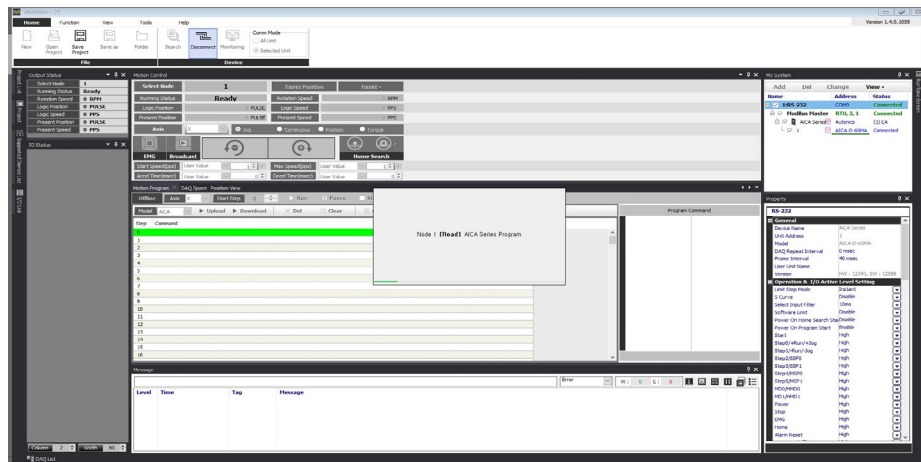
8th To make sure the communication is connected properly, check the 'My System'
items on the right side of the window to figure out the device node setting.

9.2.1 Jog Mode

Jog mode operates the motor in CW or CCW direction by clicking ⊕ or ⊖ button.

- Jog mode operation

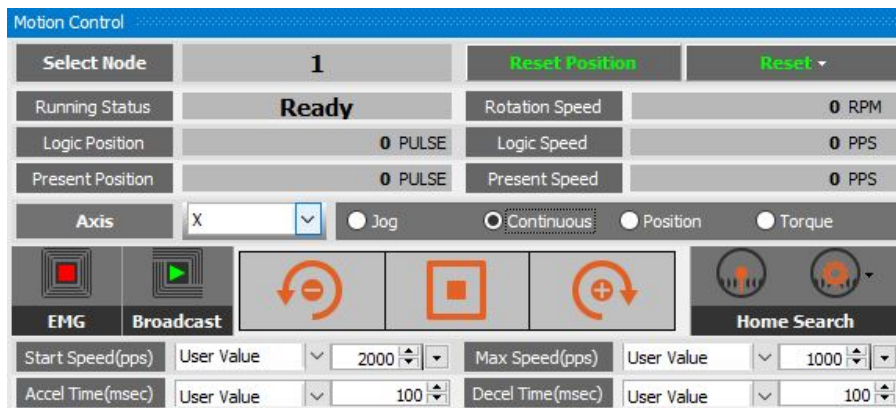   1st Select 'Jog' on Motion Control – mode selection box.

    2nd Set the 'Start Speed', 'Max Speed', 'Accel Rate', 'Decel Rate' value for jog mode.

    3rd Motor begins to operate to designated directon by clicking ⊕ or ⊖ button.

    4th Operation stops by releasing the button.

Note

- Start Speed, Max Speed, Accel Rate and Decel Rate can be loaded from the saved value without entering these values.

9.2.2 Continuous Mode

Continuouse mode outputs pulse continuously in the designated direction until stop command from upper level or stop signal from outside. Continuous mode and home search mode is applicable for this funciton.

Stop commands include deceleration stop and immidiate stop. Deceleration stop is operated when final operation spped is lower than the initial operation speed or in all cases except for reset or emergency stop.

Continuous mode operates the motor continuously in CW or CCW direction by clicking or button.

- Continuous mode operation
    1st Select 'Continuous' on Motion Control – mode selection box.
    2nd Set the 'Start Speed', 'Max Speed' value for continuous mode.
    3rd Motor begins to operate to designated directon by clicking or button.
    4th Operation stops by clicking button or when the designated direction limit signal is applied.

Note

- Start Speed, Max Speed, Accel Rate and Decel Rate can be loaded from the saved value without entering these values.

9.2.3   Position Mode
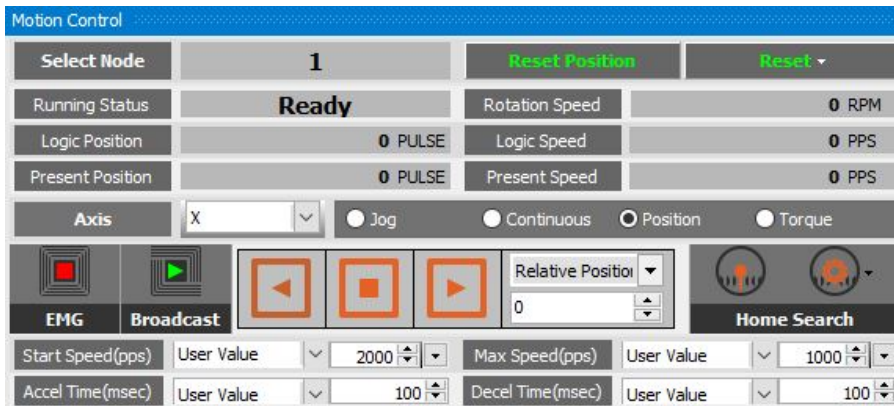
atMotion provides 'relative position' and 'absolute position' control.

Relative position control moves by the input pulse based on current position.
Absolute position control moves by the input pulse based as the origin.

The position value may change depending on the parameter 'Resolution' setting.

Check the actual position displayed on the program screen to move the position.

- Position mode operation

    1st Select 'Position' on Motion Control – mode selection box.

    2nd Set the 'Start Speed', 'Max Speed', 'Accel Rate', 'Decel Rate' value for position mode.

