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2017-04-26

Delta ASDA-A3 Series Servo Drive User Manual

Delta ASDA-A3 Series Servo Drive User Manual

www.deltaww.com

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Preface

Thank you for purchasing this product. This manual provides information about the ASDA-A3 series servo drive (A3) and the ECM-A3 series servo motor.

This manual includes:

- Installation and inspection of servo drive and servo motor
- Servo structure and wiring diagram
- Instructions for trial operation
- Instructions for servo tuning
- Description of parameters
- Description of communication protocol
- Troubleshooting
- Inspection and maintenance

ASDA-A3 product features:

Delta has developed a new control algorithm that enables you to easily overcome the problems of a lack of stiffness or flexibility in the machine structure. The new automatic tuning function is more user-friendly and allows you to complete tuning easily. In addition, you can use the gain adjustment function to improve the performance of the drive. Its compact design can reduce the space required inside the cabinet. The smaller design of the new generation of the ECM-A3 series servo motor can also meet the need to reduce equipment structures' size and weight.

How to use this manual:

You can use this manual as a reference when installing, setting up, using, and maintaining the servo drive. Before initiating the tuning or setup process, please read through Chapters 1 to 5. You can also use the Table of Contents and the Index to quickly locate the information you need.

DELTA technical services:

Please consult your DELTA equipment distributor or DELTA Customer Service Center if you encounter any problems.

Safety Precautions

ASDA-A3 is a high resolution, open type servo drive. It should be installed in a shielded control box during operation. This product uses precise feedback control and a digital signal processor (DSP) with high-speed calculation functions to control the current output generated by IGBT to operate three-phase permanent magnet synchronous motors (PMSM) and to achieve precise positioning.

The ASDA-A3 series are used in industrial applications and should be installed in the control box.
Servo drives, wires, and motors should all be installed in an environment which complies with the minimum requirement of UL50 Type 1.

Pay special attention to the following safety precautions at all times during inspection, installation, wiring, operation, maintenance, and examination of the servo drive.

The symbols of “DANGER”, “WARNING”, and “STOP” indicate:

DANGER	**Danger. May cause severe or fatal injuries to personnel if the instructions are not followed.**
WARNING	**Warning. May cause moderate injury to personnel, or lead to severe damage or even malfunction of the product if the instructions are not followed.**
STOP	**Absolutely prohibited activities. May cause serious damage or even malfunction of the product if the instructions are not followed.**

Inspection

DANGER

Please follow the instructions when using the A3 servo drive and servo motor, or it may cause fire or malfunction.

Installation

DANGER

Do not expose the product to an environment containing water, corrosive gas, inflammable gas...etc., or it may result in electric shock or fire.

Wiring

DANGER

- Connect the ground terminals to class-3 ground system. Ground resistance should not exceed 100 Ω. Improper grounding may result in electric shock or fire.
- Do not connect the three-phase source to the motor output terminals U, V, and W, or it may cause personnel injury or fire.
- Please tighten the screws of the power and motor output terminals, or it may cause fire.
- Please refer to description of wire selection in Chapter 3 to prevent any danger.

Operation

- Before operating, please change the parameter setting according to the application. If the parameters are not adjusted to the correct values, it may lead to malfunction of the machine or the operation might be out of control.
- Before the machine starts to operate, please ensure that the emergency stop can be activated at any time.
- When applying power, please make sure the motor is not rotating because of inertia of the machine or other causes.

During the operation, do not touch any rotating motor parts, or it may cause personnel injury.

- To avoid accidents, please remove all units during the first test run, so that the motor is operating without any load.
- If you fail to operate the machine properly after connecting the servo motor to the equipment, it may damage the equipment and lead to personnel injury.
- In order to reduce the danger, it is strongly recommended that you check if the motor can operate normally without load first. Then try operating the motor with load.
- Do not touch the heat sink of the servo drive during operation, or it may cause burns.

Maintenance and Inspection

- Do not touch the internal parts of the servo drive and servo motor, or it may cause electric shock.
- Do not disassemble the servo drive panel when the power is on, or it may cause electric shock.
- Do not touch the ground terminal within 10 minutes after turning off the power, or the residual voltage may cause electric shock.
- Do not disassemble the motor, or it may cause electric shock or personnel injury.
- Do not change the wiring when the power is on, or it may cause electric shock or personnel injury.
- Only qualified electricians can install, wire, and maintain the servo drive and servo motor.

Main Circuit Wiring

- Do not put the power cable and signal cable in the same channel or bond them together. Separate the power cable and signal cable by at least 30 centimeters (11.8 inches).
- Please use stranded wires and multi-core shielded-pair wires for signal cables and encoder feedback cables. The maximum length of signal input cable is 3 meters (9.84 feet) and the maximum length of feedback cable is 20 meters (65.62 feet).
- The high voltage may remain in the servo drive immediately after the power is turned off. Please wait for 10 minutes before touching the terminals.

Do not repeatedly turn the power on and off. If it is necessary to turn the power on and off, make sure that you wait one minute at least before turning the power on or off again.

Terminal Wiring of the Main Circuit

- When wiring the servo drive, please remove the terminal blocks from the servo drive.
- Insert only one electric wire per terminal socket.
- When inserting the electric wires, do not short circuit the adjacent conductors.
- Before connecting to the power source, please inspect and ensure that the wiring is correct.

Leakage Current

- The leakage current of the servo drive is greater than 3.5 mA.
- According to the IEC 61800-5-1 standards, the wires must comply with one of the following specifications to ensure proper grounding:
  1. Copper wire cross-sectional area is at least 10 mm^2.
  2. Aluminum wire cross-sectional area is at least 16 mm^2.
- Failure to comply with the specifications may result in personnel injury.
- Before applying power, please inspect and ensure that the wiring is correct.

Note: the content of this manual may be revised without prior notice, please download the latest version from Delta's website (http://www.deltaww.com).

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Before Operation

1 Product Overview

2 Installation

3 Wiring

4 Trial Operation and Panel Display

Tuning

5 Tuning

Operation and Motion control

6 Operation Mode

7 Description of Motion Control

Parameter Setting

8 Parameter

9 MODBUS Communication

10 Absolute System

Troubleshooting

11 Troubleshooting

Appendix

A Specifications

B Accessories

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Product Overview

1

Before using the ASDA-A3 series servo drive, please pay attention to the description of the inspection, nameplate, and model type. You can find a suitable motor model for your A3 servo drive in the table in Section 1.3.

1.1 Components of the servo set

A complete servo set includes:

(1) A servo drive and a servo motor.

(2) A UVW motor power cable: one end of the U, V, and W wires connects to the servo drive and the other end to the motor (Optional purchase).

(3) A green ground wire: it connects to the ground terminal of servo drive (Optional purchase).

(4) An encoder cable: one end of it connects the encoder and other end to the CN2 on the servo drive (Optional purchase).

(5) Communication type converter box (Optional purchase).

(6) A 26-pin connector for the communication type converter box (Optional purchase).

(7) A 50-pin connector for CN1 (Optional purchase).

(8) A 6-pin connector for CN2 (Optional purchase).

(9) An RJ45 connector for CN3, which you use for general (RS-485) and high-speed (CANopen) communication (Optional purchase).

(10) A 4-pin connector for CN4 (Mini-USB connector) (Optional purchase).

(11) Power supply for the servo drive:

Model	Control circuit	Main circuit
100 W - 400 W	L1c, L2C, P1, P2, ⊖ quick connector	R, S, T quick connector

(12) A 3-pin quick connector (U, V, W).

(13) A 3-pin quick connector (P3, D, C).

(14) A plastic lever.

(15) Two metal pieces for short circuiting the terminal block.

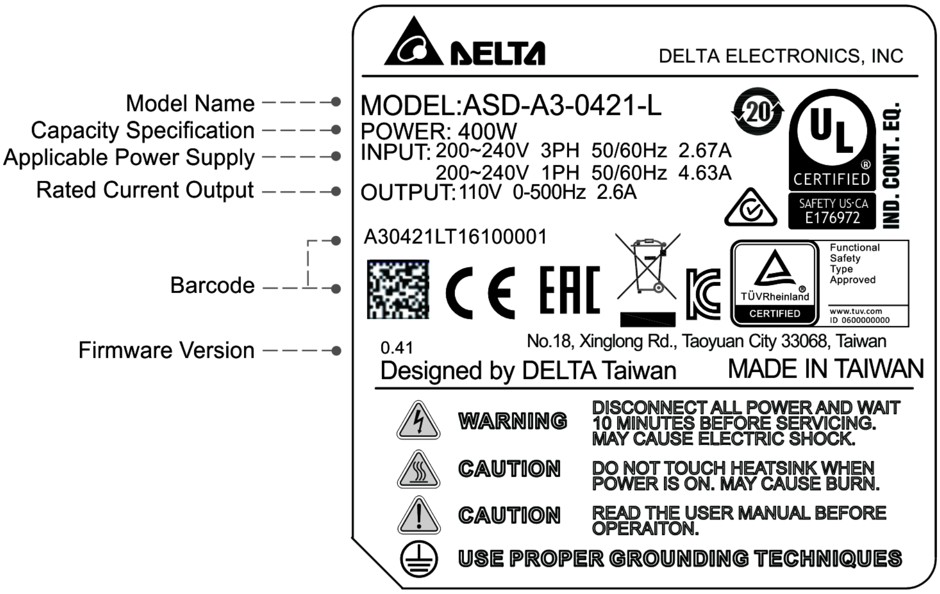
(16) An installation instruction sheet.

1.2 Model overview

1.2.1 Nameplate information

ASDA-A3 series servo drive

- **Nameplate information**



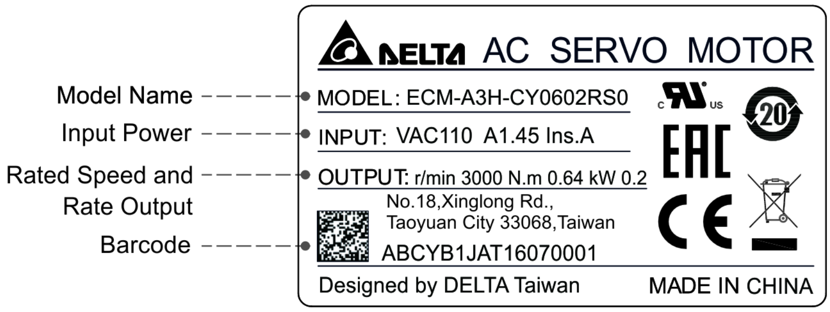
- **Serial number**

A30421L	T	15	07	0006
(1)	(2)	(3)	(4)	(5)

(1) Model name
(2) Manufacturing plant (T: Taoyuan; W: Wujiang)
(3) Year of production (15: year 2015)
(4) Week of production (From 1 to 52)
(5) Serial number (Production sequence in a week, starting from 0001)

ECM-A3 series servo motor

■ **Nameplate information**



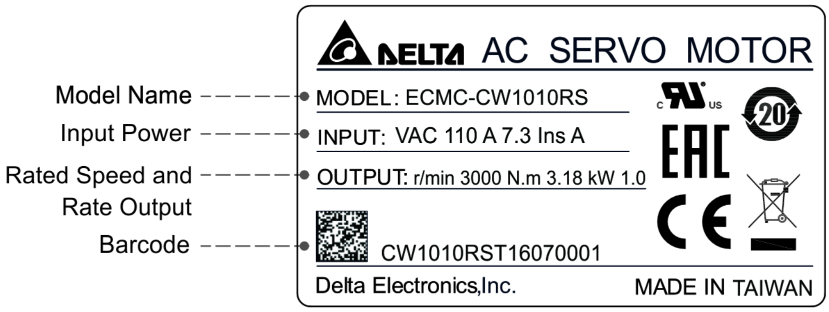
■ **Serial number**

ABCYA3AA	T	16	07	0001
(1)	(2)	(3)	(4)	(5)

(1) Model name
(2) Manufacturing plant (T: Taoyuan; W: Wujiang)
(3) Year of production (16: year 2016)
(4) Week of production (From 1 to 52)
(5) Serial number (Production sequence in a week, starting from 0001)

ECMC series servo motor

■ **Nameplate information**



■ **Serial number**

CW1010RS	T	16	07	0001
(1)	(2)	(3)	(4)	(5)

(1) Model name
(2) Manufacturing plant (T: Taoyuan; W: Wujiang)
(3) Year of production (16: year 2016)
(4) Week of production (From 1 to 52)
(5) Serial number (Production sequence in a week, starting from 0001)

1.2.2 Model explanation

ASDA-A3 servo drive

ASD – A3 – 04 21 – L

(1) (2) (3) (4) (5)

(1) Product name

AC Servo Drive

(2) Series

A3

(3) Rated output power:

Code	Spec.	Code	Spec.	Code	Spec.
01	100 W	07	750 W	20	2.0 kW
02	200 W	10	1.0 kW	30	3.0 kW
04	400 W	15	1.5 kW	-	-

(4) Input voltage and phase

21: 220V, single / three-phase

23: 220V, three-phase

(5) Model type:

Type	Pulse input	RS-485	CANopen	Full-closed loop control	Analog voltage control	DMCNET	E-CAM	STO
L	○	○	×	○	○	×	×	×
M*	○	○	○	○	○	×	○	○
F*	×	×	×	○	×	○	○	×

Note: models with an * means that this type of motor is coming soon.

1

ECM-A3 series servo motor

ECM	-	A	3	H	-	C	Y	06	04	R	S	1
(1)		(2)	(3)	(4)		(5)	(6)	(7)	(8)	(9)	(10)	(11)

(1) Product name

ECM: Electronic Communication Motor

(2) Servo type

A: High precision servo motor

(3) Series

3: A3 series

(4) Inertia

H: High inertia

L: Low inertia

(5) Rated voltage and speed

C: 200V and 3,000 rpm

(6) Encoder type

Y: 24-bit absolute type encoder (resolution of single turn: 24-bit; resolution of multiple turns: 16-bit)

(7) Motor frame size

04: 40 mm

06: 60 mm

08: 80 mm

(8) Rated power output

Code	Spec.	Code	Spec.
0F	50 W	04	400 W
01	100 W	07	750 W
02	200 W		

(9) Type of shaft and oil seal

	w/o brake w/o oil seal	with brake w/o oil seal	w/o brake with oil seal	with brake with oil seal
Round shaft (with fixed screw holes)	-	-	C*	D*
Keyway (with fixed screw holes)	P*	Q*	R	S

Note: models with an * means that this type of motor is coming soon.

(10) Shaft diameter

S: Standard

7: 14 mm (specific)

(11) Special code

1: Standard products

1

ECMC series servo motor

ECM	C	-	C	W	13	08	R	S
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)

(1) Product name

ECM: Electronic Communication Motor

(2) Servo type

C: High-precision AC servo motor (Suitable for CNC applications)

(3) Rated voltage and speed

C: 200V and 3,000 rpm

E: 200V and 2,000 rpm

F: 200V and 1,500 rpm

(4) Encoder type

W: 22-bit Absolute type (resolution of single turn: 22-bit; multiple turns: 16-bit)

(5) Motor frame size

10: 100 mm

13: 130 mm

18: 180 mm

(6) Rated power output

Code	Spec.	Code	Spec.
08	850 W	18	1.8 kW
10	1.0 kW	20	2.0 kW
13	1.3 kW	30	3.0 kW
15	1.5 kW	-	-

(7) Type of shaft and oil seal

	w/o brake w/o oil seal	with brake w/o oil seal	w/o brake with oil seal	with brake with oil seal
Round shaft (with fixed screw holes)	-	-	C	D
Keyway (with fixed screw holes)	-	-	R	S

(8) Shaft diameter

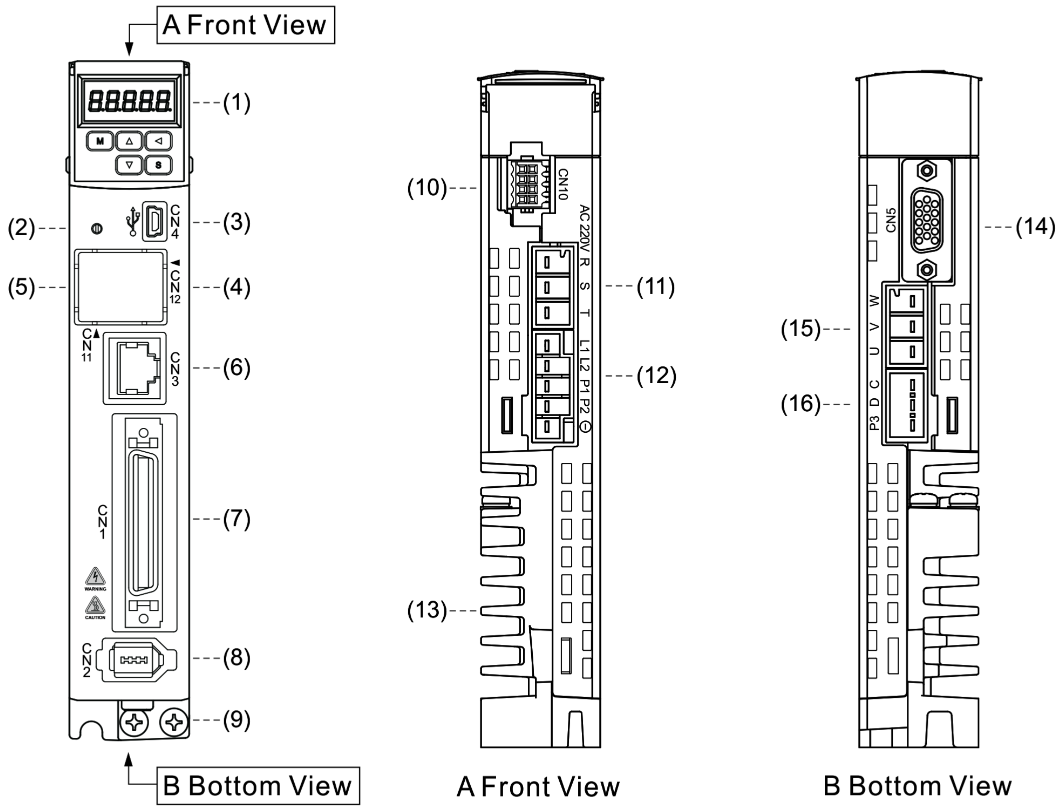
S: Standard

1.3 ASDA-A3 servo drive and motor

Motor							Servo drive		
Series		Power	Output (W)	Model number	Rated current (Arms)	Max. instan-taneous current (A)	Model number	Conti-nuous output current (Arms)	Max. instan-taneous output current (A)
Low inertia	ECM-A3L 3000 rpm	Single-/Three-phase	50	ECM-A3L-C①040F②③1	0.67	2.62	ASD-A3-0121	0.9	3.54
			100	ECM-A3L-C①0401②③1	0.89	3.5			
			200	ECM-A3L-C①0602②③1	1.45	5.55	ASD-A3-0221	1.55	7.07
			400	ECM-A3L-C①0604②③1	2.65	9.2	ASD-A3-0421	2.6	10.61
			400	ECM-A3L-C①0804②③1	2.6	8.6			
			750	ECM-A3L-C①0807②③1	5.1	15.9	ASD-A3-0721	5.1	21.21
Medium inertia	ECMC-C 3000 rpm	Single-/Three-phase	1000	ECMC-C①1010②③	7.3	21.9	ASD-A3-1021	7.3	24.75
	ECMC-E 2000 rpm	Single-/Three-phase	1000	ECMC-E①1310②③	5.6	16.8			
			1500	ECMC-E①1315②③	8.3	24.9	ASD-A3-1521	8.30	35.36
			2000	ECMC-E①1320②③	11.01	33	ASD-A3-2023	13.40	53.03
			2000	ECMC-E①1820②③	11.22	33.7			
			3000	ECMC-E①1830②③	16.1	48.3	ASD-A3-3023	19.40	70.71
	ECMC-F 1500 rpm	Three-phase	3000	ECMC-F①1830②③	19.4	58.2			
High inertia	ECM-A3H 3000 rpm	Single-/Three-phase	50	ECM-A3H-C①040F②③1	0.67	2.68	ASD-A3-0121	0.9	3.54
			100	ECM-A3H-C①0401②③1	0.9	3.52			
			200	ECM-A3H-C①0602②③1	1.45	5.7	ASD-A3-0221	1.55	7.07
			400	ECM-A3H-C①0604②③1	2.65	10.2	ASD-A3-0421	2.6	10.61
			400	ECM-A3H-C①0804②③1	2.6	9.4			
			750	ECM-A3H-C①0807②③1	4.5	16.6	ASD-A3-0721	5.1	21.21
	ECMC-F 1500 rpm	Single-/Three-phase	850	ECMC-F①1308②③	7.1	19.4	ASD-A3-1021	7.3	24.75
			1300	ECMC-F①1313②③	12.6	38.6	ASD-A3-2023	13.40	53.03
			1800	ECMC-F①1318②③	13	36			

Note: in the servo motor model name, ① signifies the encoder type; ② signifies brake or keyway / oil seal type; ③ signifies the shaft diameter.

1.4 Description of the drive interface



No.	Description	No.	Description
(1)	7-segment display	(9)	Ground terminal: connects to grounding wire for the power supply and servo motor.
(2)	CHARGE: power indicator	(10)	CN10 – STO (Safety Torque Off)
(3)	CN4 - Mini USB connector: connects to PC	(11)	RST main circuit terminal: connects to the commercial power source (AC200 – 230V, 50 / 60 Hz).
(4) (5)	CN12, CN11: reserved	(12)	L1c / L2c control circuit terminal: for single-/three-phase power supply (200 – 230 V_{AC}, 50 / 60 Hz)
(6)	CN3 - RS-485 and high speed communication connector: connects to controller and communication ports.	(13)	Heat sink: for securing the servo drive and heat dissipation.
(7)	CN1 - I/O signal interface: connects to PLC and controls I/O.	(14)	CN5 - Connector for transmitting feedback signals.
(8)	CN2 - Encoder connector: connects to the encoder.	(15)	UVW motor power output: connects to motor power connector (UVW). Do not connect to the main circuit power. Incorrect wiring will damage the servo drive.
(16)	Regenerative resistor: a. Install the external regenerative resistor: P3 and C contacts connect to the resistor; P3 and D contacts are left open. b. To use the built-in regenerative resistor: P3 and C contacts are left open; P3 and D contacts are short circuited (connected). c. Connect external regenerative brake unit: P2 and ⊖ contacts connect to the brake unit; P3 & C contacts and P3 & D contacts are left open.		

Installation 2

Please follow the instructions in this chapter during installation. This chapter includes information about the circuit breaker, fuse, EMI filter selection, and the regenerative resistor.

2

Safety precautions:

If the connection between the servo drive and servo motor is over 20 meters, please increase the gauge of the UVW connecting wire and the encoder cable. Please refer to Section 3.1.6 for the wire specification.

2.1 Ambient storage conditions

Before installation, this product must be kept in the shipping carton. In order to retain the warranty coverage and for maintenance, please follow the instructions below for storage.
While the product is temporarily not in use:

- Store the product in an ambient temperature range of -20°C to +65°C.
- Store the product in a relative humidity range of 0% to 90% and a non-condensing environment.
- Avoid storing the product in an environment containing corrosive gas.

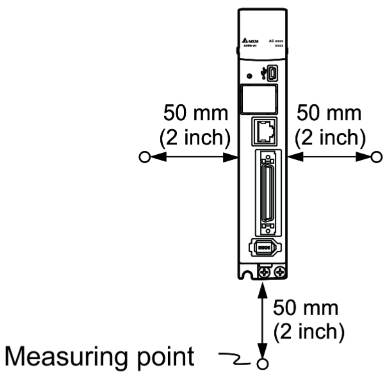
2.2 Ambient installation conditions

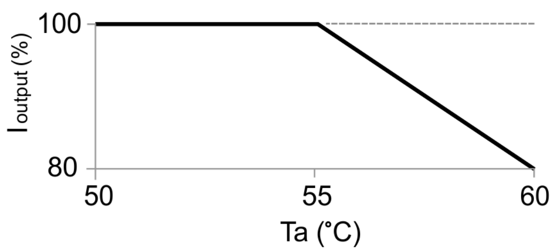
WARNING

A3 servo drive: the installation location should be free of devices that generate excessive heat, water, vapor, dust, and oily dust, corrosive and inflammable gas and liquids, airborne dust and metal particles, or vibration and electronic interference.

Motor: the ambient temperature for the motor location should be between 0°C and 40°C. The installation location should be free of heat-generating devices, water, vapor, dust and oily dust, corrosive and inflammable gas and liquids, airborne dust and metal particles.

The ambient temperature for the servo drive should be between 0°C and 55°C. If the temperature is over 45°C, please place the product in a well-ventilated environment. During long-term operation, the ambient temperature should be under 45°C to ensure the servo drive's performance. If the product is installed in an electric box, make sure the servo drive is vertically mounted with a fan installed on the box. Allow 5 cm of clearance beneath and on both sides of the servo drive. Its temperature must be kept under 55°C and it must be kept clear of heat sources. Ensure the size of the electric box and ventilation to prevent overheating and endangering the internal electronics of the device. In addition, check if the machine's vibration affects the electrical devices in the electric box.





I output (%) is the current output percentage %;

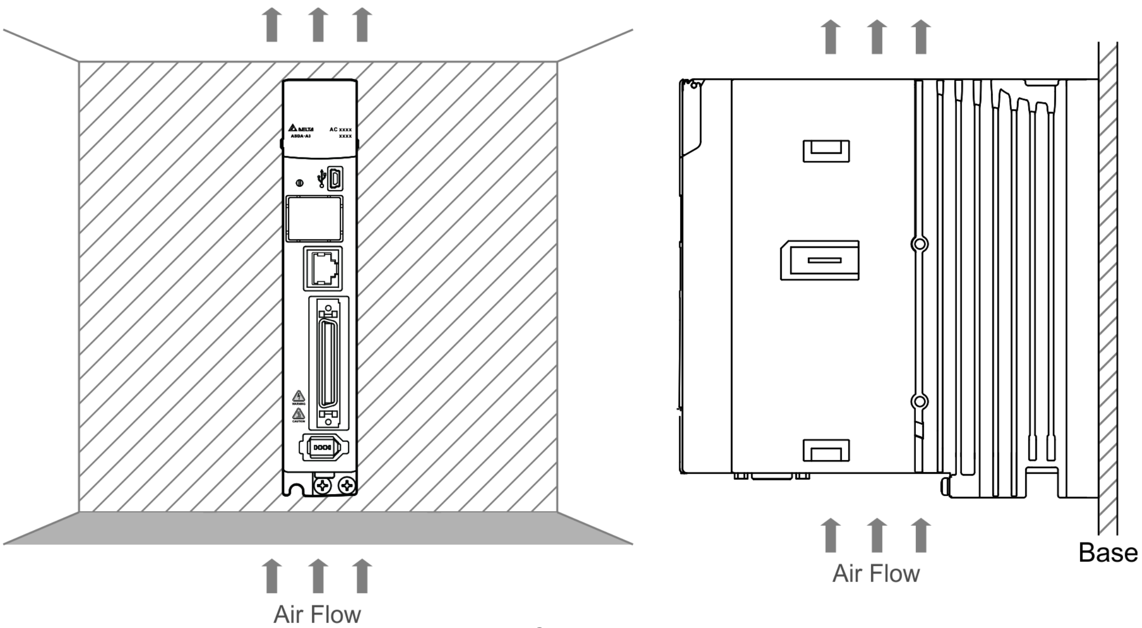
Ta is the operation temperature

Note: the maximum operation temperature of models of 750W (or above) is 60°C, but the output current is reduced as shown in the figure above; the maximum operation temperature for models of 400W (or below) is 55°C.

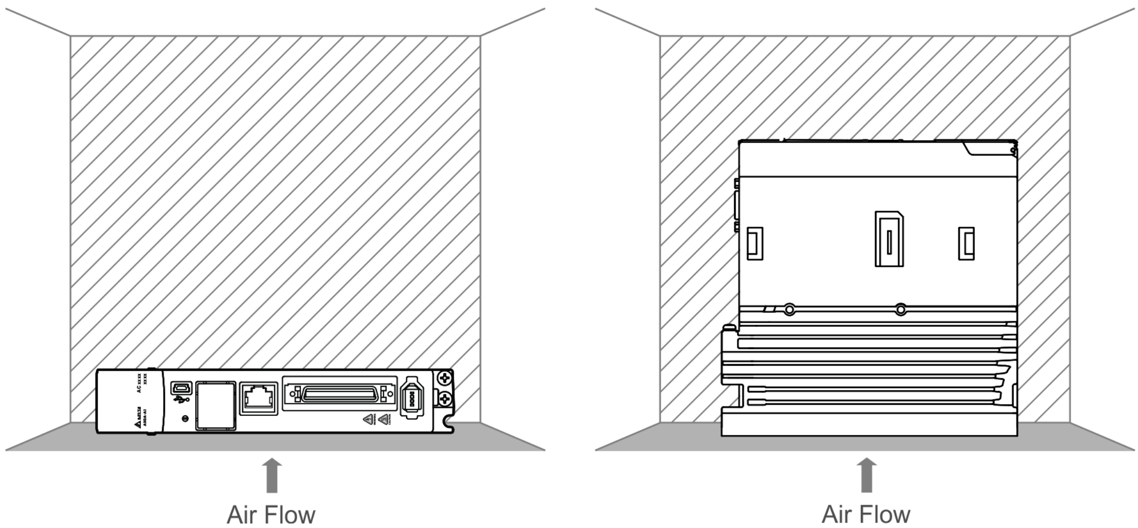
2.3 Mounting direction and space

Attention:

- Mount the servo drive according to the illustration below. The base of heat sink must be mounted vertically on the wall. Incorrect installation may result in a drive malfunction.
- For better ventilation and cooling, make sure there is sufficient space between the adjacent objects and the wall; otherwise, product malfunction may occur.
- Do not obstruct the ventilation holes when mounting the servo drive. Make sure you mount it in the correct orientation or malfunction may occur.



Correct



Incorrect

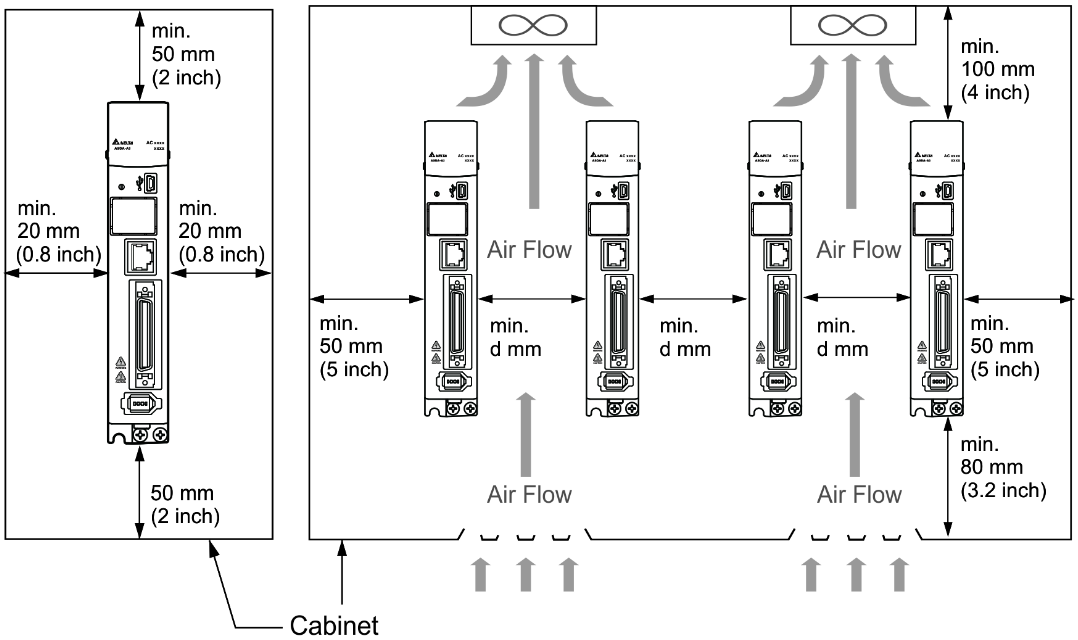
2

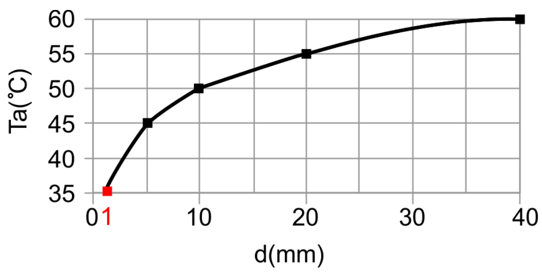
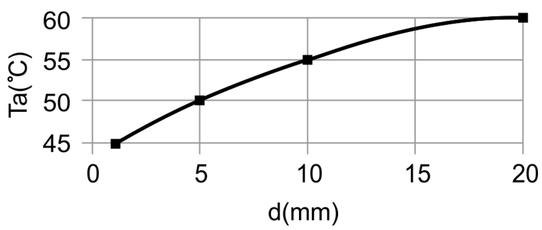
Heat dissipation requirements:

In order to have adequate air flow for ventilation, please follow the suggested clearances when installing one or more servo drives (refer to the following diagrams). Avoid mounting one servo drive above one another. Keep the bottom of the servo drive clear because the generated heat rises and causes higher temperature for the drives mounted above.

Note: the diagrams below are not accurately scaled. Please refer to the annotations on the diagrams.

Single servo drive **Multiple servo drives**



Servo drive model	Cooling method	Operating temperature (Ta) corresponding to minimum clearance (d) *Due to the assembly tolerance, the minimum clearance for the servo drive is 1 mm.
ASD-A3-0121-□ ASD-A3-0221-□ ASD-A3-0421-□	Natural cooling	
ASD-A3-0721-□ ASD-A3-1021-□ ASD-A3-1521-□ ASD-A3-2021-□	Natural cooling & forced cooling	

Note: the maximum operating temperature for models of 750W (or above) is 60˚C, but the output current will be reduced as shown in the figure above; the maximum operating temperature for models of 400 W (or below) is 55˚C.

2

2.4 Safety precautions for using motors

The Delta AC servo motor is designed for industrial applications. It is necessary that you fully understand the motor specifications and operation manual. For your safety and correct use, please carefully read the manual, specifications, and precautions for the motor before connecting the motor to any equipment.

The safety precautions are as follows:

Handling, mounting, and storage

- When removing or installing a servo motor, please hold the whole motor instead of holding the cable or only the motor shaft.
- Do not hit the motor shaft. Impact force will damage the encoder that is attached at the rear end of shaft.
- Keep the axial or radial load within the allowable range listed in the specifications.
- The shaft of servo motor is not water- or oil-proof. Do not use, install, or store the servo motor in a humid environment that contains water, oil, corrosive gases, or liquids.
- The material of motor shaft is not rust-proof. Although the rust-proof oil has been applied to the shaft during the manufacturing process, you must check the shaft condition and apply rust-proof oil every three (3) months if storing the motor for more than six (6) months.
- Ensure that the environmental conditions for storing the servo motor conform to the specifications in the instruction sheet.
- The encoder attached to the motor is easily damaged; please take the necessary steps to avoid electric interference, vibration, and abnormal temperature changes.

Wiring

- If the current exceeds the maximum current in the Specifications, the internal parts of the motor may lose their magnetism. Please contact the distributor or local Delta sales representative if this problem occurs.
- Please check that the motor wiring and the voltage of the motor brake are correct. Also, make sure that the wiring of the encoder signal and power cables is correct. Incorrect wiring will lead to abnormal operation of motor, malfunction, or damage.
- To avoid capacitive coupling and noise, isolate the motor power cable from the encoder power and signal cables. Do not connect them to the same circuit.
- The AC servo motor must be correctly grounded.

- The encoder connector must not undergo any high-voltage component test because it will damage the encoder.
- When the motor or brake is undergoing high-voltage component tests, please cut off the power supply of the controller. You should perform this kind of test only when necessary so as to protect the product lifespan.

Operation

- AC servo motor operation is controlled by the servo drive. Do not directly connect a commercial type power source (100/200V, 50/60 Hz) to the servo motor circuit; otherwise, the motor cannot operate normally and may be permanently damaged.
- Follow the motor specifications when using the product. The motor's operation temperature must not exceed the specified range.
- The material of the motor shaft is not rust-proof. To ensure a longer motor life, please apply rust-proof oil during operation.
- The built-in brake is for clamping the motor. Do not use it for stopping the motor.
  Caution: the built-in brake is not a device for safely stopping the machine. Please install another safety stopping device for the machine. When the built-in brake is clamping the motor, rotation backlash can still occur and the maximum rotation is 1° – 2°. When a motor with a brake is operating, the brake lining sometimes generates a noise (a swishing or clicking sound). This is caused by the structure of brake module and is not a malfunction. It will not affect the motor's function.
- If any odor, noise, smoke, vapor, or abnormal vibration occurs during motor operation, please stop the motor and turn off the power immediately.

Others

- Delta servo motor has no user-replaceable parts.
- Do not disassemble the motor or change its parts. This will void the warranty.
- Do not disassemble the motor by yourself. Permanent damage or malfunction of the motor may occur.
- Do not splash any water or oil on the product.

2

2.5 Specifications for the circuit breaker and fuse

Servo drive model	Circuit breaker	Fuse (Class T)
ASD-A3-0121-☐	5A	5A
ASD-A3-0221-☐	5A	5A
ASD-A3-0421-☐	10A	10A
ASD-A3-0721-☐	10A	20A
ASD-A3-1021-☐	15A	25A
ASD-A3-1521-☐	20A	40A
ASD-A3-2023-☐	30A	50A
ASD-A3-3023-☐	30A	70A

Note:

1. ☐ in the servo drive model name signifies model type.
2. Operation mode: General.
3. If the servo drive is equipped with a residual-current circuit breaker for electricity leakage protection, then to avoid incorrect operation of the RCD, please select the circuit breaker with sensitivity of at least 200 mA and with minimum 0.1 sec working time.
4. Select Type B residual-current circuit breaker (with time delay) ONLY if the system ground wire may contain DC electricity.
5. Please use the circuit breaker and fuse that comply with the UL / CSA standard.

2.6 Ferrite ring

The movable or round-shaped ferrite ring is usually made of Mn-Zn ferrite. The impedance of the ferrite ring varies with frequency. Normally, its impedance is relatively small to a low-frequency signal; however, when the frequency of the signal increases, the impedance may increase dramatically. Use the ferrite ring to optimize signal transmission and suppress high-frequency noise, and reduce high-frequency interference in the power and signal cables.

Ferrite ring model	Applicable servo drive model
ASD-ACFC7K00	ASD-A3-4523-☐, ASD-A3-5523-☐, ASD-A3-7523-☐, ASD-A3-1B23-☐, ASD-A3-1F23-☐
	ASD-A3-2043-☐, ASD-A3-3043-☐, ASD-A3-4543-☐, ASD-A3-5543-☐, ASD-A3-7543-☐, ASD-A3-1B43-☐, ASD-A3-1F43-☐

Note: ☐ in the servo drive model name signifies model type.

Installation precautions

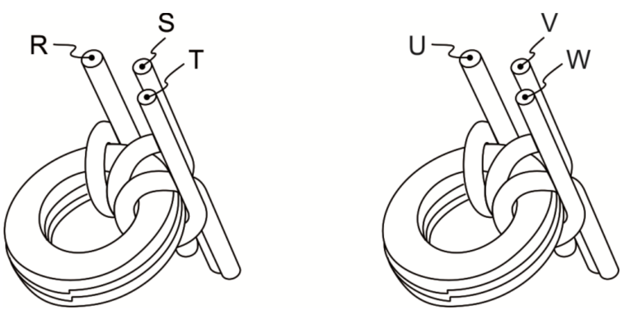
The ferrite ring is commonly used when peripheral devices (such as controller) are affected by noise from conduction and radiation when the servo motor is in the Servo On state. The parasitic capacitance between the cables in the wiring panel and the ground is typically small. As the frequency of the signal increases (Servo On state), the resistance of the parasitic capacitance becomes small enough to let common-mode current flow through. Normally, common-mode current only leads to common-mode interference due to an unstable circuit caused by a poor connection between the power circuit and ground. If the common-mode current flows through the external cables, common-mode interference may also happen due to electrical interference caused by unstable electric potential.

The ferrite ring causes eddy current losses to high-frequency signal and transforms it into heat when suppressing common-mode interference. The ferrite ring acts as a low-pass filter to effectively suppress high-frequency noise and ensure the stability of the circuit while the impedance to low-frequency signals is relatively small.

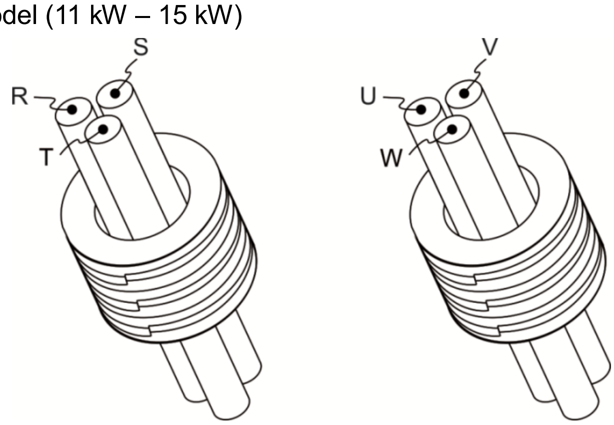
Winding several turns of wire onto the ferrite ring can increase inductance and the ability to filter out high-frequency noise.

The suggested winding methods are shown below:

1. For A3-220V model (4.5 kW – 7.5 kW)



2. For A3-220V model (11 kW – 15 kW)



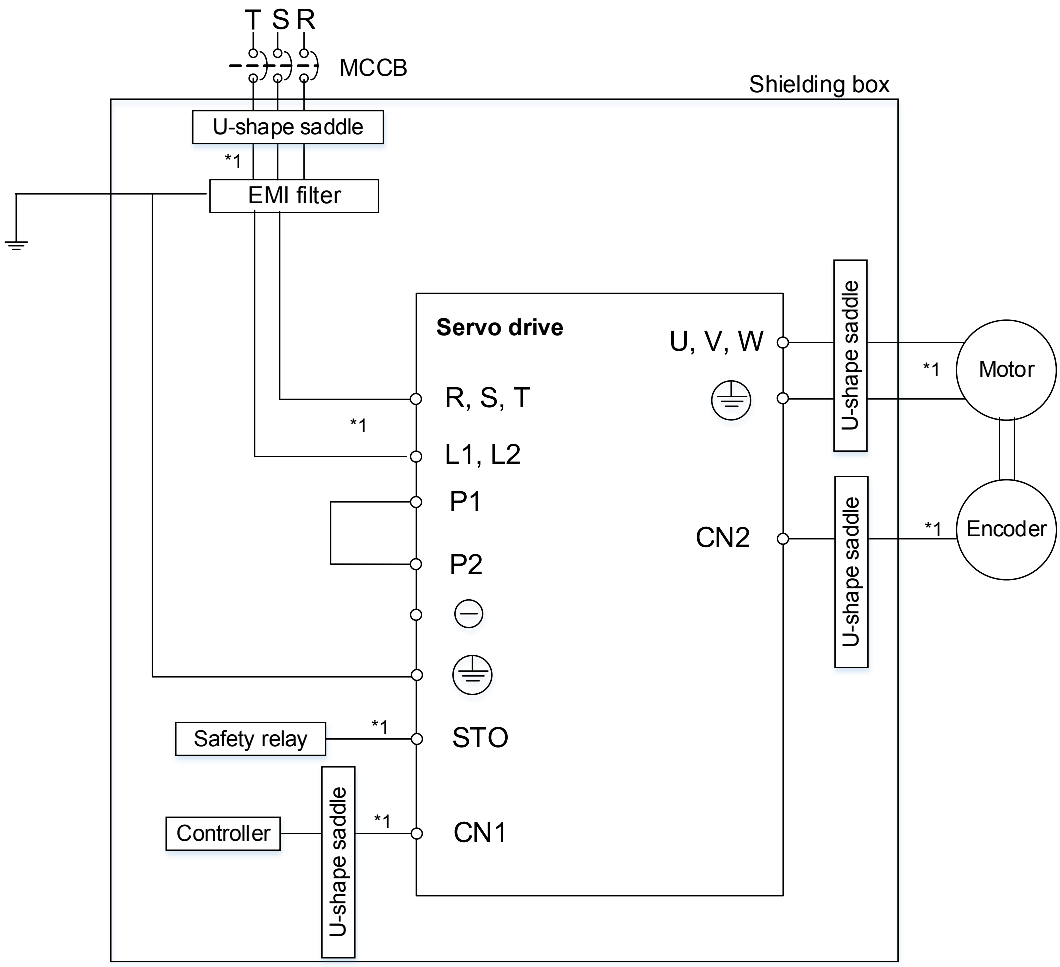
Note:

1. Please refer to Section 3.1.4 for the selection of the motor power cable.
2. Only the motor power cable or power cable can run through ferrite ring. If needed, please prepare extra ferrite rings for grounding.
3. An EMI filter may be required for absorbing radiation when using a longer motor power cable.

2

2.7 Installation requirements for EMC

This section illustrates the installation requirements for passing the EMC test. Please note that the EMC rating varies based on the installation structure or wiring. Delta servo products are designed to conform to the specifications of the EMC test. Please refer to the following diagram for the standard installation.



Note:

*1. Please use shielded wires.

2.7.1 EMI filters

All electronic equipment (including servo drives) generates high or low frequency noise during operation, which interferes with peripheral equipment through conduction or radiation. With an EMI filter and the correct installation, you can eliminate much of the interference. For better performance, using Delta's EMI filter to suppress the interference is recommended.

2

Power	Servo drive model	Recommended EMI filter		Foot print
		1PH	3PH	
100 W	ASD-A3-0121-☐	RF007S21AA	RF022B43AA	N
200 W	ASD-A3-0221-☐	RF007S21AA	RF022B43AA	N
400 W	ASD-A3-0421-☐	RF007S21AA	RF022B43AA	N
750 W	ASD-A3-0721-☐	RF007S21AA	RF037B43BA	N
1000 W	ASD-A3-1021-☐	RF007S21AA	RF037B43BA	N
1500 W	ASD-A3-1521-☐	RF015B21AA	RF037B43BA	N
2000 W	ASD-A3-2023-☐	-	RF037B43BA	N
3000 W	ASD-A3-3023-☐	-	RF037B43BA	N

Note: ☐ in the servo motor model name signifies the model type.

General precautions for installation

To ensure the best performance of the EMI filter, apart from the instructions on installation and wiring of servo drive, please observe the precautions below:

1. The servo drive and EMI filter should be mounted on the same metal plate.
2. The wiring should be as short as possible.
3. The metal plate should be well grounded.

More specifications for mounting the servo drive are listed below:

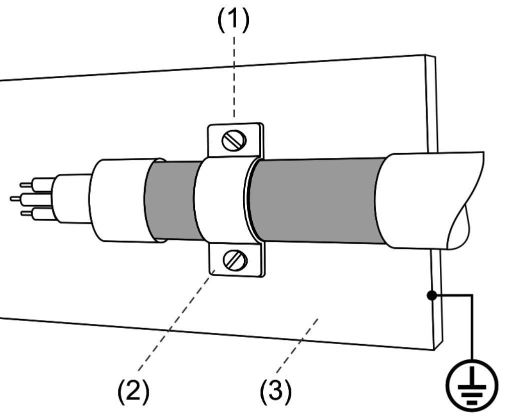
1. EN61000-6-4 (2001)
2. EN61800-3 (2004) PDS of category C2
3. EN55011+A2 (2007) Class A Group 1

2

Motor cable selection and installation precautions

The selection of motor cables (please refer to Appendix B Accessories) and installation determines the performance of the EMI filter. Please follow the precautions below.

1. Use a cable that has braided shielding (the effect of double shielding is better).
2. The shield on both ends of the motor cable should be grounded with the shortest cable length and the largest contact area.
3. Remove the protective paint on the U-shape saddle and metal plate in order to ensure good contact. Please see the figure below.
4. A correct connection between the braided shielding of the motor cable and the metal plate is required. The braided shielding on both ends of the motor cable should be fixed by the U-shape saddle and metal plate. Please see the figure below for the correct connection.



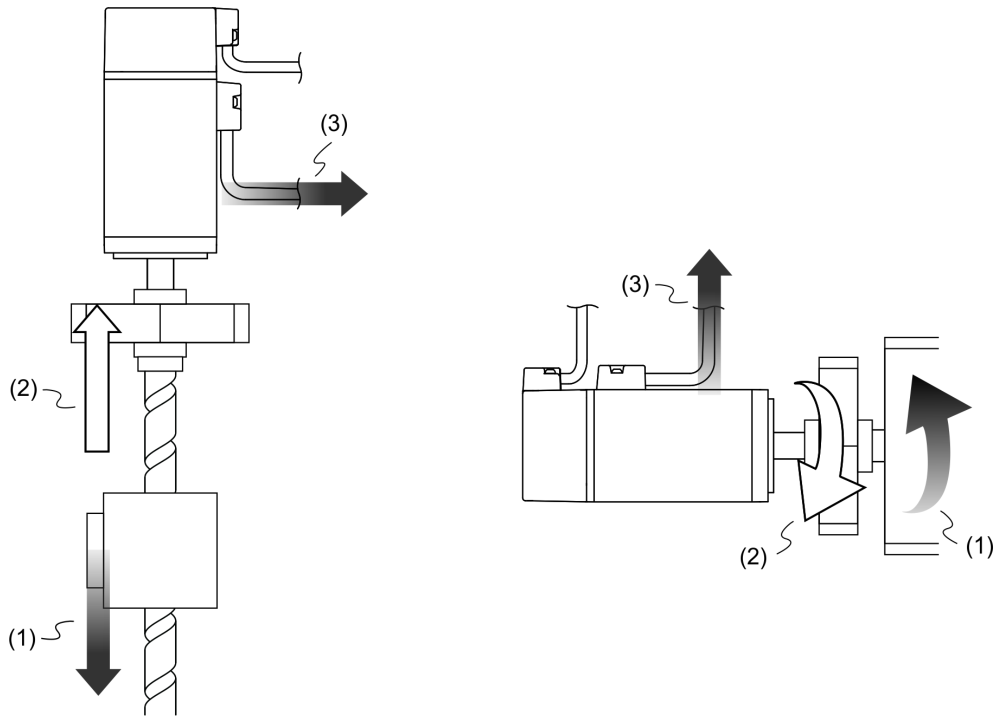
(1) The protective paint of the U-shape saddle and metal plate should be removed in order to ensure good contact.

(2) U-shape saddle

(3) Well-grounded metal plate

2.8 Selecting the regenerative resistor

When the direction of torque is different from the direction of rotation, the energy generated returns to the servo drive from the load. This energy is turned into electricity in the capacitance of the DC Bus and thus increases the voltage. When the voltage reaches a given value, it is consumed by a regenerative resistor. The servo drive has a built-in regenerative resistor. You can also use the external regenerative resistor if needed.



(1) Moving direction of the object; (2) Direction of torque; (3) Regenerative energy

The built-in regenerative resistor in the ASDA-A3 is as follows:

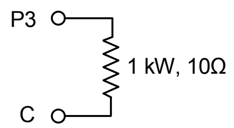
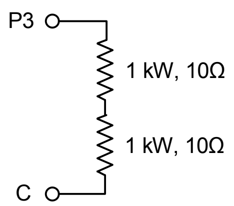
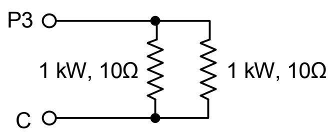
Servo drive (kW)	Built-in regenerative resistor specifications		Built-in regenerative resistor capacity (Watt)	Minimum allowable resistance (connected to external resistor) (Ohm)
	Resistance (P1.052) (Ohm)	Capacity (P1.053) (Watt)		
0.1	-	-	-	60
0.2	-	-	-	60
0.4	100	40	20	60
0.75	100	40	20	60
1.0	100	40	20	30
1.5	100	40	20	30
2.0	20	80	40	15
3.0	20	80	40	15

2

When the regenerative energy exceeds the capacity of built-in regenerative resistor, you should use an external regenerative resistor. Please pay special attention to the following when using an external regenerative resistor.

1. Please choose the correct resistance (P1.052) and capacity (P1.053) for the regenerative resistor; otherwise it might influence the performance.
2. When using an external regenerative resistor, please note that its resistance must be greater than the resistance of the built-in regenerative resistor. For general application, you can connect more than one resistor in series. If the value (from resistors connected in series) exceeds the rated range, you can reduce the value by connecting the resistor in parallel.
   If you want to connect the resistors in parallel to increase the power of the regenerative resistor, please make sure the capacitance meets the requirements.

   See the following diagram and settings for connecting the regenerative resistors in serial and parallel.

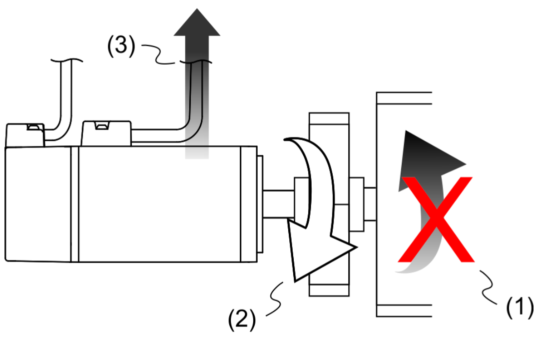
Connect to one external regenerative resistor 	Settings: P1.052 = 10 (Ω) P1.053 = 1000 (W)
Connect to external regenerative resistors (serial connection) 	Settings: P1.052 = 20 (Ω) P1.053 = 2000 (W)
Connect to external regenerative resistors (parallel connection) 	Settings: P1.052 = 5 (Ω) P1.053 = 2000 (W)

3. Normally, if the capacity of the regenerative resistor (the average value) is within the rated capacity, the temperature of the resistor can increase to 120°C or even higher (under the condition that the regenerative energy continues to function). For safety reasons, please use forced cooling in order to reduce the temperature of the regenerative resistor. Alternatively, you can use regenerative resistors that are equipped with thermal switches. Please contact your distributor for the load characteristics of the regenerative resistor.

When using an external regenerative resistor, the resistor should connect to P3, C terminal; and the contact of P3, D terminal should be left open. It is recommended that you choose the above mentioned resistance. For easy calculation of the regenerative resistor capacity, except for the energy consumed by IGBT, there are two ways provided to calculate the capacity according to the selected linear motor or rotary motor.

Rotary Motor:

(a) Calculation of the regenerative power when there is no external torque



(1) Direction of motion of the object; (2) Force direction of the motor;

(3) Regenerative power generated while the motor decelerates

If the motor is making a reciprocating motion, the regenerative resistor consumes the spare energy. You can select the regenerative resistor by calculating the regenerative power. Refer to the following table when calculating and selecting the required regenerative resistor.

	Servo drive (kW)	Motor	Rotor inertia (× 10-4kg.m2)	Regenerative power generated when the motor decelerates from 3000 rpm to 0 without load Eo (joule)	Max. regenerative power of the capacitance Ec (joule)
Low inertia	0.05	ECM-A3L-C$\boxed{1}$040F$\boxed{2}\boxed{3}$1	0.0231	0.11	8.42
	0.1	ECM-A3L-C$\boxed{1}$0401$\boxed{2}\boxed{3}$1	0.0405	0.20	8.42
	0.2	ECM-A3L-C$\boxed{1}$0602$\boxed{2}\boxed{3}$1	0.09	0.45	8.42
	0.4	ECM-A3L-C$\boxed{1}$0604$\boxed{2}\boxed{3}$1	0.15	0.74	8.42
	0.4	ECM-A3L-C$\boxed{1}$0804$\boxed{2}\boxed{3}$1	0.352	1.76	8.42
	0.75	ECM-A3L-C$\boxed{1}$0807$\boxed{2}\boxed{3}$1	0.559	2.54	26.21
Medium inertia	1.0	ECMC-C$\boxed{1}$1010$\boxed{2}\boxed{3}$	2.65	13.1	26.21
	1.0	ECMC-E$\boxed{1}$1310$\boxed{2}\boxed{3}$	8.41	18.48	26.21
	1.5	ECMC-E$\boxed{1}$1315$\boxed{2}\boxed{3}$	11.2	24.62	26.21
	2.0	ECMC-E$\boxed{1}$1320$\boxed{2}\boxed{3}$	14.6	32.09	34.94
	2.0	ECMC-E$\boxed{1}$1820$\boxed{2}\boxed{3}$	34.7	76.26	34.94
	3.0	ECMC-E$\boxed{1}$1830$\boxed{2}\boxed{3}$	55	120.88	34.94
	3.0	ECMC-F$\boxed{1}$1830$\boxed{2}\boxed{3}$	55	67.99	34.94

	Servo drive (kW)	Motor	Rotor inertia (× 10-4kg.m2)	Regenerative power generated when the motor decelerates from 3000 rpm to 0 without load Eo (joule)	Max. regenerative power of the capacitance Ec (joule)
High inertia	0.05	ECM-A3H-C[1]040F[2][3]1	0.043	0.21	8.42
	0.1	ECM-A3H-C[1]0401[2][3]1	0.0742	0.37	8.42
	0.2	ECM-A3H-C[1]0602[2][3]1	0.25	1.24	8.42
	0.4	ECM-A3H-C[1]0604[2][3]1	0.45	2.23	8.42
	0.4	ECM-A3H-C[1]0804[2][3]1	0.914	4.55	8.42
	0.75	ECM-A3H-C[1]0807[2][3]1	1.51	7.47	26.21
	0.85	ECMC-F[1]1308[2][3]	13.6	16.81	26.21
	1.3	ECMC-F[1]1313[2][3]	20	24.73	26.21
	1.8	ECMC-F[1]1318[2][3]	24.9	30.78	26.21

Note:

1. [1] in the servo motor model name signifies the encoder type.
2. [2] in the servo motor name signifies brake or keyway / oil seal type.
3. [3] in the servo motor model name signifies shaft diameter.
4. The * signifies that this model is coming soon.

Assume that the load inertia is N times the motor inertia, and when motor decelerates from 3000 rpm to 0, the regenerative power is (N+1) × Eo and the regenerative resistor needs to consume (N+1) × Eo - Ec joules. Assume that the reciprocate operation cycle is T sec, then the required power of regenerative resistor = 2× ((N+1)× Eo - Ec) / T.

The calculation is as follows:

Step	What to do	Calculation and setting method
1	Set the capacity of the regenerative resistor to the maximum.	Set P1.053 to the maximum value
2	Set the operation cycle (T)	Manual input
3	Set the rotation speed (wr)	Manual input or read the status with P0.002
4	Set the load / motor inertia ratio (N)	Manual input or read the status with P0.002
5	Calculate the maximum regenerative resistor (Eo)	$Eo = J*wr^2/182$
6	Find the regenerative power that can be absorbed by the capacitor (EC)	Refer to the table above
7	Calculate the required capacity of the regenerative resistor	2 × ((N+1)× Eo - Ec) / T

Example:

For the motor ECM-A3L-CY0604RS1 (400 W), the reciprocating motion cycle is T = 0.4 sec. Its maximum speed is 3000 rpm and the load inertia is 15 times of the motor inertia.

Servo drive (kW)	Motor	Rotary inertia J (× 10-4kg.m2)	Regenerative power generated when the motor decelerates from 3000 rpm to 0 without load Eo (joule)	Max. regenerative power of the capacitance Ec (joule)
0.4	ECM-A3L-CY0604RS1	0.15	0.74	8.42

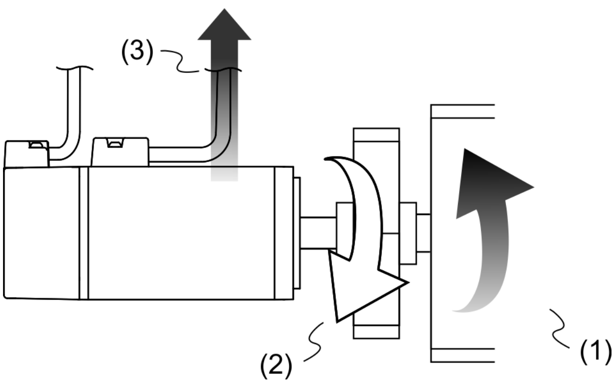
Find the maximum regenerative power: Eo = 0.74 joules (from the table).

Find the regenerative power that can be absorbed by the capacitor; Ec = 8.42 joules (from the table).

The required capacity of the regenerative resistor = $\frac{2\times((\mathrm{N}+1)\times E_0 - E_c)}{\mathrm{T}} = \frac{2\times((15+1)\times 0.74 - 8.42)}{0.4}$ = 17.1 W.

From the calculation above, the required power of regenerative resistance is 17.1 W, which is smaller than the specified capacity. In this case, a built-in 40 W regenerative resistor fulfills the need. In general, the built-in regenerative resistor can meet the requirement when the external load is not too great.

(b) Calculation of the regenerative power when there is external torque and the motor does the negative work.



(1) Direction of motion of the object; (2) Force direction of the motor; (3) Regenerative power

Usually, the motor does positive work and the motor's torque direction is identical to the rotation direction. However, in some instances, the motor's torque direction is opposite to the rotation direction. This means the motor is doing negative work and the external power is applied to the servo drive through the motor. For instance, if the external force direction is identical to the rotation direction (such as vertical downward motion of the machine), the servo system outputs more power to counterbalance the excessive external load (the weight of vertical-mounted machine) in order to keep up with the specified target speed. In this case, considerable power returns to the servo drive. When DC Bus is full and cannot store more power, this power is consumed by the regenerative resistor.

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Example:

For a 400 W motor (ECM-A3L-CY0604RS1), and the torque of the external load is +70% of the rated torque (1.27 N-m) with rotation speed up to 3000 rpm, the required external regenerative resistance is:

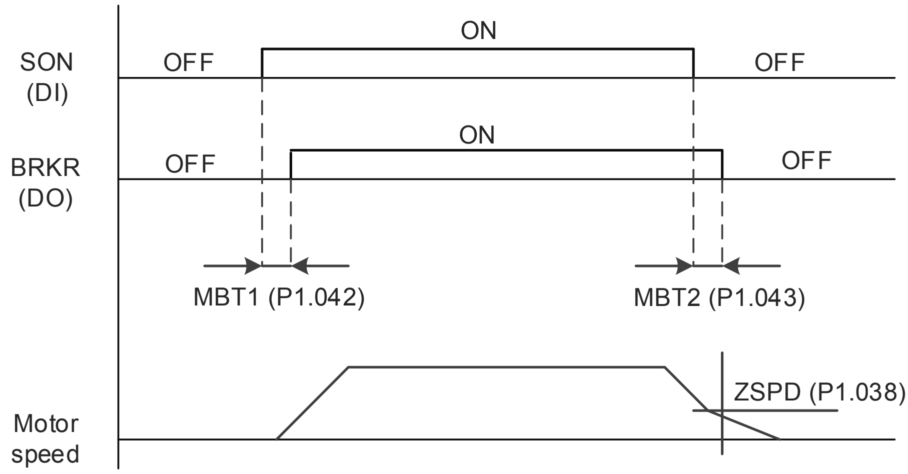
$2 \times (0.7 \times 1.27) \times (\frac{3000 \times 2 \times \pi}{60})$ = 558 W

So, a regenerative resistor of 560 W and 40Ω is needed.

2.9 The use of braking

A brake is usually used for motions in Z-axis direction because gravity causes the mechanism to fall. A brake can prevent the mechanism from falling and greatly reduce the motor's resistance output. The motor lifespan could be reduced due to resistance and excessive heat generation. To avoid incorrect operation, the brake can be enabled only when the servo is switched off. The servo drive controls the brake with DO. If DO.BRKR is set to off, it means the brake is not operating and the motor is clamped. If DO.BRKR is set to on, it means the brake is operating and the motor can run freely. You can use MBT1 (P1.042) and MBT2 (P1.043) to set the delay time.

Timing diagram of brake control:

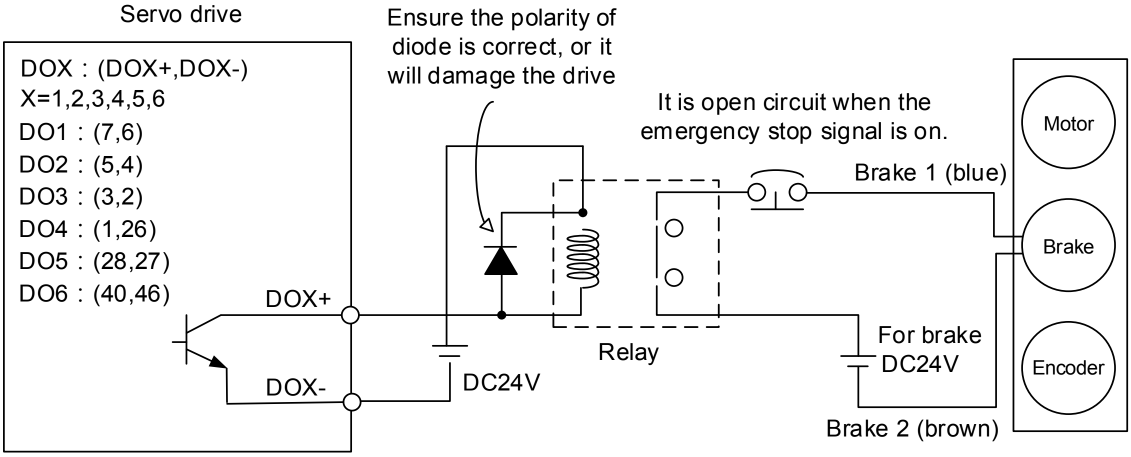


Output timing of the BRKR signal:

1. When the servo drive is off and the time set for P1.043 is exceeded, but the motor speed is still higher than the speed set for P1.038, DO.BRKR ends off (the motor is clamped).
2. When the servo drive is off and the time set for P1.043 is not yet reached, but the motor speed is already lower than the speed set for P1.038, DO.BRKR is off (the motor is clamped).

2

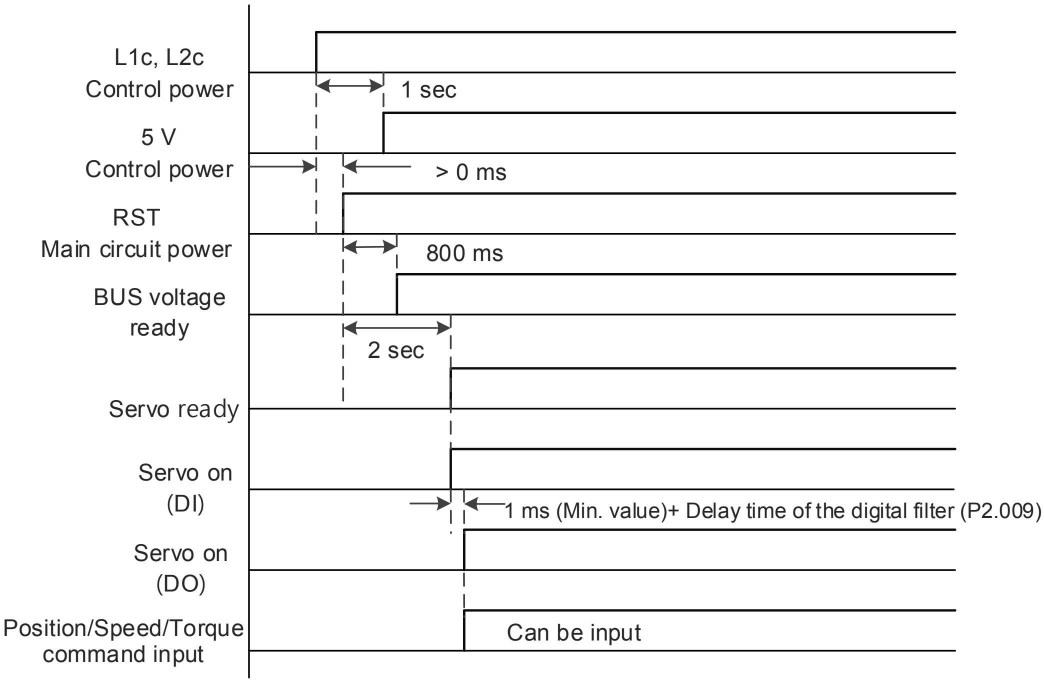
Wiring of the brake:



Note:

1. Please refer to Chapter 3 Wiring.
2. The brake signal controls the solenoid valve, providing power to the brake and enabling the brake.
3. Please note that there is no polarity for the coil brake.

Timing diagram of control power and main power:



Calculating the brake's rated current (ECM-A3L-CY0604RS1 is used as an example here).

Power consumption of the brake (20°C) = 6.5 W (refer to Appendix A Motor specifications),

so the brake's rated current = $\frac{6.5\ \mathrm{W}}{24\mathrm{V}}$ = 0.27 A

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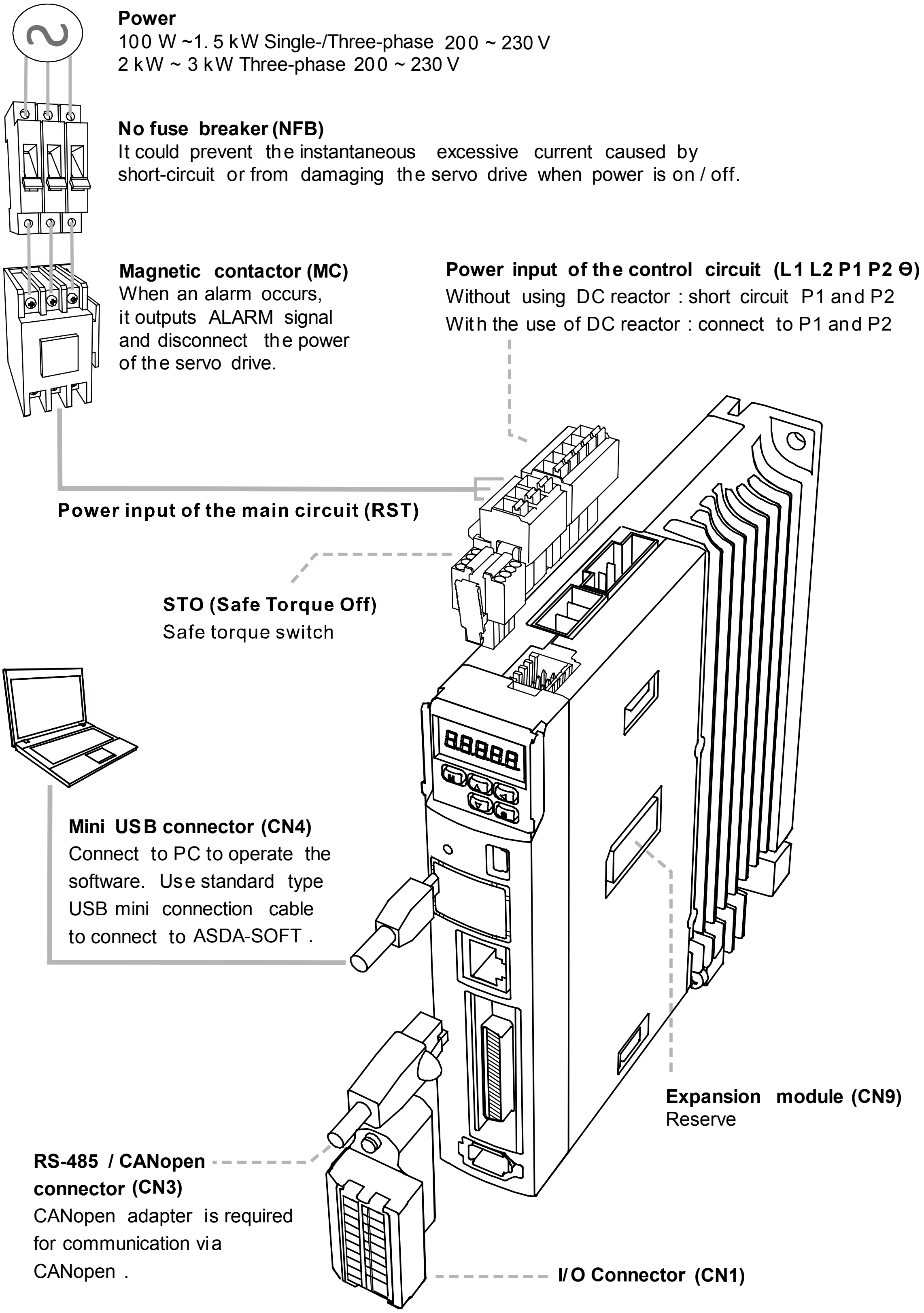
Wiring 3

This chapter illustrates the power supply circuit, connectors, and wiring for each mode of the ASDA-A3.

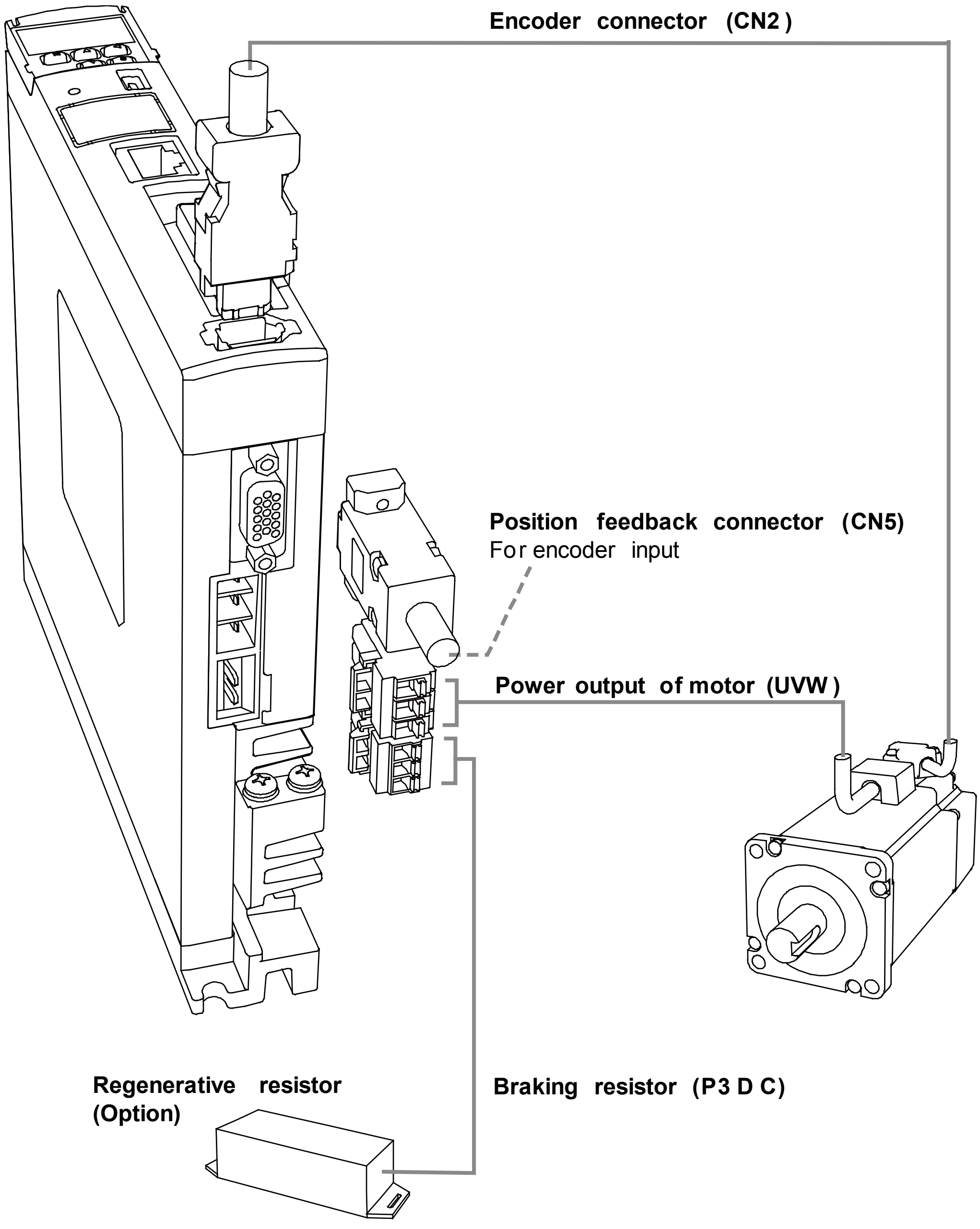
3.1 System connection

3.1.1 Connecting to peripheral devices (connecting to Delta communication type of servo motor)



Connecting to peripheral devices (connecting to Delta communication type of servo motor)

3



Installation safety precautions:

1. Make sure the power and wiring connections between the R, S, T, and L1, L2 are correct. Please refer to Appendix A Specifications in this user manual for the correct voltage input to avoid any damage to the servo drive and dangerous operating conditions.