    3rd Select the position control method between 'Relative Position' and 'Absolute Position'.

    4th After entering designated position value, select ▶ and ◀ to input pulse value in the desired direction to move the position.

   5th If the middle button is clicked during the position moving, it does not reach the entered position and stops immediately by decelerating operation.

📝 **Note**

- Start Speed, Max Speed, Accel Rate and Decel Rate can be loaded from the saved value without entering these values.
- Recognize the position when the initial power is entered as the origin. To change the origin, run home search mode.
- To specify the current position as the origin, click the 'Reset Position' button to set as the origin.

9.2.4   Torque Mode

Control the motoer by setting the torque that the motor can operate at the specified speed.

▪ Torque mode operation

1st Select 'Torque' on Motion Control – mode selection box.

2nd Assign motor speed by setting the parameter 'T_Mode Limit Speed'.

3rd Set the desired torque in percentage, and assign the 'Rise Time' to reach the
output torque.

4th Control the motor torque by clicking the ▶ and ◀ to designated direction.

5th By clicking ■ button to stop the motor.

9.2.5 Program Mode
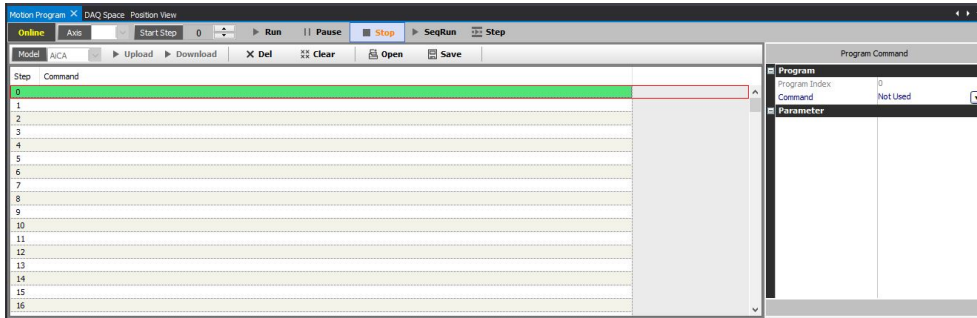
To end the program operation, 'END' command must be entered at the end of the step. The alarm no. 15 will occur when the 'END' command is not entered.

There are 256 steps in range of 0 to 255.

If the parameter 'Power On Program Start' is set to 'Enable', it automatically executes the saved program operation sequentially at initial power on.

- Program mode operation

    1st Enter the command at the desired step.

    2nd When step input is completed, click ▶ **SeqRun** button to execute program operation sequentially.

    3rd To start from a step other than step 0, select the step number from **Start Step 0** and click the ▶ **Run** button.

    4th Click the ‖ **Pause** button to finish the active step and pause the motor. Click ▶ **Run** button to start the next step.

    5th Click the ■ **Stop** button to finailze and stop the active step. Click ▶ **Run** button to restart at the designated step.

    6th When the program command 'END' reaches the entered step during program operation, the program operation is terminated.

![Note]

- For more information, refer to '10 Program Instructions'.
- To execute only one step, select the desired step and click the ⊞ **Step** button. However, executing a step with a command other than 'ABS' or 'INC', or clicking 'Stop' button during the step operation, the alarm no. 16 will occur.

9.2.6   Home Search Mode
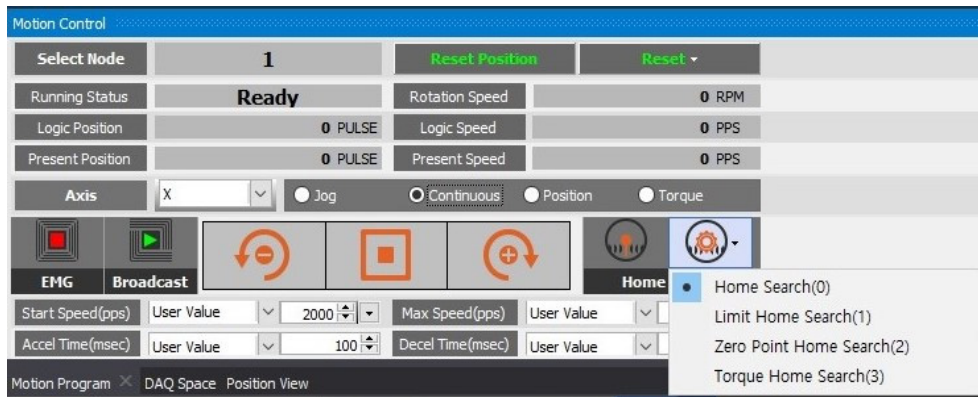
There are 4 types of home search mode can be executed; 'Nomal', 'Limit', 'Position' and 'Torque'.

If the parameter 'Power On Home Search' is set to 'Enable', it automatically executes the home search mode from the time when the power is applied and motor alignment is completed. (However, alarm no. 17 occurs when it is executed by zero point home search mode operation.)

- Home search mode operation
    1st Click ⊙ button to select the home search operation mode.
    2nd Set the value of Start Speed, Max Speed, Accel Rate and Decel Rate for Home search mode.
    3rd Click ⊙ button to execute the home search operation.
    4th When the home is found, the home search operation is completed.

9.2.6.1 Normal Home Search

Connect the external origin sensor to 'ORG' and receive the signal output from the sensor to designate as home.

1st Click ⬤ button and select 'Nomal'.

2nd Click ⬤ button to execute the home search operation.

3rd When the operation is executed, the motor operates in the direction set in the parameter 'Home Search Direction'.

4th Operation starts according to the start speed set in the parameter 'Home Search Start Speed', and acceleration starts according to the acceleration time set in the parameter 'Home Search Acceleration Time'.

5th The constant speed operation is performed until a signal is input to the origin sensor 'ORG', when the maximum speed set in the parameter 'Home Search Max Speed' is reached.

6th If a signal is input to the limit sensor (±Limit) before the signal is input to the origin sensor 'ORG', after the deceleration stop, it operates in the opposite direction to find the origin.

7th When a signal is input to the origin sensor 'ORG', the motor decelerates and stops according to the deceleration time set in the parameter 'Home Search Deceleration Time'.

8th After stop, it moves to the opposite diretion as far as the distance past the origin sensor at the start speed set in the parameter 'Home Search Start Speed'to find the origin sensor and stops.

9th When the origin found, the operation completion signal (In-Position) is output and the In-Position indicator lights to indicate the status.

📝 **Note**

- If a value other than 0 is set in the parameter 'Home Search Offset', it moves to the set position value after finding the home and outputs the operation completion signal (In-Position) and lights up in the In-Position indicator to display the status.
- If a value other than 0 is set in the parameter 'Home Search Position Set', the position specified after finding the home is set to the set value other than 0.
- In normal home search mode, alarm no. 17 occurs if the ORG signal does not input until it reaches the opposite limit sensor past the limit sensor (±Limit).

9.2.6.2   **Limit Home Search**

Connect the external limit sensor to '±Limit' and receive the signal output from the sensor to designate as home.

If the parameter 'Software Limit' is set to 'Enable', the home search mode is available with Software ±Limit.

1st Click [icon] button and select 'Limit'.

2nd Click [icon] button to execute the home search operation.

3rd When the operation is executed, the motor operates in the direction set in the parameter 'Home Search Direction'.

4th Operation starts according to the start speed set in the parameter 'Home Search Start Speed', and acceleration starts according to the acceleration time set in the parameter 'Home Search Acceleration Time'.

5th The constant speed operation is performed until a signal is input to the limit sensor '±Limit' when the maximum speed set in the parameter 'Home Search Max Speed' is reached.

6th If a signal is input to the limit sensor (±Limit) or reaches to Software ±Limit, the motor decelerates and stops according to the deceleration time set in the parameter 'Home Search Deceleration Time'.

7th After stop, it moves to the opposite direction as far as the distance past the limit sensor at the sart speed set in the parameter 'Home Search Start Speed' to find the limit sensor and stops.

8th When the home found, the operation completion signal (In-Position) is output and the In-Position indicator lights to indicate the status.

[icon] **Note**

- If a value other than 0 is set in the parameter 'Home Search Offset', it moves to the set position value after finding the home and outputs the operation completion signal (In-Position) and lights up in the In-Position indicator to display the status.

- If a value other than 0 is set in the parameter 'Home Search Position Set', the position specified after finding the origin is set to the set value other than 0.

- If the deceleration time is set long during deceleration and stop, it may collide with the structure, so the deceleration time should be set short or the limit sensor should be installed from the structure with sufficient margin.

9.2.6.3   **Zero Point Home Search**

Zero point home search operation can be performed by specifying zero point (absolute coordinate '0') as home.

To change the home position, use 'Reset Position'.

The zero point should be re-assigned since the zero point is also reset when reset or resupplying the power.

The alarm no. 17 occurs since the zero point is not assigned when use automatically execution by setting parameter 'Power On Home Search' is set to 'Enable'.

1st   Click button and select 'Position'.

2nd   Click button to execute the home search operation.

3rd   When the operation is executed, the motor operates in the direction set in the parameter 'Home Search Direction'.

4th   Operation starts according to the start speed set in the parameter 'Home Search Start Speed', and acceleration starts according to the acceleration time set in the parameter 'Home Search Acceleration Time'.

5th   The constant speed operation is performed when the maximum speed set in the parameter 'Home Search Max Speed' is reached.

6th   As closer to home (zero point), the motoer decelerates and stops according to the deceleration time set in the parameter 'Home Search Deceleration Time'.

7th   When the home found, the operation completion signal (In-Position) is output and the In-Position indicator lights to indicate the status.

Note

- If a value other than 0 is set in the parameter 'Home Search Offset', it moves to the set position value after fining the home and outputs the operation completion signal (In-Position) and lights up in the In-Position indicator to display the status.

- If a value other than 0 is set in the parameter 'Home Search Position Set', the position specified after finding the origin is set to the set value other than 0.

9.2.6.4   **Torque Home Search**

If there is no home sensor and limit sensor, home search mode can be executed by contact with a specific instrument.

If the torque value is output as much as the value set in the parameter 'Home Search Torque' after contacting a specific device, the position that has moved in the opposite direction by the position valu set in the parmeter 'Home Search Offset' is designated as the origin.

1st Click ⊙ button and select 'Position'.

2nd Click ⊙ button to execute the home search operation.

3rd When the operation is executed, the motor operates in the direction set in the parameter 'Home Search Direction'.

4th Operation starts according to the start speed set in the parameter 'Home Search Start Speed', and acceleration starts according to the acceleration time set in the parameter 'Home Search Acceleration Time'.

5th The constant speed operation is performed until contact is made with a specific instrument.

6th Stops when the load is applied as the torque value set in the parameter 'Home Search Torque' by contacting a specific instrument.

7th After stop, it moves to the opposite direction as far as the distance past the limit sensor at the start speed set in the parameter 'Home Search Start Speed' and stops.

8th The operation completion signal (In-Position) is output and the In-Position indicator lights to indicate the status.

📝 **Note**

■   If a value other than 0 is set in the parameter 'Home Search Position Set', the position specified after finding the origin is set to the set value other than 0.

10 Program Instructions

There are 15 program instructions as below table.

Type	Instruction	Description
Drive	ABS	Absolute position move
	INC	Relative position move
	HOM	Home search
Input/Output	ICJ	Input condition jump
	IRD	Input wait
	OPC	Output port ON/OFF
	OPT	Output port ON pulse
	CMP	Compare output
Program control	JMP	Jump
	REP	Repeat start
	RPE	Repeat end
	END	Program end
	POS	Position set
	TIM	Ready
Torque mode	TOQ	Torque mode drive

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	Pos	Start	Max	Acc	Dec	S Enable	S Time	C Enable

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

- Position
  : Input moving position value.
  In case of moving range is over -2,147,483,648 to 2,147,483,647, the program mode error occurs

- Start speed level (start drive speed)
  : Select the start drive speed during drive.
  Set the start drive speed from 1 to 5.
  When selecting 'User Value', it is available to set as the desired value.