2. Make sure the UVW terminal block is correctly wired to avoid abnormal operation of the motor.

3. When using the external regenerative resistor, the contact between P3 and D should be open and the external regenerative resistor should connect to P3 and C. When using the internal regenerative resistor, the contact between P3 and D should be short-circuited and the contact between P3 and C should be open.

4. When an alarm occurs or the system is under emergency stop status, please use DO.ALARM or DI.WARN to disconnect the power at the magnetic contactor (MC) so as to power off the servo drive.

3.1.2 Connectors and terminal blocks

<table>
<tr><th>Symbol</th><th>Name</th><th colspan="3">Description</th></tr>
<tr><td>L1, L2</td><td>Power input for the control circuit</td><td colspan="3">Connect to single-phase AC power (please refer to the model specification for the proper input voltage).</td></tr>
<tr><td>P1, P2</td><td>Input for the DC reactor</td><td colspan="3">For harmonic suppression. If this function is not required, short-circuit P1 and P2.</td></tr>
<tr><td>R, S, T</td><td>Power input for the main circuit</td><td colspan="3">Connect to three-phase AC power (please refer to the model specification for the proper input voltage).</td></tr>
<tr><td rowspan="6">U, V, W
FG</td><td rowspan="6">Motor power</td><td colspan="3">Connect to the servo motor</td></tr>
<tr><th>Symbol</th><th>Wire color</th><th>Description</th></tr>
<tr><td>U</td><td>Red</td><td rowspan="3">Three-phase main power cable for the motor.</td></tr>
<tr><td>V</td><td>White</td></tr>
<tr><td>W</td><td>Black</td></tr>
<tr><td>FG</td><td>Green</td><td>Connect to ground terminal ⏚ for the servo drive.</td></tr>
<tr><td rowspan="3">P2, P3, D, C, ⊖</td><td rowspan="3">Regenerative resistor terminal or braking unit</td><td colspan="2">Use internal resistor</td><td>The contact between P3 and D should be short-circuited The contact between P3 and C should be open.</td></tr>
<tr><td colspan="2">Use external resistor</td><td>Connect P3 and C to the resistor and the contact between P3 and D should be open.</td></tr>
<tr><td colspan="2">Use external braking unit</td><td>Connect the braking unit to P2 and ⊖ of the servo drive. The connection between P3 & D, and P3 & C should be opened.</td></tr>
<tr><td>⏚</td><td>Ground terminal</td><td colspan="3">Connect to the ground wire for the power and servo motor.</td></tr>
<tr><td>CN1</td><td>I/O connector (Optional)</td><td colspan="3">Connect to the host controller. Please refer to section 3.3 for more information.</td></tr>
<tr><td>CN2</td><td>Connector for encoder (Optional)</td><td colspan="3">Connect to the encoder or conversion board. Please refer to section 3.4 for more information.</td></tr>
<tr><td>CN3</td><td>Connector of RS-485 and CANopen (Optional)</td><td colspan="3">For RS-485 and CANopen. Please refer to section 3.5 for more information.</td></tr>
<tr><td>CN4</td><td>Mini USB connector (Optional)</td><td colspan="3">Connect to PC or notebook. Please refer to section 3.6 for more information.</td></tr>
<tr><td>CN5</td><td>Position feedback connector (Optional)</td><td colspan="3">Connect to external linear scale or encoder for full-closed loop and motor feedback. Please refer to section 3.8 for more information.</td></tr>
<tr><td>CN6</td><td>DMCNET connector (Optional)</td><td colspan="3">For DMCNET communication. Please refer to section 3.8 for more information.</td></tr>
<tr><td>CN9</td><td>Expansion module</td><td colspan="3">Reserved</td></tr>
<tr><td>CN10</td><td>STO</td><td colspan="3">Connect to STO. Please refer to section 3.9 for more information.</td></tr>
<tr><td>CN11</td><td>Reserved</td><td colspan="3">Reserved</td></tr>
<tr><td>CN12</td><td>Reserved</td><td colspan="3">Reserved</td></tr>
</table>

Pay special attention to the following when connecting the wiring:

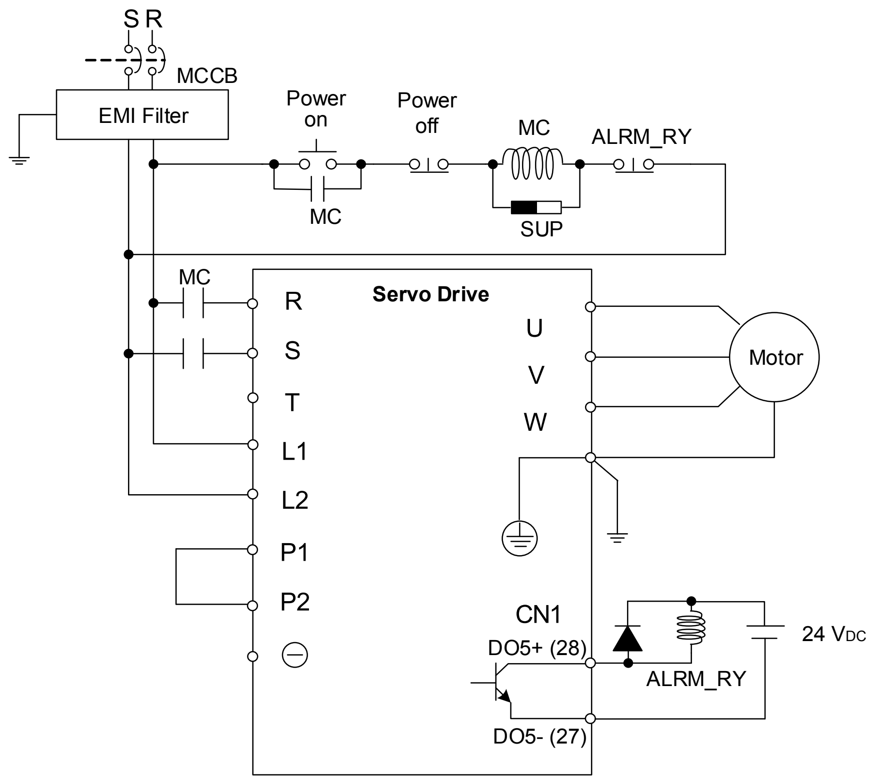
1. When the power is off, do not touch R, S, T and U, V, W since the capacitance inside the servo drive can still contain a dangerously large amount of electric charge. Wait until the charging light is off.
2. Separate R, S, T and U, V, W from other wires. The separation should be at least 30 cm (11.8 inches).
3. If the connection cable for CN2 (encoder) or CN5 (position feedback) is not long enough, please use an AWG26 shielded twisted-pair cable that conforms to UL2464 specifications. If it is over 20 meters (65.62 ft), please choose a signal cable with diameter two times greater than AWG26 to avoid excessive signal attenuation.
4. When using RS-485, CAN, and DMCNET, please replace the standard wiring with shielded twisted-pair cable to ensure the communication quality.
5. When selecting the wires, please refer to section 3.1.6.
6. Do not use any external capacitors or it might damage the servo drive.

3.1.3 Wiring for power supply

There are two methods for wiring the power supply: single-phase and three-phase. In the diagram below, Power On is normally open, Power Off and ALRM_RY are normally closed. MC (magnetic contactor) is the power relay and the contact for the main power circuit.

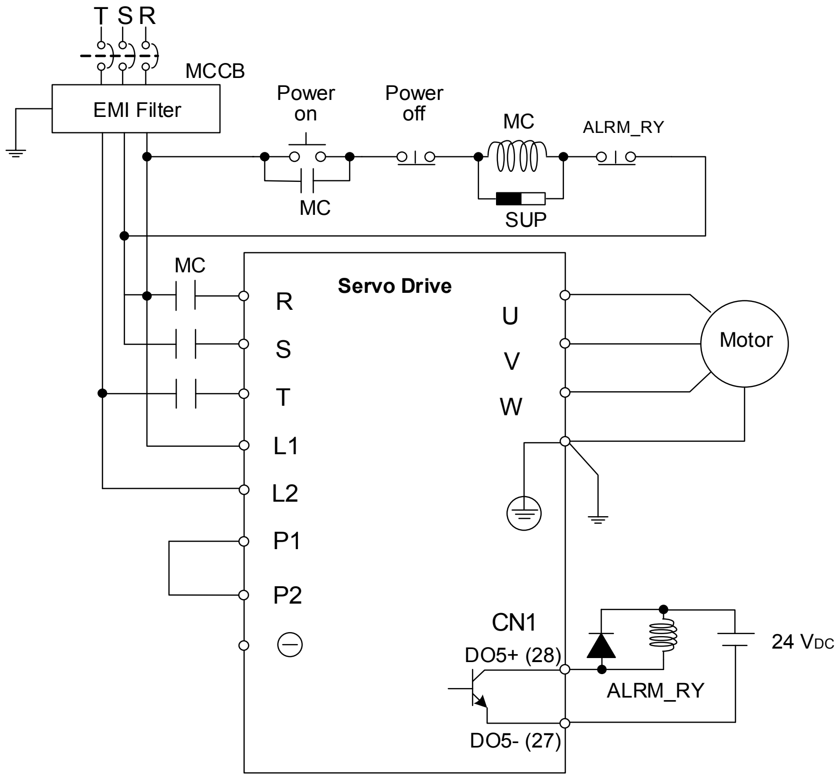
3

- Wiring Method for Single-phase Power Supply (suitable for models of 1.5 kW and below)



3

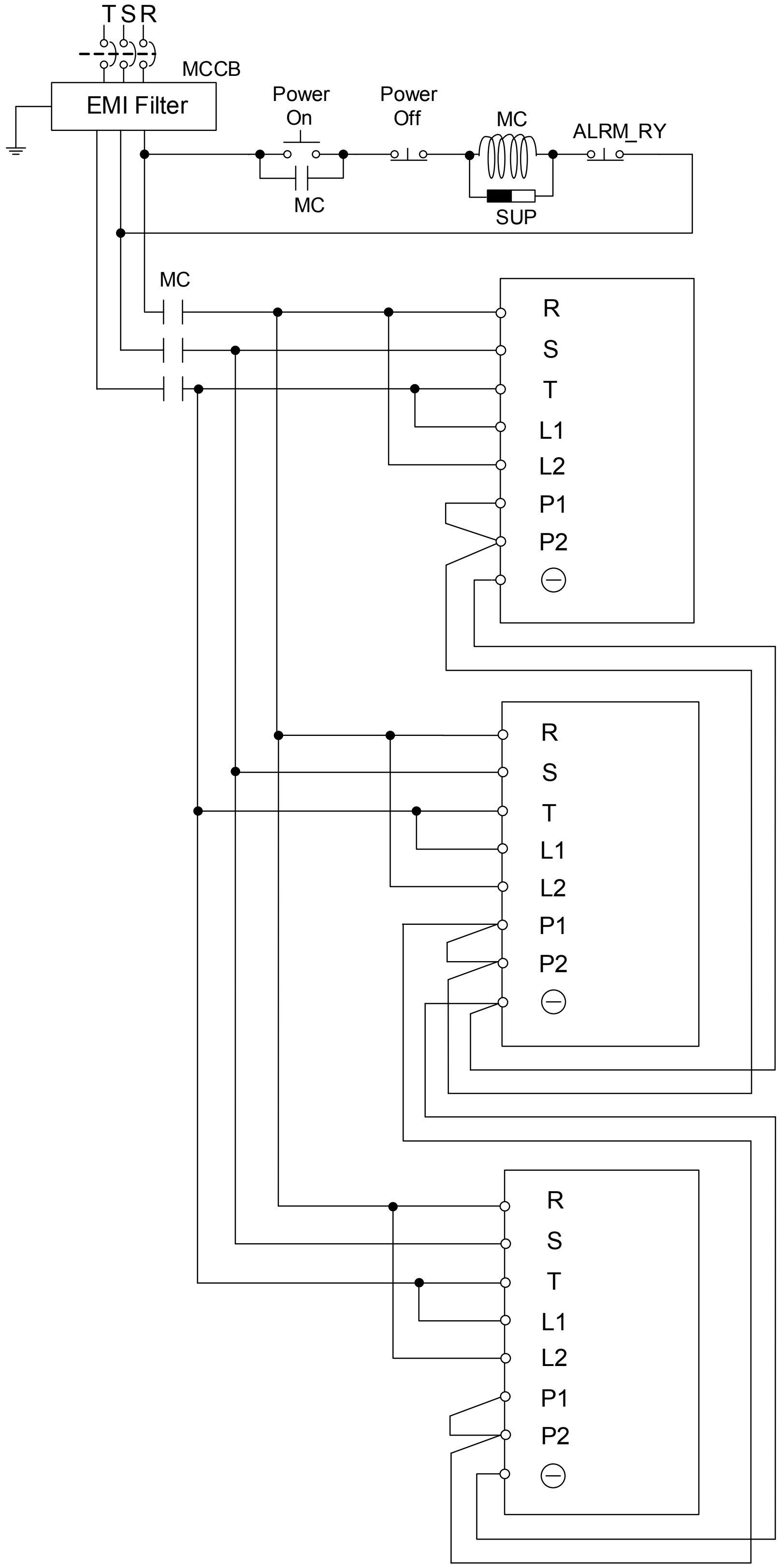
- Wiring Method for Three-phase Power Supply (suitable for all series)



3

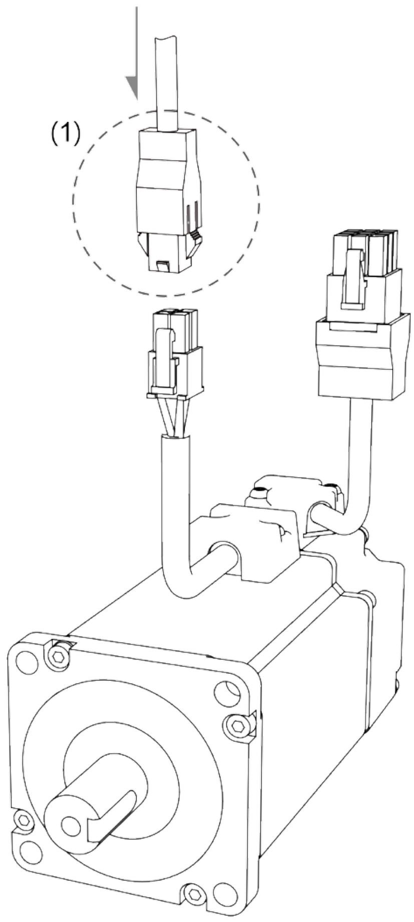
- Connecting multiple servo drives (connecting in series)

Using a common DC-BUS can increase the efficiency of the regenerative power. For instance, while one of the axes is decelerating, the regenerative power can supply other axes.



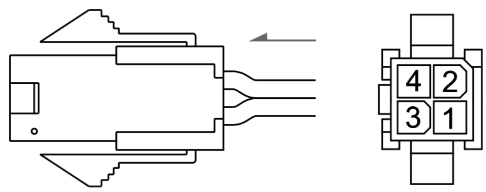
3

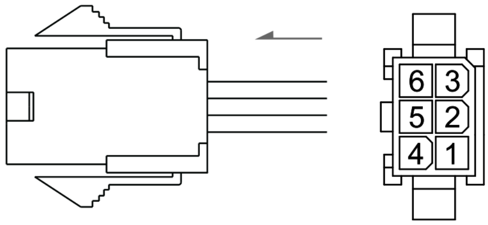
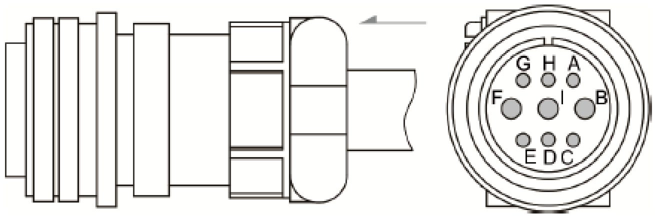
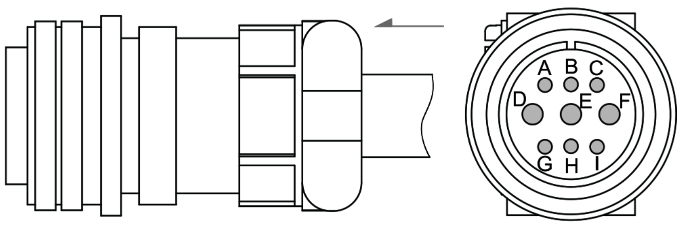
3.1.4 UVW connectors for the ASDA-A3 servo drive



Note: pin assignments of the A3 and A2 model are the same. For easier wiring, A3's connector illustration (angle of viewing) is changed, which is different from that of A2.

(1) Please refer to the following table for UVW connector specifications

Motor model	UVW connector					
ECM-A3$\boxed{1}$-C$\boxed{2}$040F (50W) ECM-A3$\boxed{1}$-C$\boxed{2}$0401 (100W) ECM-A3$\boxed{1}$-C$\boxed{2}$0602 (200W) ECM-A3$\boxed{1}$-C$\boxed{2}$0604 (400W) ECM-A3$\boxed{1}$-C$\boxed{2}$0804 (400W) ECM-A3$\boxed{1}$-C$\boxed{2}$0807 (750W)						
	Pin assignment					
	U (Red)	V (White)	W (Black)	CASE GROUND (Green)	BRAKE1 (Yellow)	BRAKE2 (Blue)
	1	2	4	3	-	-

<table>
<tr><th>Motor model</th><th colspan="6">UVW connector</th></tr>
<tr><td rowspan="4">ECM-A3$\boxed{1}$-C$\boxed{2}$040F (50W)
ECM-A3$\boxed{1}$-C$\boxed{2}$0401 (100W)
ECM-A3$\boxed{1}$-C$\boxed{2}$0602 (200W)
ECM-A3$\boxed{1}$-C$\boxed{2}$0604 (400W)
ECM-A3$\boxed{1}$-C$\boxed{2}$0804 (400W)
ECM-A3$\boxed{1}$-C$\boxed{2}$0807 (750W)</td><td colspan="6"></td></tr>
<tr><td colspan="6">Pin assignment</td></tr>
<tr><td>U
(Red)</td><td>V
(White)</td><td>W
(Black)</td><td>CASE GROUND
(Green)</td><td>BRAKE1
(Brown)</td><td>BRAKE2
(Blue)</td></tr>
<tr><td>1</td><td>2</td><td>4</td><td>5</td><td>3</td><td>6</td></tr>
<tr><td rowspan="4">ECMC-F$\boxed{1}$1308 (850 W)
ECMC-C$\boxed{1}$1010 (1000 W)
ECMC-E$\boxed{1}$1310 (1000 W)
ECMC-F$\boxed{1}$1313 (1300 W)
ECMC-E$\boxed{1}$1315 (1500 W)
ECMC-F$\boxed{1}$1318 (1800 W)
ECMC-E$\boxed{1}$1320 (2000 W)</td><td colspan="6"></td></tr>
<tr><td colspan="6">Pin assignment</td></tr>
<tr><td>U
(Red)</td><td>V
(White)</td><td>W
(Black)</td><td>CASE GROUND
(Green)</td><td>BRAKE1
(Yellow)</td><td>BRAKE2
(Blue)</td></tr>
<tr><td>F</td><td>I</td><td>B</td><td>E</td><td>G</td><td>H</td></tr>
<tr><td rowspan="4">ECMC-E$\boxed{1}$1820 (2000 W)
ECMC-E$\boxed{1}$1830 (3000 W)
ECMC-F$\boxed{1}$1830 (3000 W)</td><td colspan="6"></td></tr>
<tr><td colspan="6">Pin assignment</td></tr>
<tr><td>U
(Red)</td><td>V
(White)</td><td>W
(Black)</td><td>CASE GROUND
(Green)</td><td>BRAKE1
(Yellow)</td><td>BRAKE2
(Blue)</td></tr>
<tr><td>D</td><td>E</td><td>F</td><td>G</td><td>A</td><td>B</td></tr>
</table>

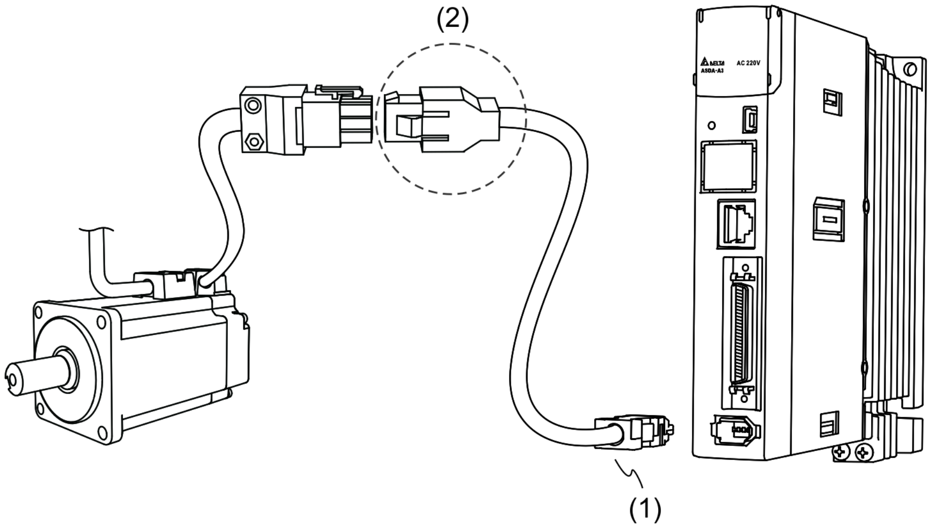
Wire selection: please use a 600 V PVC cable. If it is longer than 30 meters, refer to the voltage drop (wire impedance) to select the cable size. See section 3.1.6 for more information.

Note:
1. (☐) in the motor model names represents brake or keyway / oil seal.
2. The brake coil has no polarity. Its pin symbols are BRAKE 1 & BRAKE2.
3. Power supply for the brake is 24 V_{DC}. Do not share the same power supply with control signals.
4. (△) in the servo drive model represents the encoder type. When △ = Y, the encoder type is absolute (resolution of single turn: 24-bit; resolution of multiple turns: 16-bit).

3

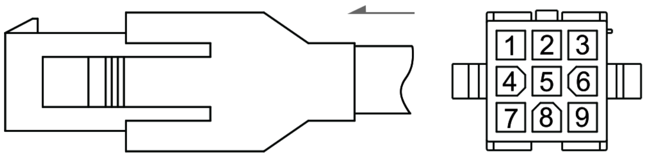
3.1.5 Specification for the encoder connector

Encoder connection (Diagram 1): Quick connector



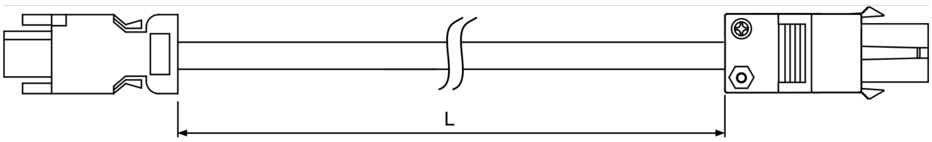
(1) CN2 connector (2) Quick connector (Male)

Note: the diagram shows the connection between the servo drive and the encoder and is not drawn to scale. The specification is subject to change depending on the selected servo drive and motor models.

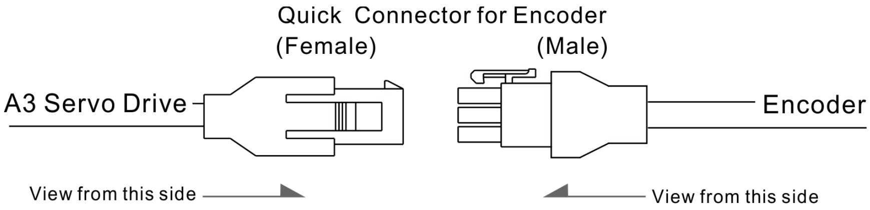
Motor model	Quick connector (Male)
ECM-A3$\boxed{1}$-C$\boxed{2}$040F (50 W) ECM-A3$\boxed{1}$-C$\boxed{2}$0401 (100 W) ECM-A3$\boxed{1}$-C$\boxed{2}$0602 (200 W) ECM-A3$\boxed{1}$-C$\boxed{2}$0604 (400 W) ECM-A3$\boxed{1}$-C$\boxed{2}$0804 (400 W) ECM-A3$\boxed{1}$-C$\boxed{2}$0807 (750 W)	

3

Specifications and Pin assignment for the incremental encoder connector:



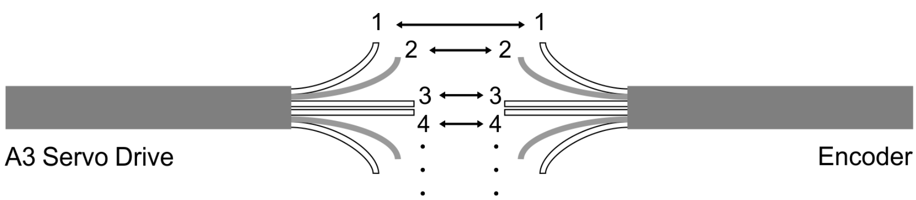
Title	Model name	L	
		mm	inch
1	ACS3-CAEN1003	3000 ± 100	118 ± 4
2	ACS3-CAEN1005	5000 ± 100	197 ± 4



1 White T+	2 Black Reserved	3 Reserved
4 White/Red T-	5 Red/Black Reserved	6 Reserved
7 Brown DC+5V	8 Blue GND	9 Shield

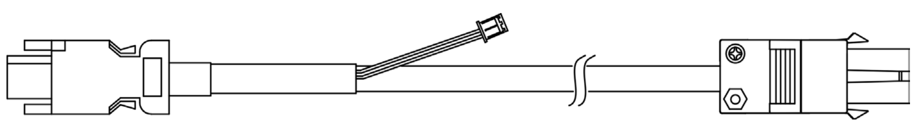
3 Reserved	2 Black Reserved	1 White T+
6 Reserved	5 Red/Black Reserved	4 White/Red T-
9 Shield	8 Blue GND	7 Brown DC+5V

The wire color for the ASDA-A3 servo drive is for reference only. Please refer to the actual servo drive.



To directly connect the wires without using the connectors, please wire them according to the corresponding wire number (shown above). For example, connect wire No. 1 of the servo drive to No. 1 of the motor encoder; connect wire No. 2 of the servo drive to wire No. 2 of the motor encoder and so on. Please number the wires of the servo drive in sequence and then connect them to the encoder.

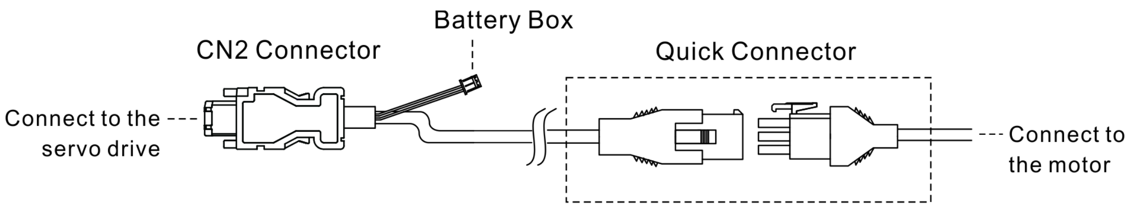
Specification and Pin assignment for the absolute encoder connector:

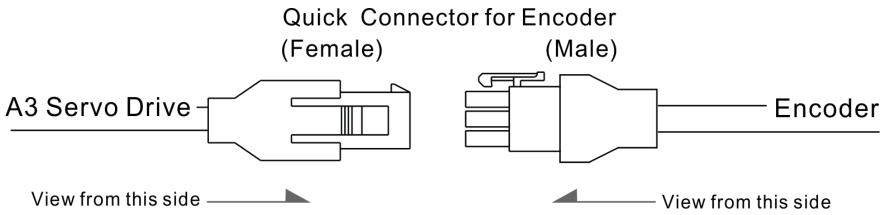


Model name	L	
	mm	inch
ACS3-CAEA1003	3000 ± 100	118 ± 4
ACS3-CAEA1005	5000 ± 100	197 ± 4

Connection method:

Caution Please wire as instructed below. Incorrect wiring may cause battery explosion.





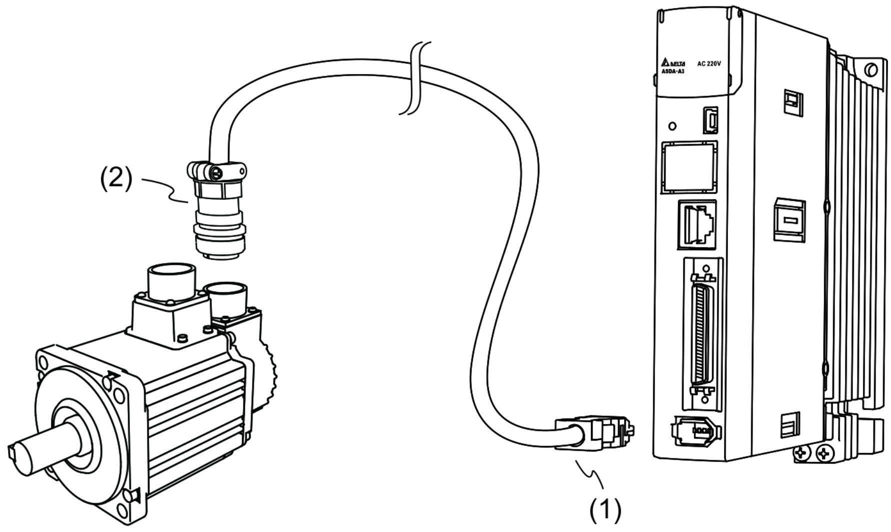
1 White T+	2 Red BAT+	3 Reserved
4 White/Red T-	5 Black BAT-	6 Reserved
7 Brown DC+5V	8 Blue GND	9 Shield

3 Reserved	2 Orange BAT+	1 White T+
6 Reserved	5 Gray BAT-	4 White/Red T-
9 Shield	8 Blue GND	7 Brown DC+5V

The wire color of the ASDA-A3 servo drive is for reference only. Please refer to the actual servo drive.

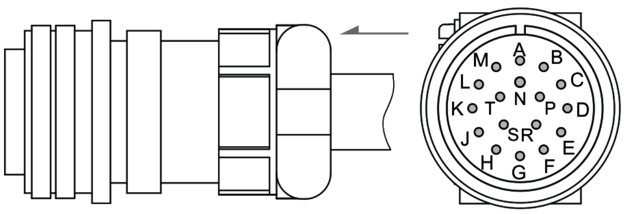
3

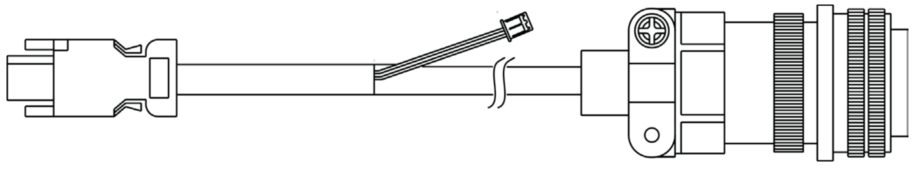
Encoder connection (Diagram 2): Military connector



(1) CN2 connector (2) Military encoder

Note: the diagram shows the connection between the servo drive and the encoder and is not drawn to scale. The specification is subject to change according to the selected servo drive and motor models.

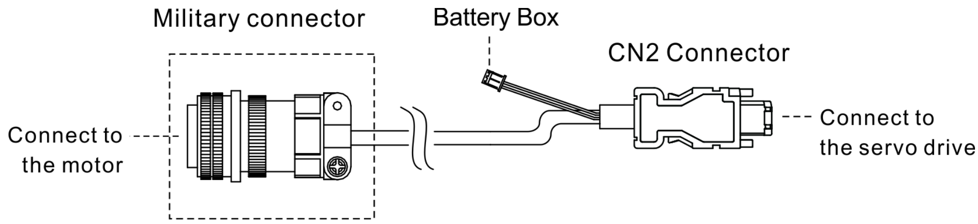
Motor model	Military connector
ECMC-F[1]1308 ECMC-C[1]1010 ECMC-E[1]1310 ECMC-E[1]1315 ECMC-E[1]1320 ECMC-F[1]1313 ECMC-F[1]1318 ECMC-E[1]1820 ECMC-E[1]1830 ECMC-F[1]1830	

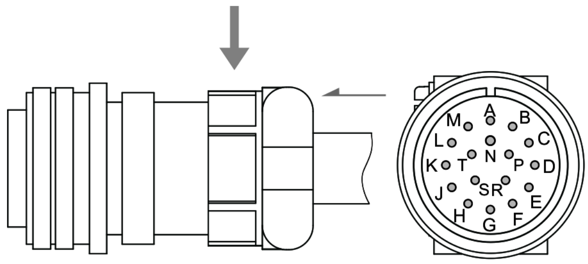


Model name	Straight	L	
		mm	inch
ACS3-CAEA3003	3106A-20-29S	3000 ± 100	118 ± 4
ACS3-CAEA3005	3106A-20-29S	5000 ± 100	197 ± 4

Connection method:

Caution Please wire as instructed below. Incorrect wiring may cause battery explosion.





Pin No.	Symbol	Color
A	T+	White
B	T-	White / Red
C	BAT+	Red
D	BAT-	Black
S	DC+5V	Brown
R	GND	Blue
L	BRAID SHIELD	–

Note: if using an incremental type of encoder, connecting BAT+ and BAT- is not required.

3.1.6 Wire selection

Please refer to the requirements for doubling and note the recommended wire for connectors and signal wiring for the ASDA-A3 as listed below:

Note:

1. The shield should connect to the ⏚ phase of SHIELD.
2. When wiring, please use the wires suggested in this section to avoid danger.

■ No doubling: single wire for one terminal

<table>
<tr><th rowspan="3" colspan="2">Servo drive and corresponding servo motor</th><th colspan="5">Power cable - wire diameter (AWG)</th></tr>
<tr><th rowspan="2">UVW</th><th rowspan="2">P3, C</th><th colspan="3">L1, L2, R, S, T, P1, P2</th></tr>
<tr><th>Bare wire</th><th>Crimping</th><th>Terminal type / part name</th></tr>
<tr><td rowspan="2">ASD-A3-0121</td><td>ECM-A3[1]-C[2]040F</td><td rowspan="6">18 AWG</td><td rowspan="6">14 AWG</td><td rowspan="2">12–24 AWG</td><td rowspan="2">14–24 AWG</td><td rowspan="5">DN02512D(14AWG)
DN01512D(16AWG)
DN00712D(18–24AWG)</td></tr>
<tr><td>ECM-A3[1]-C[2]0401</td></tr>
<tr><td>ASD-A3-0221</td><td>ECM-A3[1]-C[2]0602</td><td>12–22 AWG</td><td>14–22 AWG</td></tr>
<tr><td rowspan="2">ASD-A3-0421</td><td>ECM-A3[1]-C[2]0604</td><td rowspan="2">12–20 AWG</td><td rowspan="2">14–20 AWG</td></tr>
<tr><td>ECM-A3[1]-C[2]0804</td></tr>
<tr><td>ASD-A3-0721</td><td>ECM-A3[1]-C[2]0807</td><td>12–16 AWG</td><td>14–16 AWG</td><td>DN02512D(14AWG)
DN01512D(16AWG)</td></tr>
</table>

Note: [1] in the servo motor model represents inertia ratio of motor and [2] is the encoder type.

<table>
<tr><th rowspan="3" colspan="2">Servo drive and corresponding servo motor</th><th colspan="5">Power cable - wire diameter (AWG)</th></tr>
<tr><th rowspan="2">UVW</th><th rowspan="2">P3, C</th><th colspan="3">L1, L2, R, S, T, P1, P2</th></tr>
<tr><th>Bare wire</th><th>Crimping</th><th>Terminal type / part name</th></tr>
<tr><td rowspan="3">ASD-A3-1021</td><td>ECMC-F[1]1308</td><td rowspan="4">16 AWG</td><td rowspan="9">14 AWG</td><td rowspan="3">12–14 AWG</td><td rowspan="3">14 AWG</td><td rowspan="3">DN02512D</td></tr>
<tr><td>ECMC-C[1]1010</td></tr>
<tr><td>ECMC-E[1]1310</td></tr>
<tr><td>ASD-A3-1521</td><td>ECMC-E[1]1315</td><td>Single-phase: 14 AWG
Three-phase: 12–14 AWG</td><td>Single-phase: N/A
Three-phase: 14 AWG</td><td>Single-phase: N/A
Three-phase: DN02512D</td></tr>
<tr><td rowspan="4">ASD-A3-2023</td><td>ECMC-E[1]1320</td><td>14 AWG</td><td rowspan="4">10–14 AWG</td><td rowspan="4">12–14 AWG</td><td rowspan="4">DN04012D (12AWG)
DN02512D (14AWG)</td></tr>
<tr><td>ECMC-F[1]1313</td><td rowspan="5">12 AWG</td></tr>
<tr><td>ECMC-F[1]1318</td></tr>
<tr><td>ECMC-E[1]1820</td></tr>
<tr><td rowspan="2">ASD-A3-3023</td><td>ECMC-E[1]1830</td><td rowspan="2">10–12 AWG</td><td rowspan="2">12 AWG</td><td rowspan="2">DN04012D</td></tr>
<tr><td>ECMC-F[1]1830</td></tr>
</table>

Note: [1] in the servo motor model represents the encoder type.

Terminal illustration:

Crimping tool:

DNT13-010

■ Doubling: two wires for one terminal

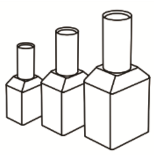
Servo drive and corresponding servo motor		Power cable - wire diameter (AWG)				
		UVW	P3, C	L1, L2, R, S, T, P1, P2		
				Bare wire	Crimping	Terminal type / part name
ASD-A3-0121	ECM-A3$\boxed{1}$-C$\boxed{2}$040F	18 AWG	14 AWG	16–24 AWG	16–24 AWG	DN01512B
	ECM-A3$\boxed{1}$-C$\boxed{2}$0401					
ASD-A3-0221	ECM-A3$\boxed{1}$-C$\boxed{2}$0602			16–22 AWG	16–22 AWG	
ASD-A3-0421	ECM-A3$\boxed{1}$-C$\boxed{2}$0604			16–20 AWG	16–20 AWG	
	ECM-A3$\boxed{1}$-C$\boxed{2}$0804					
ASD-A3-0721	ECM-A3$\boxed{1}$-C$\boxed{2}$0807			16 AWG	16 AWG	

Note: $\boxed{1}$ in the servo motor model represents inertia ratio of motor and $\boxed{2}$ is the encoder type.

Servo drive and corresponding servo motor		Power cable - wire diameter (AWG)				
		UVW	P3, C	L1, L2, R, S, T, P1, P2		
				Bare wire	Crimping	Terminal type / part name
ASD-A3-1021	ECMC-F$\boxed{1}$1308	16 AWG	14 AWG	N/A	N/A	N/A
	ECMC-C$\boxed{1}$1010					
	ECMC-E$\boxed{1}$1310					
ASD-A3-1521	ECMC-E$\boxed{1}$1315					
ASD-A3-2023	ECMC-E$\boxed{1}$1320	14 AWG		16–20 AWG	16–20 AWG	DN02513B
	ECMC-F$\boxed{1}$1313	12 AWG				
	ECMC-F$\boxed{1}$1318			14 AWG	14 AWG	
	ECMC-E$\boxed{1}$1820					
ASD-A3-3023	ECMC-E$\boxed{1}$1830			N/A	N/A	N/A
	ECMC-F$\boxed{1}$1830					

Note: $\boxed{1}$ in the servo motor model represents the encoder type.

Terminal illustration:



Crimping tool:

DNT13-010

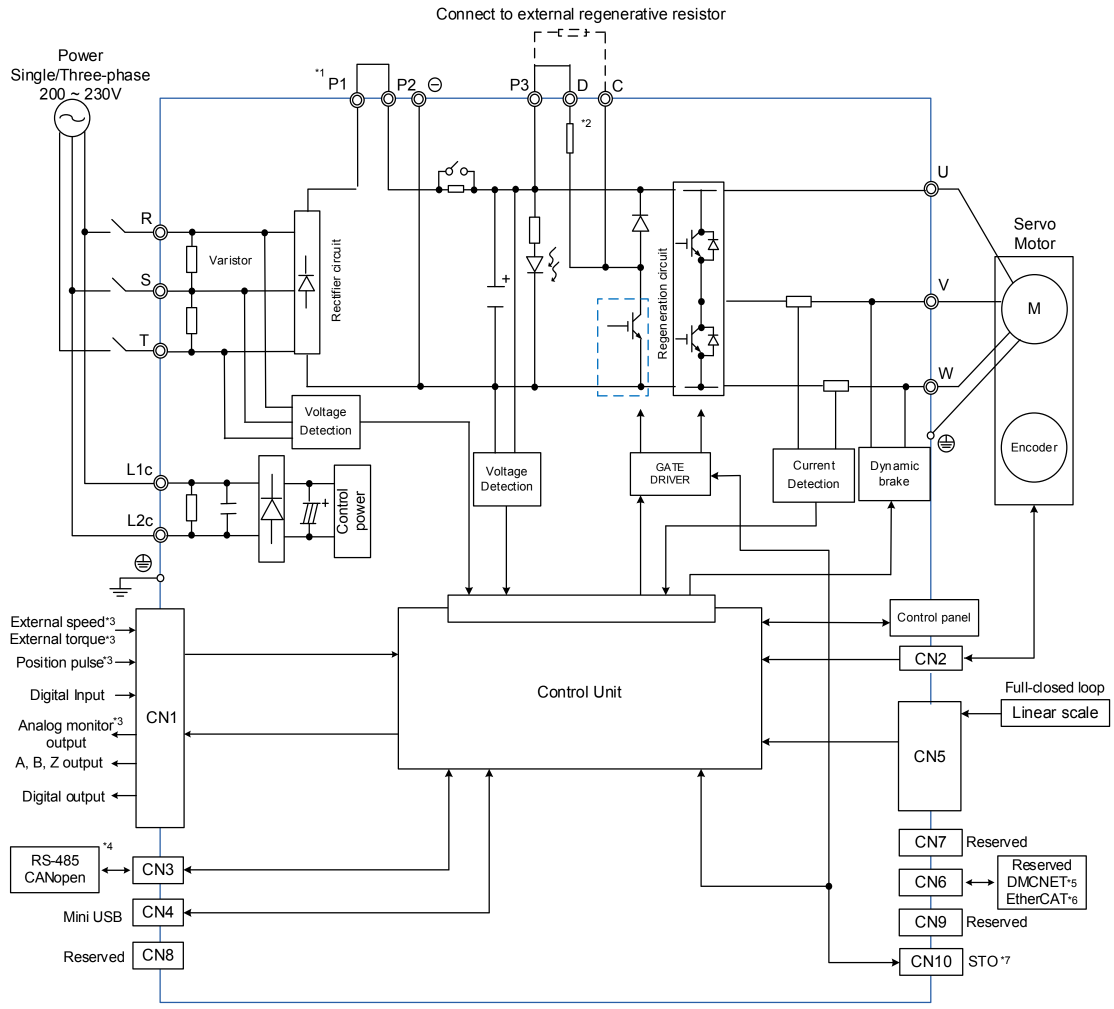
Servo drive model	Encoder cable - wire diameter mm² (AWG)			
	Size	Number	Specification	Standard length
ASD-A3-0121	0.13 (AWG26)	10 cores (4 pairs)	UL2464	3 m (9.84 ft)
ASD-A3-0221				
ASD-A3-0421				
ASD-A3-0721				
ASD-A3-1021				
ASD-A3-1521				
ASD-A3-2023				
ASD-A3-3023				

Note:
1. Please use shielded twisted-pair cable for wiring the encoder to reduce the noise interference.
2. The shield should connect to the ⏚ phase of the SHIELD.
3. Please use the suggested wires listed above when wiring to avoid danger.

3

3.2 Wiring diagram for the servo system

Models of 400 W and below



Note:

*1: If DC reactor is not used, short circuit P1 and P2 as illustrated in the diagram.

*2: Models of 200 W and below (without built-in regenerative resistor); models of 400 W have built-in regenerative resistor.

*3: Functions that are not provided by A3-F and A3-E.

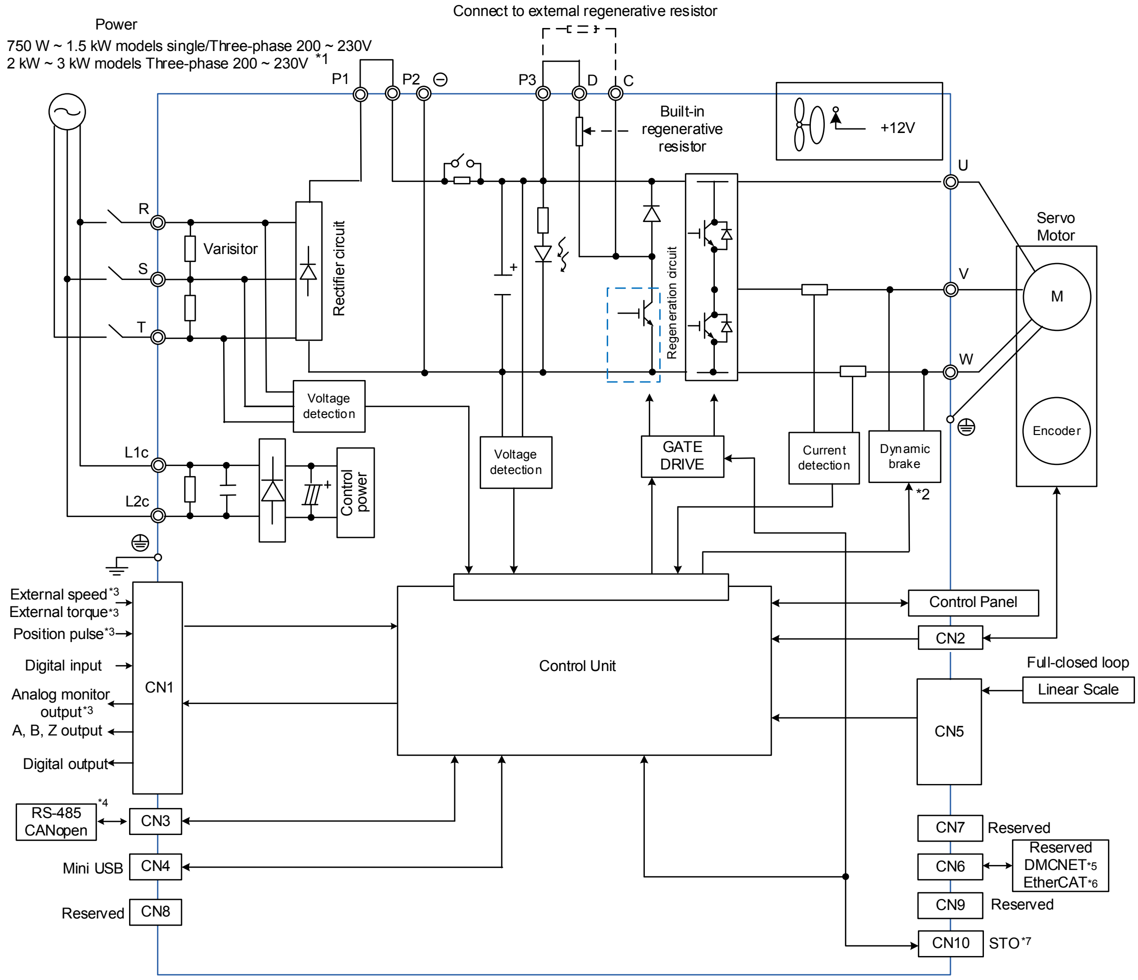
*4: Serial communication (RS-485) is available for A3-L and A3-M; CANopen is for A3-M only.

*5: DMCNET is available on A3-F only.

*6: EtherCAT is available on A3-E only.

*7: STO function is only available on A3-M and A3-E.

Models of 750 W – 3 kW (with built-in regenerative resistor and fan)



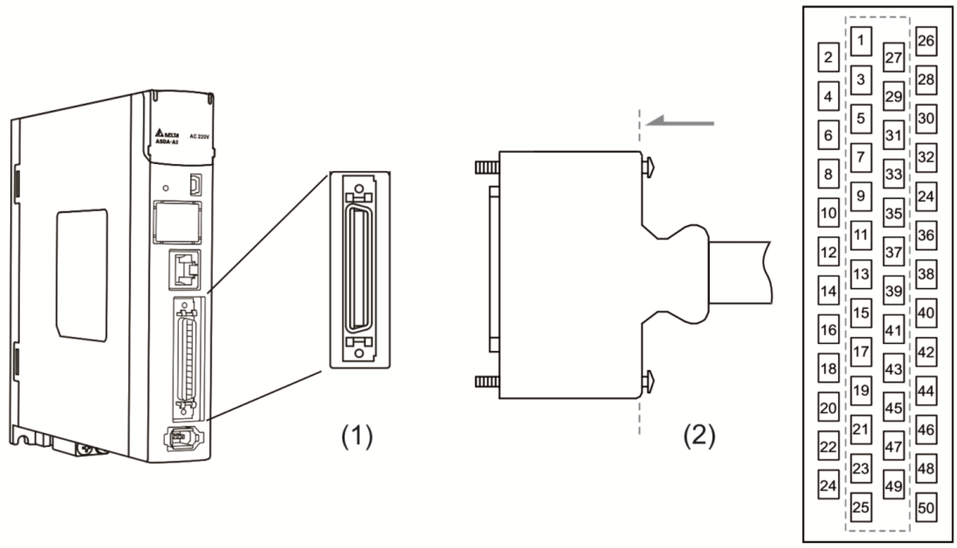
Note:
*1: If DC reactor is not used, short circuit P1 and P2 as illustrated in the diagram.
*2: The dynamic brakes of 2 kW – 3 kW models are three-phase and UVW is short-circuited.
*3: Functions that are not provided by A3-F and A3-E.
*4: Serial communication (RS-485) is available for A3-L and A3-M; CANopen is for A3-M only.
*5: DMCNET is available on A3-F only.
*6: EtherCAT is available on A3-E only.
*7: STO function is only available on A3-M and A3-E.

3

3.3 Wiring for CN1 (I/O signal)

3.3.1 CN1 I/O connector (for A3-L and A3-M series)

The ASDA-A3 provides 10 user-defined digital input (DI) points and 6 digital output (DO) points to provide highly flexible communication between the servo drive and the controller. For more information, please refer to section 3.3.5. In addition, differential type output signals for encoder A+, A-, B+, B-, Z+, and Z- are provided. Analog torque command input, analog speed/position command input, pulse position input are also available. The pin assignments are shown below:



(1) CN1 connector (Female) (2) CN1 connector (Male)

Pin assignment:

Pin	Signal	Function	Pin	Signal	Function	Pin	Signal	Function
1	DO4+	Digital output	18	T_REF	Analog torque input	35	PULL HI_S (Sign)	External power input of Sign pulse
2	DO3-	Digital output	19	GND	Analog input signal ground	36	SIGN	Position sign (+)
3	DO3+	Digital output	20	NC	Not in use	37	/SIGN	Position sign (-)
4	DO2-	Digital output	21	OA	Encoder A pulse output	38	DI10	Digital input
5	DO2+	Digital output	22	/OA	Encoder /A pulse output	39	PULL HI_P (Pulse)	External power input of pulse
6	DO1-	Digital output	23	/OB	Encoder /B pulse output	40	DO6-	Digital output
7	DO1+	Digital output	24	/OZ	Encoder /Z pulse output	41	/PULSE	Position pulse (-)
8	DI4-	Digital input	25	OB	Encoder B pulse output	42	V_REF	Analog command input speed (+)
9	DI1-	Digital input	26	DO4-	Digital output	43	PULSE	Position pulse (+)
10	DI2-	Digital input	27	DO5-	Digital output	44	GND	Analog input signal ground
11	COM+	Power input (24 V ± 10%)	28	DO5+	Digital output	45	NC	Not in use
12	GND	Analog input signal ground	29	DI9-	Digital input	46	DO6+	Digital output
13	GND	Analog input signal ground	30	DI8-	Digital input	47	NC	Not in use
14	NC	Not in use	31	DI7-	Digital input	48	OCZ	Encoder Z pulse open-collector output
15	MON2	Analog monitor output 2	32	DI6-	Digital input	49	NC	Not in use
16	MON1	Analog monitor output 1	33	DI5-	Digital input	50	OZ	Encoder Z pulse line-driver output
17	NC	Not in use	34	DI3-	Digital input	-	-	-

Note: NC represents “No connection”, which is for internal use only. Do not connect to NC or it may damage the servo drive.

3.3.2 Signal explanation for connector CN1 (for A3-L and A3-M series)

The following table details the signals listed in the previous section.

General signals:

Signal		Pin No.	Function	Wiring method (refer to 3.3.3)
Analog command (Input)	V_REF	42	(1) When motor speed command is set to -10 V to +10 V, it means the rotation speed is -3000 to +3000 r/min (default). You can set the corresponding range with parameters. (2) When motor position command is set to -10 V to +10 V, it means the range of the rotation position is -3 to +3 cycles (default).	C1
	T_REF	18	When motor torque command is set to -10 V to +10 V, it means the rated torque is -100% to +100%.	C1
Analog Monitor (output)	MON1 MON2	16 15	The operation status of motor can be displayed in analog voltage, such as speed and current. This servo drive provides 2 output channels. You can select the data to be monitored with parameter P0.003. This signal is based on the power ground.	C2
Position Pulse (input)	PULSE /PULSE	43 41	Position pulse can be sent by Line Driver (single-phase max. frequency 4 MHz) or open-collector (single-phase max. frequency 200 KHz). Three command types can be selected with P1.000, CW/CCW pulse, pulse and direction, and A/B pulse. If open collector type is used when sending position pulses, CN1 should be connected to an external power supply for pull high.	C3/C4
	SIGN /SIGN	36 37		
	PULL HI_P PULL HI_S	39 35		
Position Pulse (output)	OA /OA	21 22	Encoder signal output A, B, and Z (Line Driver).	C9/C10
	OB /OB	25 23		
	OZ /OZ	50 24		
	OCZ	48	Encoder Z pulse output (Open-collector).	C11
Power	COM+	11	NPN: COM+ is for DI voltage input and requires external power supply (24 V ± 10%). PNP: COM+ is for DI voltage input (negative end) and also requires external power supply (24 V ± 10%).	-
	GND	12, 13, 19, 44	GND for analog signal and differential signal output	
Other	NC	14	No connection. This is for internal use only. Do not connect to NC, or it may damage the servo drive.	

There are various operation modes available (refer to section 6.1) and the I/O configuration differs for each mode. The ASDA-A3 provides user-defined I/O for you to set functions according to the application requirements. See Chapter 8 and refer to Table 8.1 DI function setting and 8.2 DO function setting. The default DI/DO signal configuration for each operation mode includes the most commonly used functions and meets the requirements for general applications.

See the table below for the default DI signal of each control mode:

DI	Control mode								
	PT	PR	S/Sz	T/Tz	PT-S	PT-T	PR-S	PR-T	S-T
	Default signal	Default signal	Default signal	Default signal	Default signal	Default signal	Default signal	Default signal	Default signal
1	0x01	0x01	0x01	0x01	0x01	0x01	0x01	0x01	0x01
	SON	SON	SON	SON	SON	SON	SON	SON	SON
2	0x04	0x08	0x09	0x10	0x04	0x04	0x08	0x08	-
	CCLR	CTRG	TRQLM	SPDLM	CCLR	CCLR	CTRG	CTRG	
3	0x16	0x11	0x14	0x16	0x14	0x16	0x11	0x11	0x14
	TCM0	POS0	SPD0	TCM0	SPD0	TCM0	POS0	POS0	SPD0
4	0x17	0x12	0x15	0x17	0x15	0x17	0x12	0x12	0x15
	TCM1	POS1	SPD1	TCM1	SPD1	TCM1	POS1	POS1	SPD1
5	0x02	0x02	0x02	0x02	-	-	0x14	0x16	0x16
	ARST	ARST	ARST	ARST	-	-	SPD0	TCM0	TCM0
6	0x22	0x22	0x22	0x22	-	-	0x15	0x17	0x17
	NL	NL	NL	NL			SPD1	TCM1	TCM1
7	0x23	0x23	0x23	0x23	0x18	0x20	0x18	0x20	0x23
	PL	PL	PL	PL	S-P	T-P	S-P	T-P	PL
8	0x21	0x21	0x21	0x21	0x21	0x21	0x21	0x21	0x21
	EMGS	EMGS	EMGS	EMGS	EMGS	EMGS	EMGS	EMGS	EMGS
9	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-

Note: please refer to figure C7/C8 in 3.3.3 for wiring.

3

The default DO signal is explained in the following table:

DO	PT/PR/Communication		Speed/Torque		Wiring method (refer to 3.3.3)
	Signal	Function	Signal	Function	
DO1	SRDY	Servo ready	SRDY	Servo ready	C5/C6
DO2	ZSPD	Zero motor speed	ZSPD	Zero motor speed	
DO3	HOME	Homing completed	TSPD	Target speed reached	
DO4	TPOS	Target position reached	TPOS	Target position reached	
DO5	ALRM	Servo alarm	ALRM	Servo alarm	
DO6	-	-	-	-	

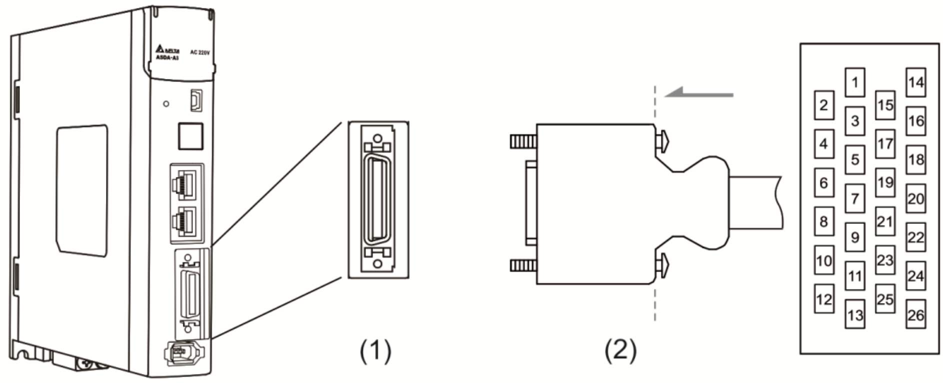
If the default DI/DO function cannot meet the application requirements, you can set the functions of DI1–10 and DO1–6 with the corresponding parameters listed in the following table. That is, you can specify the DI/DO functions by setting DI or DO code to the corresponding parameters.

DI signal		Pin No.	Corresponded parameter	DI signal		Pin No.	Corresponded parameter
Standard DI	DI1-	9	P2.010	Standard DI	DI6-	32	P2.015
	DI2-	10	P2.011		DI7-	31	P2.016
	DI3-	34	P2.012		DI8-	30	P2.017
	DI4-	8	P2.013		DI9-	29	P2.036
	DI5-	33	P2.014		DI10-	38	P2.037

DO signal		Pin No.	Corresponded parameter	DO signal		Pin No.	Corresponded parameter
Standard DO	DO1+	7	P2.018	Standard DO	DO4+	1	P2.021
	DO1-	6			DO4-	26	
	DO2+	5	P2.019		DO5+	28	P2.022
	DO2-	4			DO5-	27	
	DO3+	3	P2.020		DO6+	46	P2.041
	DO3-	2			DO6-	40	

3.3.3 CN1 I/O connector (for A3-F series)

The A3-F provides 7 user-defined digital input (DI) points and 4 digital output (DO) points to provide highly flexible communication between the servo drive and the controller. For more information, please refer to section 3.3.5. In addition, differential type output signals for encoder A+, A-, B+, B-, Z+, and Z- are provided. The pin assignments are shown as follows.



(1) CN1 connector (Female) (2) CN1 connector (Male)

Pin assignment:

Pin	Signal	Function	Pin	Signal	Function	Pin	Signal	Function
1	DO1+	Digital output	10	DI4-	Digital input	19	OB	Encoder B pulse output
2	DO1-	Digital output	11	DI5-	Digital input	20	/OB	Encoder /B pulse output
3	DO2+	Digital output	12	DI6-	Digital input	21	OZ	Encoder Z pulse output
4	DO2-	Digital output	13	DI7-	Digital input	22	/OZ	Encoder /Z pulse output
5	NC	Not in use	14	NC	Not in use	23	DO4+	Digital output
6	COM+	Power input (24 V ± 10%)	15	NC	Not in use	24	DO4-	Digital output
7	DI1-	Digital input	16	GND	Differential output signal	25	DO3+	Digital output
8	DI2-	Digital input	17	OA	Encoder A pulse output	26	DO3-	Digital output
9	DI3-	Digital input	18	/OA	Encoder /A pulse output	-	-	-

Note: NC represents “No connection”, which is for internal use only. Do not connect to NC or it may damage the servo drive.

3

3.3.4 Signal explanation for connector CN1 (for A3-F series)

The following details the signals listed in the previous section.

General signals:

Signal		Pin No.	Function	Wiring method (Refer to 3.3.3)
Position Pulse (output)	OA /OA	17 18	Encoder signal output A, B, and Z (Line Driver).	C9/C10
	OB /OB	19 20		
	OZ /OZ	21 22		
Power	COM+	6	NPN: COM+ is for DI input and requires external power supply (24 V ± 10%). PNP: COM+ is for DI voltage input (negative end) and also requires external power supply (24 V ± 10%).	-
	GND	16	GND for differential signal output	
Other	NC	14, 15	No connection. This is for internal use only. Do not connect to NC, or it may damage the servo drive.	

A3-F series servo drives provides user-defined I/O for you to set functions according to the application requirements. See chapter 8 and refer to Table 8.1 DI functions and 8.2 DO functions. The default DI/DO signal configuration for each operation mode includes the most commonly used functions and meets the requirements for general applications.

See the default DI signal for each control mode below:

DI	Control mode	
	DMCNET	
	Default	Signal
1	0x00	-
2	0x00	-
3	0x00	-
4	0x24	ORGP
5	0x22	NL
6	0x23	PL
7	0x21	EMGS

Note: please refer to figure C7/C8 in 3.3.3 for wiring.

See the default DO signal for each control mode in the table below:

DO	DMCNET		Wiring method (Refer to 3.3.3)
	Signal	Function	
DO1	SRDY	Servo is ready.	C5/C6
DO2	-	-	
DO3	-	-	
DO4	ALRM	Alarm reset.	

If the default DI/DO function cannot meet the application requirement, you can specify the DI/DO functions by setting the DI or DO code to the corresponding parameters.

DI signal		Pin No.	Corresponded parameter	DI signal		Pin No.	Corresponded parameter
Standard DI	DI1-	7	P2.010	Standard DI	DI5-	11	P2.014
	DI2-	8	P2.011		DI6-	12	P2.015
	DI3-	9	P2.012		DI7-	13	P2.016
	DI4-	10	P2.013				

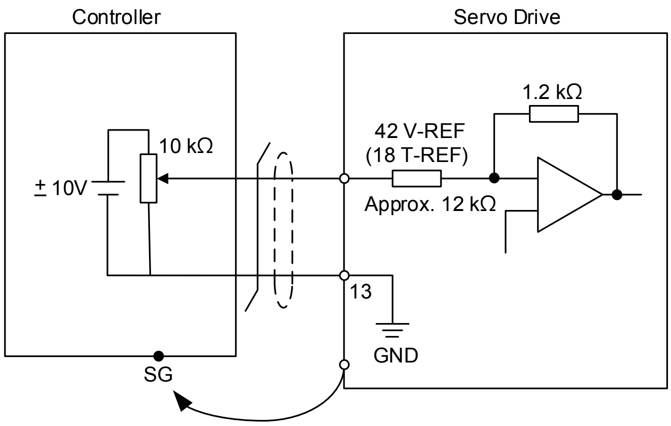
DO signal		Pin No.	Corresponded parameter	DO signal		Pin No.	Corresponded parameter
Standard DO	DO1+	1	P2.018	Standard DO	DO3+	25	P2.020
	DO1-	2			DO3-	26	
	DO2+	3	P2.019		DO4+	23	P2.021
	DO2-	4			DO4-	24	

3

3.3.5 Wiring diagrams (CN1)

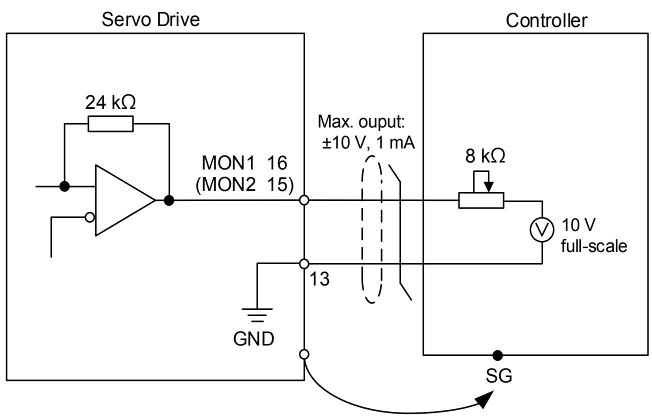
The valid voltage for the analog speed command and the analog torque command is between -10 V and +10 V. You can set the command value that corresponds to the voltage range with the relevant parameters.

C1: input for speed/torque (force) analog command



Note: this is not supported by the A3-F.

C2: output for analog monitoring command (MON1 and MON2)

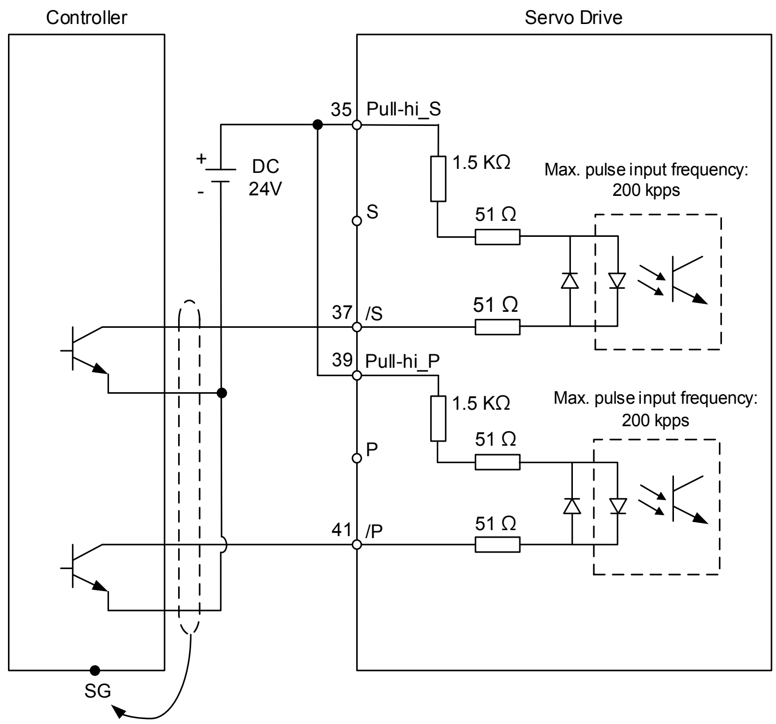


Note:

1. Please refer to parameter P2.112 [Bit 0] for the maximum voltage for analog output. 8 V or 10 V are suggested.
2. This is not supported by the A3-F.

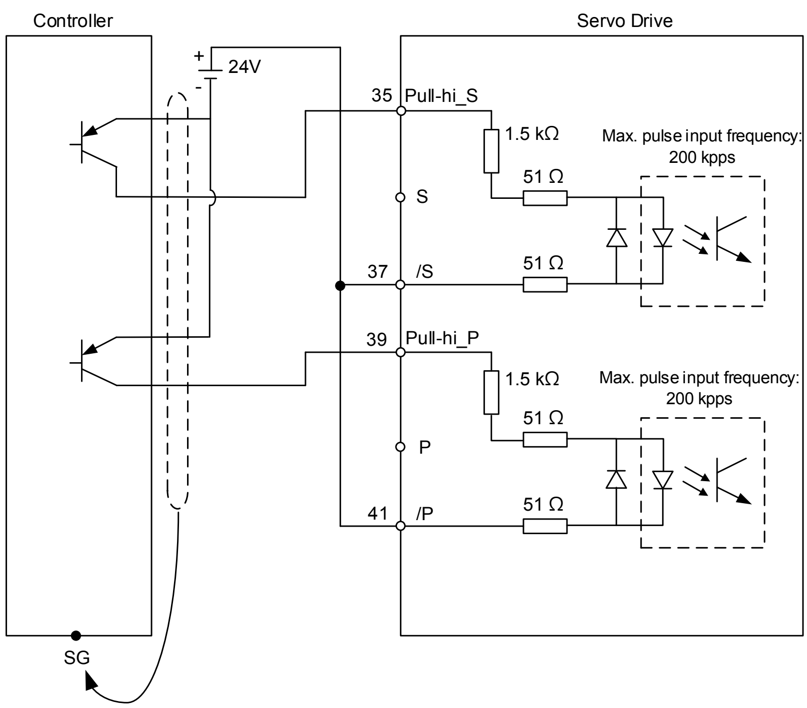
You can input the Pulse command with the open-collector or line driver. The maximum input pulse for the line driver is 4 mpps and 200 kpps for open-collector.

C3-1: the source for the pulse input is open-collector NPN type equipment, which uses the external power supply.



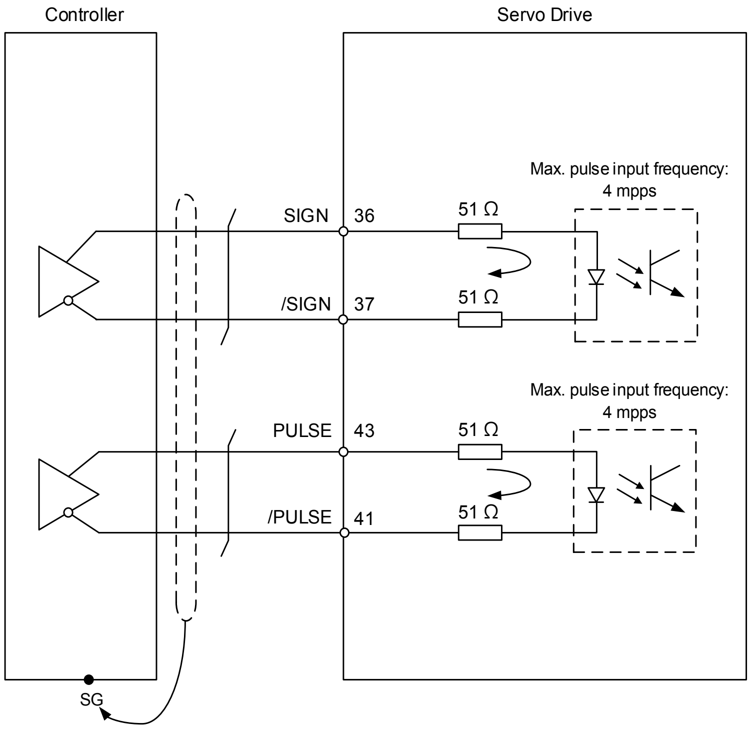
Note: this is not supported by the A3-F.

C3-2: the source for the pulse input is open-collector PNP type equipment, which uses the external power supply.



Note: this is not supported by the A3-F.

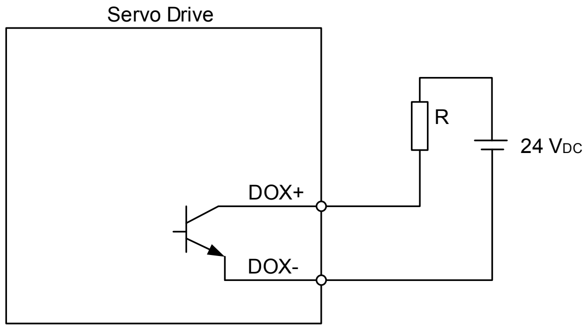
C4: pulse input (Line driver) can only be used with 2.8 V – 3.6 V power systems. Do not use with 24 V power.



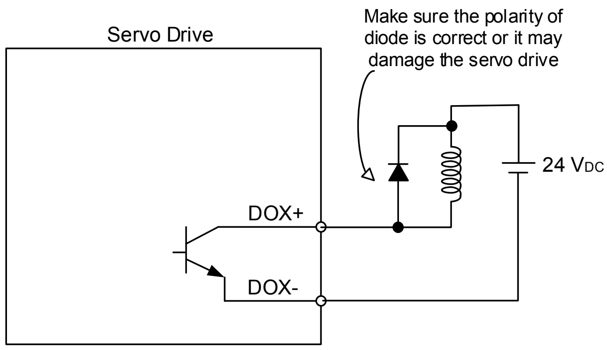
Note: this is not supported by the A3-F.

When the drive connects to an inductive load, you must install the diode (permissible current: below 40 mA; surge current: below 100 mA; maximum voltage: 30 V).

C5: DO wiring - the servo drive uses an external power supply and the resistor is for general load.



C6: DO wiring - the servo drive uses an external power supply and the resistor is for inductive load.



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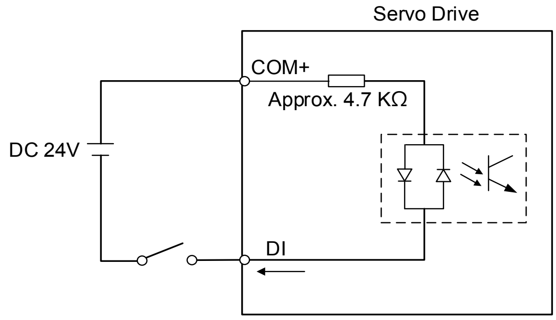
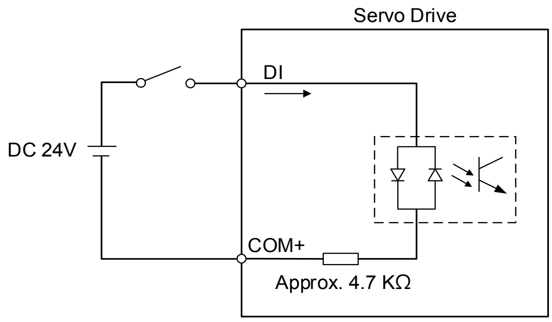
DI wiring - Input signals by relay or open-collector transistor.

Conditions of DI On/Off:
ON: 15 V – 24 V; Condition: Input current = 8 mA
OFF: below 5 V; the input current must not be higher than 0.5 mA.