- Max speed level (max. drive speed)
  : Select the max. drive speed during drive.
  Set the max. drive speed from 1 to 5.
  When selecting 'User Value', it is available to set as the desired value.

- Accel time level
  : Set the acceleration time of drive.
  Set the acceleration time from 1 to 5.
  When selecting 'User Value', it is available to set as the desired value.

- Decel time level
  : Set the deceleration time of drive.
  Set the deceleration time from 1 to 5.
  When selecting 'User Value', it is available to set as the desired value.

- S Curve enable
  : Set use/not use of S-curve acceleration/deceleration.
    - Enable=Use S-curve acceleration/deceleration
    - Disable=Not use S-curve acceleration/deceleration

- S Curve Acc/Dec Time
  : When using S curve, set the S-curve acceleration/deceleration time.

■   Continue enable

: It drives continuously removing acceleration/deceleration time of each step at
program mode.

Set the use/not use continuation.

•   Enable = Use continuation

•   Disable = Not use continuation

Step	Acceleration time (msec)	Deceleration time (msec)	Start drive speed (pps)	Max. drive speed (pps)
1	1,000	0	500	5,000
2	1,000	0	5,000	10,000
3	1,000	0	10,000	20,000
4	0	1,000	7,000	20,000
5	0	1,000	0	7,000

Note

■   For the step with acceleration, set deceleration time as 0 msec.

■   For the step with deceleration, set acceleration time as 0 msec.

10.1.2   INC (Relative position move)

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

Instruction	DATA								
INC	Instruction	Pos	Start	Max	Acc	Dec	S Enable	S Time	C Enable

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

- Position

  : Input moving position value.

    In case of moving range is over -2,147,483,648 to 2,147,483,647, the program mode

    error occurs

- Start speed level (start drive speed)

  : Select the start drive speed during drive.

    Set the start drive speed from 1 to 5.

    When selecting 'User Value', it is available to set as the desired value.

- Max speed level (max. drive speed)

  : Select the max. drive speed during drive.

    Set the max. drive speed from 1 to 5.

    When selecting 'User Value', it is available to set as the desired value.

- Accel time level

  : Set the acceleration time of drive.

    Set the acceleration time from 1 to 5.

    When selecting 'User Value', it is available to set as the desired value.

- Decel time level

  : Set the deceleration time of drive.

    Set the deceleration time from 1 to 5.

    When selecting d'User Value', it is available to set as the desired value.

- S Curve enable

  : Set use/not use of S-curve acceleration/deceleration.

    - Enable=Use S-curve acceleration/deceleration

    - Disable=Not use S-curve acceleration/deceleration

- S Curve Acc/Dec Time

  : When using S curve, set the S-curve acceleration/deceleration time.

- Continue enable

  : It drives continuously removing acceleration/deceleration time of each step at program mode.

  Set the use/not use continuation.

  - Enable=Use continuation

  - Disable=Not use continuation

Step	Acceleration time (msec)	Deceleration time (msec)	Start drive speed (pps)	Max. drive speed (pps)
1	1,000	0	500	5,000
2	1,000	0	5,000	10,000
3	1,000	0	10,000	20,000
4	0	1,000	7,000	20,000
5	0	1,000	0	7,000

Note

- For the step with acceleration, set deceleration time as 0 msec.
- For the step with deceleration, set acceleration time as 0 msec.
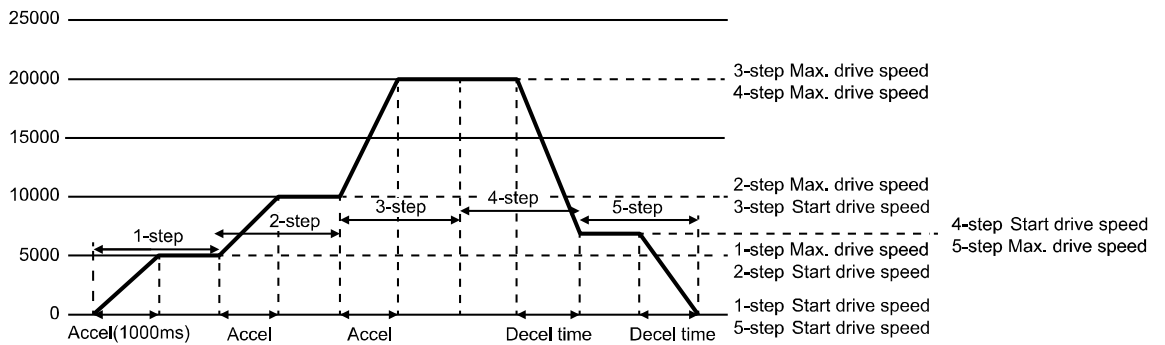
10.1.3 HOM (Home search)

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

Instruction	DATA	
HOM	Instruction	Mode

For more information, refer to '9.5 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	Port	Step

- Input port: Select Input port number.

  For more information of input port number, refer to '8.1.3 General Input (9)'.
- Step Number: 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	Port

- Input port: Select the input port number.

  For more information of input port number, refer to '8.1.3 General Input (9)'.

10.2.3　OPC (Output port ON/OFF)

It turns ON/OFF the selected output port.

Instruction	DATA		
OPC	Instruction	Port	OnOff

- Output port: Select the output port number.

  For more information of output port number, refer to '8.2.3 General Output (10)'.
- ON/OFF: When setting as Enable, it turns ON. When setting as Disable, it turns OFF.