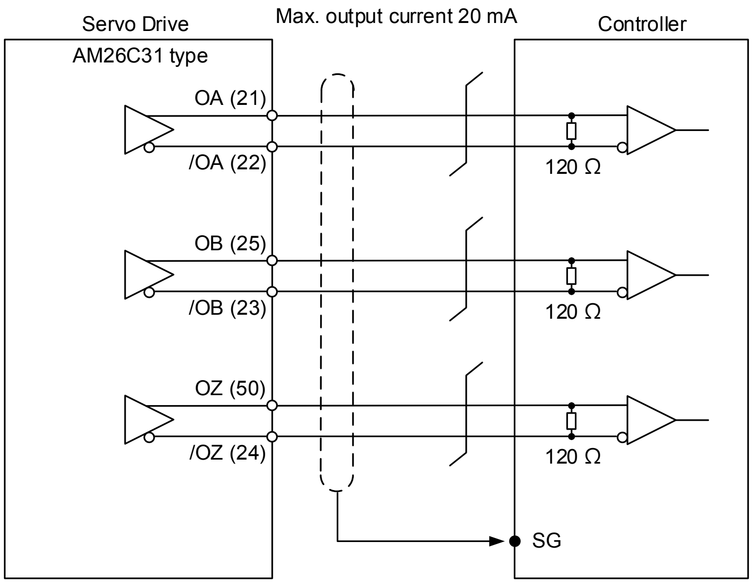
C7: NPN transistor (SINK mode)



C8: PNP transistor (SOURCE mode)



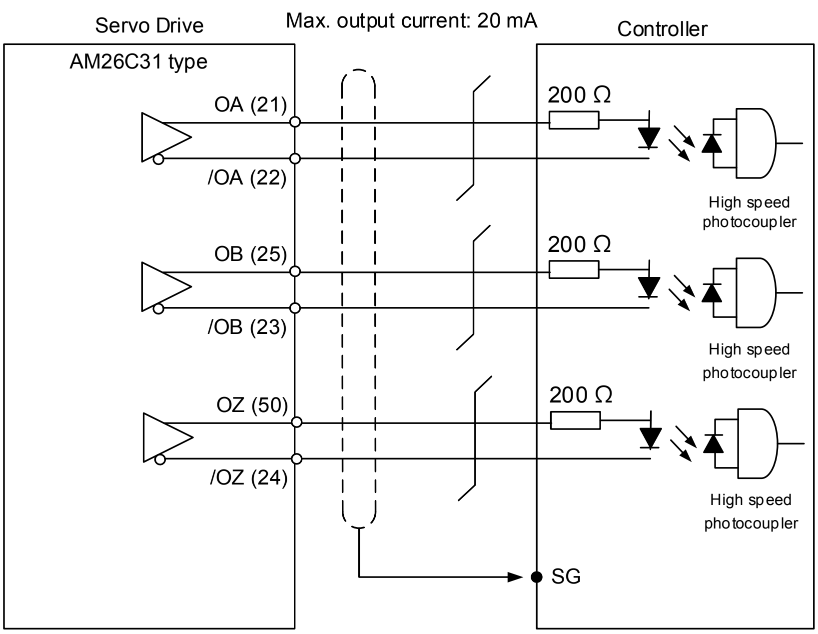
C9: output for encoder position signal (Line driver)



Note:

1. A3-F pins: OA (17), /OA (18), OB (19), /OB (20), OZ (21), /OZ (22).
2. It is suggested that you connect the two GND for the controller and servo drive in parallel when the voltage level is not the same for the controller and the servo drive.

C10: output for encoder position signal (Opto-isolator)



Note: A3-F pins: OA (17), /OA (18), OB (19), /OB (20), OZ (21), /OZ (22).

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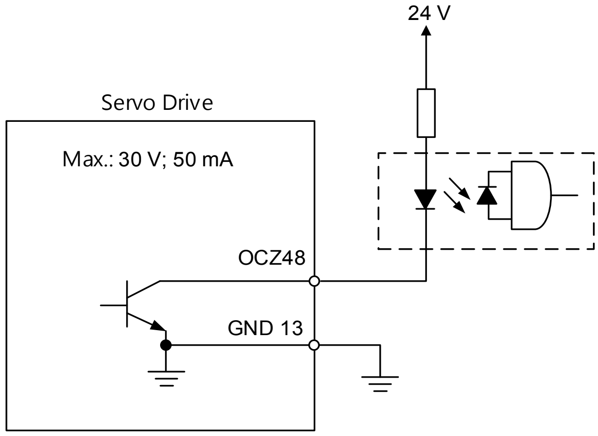
C11: encoder OCZ output (open-collector Z pulse output)



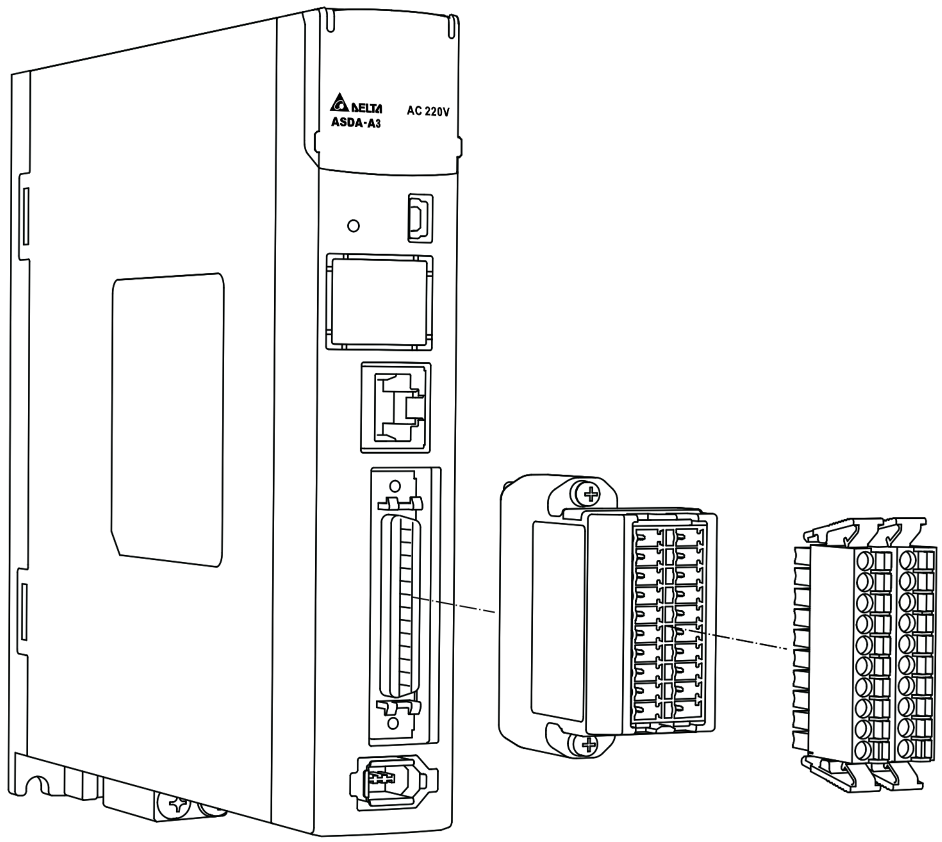
Note: this is not supported by the A3-F.

3.3.6 Application: using the CN1 quick connector for wiring

3

The CN1 quick connector (ASD-IF-SC5020) is designed for easy wiring. It can be used with the ASDA-A3, ASDA-A2 and ASDA-A2R series servo drive and can satisfy the needs of different DI/O applications. It is a good choice if you do not want to solder the wires. Its spring terminal blocks prevent vibration from loosening the wire. It includes five digital inputs, four digital outputs, differential pulse command inputs and Z phase open-collector outputs.

Note: please select the quick connector ASD-IF-SC2616 for the A3-F series servo drive.



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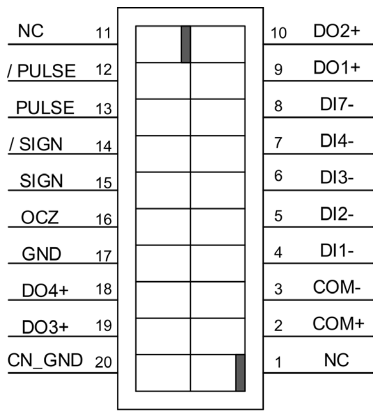
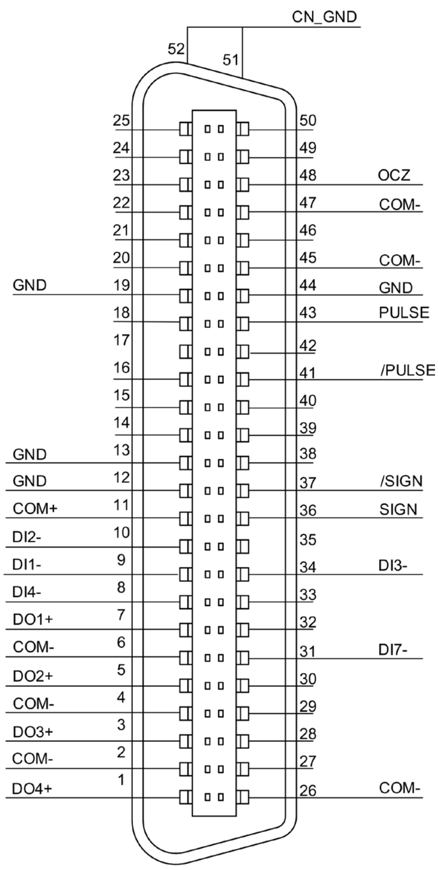
Pin assignment for the CN1 quick connector (J2 and J1):

J2:



J2

J1:



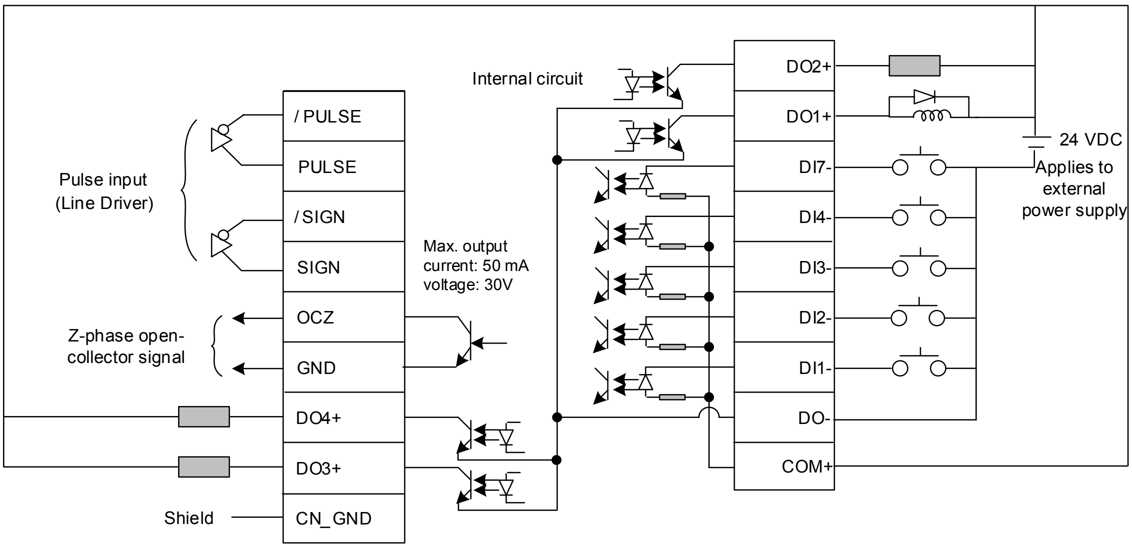
J1

PIN	Signal
1	NC
2	COM+
3	DO-
4	DI1-
5	DI2-
6	DI3-
7	DI4-
8	DI7-
9	DO1+
10	DO2+
11	NC
12	/PULSE
13	PULSE
14	/SIGN
15	SIGN
16	OCZ
17	GND
18	DO4+
19	DO3+
20	CN_GND

PIN	Signal
17	NC
11	COM+
2, 4, 6, 26	DO-
9	DI1-
10	DI2-
34	DI3-
8	DI4-
31	DI7-
7	DO1+
5	DO2+
NC	NC
41	/PULSE
43	PULSE
37	/SIGN
36	SIGN
48	OCZ
12, 13, 19, 44	GND
1	DO4+
3	DO3+
51, 52	CN_GND

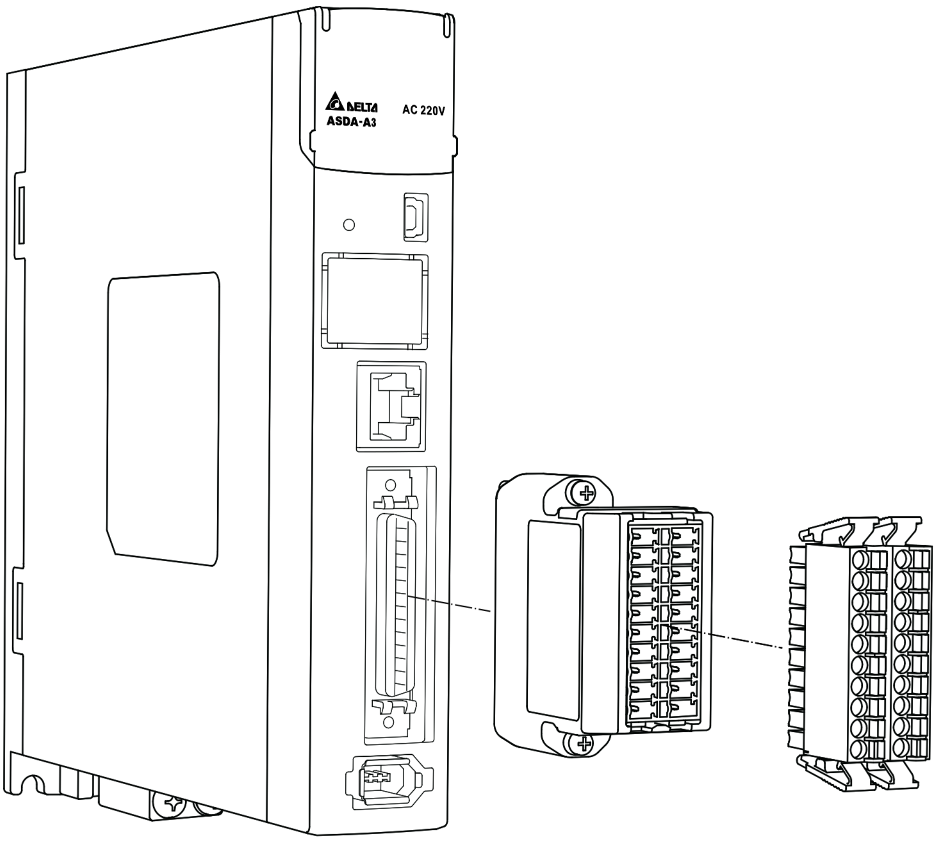
Note:
1. NC represents “No connection”.
2. The A3 does not support open-collector pulse command due to the configuration of pin definition.

Wiring example:



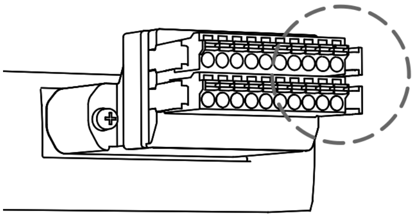
Wiring for CN1 quick connector and installation:

Installation

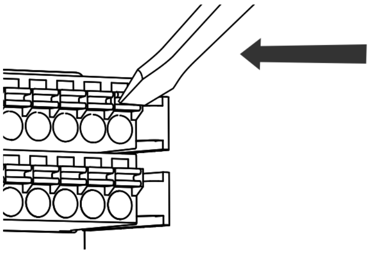


Wiring

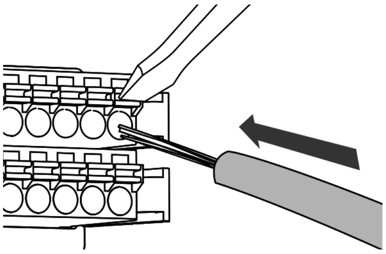
3



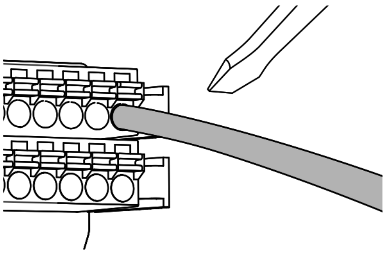
(1) The CN1 quick connector has multiple spring terminals. Please determine which terminal is to be wired in advance.



(2) Use a flathead screwdriver to press the spring down to open the pin.



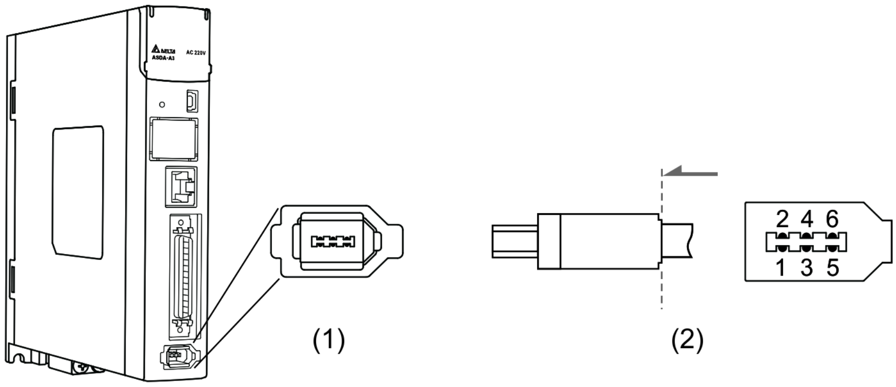
(3) Insert the stripped wire into the pin.



(4) Withdraw the screwdriver to complete the wiring.

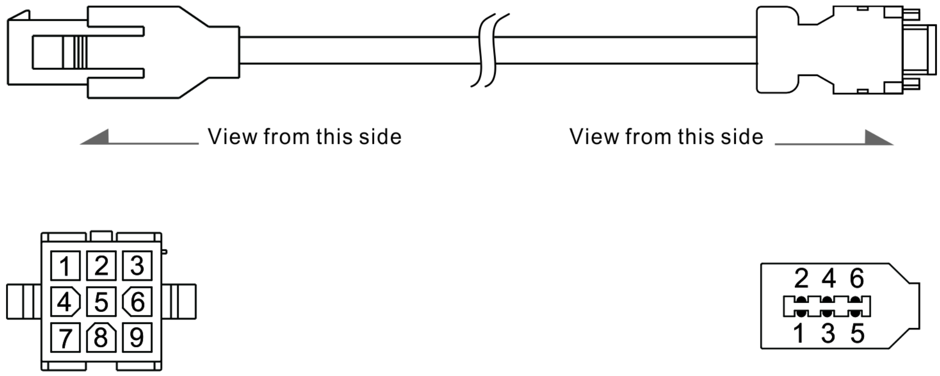
3.4 Wiring for the CN2 encoder connector

The CN2 encoder signal connector is shown below:

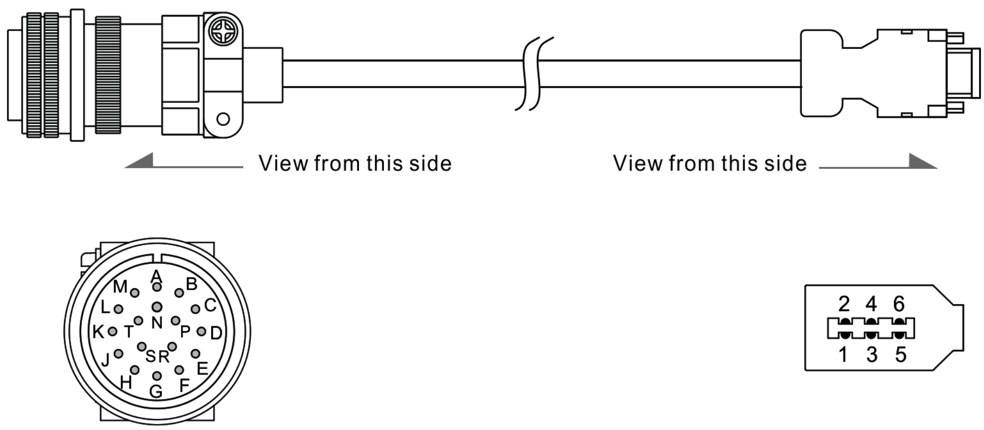


(1) CN2 connector (Female) (2) CN2 connector (Male)

Quick connector ends:



Military connector ends:

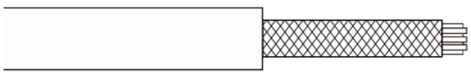


CN2 pin assignment:

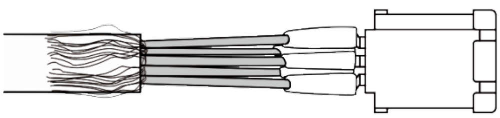
The end that connects to the encoder			The end that connects to the servo drive		
Military Connector	Quick Connector	Color	Pin No.	Symbol	Description
A	1	White	5	T+	Serial communication signal (+)
B	4	White / Red	6	T-	Serial communication signal (-)
S	7	Brown	1	+5V	+5 V power supply
R	8	Blue	2	GND	Power ground
L	9	-	Case	Shielding	Shielding

Note: when using an absolute type encoder, the battery directly supplies the power to the encoder. In this case wiring for CN2 for the servo drive is not required. Please refer to the detailed wiring description in section 3.1.5 Specifications for the encoder connector.

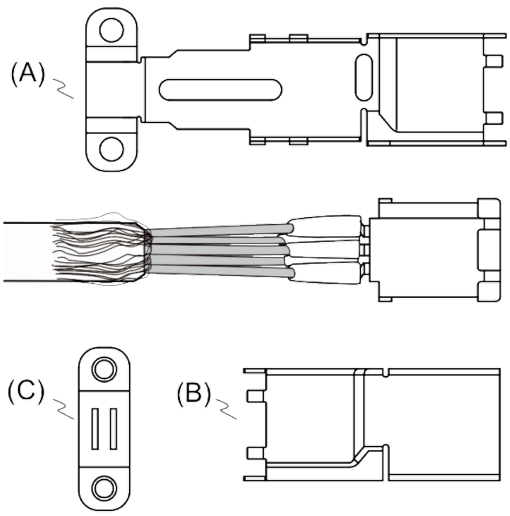
Connecting shielded wire to the CN2 encoder connector is shown below:



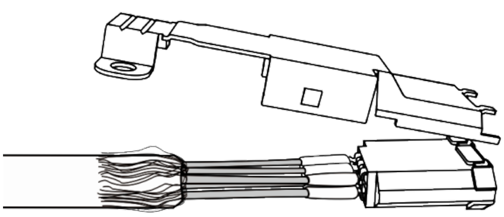
Step 1:
Cut through the cable and expose the shielding. The exposed wire length should be 20 – 30 mm.



Step 2:
Spread the metal shielding and fold it back. Refer to the CN2 pin assignment (see the table above) to connect the pins.



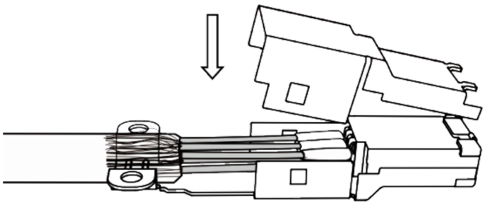
Step 3:
You need the following items to assemble the connector:
(A) Big metal case
(B) Small metal case
(C) Metal ring



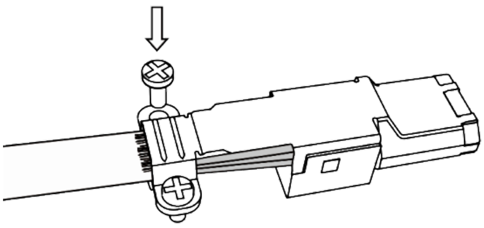
Step 4:
Place the metal case to cover the exposed wire shielding. Make sure the shielding is completed covered to maintain the integrity of the shielding.

3

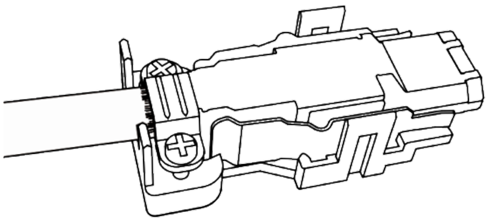
(continued)



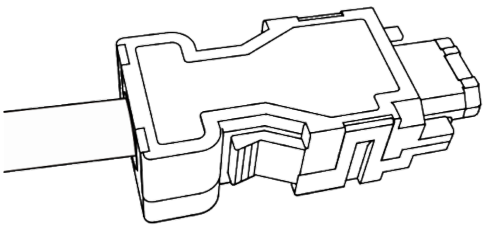
Step 5:
Fasten the other side of the metal case.



Step 6:
Tighten the screws of the metal case.



Step 7:
Fit one side of the plastic case over the connector.



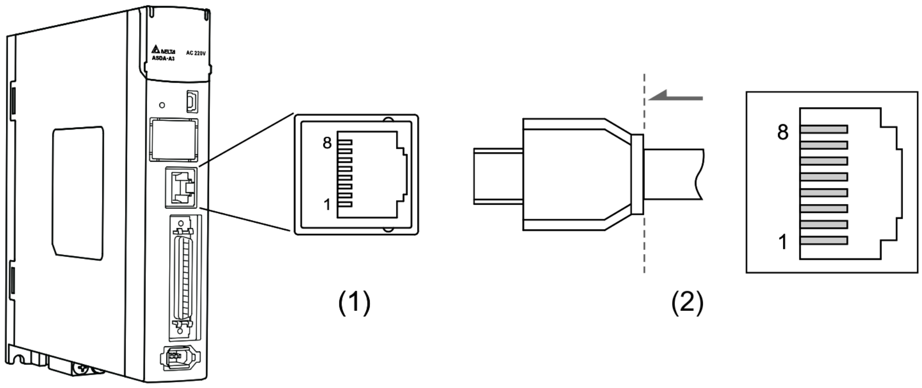
Step 8:
Place and fasten the other side of the case to complete the connector.

3

3.5 Wiring for the CN3 connector (RS-485 / high speed communication)

When the servo drive is connected to the PC via CN3, you can operate the servo drive, PLC, or HMI through MODBUS using the assembly language. The CN3 connector supports two commonly used communication interfaces, RS-485 and CAN. This enables you to connect to multiple servo drives simultaneously.

Note: RS-485 and high speed communication are not supported by A3-F.



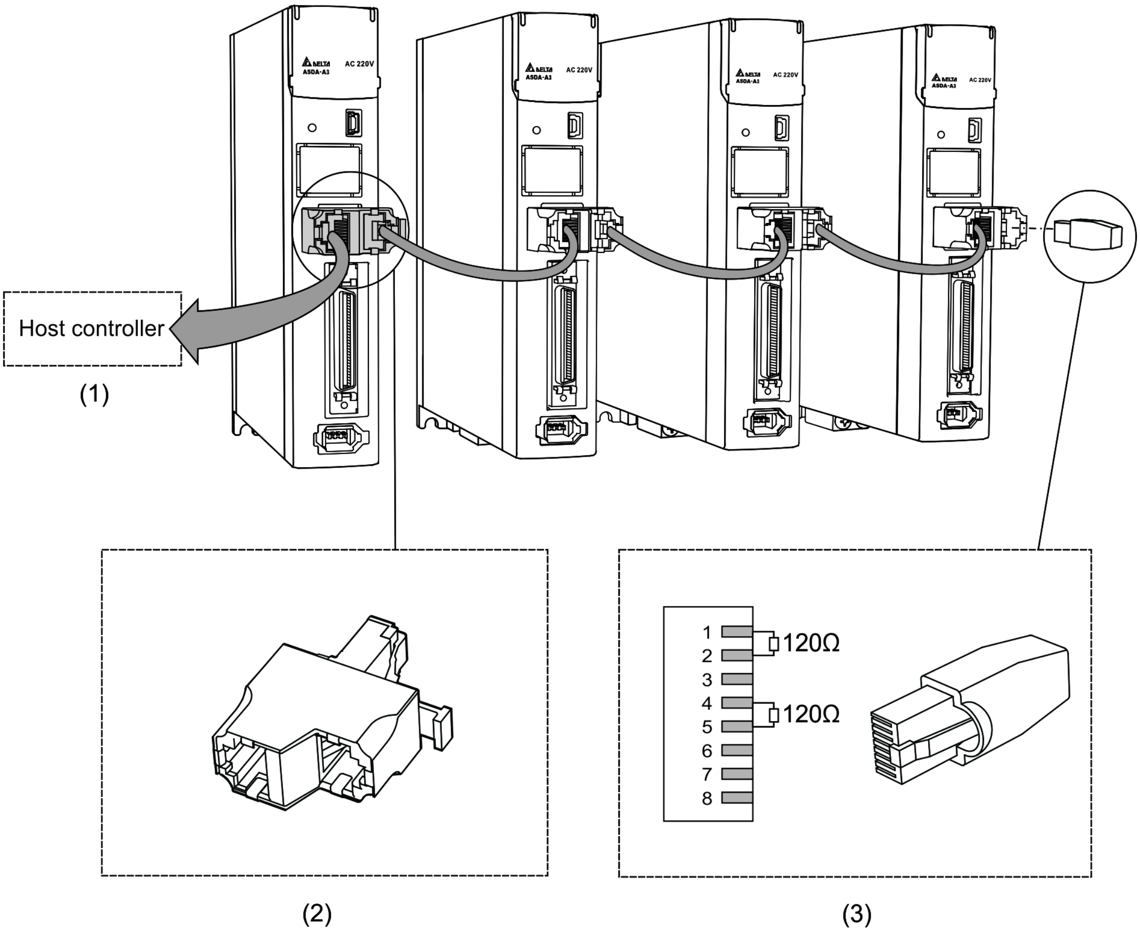
(1) CN3 connector (Female) (2) CN3 connector (Male)

Pin assignment:

Pin No.	Signal	Function
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3, 7	GND_ISO	Signal GND
4	RS-485-	The servo drive transmits the data to differential terminal (-)
5	RS-485+	The servo drive transmits the data to differential terminal (+)
6, 8	-	-

Note: please refer to Chapter 9 for the RS-485 wiring.

Connecting multiple servo drives:



(1) Connect to the controller / PLC

(2) Modbus/CAN connector (part name: ACS3-CNADC3)

(3) Wiring for CAN / RS-485 terminal resistor (part name: ACS3-CNTRC3)

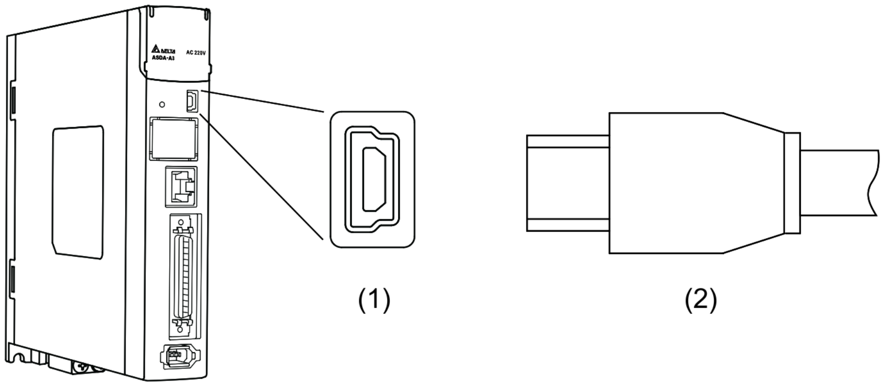
Note:

1. This supports up to 32 axes via RS-485 with the CANopen cable length of up to 30 m. The communication quality and the connectable axes are determined by the controller's specifications, quality of wires, grounding, interference, and whether twisted-pair cable with shielding is used.
2. It is suggested to use a terminal resistor of 120 Ω (Ohm) and 0.5 W (or more).
3. To connect multiple servo drives in parallel, please use CAN/RS-485 connectors as shown above, and put the terminal resistor in the last servo drive.

3.6 CN4 serial connector (Mini USB)

CN4 is a serial connector that connects to a PC and allows you to operate the servo drive with the software. This is a Type B Mini-USB that is compatible with the USB 2.0 specification.

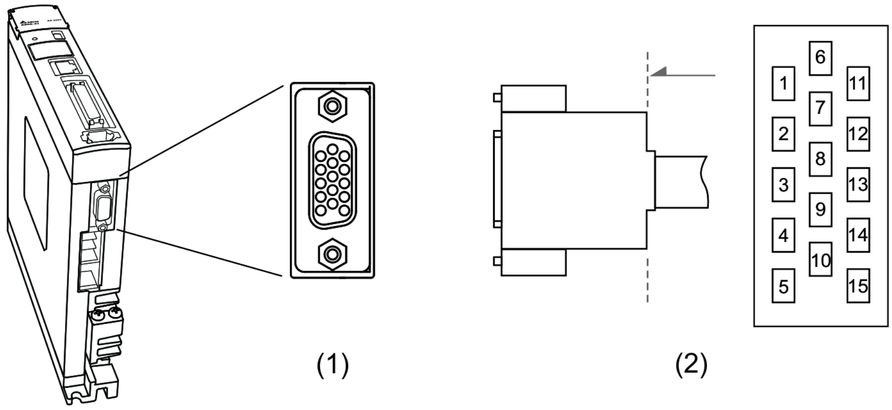
Note: when there is high interference during operation, it is suggested that you install the USB isolator (Part number: ACS3-CAUC15 / ACS3-CAUC30).



(1) USB connector (Female) (2) USB connector (Male)

3.7 CN5 connector (for machine position feedback, applicable to full-closed loop)

The CN5 connects to the external linear scale for the encoder (A, B, and Z) and forms a full closed loop with the servo system.



(1) CN5 connector (Female) (2) CN5 connector (Male)

Pin assignment:

Pin No.	Signal	Function
1	Opt_/Z	/Z phase input
2	Opt_/B	/B phase input
3	Opt_B	B phase input
4	Opt_A	A phase input
5	Opt_/A	/A phase input
6	GND	Encoder grounding
7	GND	Encoder grounding
8	+5V	Encoder power
9	Opt_Z	Z phase input
10	Reserved	Reserved
11	Reserved	Reserved
12	Reserved	Reserved
13	Reserved	Reserved
14	Reserved	Reserved
15	Reserved	Reserved

Note:

1. This only supports AB phase signal and the encoder of 5 V.
2. The maximum single-phase pulse frequency for the encoder is 1 MHz.

3

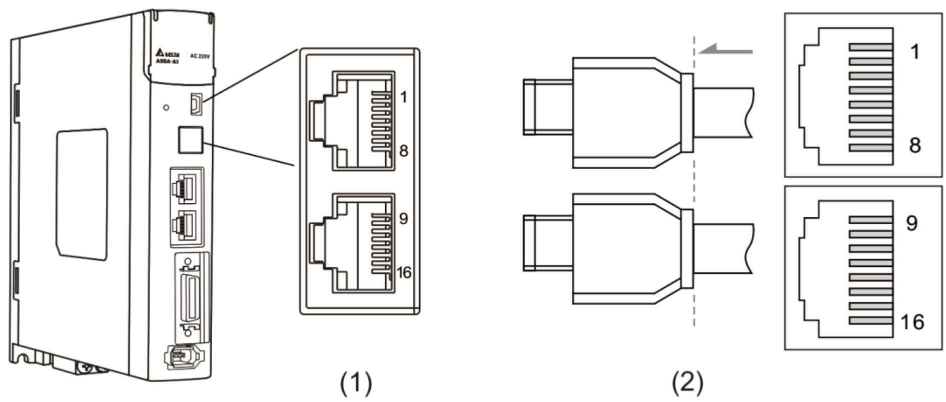
3.8 CN6 connector

3.8.1 DMCNET communication connector for wiring

The CN6 connector is a standard RJ45 connector with shielded cable. You can use it to connect to the host controller or motion control card. With Delta's DMCNET system, you can control position, torque and speed, as well as accessing or monitoring the servo status.

You can set the station number of DMCNET with P3.000. Its maximum transmission rate is 20 Mbps. Two ports are provided for connecting multiple servo drives, with one way in and the other way out. Please remember to put the terminal resistor (150 Ω) in the last servo drive.

Note: DMCNET is supported by the A3-F only.

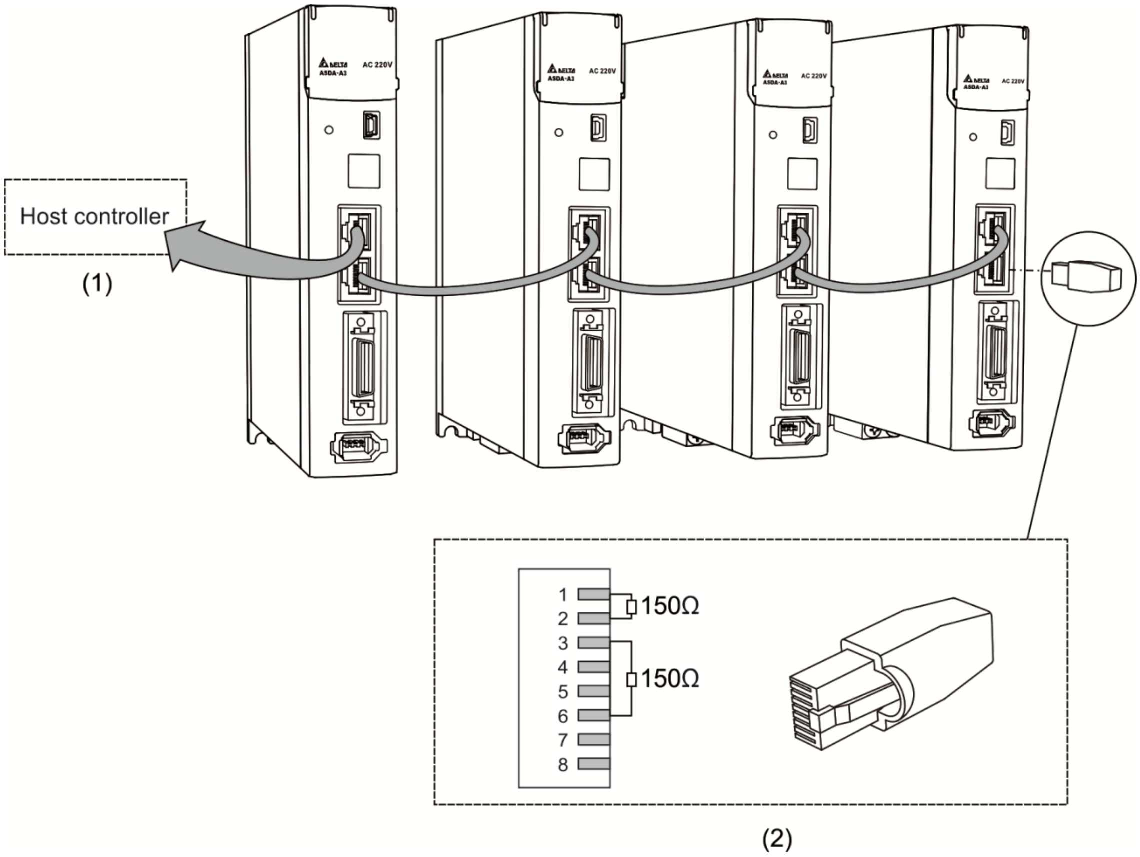


(1) CN6 connector (female) (2) CN6 connector (male)

Pin assignment:

Pin No.	Signal	Function
1, 9	DMCNET_1A	DMCNET Channel 1 bus line (+)
2, 10	DMCNET_1B	DMCNET Channel 1 bus line (-)
3, 11	DMCNET_2A	DMCNET Channel 2 bus line (+)
4, 12 5, 13	-	-
6, 14	DMCNET_2B	DMCNET Channel 2 bus line (-)
7, 15 8, 16	-	-

Connecting multiple servo drives:



(1) Connection to the controller / motion control card

(2) DMCNET terminal resistor. This is produced by Delta PLC department; please contact your local distributors for ordering information.

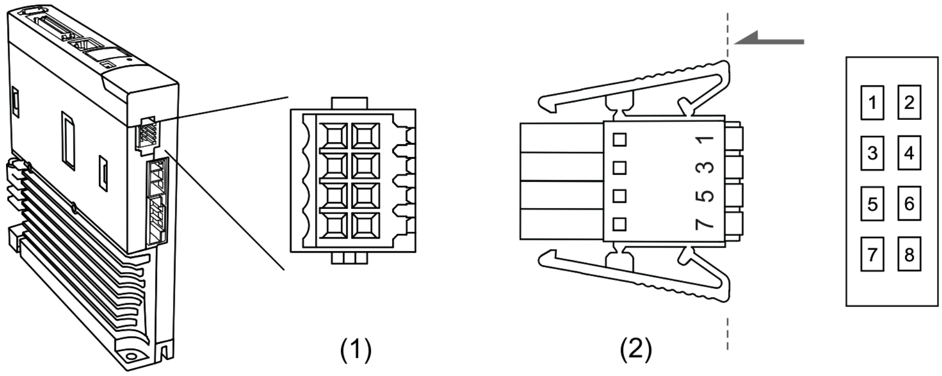
Note:

1. This supports up to 12 axes and the cable length of up to 30 m.
2. It is suggested that you use a terminal resistor of 150 Ω (Ohm) and 0.5 W (or more).
3. To connect multiple servo drives in serial, please use DMCNET connectors as shown above, and put the terminal resistor in the last servo drive.

3.9 CN10 STO connector (Safe torque off)

This connector provides the STO function. More details are provided in the next section.

Note:
1. The STO function is supported by the A3-M only.
2. STO certification application in progress.

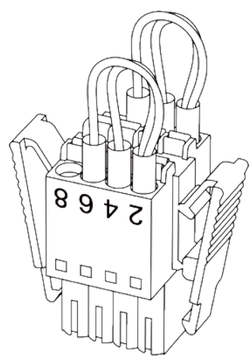


(1) CN10 STO connector (Female) (2) CN10 quick connector (Male)

Pin assignment:

Pin No.	Signal	Function
1	Reserved	Reserved
2	Reserved	Reserved
3	STO_A	STO input A+
4	/STO_A	STO input A-
5	STO_B	STO input B+
6	/STO_B	STO input B-
7	FDBK+	STO alarm output (+), BJT Output Max. rating: 80 V_{DC}, 0.5 A
8	FDBK-	STO alarm output (-), BJT Output Max. rating: 80 V_{DC}, 0.5 A

If you use the STO function, you can plug in the STO connector that comes with the servo drive. The wiring has been done as shown in the figure on the right. If this connector has been disassembled, refer to section 3.9 STO Function (Safe Torque Off) for wiring information.



3.10 STO function (Safe torque off)

3.10.1 Introduction to STO

Once the STO function is activated, the servo drive stops supplying current to the motor, cutting off the power supply and torque force.

Note:
1. The STO function is supported by the A3-M only.
2. STO certification application in progress.

3.10.2 The potential danger of STO

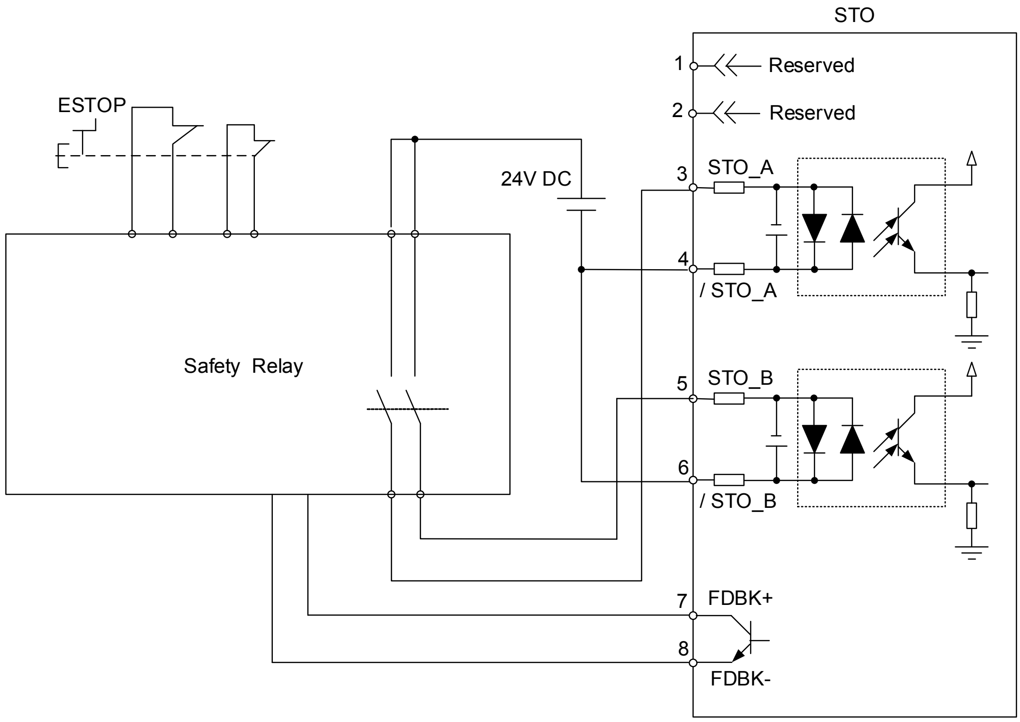
After the STO function is activated, the motor is no longer controlled by the servo motor. Thus, the potential danger from STO must be taken into consideration when designing and wiring the machine. Delta is not liable for mechanical damage and personnel injury if you fail to observe the following instructions:

1. For a safety circuit design, make sure the selected components conform to the safety specifications.
2. Before installation, read the safety instructions in the STO-related user manual for the components you use.
3. To avoid electric shock, do not touch the servo drive even when the STO function is activated. Although the power to the motor is cut off, there is residual electricity since the power supply is not completely removed from the servo drive.
4. When the STO function is enabled, the servo drive can no longer control, stop or decelerate the motor.
5. After the STO function is activated, the servo drive no longer controls the motor, but the motor can still be moved by other external forces.

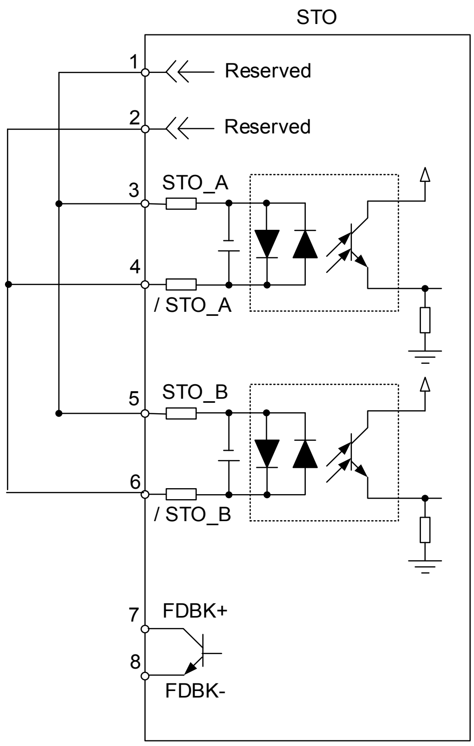
3

3.10.3 Wiring for STO

To use a safety relay to trigger the STO function, please connect the wiring as shown in the following diagram:



If you are not using the STO function, you can short-circuit the connector or plug in the connector that has been wired (provided with the servo drive).



3.10.4 How does the STO function work?

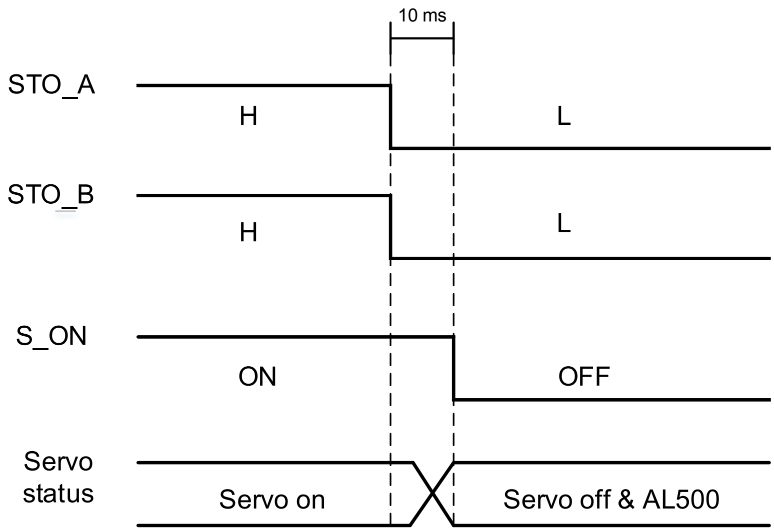
The STO function is controlled by the motor current from two individual circuits. It cuts off the power supply to the motor when needed, after which the motor is free from torque force. Table 1 details how this function works.

Table 1: actions description (ON = 24V; OFF = 0V)

Signal	Channel	Status of opto-isolator			
STO	STO_A ~ / STO_A	ON	ON	OFF	OFF
	STO_B ~ / STO_B	ON	OFF	ON	OFF
Servo Drive Output Status		Ready	Torque off (STO_B lost)	Torque off (STO_A lost)	Torque off (STO Mode)

(1) Description of the STO alarm:

See the diagram below. When the motor runs normally (Servo On), but both STO_A and STO_B signals are low for 10 ms at the same time, AL500 occurs and the drive is in the Servo Off state.



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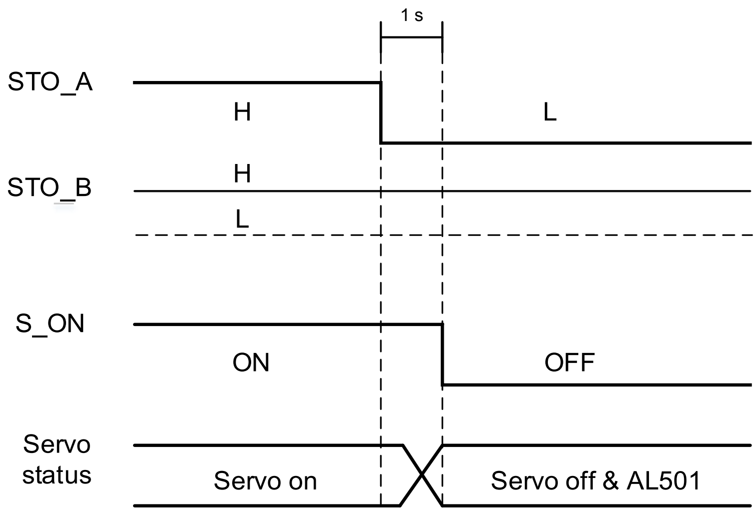
When the motor runs normally (Servo On), but one of the safety signal source is low for 1s, AL501 or AL502 occurs. Then the servo drive is in the Servo Off state.



3.10.5 Related parameter of the STO function

By setting parameter P2.093, you can determine the FDBK status (Pin FDBK+ and FDBK-) and whether FDBK latches if an STO alarm occurs. The structure for P2.093 is shown below:

$$P2.093 = \underbrace{XX}_{(1)}\ \underbrace{1}_{(2)}\underbrace{0}_{(3)}$$

(1)	Not in use
(2)	1: FDBK no latch 2: FDBK latch
(3)	0: Logic A 1: Logic B 2: Logic C 3: Logic D

STO function description:

See the table below. Four logic conditions (Logic A, B, C, and D) are available to standardize the FDBK status when different STO alarms occur. You can select the corresponding logic according to the needs of the application. In this table, “Open” means FDBK+ and FDBK- of CN8 are an open circuit. Take Logic C as an example: when AL500 occurs, FDBK+ and FDBK- of CN8 are short circuited.

Servo drive status		FDBK status							
		Logic A		Logic B		Logic C		Logic D	
Parameter P2.093		XX10	XX20	XX11	XX21	XX12	XX22	XX13	XX23
FDBK behavior		No latch	latch	No latch	latch	No latch	Latch	No latch	latch
No STO alarm occurs		Open		Close		Open		Close	
Alarm occurs	AL500	Close		Open		Close		Open	
	AL501	Close		Open		Open		Close	
	AL502	Close		Open		Open		Close	
	AL503	Close		Open		Open		Close	

Note:
1. Open = open circuit; Close = short circuit
2. Please refer to Chapter 10 Alarms for more details.

FDBK behavior (Latch /No Latch):

If FDBK is latched when the STO alarm occurs, the status of FDBK does not change even when the alarm is cleared. Please note that when more than one alarm occurs, the drive panel only shows AL500.

■ Example of Latching:

If Logic C P2.093 = XX22 is set, the FDBK status is closed when safety signal is lost and AL005 occurs.

1. Since FDBK is selected as Latch, even when the safety signal is back to normal, the FDBK status remains closed. To reset FDBK:
   (1) Reconnect the power supply: FDBK status returns to “open”.
   (2) Do not reconnect the power supply. Instead, set P2.093 to XX12 to make the FDBK status return to “open”. Then set P2.093 to XX22 again. This step sets the FDBK behavior to Latch.
2. After the FDBK status is restored, you can clear the alarms by the normal corrective actions. In this case, you can clear AL500 by DI.Alm Reset.

■ Example of Not Latching:

If Logic C P2.093 is set to XX12, the FDBK status is closed when the safety signal is lost and AL500 occurs.

1. Since FDBK is selected as No Latch, when the safety signals return to normal, the FDBK status automatically changes from short-circuited to normal when AL500 occurs. Setting P2.093 to XX12 again is not required.
2. After the FDBK status is restored, you can clear the alarms by the normal corrective actions. In this case, you can clear AL500 that by DI.Alm Reset.

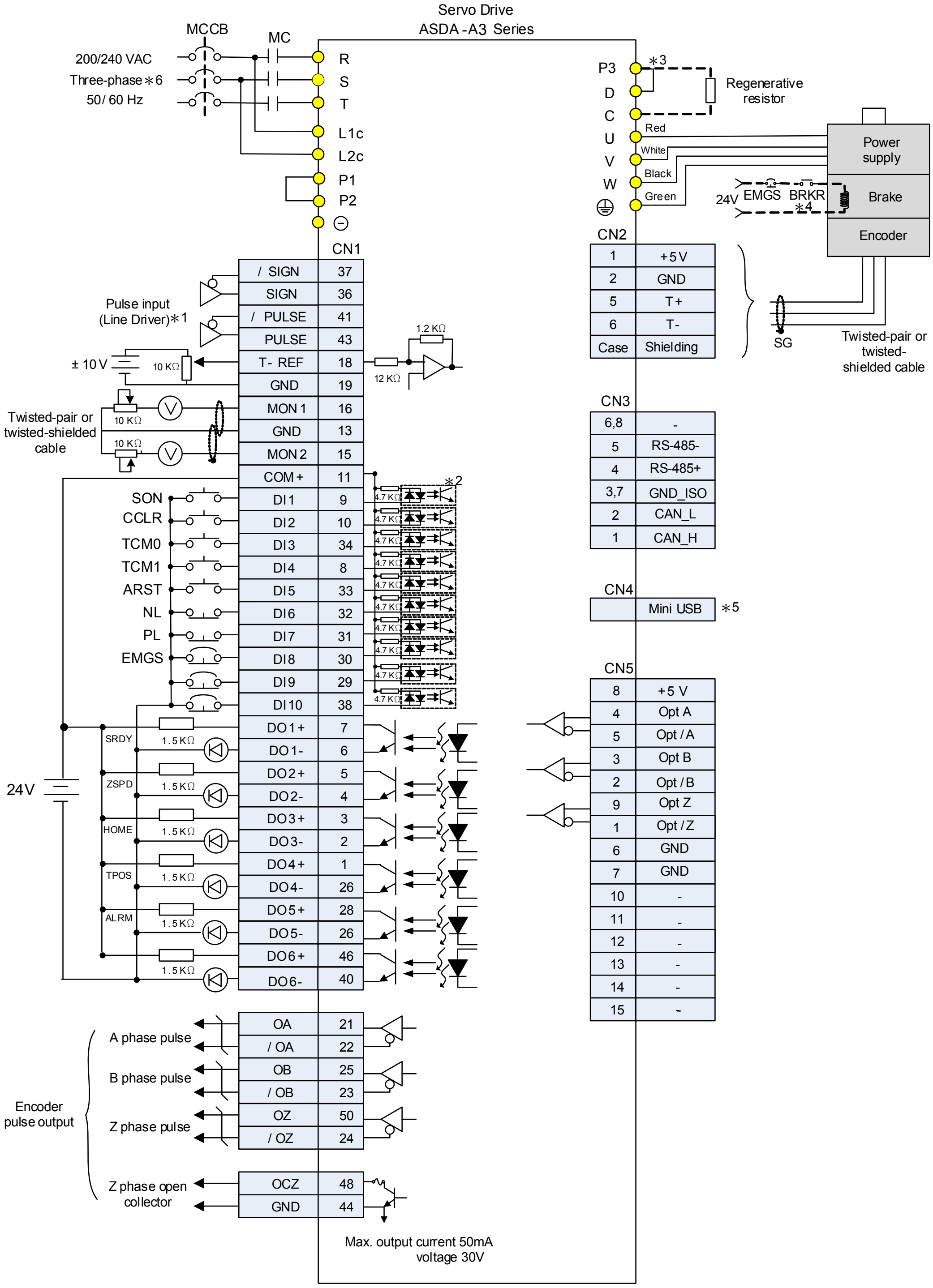
Relevant parameters (Please refer to Chapter 8 for detailed information):

Parameter	Function
P2.093	STO FDBK Control

3

3.11 Standard wiring example

3.11.1 Position (PT) control mode



Note:

*1: Please refer to section 3.3.3 for C4 wiring diagram.

*2: Please refer to section 3.3.3 for wiring diagram C7 SINK / C8 SOURCE.

*3: Models of 200 W and below have no built-in brake resistor.

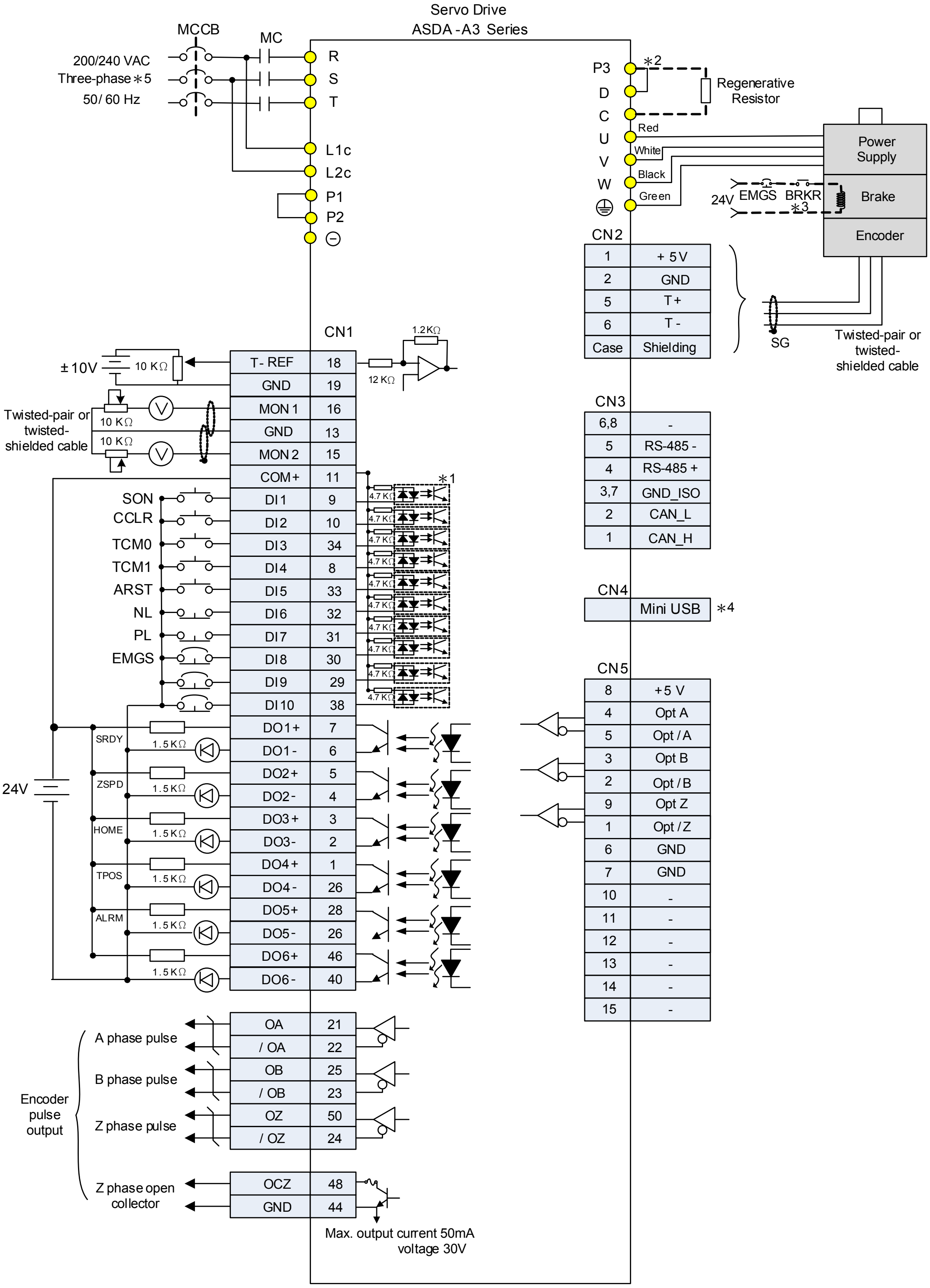
*4: The brake coil you has no polarity.

*5: Connect to Mini-USB (for PC communication).

*6: Models of 1.5 kW and below can use single-phase power supply.

3

3.11.2 Position (PR) control mode



Note:

*1: Please refer to section 3.3.3 for wiring diagram C7 SINK / C8 SOURCE.

*2: Models of 200 W and below have no built-in brake resistor.

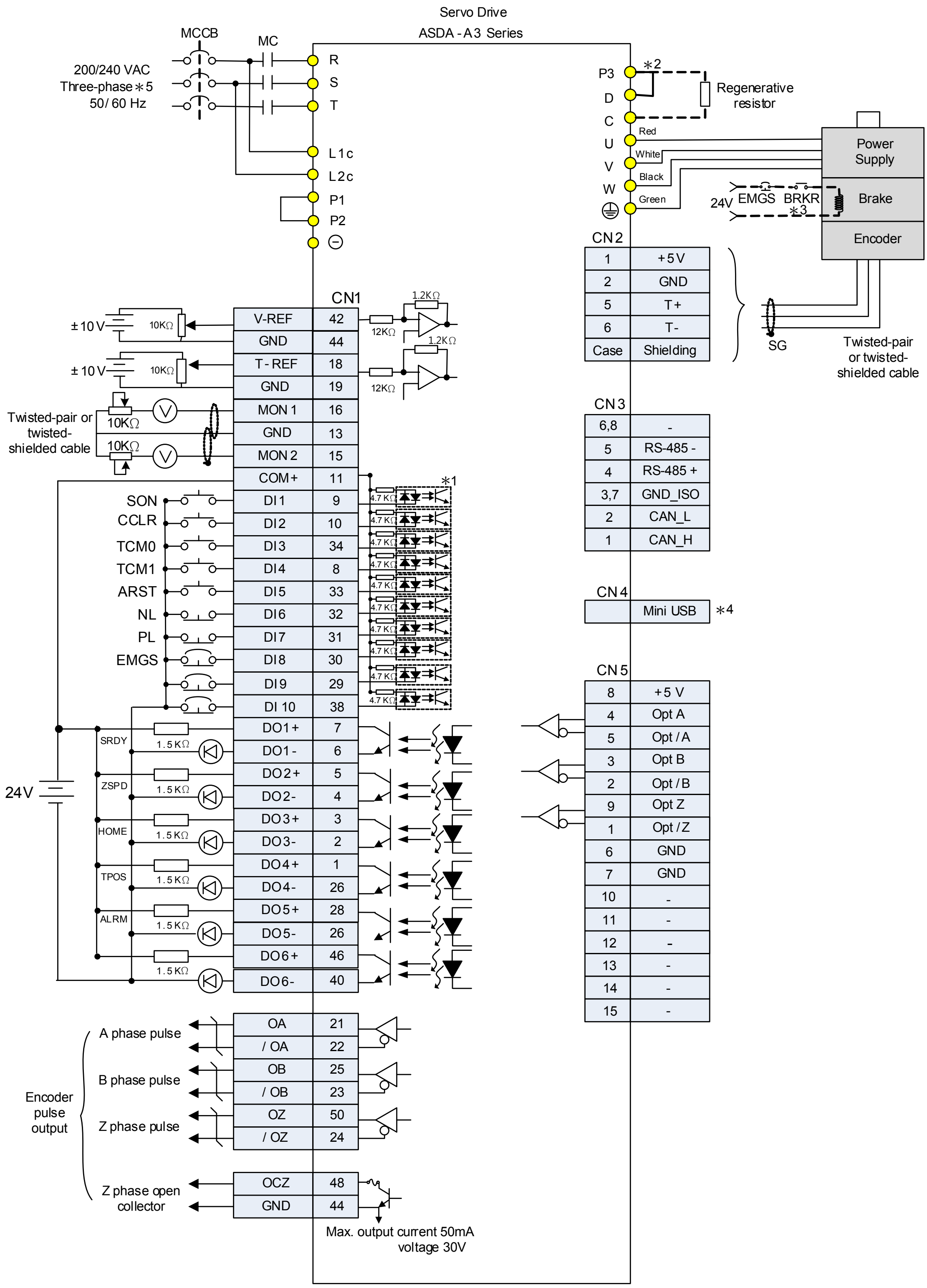
*3: The brake coil has no polarity.

*4: Connect to Mini-USB (for PC communication).

*5: Models of 1.5 kW and below can use single-phase power supply.

3

3.11.3 Speed control mode



Note:

*1: Please refer to section 3.3.3 for wiring diagram C7 SINK / C8 SOURCE.

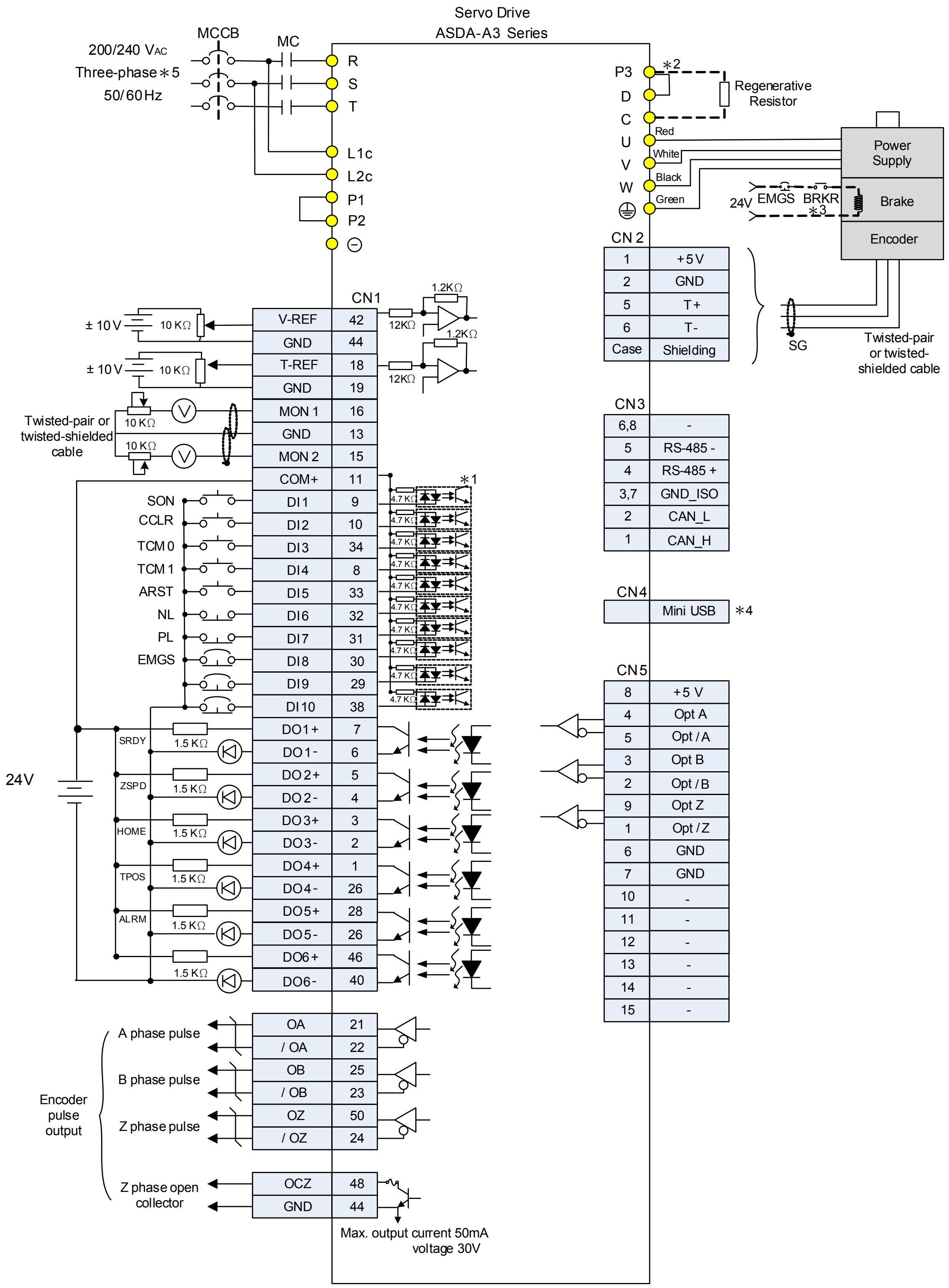
*2: Models of 200 W and below have no built-in brake resistor.

*3: The brake coil has no polarity.

*4: Connect to Mini-USB (for PC communication).

*5: Models of 1.5 kW and below can use single-phase power supply.

3.11.4 Torque control mode



Note:

*1: Please refer to section 3.3.3 for wiring diagram C7 SINK / C8 SOURCE.

*2: Models of 200 W and below have no built-in brake resistor.

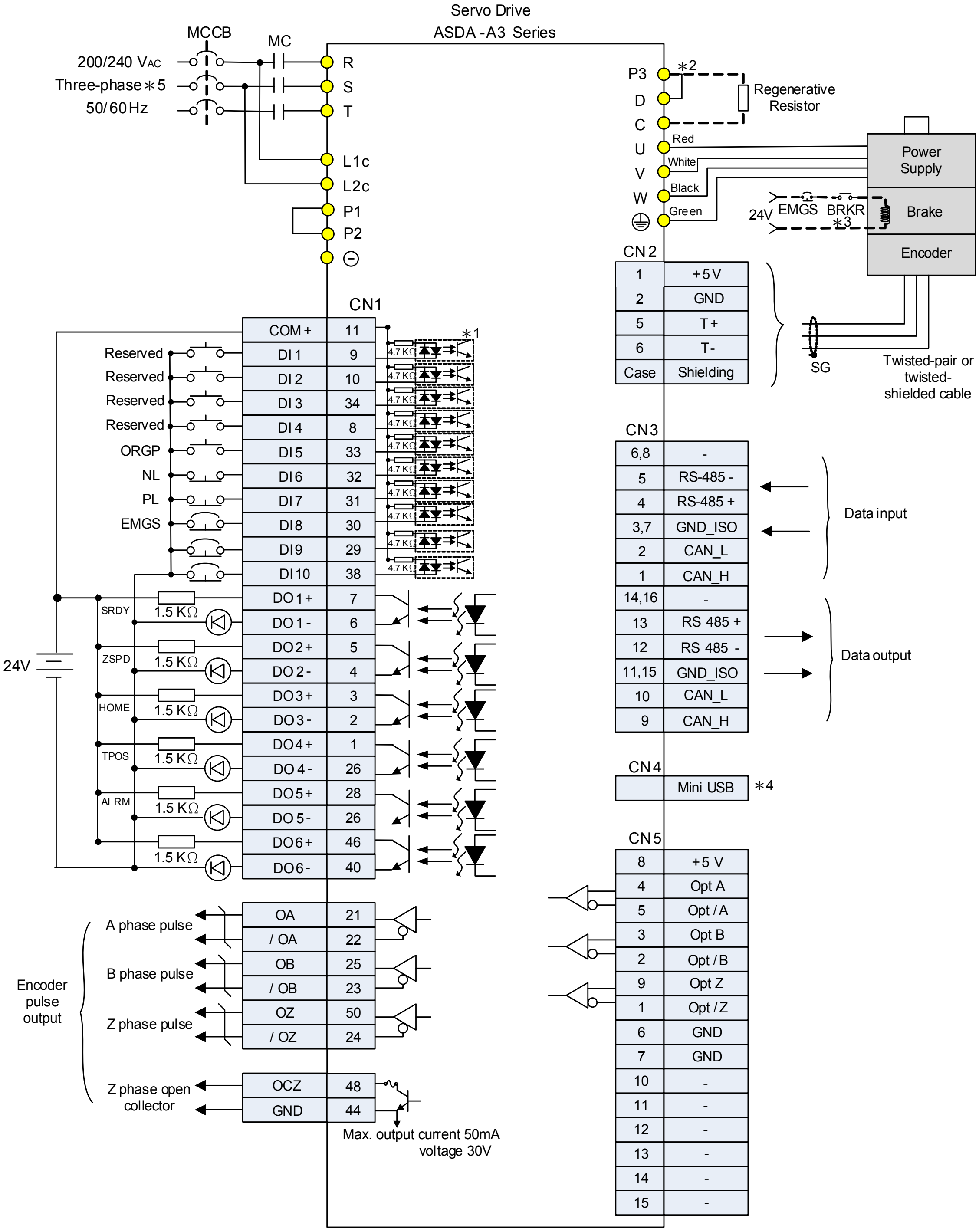
*3: The brake coil has no polarity.

*4: Connect to Mini-USB (for PC communication).

*5: Models of 1.5 kW and below can use single-phase power supply.

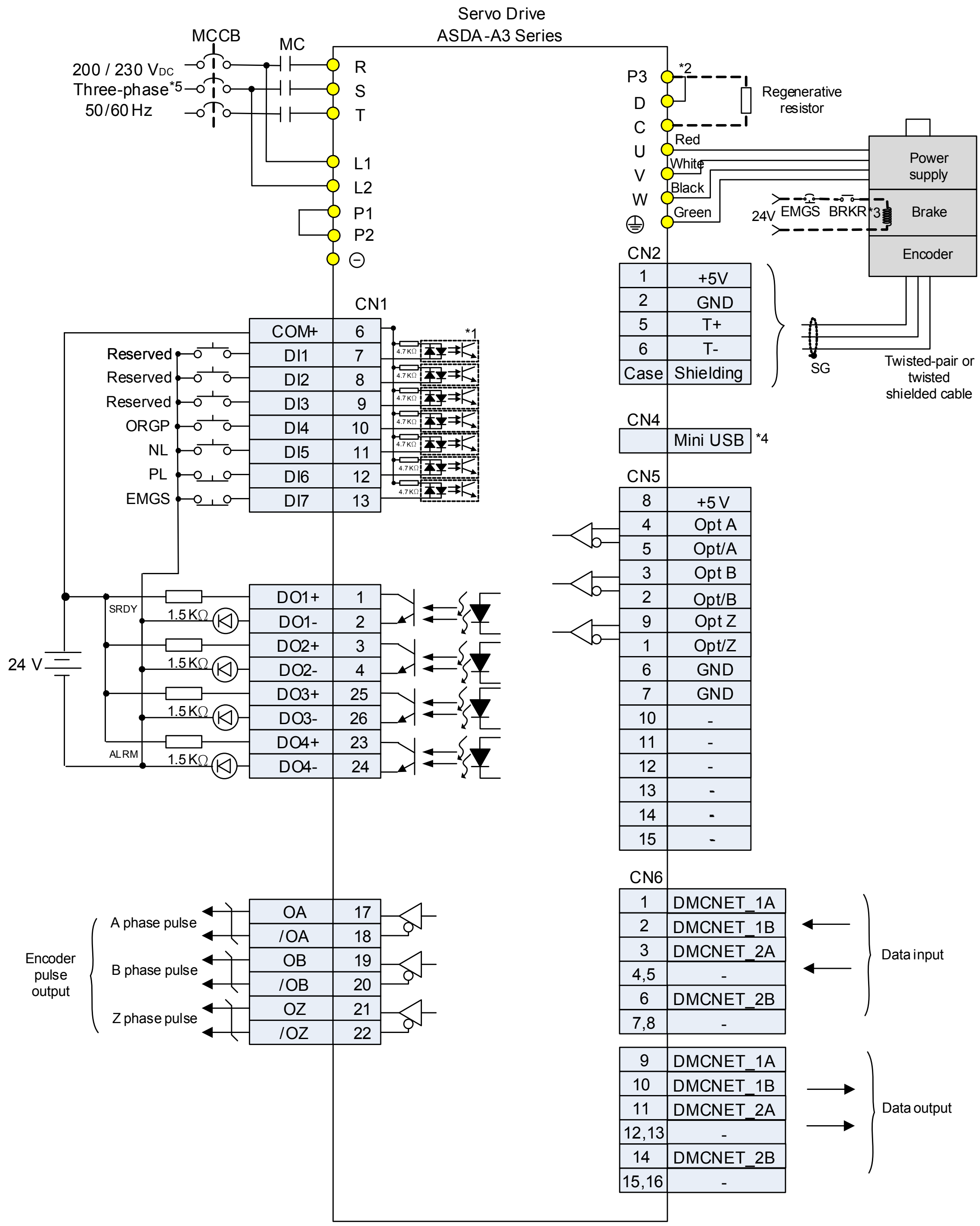
3

3.11.5 Communication mode (CANopen)



Note:
*1: Please refer to section 3.3.3 for wiring diagram C7 SINK / C8 SOURCE.
*2: Models of 200 W and below have no built-in brake resistor.
*3: The brake coil has no polarity.
*4: Connect to Mini-USB (for PC communication).
*5: Models of 1.5 kW and below can use single-phase power supply.