10.2.4   OPT (Output port ON pulse)

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

Instruction	DATA			
OPT	Instruction	Port	Next	Time

■ Output port: Set the output port number.

For more information about output port number, refer to '8.2.3 General Output (10)'.

■ 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 level: Set the ON time for output port.

Set the On time level from 1 to 5.
When selecting On time level as 6, it is available to set as the desired value.
Setting range is 1 to 10,000 msec.

10.2.5   CMP (Compare output)

It outputs trigger pulse for the set period.

Instruction	DATA					
CMP	Instruction	Pos	Port	Mode	Width	Period

For more information, refer to '8.2.1.3 Compare1, Compare2'.

■ Position

: Set the trigger position of output signal.

Setting range is 1 to 10,000 msec

■ Compare Port

: Set the compare output port number.

■ Compare Mode

: Set the compare output mode.

■ Pulse Width

: Set the output pulse width.

Applied when compare mode is 3.

Setting range is 1 to 10,000 msec.

■ Pulse Period

: Set the output pulse period.

Applied when compare mode is 3.

Setting range is 1 to 2,147,483,647.

10.3 Program Control Instruction

10.3.1 JMP (Jump)

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

Instruction	DATA	
JMP	Instruction	Step

▪ Step Number

: 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 instruction to RPE (repeat end instruction).

Instruction	DATA	
REP	Instruction	Cnt

▪ 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.

```
05   REP   5
10   REP   10
15   REP   3
                    Repeat   Repeat    Repeat
20   REP            3 times  10 times  5 times
25   REP
30   REP
```
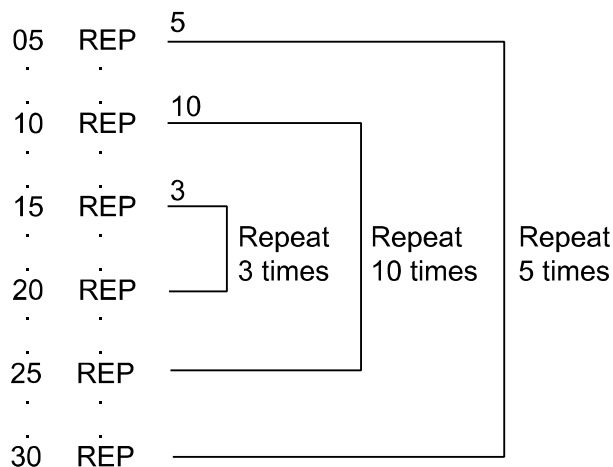
10.3.3   RPE (Repeat end)

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. You must enter this instruction at the end of program.

Instruction	DATA
END	Instruction

10.3.5   POS (Position set)

It sets the position value.

Instruction	DATA	
POS	Instruction	Pos

- Position

  : Set the position value.

    Setting range is -2,147,483,648 to +2,147,483,647.

10.3.6   TIM (Ready)

It is ready instruction for the set time.

Instruction	DATA	
TIM	Instruction	Delay

- Delay Time level

  : Set the wait time as msec.

    Set the Delay Time level from 1 to 5.

    When selecting Delay Time level as 6, it is available to set as the desired value.

10.4 Torque Mode Command

10.4.1 TOQ (Torque mode drive)

Run torque drive mode.

The drive speed is able to controll with T_Mode Limit Speed parameter.

Instruction	DATA		
TOQ	Instruction	Torque	Torque Time

- Torque

  : Set the torque on motor's output.

    Setting range is -100 to 100%.

    Operates CCW direction in –sign and CW direction in +sign.

- Torque Acc Time

  : Set the rise time until motor torque is output.

    Setting range is 0 to 5,000 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 +/- directions by drive instruction of a fixed or continuous pulse.

11.1.1.1 Fixed Pulse Drive

Fixed pulse drive is used to move something 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.
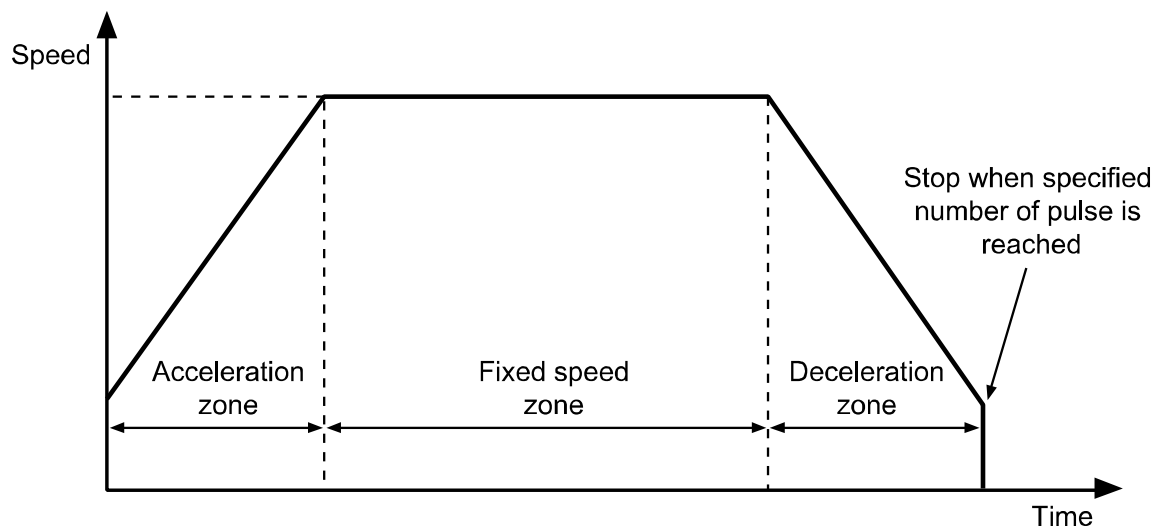
- Absolute position movement and relative position movement
  : There are absolute position movement and relative position movement.
    These are fixed pulse drive.
- Absolute position movement drives from home to the position of a specified distance.
  This is ABS command in program mode.
- Relative position movement sets a distance to drive from present coordinates.
  This is INC of program mode.