3.11.6 Communication mode (DMCNET)



Note:

*1: Please refer to section 3.3.3 for wiring diagram C7 SINK / C8 SOURCE.

*2: Models of 200 W and below have no built-in brake resistor.

*3: The brake coil has no polarity.

*4: Connect to Mini-USB (for PC communication).

*5: Models of 1.5 kW and below can use single-phase power supply.

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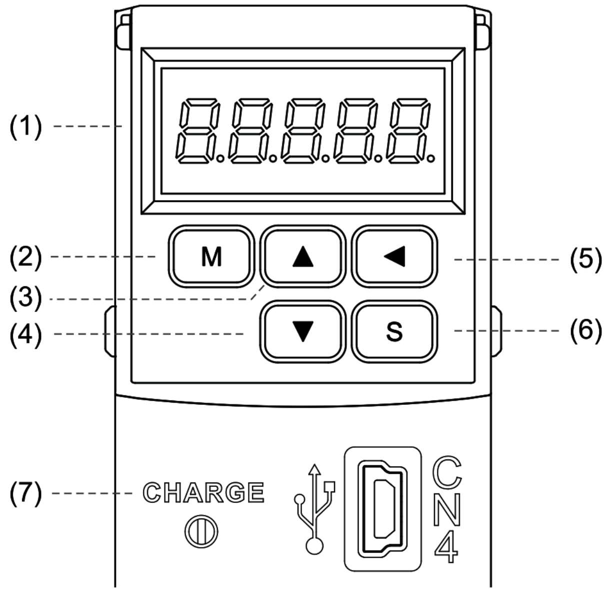
Test Operation and Panel Display

4

This chapter describes the panel display of ASDA-A3 series servo drive, as well as its operation and testing.

4

4.1 Panel description



(1) Display: 5-digit, 7-segment LED displays the monitoring values, parameters, and setting values.

(2) MODE key: switches the display among Monitoring mode, Parameter mode, and Alarm mode. In Editing mode, press the MODE key to switch to Parameter mode.

(3) UP key: changes monitoring code, parameter number, and value.

(4) DOWN key: changes monitoring code, parameter number, and value.

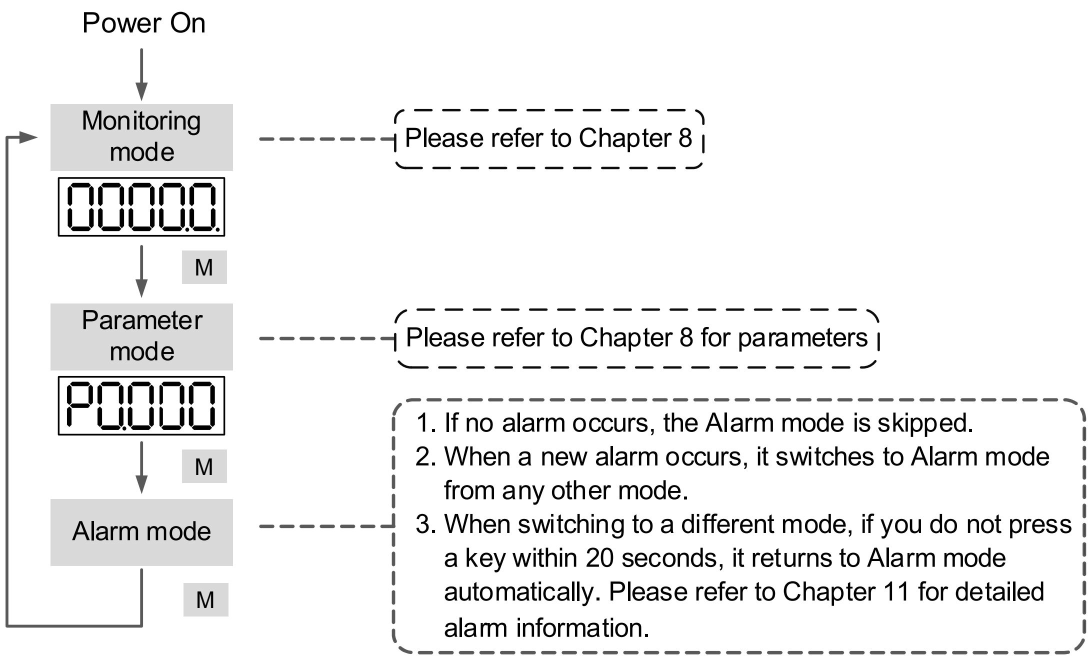
(5) SHIFT key: in Parameter mode, use this key to change the group number. In Editing mode, moving the flashing (selected) digit to the left lets you adjust the higher setting bit. You can switch the display of high / low digits in Monitor mode.

(6) SET key: displays and stores the parameter value. In Monitor mode, pressing the SET key switches between decimal and hexadecimal display. In Parameter mode, pressing the SET key switches to Editing mode.

(7) Charge LED: the Charge LED indicator is on when the circuit is powered.

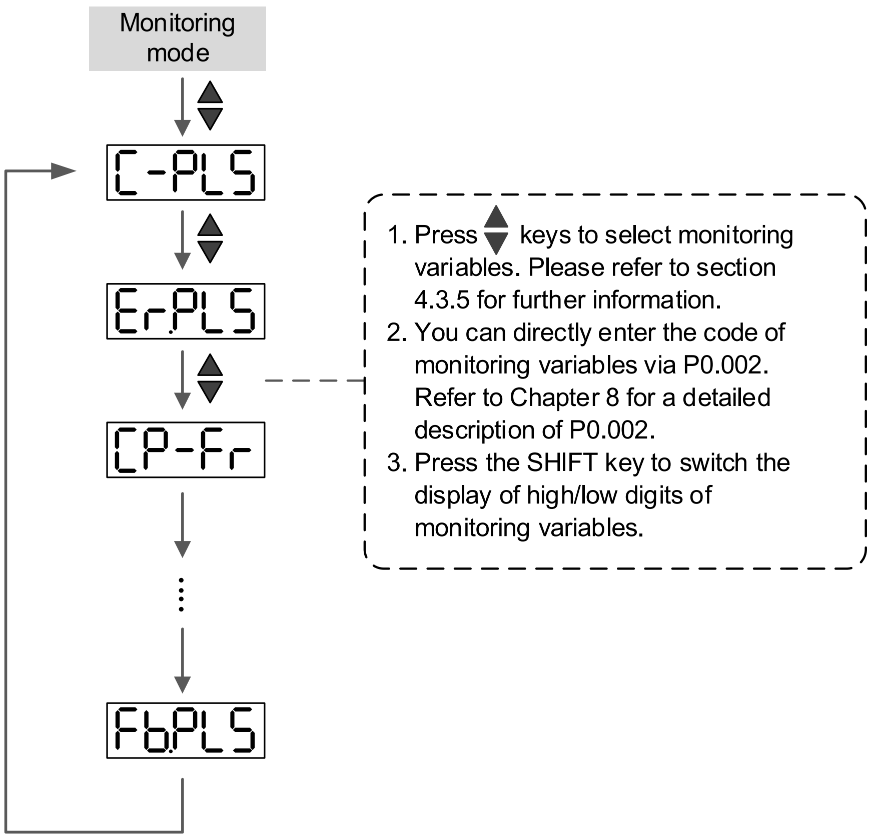
4.2 Parameter setting procedure

Switching modes:



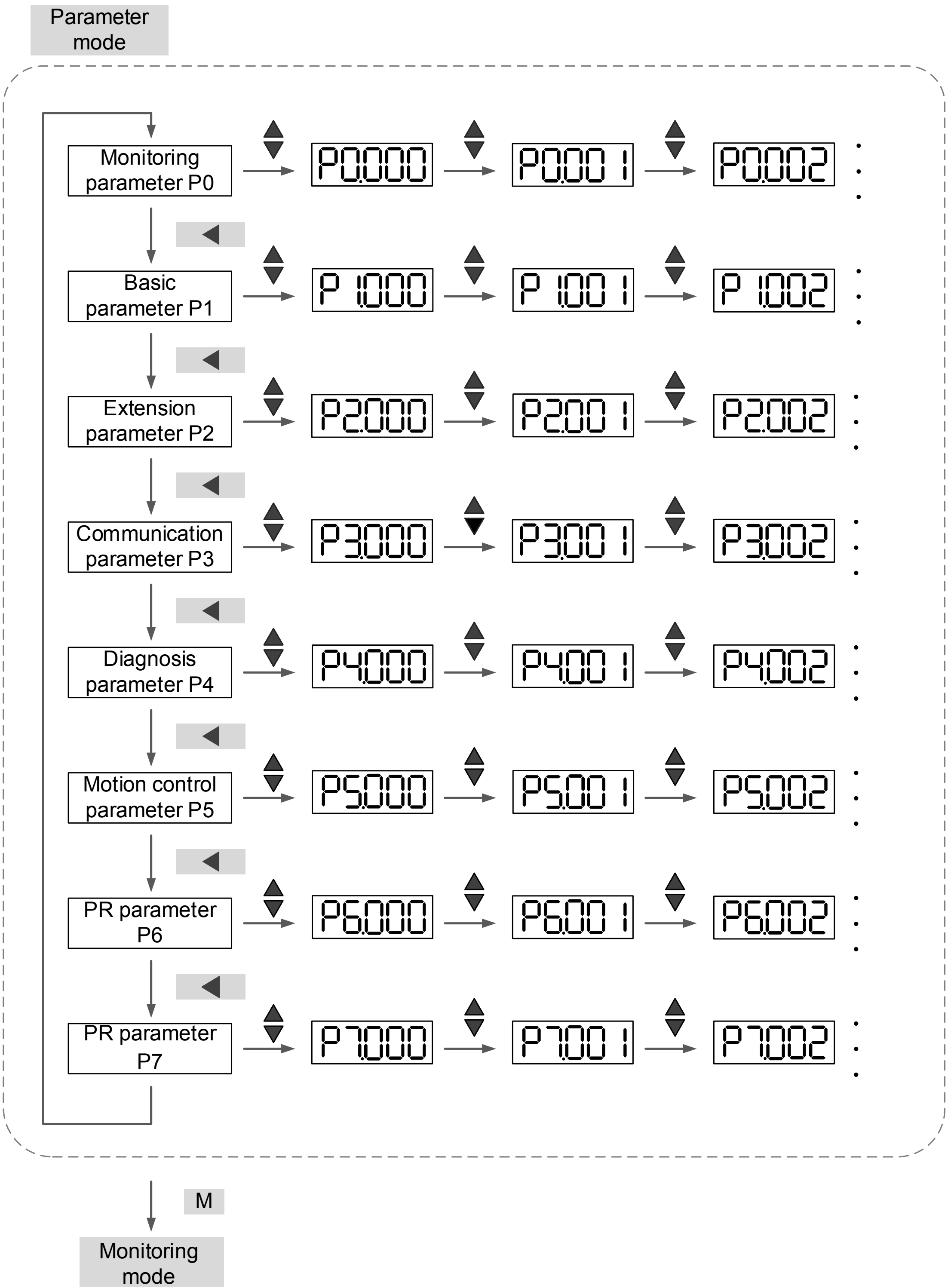
Operating in each mode:

Monitoring mode

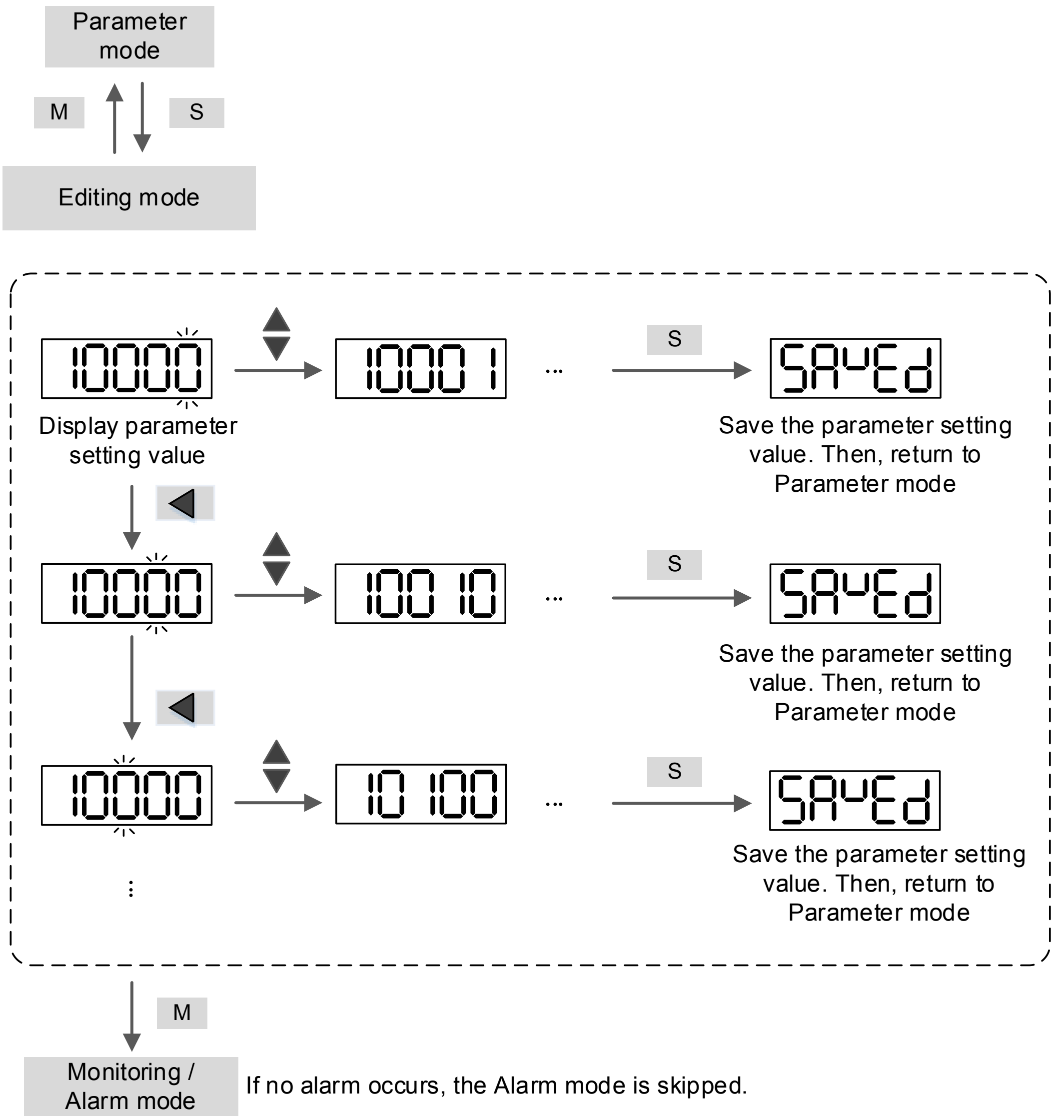


4

Parameter mode



Editing mode

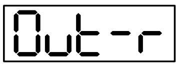
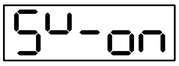
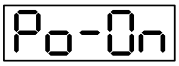


4

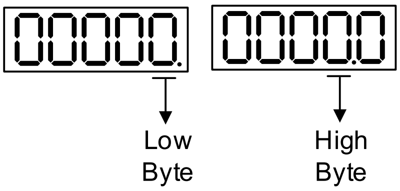
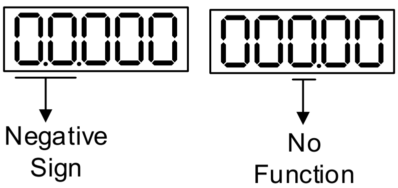
4.3 Status display

4.3.1 Save the setting display

When you complete the parameter setting, press the SET key to save the parameters.
The panel displays the status for one second.

Displayed symbol	Description
	Correctly saved the setting value (Saved).
	Read-only and write-protected parameter (Read-only).
	Entered the wrong password or did not enter a password (Locked).
	Entered an incorrect setting value or the reserved setting value (Out of Range).
	You cannot enter a value when in Servo On state (Servo On).
	Changes to the parameter take effect after cycling the power to the servo drive (Power On).

4.3.2 Display the decimal point

Displayed symbol	Description
	High byte / low byte indication: this indicates the current high byte or low byte when the data is displayed in decimal (32 bits).
	Negative sign: the two decimal points on the left represents the negative sign when the data is displayed in decimal format, (16 or 32 bits). In hexadecimal format, it only shows positive values.

4.3.3 Alarm messages

Displayed symbol	Description
ALnnn	When an alarm occurs, the servo drive shows 'AL' as the alarm symbol and 'nnn' as the alarm code. For detailed information, please refer to Chapter 8 P0.001 Parameter Description or Chapter 11 Troubleshooting.

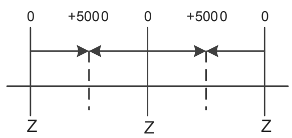
4.3.4 Positive and negative sign setting

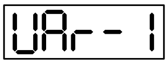
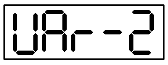
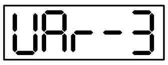
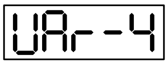
Displayed symbol	Description
02468	In Editing mode, press the UP and DOWN keys to change the displayed value. Use the SHIFT key to change the selected value (the selected value is flashing.)
2.4.680	Press the SHIFT key for two seconds to switch between the positive (+) and negative (-) sign. If the parameter value is out of range after switching the positive or negative sign, then the value automatically resets to the original value.

4.3.5 Monitoring display

When you apply power to the drive, the display shows the monitoring symbol for one second, and then enters Monitoring mode. In Monitoring mode, use the UP and DOWN keys to change the monitoring variable. Or you can directly change the setting of P0.002 to specify the monitoring code. When powered, the monitoring code is set to the value of P0.002. For example, the value of P0.002 is 4. When the drive is powered, it displays C-PLS monitoring sign first, and then shows the input number of pulses. See the details in the table below:

P0.002 setting value	Monitoring displayed symbol	Description	Unit
0	Fb.PUU	Motor feedback pulse number (after the scaling of E-Gear ratio) (user unit)	[user unit]
1	C-PUU	Input the number of pulses command (after the scaling of E-Gear ratio) (user unit)	[user unit]
2	Er.PUU	The deviation between control command pulse and feedback pulse number (user unit)	[user unit]
3	Fb.PLS	Motor feedback pulse number (encoder unit) (1.28 million pulse/rev)	[pulse]
4	C-PLS	Input the number of pulses command (before the scaling of E-Gear ratio) (encoder unit)	[pulse]
5	Er.PLS	Error pulse number (after the scaling of E-Gear ratio) (encoder unit)	[pulse]

P0.002 setting value	Monitoring displayed symbol	Description	Unit
6	CP-Fr	Input frequency of pulse command	[kpps]
7	SPEEd	Motor speed	[rpm]
8	CSPd1	Speed command	[Volt]
9	CSPd2	Speed command	[rpm]
10	C-tq1	Torque command	[Volt]
11	C-tq2	Torque command	[%]
12	AUG-L	Average torque	[%]
13	PE-L	Peak torque	[%]
14	U buS	Main circuit voltage	[Volt]
15	J-L	Load / Motor inertia ratio (note: if it shows 13.0, it means the actual inertia is 13)	[1 times]
16	IGbt.t	IGBT temperature	[°C]
17	rSn.Fr	Resonance frequency (low byte is the first resonance and high byte is the second one)	[Hz]
18	dIFF.2  	The absolute pulse number of encoder Z phase equals the homing value, 0. It is +5000 or -5000 pulses when the motor rotates in the forward or reverse direction.	-
19	MAP1	Mapping parameter #1: shows the content of parameter P0.025 (specify the mapping target by P0.035)	-
20	MAP2	Mapping parameter #2: shows the content of parameter P0.026 (specify the mapping target by P0.036)	-

P0.002 setting value	Monitoring displayed symbol	Description	Unit
21		Mapping parameter #3: shows the content of parameter P0.027 (specify the mapping target by P0.037)	-
22		Mapping parameter #4: shows the content of parameter P0.028 (specify the mapping target by P0.038)	-
23		Monitoring variable #1: shows the content of parameter P0.009 (specify the monitoring variable code by P0.017)	-
24		Monitoring variable #2: shows the content of parameter P0.010 (specify the monitoring variable code by P0.018)	-
25		Monitoring variable #3: shows the content of parameter P0.011 (specify the monitoring variable code by P0.019)	-
26		Monitoring variable #4: shows the content of parameter P0.012 (specify the monitoring variable code by P0.020)	-

The following table shows the panel display of 16-bit and 32-bit value:

Example of the displayed value	Description	
01234 (Dec)	16 bits	If the value is 1234, it displays 01234 (in decimal format).
1234 (Hex)		If the value is 0x1234, it displays 1234 (in hexadecimal format; the first digit does not show).
12345 (Dec high) 67890. (Dec low)	32 bits	If the value is 1234567890, the display of the high byte is 1234.5 and displays 67890 as the low byte (in decimal format).
h1234 (Hex high) L5678 (Hex low)		If the value is 0x12345678, the display of the high byte is h1234 and displays L5678 as the low byte (in hexadecimal format).

The following table shows the panel display for the negative sign:

Example of the displayed value	Description
1.2.345	If the value is -12345, it displays as 1.2.345 (only in decimal format; there is no positive or negative sign for hexadecimal format display).

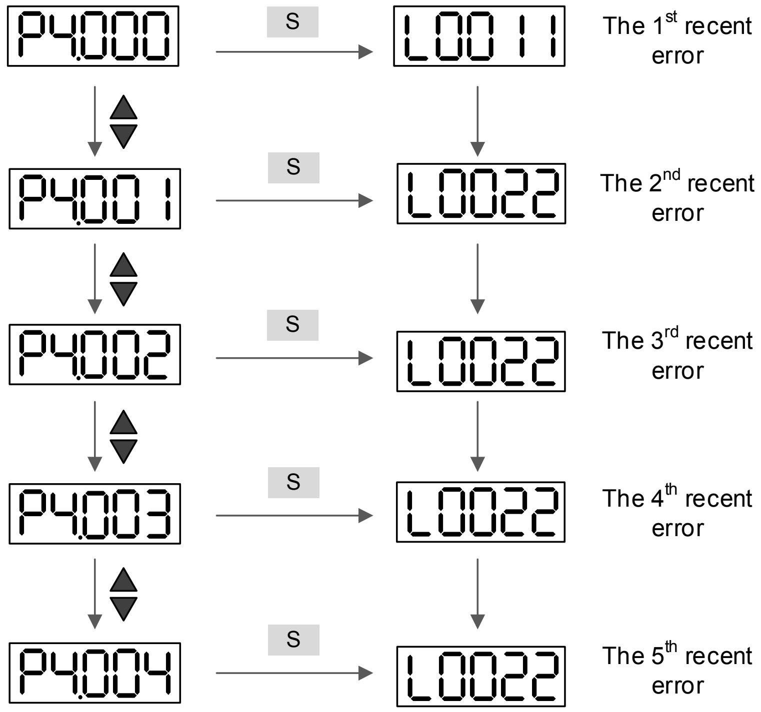
Note:

1. Dec means the value is displayed in decimal format; Hex represents hexadecimal format.
2. The display is applicable in both Monitoring mode and Editing mode.
3. When all monitoring variables are 32 bits, you can switch the high / low bit and the display (Dec / Hex). As described in Chapter 8, each parameter only supports one display method and cannot be switched.

4.4 General functions

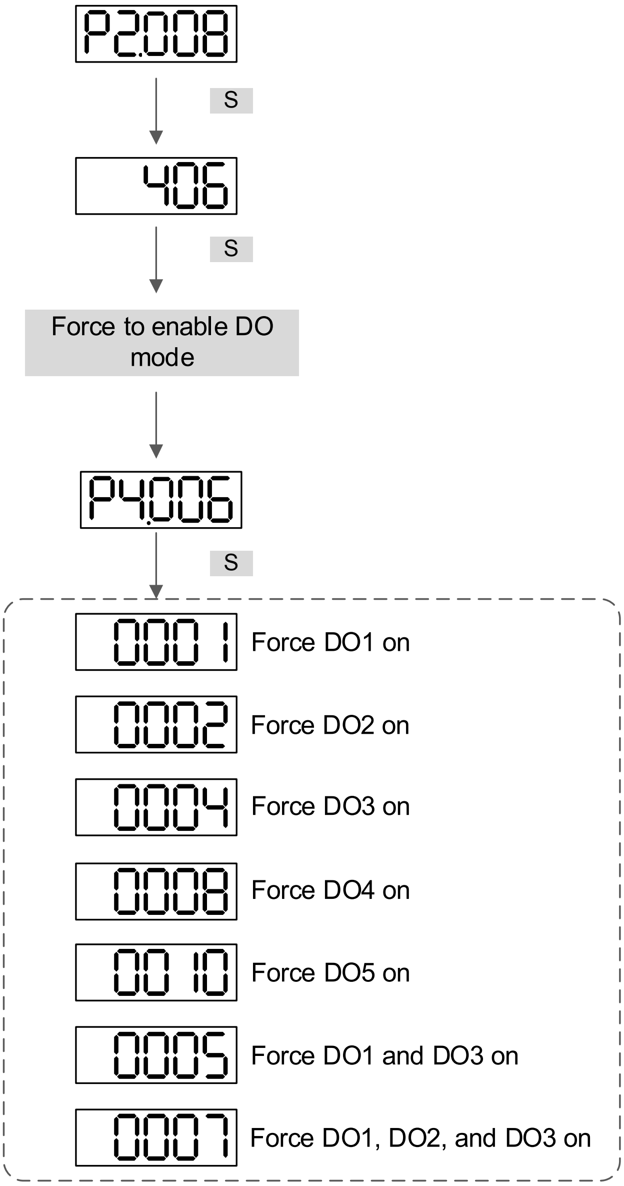
4.4.1 Operation of fault record display

In Parameter mode, select P4.000 – P4.004 and press the SET key to show the corresponding fault record.



4.4.2 Force DO on

You can switch to the Diagnosis mode by the following steps. Set P2.008 to 406 and enable the function to force DO on. Then, set the DO by binary method with P4.006. When the parameter value is 2, it forces DO2 on. When the value is 5, it forces DO1 and DO3 on. No data is retained in this mode. The mode returns to the normal DO mode after cycling the power. You can also set P2.008 to 400 to switch to the normal DO mode.



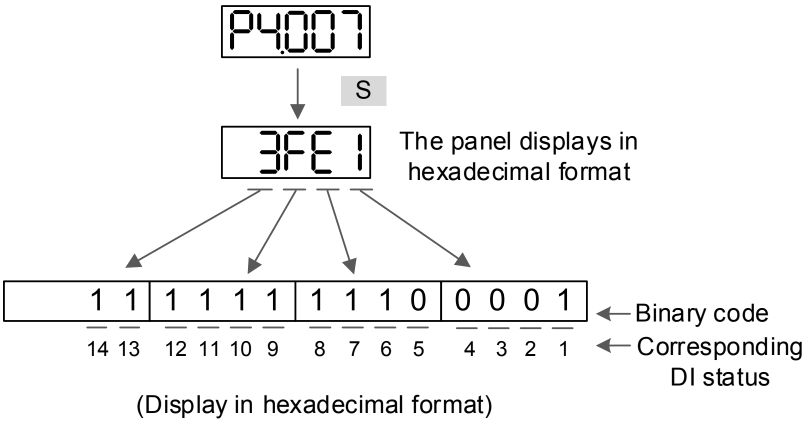
Note: P4.006 is displayed in hexadecimal format. Therefore, it does not show the fifth 0.

4

4.4.3 Digital input diagnosis operation

You can switch to the Diagnosis mode by the following steps. When DI1 – DI10 are triggered by the external output signal, the panel shows the corresponding signal, displayed by bit. When it shows 1, it means the DI is on.

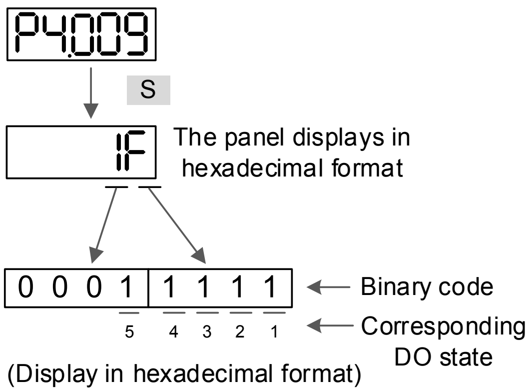
For example, if it shows 3FE1, E is in hexadecimal format, and is 1110 in binary format.
Then, DI6 – DI8 are ON.



4.4.4 Digital output diagnosis operation

You can switch to the Diagnosis mode by the following steps. The output signals DO1 – DO5 are triggered and the corresponding signal appears on the panel, displayed by bit. When it shows 1, it means the DO is on.

For example, if it shows 1F, F is in hexadecimal format, it is 1111 in binary format.
Then, DO1 – DO4 are on.



4

4.5 Testing

This section is divided into two parts. The first part introduces testing without load. And the second part describes testing when running the servo motor with load. To avoid danger, please operate the servo motor without load first.

4.5.1 Testing without load

Please remove the load from the servo motor, including coupling on the shaft and accessories, to avoid any damage to servo drive or machine. This prevents the disassembled parts of the motor shaft from falling off and possibly causing personnel injury or equipment damage during operation. Please run the motor without load first to see if the servo motor can run during normal operation.

Caution: in order to prevent danger, it is strongly recommended that you check if the motor can operate normally without load first. Then, operate the motor with load.

Please carefully check the following items before operation:

Testing before running the servo drive (without power)	■ Check for any obvious visible damage. ■ The wires at the wiring terminal should be isolated. ■ Make sure the wiring is correct to avoid damage or any abnormal operation. ■ Check for and remove any electrically conductive objects, including metal (such as screws) or inflammable objects inside or near the servo drive. ■ Check that the control switch is in OFF state. ■ Do not place the servo drive or external regenerative resistor on inflammable objects. ■ To ensure the electromagnetic brake works, please check if the stop and circuit breaker functions are working normally. ■ If there is electronic interference with any peripheral devices, please reduce electromagnetic interference from the devices. ■ Please make sure the external voltage level of the servo drive is correct.
Testing when running the servo drive (applied to the power)	■ The encoder cable should be protected from excessive stress. When the motor is running, please make sure the cable is not worn or stretched. ■ Please contact Delta if the servo motor vibrates or makes unusual noise during operation. ■ Make sure the setting for the parameters are correct. Different machinery has different characteristic. Please adjust the parameters according to the characteristics of each machine. ■ Only change parameters when the servo drive is in the Servo Off status, or you may cause the servo drive to malfunction.

	■ When the machinery is operating, please contact Delta if there is no contact noise or other abnormal noise. ■ Check if the power indicator and LED display work properly. ■ The 7.5 kW model is controlled by PWM. When the temperature is lower than 40°C, the fan stops running.

4.5.2 Apply power to A3 servo drive

Please follow the instructions below.

1. Make sure the wiring between the motor and servo drive is correct:
   (1) U, V, W, and FG have to connect to the red, white, black, and green wires respectively. If the wiring is incorrect, the motor cannot work properly. Please refer to Section 3.1 – 3.2 for wiring.
   (2) The encoder cable for the motor is correctly connected to CN2: if you only want to use the JOG function, connecting CN1 and CN3 is not necessary. Please refer to Sections 3.1 and 3.4 for the wiring for CN2.

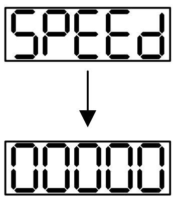
Caution: do not connect the power (R, S, T) to the output terminal (U, V, W) of A3 servo drive, or you may damage the servo drive.

2. Connect the power circuit for the servo drive:
   220V servo drive: connect the power to the servo drive. Please refer to Section 3.1.3 for power wiring.
3. Turn on the power:
   220V servo drive supply: apply power, including to the control circuit (L1c, L2c) and main circuit (R, S, T).

When the power is on, the display of the servo drive shows:

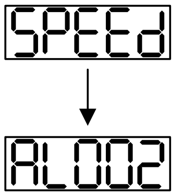
The default digital inputs (DI6 – DI8) are the signal for reverse inhibit limit (NL), forward inhibit limit (PL), and emergency stop (EMGS). If DI6 – DI8 is not used, you must change the values of P2.015 – P2.017, which you can set to 0 (disable the DI function) or some other value for a different function.

If the servo drive status displays P0.002 setting as the motor speed (07), then the screen display shows:



When the panel displays no text, please check if the control circuit power is undervoltage.

- When the screen displays



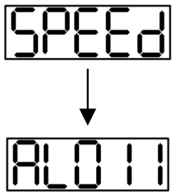
Overvoltage warning:

This means the voltage input from the main circuit is higher than the rated range or a power input error has occurred (incorrect power system).

Corrective action:

1. Use the voltmeter to measure the input voltage from the main circuit, and ensure it is within the rated range.
2. Use the voltmeter to check if the power system complies with the specifications.

- When the screen displays



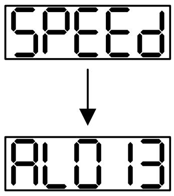
Encoder error warning:

Check that the motor encoder is securely connected and the wiring is correct.

Corrective action:

1. Make sure the wiring is following the instructions in the user manual.
2. Check the encoder connector.
3. Check for loose wiring.
4. Check for damage to the encoder.

- When the screen displays:



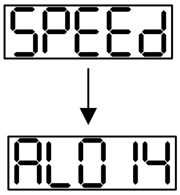
Emergency stop warning:

Please check if any of the digital inputs DI1 – DI10 are set to emergency stop (EMGS).

Corrective action:

1. If you do not want to set the emergency stop (EMGS) as one of the digital inputs, make sure no other digital input is set to emergency stop (EMGS) for DI1 – DI10 (make sure that none of the parameters, P2.010 – P2.017, P2.036, and P2.037 is set to 21).
2. If the emergency stop (EMGS) function is needed and DI is set as normally closed (function code: 0x0021), please make sure that DI is always normally closed. If not, please set DI as normally open (function code: 0x0121).

- When the screen displays:



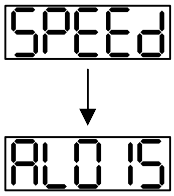
Negative limit error warning:

Please check if any of the digital inputs DI1 – DI8 are set to negative limit (NL) and that DI is on.

Corrective action:

1. If you do not want to set the negative limit (NL) as one of the digital inputs, make sure no other digital input is set to negative limit (NL) for DI1 – DI10 (make sure that none of the parameters, P2.010 – P2.017, P2.036, and P2.037 is set to 22).
2. If the negative limit (NL) function is needed and DI is set as normally closed (function code: 0x0022), please make sure that DI is always normally closed. If not, please set DI as normally open (function code: 0x0122).

- When the screen displays:



Positive limit error warning:

Please check if any of the digital inputs DI1–DI10 are set to positive limit (PL) and that DI is on.

Corrective action:

1. If you do not want to set the positive limit (PL) as one of the digital inputs, make sure no other digital input is set to positive limit (PL) for DI1 – DI10 (make sure that none of the parameters, P2.010 – P2.017, P2.036, and P2.037 is set to 23).
2. If the positive limit (PL) function is needed and DI is set as normally closed (function code: 0x0023), please make sure DI is always normally closed. If not, please set DI as normally open (function code: 0x0123).

- When the screen displays:

Overcurrent warning.

Corrective action:

1. Check the connection between the motor and servo drive.
2. Check if the conducting wire is short circuited. Fix the short circuit and avoid any metal conductors being exposed.

- When the screen displays:

Undervoltage warning.

Corrective action:

1. Check if the main circuit wiring is correct.
2. Use a voltmeter to make sure that the main circuit voltage is normal.
3. Use a voltmeter to make sure that the power system complies with the specification.

Note: during power on or in Servo On state (without issuing any commands), if an alarm occurs or any abnormal display appears, please contact the distributors.

4.5.3 JOG trial run without load

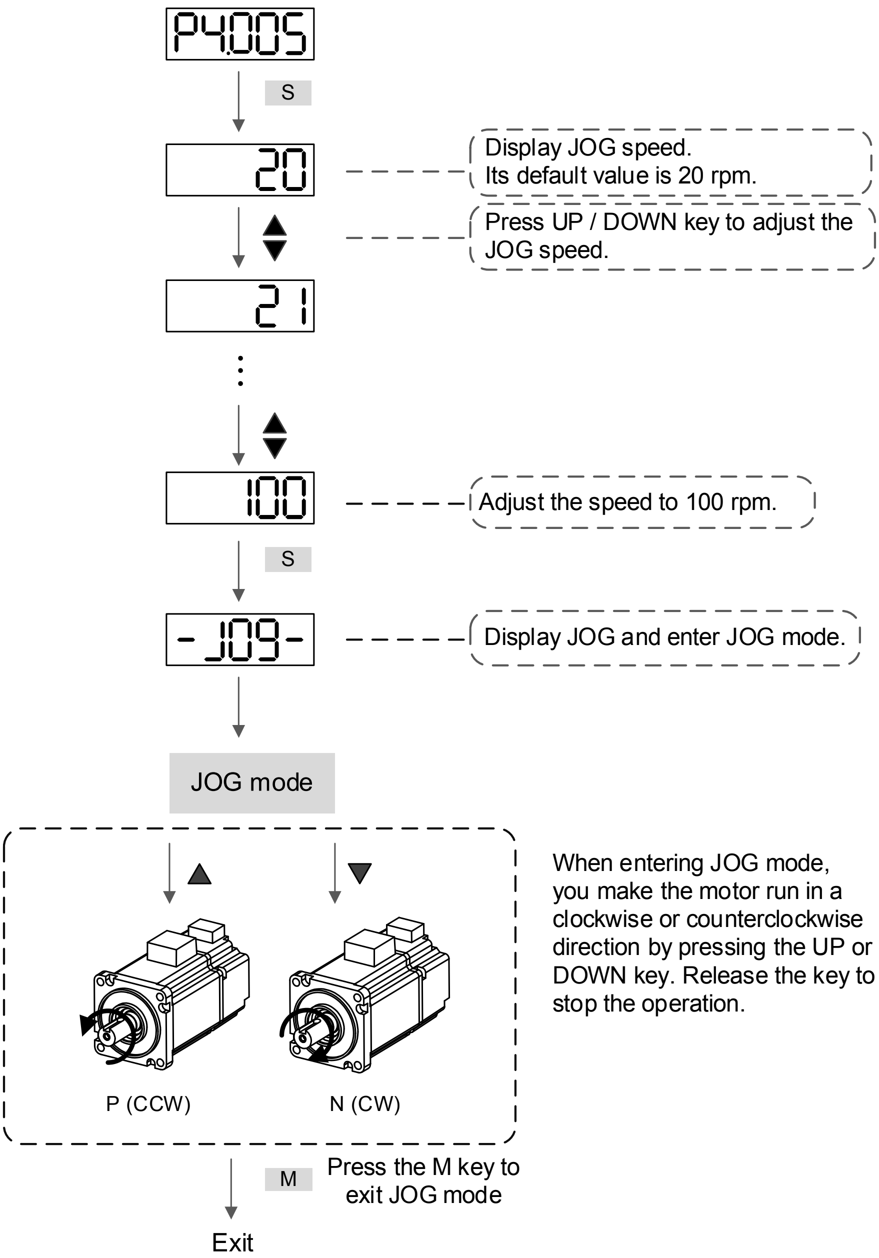
It is easy to test the motor and servo drive using a JOG trial run without load since no extra wiring is needed. For safety reasons, it is recommended to set JOG at low speed. Follow the steps below:

Step 1: JOG trial run is available only when the servo drive is in the Servo On state. The drive can be forced into the Servo On state by setting P2.030 to 1 or with the host controller.

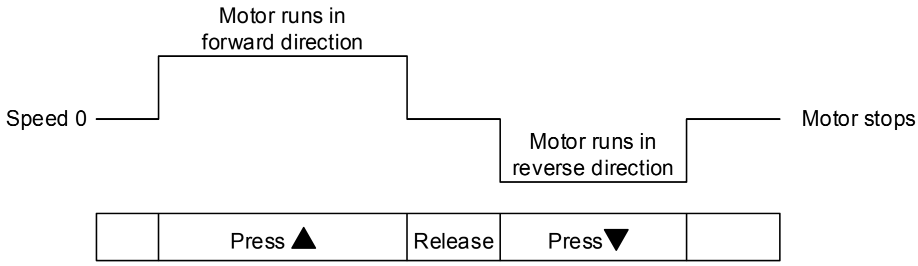
Step 2: Set P4.005 to JOG speed (unit: rpm). Press the S key to display the JOG speed. The default is 20 rpm.

Step 3: Press the ▲ or ▼ key to adjust the JOG speed. In the following example, the speed is set to 100 rpm.

Step 4: Press the S key to display JOG and enter JOG mode.



The following shows the JOG timing diagram:



If the motor does not run, please check if the wiring between U, V, W and encoder cable is correct.
If the motor runs abnormally, please check if the U, V, W phase sequence is correct.

4.5.4 Trial run without load (Speed mode)

Before starting the trial run without load, firmly secure the motor base to avoid any danger caused by force generated by the motor during speed changes.

Step 1: Set the control mode of the servo drive to Speed mode. Set P1.001 to 2 for Speed mode. Then cycle the power to the servo drive.

Step 2: In Speed mode, the following table lists the digital input settings for the trial run:

Digital input	Parameter value	Symbol	Function description	CN1 Pin No.
DI1	P2.010 = 101	SON	Servo is activated	DI1- = 9
DI2	P2.011 = 109	TRQLM	Torque limit	DI2- = 10
DI3	P2.012 = 114	SPD0	Speed selection	DI3- = 34
DI4	P2.013 = 115	SPD1	Speed selection	DI4- = 8
DI5	P2.014 = 102	ARST	Alarm reset	DI5- = 33
DI6	P2.015 = 0	-	DI disabled	-
DI7	P2.016 = 0	-	DI disabled	-
DI8	P2.017 = 0	-	DI disabled	-
DI9	P2.036 = 0	-	DI disabled	-
DI10	P2.037 = 0	-	DI disabled	-
VDI11	P2.038 = 0	-	DI disabled	-
VDI12	P2.039 = 0	-	DI disabled	-
VDI13	P2.040 = 0	-	DI disabled	-

This table shows the settings that disable the negative limit (DI6), positive limit (DI7), and emergency stop (DI8) functions. Thus, parameter P2.015 – P2.017 and P2.036 – P2.041 are set to 0 (disabled); you can program the digital input of Delta’s servo drive. When programming the digital input for the servo drive, please refer to the DI code descriptions.

The default setting includes the negative limit, positive limit, and emergency stop functions; therefore, if any alarm occurs after you complete the settings, please cycle the power to the servo drive or set DI5 to ON to clear the error. Please refer to Section 4.5.

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The speed command selection is determined by SPD0 and SPD1. See the following table:

Speed command No.	DI signal for CN1		Command source	Content	Range
	SPD1	SPD0			
S1	0	0	External analog command	Voltage difference between V-REF and GND	-10V to +10V
S2	0	1	Internal register (parameters)	P1.009	-60000 – 60000
S3	1	0		P1.010	-60000 – 60000
S4	1	1		P1.011	-60000 – 60000

0: means the switch is open (off).

1: means the switch is closed (on).

The parameter setting range is from -60000 to 60000. Setting speed = Setting range x unit (0.1 rpm). For example: P1.009 = +30000; Setting speed = +30000 x 0.1 rpm = +3000 rpm.

Command setting for the speed register:

Set P1.009 to +30000.

Set P1.010 to +1000.

Set P1.011 to -30000.

Motor's running direction:

Input command	Rotation direction
+	CCW (forward direction)
-	CW (reverse direction)

Step 3:

1. Switch on DI1 to put the drive in the Servo On state.
2. Both speed commands: DI3 (SPD0) and DI4 (SPD1) are off. This means that it executes the S1 command. The motor rotates according to the analog voltage command.
3. When DI3 (SPD0) is on, that means it executes the S2 command (3000 rpm). The rotation speed is 3000 rpm.
4. When DI4 (SPD1) is on, that means it executes the S3 command (100 rpm). The rotation speed is 100 rpm.
5. When both DI3 (SPD0) and DI4 (SPD1) are on, that means it executes the S4 command (-3000 rpm). The rotation speed is -3000 rpm.
6. You can repeatedly execute steps 3, 4, and 5.
7. If you want to stop the motor, switch off DI1 (Servo Off).

4.5.5 Trial run without load (Position mode)

Before starting the trial run without load, firmly secure the motor base to avoid any danger caused by the force generated by the motor during speed changes.

Step 1: set the control mode of the servo drive to Position mode. Set P1.001 to 1 for Position mode). Then cycle the power to the servo drive.

Step 2: in Position mode, the following table lists the digital input settings for the trial run:

Digital input	Parameter value	Symbol	Function description	CN1 Pin No.
DI1	P2.010 = 101	SON	Servo is activated	DI1- = 9
DI2	P2.011 = 108	CTRG	Command triggered	DI2- = 10
DI3	P2.012 = 111	POS0	Position selection	DI3- = 34
DI4	P2.013 = 112	POS1	Position selection	DI4- = 8
DI5	P2.014 = 102	ARST	Alarm reset	DI5- = 33
DI6	P2.015 = 0	-	DI disabled	-
DI7	P2.016 = 0	-	DI disabled	-
DI8	P2.017 = 0	-	DI disabled	-
DI9	P2.036 = 0	-	DI disabled	-
DI10	P2.037 = 0	-	DI disabled	-
VDI11	P2.038 = 0	-	DI disabled	-
VDI12	P2.039 = 0	-	DI disabled	-
VDI13	P2.040 = 0	-	DI disabled	-

The above table shows the settings that disable the negative limit (DI6), positive limit (DI7), and emergency stop (DI8) functions. Thus, parameter P2.015 – P2.017 and P2.036 – P2.041 are set to 0 (disabled); you can program the digital input of Delta's servo drive. When programming the digital input, please refer to the DI code descriptions.

The default setting includes the negative limit, positive limit, and emergency stop functions; therefore, if any alarm occurs after you complete the settings, please cycle the power to the servo drive or set DI5 to ON to clear the alarm. Please refer to Section 4.5.

Refer to Section 3.10.2 for the wiring for Position (PR) control mode. Please see the table below for the 99 sets for PR and the position command (POS0 – POS6):

Position command	POS6	POS5	POS4	POS3	POS2	POS1	POS0	CTRG	Corresponding parameters
Homing	0	0	0	0		0	0	↑	P6.000 P6.001
PR1	0	0		0	0	0	1	↑	P6.002 P6.003
~									~
PR50	0	1	1	0	0	1	0	↑	P6.098 P6.099
PR51	0	1	1	0	0	1	1	↑	P7.000 P7.001
~									~
PR99	1	1	0	0	0	1	0	↑	P7.098 P7.099

0: means the switch is open (off).

1: means the switch is closed (on).

You can set the 99 sets of PR (P6.000 – P7.099), which you can also set for absolute position commands.

Tuning

5

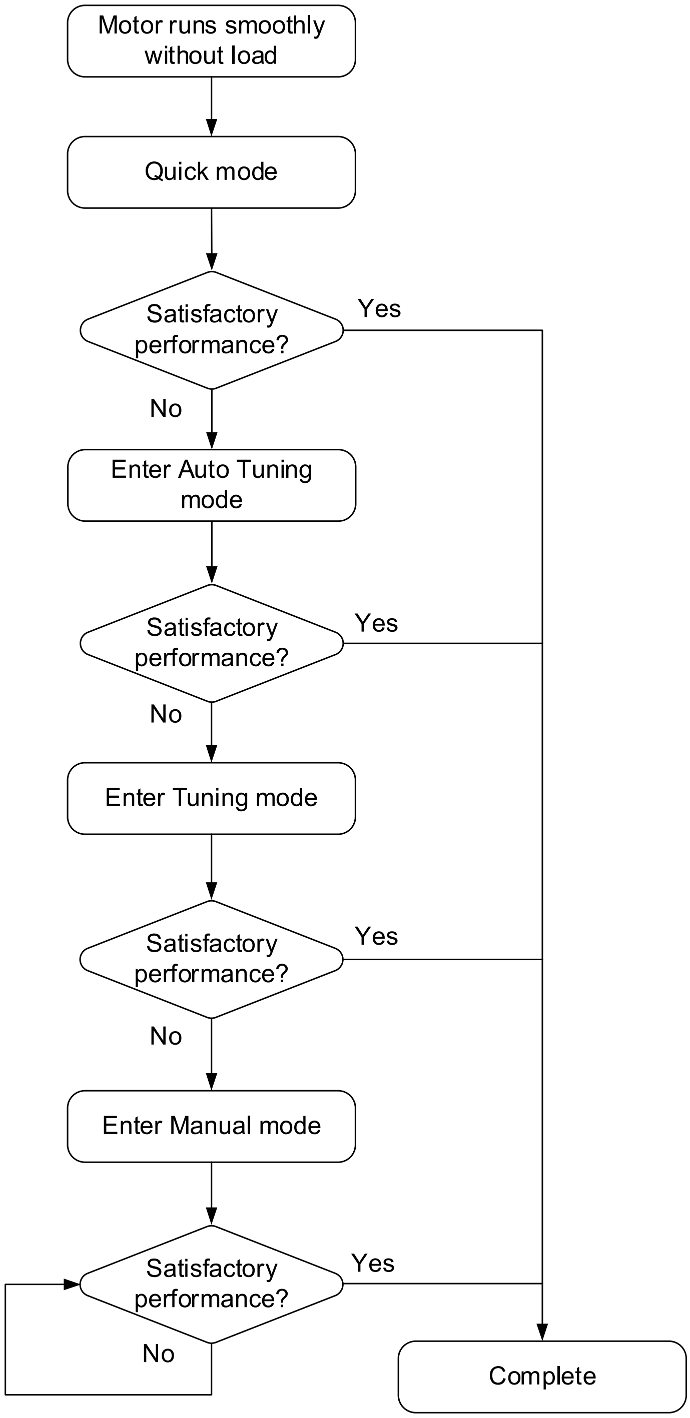
This chapter contains information about the auto tuning procedure and the three tuning modes. Advanced users can also tune the servo system using the manual mode.

5

5.1 Tuning procedure and the applied mode

5.1.1 Flow chart for the tuning procedure

You can tune the servo drive by following the flow chart below. First, start from the Auto Tuning mode. If you are not satisfied with the system's performance, you can use Tuning modes 1, 2, 3 or Manual mode for tuning the servo system.



5.1.2 Tuning modes

P2.032 Setting value	Tuning mode	Inertia estimation	Parameter	
			Manual tuning	Auto tuning
0	Manual mode	Value of P1.037	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102、	N/A
1	Tuning mode 1	Real-time estimation	P2.031	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102、
2	Tuning mode 2	Value of P1.037	P1.037 P2.031	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102、
3	Tuning mode 3	Value of P1.037	P1.037 P2.031 P2.089	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.098, P2.099, P2.101, P2.102
4	Tuning mode 4	Restore default gain settings	-	-

Note: please refer to the parameters list in Section 5.3 Auto tuning.

5

5.2 Quick mode

Quick mode is the default mode for the servo drive. In most applications, you can start the servo drive after it is installed. Please note that the gain related parameter settings are invalid when starting in Quick mode. You can enable or disable Quick mode with P2.033. When switching to Auto Tuning mode, Quick mode is automatically disabled.

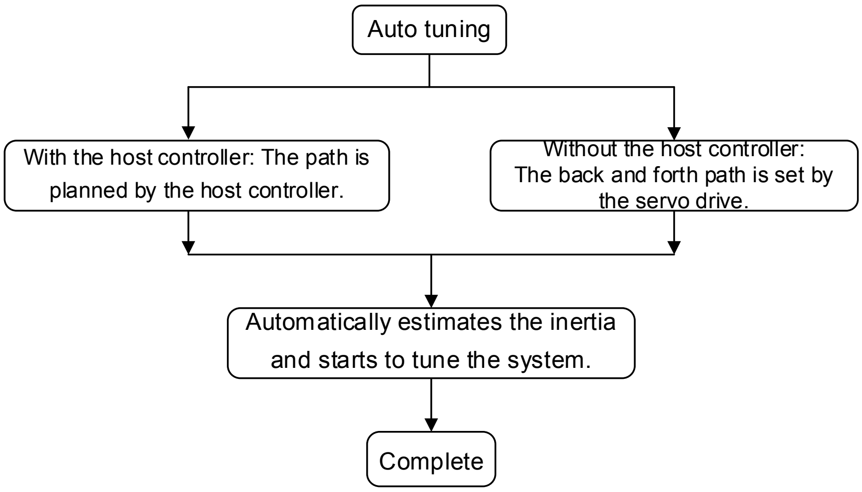
5.3 Auto tuning

The Auto Tuning function provided by the ASDA-A3 enables the system to perform real-time machine inertia estimation and upload the corresponding tuning parameters to the servo drive. You can start auto tuning with ASDA-Soft (software) or at the drive panel. The following table lists the parameters that change according to the results of auto tuning.

Gain related parameters		Filter and resonance suppression parameters	
Parameter No.	Function	Parameter No.	Function
P1.037	Inertia ratio and load weight ratio of servo motor	P1.025	Low-frequency vibration suppression (1)
P2.000	Position control gain	P1.026	Low-frequency vibration suppression gain (1)
P2.004	Speed control gain	P1.027	Low-frequency vibration suppression (2)
P2.006	Speed integral compensation	P1.028	Low-frequency vibration suppression gain (2)
P2.031	Level of frequency response	P2.023	Notch filter frequency (1)
P2.032	Gain tuning method	P2.024	Notch filter attenuation level (1)
P2.089	Command response gain	P2.025	Low-pass filter of resonance suppression
-	-	P2.043	Notch filter frequency (2)
-	-	P2.044	Notch filter attenuation level (2)
-	-	P2.045	Notch filter frequency (3)
-	-	P2.046	Notch filter attenuation level (3)
-	-	P2.049	Speed detection and jitter suppression
-	-	P2.098	Notch filter frequency (4)
-	-	P2.099	Notch filter attenuation level (4)
-	-	P2.101	Notch filter frequency (5)
-	-	P2.102	Notch filter attenuation level (5)

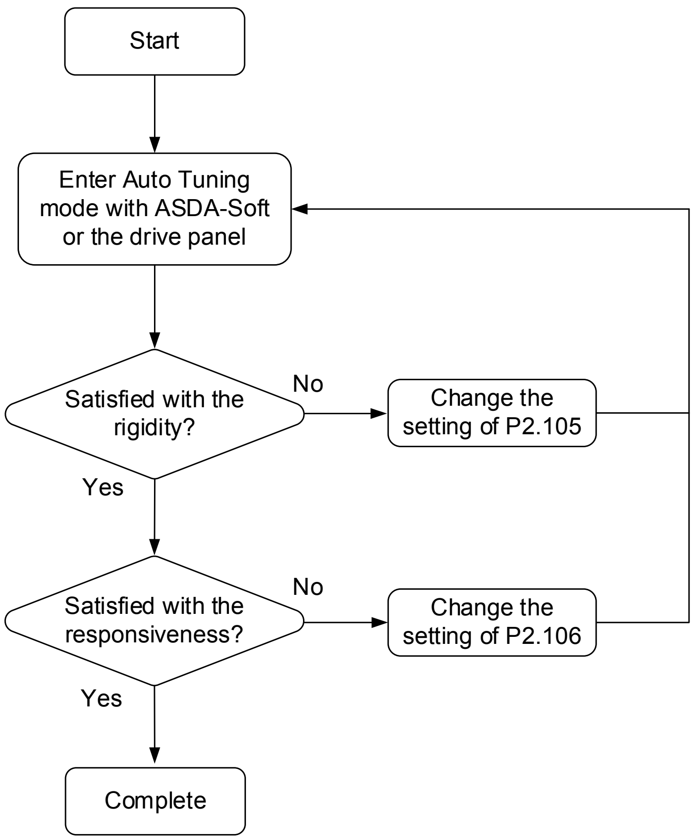
5.3.1 Flow chart for auto tuning

You can complete auto tuning with the drive panel or ASDA-Soft. The Auto Tuning function in the A3 servo drive helps you to find the most suitable parameters for your system according to the machine characteristics.



Note: when the running distance is configured by the host controller, make sure the delay time is added to the operation time. Otherwise, AL08C occurs and the servo drive cannot complete auto tuning.

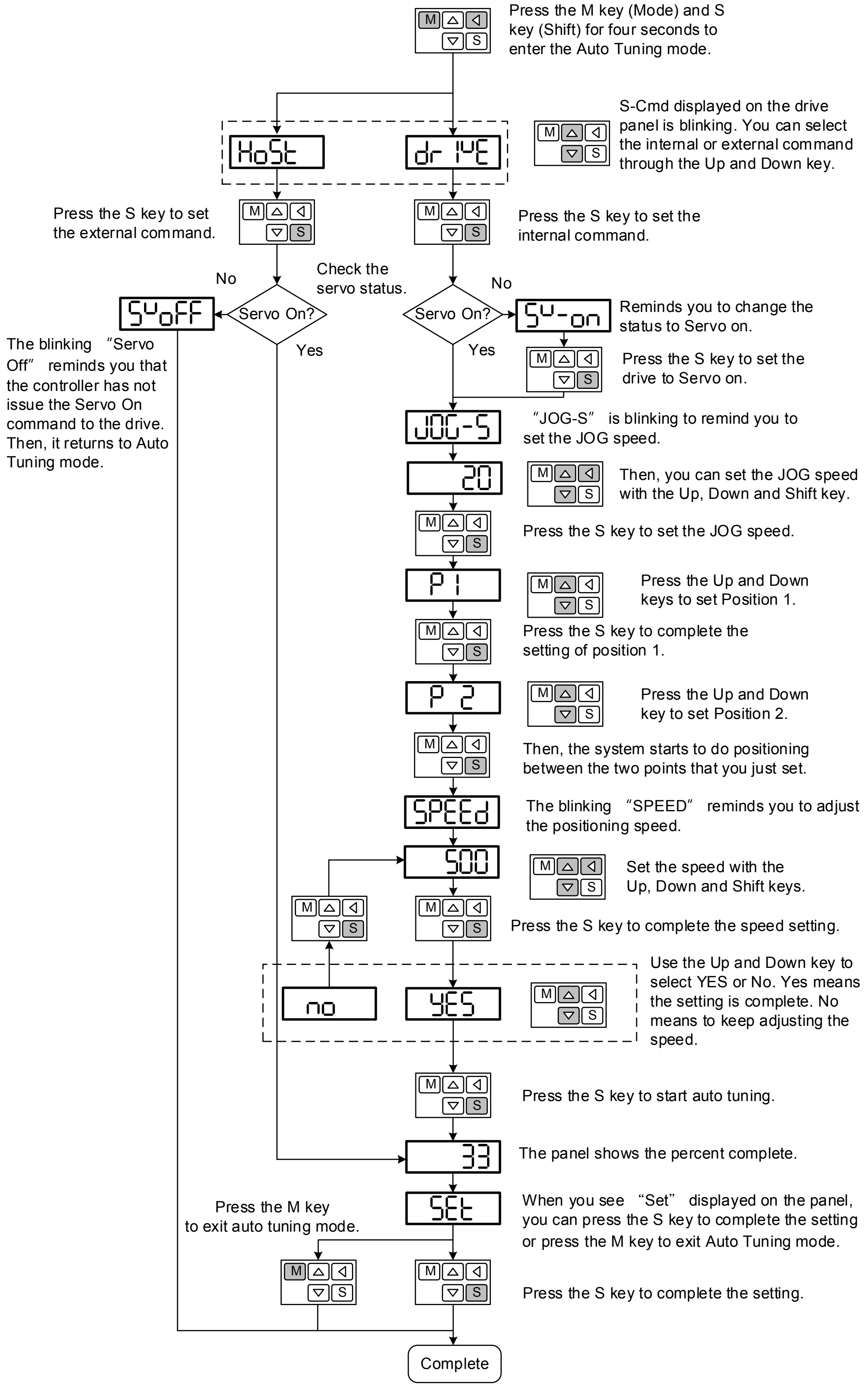
You can use P2.105 and P2.106 to adjust the responsiveness and rigidity in Auto Tuning mode. See the flow chart below.



5.3.2 Auto tuning through the drive panel

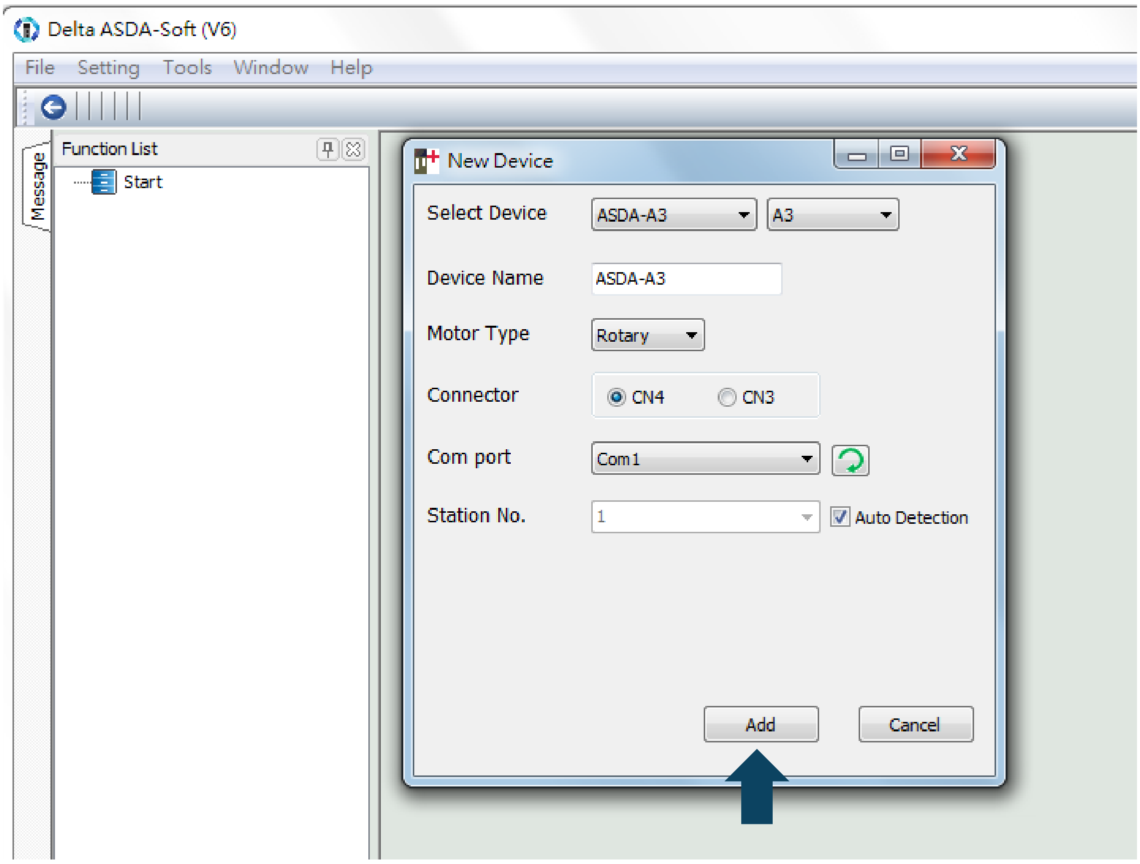
With the tuning procedure below, you can complete auto tuning with the drive panel. Make sure the emergency stop, positive and negative limit switches work properly before you start to tune the system.

Flow chart for auto tuning:



5.3.3 Auto tuning with ASDA-Soft (software)

Instead of using the drive panel, you can use ASDA-Soft to complete auto tuning. Please go to Delta's website (http://www.deltaww.com/) to download ADSA-Soft for free. Install the software and open the executable file (.exe). You see the screen shown below.



Make sure your ASDA-A3 servo drive, servo motor and power are all properly connected. Then click **Add** to connect to the servo drive with ASDA-Soft.

There are two types of auto-tuning procedure, one using the host controller and one using the servo drive. Both procedures are described below.

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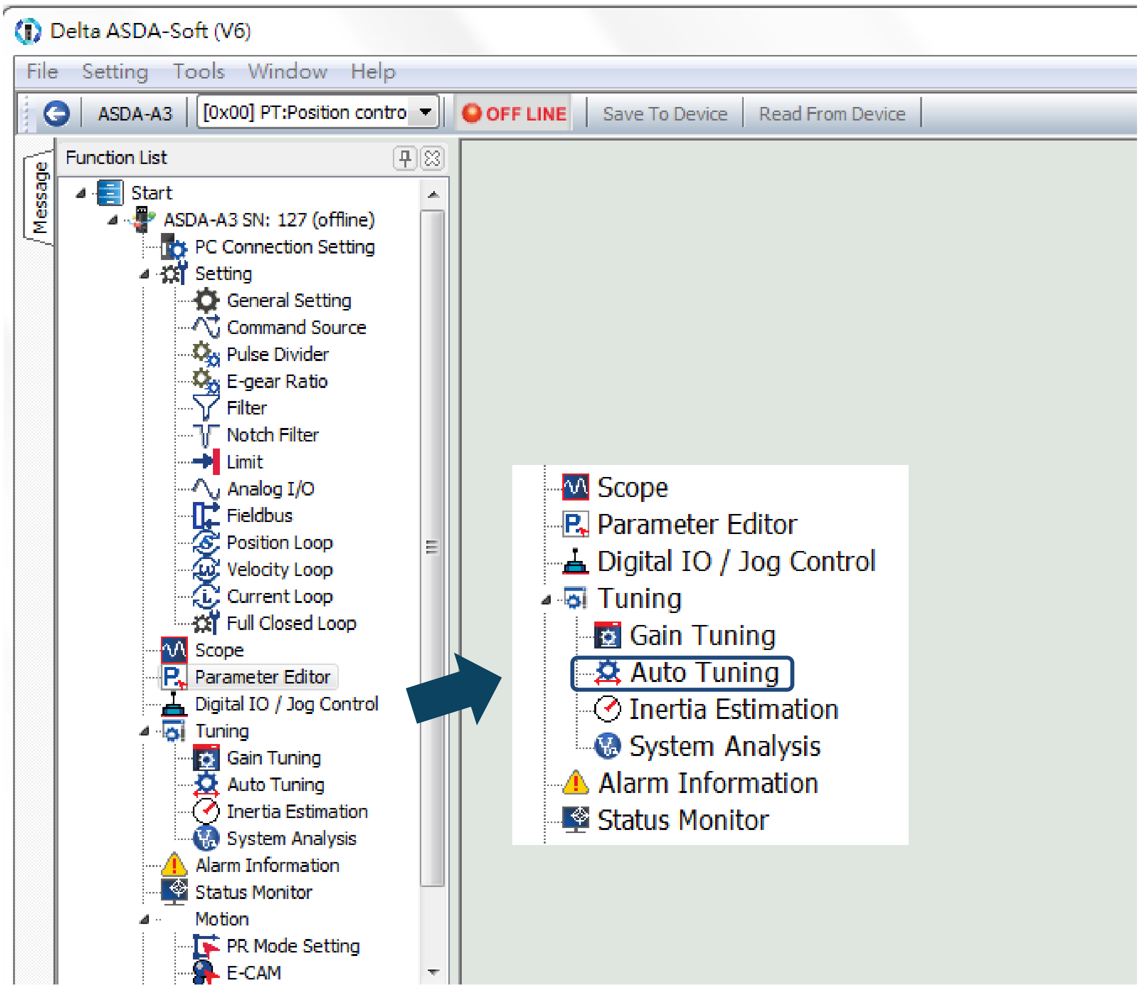
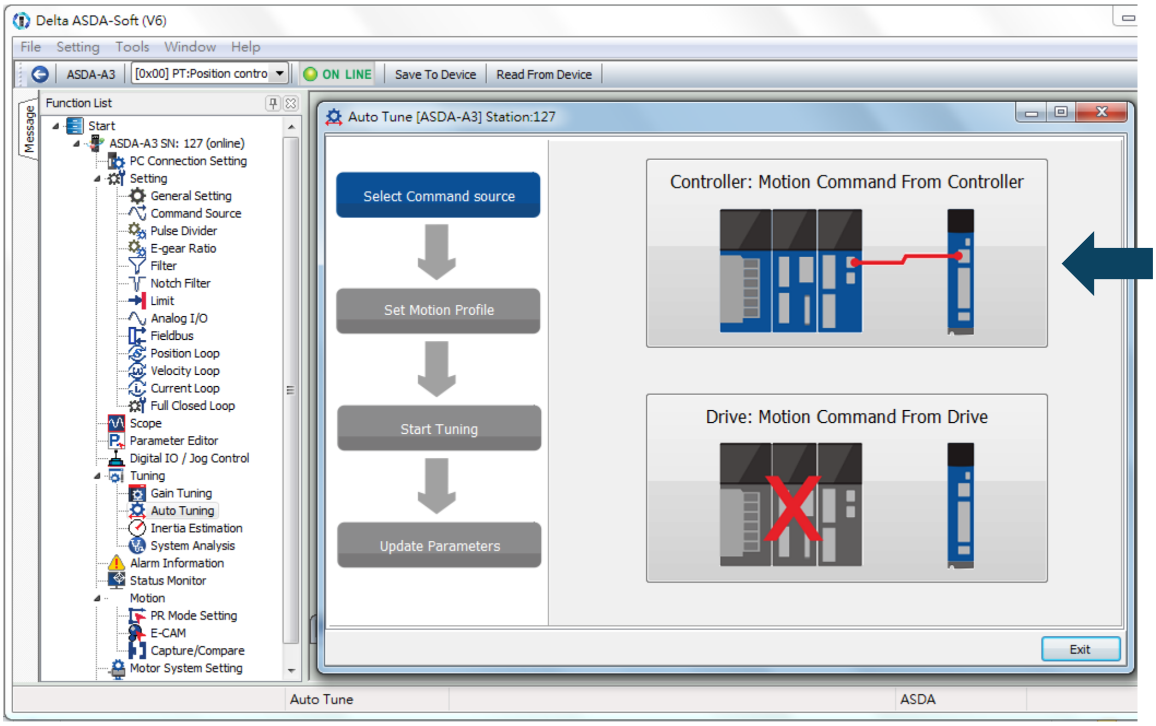
■ Auto-tuning with host controller: the host controller sends the commands to drive the motor.

Step 1: When the computer is connected to the controller, the program window appears as below. Click **Auto Tuning** in the Function List tree view.

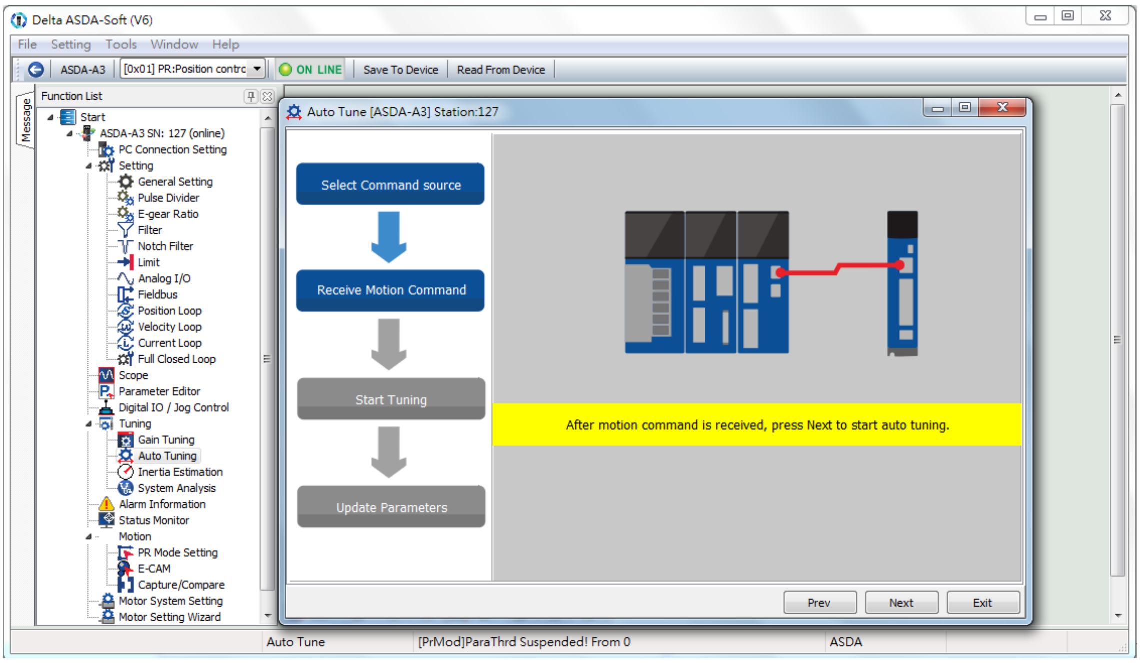


Step 2: Click **Controller: Motion Command From Controller** and make sure the motion/machining path is set correctly.

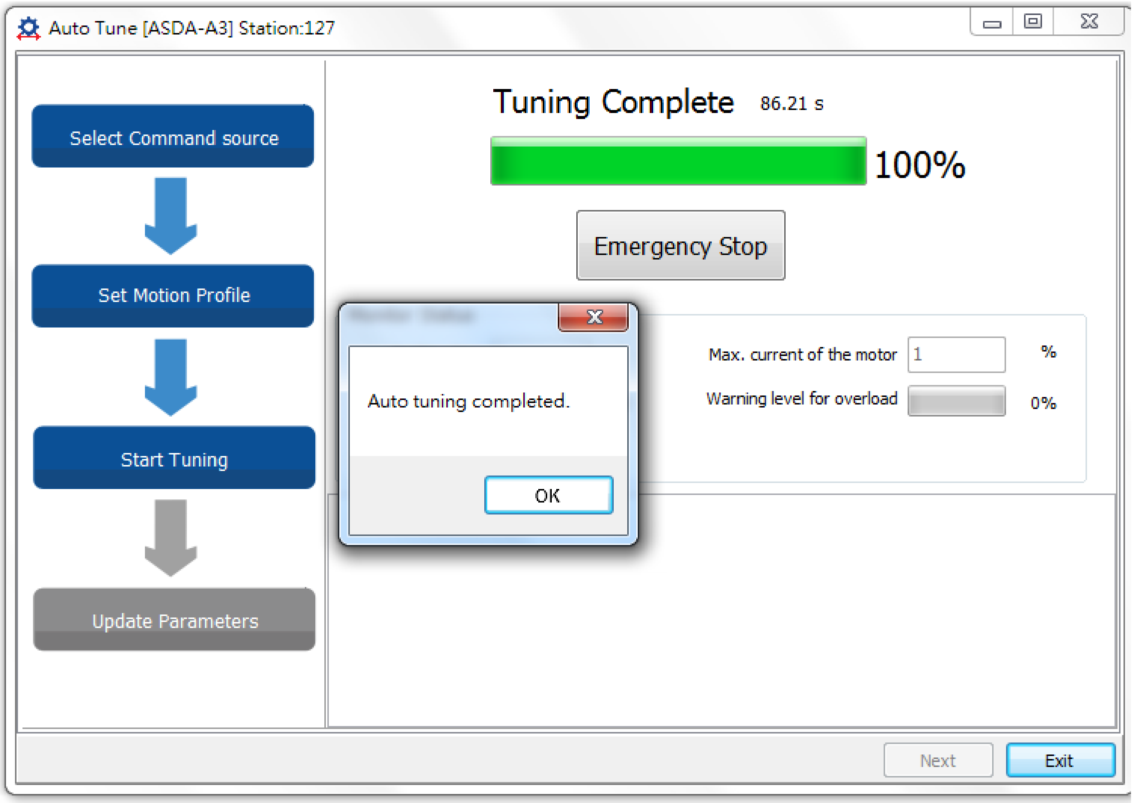


Suggestions: you should set the motor to operate at least one cycle in both forward and backward directions. It should reach the positions (in both forward and backward directions) in 1000 ms or less with the running speed not less than 500 rpm.