Ex.

- Example of Absolute position movement

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

  For example, if you execute the absolute position movement command ABS for 9,000 pulse 3 times, it moves to A in the image.

  In order to move to points A, B, C, as in an absolute position movement, you need to set ABS instruction for each of 9,000/18,000/27,000 pulse.
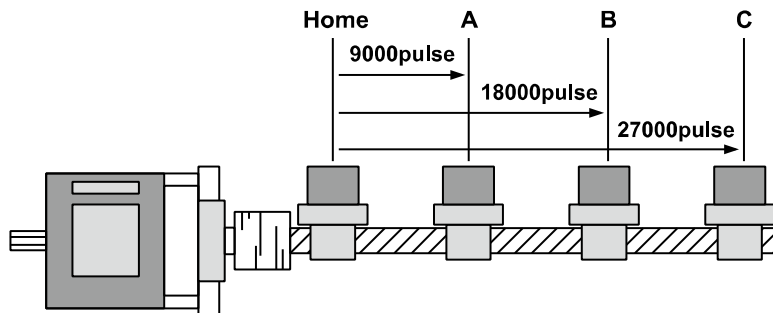
Ex.

- Example of relative position movement

  Move relative position works as shown in the image below.

  For example, if you execute relative position movement command INC for 9.000 pulse 3 times, it moves to points A→B→C.
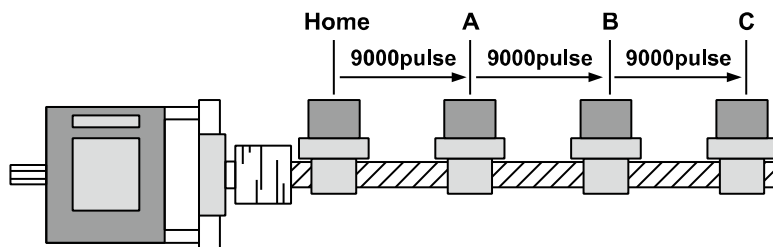
11.1.1.2 Continuous Drive

Continuous pulse drive outputs drive pulse sequentially until the stop command from the high level or external stop signal becomes active. Continuous mode and home search mode are in this category.

Decelerating stop and immediate stop are in stop instruction. Slow 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 operates speed curve of fixed speed, trapezoidal acceleration/deceleration, S-curve 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.
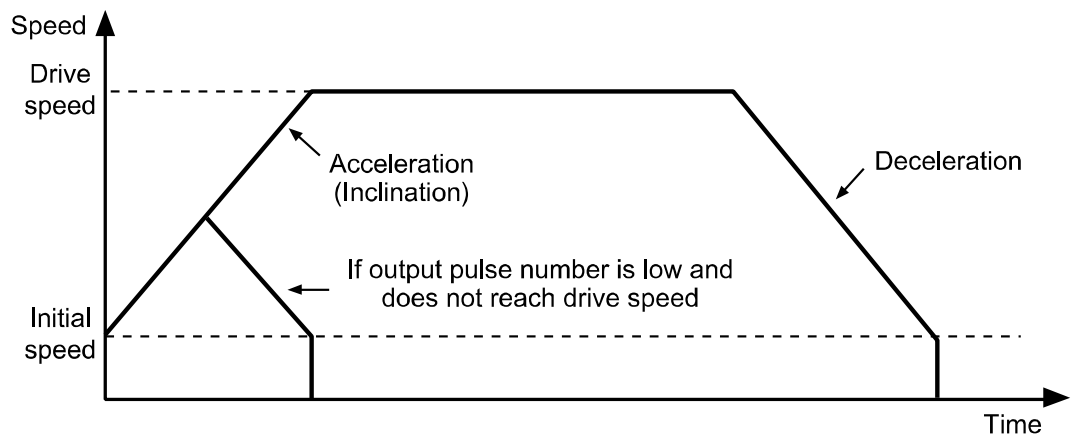
11.1.2.2   Symmetric Trapezoidal Acceleration/Deceleration Drive

- Trapezoidal acceleration/deceleration drive accelerates from initial speed to drive speed trapezoidally 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 arrives with not 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

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

  For moving the object to the vertical direction such as stacking device of semi-conductor 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,
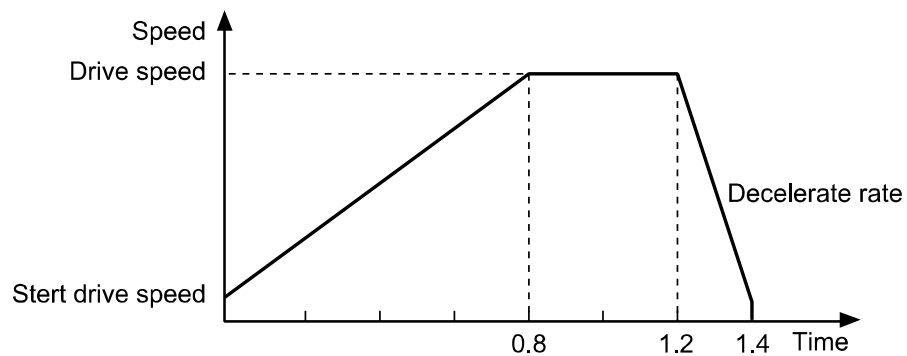
  - When acceleration speed is higher than deceleration speed,
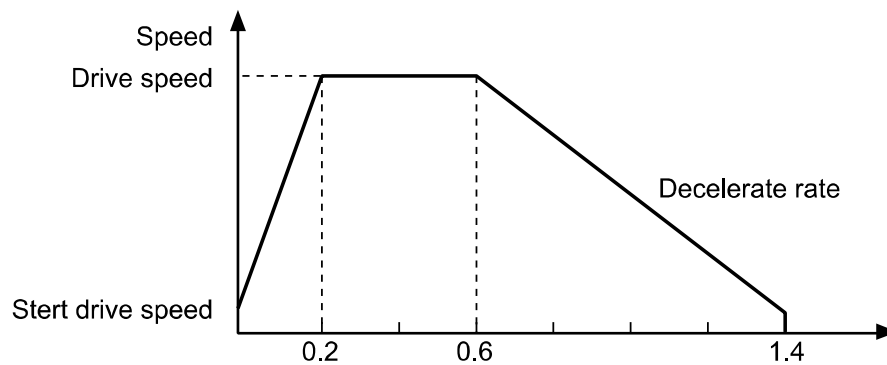
11.1.2.4   S Curve (S-curve acceleration/deceleration)

S curve generates an S shape speed curve according to linear increase/decrease of drive acceleration/deceleration.

It smoothly increases and reduces speed when starting and stopping, and helps achieve smoother operation.

Note

- a, b, c=Acceleration Time
- d, e, f=Deceleration Time
- S curve occurs at the a, c, d, f zones during the set "S Curve Time".
- When "S Curve Time" is set the half of "Acceleration Time (=Deceleration Time)", it operates S curve without b, e (trapezoidal zone).
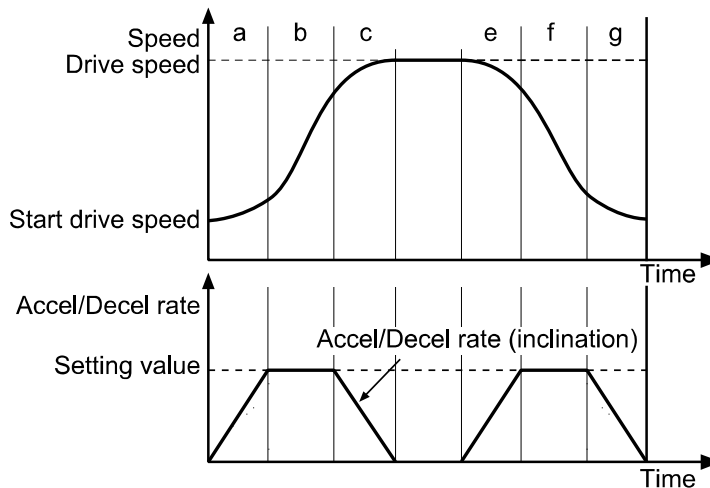
Caution

Precautions for S curve acceleration/deceleration drive

- In a fixed pulse S curve acceleration/deceleration drive, you cannot change speed while driving.
- At S-curve acceleration/deceleration fixed pulse drive, "S Curve Time (S-curve acceleration/deceleration time)" is set 1/2 of "Acceleration Time (=Deceleration Time)". If it is set over 1/2, the drive pulse ends during deceleration before arriving the start drive speed or it outputs the left drive pulses as start drive speed and does not stop even though arriving the start drive speed.
- During S curve operation, acceleration/deceleration time should be set as same. If it is set differently, deceleration time is set same as acceleration time.

📖 **Ex.**

- Example of S-curve acceleration/deceleration parameter setting (full S-curve acceleration/deceleration)

This example is S-curve acceleration with start drive speed 0 pps and max. drive speed 40 kpps during 0.4 sec. For full S-curve acceleration drive without trapezoidal zone, set the "S Curve Time" as 0.2 sec which is half of acceleration time.
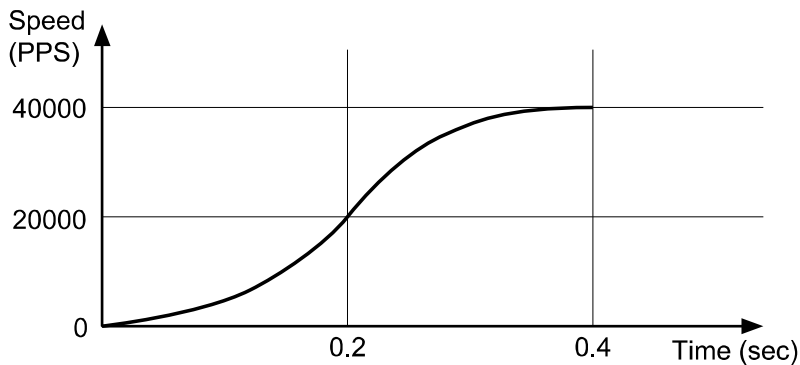
1st Start drive speed as 0 is ignored.

2nd This is full S-curve acceleration.

During 0.2 sec, it drives trapezoidal acceleration up to 20,000pps.

3rd At the left 0.2 sec, it drives trapezoidal deceleration up to 40,000pps.

For each setting value of parameters and descriptions, refer to the below table.

Parameter	Setting value	Description
Acceleration Time	4000 msec	For S-curve drive, acceleration/ deceleration time should be same.
Deceleration Time	4000 msec	
S Curve Time (S-curve acceleration/deceleration time)	2000 msec	For S-curve drive without trapezoidal, it should be set the half of acceleration/deceleration time.
Start Speed (start drive speed)	0 pps	-
Max Speed (max. drive speed)	40000 pps	-

■ Example of S-curve acceleration/deceleration parameter setting (partial S-curve acceleration/deceleration)

This example is S-curve acceleration with start drive speed 0 pps and max. drive speed 40 kpps during 0.6 sec. Follow the below graph.

1st Start drive speed as 0 is ignored.

2nd During 0.2 sec, it drives trapezoidal acceleration up to 10,000pps.