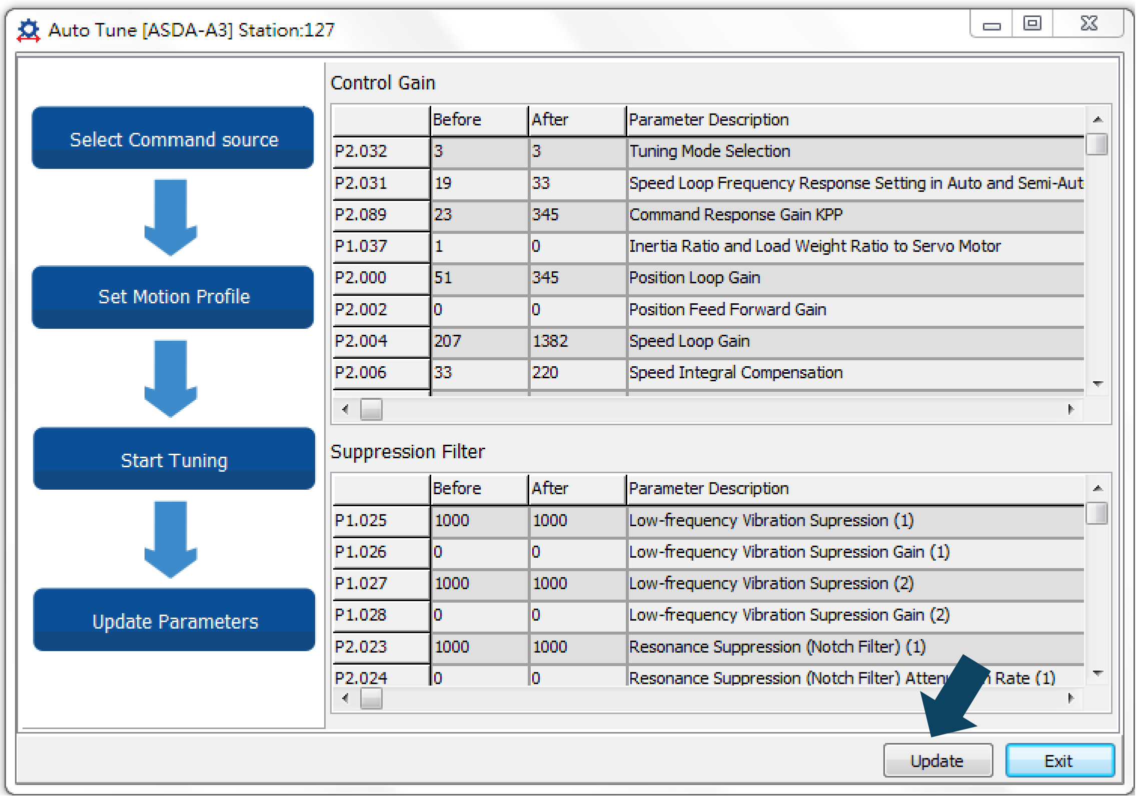
Step 3: Please repeatedly start and run the motor with the path you just set. Before running the motor, make sure no one is standing close to the machinery.
Then, click **Next**.



Wait until the tuning progress bar reaches 100%, after which a window with “Auto tuning completed” appears. Click **OK** to continue.



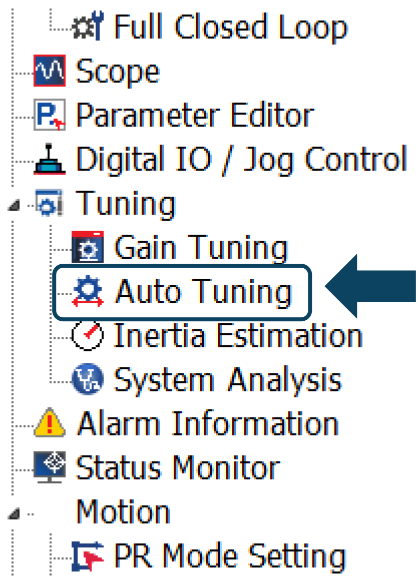
The screen shows a table comparing the parameters before and after being changed by auto tuning.



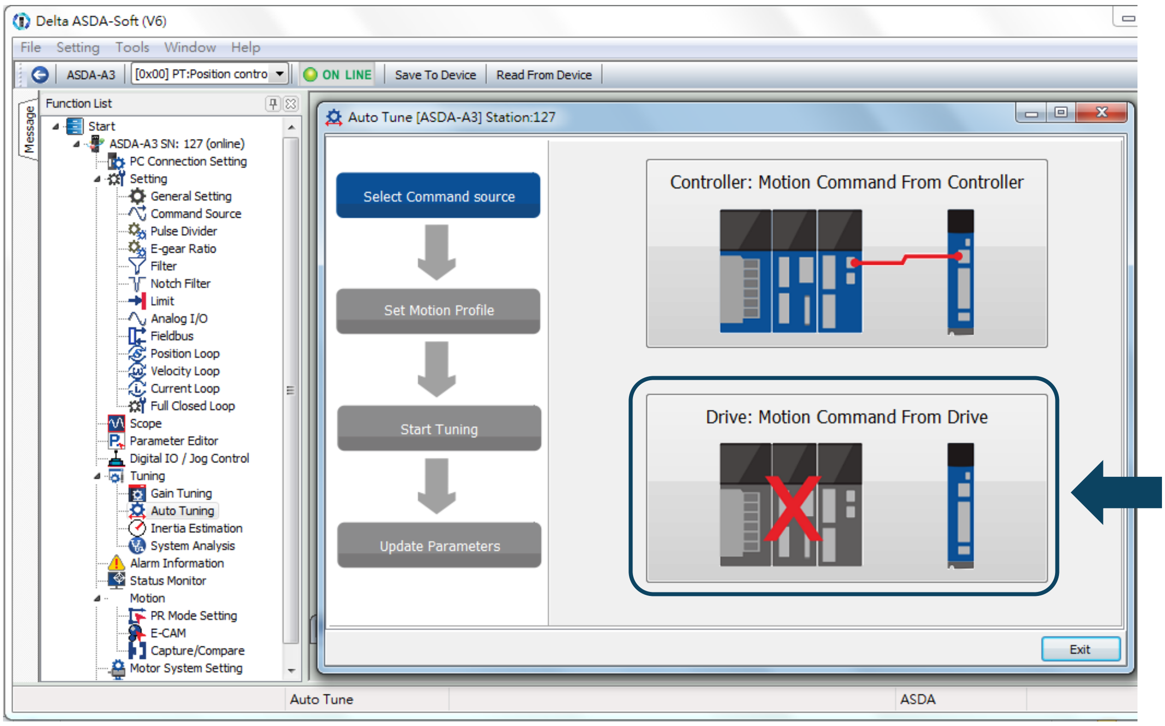
Click **Update** to complete auto tuning.

■ Auto-tuning with servo drive: the servo drive sends the commands to drive the motor.

Step 1: When the computer is connected to the servo drive, the program window appears as below. Click **Auto Tuning** in the Function List tree view.



Step 2: Click **Drive: Motion Command From Drive** to start the Auto Tuning procedure.



Please follow the steps below to set the motor running path:

1. Set the system to Servo On state.
2. Set the acceleration/deceleration time and jog speed. The default setting for acceleration/deceleration time is 500 ms. Set the jog speed to no less than 500 rpm. Then click **Download**.

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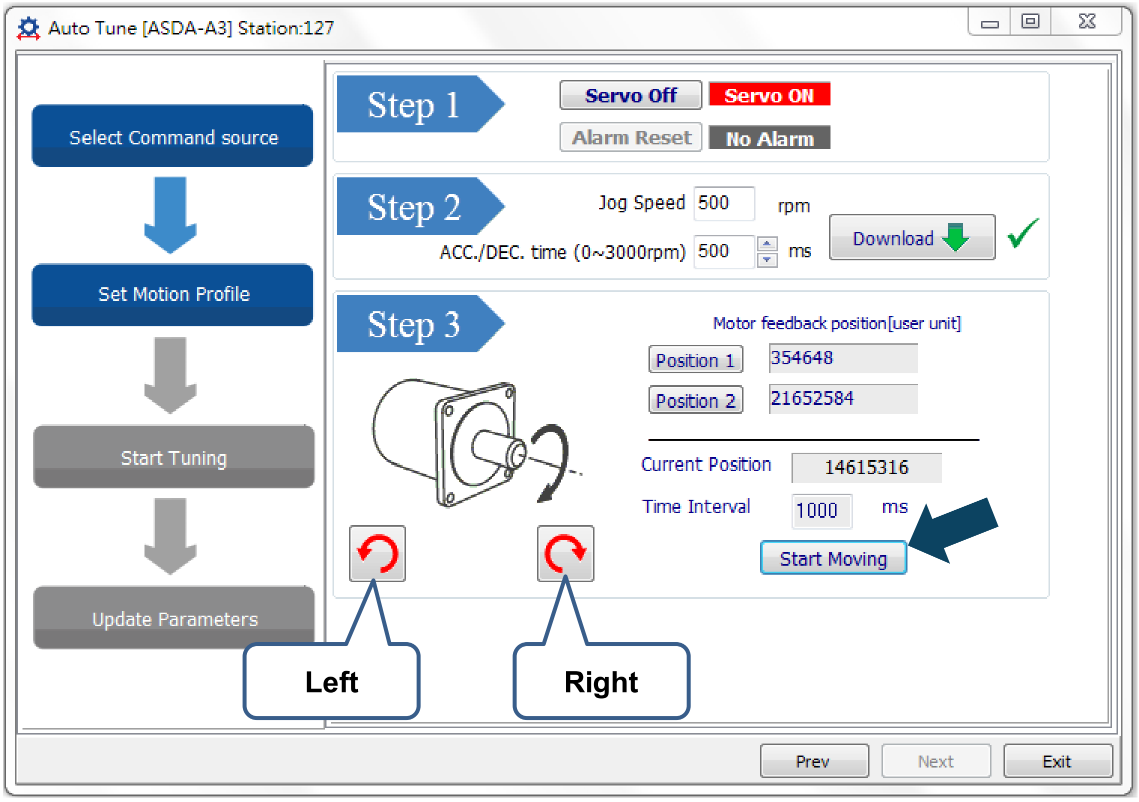
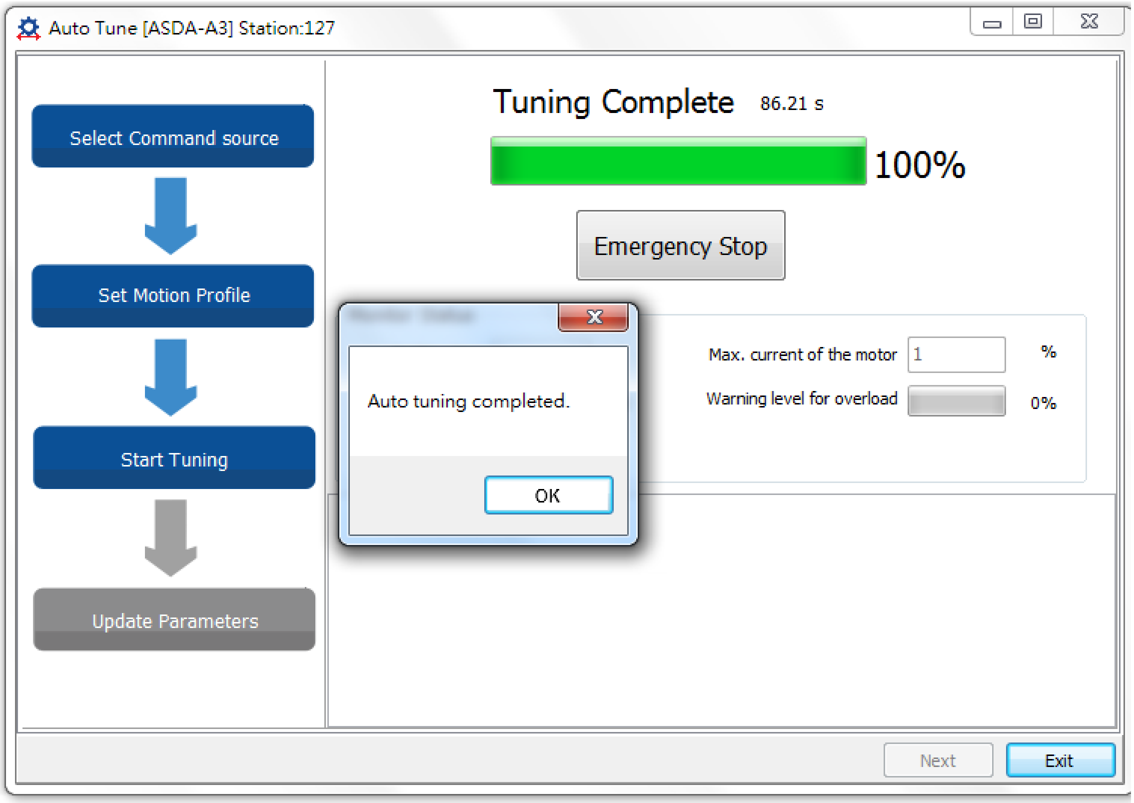
3. After you set the motor's running path, you can use the Left or Right button to run the motor to position 1 and 2. Then, click **Start Moving** to run between two positions. The motor moves to position 1 and 2 in the forward and backward directions.

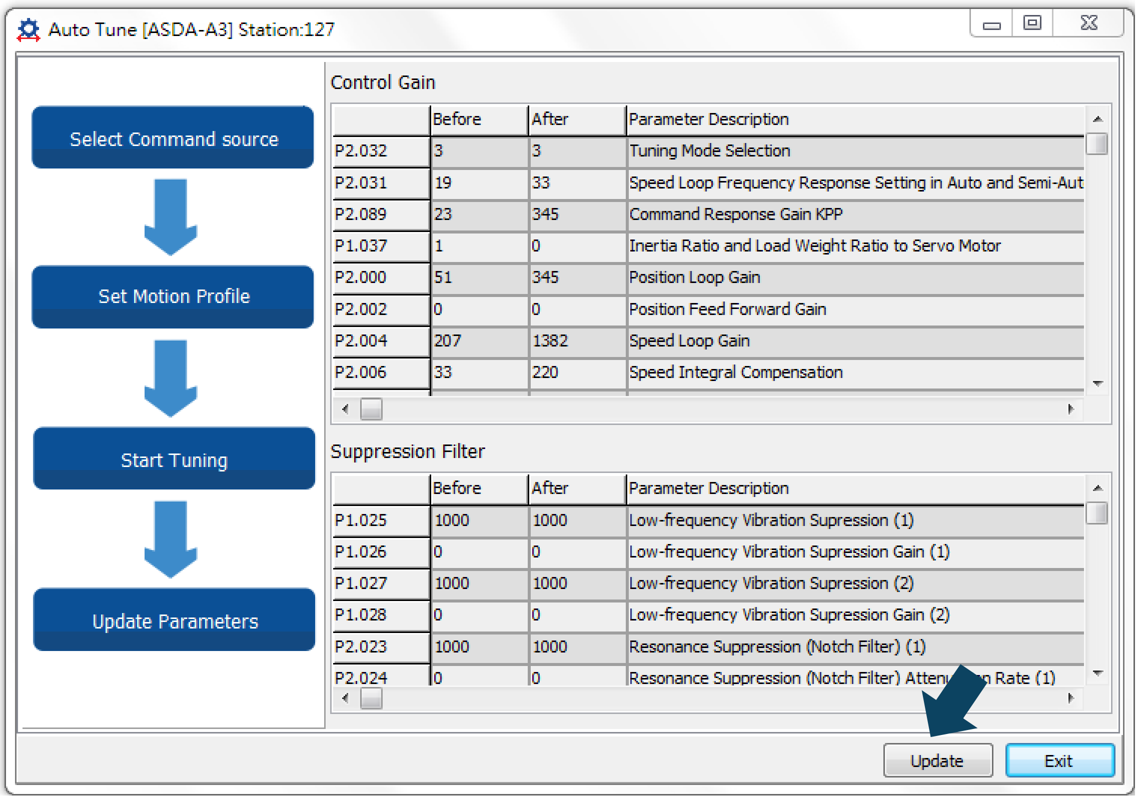
Before running the motor, make sure no one is standing close to the machinery.



Step 3: Wait until the tuning progress bar reaches 100%, after which a window with “Auto tuning completed” appears. Click **OK** to continue.



The screen shows a table comparing the parameters before and after being changed by auto tuning.



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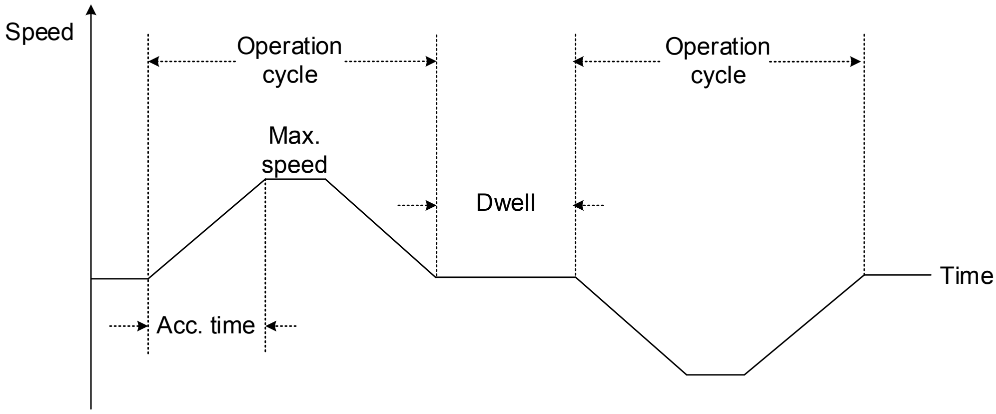
Please click **Update** to complete auto tuning.

5.3.4 Alarms related to auto tuning

In Auto Tuning mode, it is vital that you program the command path, including the operation cycle (such as acceleration, constant speed and deceleration) and dwell time. See the figure below. When any of the settings are incorrect, the servo drive stops and displays an alarm. Please check the alarm causes and take corrective action.

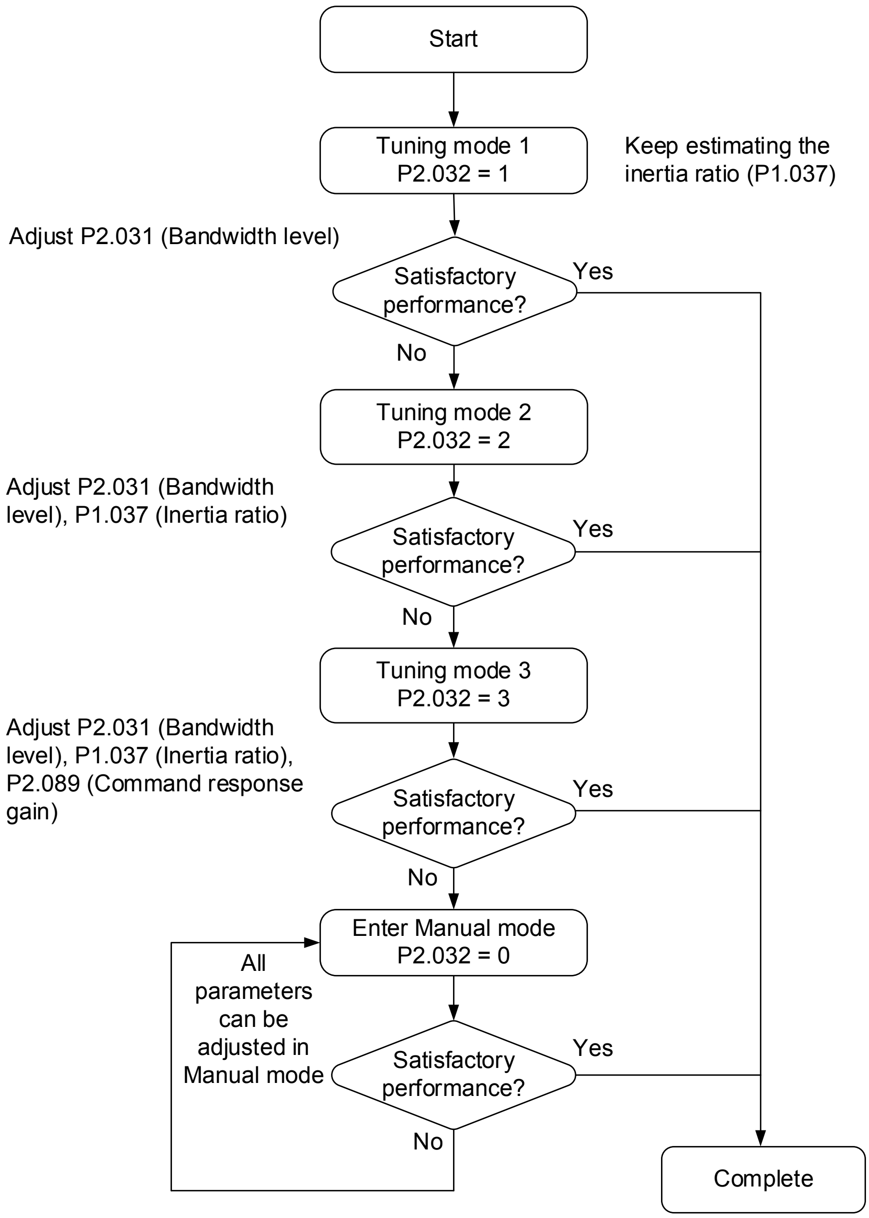


Display	Alarm name
AL08A	Auto-tuning function - Command error
AL08B	Auto-tuning function - Inertia estimation error
AL08C	Auto-tuning function - Pause time is too short

5.4 Tuning mode

Apart from the Auto Tuning function described above, there are three other tuning modes you can use to fine tune the system. You can then easily complete tuning by increasing or decreasing the frequency response bandwidth (P2.031). Please follow the tuning procedure in Section 5.1.

5.4.1 Flow chart of Tuning mode



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5.4.2 Tuning mode 1

In this mode, the servo drive continues to estimate the machine inertia and updates the value of parameter P1.037.

P2.032 Setting value	Tuning mode	Inertia estimation	Parameter	
			Manual tuning	Auto tuning
1	Tuning mode 1	Real-time estimation	P2.031	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102、

Requirements for inertia estimation:

1. Motor speed increases from 0 rpm to 3000 rpm within 1.5 seconds.
2. It is suggested to set the speed to 500 rpm or higher. The lowest speed should be no less than 200 rpm.
3. The load inertia should be less than 50 times the motor inertia.
4. The change in the external force or inertia ratio cannot be too great.

5.4.3 Tuning mode 2

When Tuning mode 1 cannot meet your need, you can try Tuning mode 2 to tune the servo system. In Tuning mode 2, the system does not automatically estimate the inertia. You must set the correct mechanical inertia in parameter P1.037.

P2.032 Setting value	Tuning mode	Inertia estimation	Parameter	
			Manual tuning	Auto tuning
2	Tuning mode 2	Value of P1.037	P1.037 P2.031	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102

Inertia estimation is applicable to most applications. However, when the machine does not comply with the requirements for inertia estimation, you have to set the correct inertia ratio in parameter P1.037.

5.4.4 Tuning mode 3

If your need cannot be met by Tuning mode 1 and 2, please select Tuning mode 3. Parameter P2.089 (Command Response Gain) is available in this mode. You can increase the gain value to shorten the response and settling time for the position command. However, if you set the parameter value too high, it might cause overshoot and machinery vibration. This function is only available when changing the command, such as the acceleration / deceleration application.

5

P2.032 Setting value	Tuning mode	Inertia estimation	Parameter	
			Manual tuning	Auto tuning
3	Tuning mode 3	Value of P1.037	P1.037 P2.031 P2.089	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.098, P2.099, P2.101, P2.102

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5.4.5 Setting the frequency response bandwidth (stiffness)

You can use parameter P2.031 to tune the servo system with an easier and user-friendly way. With the fixed inertia ratio, when increasing the bandwidth level (P2.031), the servo's bandwidth increases as well. If resonance occurs, please lower the parameter value by one or two bandwidth levels (you should adjust the bandwidth level according to the actual situation). For instance, if the value of P2.031 is 30, you can reduce the bandwidth level to 28. When adjusting the value of this parameter, the servo system automatically adjusts the corresponding parameters, such as P2.000 and P2.004.

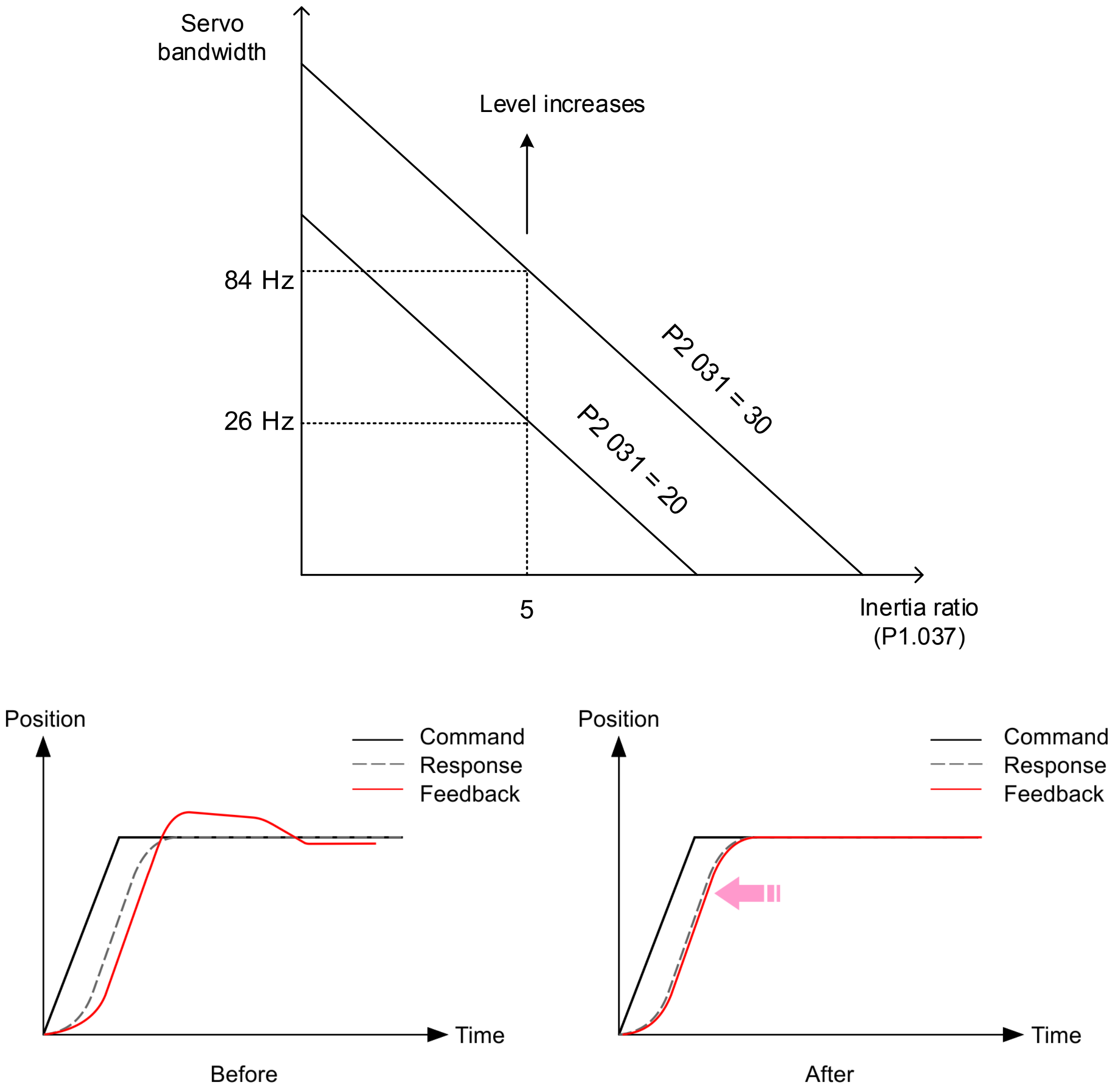

Figure 5.4.5.1 Adjust the bandwidth level

5.4.6 Gain response

You can use parameter P2.089 to adjust the response. Increasing the gain can minimize the deviation between the position command and command response in intermittent duty zone. When adjusting the value of P2.089, please enable the function for two degrees of freedom (set P2.094 to 0x1000).

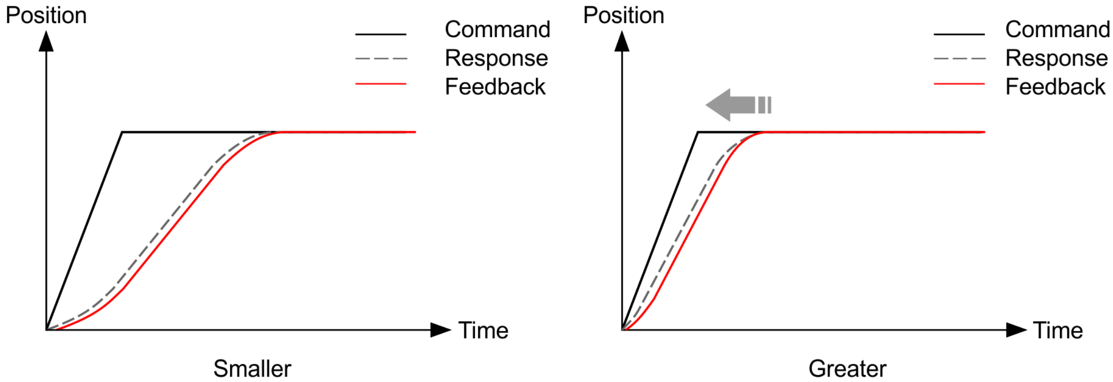

Figure 5.4.6.1 Adjust the gain response

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5.5 Tuning in Manual mode

The selection of the position and speed response frequency should be determined by the machinery stiffness and the application. Generally, for applications or machines that require high speed and high precision, higher frequency response bandwidth is required. However, increasing the response bandwidth might cause resonance. Thus, machinery with higher stiffness is used to solve this problem. When the resonance frequency is unknown, you can gradually increase the gain parameter values to increase the frequency resonance bandwidth. Then, decrease the gain parameter values until you hear the sound of the resonance. The following are the descriptions of the gain adjustment parameters.

- Position control gain (KPP, parameter P2.000)

  This parameter determines the response of the position loop. The bigger the KPP value, the higher the response frequency of the position loop. This lowers following error and position error, and shortens the settling time. However, if you set the value too high, it can cause the machinery to vibrate or cause overshoot when positioning. The calculation of position loop frequency response is as follows:

$$\text{Frequency response bandwidth of position loop (Hz)} = \frac{\text{KPP}}{2\pi}$$

- Speed control gain (KVP, parameter P2.004)

  This parameter determines the response of speed loop. The bigger the KVP value, the higher the response frequency of the speed loop and the lower the following error. However, if you set the value too high, it could cause machinery resonance. The response frequency of the speed loop must be 4–6 times higher than the response frequency of the position loop; otherwise, the machinery might vibrate or it might cause overshoot when positioning. The calculation of speed loop frequency response is as follows:

$$\text{Frequency response bandwidth of speed loop}$$
$$\text{fv} = \left(\frac{\text{KVP}}{2\pi}\right) \times \left[\frac{(1 + \text{P1} - 37/10)}{(1 + \text{JL}/\text{JM})}\right] \text{Hz}$$

  JM: Motor Inertia; JL: Load Inertia; P1.037: 0.1 (times)

  When P1.037 (auto estimation or manually set value) is equal to the real inertia ratio (JL / JM), the real speed loop frequency response is:

$$\text{fv} = \left(\frac{\text{KVP}}{2\pi}\right) \text{Hz}$$

- Speed integral compensation (KVI, parameter P2.006)

  The higher the KVI value, the better the elimination of the deviation. However, if you set the value too high, it can cause the machinery to vibrate. It is suggested that you set the value as follows:

$$\text{KVI (P2.006)} \leq 1.5 \times \text{Speed loop frequency response}$$

- Low-pass filter for resonance suppression (NLP, parameter P2.025)

  A high inertial value ratio reduces the frequency response of the speed loop. Therefore, you must increase the KVP value to maintain the response frequency. Increasing KVP value might cause machinery resonance. Please use this parameter to eliminate the noise from resonance. The higher the value, the better the capability for reducing high-frequency noise. However, if you set the value too high, it can cause instability in the speed loop and overshoot in positioning. It is suggested that you set the value as follows:

$$\text{NLP (P2.025)} \leq \frac{10000}{6 \times \text{Speed loop frequency response (Hz)}}$$

- Anti-interference gain (DST, parameter P2.026)

  Use this parameter to increase the ability to resist external force and eliminate overshoot during acceleration / deceleration. The default value is 0. Adjusting this value in Manual mode is not suggested unless it is for fine-tuning.

- Position feed forward gain (PFG, parameter P2.002)

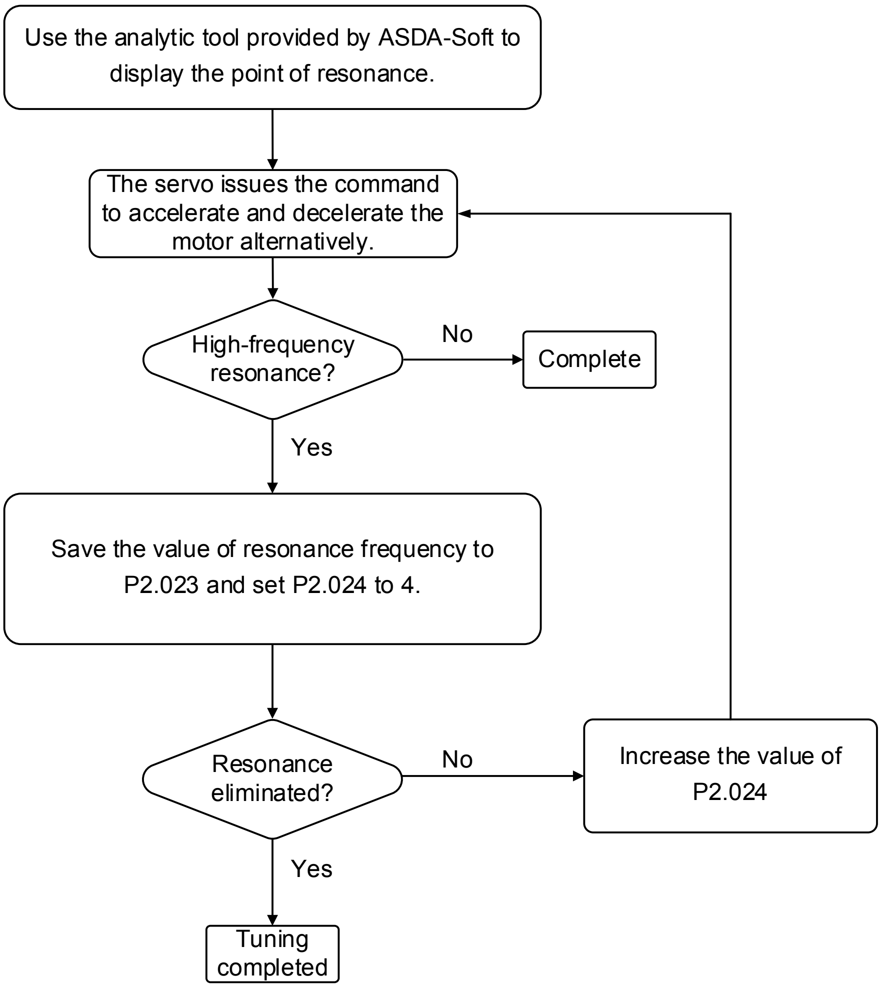
  This parameter can reduce the position error and shorten the settling time. However, if you set the value too high, it might cause overshoot in positioning. If the setting of the e-gear ratio is larger than 10, it might cause noise as well.

5

5.6 Mechanical resonance suppression

Five sets of notch filters are provided to suppress mechanical resonance. You can set all five to the auto resonance suppression parameter (P2.047) with manual adjustment.

Please see the following flowchart for manual adjustment.



Operation Mode 6

This chapter describes the operation of each control mode, including gain adjustment and filters. For position control, you use the external pulse and commands from the internal registers. For Speed mode and Torque mode, apart from the commands from the internal registers, you can also control the servo drive by the analog voltage input. In addition to Single mode, Dual mode is also available for meeting the application requirements.

6.1 Selecting the operation mode

This servo drive provides three basic operation modes: Position, Speed, and Torque. The available communication modes are CANopen, DMCNET and EtherCAT respectively. For basic operation mode, you can choose from Single mode, Dual mode, and Multi-mode. The following table lists all the available modes.

Mode		Short name	Code	Description
Single mode	Position mode (Terminal block input)	PT	00	The servo drive receives the Position command and commands the motor to run to the target position. The Position command is communicated through the terminal block and the signal type is pulse.
	Position mode (Register input)	PR	01	The servo drive receives the Position command and commands the motor to run to the target position. Position commands are issued from the internal registers (99 sets in total). You can select the register number with DI signals or through communication.
	Speed mode	S	02	The servo drive receives the Speed command and commands the motor to run at the target speed. The Speed command is issued from the internal registers (3 sets in total) or by analog voltage (-10V to +10V) which is communicated through the terminal block. You select the command with DI signals.
	Speed mode (No analog input)	Sz	04	The servo drive receives the Speed command and commands the motor to run at the target speed. The Speed command can only be issued from the internal registers (3 sets in total) instead of through the external terminal block. You select the command with DI signals.
	Torque mode	T	03	The servo drive receives the Torque command and commands the motor to run with the target torque. The Torque commands can be issued from the internal registers (3 sets in total) as well as by analog voltage (-10V to +10V) which is communicated through the terminal block. You select the command with DI signals.
	Torque mode (No analog input)	Tz	05	The servo drive receives the Torque command and commands the motor to run with the target torque. The Torque command can only be issued from the internal registers (3 sets in total). You select the command with DI signals.
Dual mode		PT-S	06	You can switch PT and S mode with DI signals.
		PT-T	07	You can switch PT and T mode with DI signals.
		PR-S	08	You can switch PR and S mode with DI signals.
		PR-T	09	You can switch PR and T mode with DI signals.
		S-T	0A	You can switch S and T mode with DI signals.
		-	0B	Reserved
		Communication	0C	DMCNET mode
				CANopen mode
				EtherCAT mode
		PT-PR	0D	You can switch PT and PR mode with DI signals.
Multi-mode		PT-PR-S	0E	You can switch PT, PR, and S mode with DI signals.
		PT-PR-T	0F	You can switch PT, PR, and T mode with DI signals.

6

Here are the steps to switch the operation mode:

1. Switch the servo drive to Servo Off status. You can do this by setting DI.SON to OFF.
2. Set P1.001 and refer to the code listed above for the mode selection.
3. After setting the parameter, cycle the power to the servo drive.

The following sections describe the operation of each mode, including the mode structure, command source, selection and processing of the command, and gain adjustment.

6.2 Position mode

Two input modes for position control are available on the ASDA-A3: external pulse (PT mode) and internal register (PR mode). In PT mode, the ASDA-A3 servo drive receives the pulse command for direction (motor runs forward or reverse). You can control the rotation angle of the motor with the input pulse. The ASDA-A3 can receive pulse commands of up to 4 Mpps.

You can also accomplish position control using the internal register (PR mode) without the external pulse command. The ASDA-A3 provides 99 command registers with two input modes. You can set the 99 registers first before switching the drive to Servo On status and then set DI.POS0 – DI.POS6 of CN1 for the switch. Or, you can directly set the register values through communication.

6.2.1 Position command in PT mode

The PT Position command is the pulse input from the terminal block. There are three pulse types and each type has positive and negative logic that you can set in parameter P1.000. Please refer to Chapter 8 for more details.

Parameter	Function
P1.000	External pulse input type

6

6.2.2 Position command in PR mode

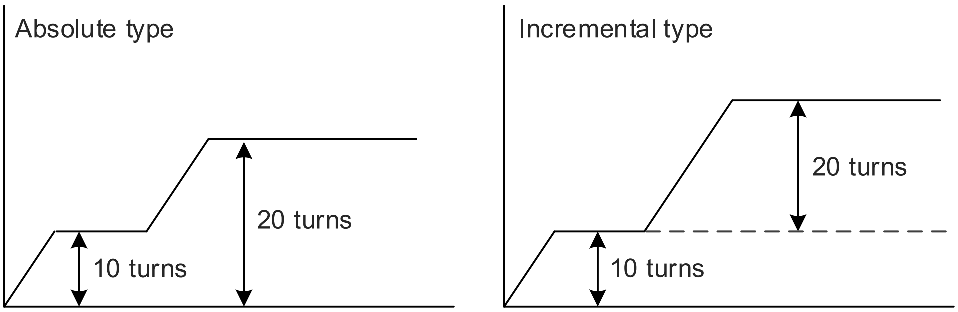
You select the PR command source with (P6.000, P6.001) – (P7.098, P7.099), which are the 99 built-in command registers. Then, you trigger the Position command with DI.CTRG (0x08). See the following table for more detail.

Position command	POS6	POS5	POS4	POS3	POS2	POS1	POS0	CTRG	Setting parameter
Homing	0	0	0	0	0	0	0	↑	P6.000 P6.001
P1	0	0	0	0	0	0	1	↑	P6.002 P6.003
~									~
P50	0	1	1	0	0	1	0	↑	P6.098 P6.099
P51	0	1	1	0	0	1	1	↑	P7.000 P7.001
~									~
P99	1	1	0	0	0	1	1	↑	P7.098 P7.099

State of POS0 – POS6: 0 signifies that DI is off; 1 signifies that DI is on.

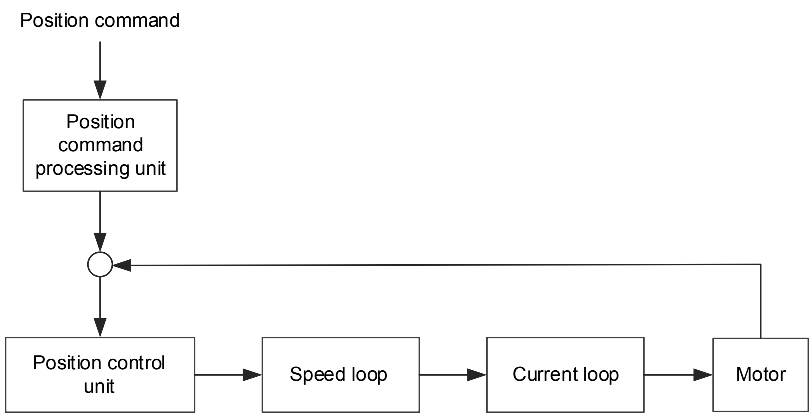
CTRG↑: this signifies the moment that DI is switched from off to on.

There are many applications for both absolute type and incremental type registers. For example, assume the Position command P1 is 10 turns and P2 is 20 turns. P1 is issued first and P2 comes second. The following diagram shows the difference between absolute and incremental positioning.



6.2.3 Control structure of Position mode

The basic control structure is shown in the following flow chart:



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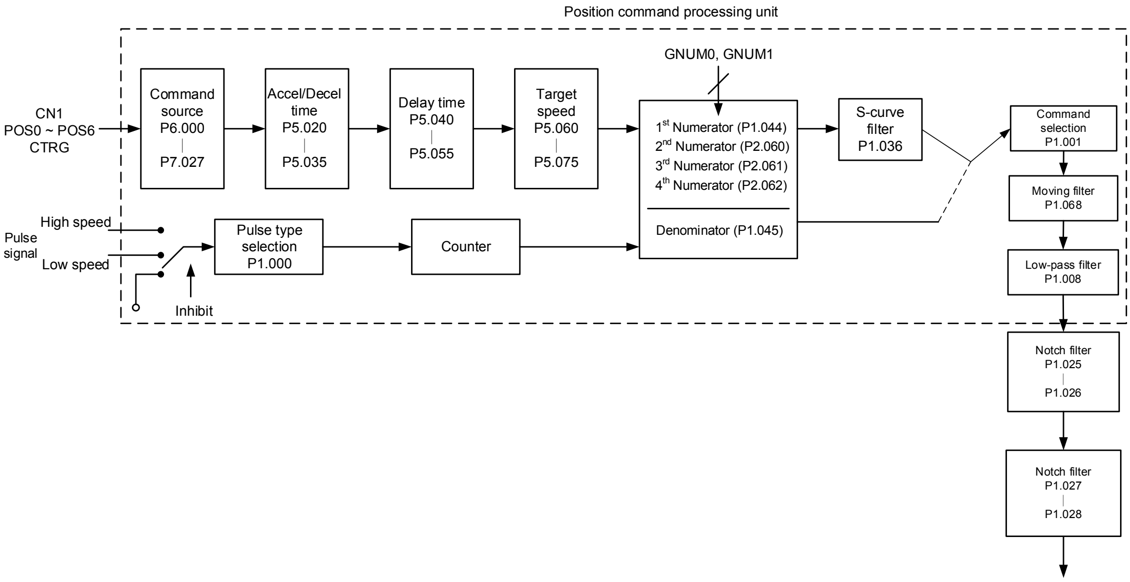
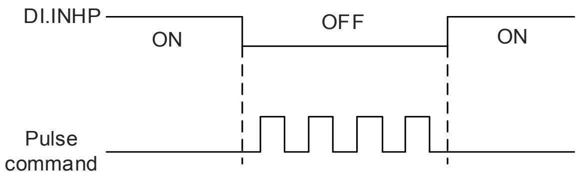
For better control, the pulse signals are processed by the Position Command processing unit. The structure is shown in the diagram below.



The upper path of the above diagram is the PR mode and the lower one is the PT mode that you can select with P1.001. You can set E-Gear ratio in both modes to adjust the positioning resolution. In addition, you can use either an S-curve or low-pass filter to smooth the command (described below).

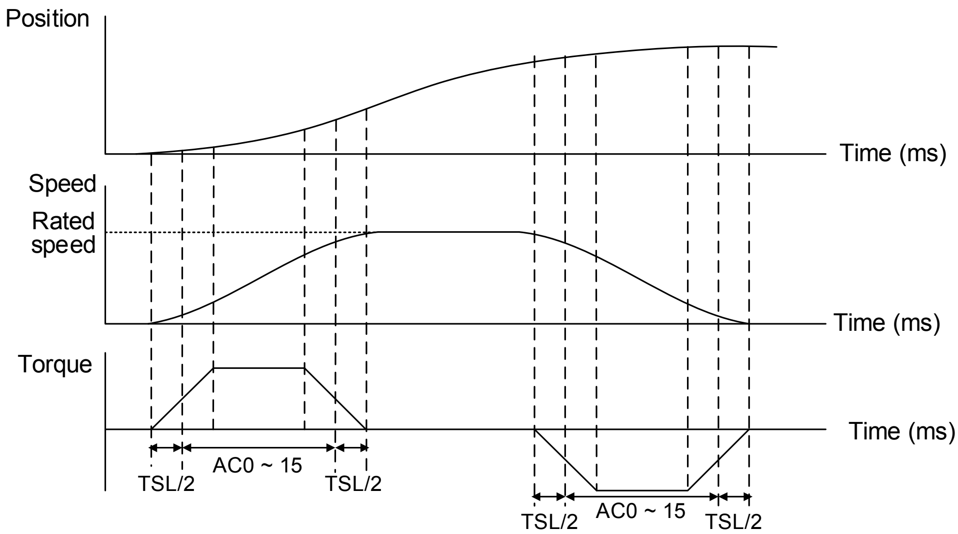
The Pulse Command Input Inhibit (INHP) function

In PT mode, when DI.INHP is on, the servo drive stops receiving external pulse commands and the motor stops running. As this function is only supported by DI 8, setting 0x45 (DI.INHP) to P2.017 (DI 8) is required.

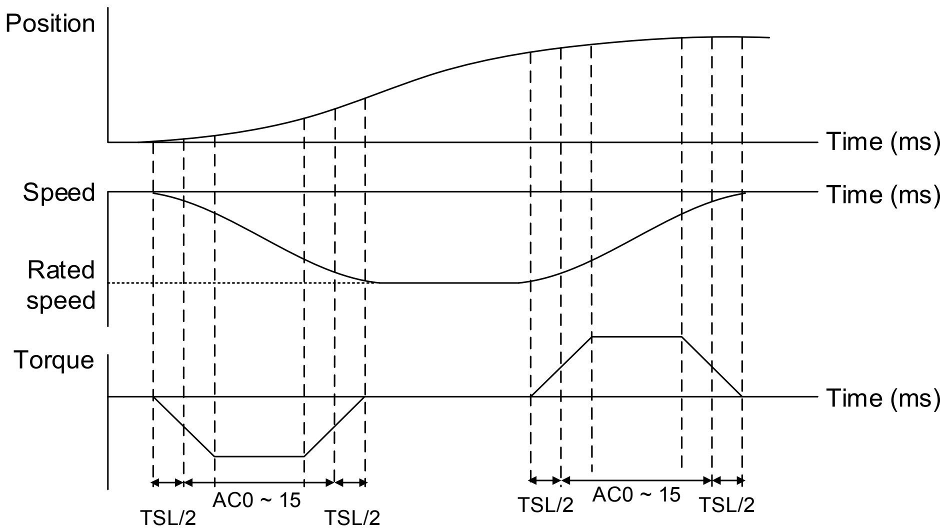


6.2.4 S-curve filter (Position)

The S-curve filter smoothes the motion command in PR mode. This filter makes speed and acceleration continuous and reduces jerking, resulting in a smoother mechanical operation. If the load inertia increases, the motor operation is influenced by friction and inertia when the motor starts or stops rotating. Setting a larger acceleration / deceleration constant for the S-curve (TSL) and for the acceleration / deceleration time in P5.020 – P5.035 can increase the smoothness of operation. When the Position command source is pulse, the speed and angular acceleration are continuous, and the S-curve filter is not necessary.



Position and S-curve speed and time setting
(Acceleration for position command)



Position and S-curve speed and time setting
(Deceleration for position command)

Relevant parameters: please refer to Chapter 8 for detailed descriptions.

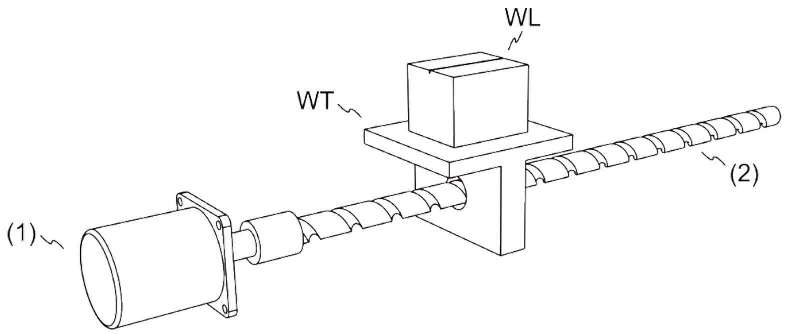
Parameter	Function
P1.036	S-curve acceleration / deceleration constant
P5.020 – P5.035	Acceleration / deceleration time (Number #0 – 15)

6

6.2.5 Electronic gear ratio (E-Gear ratio)

The resolution of ASDA-A3 is 24 bits, which means that it generates16777216 pulses per motor rotation. Regardless of the encoder resolution (17-bit, 20-bit, or 22-bit), the E-Gear ratio is set according to 24-bit resolution of ASDA-A3 servo drive.

The Electronic gear ratio changes the resolution. When E-Gear ratio is 1, it generates 16777216 pulses per motor rotation; when you set the ratio to 0.5, then every two pulses from the command (controller) corresponds to one pulse for the motor. However, larger E-Gear ratio might create a sharp corner in the profile and lead to a high jerk. To solve this problem, you can apply an S-curve acceleration / deceleration filter, or a low-pass filter to reduce the jerk. For example, if you set the E-Gear ratio so that the workpiece is moved at the speed of 1 μm/pulse, then it means the workpiece moves 1 μm per pulse.



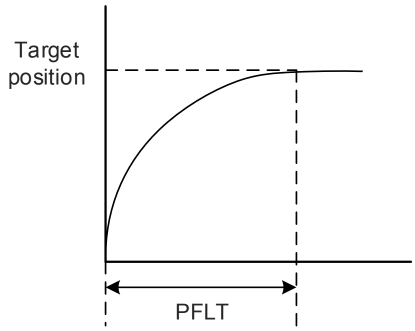
(1) Motor (2) Ball screw pitch: 3 mm (equals 3000 μm)
WL: Workpiece; WT: platform

	Gear Ratio	Moving distance per 1 pulse command
Electronic gear is not applied	$= \frac{1}{1}$	$= \frac{3000 \frac{\mu m}{rev}}{16777216 \frac{Pulse}{rev}} \times \frac{1}{1} = \frac{3000}{16777216} \quad (\text{Unit}: \frac{\mu m}{Pulse})$
Electronic gear is applied	$= \frac{16777216}{3000}$	$= \frac{3000 \frac{\mu m}{rev}}{16777216 \frac{Pulse}{rev}} \times \frac{16777216}{3000} = 1 \quad (\text{Unit}: \frac{\mu m}{Pulse})$

Relevant parameters: please refer to Chapter 8 for detailed descriptions.

Parameters	Function
P1.044	E-Gear ratio (Numerator) (N1)
P1.045	E-Gear ratio (Denominator) (M)

6.2.6 Low-pass filter

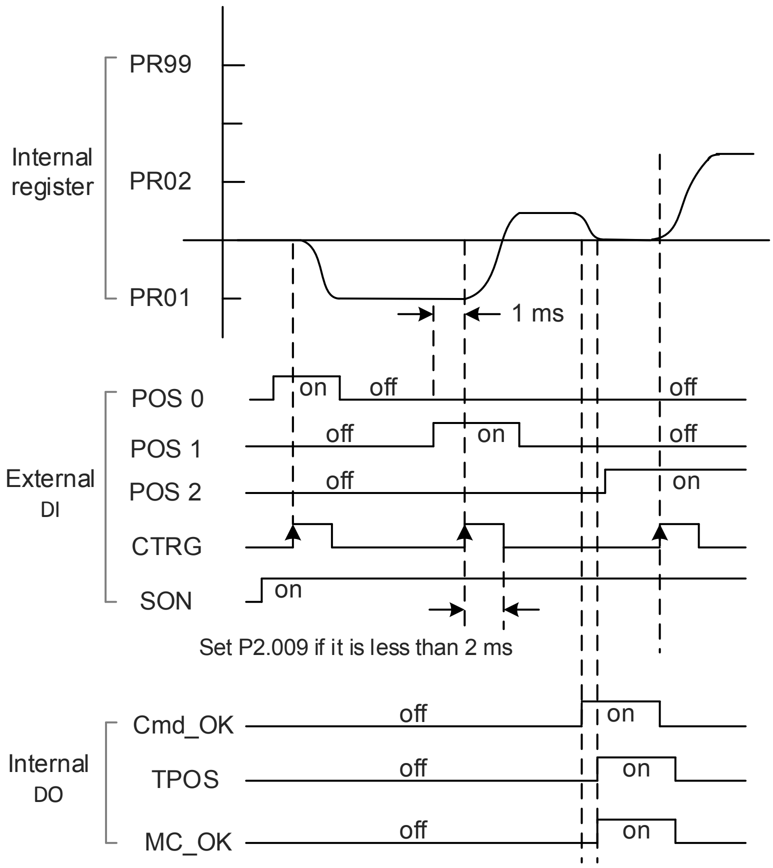


Relevant parameters: please refer to Chapter 8 for detailed descriptions.

Parameter	Function
P1.008	Position command smoothing constant (Low-pass filter)

6.2.7 Timing diagram of PR mode

In PR mode, the Position command is issued with the DI signal (POS0 – POS6 and CTRG) for CN1. Please refer to Section 6.2.2 for information about the DI signal and its selected register. The timing diagrams are shown below.



Note: Cmd_OK is on when the PR command completes; TPOS is on when the error is smaller than value set by P1.054; MC_OK is on when Cmd_OK and TPOS are both on.

6.2.8 Gain adjustment for the position loop

There are two types of gain adjustment for the position loop: auto and manual.

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- Auto adjustment:

The ASDA-A3 servo drive provides an Auto Tuning function that allows you to easily complete the gain adjustment. Please refer to Chapter 5 Tuning for a detailed description.

- Manual adjustment:

Before setting the position control unit, you have to manually set the speed control unit (P2.004 and P2.006) since a speed loop is included in the position loop. Then set the position loop gain (P2.000) and position feed forward gain (P2.002).

Description of the proportional gain and feed forward gain:

1. Proportional gain: a larger gain increases the response bandwidth of position loop.
2. Feed forward gain: reduces the deviation of phase delay.

Please note that the position loop bandwidth should not be larger than the speed loop bandwidth.

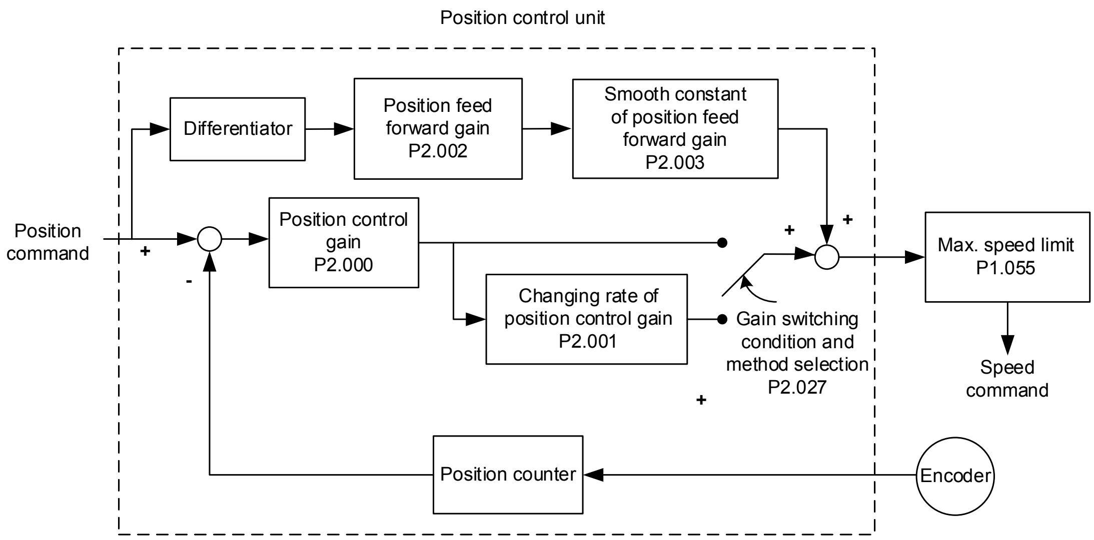
Calculation: $fp \leq \frac{fv}{4}$ (fv: response bandwidth of speed loop (Hz); fp: response bandwidth of position loop (Hz).)

$$KPP = 2 \times \pi \times fp$$

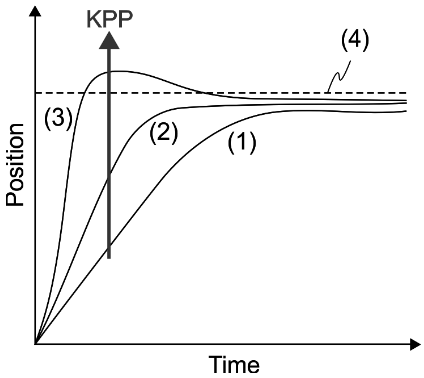
Example: if the desired position bandwidth is 20 Hz, then adjust KPP (P2.000) to 125. ($2 \times \pi \times 20$ Hz = 125)

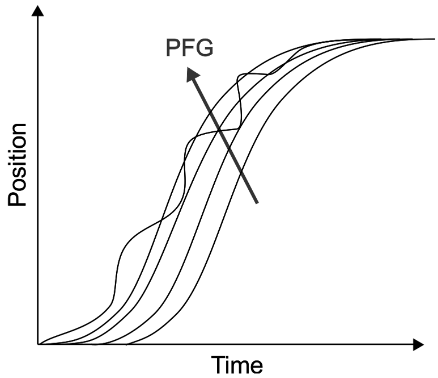
Relevant parameters: please refer to Chapter 8 for detailed descriptions.

Parameter	Function
P2.000	Position control gain
P2.002	Position feed forward gain



When you set the value of KPP (P2.000) too high, the bandwidth for the position loop is increased and the phase margin is reduced. Meanwhile, the motor rotates and vibrates in the forward and reverse directions. In this case, you have to decrease KPP until the rotor stops vibrating. When the external torque is too high, the low value for KPP cannot meet the demand of reducing position error. In this case, increasing position the feed forward gain, PFG (P2.002), can effectively reduce the following error.





The actual position curve changes from (1) to (3) with the increase in the KPP value. (4) stands for the Position command.

6

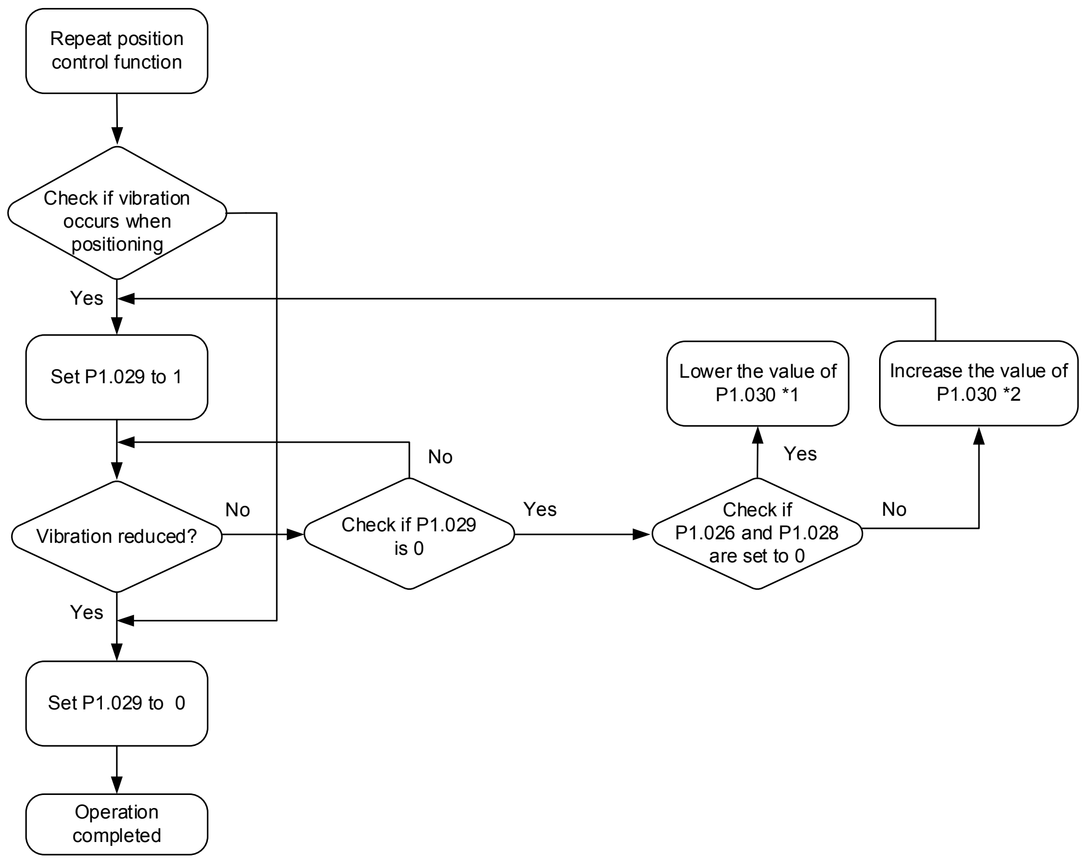
6.2.9 Low-frequency vibration suppression in Position mode

If the machine is too flexible, vibration persists even when the motor stops after executing the Positioning command. The low-frequency vibration suppression function can reduce the machine vibration. The suppression range is between 1.0 Hz and 100.0 HZ. Both auto and manual functions are available.

Auto function

If you have difficulty finding the resonance frequency, you can enable the auto low-frequency vibration suppression function, which searches for the specific resonance frequency. If you set P1.029 to 1, the system disables this function automatically and starts to search the vibration frequency. When the detected resonance frequency remains at the same level, it automatically sets P1.029 to 0 and sets P1.025 to the first frequency and sets P1.026 to 1. It sets P1.027 to the second frequency and then sets P1.028 to 1. If P1.029 is automatically reset to 0, but the low-frequency vibration persists, please check that P1.026 or P1.028 is enabled. If the values of P1.026 and P1.028 are both 0, it means no frequency is detected. Please lower the value of P1.030 and set P1.029 to 1 to search the vibration frequency again. Please note that when you set the detection level too low, it might detect noise as low-frequency vibration.

The diagram of the basic control structure is shown in the following flowchart:



Note:

1. When the values of P1.026 and P1.028 are 0, it means that the frequency cannot be found, probably because the detection level is set too high so that the low-frequency vibration is not detected.
2. When the values of P1.026 or P1.028 are greater than 0 and the vibration is not reduced, it is probably because the detection level is set too low, and the system detects noise or other frequency as low-frequency vibration.
3. When the auto suppression procedure completes, but the vibration persists, you can manually set P1.025 or P1.027 to suppress the vibration if you have identified the low frequency.

Relevant parameters: please refer to Chapter 8 for detailed descriptions.

Parameter	Function
P1.029	Auto low-frequency vibration suppression mode
P1.030	Low-frequency vibration detection

P1.030 sets the detection range for the magnitude of low-frequency vibration. When the frequency is not detected, it is probably because you set the value of P1.030 too high and it exceeds the vibration range. In this case, it is suggested that you decrease the value of P1.030. Please note that if the value is too small, the system might detect noise as the resonance vibration frequency. You can also use a software Scope to observe the range of position error (pulse) between the upper and lower magnitude of the curve to adjust the value of P1.030.

Manual Setting

There are two sets of low-frequency vibration suppression: one is parameters P1.025 – P1.026 and the other is parameters P1.027 – P1.028. You can use these two sets of low-frequency vibration suppression parameters to reduce two different frequency vibrations. Use parameters P1.025 and P1.027 to suppress the low-frequency vibration. The function works only when the low-frequency vibration setting is close to the real vibration frequency. Use parameters P1.026 and P1.028 to set the response after frequency filtering. The bigger the values of P1.026 and P1.028, the better the response. However, if you set the values too high, the motor might not operate smoothly. The default values of parameters P1.026 and P1.028 are 0, which means the two filters are disabled by default.

Relevant parameters: please refer to Chapter 8 for detailed descriptions.

Parameter	Function
P1.025	Low-frequency vibration suppression frequency (1)
P1.026	Low-frequency vibration suppression gain (1)
P1.027	Low-frequency vibration suppression frequency (2)
P1.028	Low-frequency vibration suppression gain (2)

6

6.3 Speed mode

This servo drive includes two types of command inputs: analog and internal register (parameters). The Analog command controls the motor speed by scaled external voltage input. The command register input controls the speed in two ways. The first is to set different speed values in three command registers and then switch the speed by using DI.SPD0 and DI.SPD1 for CN1. The second is to change the value in the register by communication. In order to deal with the problem of non-continuous speed when switching registers, you can use the S-curve acceleration / deceleration filter. In a closed-loop system, the servo drive uses gain adjustment, the integrated PI controller, and the two modes (Manual and Auto).

You use Manual mode to manually set the parameters. In this mode, all auto or auxiliary function are disabled. The gain adjustment function provides different modes for you to estimate load inertia and tune the bandwidth as well as the responsiveness. In addition, the parameter values you set are regarded as the default values.

6.3.1 Selecting the Speed command source

There are two types of Speed command sources: analog voltage and internal register (parameters). You can select the source by using DI signal for CN1. See the following table for the command source selection:

<table>
<tr><th rowspan="2">Speed command</th><th colspan="2">CN1 DI signal</th><th rowspan="2" colspan="3">Command source</th><th rowspan="2">Content</th><th rowspan="2">Range</th></tr>
<tr><th>SPD1</th><th>SPD0</th></tr>
<tr><td rowspan="2">S1</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">Mode</td><td>S</td><td>External analog signal</td><td>Voltage difference between V-REF and GND</td><td>-10V to +10V</td></tr>
<tr><td>Sz</td><td>N/A</td><td>Speed command is 0</td><td>0</td></tr>
<tr><td>S2</td><td>0</td><td>1</td><td rowspan="3" colspan="3">Register parameters</td><td>P1.009</td><td>-60000 – 60000</td></tr>
<tr><td>S3</td><td>1</td><td>0</td><td>P1.010</td><td>-60000 – 60000</td></tr>
<tr><td>S4</td><td>1</td><td>1</td><td>P1.011</td><td>-60000 – 60000</td></tr>
</table>

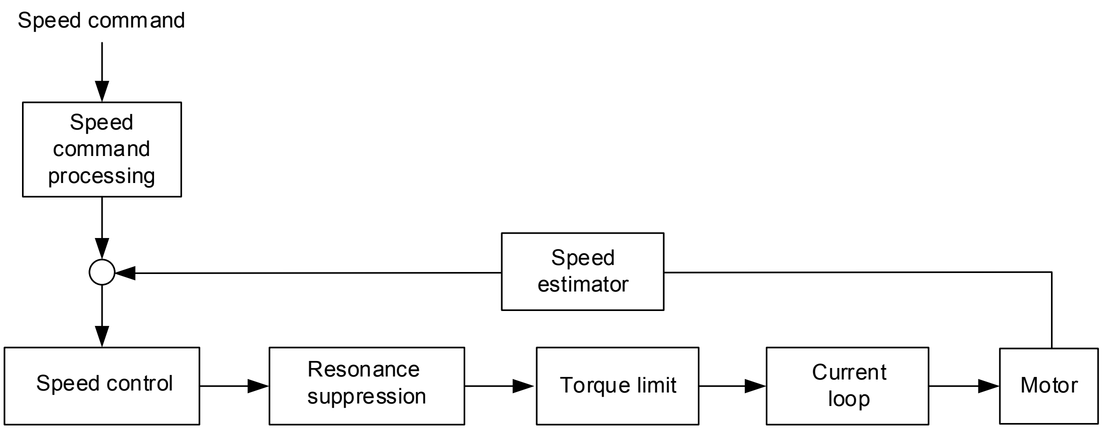
- Status of SPD0 – SPD1: 0 means that DI is off; 1 means that DI is on.
- When both SPD0 and SPD1 are 0, if in Sz mode, the command is 0. Thus, if the Speed command using analog voltage type is not required, you can use Sz mode to address the problem of zero drift in the voltage. If it is in S mode, the command is the voltage deviation between V-REF and GND. The range of the input voltage is between -10V and +10V and you can adjust the corresponding speed (P1.040).
- When either one of SPD0 and SPD1 is not 0, the Speed command comes from the internal register. The command is activated once the status of SPD0 – SPD1 is changed. There is no need to use CTRG for triggering.

- The parameter setting range (internal register) is -60000 – 60000.
  Setting value = setting range x unit (0.1 rpm). For example, if P1.009 = +30000, then rotation speed = +30000 x 0.1 rpm = +3000 rpm

You can use the Speed command in Speed mode (S or Sz) as well as in Torque mode (T or Tz) to set the speed limit.

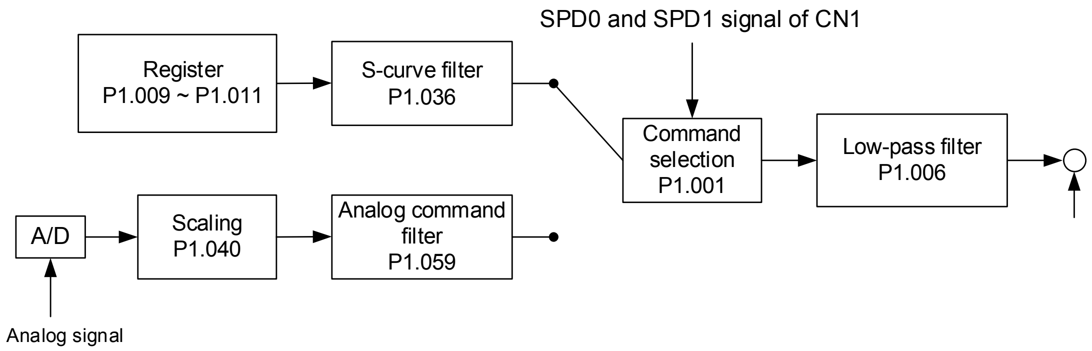
6.3.2 Control structure of Speed mode

The diagram of the basic control structure is shown in the following flowchart:



The Speed Command processing unit selects the command source (see Section 6.3.1), including the scaling parameter (P1.040) for rotation speed and S-curve parameter for smoothing the speed. The Speed Control unit manages the gain parameters for the servo drive and calculates the current command for servo motor in real-time. The Resonance Suppression unit suppresses the resonance of the machine.

The following diagram introduce the function of Speed Command unit. Its structure is shown below.



Control in the upper path is from the register while the in lower path it is from the external analog voltage. The command is selected according to the status of SPD0, SPD1 and P1.001 (S or Sz). In this condition, the S-curve and low-pass filters are applied to achieve a smoother response.

6

6.3.3 Smooth Speed command

S-curve filter

During the process of acceleration or deceleration, the S-curve filter uses the three-stage acceleration curve and creates a smoother motion trajectory. It avoids jerk (rapid change of acceleration), resonance, and noise caused by abrupt speed variation. You can use the S-curve acceleration constant (TACC) to adjust the slope of the change in acceleration; the S-curve deceleration constant (TDEC) adjusts the slope of the change in deceleration; and the S-curve acceleration / deceleration constant (TSL) improves the status of motor activating and stopping. This can also calculate the total time for executing the command.

T (m) signifies the operation time and S (rpm) signifies the absolute Speed command, which is the absolute value of the initial speed minus the end speed.

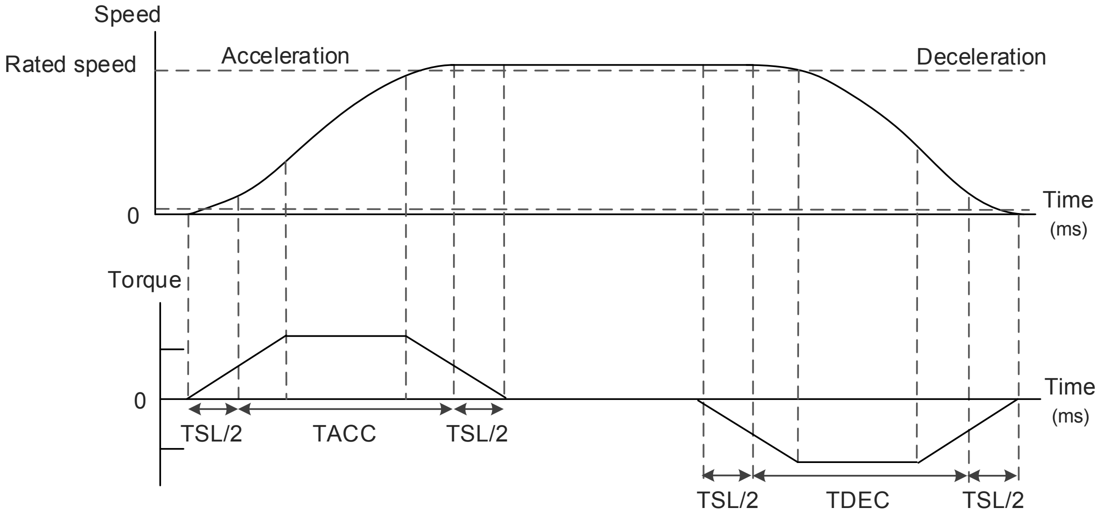


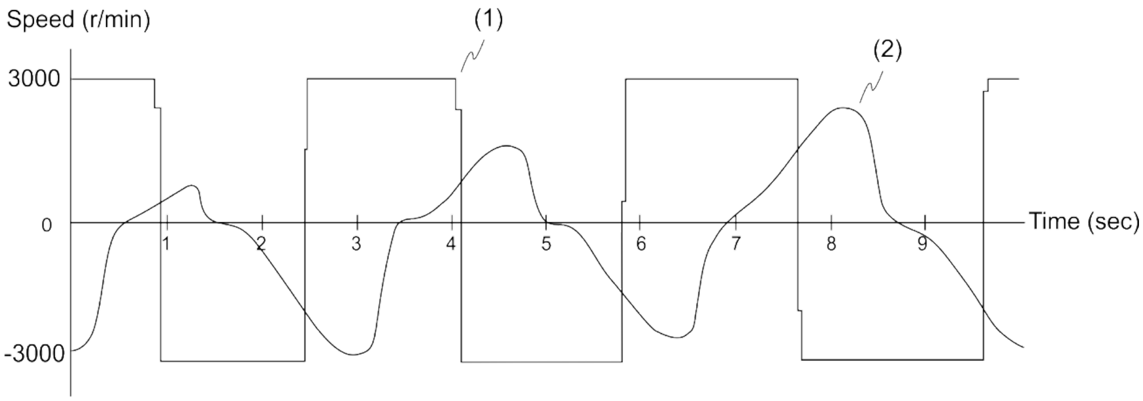
Figure 6.3.3.1 S-curve and time setting

Relevant parameters: refer to Chapter 8 for more information.

Parameter	Function
P1.034	S-curve acceleration constant
P1.035	S-curve deceleration constant
P1.036	S-curve acceleration / deceleration constant

Analog Speed command filter

The Analog Speed Command filter helps to stabilize the motor operation when the analog input signal (speed) changes rapidly.



(1) Analog Speed command (2) Motor torque

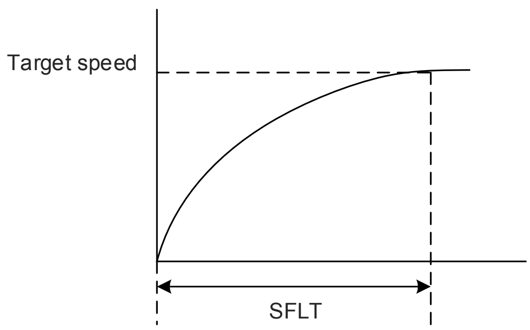
The Analog Speed Command filter smoothes the analog input signal. Its time program is the same as the S-curve filter at normal speed. Also, the speed and acceleration curves are both continuous. The above graph shows the curve of the Speed command and the motor torque when you apply the Analog Speed Command filter. In the diagram above, the slopes of the Speed command in acceleration / deceleration are different. You can adjust the time setting (P1.034, P1.035, and P1.036) according to the actual application to improve the performance.

Low-pass filter for commands

You usually use the low-pass filter to remove unwanted high-frequency response or noise so that the speed change is smoother.

Relevant parameters: refer to Chapter 8 for more information.

Parameter	Function
P1.006	Speed command smoothing constant (Low-pass filter)



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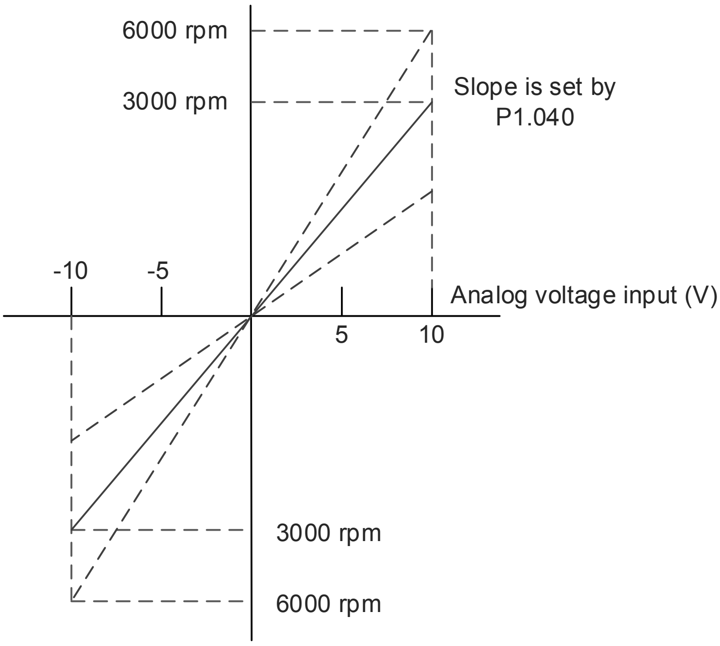
6.3.4 Scaling of the analog command

In Analog mode, you control the motor's Speed command by the analog voltage difference between V_REF and VGND. Use parameter P1.040 (maximum rotation speed for the analog Speed command) to adjust the slope of the speed change and its range.



Relevant parameters: refer to Chapter 8 for more information.

Parameter	Function
P1.040	Maximum rotation speed for the analog Speed command

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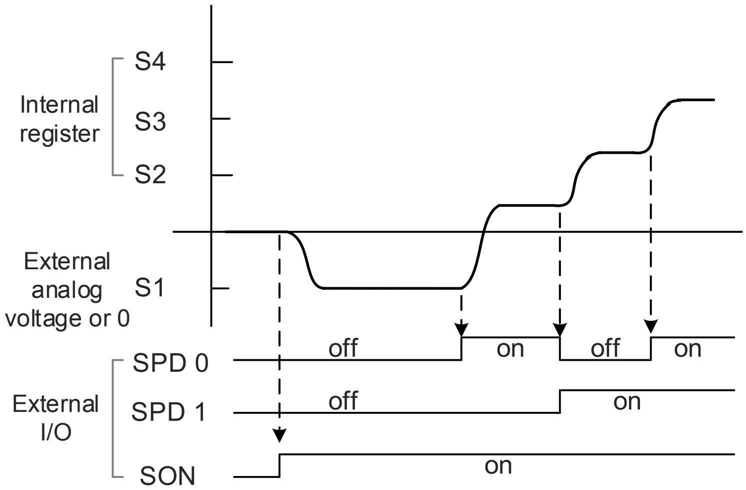
6.3.5 Timing diagram for Speed mode

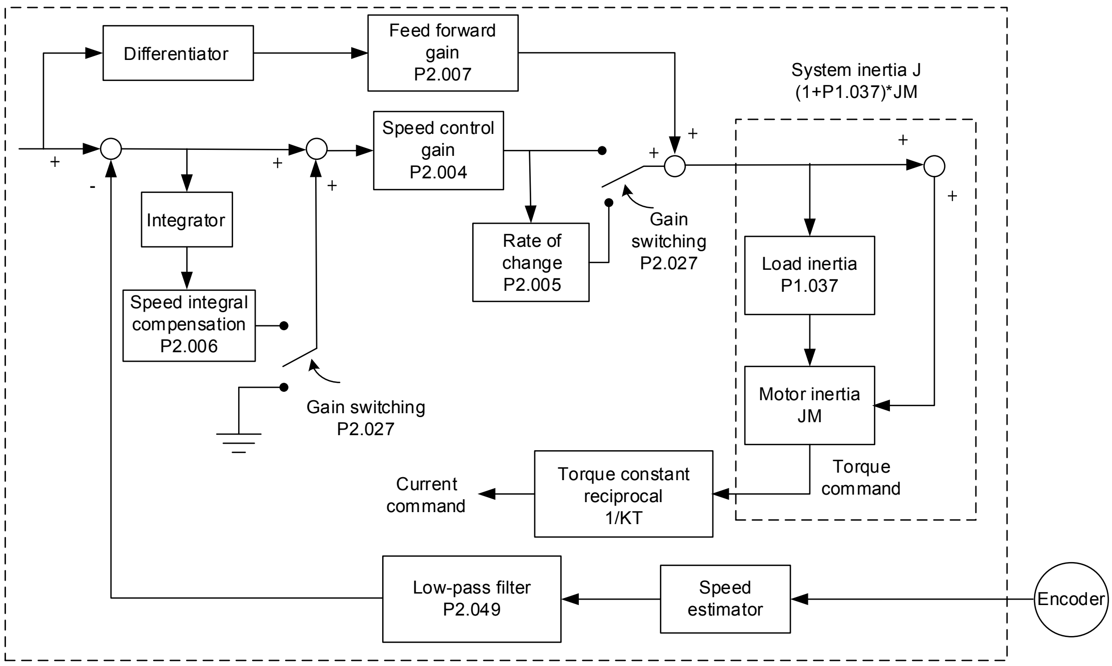


Note:

1. "off" means that the contact is open while "on" means that the contact is closed.
2. When in Sz mode, the Speed command S1 = 0; when in S mode, the Speed command S1 is the external analog voltage input.
3. In Servo On state, the command is selected by the state of SPD0 – SPD1.

6.3.6 Gain adjustment of the speed loop

The structure of the speed control unit appears in the following diagram:



In the Speed Control unit, you can adjust different types of gain. You can adjust the gain manually or use the three gain adjustment modes provided.

Manual: you set values for all the parameter settings. Auto and auxiliary functions are disabled.

Gain Adjustment mode: please refer to Chapter 5 Auto tuning.

Manual mode

When you set P2.032 to 0, you also set the Speed Loop gain (P2.004), Integral Compensation (P2.006), and Feed Forward gain (P2.007).

Speed Loop gain: the higher the gain, the larger the bandwidth for the speed loop response.

Integral Compensation gain: increasing this gain increases the low frequency rigidity and reduces the steady-state error. However, the phase margin is smaller. If you set this gain too high, you reduce the system stability.

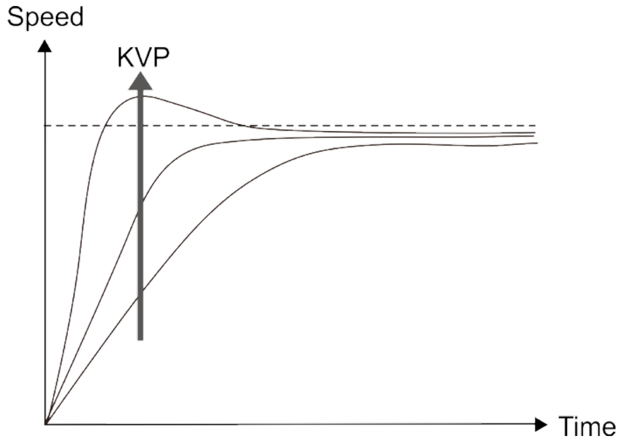
Feed Forward gain: reduce the deviation of the phase delay.

Relevant parameters: refer to Chapter 8 for more information.

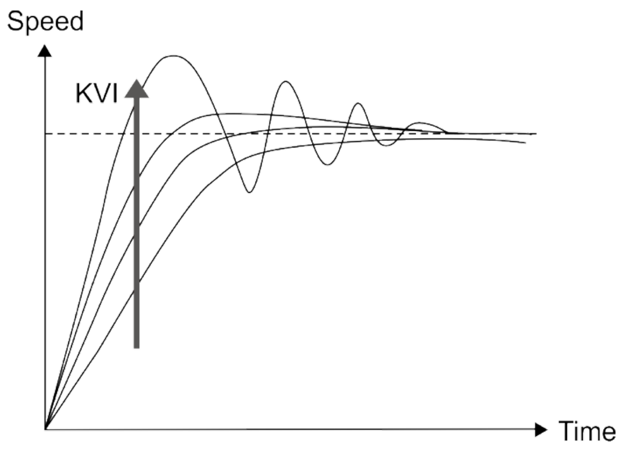
Parameter	Function
P2.004	Speed control gain (KVP)
P2.006	Speed integral compensation (KVI)
P2.007	Speed feed forward gain (KVF)

Theoretically, a stepping response can be used to explain proportional gain (KVP), integral gain (KVI), and feed forward gain (KVF). Here, the frequency domain and time domain are used to illustrate the basic principle.

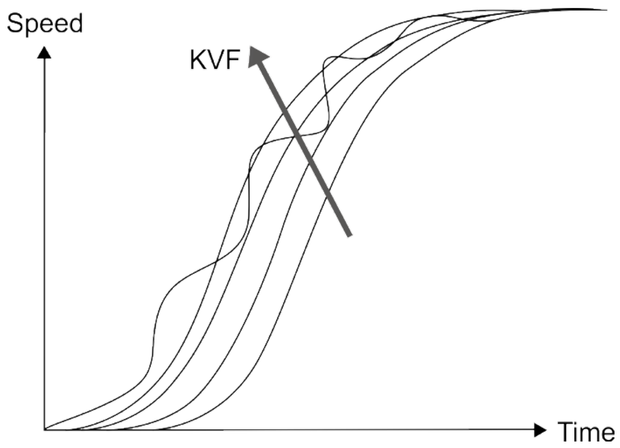
Frequency domain



The higher the KVP value, the larger the bandwidth. The time of the speed increase will also be shorter. However, if the value is set too high, the phase margin is too small. The effect is not as good as KVI for the steady-state error but is better for the effect on following.



The higher the KVI value, the larger the low frequency gain. It shortens the time for the steady-state error to reduce to zero. However, it does not significantly reduce the following error.



The closer the KVF value is to 1, the more complete the forward compensation. The following error becomes very small. But a KVF value that is set too high also causes vibration.

6.3.7 Resonance Suppression unit

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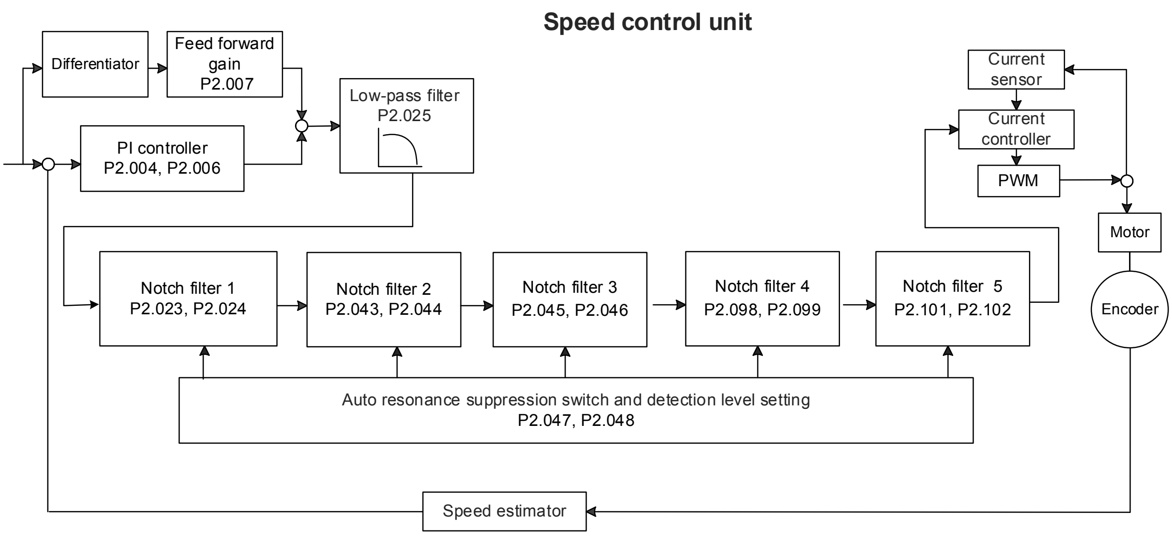
When resonance occurs, it is probably because the stiffness of the control system is too high or the response is too fast. Eliminating these two factors can improve the situation. In addition, you can use the low-pass filter (parameter P2.025) and Notch filter (parameters P2.023, P2.024, P2.043 – P2.046, P2.095 – P2.103) to suppress the resonance if you want the control parameters to remain unchanged.

Relevant parameters: refer to Chapter 8 for more information.

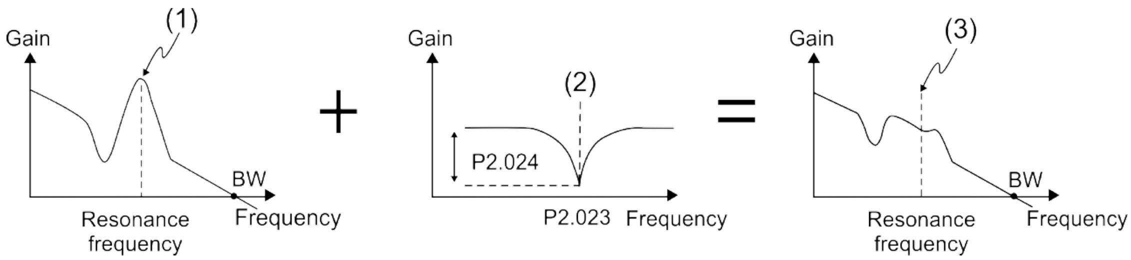
Parameter	Function
P2.023	Notch filter frequency (1)
P2.024	Notch filter attenuation level (1)
P2.043	Notch filter frequency (2)
P2.044	Notch filter attenuation level (2)
P2.045	Notch filter frequency (3)
P2.046	Notch filter attenuation level (3)
P2.095	Notch filter bandwidth (1)
P2.096	Notch filter bandwidth (2)
P2.097	Notch filter bandwidth (3)
P2.098	Notch filter frequency (4)
P2.099	Notch filter attenuation level (4)
P2.100	Notch filter bandwidth (4)
P2.101	Notch filter frequency (5)
P2.102	Notch filter attenuation level (5)
P2.103	Notch filter bandwidth (5)
P2.025	Resonance suppression low-pass filter



The ASDA-A3 provides two types of resonance suppression: one is the Notch filter and the other is the low-pass filter. See the following diagrams for the results of using these filters.

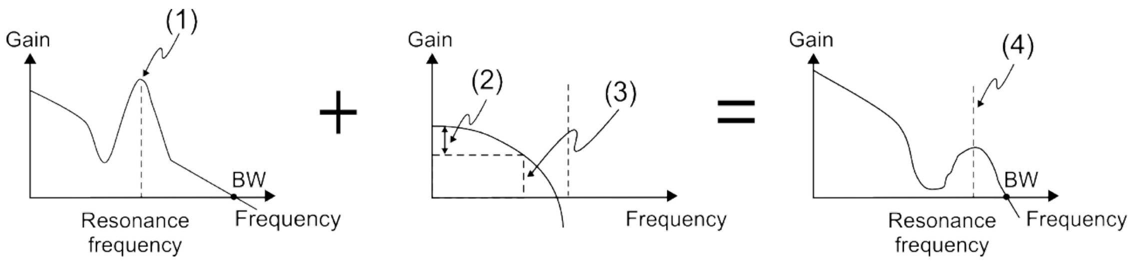
System open-loop gain with resonance:

- Notch Filter



(1) Point of resonance (2) Notch filter (3) Point of resonance suppressed by the Notch filter

- Low-pass filter

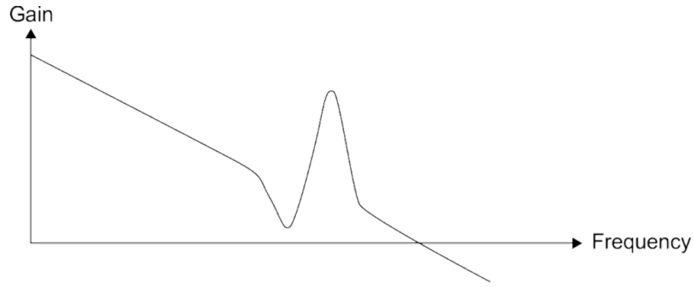


(1) Point of resonance (2) Attenuation rate (-3 dB)
(3) Low-pass filter (Cutoff frequency of low-pass filter = 1000 / P2.025 Hz)
(4) Resonance point suppressed by the low-pass filter

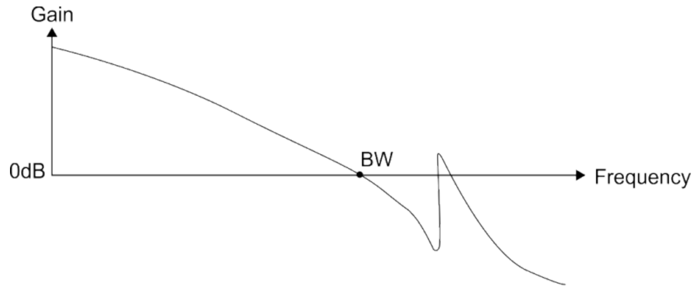
To conclude from these two examples, if you increase the value of P2.025 from 0, the bandwidth (BW) becomes smaller. Although it solves the problem of resonance, it also reduces the response bandwidth and phase margin, and thus the system becomes unstable.

If you know the resonance frequency, you can suppress the resonance by using the Notch filter, which is better than using the low-pass filter in this condition. If the resonance frequency drifts significantly with time or due to other cause, using the Notch filter is not suggested.

The following figure shows the system open-loop gain with resonance suppression.



When the value of P2.025 is increased from 0, BW becomes smaller. Although it solves the problem of the resonance frequency, the response bandwidth and phase margin are reduced. Also, the system becomes unstable.



If you know the resonance frequency, the Notch filter can eliminate the resonance directly. The frequency range of the notch filter is 50 – 5000 Hz and the suppression strength is 0 – 32 dB. If the frequency does not meet the Notch filter conditions, then using the low-pass filter to reduce the resonance is suggested.

6.4 Torque mode

Torque Control mode (T or Tz) is suitable for torque control applications, such as printing machines and winding machines. There are two kinds of command sources: analog input and internal register (parameters). The analog command input uses scaled external voltage to control the torque of the motor while the register uses the internal parameters (P1.012 – P1.014) for the Torque command.

6.4.1 Selecting the Torque command source

External analog voltage and internal parameters are the two Torque command sources. You select the command source with CN1's DI signal. See the table below for more detail.

Torque command	DI signal of CN1		Command source			Content	Range
	TCM1	TCM0					
T1	0	0	Mode	T	External analog command	Voltage difference between T-REF and GND	-10V to +10V
				Tz	N/A	Torque command is 0	0
T2	0	1	Parameters			P1.012	-300% – 300%
T3	1	0				P1.013	-300% – 300%
T4	1	1				P1.014	-300% – 300%

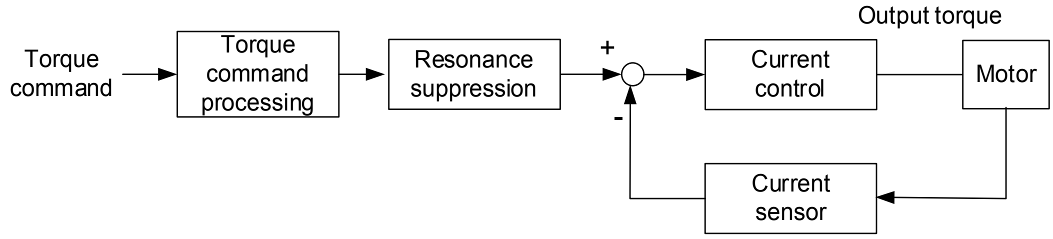
- State of TCM0 – TCM1: 0 means that the circuit is open (DI is off); 1 means that the circuit is closed (DI is on).
- When TCM0 = TCM1 = 0, if in Tz mode, then the command is 0. If there is no need to use the analog voltage for the Torque command, then Tz mode is applicable and can avoid the problem of zero voltage drift. If in T mode, then the command is the voltage difference between T-REF and GND. Its input voltage range is -10V to +10V, which means you can adjust the corresponding torque (P1.041).
- When either one of TCM0 or TCM1 is not 0, the internal parameters become the source for the Torque command. The command is executed after TCM0 – TCM1 are changed. There is no need to use CTRG for triggering.

You can use the Torque command in Torque mode (T or Tz) and Speed mode (S or Sz). When in Speed mode, you can think of it as the command input for the torque limit.

6

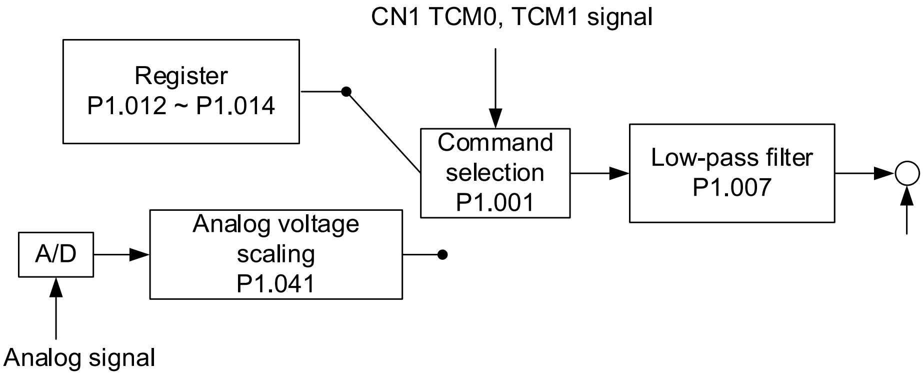
6.4.2 Control structure of Torque mode

The following diagram shows the basic control structure of Torque mode:



You use the Torque Command unit to specify the Torque command source (mentioned in Section 6.4.1), including the scaling of the analog voltage (P1.041) and the S-curve setting. The current control unit manages the gain parameters for the servo drive and calculates the current for servo motor in real-time; you can only set this by commands.

The structure of Torque Command unit is as the follows:

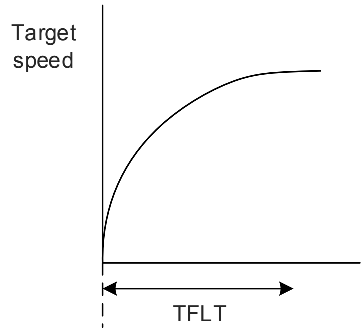


Control in the upper path is from the register while the in lower path it is from the external analog voltage. You select the command according to the status of TCM0, TCM1, and P1.001 (T or Tz). You can adjust the torque with the analog voltage scaling (P1.041) and you can smooth the response with the low-pass filter (P1.007).

6.4.3 Smooth Torque command

Relevant parameters: refer to Chapter 8 for more information.

Parameter	Function
P1.007	Torque command smoothing constant (Low-pass filter)

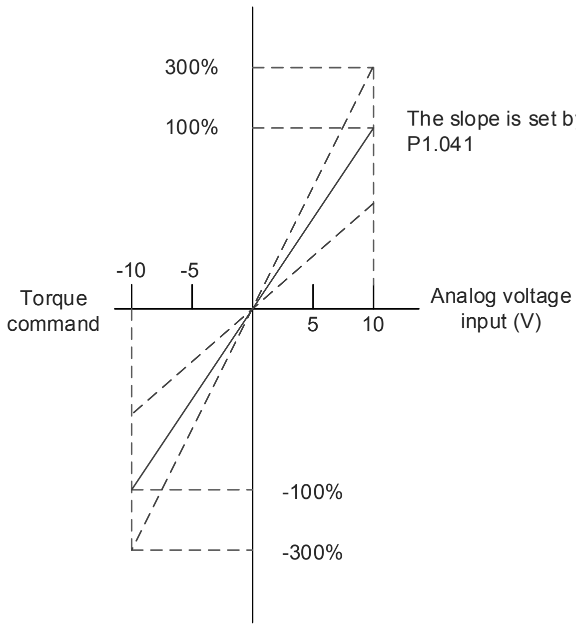


6.4.4 Scaling of the analog command

The Torque command is controlled by the analog voltage difference between T_REF and GND. You can adjust the torque slope and its range with parameter P1.041.

For example:

1. If you set P1.041 to 100 and the external input voltage is 10V, the Torque command is 100% of the rated torque.
2. If you set P1.041 to 300 and the external input voltage is 10V, the Torque command is 300% of the rated torque.

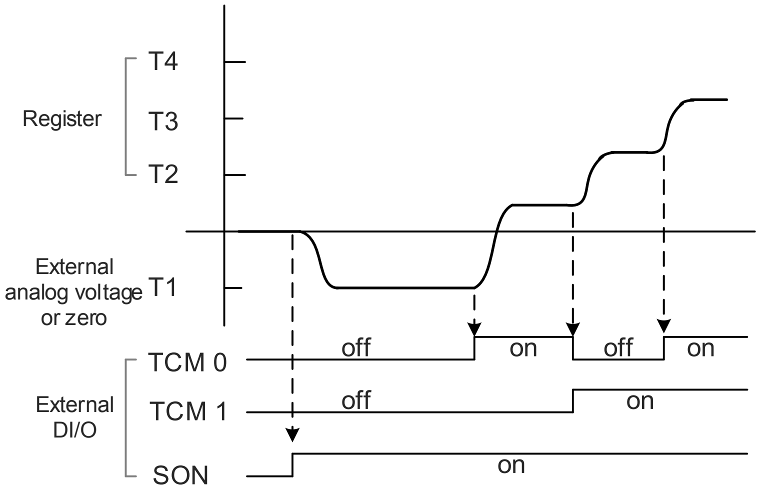


Relevant parameters: refer to Chapter 8 for more information.

Parameter	Function
P1.041	Maximum output for analog Torque command

6

6.4.5 Timing diagram in Torque mode



Note:

1. “off” signifies the contact is open while “on” signifies the contact is closed.
2. When in Tz mode, the Torque command T1 = 0; when in T mode, the Torque command T1 is the external analog voltage input.
3. In Servo On state, the command is selected according to the state of TCM0 – TCM1.

6

6.5 Dual mode

Apart from single mode for position, speed, and torque control, there are eight dual / multiple modes also provided for operation (See Section 6.1).

Mode	Short name	Setting code	Description
Dual mode	PT-S	06	PT and S can be switched with DI signal, S_P.
	PT-T	07	PT and T can be switched with DI signal, T_P.
	PR-S	08	PR and S can be switched with DI signal, S_P.
	PR-T	09	PR and T can be switched with DI signal, T_P.
	S-T	0A	S and T can be switched with DI signal, S_T.
	PT-PR	0D	PT and PR can be switched with DI signal, PT_PR.
Multiple mode	PT-PR-S	0E	PT, PR, and S can be switched with DI signal, S_P and PT_PR.
	PT-PR-T	0F	PT, PR, and T can be switched with DI signal, T_P and PT_PR.

Sz and Tz dual mode is not supported. To avoid occupying too many digital inputs in dual mode, Speed and Torque modes can use the external analog voltage as the command source to reduce the use of DI points (SPD0, SPD1 or TCM0, TCM1). In addition, Position mode can use the pulse input to reduce the use of DI points (POS0, POS1, POS2, POS3, POS4, POS5, and POS6). Please refer to Section 3.3.2 for the table of DI/O default value in each mode.

If you want to change the settings, the DI/O signals in correspondence with the PINs are defined as above in Section 3.3.4.

6

6.5.1 Speed / Position dual mode

PT-S and PR-S are available in Speed / Position dual mode. The command source for PT-S comes from the external pulse while the source for PR-S comes from the internal parameters (P6.000 – P7.027). You can control the Speed command with the external analog voltage or the internal parameters (P1.009 – P1.011). The switch for Speed / Position mode is controlled by DI.S-P (0x18) signal. The switch for PT and PR for Position mode is controlled by DI.PT-PR (0x2B). Thus, you select both Position and Speed commands in PR-S mode with the DI signal. The timing diagram is shown below.

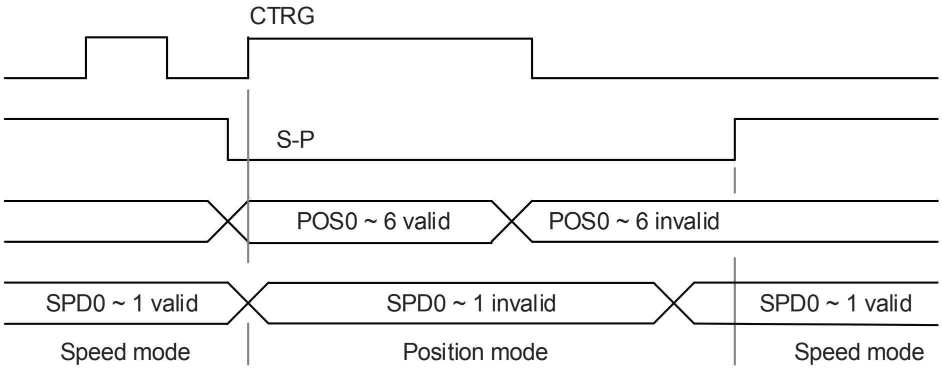


Figure 6.5.1.1 Speed / Position dual mode

In Speed mode (DI.S-P is on), you select the Speed command with DI.SPD0 and DI.SPD1. DI.CTRG is not applicable. When switching to Position mode (DI.S-P is off), since the Position command has not been issued (it waits for the rising edge of DI.CTRG), the motor stops. The Position command is controlled by DI.POS0–DI.POS6 and triggered by the rising edge of DI.CTRG. When DI.S-P is on, it returns to Speed mode. Please refer to the introduction of single mode for the DI signal and the selected commands for each mode.

6.5.2 Speed / Torque dual mode

Speed / Torque dual mode includes only the S-T mode. You control the Speed command with the external analog voltage and the internal parameters (P1.009 – P1.011), which you select with DI.SPD0 – DI.SPD1. Similarly, the source of the Torque command can be the external analog voltage or the internal parameters (P1.012 – P1.014), and is selected by DI.TCM0 – DI.TCM1. The switch between Speed and Torque mode is controlled by DI.S-T (0x19) signal. The timing diagram is shown below.

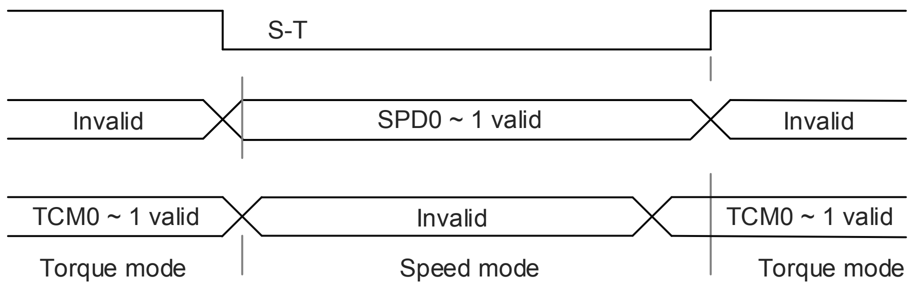


Figure 6.5.2.1 Speed / Torque dual mode

In Torque mode (DI.S-T is on), you select the Torque command with DI.TCM0 and DI.TCM1. When switching to Speed mode (DI.S-T is off), you select the Speed command with DI.SPD0 and DI.SPD1. The motor operates according to the Speed command. When DI.S-T is ON, it returns to the Torque mode. Please refer to the introduction of single mode for the DI signal and the selected commands for each mode.

6.5.3 Torque / Position dual mode

Torque / Position dual mode includes PT-T and PR-T. The command source for PT-T comes from the external pulse while the source for PR-T comes from internal parameters (P6.000 – P7.027).

You control the Torque command with the external analog voltage or the internal parameters (P1.012 – P1.014). The switch between Torque and Position mode is controlled by DI.T-P (0x20) signal. You select PT and PR in Position mode with DI.PT-PR (0x2B). Thus, you select both Position and Torque commands in PR-T mode with the DI signal. The timing diagram is shown below.

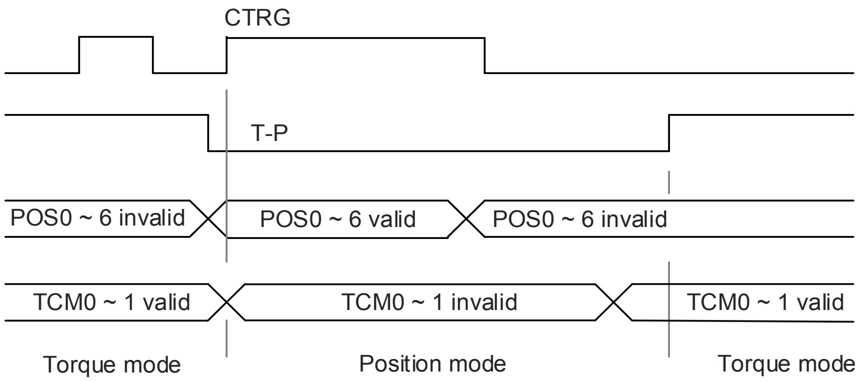


Figure 6.5.3.1 Torque / Position dual mode

In Torque mode (DI.T-P is on), you select the Torque command with DI.TCM0 and DI.TCM1. DI.CTRG is not applicable. When switching to Position mode (DI.T-P is off), since the Position command has not been issued (it waits for the rising edge of DI.CTRG), the motor stops. The Position command is determined by DI.POS0 – DI.POS6 and triggered by rising edge of DI.CTRG. When DI.T-P is on, it returns to Torque mode. Please refer to the introduction of single mode for the DI signal and the selected commands for each mode.

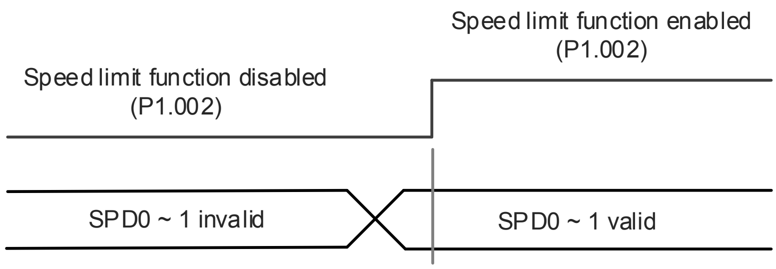
6.6 Others

6.6.1 Applying the speed limit

6

The maximum speed in each mode (Position, Speed, Torque) is determined by the internal parameter (P1.055). You use the same method for the Speed Limit and Speed commands. You can use either the external analog voltage or the internal parameters (P1.009 – P1.011). Please refer to Section 6.3.1 for descriptions.

The speed limit is applicable only in Torque mode (T) for controlling the motor's maximum speed. If you are using the external analog voltage in Torque mode, the DI signals are available and you can set SPD0–SPD1 for the motor speed limit value (internal parameters). If not, you can use the analog voltage input for the Speed Limit command. When you set P1.002 (disable / enable speed limit function) to 1, you enable the Speed Limit function. See the following timing diagram:

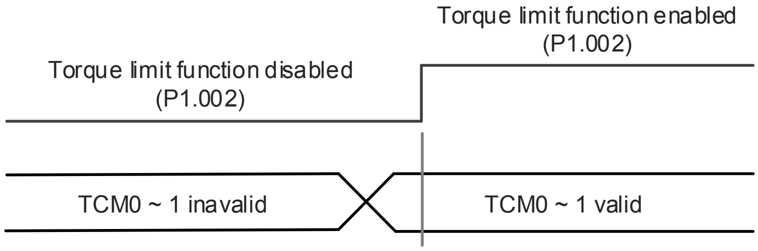


Command source selection of speed limit

6.6.2 Applying the torque limit

The method for using the Torque Limit command and Torque command are the same. You can use either the external analog voltage or the internal parameters (P1.012 – P1.014). Please refer to Section 6.4.1 for descriptions.

You can use the torque limit in Position mode (PT, PR) or Speed mode (S) to limit the motor torque output. When you execute the command in Position mode using the external pulse or execute the command in Speed mode using the external analog voltage, DI signals are available and you can set TCM0 – TCM1 to determine the Torque Limit command (internal parameters). If there is not enough DI signal available, you can execute the Torque Limit command using the analog voltage. When you set the Torque Limit function (P1.002) to 1, you enable the Torque Limit function. See the timing diagram below.



Command source selection of torque / speed limit

6.6.3 Analog monitoring

You can find the required voltage signal with analog monitoring. Two analog channels are provided by the servo drive and located on terminals 15 and 16 of CN1. Please refer to Chapter 8 for more information about the relevant parameters.

Parameter	Function
P0.003	Analog output monitoring
P1.003	Encoder pulse output polarity
P1.004	MON1 analog monitor output proportion
P1.005	MON2 analog monitor output proportion
P4.020	Offset adjustment for analog monitor output (Ch1)
P4.021	Offset adjustment for analog monitor output (Ch2)

Example:

Specify a motor speed of 1000 rpm, which corresponds to analog voltage output of 8V with the maximum speed of 5000 rpm. The setting is as follows:

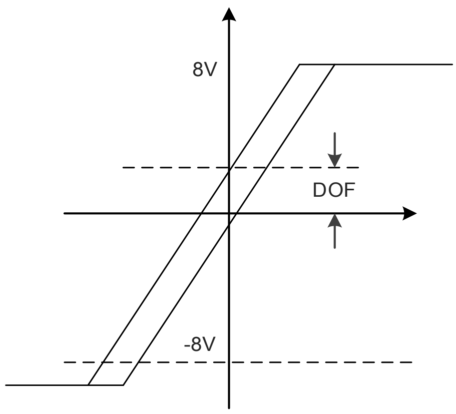
$$\text{P1.004} = \frac{\text{Required speed}}{\text{Max. speed}} \times 100\% = \frac{1000\ \text{RPM}}{5000\ \text{RPM}} \times 100\% = 20\%$$

You can calculate the corresponding voltage output for the current motor speed with the formula below.

Motor speed	Mon1 Analog monitoring output
300 rpm	MON1 = 8V $\times \frac{\text{Current speed}}{\text{Max. speed} \times \frac{\text{P1.004}}{100}} \times 100\%$ = 8V $\times \frac{300\ \text{RPM}}{5000\ \text{RPM} \times \frac{20}{100}} \times 100\%$ = 2.4V
900 rpm	MON1 = 8V $\times \frac{\text{Current speed}}{\text{Max. speed} \times \frac{\text{P1.004}}{100}} \times 100\%$ = 8V $\times \frac{900\ \text{RPM}}{5000\ \text{RPM} \times \frac{20}{100}} \times 100\%$ = 7.2V

Voltage drift:

When voltage drift occurs, the voltage level defined as zero voltage is different from the set zero point. To fix this problem, you can use DOF1 (P4.020) and DOF2 (P4.021) to calibrate the offset voltage output.



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Motion Control 7

This chapter introduces internal motion commands in the ASDA-A3 in PR mode. In this mode, commands are generated based on the internal commands of the servo drive. Various motion commands are available, including homing, speed, position, parameter writing, arithmetic operation, and jump. Other motion control functions such as high-speed position capture (Capture), high-speed position compare (Compare), and E-Cam are also available. This chapter contains detailed description of each command type.

7.1 PR mode description

In PR mode, the servo drive automatically generates the motion commands. Apart from the basic arithmetic operation commands, the ASDA-A3 saves all parameter settings in the parameter file in the servo drive. Thus changing parameter values simultaneously changes the PR commands. The ASDA-A3 provides 100 path setting sets, which include the homing method, Position command, Speed command, Jump command, Write command, Index Positioning command, and arithmetic operation commands.

Except for arithmetic operations, the properties and corresponding data for each PR path are set by parameters. You can find information for all PR parameters in the descriptions of Group 6 and 7 in Chapter 8. For example, PR#1 path is defined by two parameters: P6.002 and P6.003. P6.002 specifies the properties for PR#1, such as the PR command type, whether to interrupt and whether to auto-execute the next PR. P6.003 is subject to change based on the properties set in P6.002. If P6.002 is set to a Speed command, then P6.003 specifies the target speed. When P6.002 is set to a Jump command, then P6.003 specifies the target PR. The parameters for the PR#2 path are P6.004 and P6.005 and they work the same way as P6.002 and P6.003. The same is true for the rest of PR paths. See Figure 7.1.1.

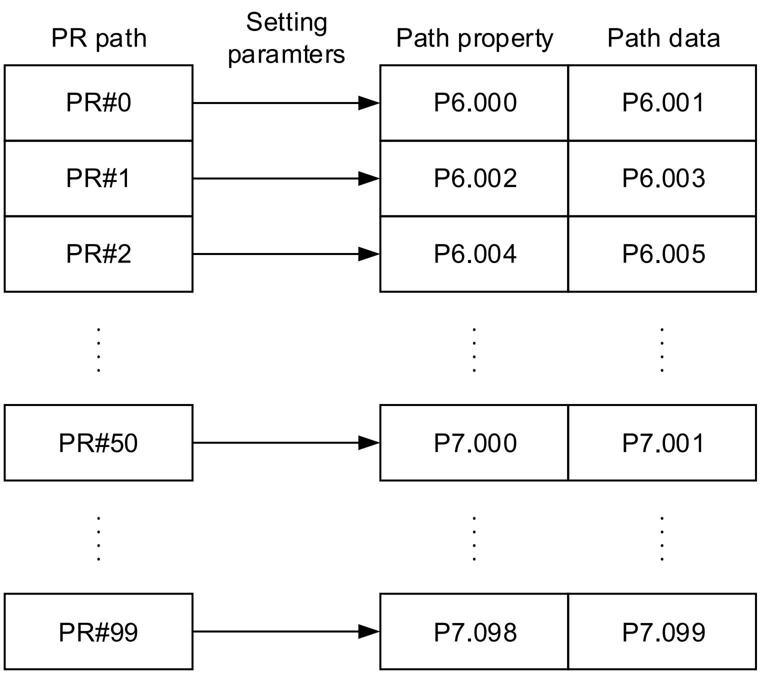

Figure 7.1.1 Setting parameters for each PR path

In the ASDA-Soft software, when you select the PR to be edited in PR mode, the corresponding parameters appear at the top of the window. See Figure 7.1.2. If you select PR#1, P6.002 and P6.003 appear at the top in the editing section (see P6.002 and P6.003 in Table 7.1.1 for example). The PR property and its data content differ in accordance with the motion command type. For more information about Motion Control mode, please refer to Section 7.1.3.

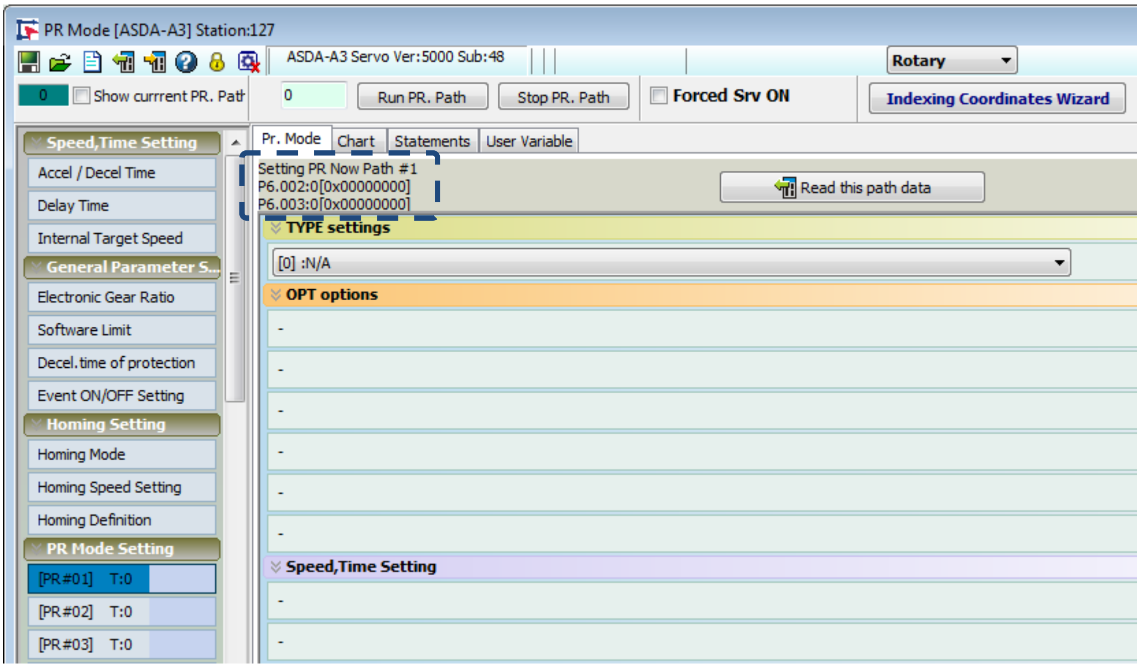

Figure 7.1.2 PR mode interface in ASDA-Soft

Table 7.1.1 Example of PR#1 property and data content

BIT / PR#1	31–28	27–24	23–20	19–16	15–12	11–8	7–4	3–0
P6.002								TYPE
P6.003	Data content (32-bit)							

Note:

TYPE: Control command mode

TYPE No.	Command mode
1	SPEED: speed control
2	SINGLE: positioning control; stop once positioning is completed.
3	AUTO: positioning control; execute the next PR path once positioning is completed.
7	JUMP: jump to the specified path.
8	WRITE: write parameters to the specified path.
0xA	INDEX: index positioning control
0xB	STATEMENT: statement / arithmetic operations

ASDA-Soft version V6 provides an editing interface for PR diagrams (see Figure 7.1.3). It is easier to set PR paths in ASDA-Soft, where you can set the options for command triggering, command types and other properties. You must set the arithmetic operations and statements in the software.

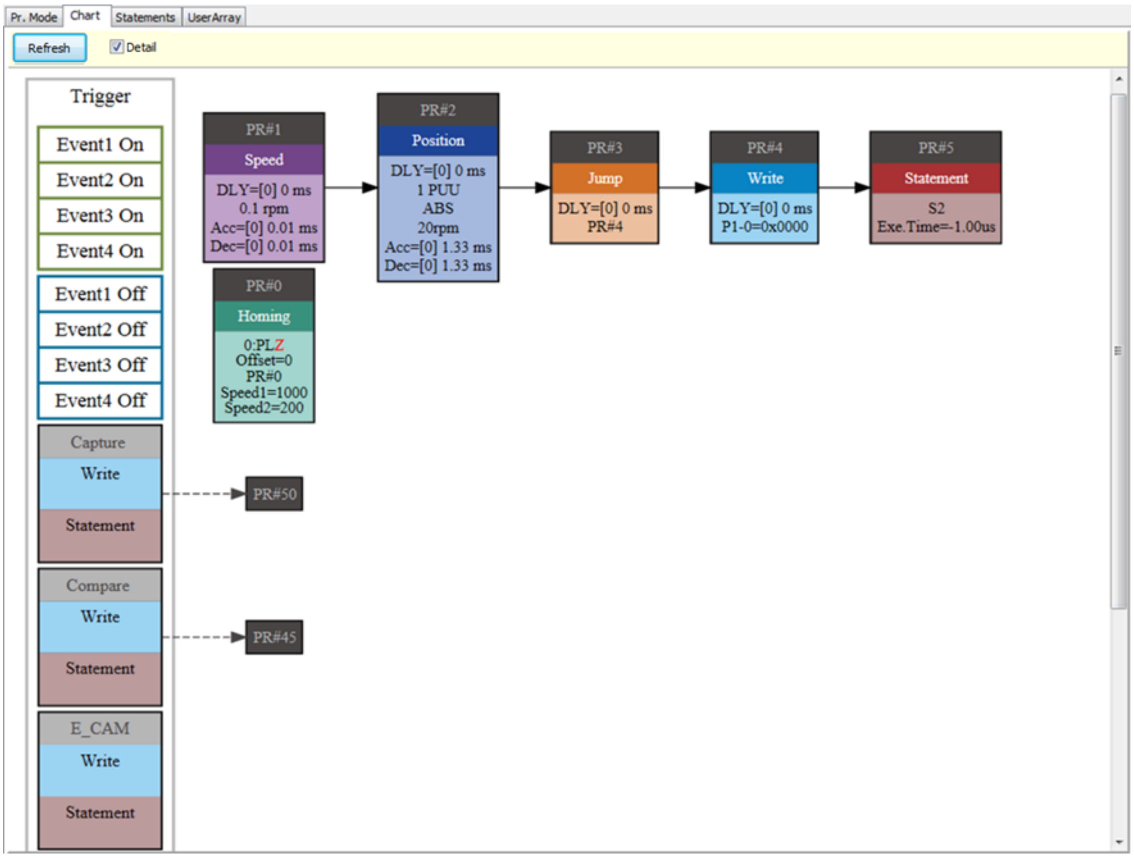

Figure 7.1.3 PR diagram display in ASDA-Soft

7.1.1 Shared PR parameters

ASDA-A3 provides 16 acceleration / deceleration time settings (P5.020–P5.035), 16 delay time settings (P5.040–P5.055), and 16 target speed settings (P5.060–P5.075) for you to set the PR paths (as shown in Figure 7.1.1.1). If you change a parameter that is used by multiple PR paths, then all PR paths using this parameter are changed as well. Please be aware of this when setting PR paths so as to avoid any danger or damage to the machine. For example, if multiple PR commands use the target speed setting from P5.060, when you change the value of P5.060, those PR commands' target speed are also changed. ASDA-Soft also provides a user-friendly interface for this shared PR parameter function (see Figure 7.1.1.2). In these data, the acceleration / deceleration time is set based on the length of time for the motor to accelerate from 0 to 3000 rpm or to decelerate from 3000 rpm to 0. For instance, if acceleration time is set to 50 ms, then the target speed for the motion command is 3000 rpm, and the required duration is 50 ms. If target speed for the motion command is 1500 rpm, then the acceleration time is 25 ms. The acceleration / deceleration time is a fixed slope, and the slope does not change when you change parameter values.

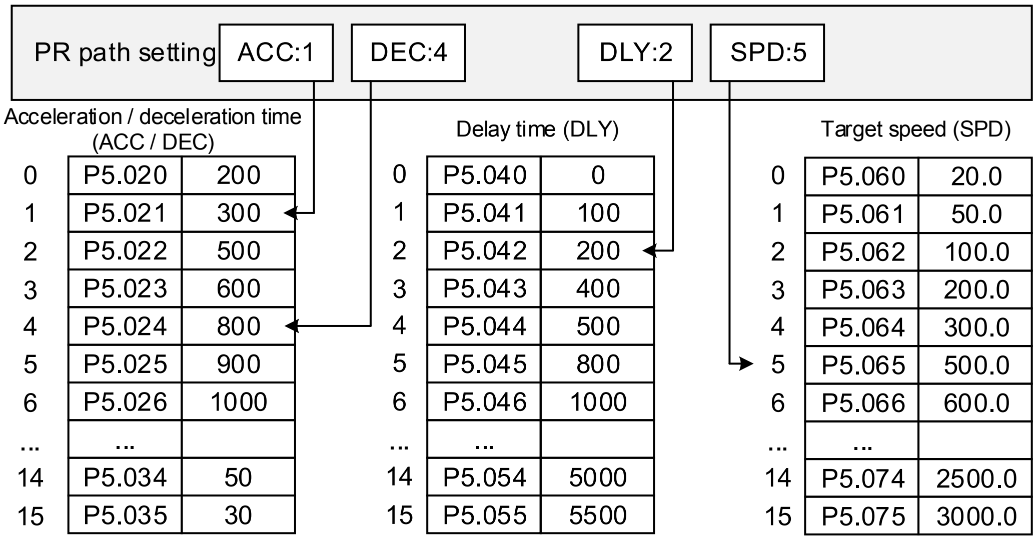

Figure 7.1.1.1 Shared parameter data for PR paths

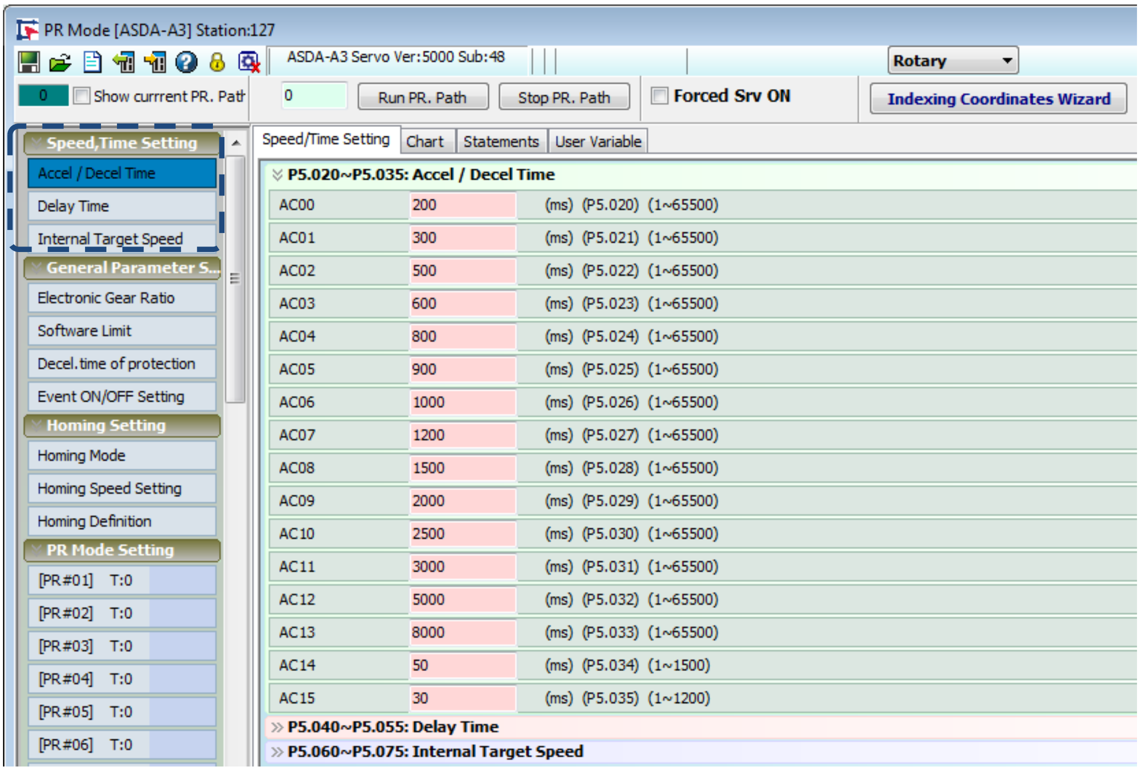

Figure 7.1.1.2 ASDA-Soft interface for shared PR parameter data

7

7.1.2 Monitoring variables of PR mode

PR mode provides four monitoring variables for the servo command and feedback: command position (PUU), PR command end register, feedback position (PUU), and position error (PUU). These are described below:

1. Command position (PUU): monitoring variable code 001. The target position of the motion command generated per scan cycle during servo operation (updated every 1 ms), simplified as Cmd_O (Command Operation).
2. PR command end register: monitoring variable code 064. The target position of the PR command, simplified as Cmd_E (Command End). When a command is triggered, the servo drive calculates the target position and then updates the PR command end register.
3. Feedback position (PUU): monitoring variable code 000. The feedback position (coordinates) for the motor, simplified as Fb_PUU (Feedback PUU).
4. Position error (PUU): monitoring variable code 002. The deviation between the command position (PUU) and the feedback position (PUU), simplified as Err_PUU (Error PUU).

How these four monitoring variables work is shown in Figure 7.1.2.1. After the servo issues a Position command, the servo sets the position of Cmd_E once the target position data is acquired. The motor operates to the target position based on the PR path setting. Cmd_O calculates the amount of command deviation in each fixed cycle and sends it to the servo drive, where it is treated as a dynamic command. Fb_PUU is motor's feedback position and Err_PUU is the deviation of Cmd_O minus Fb_PUU.

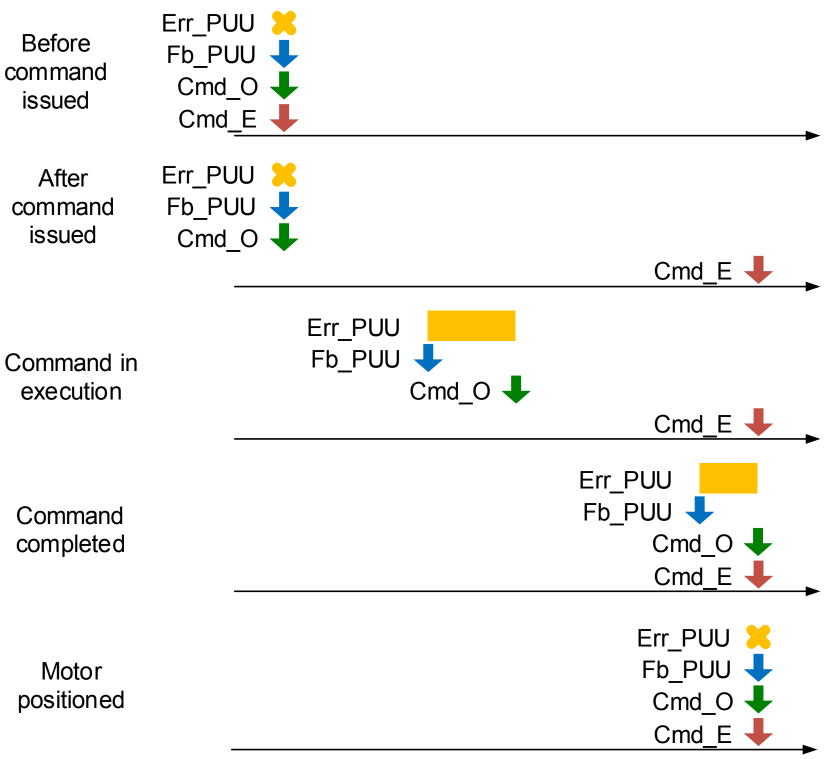

Figure 7.1.2.1 Timing diagram for PR mode monitoring variables

The detailed command behavior of each stage is illustrated in Figure 7.1.2.2. Cmd_E is the endpoint specified by the command; it is set when the PR path is triggered. Fb_PUU is the feedback position, which is motor's actual position. Divide this motion command into slices and take one of them as example. Cmd_O is the target of this command section and Err_PUU is the deviation between the target position and the feedback position.

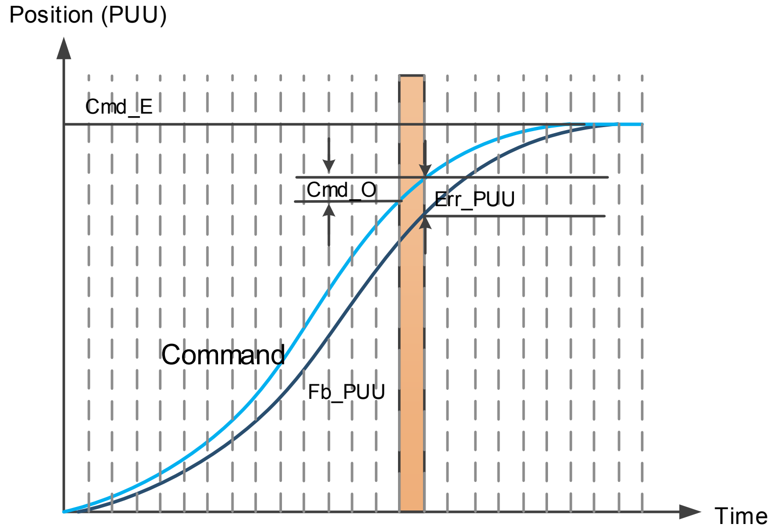

Figure 7.1.2.2 Monitoring variables status when executing a command in PR mode

You can use digital input (DI) and digital output (DO) to monitor PR paths. When you trigger the motion command with DI.CTRG [0x08], the servo drive operates based on the command from the internal registers. Once the execution is completed, DO.Cmd_OK [0x15] is set to on. When the motor reaches its target position, DO.TPOS [0x05] is set to on. Then, after the PR Position command completes and motor reaches the target position, both DO signals are on and the servo outputs the MC_OK [0x17] signal to signify that it has completed this PR path. The operation is as shown in Figure 7.1.2.3 (please refer to Table 8.2).

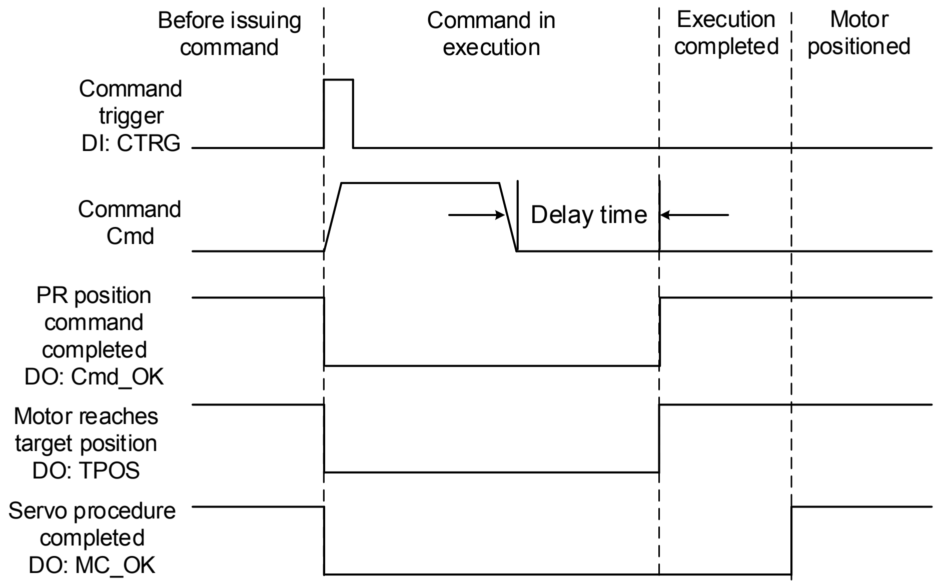

Figure 7.1.2.3 Operation of DI/DO signals in PR mode

7.1.3 Motion Control commands

The ASDA-A3 provides 100 path sets that can include homing methods, speed, position, path jumping, parameter writing, index positioning, and arithmetic operations. The following sections detail each command type.

7

Homing methods

The ASDA-A3 provides 11 homing methods in PR mode. They include home sensor, limit, and crash point. They come with sub-selections such as whether to refer to the Z pulse and the limit signal as the trigger, with more than 30 combinations available. The homing method is specified by P5.004 and the homing definition is determined by P6.000. The function of each bit is listed below.

<table>
<tr><th>P5.004</th><th colspan="2">Homing methods</th><th colspan="2">Address: 0508H
0509H</th></tr>
<tr><td>Default:</td><td>0x0</td><td>Control mode:</td><td colspan="2">PR</td></tr>
<tr><td>Unit:</td><td>-</td><td>Setting range:</td><td colspan="2">0 – 0x128</td></tr>
<tr><td>Format:</td><td>HEX</td><td>Data size:</td><td colspan="2">16-bit</td></tr>
</table>

Settings:

0000

U Z Y X

X	Homing method	Z	Limit setting
Y	Z pulse setting	U	Reserved

Definition of each setting value:

<table>
<tr><th>W</th><th>Z</th><th>Y</th><th>X</th></tr>
<tr><td>Reserved</td><td>Limit setting</td><td>Z pulse setting</td><td>Homing method</td></tr>
<tr><td rowspan="6">-</td><td>0 – 1</td><td>0 – 2</td><td>0 – 8</td></tr>
<tr><td>-</td><td rowspan="2">Y = 0: return to Z pulse
Y = 1: go forward to Z pulse
Y = 2: do not look for Z pulse</td><td>X = 0: homing in forward direction and define PL as homing origin</td></tr>
<tr><td>-</td><td>X = 1: homing in reverse direction and define NL as homing origin</td></tr>
<tr><td rowspan="3">When encounter limit:
Z = 0: show error
Z = 1: reverse direction</td><td rowspan="3">Y = 0: return to Z pulse
Y = 1: go forward to Z pulse
Y = 2: do not look for Z pulse</td><td>X = 2: homing in forward direction, ORG: OFF→ON as homing origin</td></tr>
<tr><td>X = 3: homing in reverse direction, ORG: OFF→ON as homing origin</td></tr>
<tr><td>X = 4: look for Z pulse in forward direction and define it as homing origin</td></tr>
</table>

W	Z	Y	X
			X = 5: look for Z pulse in reverse direction and define it as homing origin
			X = 6: homing in forward direction, ORG: ON→OFF as homing origin
			X = 7: homing in reverse direction, ORG: ON→OFF as homing origin
			X = 8: define current position as the origin
		Y = 0: return to Z pulse Y = 1: do not look for Z pulse	X = 9: look for the collision point in forward direction and define it as the origin
			X = A: look for the collision point in reverse direction and define it as the origin

P6.000	Homing definition		Address: 0600H 0601H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFF3F
Format:	HEX	Data size:	32-bit

Settings:

Homing definition:

D C B A

U Z YX

A	DEC2: deceleration time selection of second homing	YX	PATH: path type
B	DLY: select 0 – F for delay time	Z	ACC: select 0 – F for acceleration time
C	N/A	U	DEC1: deceleration time selection of first homing
D	BOOT	-	-

- YX: PATH: path type

  0x0: stop: homing complete and stop.
  0x1 – 0x63: auto: homing complete and execute the specified path (Path#1 – Path#99).

- Z: ACC: select 0 – F for acceleration time

  0 – F: corresponds to P5.020 – P5.035

- U: DEC1: deceleration time selection of first homing

  0 – F: corresponds to P5.020 – P5.035

- A: DEC2: deceleration time selection of second homing

  0 – F: corresponds to P5.020 – P5.035

- B: DLY: select 0 – F for delay time

  0 – F: corresponds to P5.040 – P5.055

■ D: BOOT: when the drive is powered on, whether to search for the origin.

0: do not execute homing

1: execute homing automatically (servo switches to Servo On status for the first time after applying power)

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Apart from the above definitions, the related settings for homing also include:

1. P5.004 homing methods.
2. P5.005 – P5.006 speed setting of searching for the origin.
3. P6.001: ORG_DEF is the coordinate of the origin and may not be 0. This function is used as a traversal of the coordinate.

Note:

1. After the origin is found (sensor or Z), it has to decelerate to a stop. The stop position exceeds the origin by a short distance:

   If returning to the origin is not needed, set PATH to 0;
   If returning to the origin is needed, set PATH to a non-zero value and set PABS = ORG_DEF.
   Example:
   Upon completion of P6.000 = 0x1, automatically execute Path#1.
   Set from absolute position (ABS) to 0 as the route of Path#1 (set P6.002 & P6.003).

2. If the origin is found (sensor or Z), and you want it to move an offset S and define the coordinate as P after moving, then PATH = non-zero and set ORG_DEF = P - S, and this absolute Position command = P.

The PR Homing mode includes the function for setting the origin offset. You can define any point on the coordinate axis as the reference origin, which does not have to be 0. Once you define the reference origin, the system can create the coordinate system for the motion axis. See Figure 7.1.3.1. The coordinate for the reference origin is 2000 (P6.001 = 2000). The motor passes by the reference origin and then stops at coordinate 1477. From the coordinate system that it created, the system automatically calculates the position of 0 point. As soon as the PR motion command is issued, the motor moves to the specified position.

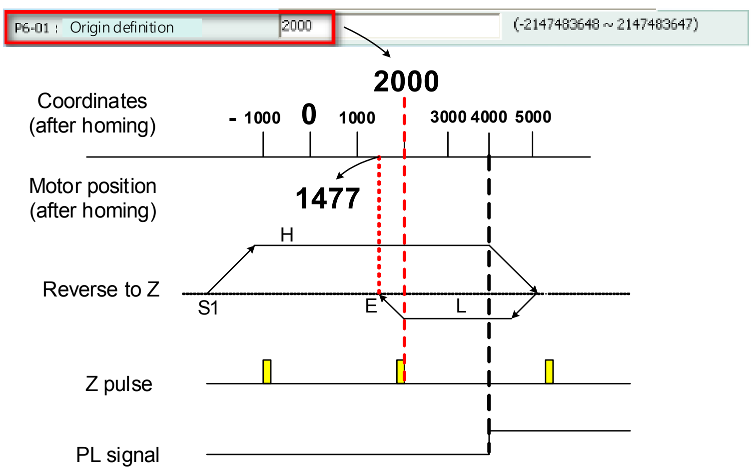


Figure 7.1.3.1 Origin definition

P6.001	Origin definition		Address: 0602H 0603H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 – 2147483647
Format:	DEC	Data size:	32-bit

Settings:

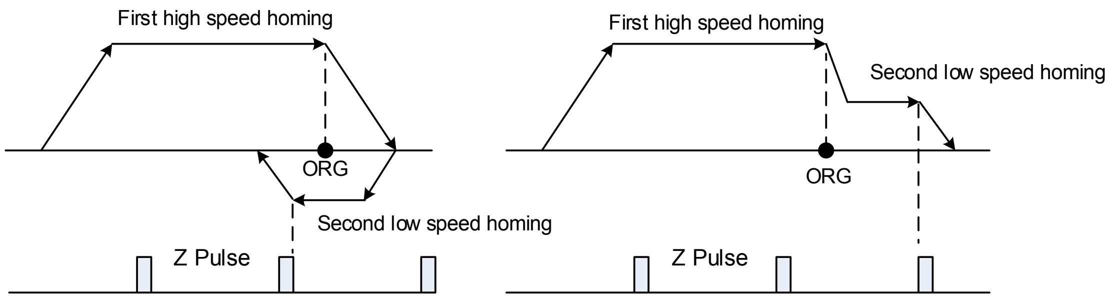
Origin definition.

The homing procedure goes through two stages: high speed and low speed. Homing starts in high speed, seeking the reference point (such as the limit switch and ORG signal). Once the servo detects the reference point, the motor runs at low speed to find the reference point accurately (such as the Z pulse). The speeds for the two stages are defined by P5.005 and P5.006.

P5.005	High speed homing (first speed setting)			Address: 050AH 050BH
Operation interface:	Panel / software	Communication	Control mode:	PR (set with P5.004)
Default:	100.0	1000	Data size:	32-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.1 – 6000.0 (rotary motor)* 0.1 – 1599999.9 (linear motor)*	1 – 60000 (rotary motor)* 1 – 15999999 (linear motor)*		
Format:	DEC	DEC	-	-
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-

Settings:

The first speed setting for high speed homing.



Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.006	Low speed homing (second speed setting)			Address: 050CH 050DH
Operation interface:	Panel / software	Communication	Control mode:	PR (set with P5.004)
Default:	20.0	200	Data size:	32-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.1 – 6000.0 (rotary motor)* 0.1 – 1599999.9 (linear motor)*	1 – 60000 (rotary motor)* 1 – 15999999 (linear motor)*		
Format:	DEC	DEC	-	-
Example:	1.5 = 1.5 rpm	150 = 1.5 rpm	-	-

Settings: the second speed setting for low speed homing.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

You can set the homing parameters in the PR mode homing screen in ASDA-Soft, including the homing methods, homing definition, and homing speed (see Figure 7.1.3.2).

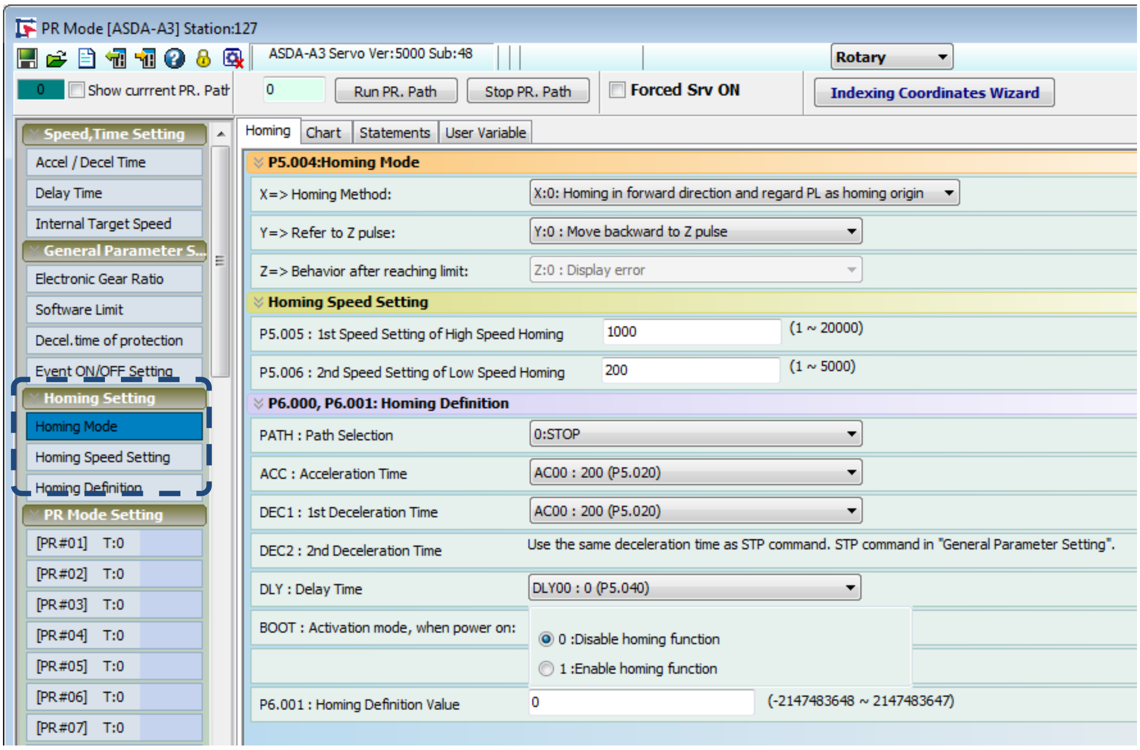
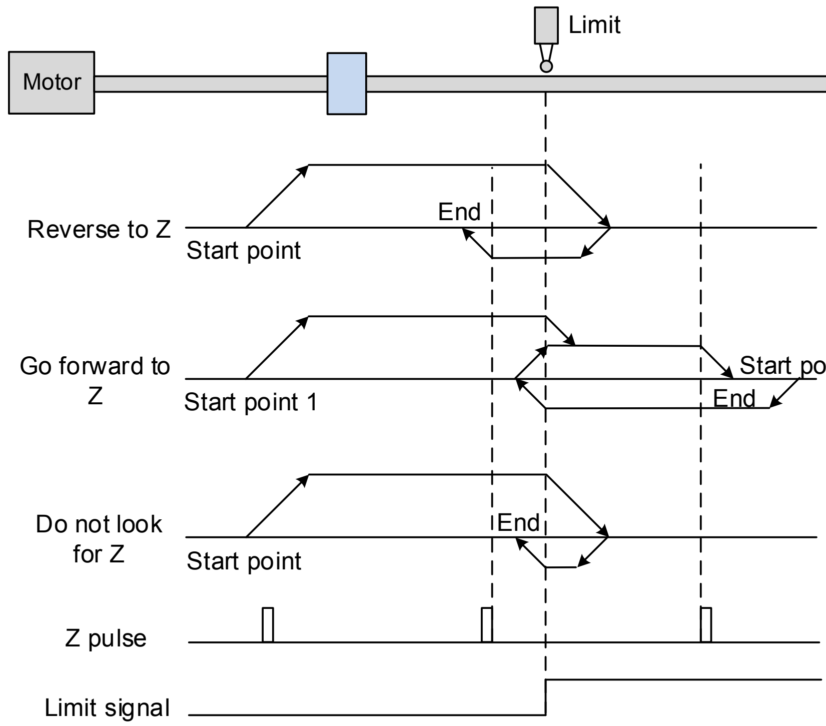


Figure 7.1.3.2 Homing screen in ASDA-Soft

The following describes the homing methods supported by the ASDA-A3. They can be categorized into six types based on their reference points.