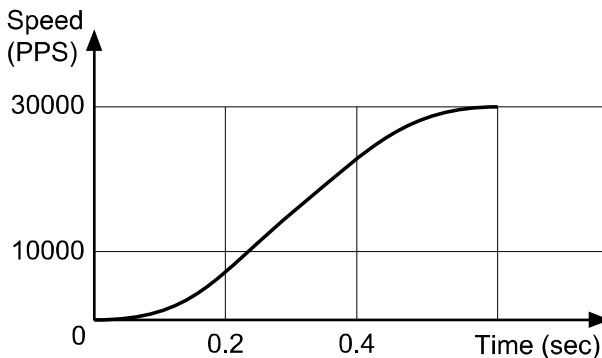3rd During 0.2 to 0.4 sec, it maintains the certain acceleration speed up to 30,000pps.

4th At the left 0.2 sec, it drives trapezoidal deceleration up to 40,000pps.

For each setting value of parameters and descriptions, refer to the below table.

Parameter	Setting value	Description
Acceleration Time	6000 msec	For S-curve drive, acceleration/deceleration time should be same.
Deceleration Time	6000 msec	
S Curve Time (S-curve acceleration/deceleration time)	2000 msec	It applies start drive speed + S Curve Time and max. drive speed - S Curve Time.
Start Speed (start drive speed)	0 pps	-
Max Speed (max. drive speed)	40000 pps	-

■ Comparing S curve and Trapezoid acceleration/deceleration drive

Trapezoid acceleration/deceleration may cause problems at start and end points in a very sensitive system. When used for a system that must be heavy, fast and accurate, and acceleration sharply changes at start and end points, it is hard on the system.

On the other hand, S curve smoothly increases acceleration at the start point and decreases it smoothly at the end point. Therefore S curve acceleration/deceleration is recommended for sensitive systems.

11.2 Other Functions

11.2.1 Limit Operation

Hardware and software limits can be used to stop drive.

- Hardware limit

  Install a limit sensor to the machine to monitor system operation directly. Connect Nlmt+/- (Pin19, 20) at I/O connector (CN3).

- Set Instant (instant stop) / Slow (deceleration stop) at Limit Stop Mode (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 ±software limit (±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.

11.2.2 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 accuracte control, check the in-position output before operating the next one.

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

12   Protection Function

12.1   Alarm

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

Note

※Depending on the alarm/warning type, it displays as a segment and indicator on the Alarm/Status display part.

1) Motor stops

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

No. of flashing	Alarm type	Desctiptions	Causes	Troubleshooting
7 (0 7)	Encoder connection error	When encoder cable connection error occurs at driver	1. Motor connector and cable connection error 2. Burnout of line driver IC in encoder	1. Check motor connector and cable connection. 2. Replace the line driver IC in encoder.
8 (0 8)	Over voltage error	When input voltage is over 24VAC +10%	1. Over load 2. Counter electromotive force overflow due to rapid deceleration	1. Change operation condition or reduce load so that sudden load fluctuation does not occur.
9 (0 9)	Under voltage error	When input voltage is under 24VAC-10%	1. Low voltage	1. Change operation condition or reduce load so that sudden load fluctuation does not occur.
10 (1 0)	Motor mis-alignment	When motor is in misalignment	1. Motor connector and cable connector error 2. Burnout of line driver IC in driver 3. Burnout of line driver IC in encoder 4. Burnout of the inverter in the driver	1. Check motor connector and cable connection. 2. Replace the line driver IC in driver. 3. Replace the line driver IC in encoder. 4. Replace burned parts of the inverter in the driver.
11 (1 1)	Input pulse error	When input pulse is over 3,500rpm When input pulse is input befor initial motor alignment	1. Enter error of user command speed input	1. Use recommended specifications. (max. 3,000rpm input) 2. Enter the speed value (PPS) by checking the resolution.
12 (1 2)	In-Position error	When position error (over 1) is kept over 3 sec, after motor stopped.	1. Over load 2. Lack of stop torque.	1. Change operation condition or reduce load so that sudden load fluctuation does not occur. 2. Increase stop torque as 50% or use the other motor with higher torque.
13 (1 3)	Memory error	When memory error is detected as power supplied	1. EEPROM error	1. Replace EEPROM parts.

2) Motor stops and maintains torque

No. of flashing	Alarm type	Desctiptions	Causes	Troubleshooting
14 (*14*)	Emer-gency 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.
15 (*15*)	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.
16 (*16*)	Index mode error	When other instruction is used but 'INC', 'ABS' When index command is not completed due to the stop command	1. When running a step with commands other than 'INC' and 'ABS'. 2. When entering the stop command during driving on index mode	1. Check whether the command of the step is 'INC' or 'ABS' 2. Check that the selected step number is correct.
17 (*17*)	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 a stop command is issued during home search operation	1. Check if the 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)

12.2   Warning

- This function notices dangers with the warning indicator prior to motor stop with limit signal or over load warning.
- When turning out from the warning 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 displays as a segment and indicator on the Alarm/Status display part.

1) Motor stops and maintains torque

No. of flashing	Warning type	Desctiptions	Causes	Troubleshooting
1	S/W +Limit	When normal direction (CW) software limit is ON	1. When the current position reaches the S/W + Limit value	1. Check S/W + Limit parameter value.
2	S/W -Limit	When reverse direction (CCW) software limit is ON	1. When the current position reaches the S/W - Limit value	1. Check S/W - Limit parameter value.
3	H/W +Limit	When normal direction (CW) hardware limit is ON	1. When + Limit signal (I/O no. 19-pin) is input	1. Check the + Limit signal is input correctly. 2. Check if the +/- Limit signal is correctly set with the motor rotation direction. (CW direction: + Limit, CCW direction: - Limit)
4	H/W -Limit	When reverse direction (CCW) hardware limit is ON	1. When - Limit signal (I/O no. 20-pin) is input	

2) Maintains torque

No. of flashing	Warning type	Desctiptions	Causes	Troubleshooting
5	Over load warning	When maximum load is kept connected over 10 sec	1. Over load	1. Change operation condition or reduce load so that sudden load fluctuation does not occur.

13   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.
	Motor gain value is not correct.	Change the Motor Gain parameter as the certain value.

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