1. Referencing the limit: this homing method uses the positive or negative limit as the reference point. When the limit is detected, you can choose to look for the Z pulse and use it as the homing reference point. Changing the starting position does not change the searching result. The ASDA-A3 always looks for the setting reference point so as to correctly reset the coordinates.



In the example above (looking for the Z pulse), the servo motor operates at high speed (first speed value) and then decelerates once it reaches the limit (rising-edge triggers the signal). Then the motor switches to low speed (second speed value) to look for the Z pulse. When the motor finds the Z pulse, it decelerates and stops, completing the homing procedure.

If you set the motor to look for the Z pulse and the limit signal remains un-triggered (low, Start point 1), the servo motor operates at high speed (first speed setting) and then decelerates once it reaches the limit (rising-edge triggers the signal). Then the motor switches to low speed (second speed setting) to look for the Z pulse. When the motor finds the Z pulse, it decelerates and stops, completing the homing procedure. If the setting is to look for the Z pulse and the limit signal is triggered (high, Start point 2), the servo motor returns to look for the rising-edge trigger signal at low speed (second speed setting). Once it is found, the servo motor starts to look for the Z pulse and decelerates to stop when it finds the Z pulse., completing the homing. In conclusion, the origin is at the same position after homing with the same condition regardless of the location of the starting point.

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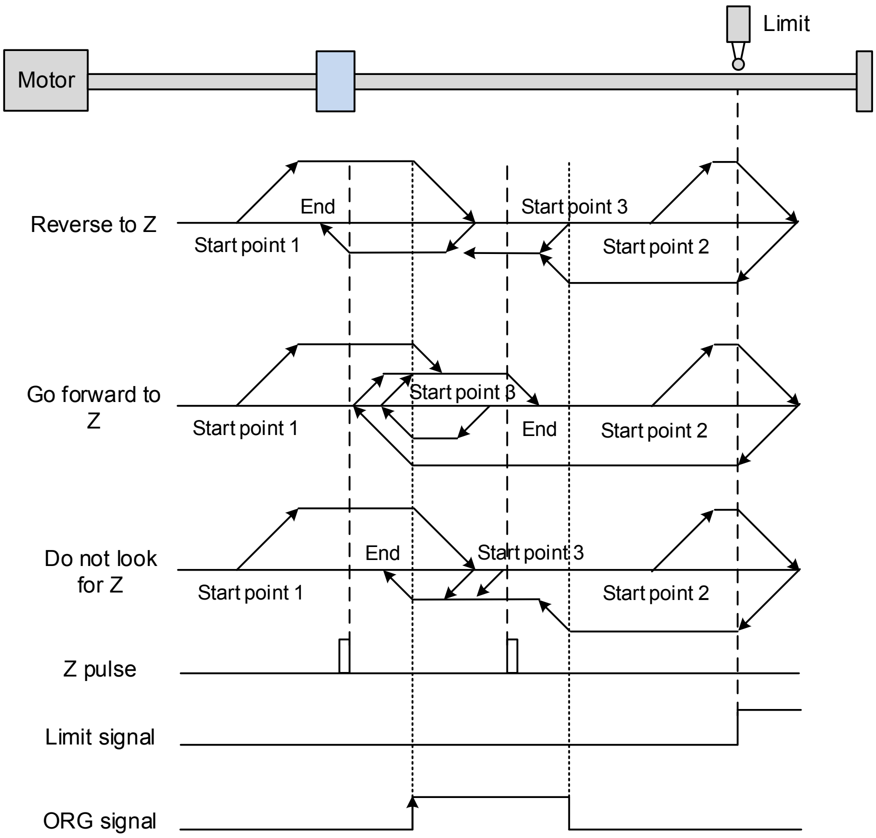
If you set the motor to not look for the Z pulse, the servo motor first operates at high speed (first speed setting) and then decelerates to a stop once rising-edge limit signal is triggered. Then the motor changes to low speed (second speed setting) to look for rising-edge signal. Once it finds the rising-edge signal, the motor decelerates to a stop, completing the homing.

2. Referencing the rising-edge signal of the home sensor. This method uses the rising-edge of the home sensor (ORG) signal as the reference point. You have the option of using the Z pulse as the reference point of the origin when the home sensor detects the signal.



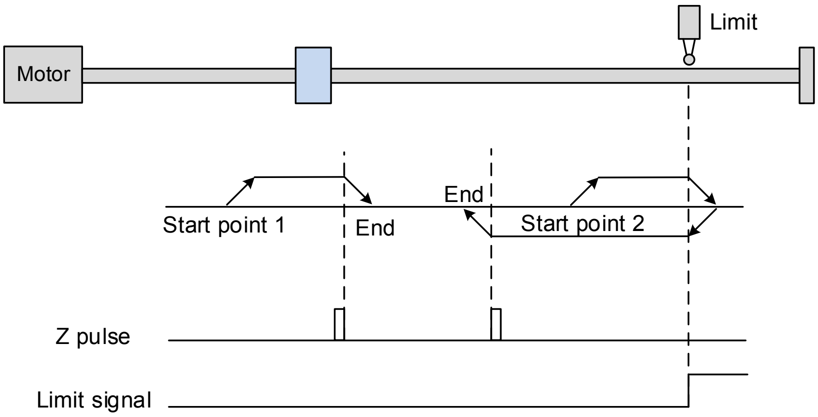
The figure above shows an example of reversing to look for the Z pulse. If the home sensor signal for the start position is un-triggered (low, Start point 1), the servo motor operates at high speed (first speed setting) until it reaches the rising-edge of ORG signal. Then it decelerates, switching to low speed (second speed setting) and reverses to look for the Z pulse. When the motor finds the Z pulse, it decelerates to a stop, completing the homing.

If the ORG signal at the start point is un-triggered and the current position is relatively closer to the limit switch (Start point 2), then the servo motor operates at high speed (first speed setting). You can choose whether to show an error or reverse the running direction when it reaches the limit switch. If you choose to reverse the rotation direction, the servo motor keeps rotating in reverse direction. Once the motor reaches the limit switch, it changes to low speed (second speed setting) and operates until the ORG signal switches to low. Next, it starts to look for the Z pulse. When the motor finds the Z pulse, it decelerates to a stop, completing the homing.

If the ORG signal is triggered (high, Start point 3), the motor reverses with low speed (second speed setting) and after the ORG signal switches to low, the motor returns to look for the Z pulse. Once the Z pulse is found, homing is complete.

If you set the server motor to look for the Z pulse, or not to look for the Z pulse in the forward direction (this is similar to the first method mentioned above, (going in the reverse direction or not to look for the pulse Z), Please refer to the timing diagram above.

3. Referencing the Z pulse. This method uses the Z pulse as the reference origin. One Z pulse is generated per rotation of the motor. This method is only suitable when the operation is kept within one motor rotation.



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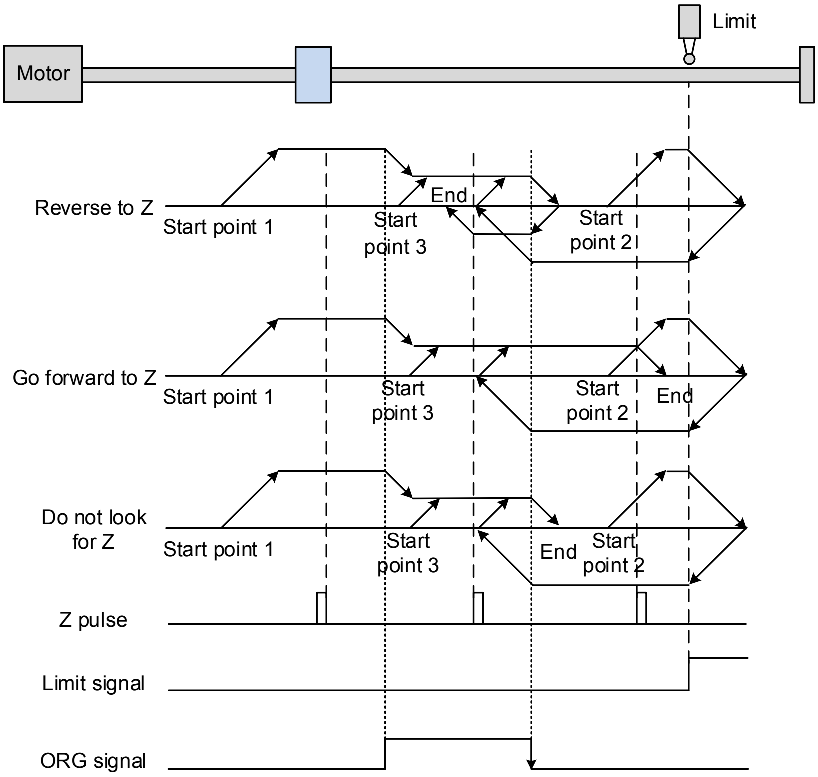
4. Referencing the falling-edge of the ORG signal. This method uses the falling-edge signal of the home sensor as the reference origin. You can choose whether or not to use Z pulse as the reference origin after the ORG signal is detected.



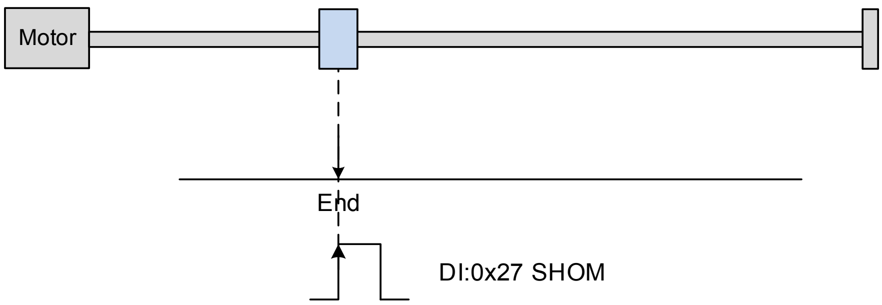
See the above example of looking for the Z pulse. If ORG signal is un-triggered at the start point (low, Start point 1), the servo motor runs at high speed (first speed setting) until reaching the rising edge of the ORG signal. Then it decelerates and switches to low speed until the ORG signal is off (low). Next, it reverses to look for the Z pulse and decelerates to a stop once it finds the Z pulse, completing the homing.

If ORG signal is un-triggered at the start point and is closer to the limit switch (Start point 2), the motor runs at high speed (first speed setting). You can set whether to show an error or reverse the running direction when it reaches the limit switch. If you set it to reverse direction, the motor operates in reverse to reach the ORG signal. Once it reaches the ORG signal, it decelerates and runs at low speed (second speed setting) until it reaches the falling edge of ORG signal. Then it reverses to look for Z pulse. When found, the servo decelerates to a stop, completing the homing.

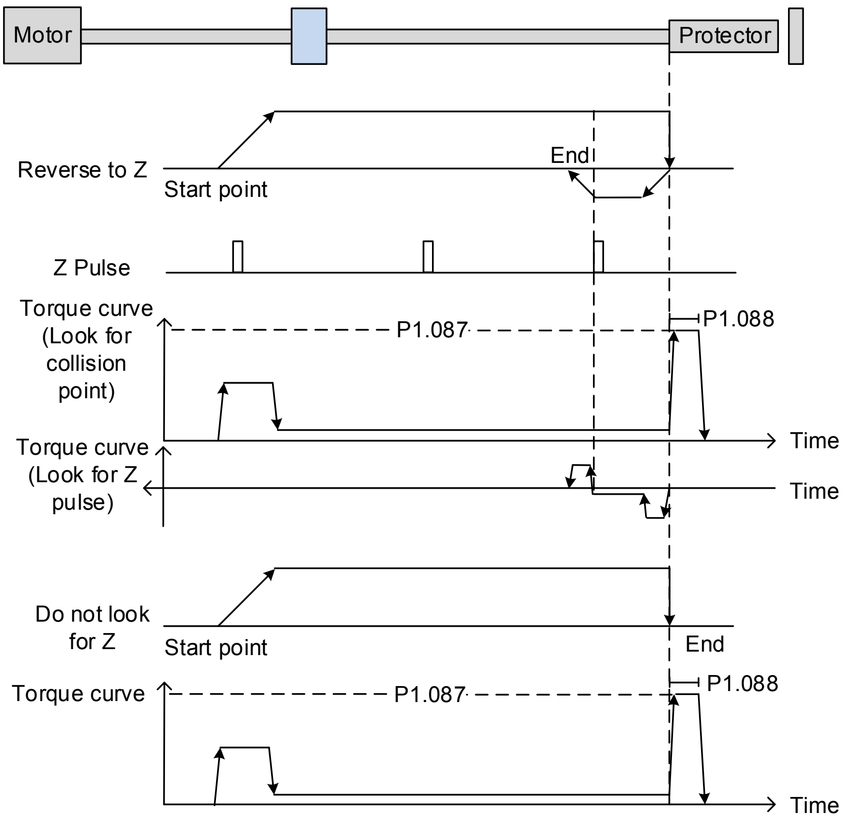
If the ORG signal is triggered at the start point (high, Start point 3), the servo motor operates at low speed (second speed setting) in the forward direction until the ORG signal switches to low. Finally, the motor reverses to look for the Z pulse and decelerates to a stop, completing the homing.

If you set it to look for the Z pulse or to not to look for the Z pulse in the forward direction, which is similar to the first setting mentioned above (going in the reverse direction or not to look for the Z pulse), please refer to the timing diagram above.

5. Referencing the current position as the origin. This method uses the motor's current position as the reference origin. As long as the homing procedure is triggered and the motor remains still, then coordinate positioning is completed.



6. Referencing the torque limit. This method uses the motor's stop position as the origin by referring to: the limit on the mechanism, the torque level setting (P1.087), and the retaining time (P1.088). You can also choose whether to use the Z pulse as the origin.



In the figure above that uses looking for the Z pulse, the motor runs at the high speed (first speed setting). Then the servo outputs a greater current to resist the external force once the motor touches the collision protector. When the motor torque reaches the set limit (P1.087) and the output duration is longer than the time setting (P1.088), the motor runs in the reverse direction to look for the Z pulse at low speed (second speed setting). Once the motor finds the Z pulse, it decelerates to a stop, completing the homing.

If you set it not to look for the Z pulse, the servo motor runs at high speed (first speed setting) until it touches the collision protector. Then the servo outputs a greater current to resist the external force. When the motor torque reaches the set limit (P1.087) and the output duration is longer than the time setting (P1.088), the motor stop stops, completing the homing.

The following table lists the parameters for the torque limit (P1.087) and the torque limit time (P1.088):

P1.087	Torque limit		Address: 01AEH 01AFH
Default:	1	Control mode:	PR
Unit:	%	Setting range:	1 – 300
Format:	DEC	Data size:	16-bit

Settings:

The Torque limit is only for Torque limit homing mode. As shown in the following diagram, when the homing command is triggered, the motor runs in one direction until it reaches the collision protector. After reaching the collision protector, the servo drive outputs a larger motor current to counter the external force from the collision protector. The servo drive uses the motor current and the Torque limit time to determine homing, and then it runs in the opposite direction to find the Z pulse.

P1.088	Torque limit time		Address: 01B0H 01B1H
Default:	2000	Control mode:	PR
Unit:	ms	Setting range:	2 – 2000
Format:	DEC	Data size:	16-bit

Settings:

Set the Torque limit time for Torque limit homing mode. Please refer to P1.087 for the timing diagram of Torque limit homing mode.

As mentioned in Section 7.1.2, the PR mode provides four monitoring variables for you to monitor the servo commands and feedback status. These are Command position PUU (Cmd_O), PR command end register (Cmd_E), Feedback position PUU (Fb_PUU), and Position error PUU (Err_PUU). Before homing completes, the command end register (Cmd_E) cannot be calculated because the coordinate system can only be created after homing is completed, and the target position remains unknown after the Homing command is issued. This is why the status of each monitoring variables is different during homing. In Homing command's default setting, the contents of Cmd_E and Cmd_O are identical. After it finds the reference origin in the coordinate system, it sets the content of Cmd_E to the coordinate of the reference origin. However, once it

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finds the reference origin, it still requires some distance for motor to decelerate to a stop. Meanwhile, Cmd_O continues to issue commands. If no other PR commands are issued after homing (other than the Position command), the contents of the final command position (Cmd_O) and command end position (Cmd_E) will be different. See Figure 7.1.3.3.

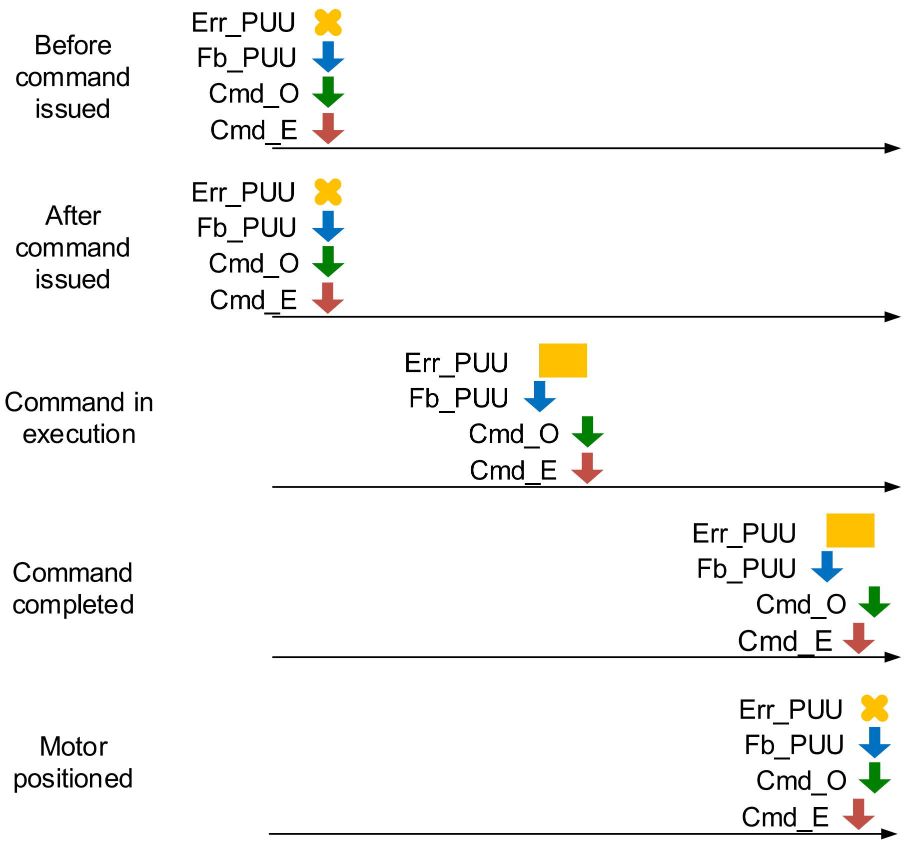

Figure 7.1.3.3 Homing mode and monitoring variables

Speed command

The PR mode provides a speed control function. The following parameters are available for PR speed setting: acceleration / deceleration time, delay time, and target speed. You can easily set the Speed command in the PR mode screen in ASDA-Soft. See Figure 7.1.3.4.

INS is an interrupt command that interrupts the previous motion command. Please refer to Section 7.1.6 for more details. AUTO is a command that automatically loads the next PR path. It executes the next PR path when the current PR path completes. In addition, you can set the target speed with two unit options, which are 0.1 rpm and 1 PPS ranging from -6000 rpm–6000 rpm. You select the ACC/DEC acceleration / deceleration time with the shared PR parameters. The software calculates and displays the required duration for accelerating from 0 to the target speed. DLY is the delay time that is determined by the shared PR parameters. It delays the command; in other words, the delay time is the time to wait after the target speed command completes.

See Figure 7.1.3.5 for the effects of the parameters for the PR mode speed control. Table 7.1.3.1 shows the bit function when speed control is in operation.

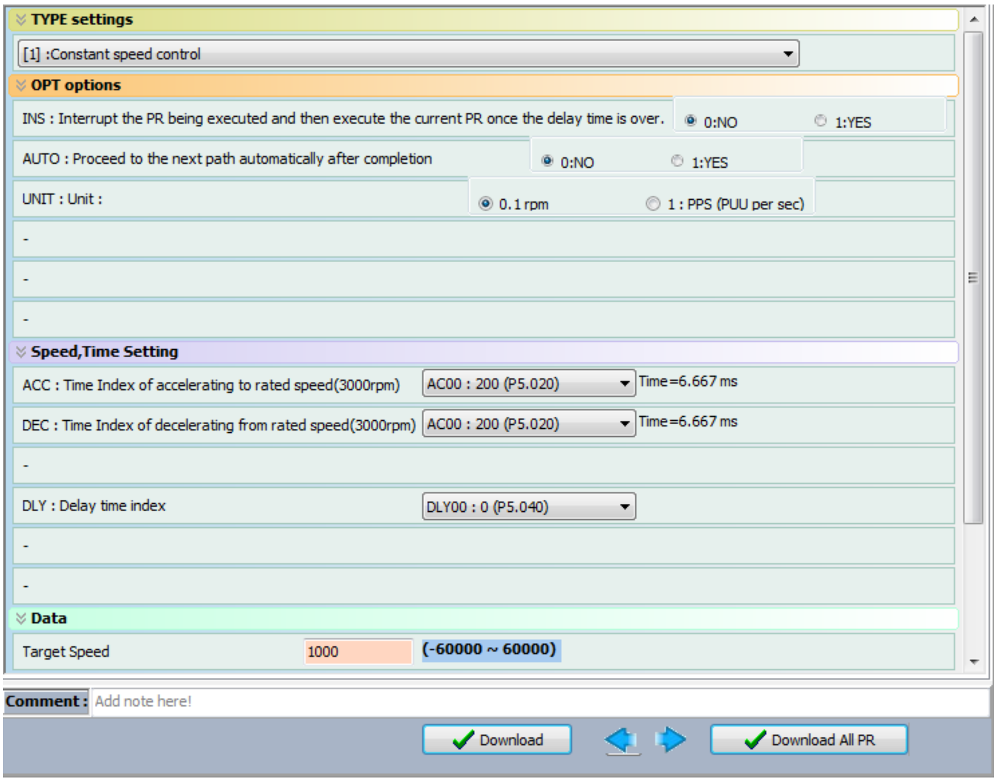

Figure 7.1.3.4 PR mode Speed screen in ASDA-Soft

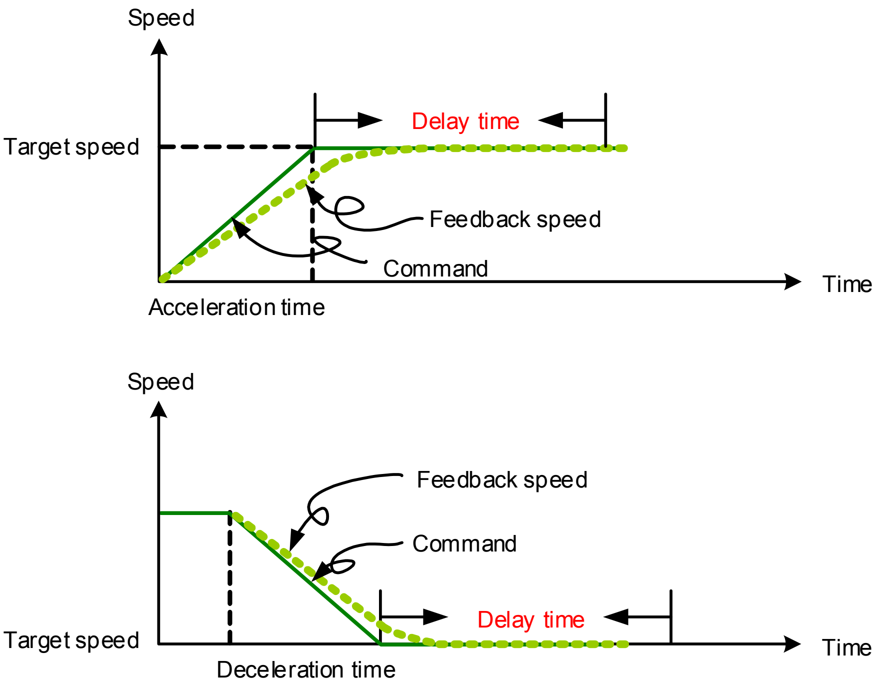

Figure 7.1.3.5 Parameters for PR mode speed control

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Table 7.1.3.1 Bit function of PR speed control

PR parameters	D	C	B	A	U	Z	Y	X
Command type	-	-	DLY	-	DEC	ACC	OPT	1
Data Content	Target speed [0.1 rpm / PPS]							

Note:

1. Y OPT: option

BIT	3	2	1	0
Command type	-	UNIT	AUTO	INS

INS: Interrupt command that interrupts the previous motion command.

AUTO: automatically load the next PR command when the current one is completed.

UNIT: speed unit selection; 0 signifies 0.1 rpm and 1 signifies PPS.

2. Z, U: ACC / DEC: acceleration / deceleration time, set by P5.020 – P5.035.

3. B: DLY: delay time, set by P5.040 – P5.055.

Position command

PR mode includes a position control function. The Position command is user-defined and its unit is PUU. There are two command types: Mode 2 and Mode 3. In Mode 2 the command signifies that it stops once the command is completed. In Mode 3 the command signifies that the next PR path is automatically executed. You use the same method to set the value for these modes in ASDA-Soft. See Figure 7.1.3.6.

In Figure 7.1.3.6, INS stands for the interrupt command that interrupts the previous motion command. OVLP stands for the overlap command that allows the next PR command to overlap the command that is currently being executed when decelerating. If you apply this this function, setting the delay time to 0 is suggested (please refer to Section 7.1.6). ACC / DEC is the acceleration / deceleration time determined by the shared PR parameters. The software calculates and displays the required time to accelerate from 0 to the target speed. SPD is the target speed specified by the shared PR parameters. You can choose whether it is multiplied by 0.1. DLY is the delay time specified by the shared PR parameters and it is defined by the command; in other words, once the target position is reached, the delay time starts counting.

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The Position command for PR mode is illustrated in Figure 7.1.3.7. Table 7.1.3.2 lists the bit functions of position control.

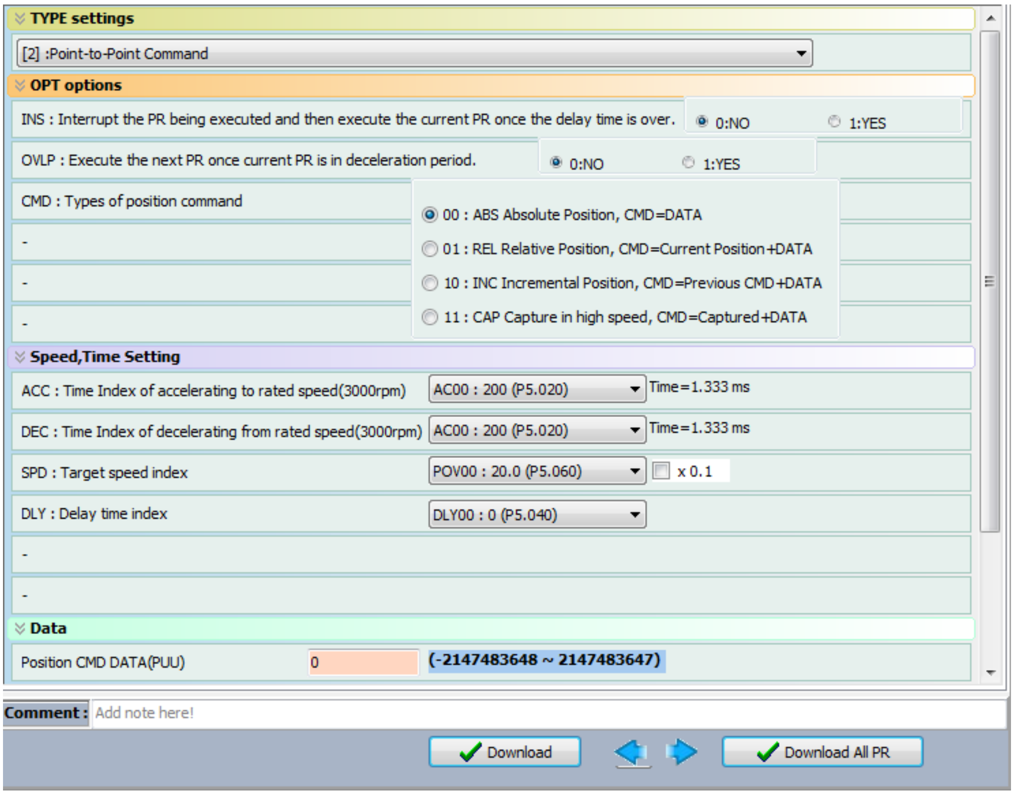

Figure 7.1.3.6 PR mode position interface of ASDA-Soft

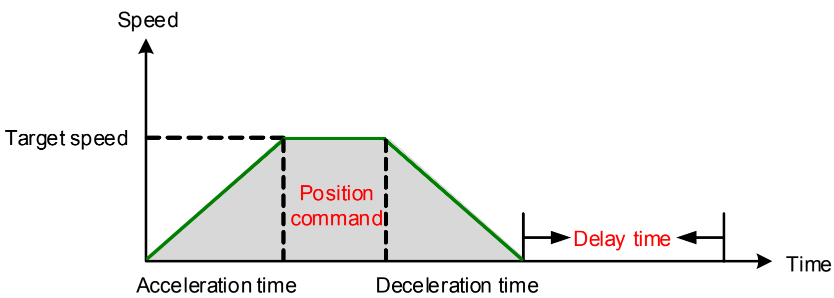

Figure 7.1.3.7 Parameters for PR mode position setting

There are four types of position commands for the PR mode. You can choose the position command according to the application requirements. The functions of each type are described in the examples below. Please note that the condition in these examples is that a position command is still being executed and another type of command is inserted. To see how the position commands are combined, please see Figure 7.1.3.8.

1. Absolute position command (ABS): when executed, the target position value equals the absolute command value. In the figure, an ABS command with the value of 60000 PUU is inserted in the previous PR path with setting target position of 60000 PUU on the coordinate axis.

2. Relative position command (REL): when executed, the target position value is the motor's current position value plus the position command value. In the figure, a REL command with the value on 60000 PUU is inserted in the previous PR path. The target position is the motor's current position (20000 PUU) plus the relative position command (60000 PUU), which equals 80000 PUU in the coordinate system. The target position specified by the original command is omitted.

3. Incremental command (INC): when executed, the target position is the previous target position value plus the current position command value. In the example below, an INC command with the value of 60000 PUU is inserted in the previous PR path. The target position is the previous target position value 30000 PUU plus the relative position command 60000 PUU, which equals 90000 PUU. The previous destination specified by the previous command is combined to define the new one.

4. High-speed position capturing command (CAP): when executed, the target position is the last position acquired by the Capture function plus the position command value. Please refer to Section 7.2.2 for more on the high-speed position capturing function. In the following example, a high-speed capturing command with the value of 60000 PUU is inserted in the previous PR path. The target position value is the captured position value of 10000 PUU plus the relative command of 60000 PUU, which equals 70000 PUU. The target position specified by the original command is omitted.

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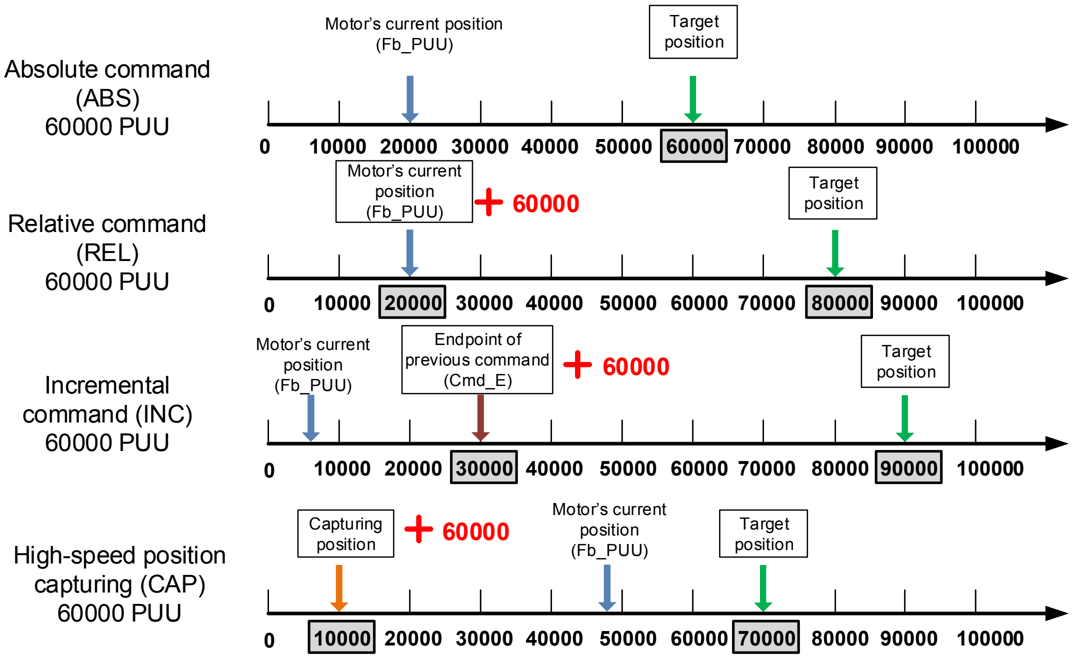

Figure 7.1.3.8 Four types of position command

Table 7.1.3.2 Bit functions of parameters of PR mode Position control

PR parameters	D	C	B	A	U	Z	Y	X
Command type	-	-	DLY	SPD	DEC	ACC	OPT	2 or 3
Data content	Target position [PUU]							

Note:

1. Y: OPT: option

BIT	3	2	1	0	Description
Command type	CMD		OVLP	INS	-
Data content	0	0	-	-	ABS (absolute positioning)
	0	1			REL (relative positioning)
	1	0			INC (incremental positioning)
	1	1			CAP (high-speed position capturing)

INS: Interrupt command interrupts the previous motion command.

OVLP: allow overlapping of the next command

CMD: Position command selection

2. Z, U: ACC / DEC: acceleration / deceleration time, set by P5.020 – P5.035.

3. A: SPD: internal target speed number, set by P5.060 – P5.075.

4. B: DLY: delay time, set by P5.040 – P5.055.

Jump command

PR mode includes a Jump command. It can call any PR paths or form PR paths into a loop, as shown in Figure 7.1.3.9. You can specify the PR path number to jump to in the PR mode screen in ASDA-Soft (see Figure 7.1.3.10). INS stands for the interrupt command that interrupts the previous motion command. You can find more information in Section 7.1.6. DLY is the delay time determined by shared PR parameters. Once a Jump command is issued, the servo drive starts counting the delay time. Available target PR numbers are PR#00 – PR#99. Table 7.1.3.3 shows the functions of each bit when executing a Jump command.

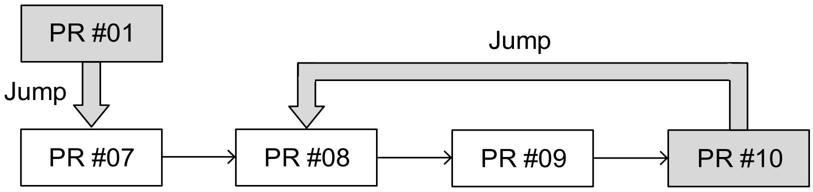

Figure 7.1.3.9 Jump command in PR mode

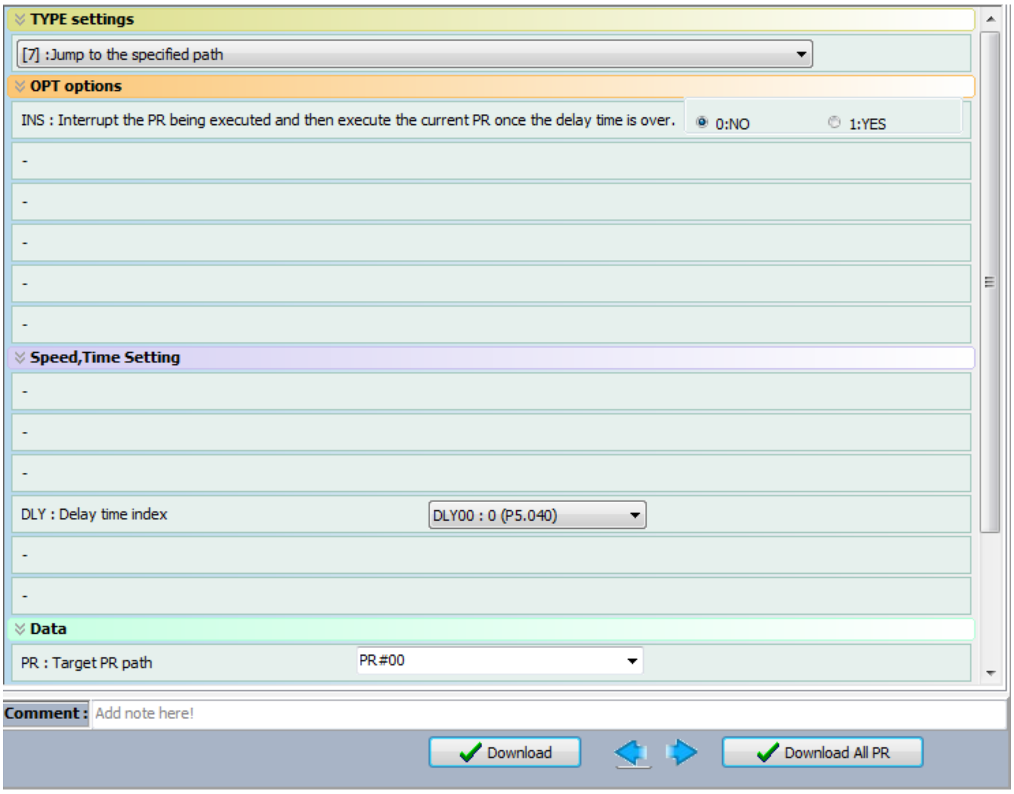

Figure 7.1.3.10 Using PR mode Jump command in ASDA-Soft

Table 7.1.3.3 Bit function of PR Jump command

PR parameters	D	C	B	A	U	Z	Y	X
Command type	-	-	DLY	-	-	-	OPT	7
Data content	Jump to target PR path (0 – 99)							

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Note:

1. Y: OPT: option

BIT	3	2	1	0
Command type	-	-	-	INS

INS: Interrupt command; interrupts the previous motion command.

2. B: DLY: delay time, which is set in P5.040 – P5.055.

Write command

PR mode includes a Write command. It can write constants, parameters, data arrays, and monitoring variables to the specified parameters or to data arrays. You can write a parameter to a specified path in the PR mode screen in ASDA-Soft (see Figure 7.1.3.11). INS is an interrupt command, which interrupts the previous motion command. Refer to Section 7.1.6 for more details. AUTO command automatically loads and executes the next PR once the current PR completes. ROM command writes parameters to both RAM and EEPROM at the same time. Writing to non-volatile memory function is also available; however, frequent usage shortens the life of the EEPROM. DLY is the delay time selected by shared PR parameters. Once a Jump command is issued, the servo drive starts calculating the delay time. Table 7.1.3.4 shows the functions of each bit when executing a Write command.

Writing target	Data source
Parameter	Constant
Data array	Parameter
-	Data array
-	Monitoring variables

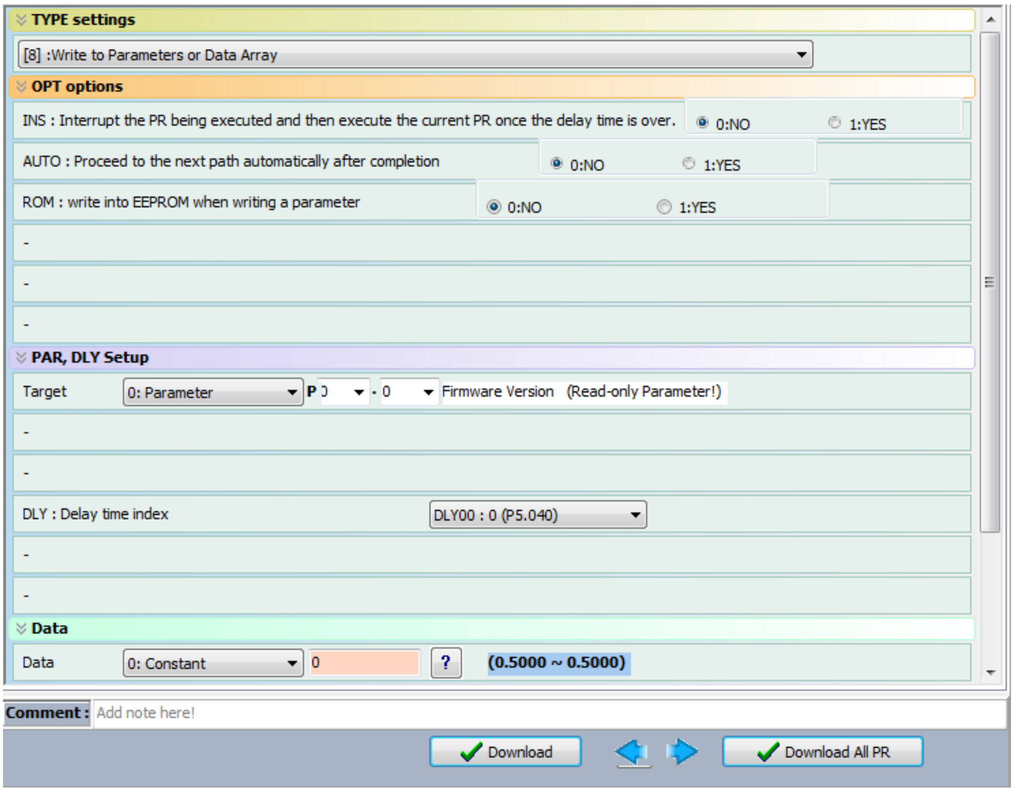

Figure 7.1.3.11 Using PR Write command in ASDA-Soft

Table 7.1.3.4 Bit function for PR Write command

PR parameters	D	C	B	A	U	Z	Y	X
Command type	0	SOUR_DEST	DLY	DESTINATION			OPT	8
Data content	SOURCE							

Note:

1. Y: OPT: option

BIT	3	2	1	0
Command type	-	ROM	AUTO	INS

INS: Interrupt command interrupts the previous motion command.

AUTO: once the current PR is completed, automatically load the next command.

ROM: write data to RAM and EEPROM at the same time. This function can only write parameters.

2. B: DLY: delay time, which is set in P5.040 – P5.055.

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3. C: SOUR_DEST: data source and data format to be written.

BIT	3	2	1	0	Description	
Command type	SOUR		-	DEST	Data source	Writing target
Data content	0	0	0	0	Constant	Parameter
	0	1		0	Parameter	Parameter
	1	0		0	Data array	Parameter
	1	1		0	Monitoring variable	Parameter
	0	0		1	Constant	Data array
	0	1		1	Parameter	Data array
	1	0		1	Data array	Data array
	1	1		1	Monitoring variable	Data array

4. Z, U, A: DESTINATION: destination

	A	U	Z
Target: Parameter	Parameter group	Parameter number	
Target: Data array	Data array number		

5. SOURCE: data source setting

	D	C	B	A	U	Z	Y	X
Data source: Constant	Constant data							
Data source: Parameter	-					Parameter group	Parameter number	
Data source: Data array	-					Data array number		
Data source: Monitoring variable	-						Monitoring variable number	

Index Position command

PR mode includes an Index Position command, which creates an index coordinate system. This command positions the motor within the indexing coordinates. Unlike other feedback positions in global coordinate system, index positioning is able to divide the total moving distance of one index into the number of paths required by the application (see Figure 7.1.3.12). Please refer to Chapter 10 for absolute position or if position counter overflows occur due to index positioning command. You can start the index positioning in the **Index Coordinates Setting Wizard** in the PR screen in ASDA-Soft (see Figure 7.1.3.13). As shown in the example, the start PR path is set to 1, the path number is set to 8, and total moving distance is 80000 PUU. When you click **OK**, the software automatically writes position command 0 PUU to PR#01, 10000 PUU to PR#02, 20000 PUU to PR#03, and so on up to PR#08. When the index position reaches 80000 PUU, it automatically returns to 0 PUU. In addition, you can modify the index position in each PR path as needed, as shown in Figure 7.1.3.14. INS stands for the interrupt command that interrupts the previous motion command (see Section 7.1.6.). OVLP stands for the overlap command that allows the next PR command to overlap the current one during deceleration. If you use OVLP, setting the delay time to 0 is suggested (refer to Section 7.1.6.). DIR sets the rotation direction with options of forward (always runs forward), backward (always runs backward), and shortest distance. The movement is illustrated in Figure 7.1.3.15. S_LOW is the speed unit with options of 0.1 rpm or 0.01 rpm. AUTO automatically loads and executes the next PR path when current PR completes. ACC / DEC is the acceleration / deceleration time setting determined by shared PR parameters. SPD is the target speed set by the PR shared parameters. DLY is the delay time defined by the command from controller; meaning that when motor reaches the target position, the servo drive starts counting the delay time. Position command is the target position of each index segment. Please note that the setting range must be smaller than the total index moving distance (P2.052). Table 7.1.3.5 shows the bit function for the Index Position command. If you use the index function, please execute homing in order to create the coordinate system so that the origin of the motor's feedback position and that of the motor's index position can be identical. If you do not execute homing, AL237 occurs.

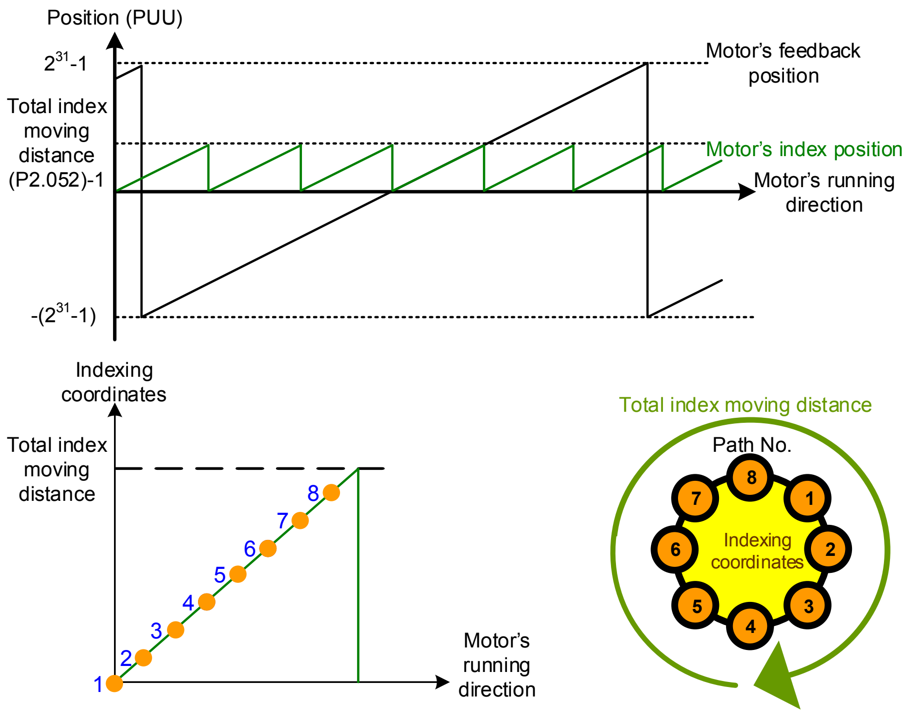

Figure 7.1.3.12 PR mode indexing coordinates

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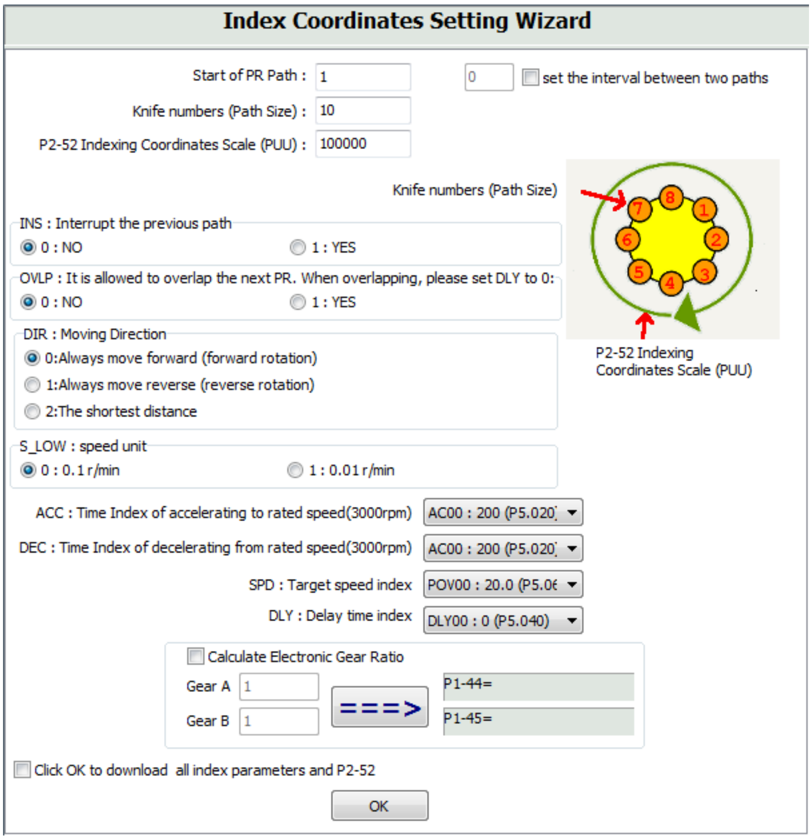

Figure 7.1.3.13 Indexing Coordinates Setting Wizard in PR mode

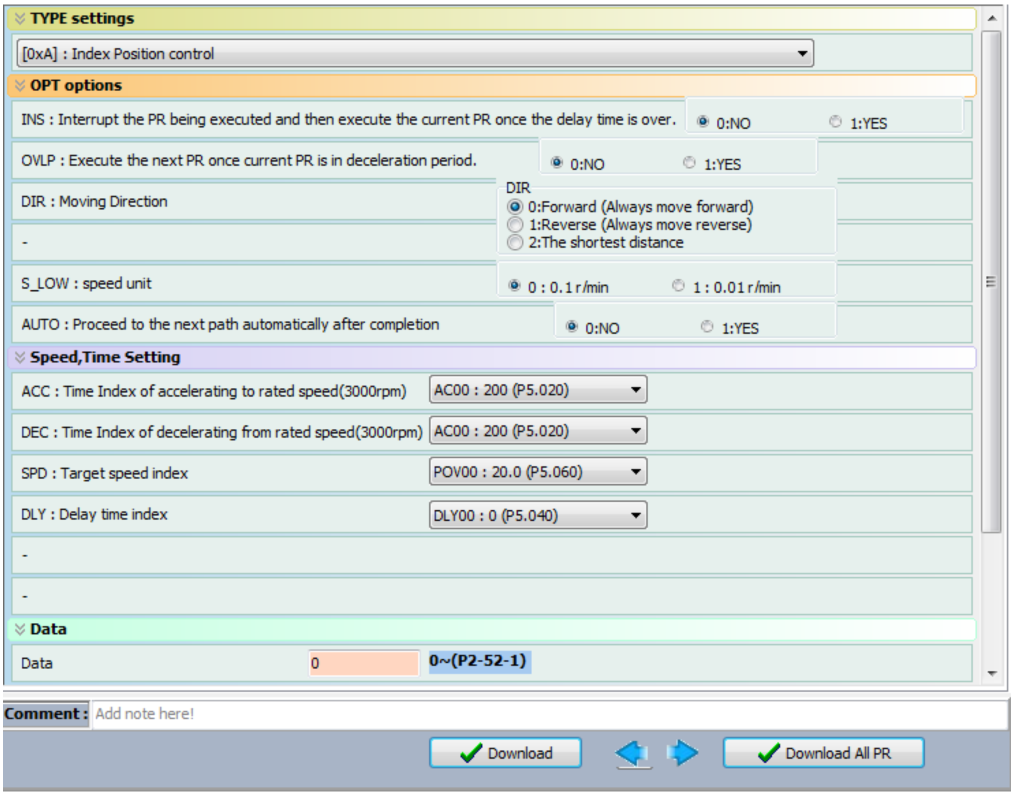

Figure 7.1.3.14 PR mode Index Position screen in ASDA-Soft

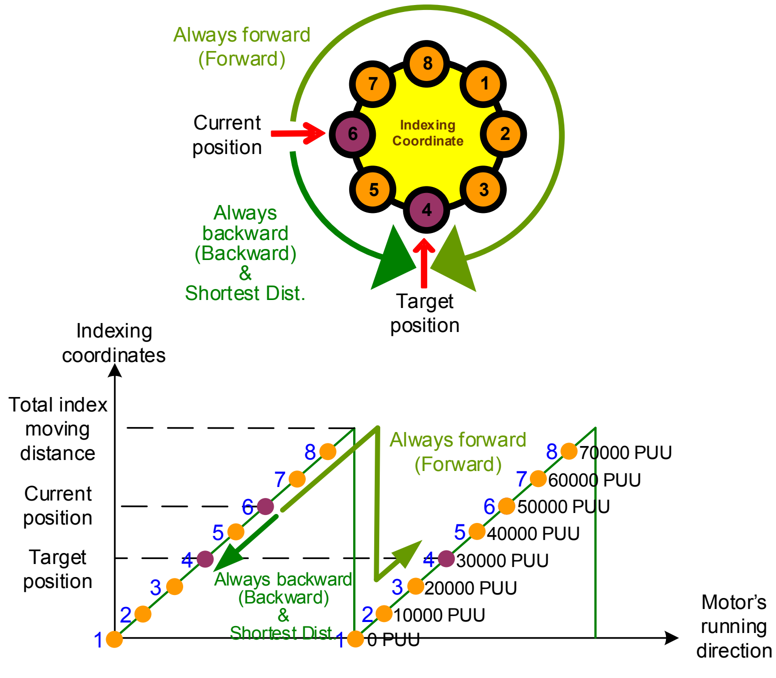

Figure 7.1.3.15 Motor's operation direction and indexing coordinates

Table 7.1.3.5 Bit function for the Index Position command

BIT / PR parameters	D	C	B	A	U	Z	Y	X
Command type	-	OPT2	DLY	SPD	DEC	ACC	OPT	0xA
Data content	Index Position command [PUU](0 – P2.052-1)							

Note:

1. Y: OPT: option

BIT	3	2	1	0	Description
Command type	DIR		OVLP	INS	-
Data content	0	0	-	-	Always goes forward (Forward)
	0	1			Always goes backward (Backward)
	1	0			Shortest distance
	1	1			-

INS: Interrupt command interrupts the previous motion command.

OVLP: allow overlapping of the next command

2. C: OPT2: Option 2

BIT	3	2	1	0
Command type	-	AUTO	-	S_LOW

S_LOW: speed unit options, 0 stands for 0.1 rpm and 1 for 0.01 rpm.

AUTO: automatically load the next PR command when the current one is completed.

3. Z, U: ACC / DEC: acceleration / deceleration time set by P5.020 – P5.035.

4. A: SPD: delay time, set by P5.060 – P5.075.

5. B: DLY: delay time, set by P5.040 – P5.055.

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Arithmetic operations

PR mode has arithmetic operations commands, including addition, subtraction, multiplication, division, OR, AND, MOD, and logic conditions. The available operands are user variables, parameters, data arrays, monitoring variables, and constants. Among them, the user variable is the register only for arithmetic operations. There are 64 sets of user variables, with a data size of 32 bits. The data size of a constant is also 32-bits. After all arithmetic operation commands are executed, you can set a jump condition in the path so that execution jumps to different PR path and then continue or stop once the operation is done. You can also use it as a loop function. The arithmetic operation commands support negative numbers operations but not floating point operations. Negative numbers are calculated by “two’s compliment”. Figure 7.1.3.16 is the Arithmetic Operations screen in ASDA-Soft. Arithmetic operations must be created in ASDA-Soft. To avoid errors, do not use the servo panel or RS-485 for arithmetic operations. Once you complete the arithmetic operation, click **Download All PR** to write all PR paths to the servo drive.

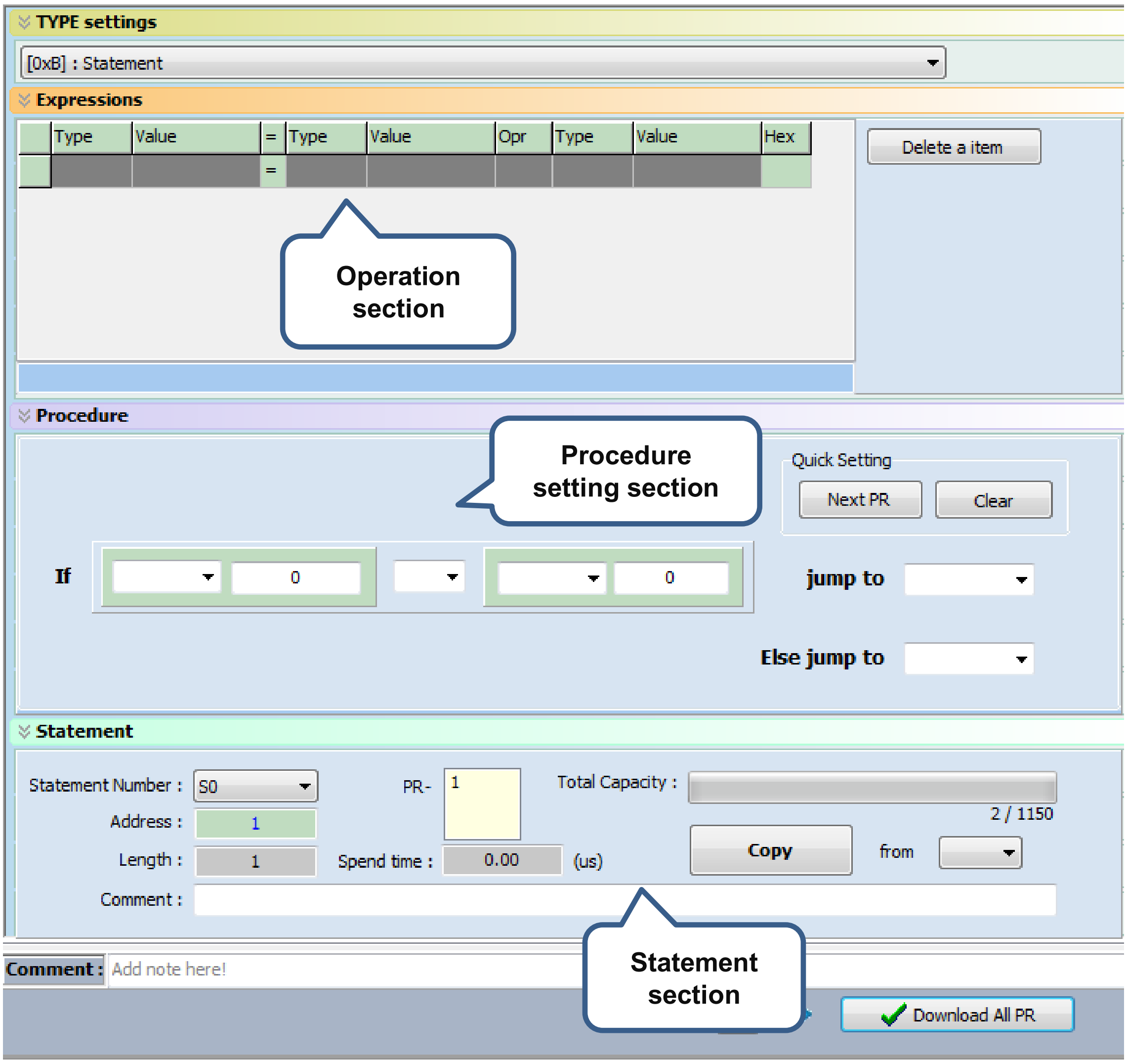

Figure 7.1.3.16 PR Arithmetic Operations screen in ASDA-Soft

1. Operation section: supports addition, subtraction, multiplication, division, AND, OR, and MOD operation as well as logical operations for multiple data. Table 7.1.3.6 shows the supported operators and calculation data with data format in DEC and HEX.

Table 7.1.3.6 Description of each field in the Operation section

<table>
<tr><th>Data to be written</th><th>=</th><th>Calculation data</th><th>Operator</th><th>Calculation data</th></tr>
<tr><td rowspan="2">User variable
(User[0-63])</td><td rowspan="5"></td><td>User variable
(User[0-63])</td><td rowspan="5">Addition (+)
Subtraction (-)
Multiplication (*)
Division (/)
Obtain remainder (%)
And (&)
Or (|)</td><td rowspan="2">User variable
(User[0-63])</td></tr>
<tr><td>Constant
(Constant)</td></tr>
<tr><td>Parameter
(PX.XXX)</td><td>Data array
(Arr[0-799])</td><td>Constant
(Constant)</td></tr>
<tr><td rowspan="2">Data array
(Arr[0-799])</td><td>Parameter
(PX.XXX)</td><td rowspan="2">Data array
(Arr[0-799])</td></tr>
<tr><td>Monitoring variable
(Mon[*])</td></tr>
</table>

2. Procedure section: uses the IF statement to determine whether the user-defined condition is fulfilled. If true, jump to the next specified PR path; if false, jump to the other specified PR path. If you click **Next PR** in **Quick Setting**, the software automatically inputs the condition and then jumps to the next PR path. If you leave this section blank, then the PR procedure stop once the basic operation is done. See Table 7.1.3.7 for data formats and operators.

Table 7.1.3.7 Field description for the Procedure setting section

<table>
<tr><th>Data format</th><th>Operator</th><th>Data format</th></tr>
<tr><td>User variable
(User[0-63])</td><td rowspan="5">Greater than (>)
Greater than or equal to(≥)
Less than (<)
Less than or equal to (≤)
Equal to (=)
Not equal to (≠)</td><td rowspan="2">User variable
(User[0-63])</td></tr>
<tr><td>Constant
(Constant)</td></tr>
<tr><td>Data array
(Arr[0-799])</td><td>Constant
(Constant)</td></tr>
<tr><td>Parameter
(PX.XXX)</td><td rowspan="2">Data array
(Arr[0-799])</td></tr>
<tr><td>Monitoring variable
(Mon[*])</td></tr>
</table>

3. Statement section: this section includes statements and memory capacity. Statements save the data from the expression and procedure sections. Data in the expression and procedure sections of the same statement always remain identical and can be shared by multiple PR paths. If data in those two sections are different, then the data is saved to another statement. The time required to execute the statement is shown in the **Spend Time** field. **Total Capacity** shows the servo drive's memory capacity; basic operations cannot be performed if there is no memory space available. The **Statements** tab is shown in Figure 7.1.3.17. The upper section displays all the statements and the lower section displays the operations in each statement and the values.

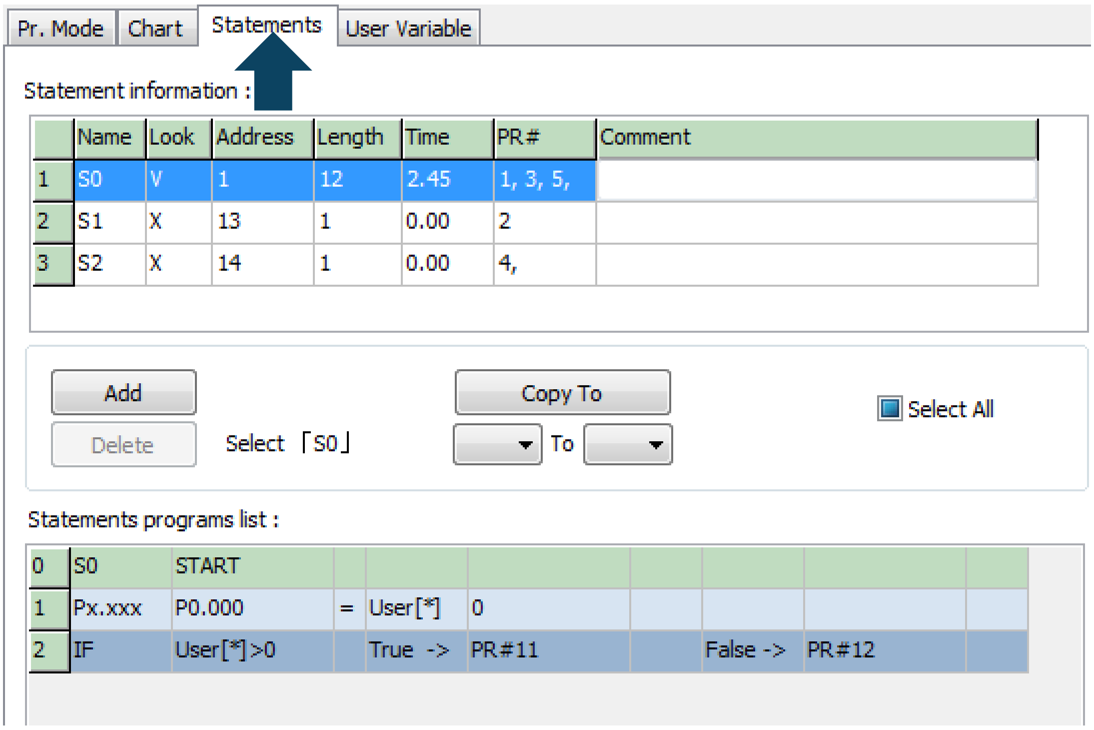

Figure 7.1.3.17 Statements tab in ASDA-Soft

7.1.4 Overview of the PR procedure

In PR mode, there are seven types of commands. To understand how the PR procedure works, ASDA-Soft presents the execution order and calling sequence of all PR procedures. First, symbols and contents in the PR figure are shown. This includes five parts: number, execution type, command type, next PR command, and command data. See Figure 7.1.4.1.

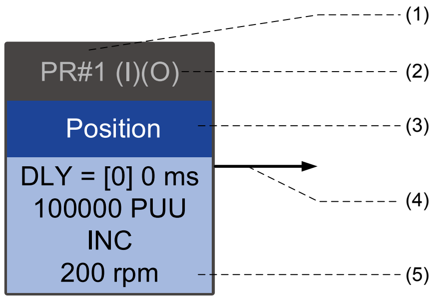

Figure 7.1.4.1 PR display

(1) Number: the PR number, ranging from PR#0 to PR#99 (100 sets of PR paths).

(2) Command execution (property): (B) Execute homing when power on; (O) Command overlap; (R) write data to EEPROM; (I) command interrupt.

(3) Command type: there are six types of PR procedure commands: homing, speed, position, writing, jumping, and arithmetic operations. The color displayed in this section depends on the command type.

(4) Next procedure command: if followed by a PR command, the arrow points to the specified PR path.

(5) Command information: displays the details of this PR path. The color depends on the information types.

The following sections illustrate each command type and its presentation.

Homing methods

In the display of homing methods, PR#0 always signifies the homing procedure, which is marked as “Homing”. See Figure 7.1.4.2.

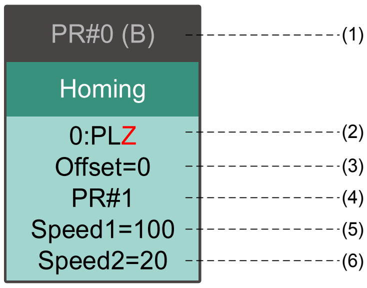

Figure 7.1.4.2 Homing methods display

(1) Activation mode (Boot): to execute homing when the drive is in Servo On state, it displays (B); if homing is not required, then no information is displayed.

(2) Method selection: homing methods and Z pulse setting are shown in the table below. Characters in red indicate the motor’s position after homing; F signifies running forward; R signifies running in reverse; ORG signifies origin; CUR signifies current position; BUMP represents the collision point.

Homing methods	Y = 0: reverse to look for Z pulse Y = 1: go forward to look for Z pulse	Y = 2: do not look for Z pulse
X = 0: homing in forward direction with PL as the homing origin	0: PLZ	0: PL
X = 1: homing in reverse direction with NL as the homing origin	1: NLZ	1: NL
X = 2: homing in forward direction with ORG (when it switches from off to on state) as the homing origin	2: F_ORGZ	2: F_ORG
X = 3: homing in reverse direction with ORG (when it switches from off to on state) as the homing origin	3: R_ORGZ	3: R_ORG
X = 4: look for the Z pulse in forward direction with it as the homing origin	4: F_Z	
X = 5: look for the Z pulse in reverse direction with it as the homing origin	5: R_Z	
X = 6: homing in forward direction with ORG (when it switches from on to off state) as the homing origin	6: F_ORGZ	6: F_ORG
X = 7: homing in reverse direction with ORG (when it switches from on to off state) as the homing origin	7: R_ORGZ	7: R_ORG
X = 8: use the current point as the origin	8: CUR	
X = 9: look for collision point in forward direction and use it as the origin	9: F_BUMPZ	9: F_BUMP
X = A: look for collision point in reverse direction and use it as the origin	A: R_BUMPZ	A: R_BUMP

(3) Offset: origin offset, P6.001

(4) Path: next PR path to be executed after homing

(5) Homing at high speed: first homing speed, P5.005.

(6) Homing at low speed: second homing speed, P5.006.

Speed command

You can use the Speed command in any PR paths (PR#1 – PR#99). It is marked as “Speed”. See Figure 7.1.4.3.

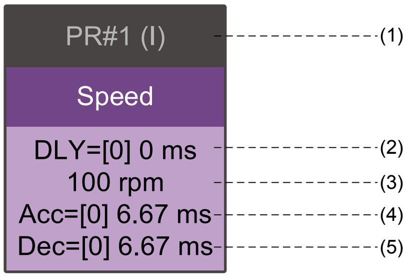

Figure 7.1.4.3 Speed command display

(1) Command execution type: a Speed command can interrupt (INS) the previous PR path. If the Interrupt function is enabled, it displays (I); if not, no information is displayed.

(2) Delay time (DLY): determined by shared PR parameters. It is defined by a command from the controller; the servo drive starts counting the delay time once it reaches the target speed.

(3) Target speed: the set target speed.

(4) Acceleration time (ACC): determined by shared PR parameters; length of time to reach the target speed from stopped.

(5) Deceleration time (DEC): determined by shared PR parameters; length of time to decelerate from target speed to stopped.

Position command

You can use the Position command in any PR paths (PR#1 – PR#99). It is marked as “Position”, and includes the options to “Stop once position control completed” and “Load the next path once position control completed”. The only difference is that “Load the next path once position control completed” shows an arrow pointing to the next PR. See Figure 7.1.4.4.

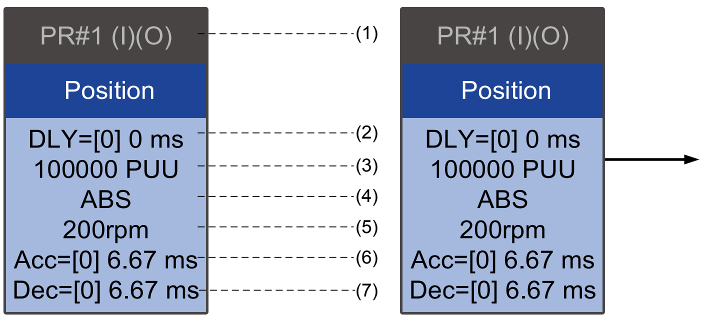

Figure 7.1.4.4 Position command display

(1) Command execution type: a Position command can interrupt (INS) the previous PR path. If the Interrupt function is enabled, it displays (I); if not, no information is displayed. The Position command can overlap (OVLP) the next PR path. If delay time is set to 0 when this

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function is enabled, it displays (O). If the Overlap function is not used, no information is displayed.

(2) Delay time (DLY): determined by shared PR parameters. It is defined by a command from the controller. The servo drive starts counting the delay time once it reaches the target position.

(3) Target position: the set target position.

(4) Position command type: “ABS” means an absolute positioning command ; “REL” means relative positioning; “INC” means incremental positioning; “CAP” means high speed position capture.

(5) Target speed: determined by shared PR parameters.

(6) Acceleration time (ACC): determined by shared PR parameters; the length of time to reach the target speed from stopped.

(7) Deceleration time (DEC): determined by shared PR parameters; the length of time to decelerate from target speed to stopped.

Jump command

You can use the Jump command in any PR paths (PR#1–PR#99). It is marked as “Jump” and followed by an arrow pointing to the next PR path. See Figure 7.1.4.5.

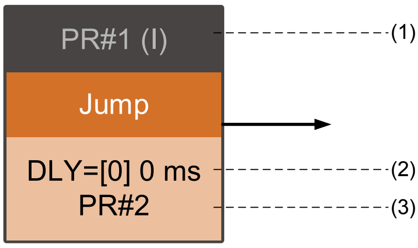


Figure 7.1.4.5 Jump command display

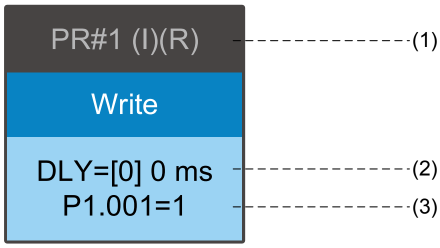
(1) Command execution type: the Jump command can interrupt (INS) the previous PR path. If the Interrupt function is enabled, it displays (I); if not, no information is displayed.

(2) Delay time (DLY): determined by shared PR parameters.

(3) Target PR number: the target PR number.

Write command

You can use the Write command in any PR paths (PR#1 – PR#99). It is marked as “Write”. See Figure 7.1.4.6.



7.1.4.6 Write command display

(1) Command execution type: a write command can interrupt (INS) the previous PR path. If the Interrupt function is enabled, it displays (I); if not, no information is displayed. You can determine whether to write the data to EEPROM. If writing data to EEPROM is required, it shows (R); if not, no information is displayed.

(2) Delay time (DLY): determined by shared PR parameters.

(3) Writing target and data source: the corresponding target and data sources are shown in the table below. Please note that constants can be written in DEC or HEX format.

Writing target	Data source
Parameter (PX.XXX)	Constant
Data array (Arr[#])	Parameter (PX.XXX)
-	Data array (Arr[#])
-	Monitoring variable (Mon[#])

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Index position command

You can use the Indexing Position command in any PR paths (PR#1–PR#99). The number of PR paths is determined by the index number. It is marked as “Index Position”. See Figure 7.1.4.7.

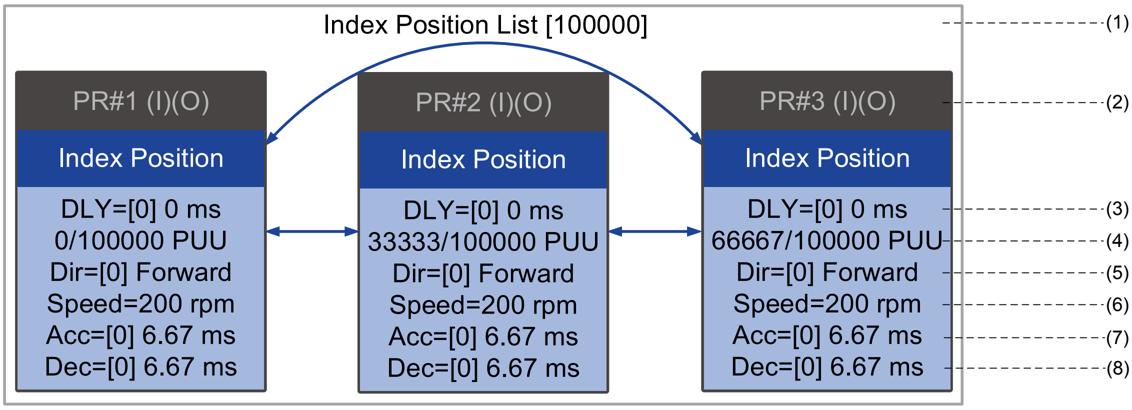


Figure 7.1.4.7 Indexing Position command display

(1) Indexing Position command section: the number of the index position. It shows the total moving distance at the top using double arrows to show that the motor can run reciprocally between each target position in each PR path.

(2) Command execution type: a position command can interrupt (INS) the previous PR path. If the Interrupt function is enabled, it displays (I); if not, no information is displayed. The Position command can overlap (OVLP) the next PR path. If delay time is set to 0 when this function is enabled, it displays (O). If the Overlap function is not used, no information is displayed.

(3) Delay time (DLY): determined by shared PR parameters. It is defined by a command from the controller The servo drive starts counting the delay time once it reaches the target position.

(4) Position command: the numerator is the position of this PR path; the denominator is the total moving distance of this indexing Position command, which is set by P2.052.

(5) Rotation direction (Dir): available options are “Rotation forward (Forward)”, “Rotation in reverse (Reverse)” and “Rotation with the shortest distance (Shortest)”.

(6) Target speed: determined by shared PR parameters.

(7) Acceleration time (ACC): determined by shared PR parameters; the length of time to reach the target speed from stopped.

(8) Deceleration time (DEC): determined by shared PR parameters; the length of time to decelerate from target speed to stopped.

Arithmetic operation

You can use arithmetic operations and statements in any PR paths (PR#1 – PR#99). It is marked as “Statement”. When the condition is fulfilled, an arrow pointing to the next PR path appears with a solid line; if the condition is unfulfilled, an arrow pointing to the next PR appears with a dotted line; Or you can choose to execute the next PR path and stop once the execution is completed. See Figure 7.1.4.8.

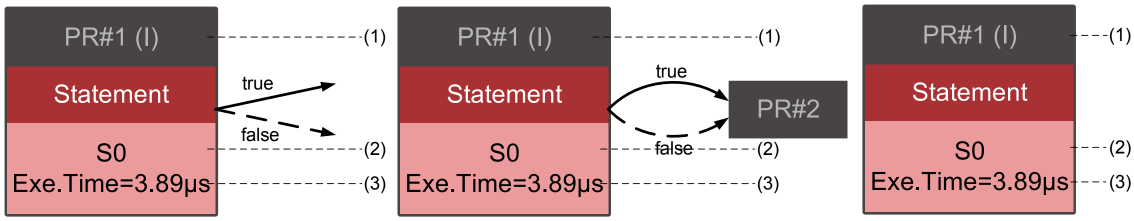


Figure 7.1.4.8 Arithmetic operation display

(1) Command execution type: an arithmetic operation command can interrupt (INS) the previous PR path. If the Interrupt function is enabled, it displays (I); if not, no information is displayed.

(2) Statement number: displays the statement number used in the PR path.

(3) Execution time (Exe. Time): the time required to execute the arithmetic operation.

7.1.5 Trigger methods for the PR command

There are six types of PR triggering methods. They are DI-triggered, Event-triggered, P5.007-triggered, Capture-triggered (high-speed position capturing), Compare-triggered (high-speed position comparing), and E-Cam-triggered. You can choose the most suitable triggering method according to the applications and requirements.

Digital input (DI) triggering

You can choose the PR path to be executed by using the internal registers (Position command Bit0 – Bit6) and use a command to trigger the selected PR path. Before using DI-triggering commands, you must define the 8 sets of DI functions, which are [0x11]POS0, [0x12]POS1, [0x13]POS2, [0x1A]POS3, [0x1B]POS4, [0x1C]POS5, [0x1E]POS6, and [0x08]CTRG (refer to Table 8.1). You can also set this in the I/O screen of ASDA-Soft, as shown in Figure 7.1.5.1.

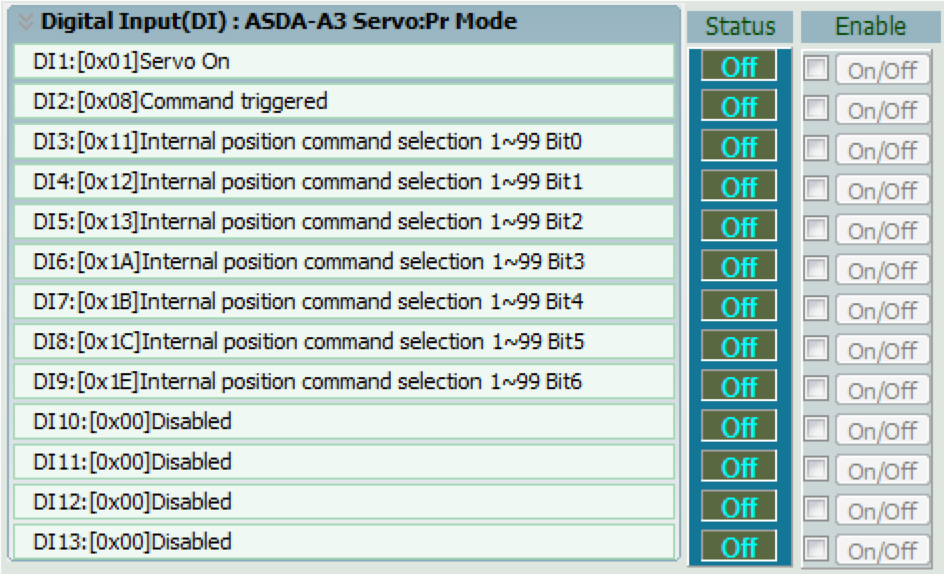


Figure 7.1.5.1 I/O screen in ASDA-Soft

Select the PR number to be executed based on the on / off status of DI.POS0–6 and use DI.CTRG to trigger the specified PR path. See Figure 7.1.5.1 for an example.

Table 7.1.5.1 Use DI to select the PR path to be triggered

Position command	POS 6	POS 5	POS 4	POS 3	POS 2	POS 1	POS 0	CTRG	Parameter
Homing	0	0	0	0	0	0	0	↑	P6.000 P6.001
PR#1	0	0	0	0	0	0	1	↑	P6.002 P6.003
~									
PR#50	0	1	1	0	0	1	0	↑	P6.098 P6.099
PR#51	0	1	1	0	0	1	1	↑	P7.000 P7.001
~									
PR#99	1	1	0	0	0	1	1	↑	P7.098 P7.099

In addition, there are two sets of DI for special functions: [0x27] homing enabling and [0x46] motor stop. If the former is triggered, the servo drive executes homing based on the homing setting. If the latter is triggered, the servo drive stops the motor. You can use the I/O screen in ASDA-Soft to set these functions, as shown in Figure 7.1.5.2.

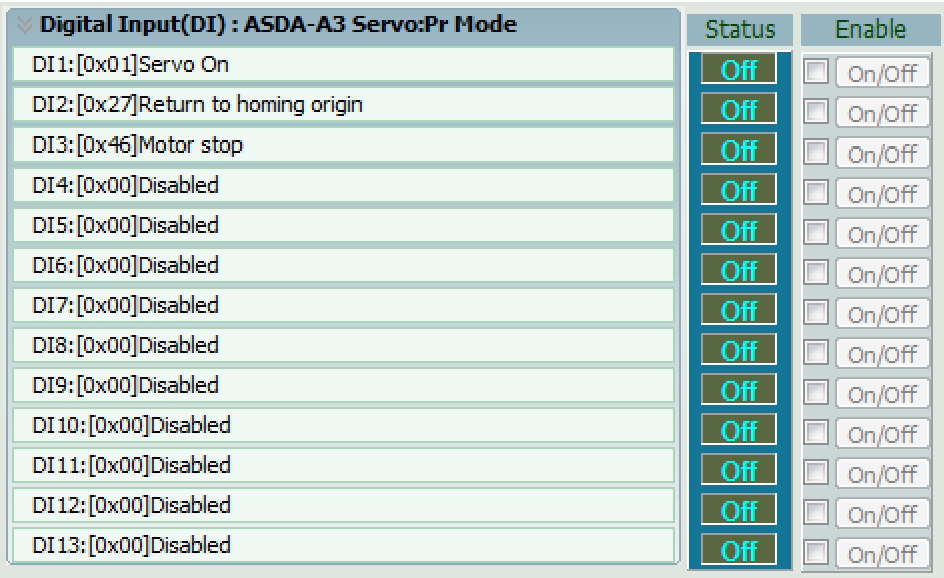


Figure 7.1.5.2 I/O screen in ASDA-Soft

7

Event triggering

You can use Event-triggered commands 1 – 4 to execute the specified PR path. You can select two types of Event triggering: rising-edge trigger and falling-edge trigger. The range of PR path numbers that you can specify is from 51 – 63 (see example in Figure 7.1.5.3). Before using the Event-trigger for PR command, you must define the DI functions, which are [0x39] Event-trigger command 1, [0x3A] Event-trigger command 2, [0x3B] Event-trigger command 3, and [0x3C] Event-trigger command 4 (see Table 8.1). You can use ASDA-Soft to set the I/O triggering as shown in Figure 7.1.5.4.

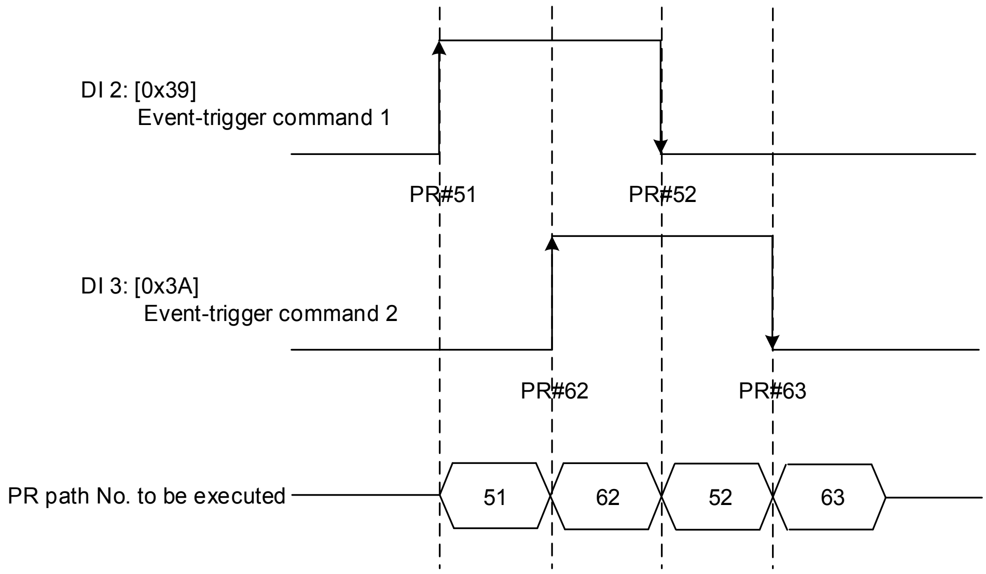


Figure 7.1.5.3 Example of Event triggering timing diagram

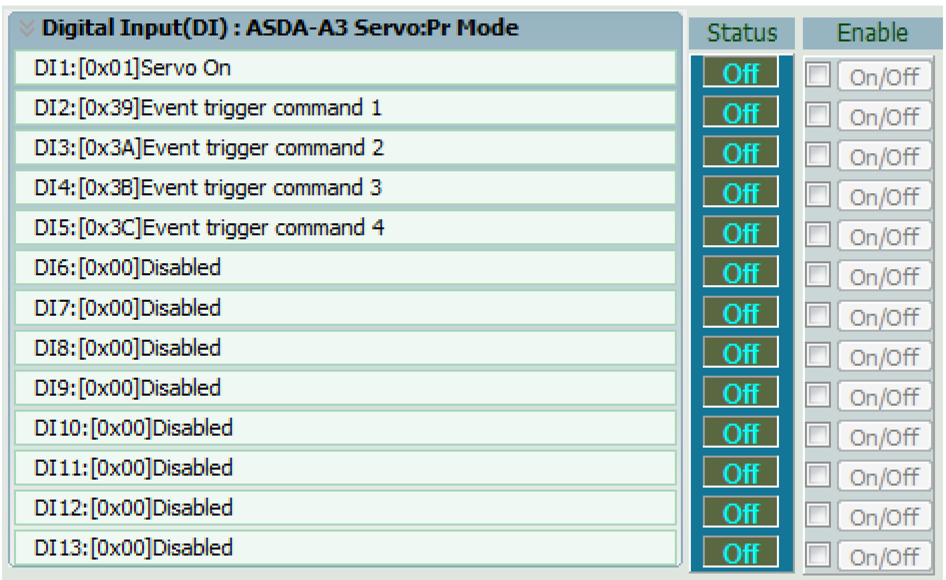


Figure 7.1.5.4 I/O screen in ASDA-Soft

You can set the rising-edge trigger of the PR path with P5.098 while you can set the falling-edge trigger with P5.099. Please refer to Chapter 8 for more details. You can set the Event trigger of PR in ASDA-Soft (see Figure 7.1.5.5).

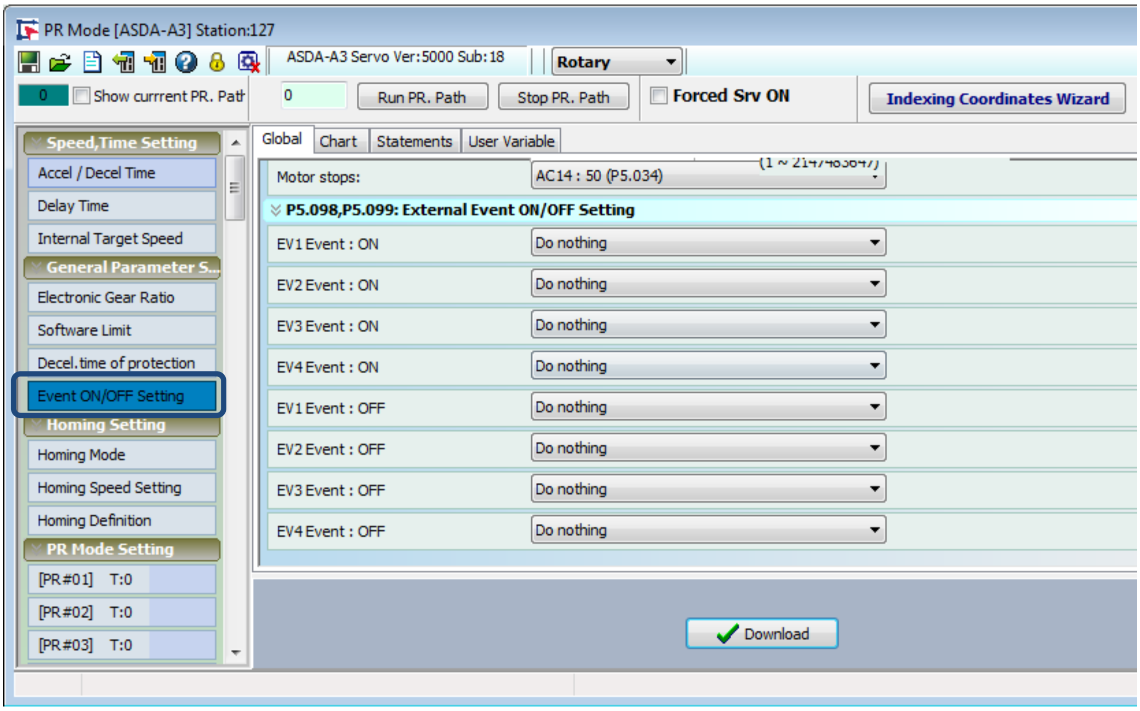


Figure 7.1.5.5 Event On/Off screen in ASDA-Soft

PR command trigger register (P5.007)

You can write the PR number to be executed in P5.007 to make the servo drive execute the specified PR path. If you write 0 to the PR Command Trigger register, the servo drive executes homing. If you write 1 – 99 to the PR Command Trigger register, the servo drive executes the specified PR path. If you write 1000, the servo drive stops executing PR commands. You can find more information in the description of P5.007 in Chapter 8.

Special trigger method

You can use High-speed position capturing (Capture), High-speed position comparing (Compare), and the E-Cam function to trigger the specified PR path. When the capturing completes, you can set Bit3 of P5.039.X to trigger or not trigger PR#50, or set Bit12 of P5.059 to trigger or not trigger PR#45 once the last data is compared. If the E-Cam disengagement setting is 2, 4, or 6, use P5.088.BA to write the PR path number. Please refer to Section 7.2 for Capture, Compare, and E-Cam functions.

Triggering method	Setting bit	Trigger PR path
High-speed position capturing (Capture)	P5.039.X Bit3	PR#50
High-speed position comparing (Compare)	P5.059.U Bit0	PR#45
E-Cam	P5.088.BA	User-defined

7.1.6 PR procedure execution flow

The ASDA-A3 updates the command status every 1 ms. Figure 7.1.6.1 illustrates the PR procedure execution flow and how the servo drive deals with PR commands. Once a PR procedure is triggered, it goes through three units, which are PR queue, PR executor, and motion command generator.

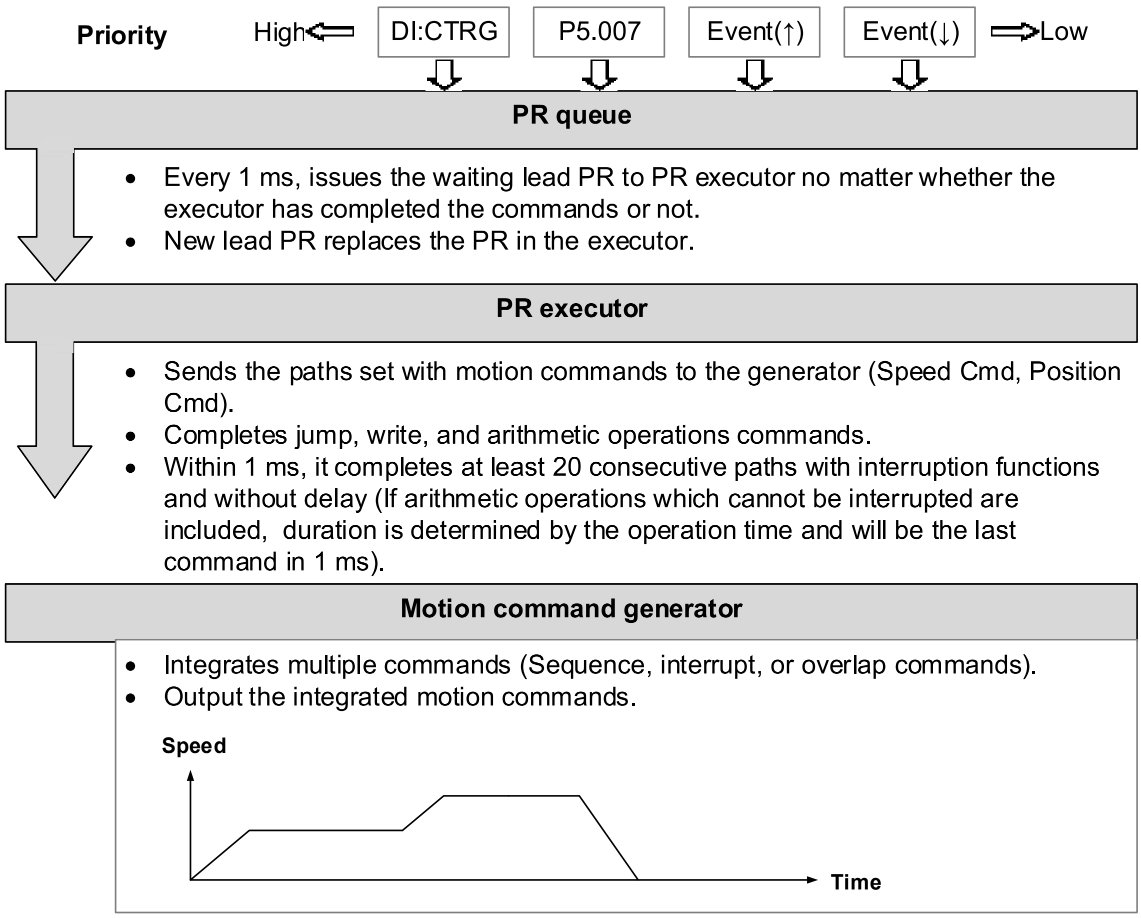


Figure 7.1.6.1 PR execution flow in the ASDA-A3

■ **Trigger mechanism**

The trigger mechanism is as mentioned in Section 7.1.5. There are three trigger methods. A PR procedure is executed as long as a trigger signal is output. When two different trigger methods are used for one PR procedure within the same ms, the priority is as follows: DI trigger (DI.CTRG) > PR command trigger register (P5.007) > Rising-edge event trigger (Event ↑) > Falling-edge event trigger (Event↓). Within this ms, commands with higher priority are executed first and then the lower priority commands are arranged in the next ms. If three trigger commands are generated in the same ms, the third is not added to the PR queue.

PR queue

The triggered PR path is the lead PR. The PR group it leads goes into the PR queue to wait for prioritization. In each ms, the servo drive sends the lead PR and the PR group it leads to the PR executor no matter whether a PR path is being executed. Therefore, as long as a PR path is triggered, the PR queue collects it and sends it to the executor.

PR executor

Once the PR executor receives the lead PR and its PR group, the PR group in execution is replaced immediately. If a PR group includes motion commands, such as Speed commands and Position commands, then the PR executor sends them to the motion command generator. PR paths with Write or Jump commands are completed at the moment when the PR executor reads the command, and thus they do not enter the generator. The arithmetic operations commands are executed when entering the PR executor; however, the execution time varies with the computing duration and the next command cannot interrupt during computing. The PR executor can consecutively complete at least 20 PR paths with interrupt commands (INS) (without delay times) within 1 ms. If there is a PR path that it has not completed within 1 ms, and a new PR group is sent to the executor by the queue, the new PR group then replaces the previous PR group. In other words, instead of executing the PR group that hasn’t been completed, the executor starts executing the new PR group. However, if a new PR group hasn’t been sent to the executor yet, the executor continues to execute the unfinished PR path.

Motion command generator

Motion commands include the Speed and Position commands. The PR executor sends this type of command to the motion command generator. This generator has a buffer for temporarily storing the next motion command and all motion commands are integrated here. Motion commands can be executed as soon as they enter the generator. If another motion command (with interrupt setting) also enters the generator, it is integrated with the current command in the generator and the integration is based on the motion command settings. The settings include whether multiple motion commands are sequence commands, and whether it is set with the Overlap or Interrupt function. All integration varies with each PR path setting.

Sequence command

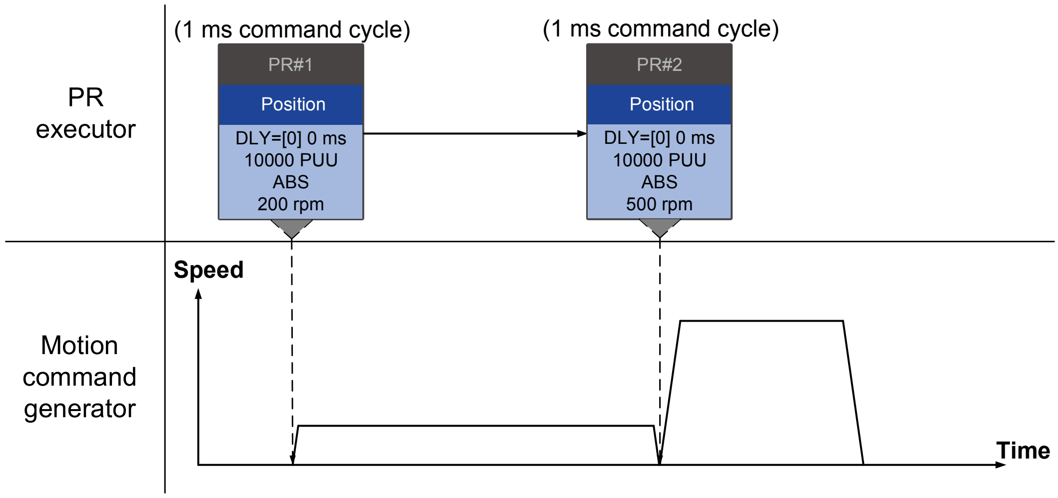
The configurable commands in PR path are the motion commands, which are the Position and Speed commands. A sequence command is a motion command without an Overlap or Interrupt function. The following command start to be executed only after the delay set in the previous command. Regarding Position commands, the delay time starts to count after the target position is reached. For Speed command, the delay time counting starts after the target speed is reached.

7

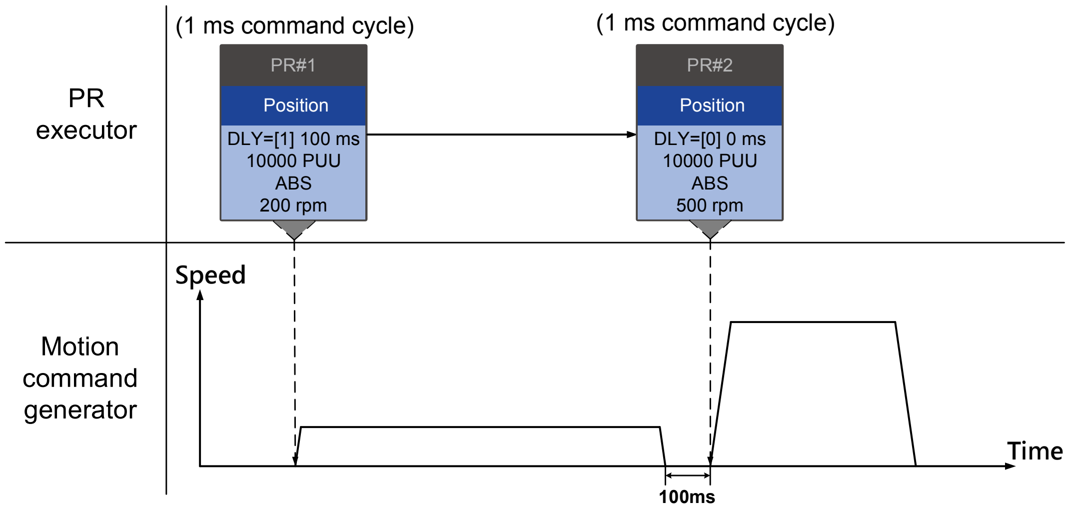
■ Position command followed by a Position command

When the PR executor receives two consecutive Position commands, if they do not have Interrupt or Overlap functions, the PR executor issues the first Position command to the motion command generator, and the generator starts the first part of position control. After the first Position command completes, if no delay time is set, the PR executor issues the second Position command for the generator to start the second part of position control (see Figure 7.1.6.2(a)).

If the first Position command includes a delay, the PR executor starts counting the delay time right after the motor reaches the target position. Then it issues the second Position command to the generator for the second part of position control as shown in Figure 7.1.6.2 (b).



(a) Position command without delay



(b) Position command with delay

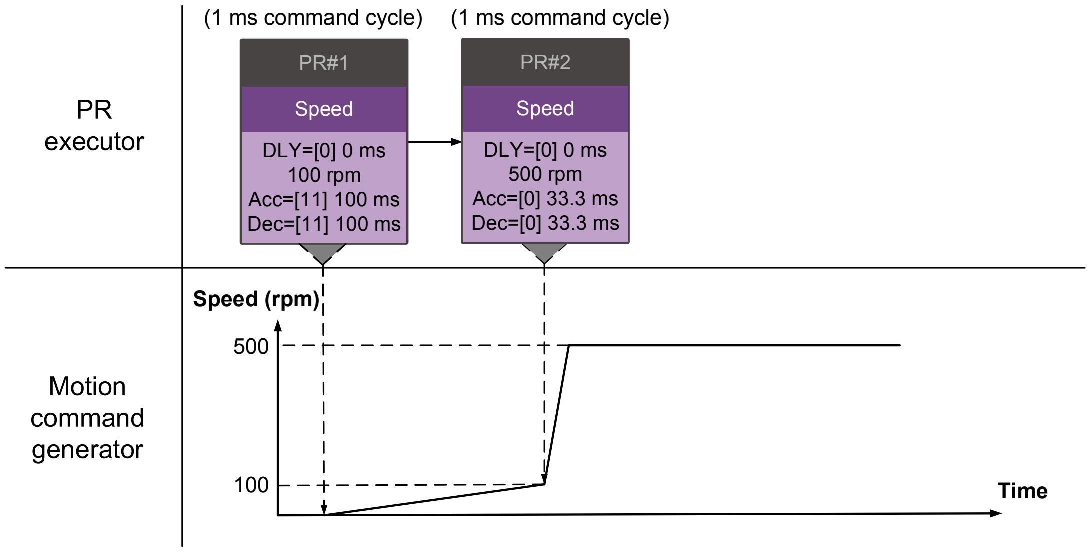
Figure 7.1.6.2 Sequence Position command

7

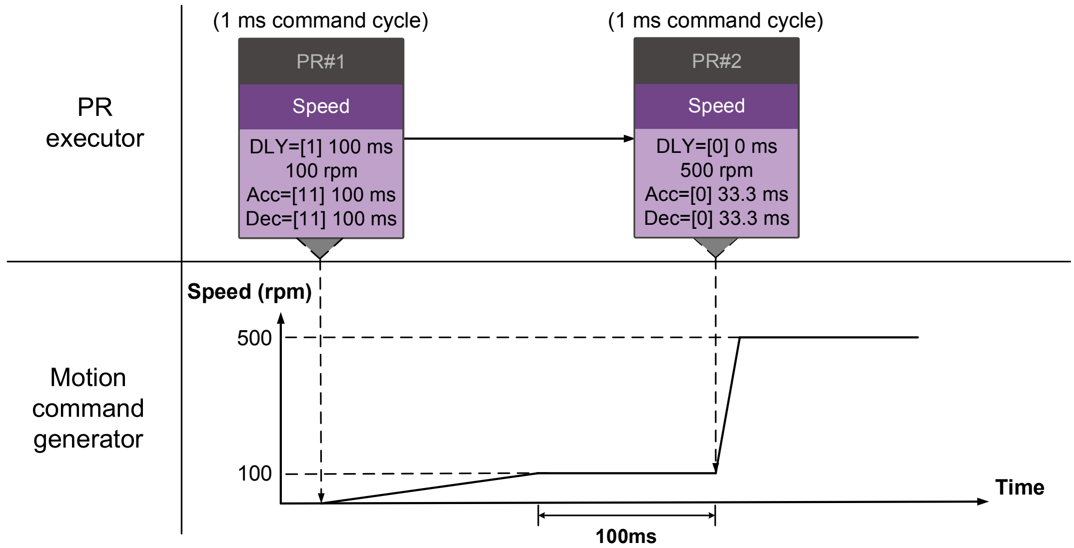
■ Speed command followed by a Speed command

When the PR executor receives two consecutive Speed commands, if they do not have Interrupt or Overlap functions, the PR executor issues the first Speed command to the motion command generator, and the generator starts the first part of speed control. After the first Speed command completes, if no delay time is set, the PR executor issues the second Speed command to the generator to start the second part of speed control (see Figure 7.1.6.3(a)).

If the first Speed command includes a delay, the PR executor starts counting the delay time right after the motor reaches the target speed. Then it issues the second Speed command to the generator for the second part of speed control as shown in Figure 7.1.6.3 (b).



(a) Speed command without delay



(b) Speed command with delay

Figure 7.1.6.3 Speed sequence command

7

■ Multiple commands

The PR queue updates commands every 1 ms. For a motion command, the PR queue sends the next command to the generator only after the previous command completes. Jump or Write commands are executed in the PR queue immediately.

As shown in Figure 7.1.6.4, in the first ms, the PR queue receives a Position command and it sends this command to the motion command generator, causing the generator to execute the command. In the second ms, the PR queue receives a Write command and executes it immediately. In the third ms, the PR queue receives a Jump command and executes it immediately as well. These last two commands are not sent to the motion command generator since the PR queue and the generator can execute commands independently. In the fourth ms, the PR queue receives a Position command. After the first Position command is completed, the PR executor sends it to the generator and the generator starts executing it immediately.

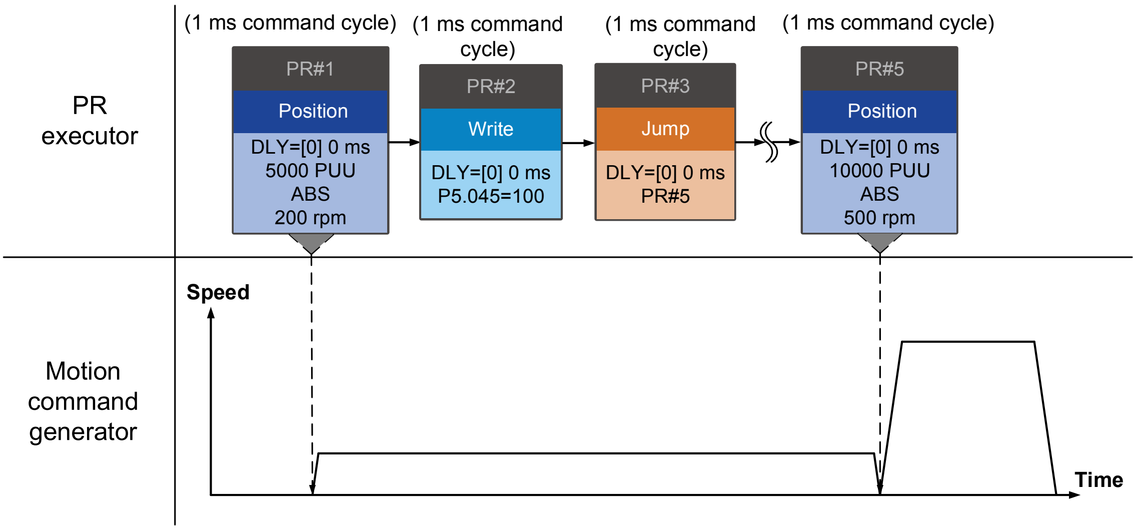


Figure 7.1.6.4 Sequence command – Multiple commands

7

Command interruption

Interruption (INS) causes a command in execution to be replaced or integrated. The results of the interruption differ based on the command types. The next command replaces the previous command. There are two types of interruption: internal and external, as shown in Figure 7.1.6.5.

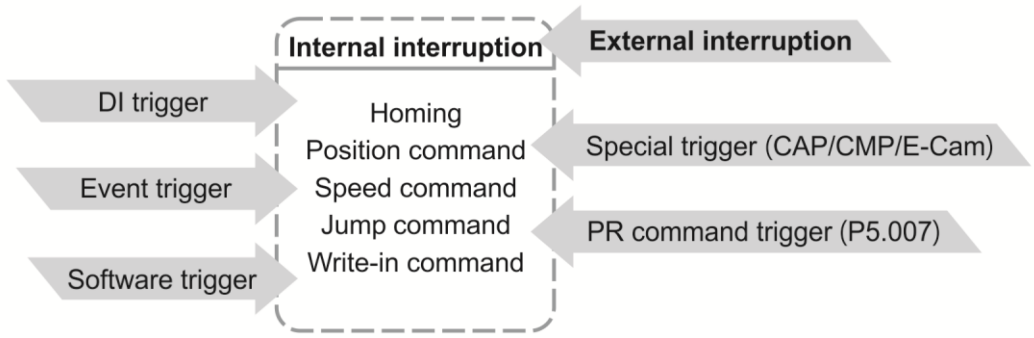


Figure 7.1.6.5 Internal and external interruption

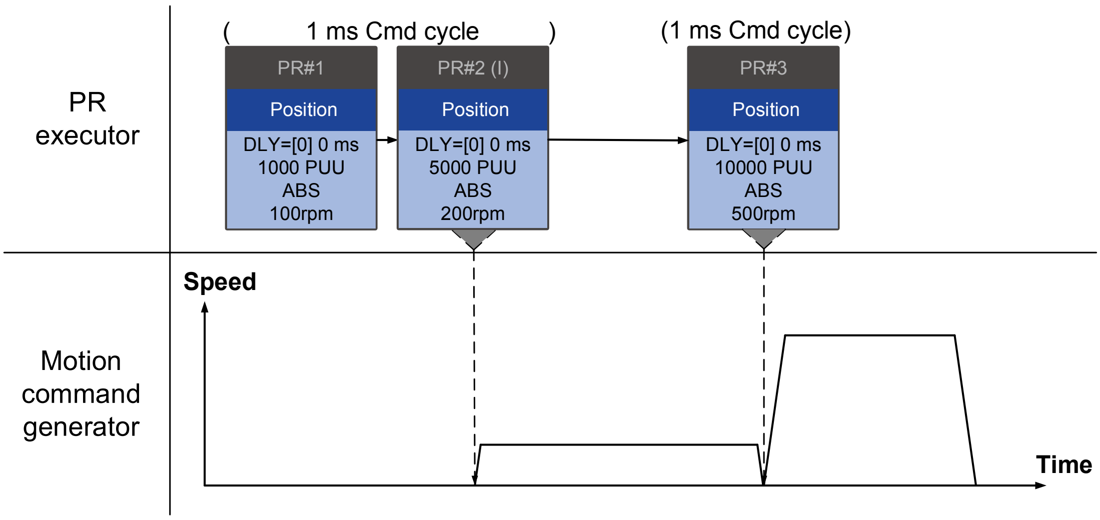
1. Internal Interruption

For a series of PR paths, if one PR path includes an AUTO function (auto-execute the next path), the system reads the next path after reading the current path. If the current path includes a delay, the next path is read after delay time is over. Meanwhile, if the next path includes an Interrupt function (which has a higher execution priority) the servo drive immediately executes the interrupt command. It replaces the un-executed part in the previous path with the next or integrates the commands in the execution of the previous path.

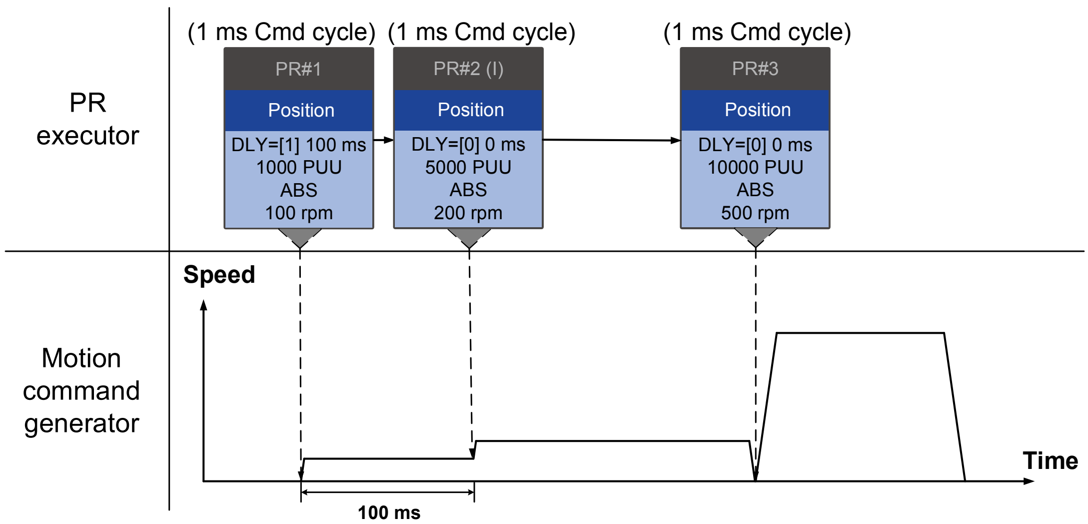
■ Position command ▶ Position command (I) ▶ Position command

When the PR executor receives three consecutive Position commands with an interrupt in the second command, the executor treats the first and the second Position commands as one PR group. Since the first Position command is not executed, the executor replaces the first command with the second. It only sends the second command to the motion command generator for execution. After the second command is completed, the executor sends the third command to the generator (see Figure 7.1.6.6 (a)).

If the first command includes a delay, then the PR executor sends the first command to the generator and then starts counting the delay time. After the delay is over, the PR executor then sends the second command and the generator starts the second part of position control. While the first command is still being executed, it is integrated with the second command. The integration is slightly different from what is described in Section 7.1.3. Please refer to the note below. Once the second command is completed, the executor sends the third command to the generator for execution (see Figure 7.1.6.6 (b)).



(a) Position command without delay



(b) Position command with delay

Figure 7.1.6.6 Internal interruption - Position command

Note: the integration for internal interrupt position command is slightly different from what is described in Section 7.1.3. The way REL and INC commands work is the identical. The target position is the previous target position plus the current position. See the example below. The rest of the integration method is the same as mentioned in Section 7.1.3.

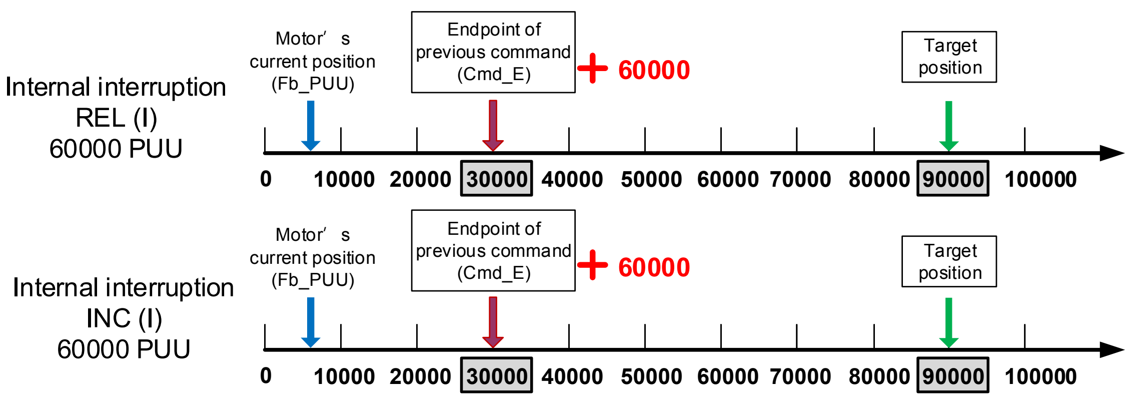
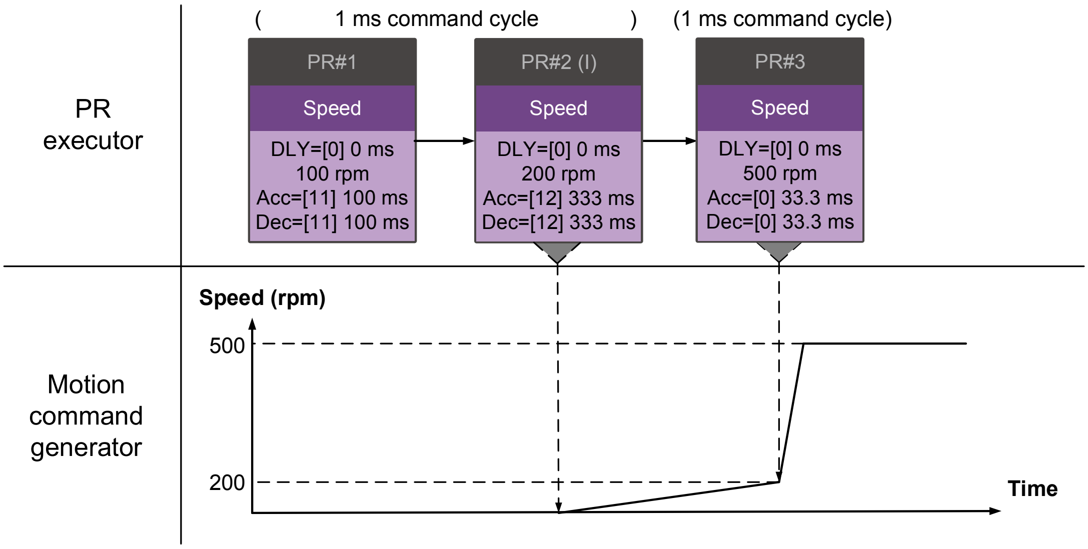


Figure 7.1.6.7 Example of relative and incremental position command for internal interruption

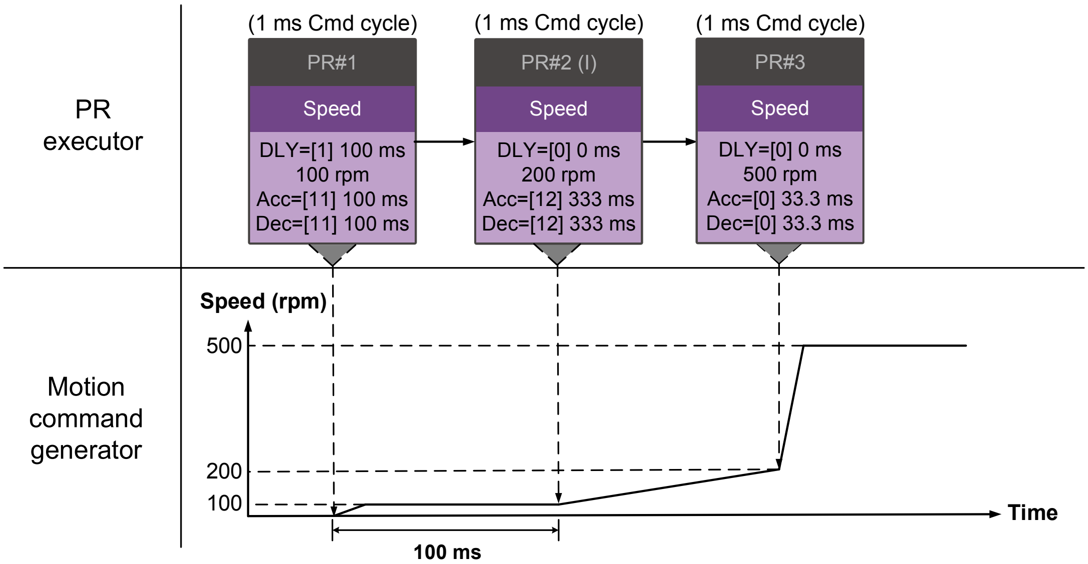
■ Speed command ▶ Speed command (I) ▶ Speed command

When the PR executor receives three consecutive Speed commands with an interrupt in the second command, the executor treats the first and the second as one PR group. Since the first Speed command is not executed, the executor replaces the first command with the second. It only sends the second command to the motion command generator for execution. After the second command is completed, the executor sends the third command to the generator (see Figure 7.1.6.8 (a)).

If the first command includes a delay, then the PR executor sends the first command to the generator and then starts counting the delay time. After the delay is over, it then sends the second command and the generator starts the second part of speed control. While the first command is still being executed, it is integrated with the second command. Once the second command is completed, the executor sends the third to the generator for execution (see Figure 7.1.6.8 (b)).



(a) Speed command without delay



(b) Speed command with delay

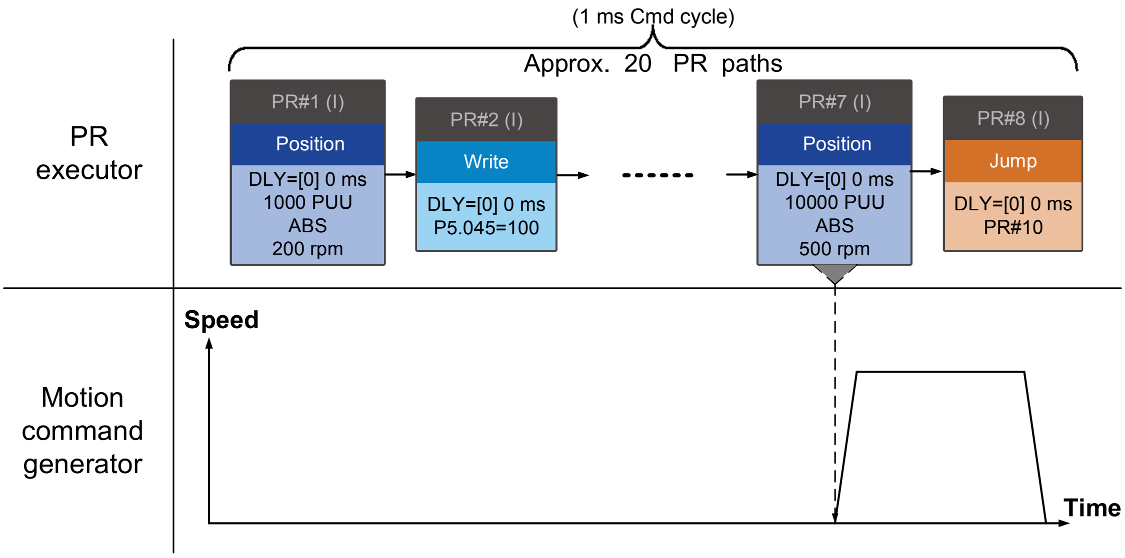
Figure 7.1.6.8 Internal interruption – Speed command

■ Multiple interrupt commands

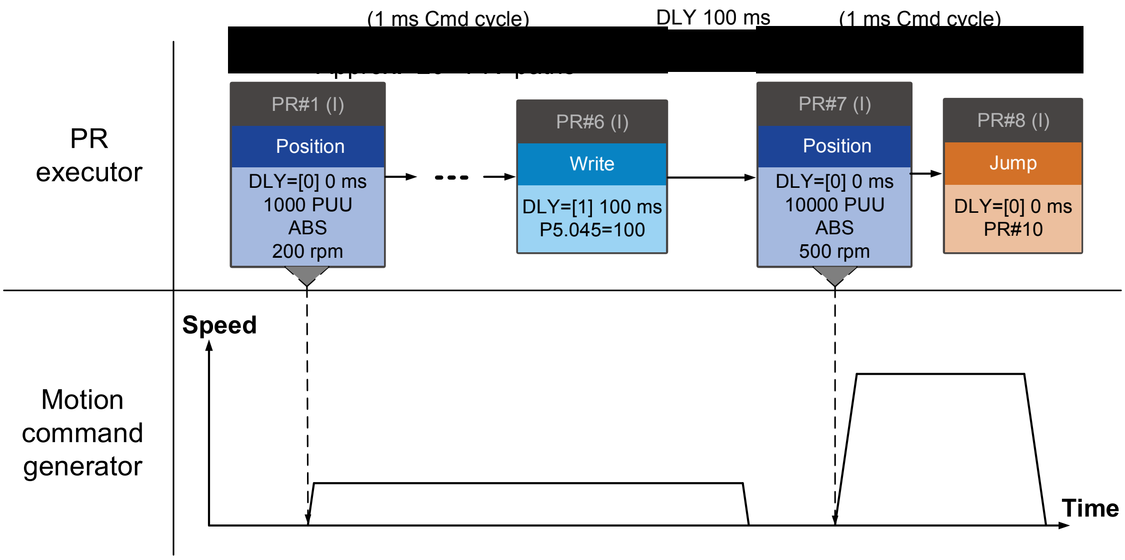
The PR queue updates once every 1 ms. If all PR paths include an Interrupt function, the queue can read at least 20 PR paths in 1 ms, and these paths are called a PR group.

If this PR group has multiple motion commands, the PR queue only sends the last command it receives to the motion command generator for execution. Therefore, in a PR group, only one PR path with motion command is executed. The latter motion command directly replaces the former, whereas Jump and Write commands are executed as soon as they are received by the PR queue (see Figure 7.1.6.9 (a)).

If one of the PR paths includes a delay, the PR queue schedules all paths on the basis of this PR path. The prior path(s) including a delay becomes as the first PR group, and what follows is the second PR group. Thus, this PR procedure can execute up to two PR paths with motion commands, as shown in Figure 7.1.6.9 (b).



(a) Multiple commands without delay



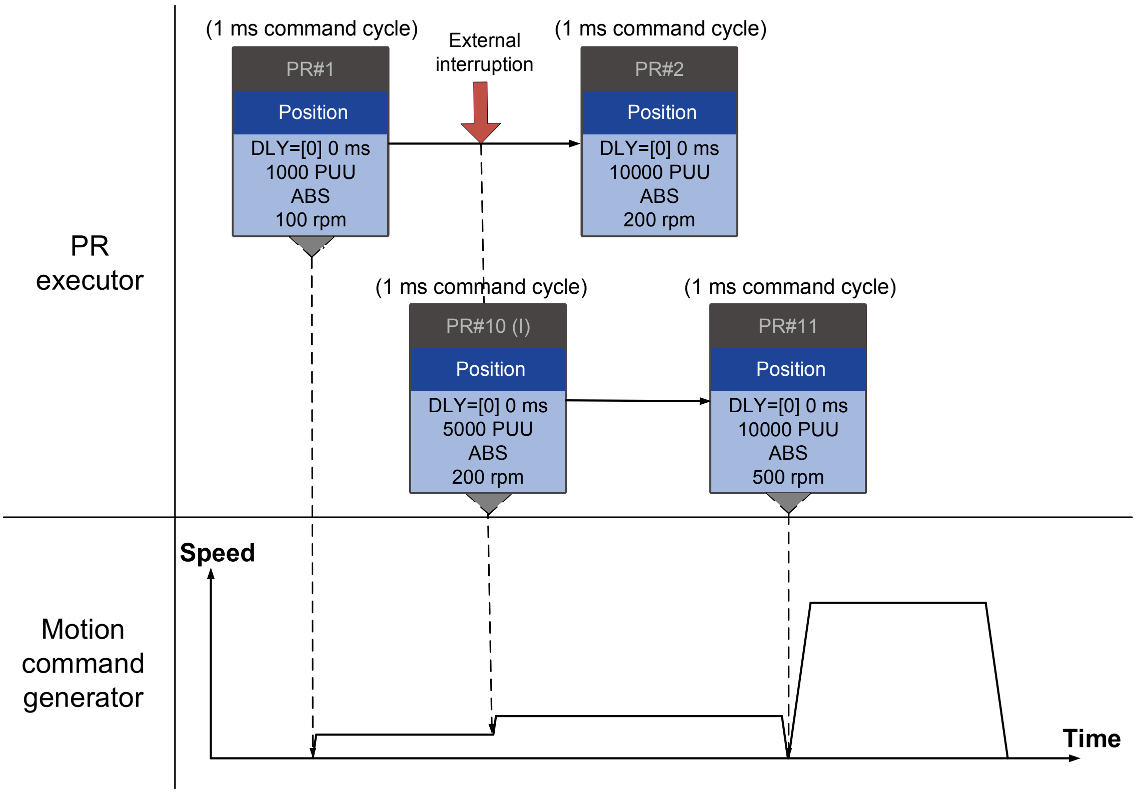
(b) Multiple commands with delay

Figure 7.1.6.9 Internal interruption – Multiple commands

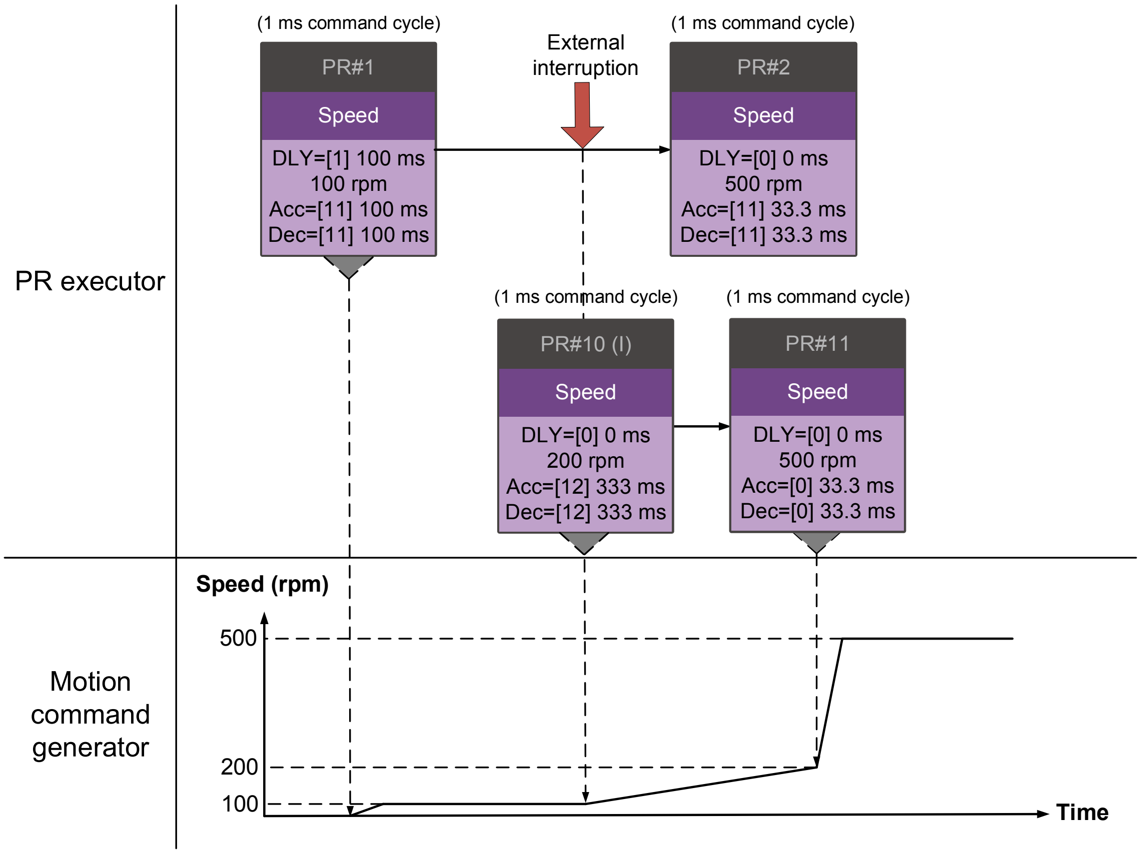
2. External Interruption

If an external interruption is encountered, it uses the PR Command trigger method to execute another PR path (refer to Section 7.1.5 for PR trigger methods). When the PR queue receives a PR path with an Interrupt function, it sends this path to the motion command generator immediately and changes the path in execution. Note that a delay does not change the result of an external interruption. That is, once the PR queue receives an external interruption command, the motion commands in the latter part are executed by the generator and integrated with the previous commands. The external interruption is as shown in Figure 7.1.6.10 (a).

If a PR path with external interruption enters the PR executor, the executor sends this Position command immediately to the generator so that the motor can run in accordance with the interruption. The motor uses the settings that integrate with the former motion commands when running. The methods of integration are described in Section 7.1.3. Similarly, an external interruption affects Speed and Position commands the same way and the same is true for multiple commands. See Figure 7.1.6.10(b) for an example.



(a) External interruption – Position command



(b) External interruption – Speed command

Figure 7.1.6.10 External interruption

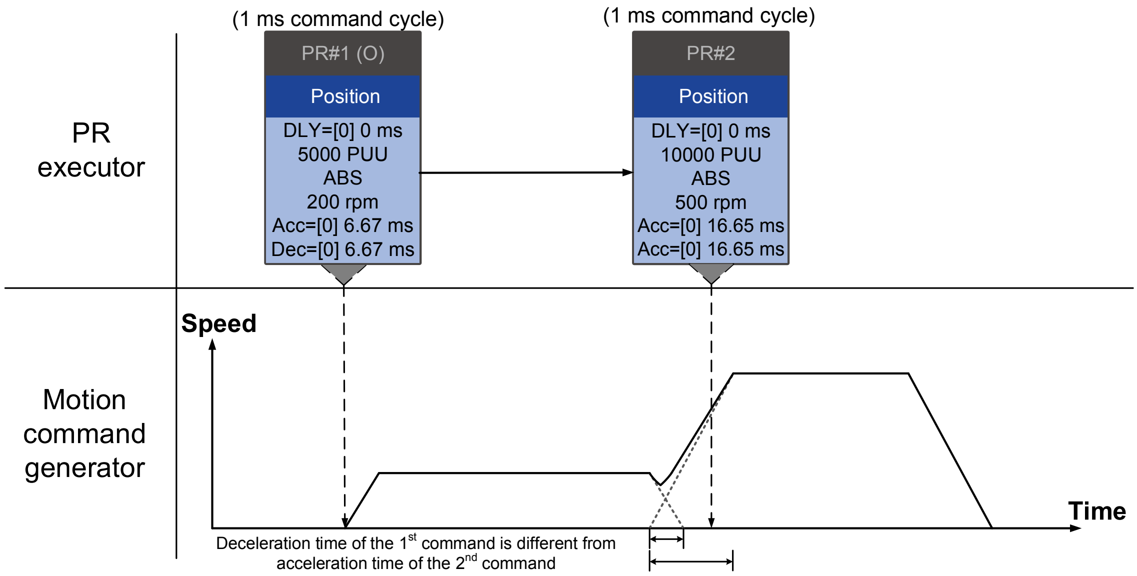
Overlap command

If the previous position command includes an Overlap function; it allows the next command to be executed while the previous motion is decelerating, thus achieving a continuous motion. When you use an Overlap command, the delay time is still effective. The delay time starts to count from the command's start point; however, in order to have the commands transition smoothly, setting the delay time of the previous command to 0 is suggested. In addition, if deceleration time of the previous command is identical to acceleration time of the next, the transition between commands can be very smooth, avoiding discontinuous speed during transition (see Figure 7.1.6.11). The calculation is as follows.

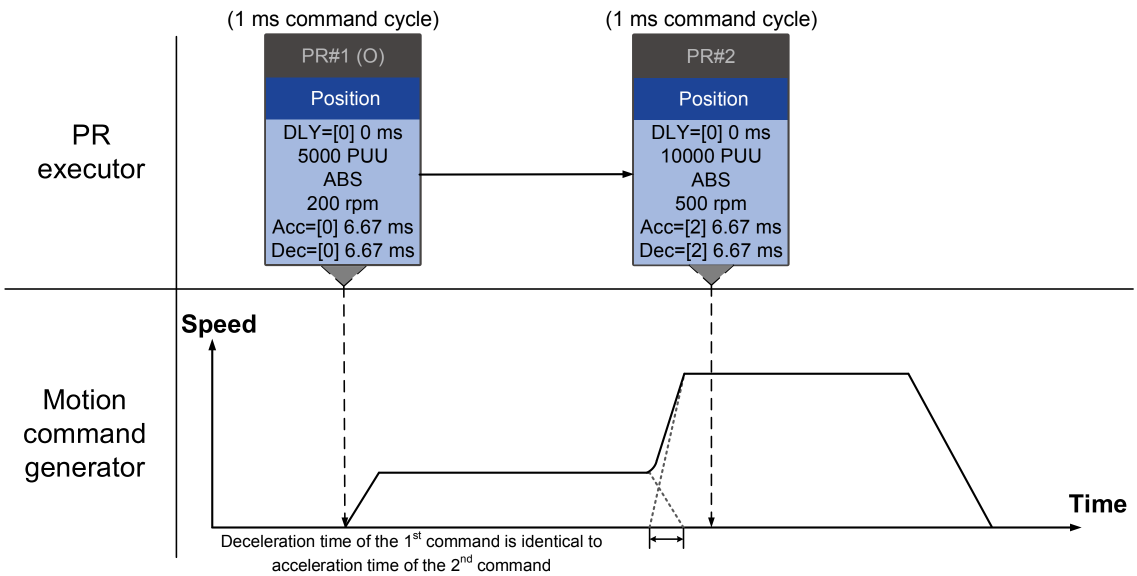
$$\frac{\text{1st target speed (Spd1)}}{3000} \times \text{Deceleration time } (Dec)$$

$$= \frac{\text{2nd target speed (Spd2)}}{3000} \times \text{Acceleration time } (Acc)$$

An Interrupt command has a higher priority than an Overlap command. Thus, when you set an Overlap function in the current Position command, and the next motion command includes an Interrupt function, only the command with the Interrupt function is executed.



(a) Overlap command - Acceleration and deceleration time are different



(b) Overlap command - Acceleration and deceleration time are identical

Figure 7.1.6.11 Overlap command

Arithmetic operations (Statement)

You can regard arithmetic operation commands as combinations of Write commands and Jump commands. Thus, the execution priority is the same as these two types of commands, which are executed by PR executor. Arithmetic operation commands can interrupt the previous command but cannot be interrupted by the following command. This ensures that all arithmetic operations are completed before the PR paths enter the PR queue. In other words, for a series of PR paths with both arithmetic operations and Interrupt functions, only the arithmetic operations commands of this PR path are executed in the first ms. The rest are sent to the PR queue in the next ms.

Therefore, the jump target PR number specified by the path with arithmetic operations is executed in the next ms (see Figure 7.1.6.12). If you have entered the triggering parameter in the Statement section, such as PR command trigger register (P5.007) (which has the highest execution priority and is processed as an external interruption) after the arithmetic operations are done, the path specified by PR command trigger register is executed in the next ms. The logic condition commands are not executed (see Figure 7.1.6.13).

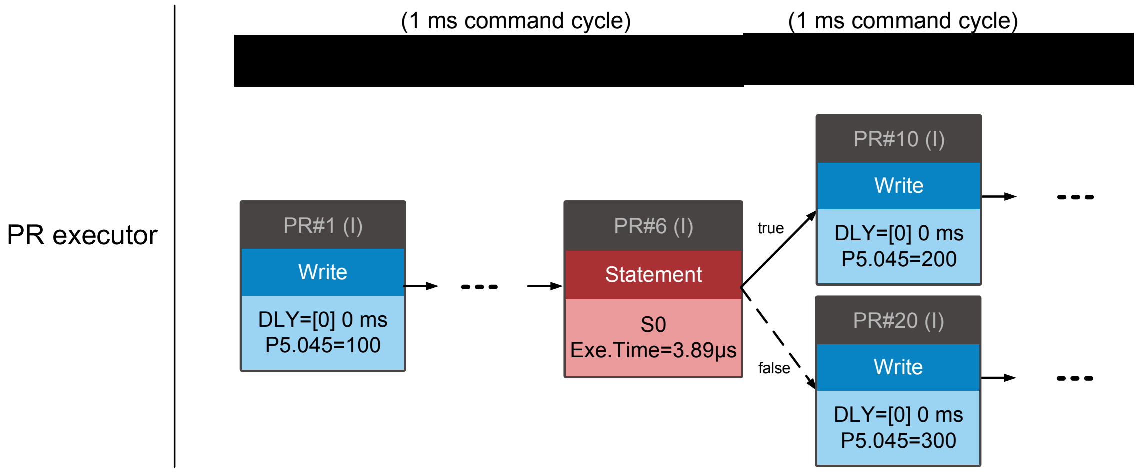


Figure 7.1.6.12 Multiple commands with arithmetic operations

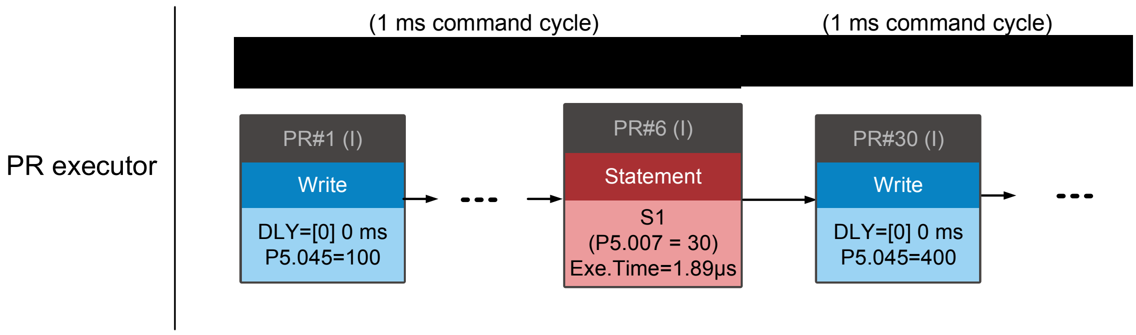


Figure 7.1.6.13 Writing trigger command in Statement section

7.2 Application of motion control

Applications of motion control in the ASDA-A3 include high-speed position capture (Capture), high-speed position comparing (Compare), and E-Cam. High-speed position capturing uses digital input (DI7) to capture the motor's feedback position instantly and store this position in the data array. For high-speed position comparing, it writes the specified motor position to the data array and outputs a high-speed digital signal (DO4) once the motor feedback position reaches this specified position. The purpose of E-Cam is to create an E-Cam curve according to the correlation between the Master and the Slave, and then store the curve in the data array. The Slave axis refers to the Master axis' position and moves to the position specified by the E-Cam. You can find more details about the setting and how it works in the following sections.

7.2.1 Data array

The data array can store up to 800 32-bit data (0–799). You can use it to store the high-speed capture data and high-speed compare data as well as the E-Cam curves. You have to segment the space for these three functions as their individual spaces are not defined by default. This prevents overwriting or accidentally changing any data. You can set P2.008 to 30 and then 35 or use ASDA-Soft to write the data to EEPROM; otherwise, the data is not saved after you turn the power off. ASDA-Soft includes a user-friendly screen for reading and writing the data array. See the following figure.

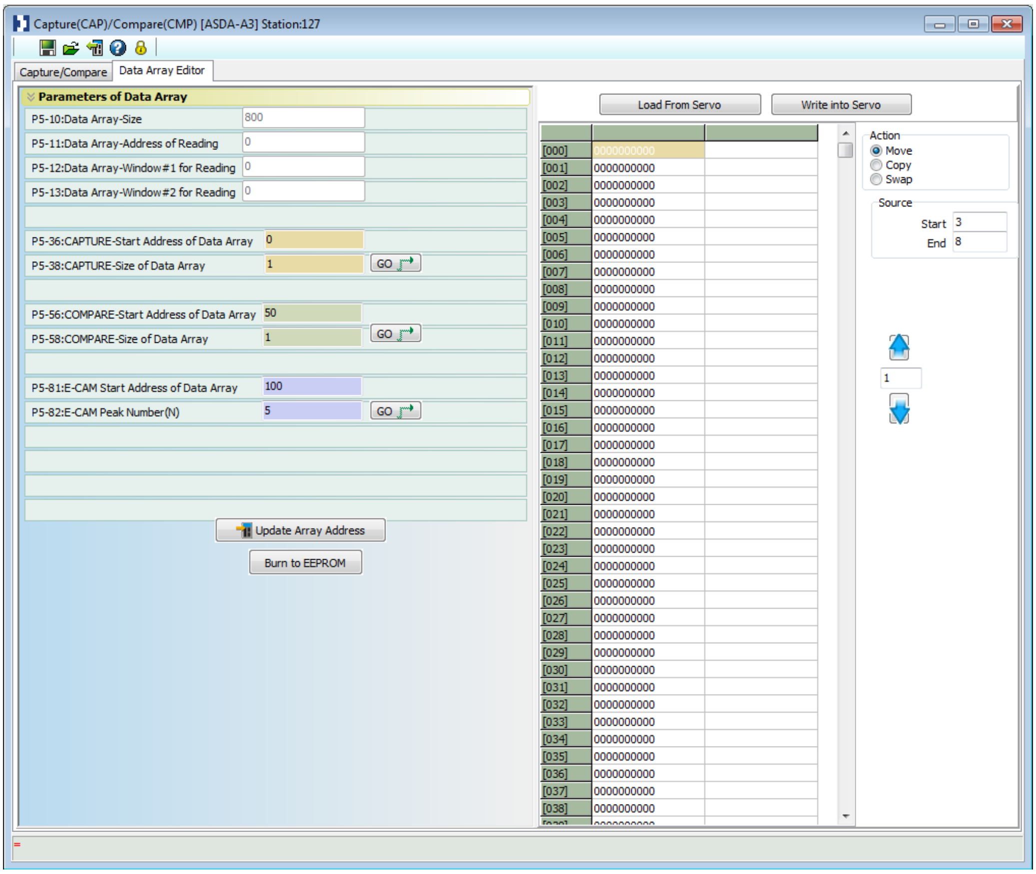


Figure 7.2.1.1 Data Array screen in ASDA-Soft

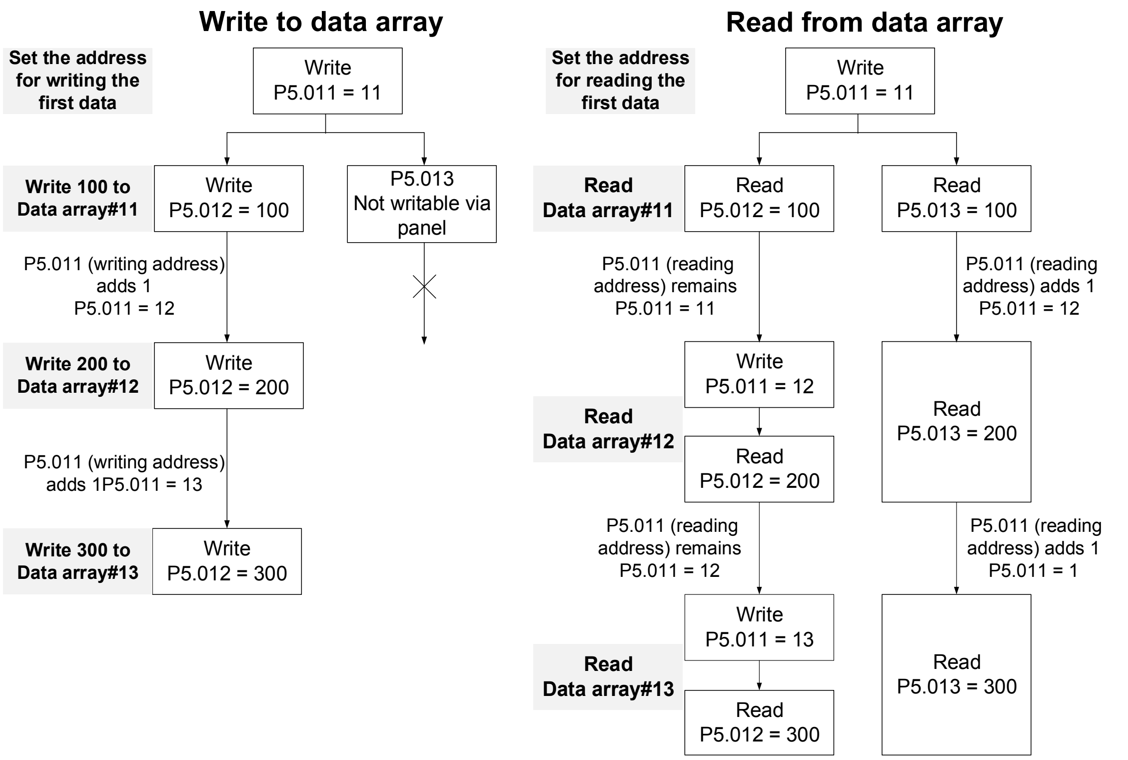
With two channels available, you can use the panel, communication, or ASDA-Soft to read data from, or write data to, the data array. You can set channel 1 with P5.011, P5.012, and P5.013. P5.011 specifies the address for reading and writing the data array. P5.012 and P5.013 define the windows for reading and writing. You can use both to read and write, but the behaviors after reading and writing differ. Please refer to Table 7.2.1.1. You can set channel 2 by P5.011 and P5.100–103. P5.011 sets the address for reading and writing the data array. P5.100 can read data from, or write data to, the data array address following the address set by P5.011. P5.012 and P5.103 work the same way. If the address number has reached the maximum (799), then the address remains at 799 instead increasing. You can find more details in Table 7.2.1.2.

Table 7.2.1.1 Channel 1 – reading / writing the data array

Parameter	Description		
P5.011 Address for reading / writing	Specify the address for reading from or writing to the data array		
Window for reading / writing	by	Behavior after reading	Behavior after writing
P5.012 Window #1 for reading / writing	Panel	Value of P5.011 does not add 1	Value of P5.011 adds 1
	Communication / ASDA-Soft	Value of P5.011 adds 1	Value of P5.011 adds 1
P5.013 Window #2 for reading / writing	Panel	Value of P5.011 adds 1	Cannot be written with the drive panel
	Communication / ASDA-Soft	Value of P5.011 adds 1	Value of P5.011 adds 1

- Example: when using the drive panel or communication for reading from or writing to the data array, input values to the data array address in sequence as follows: Data array #11 = 100, Data array #12 = 200, Data array #13 = 300. Then the data is read in sequence.

1. Read / write via panel:



2. Read and write using communication:

Reading and writing using communication requires Modbus communications. You can use the communication command 0x10 to write consecutively, 0x06 to write single data, and 0x03 to read consecutive data. First, use a consecutive writing command to write 100 to Data array #11, 200 to Data array #12, and 300 to Data array #13. When reading, use a single data writing command to set the start address as Data array #11, then use a consecutive reading command to read P5.011–P5.013 (Data array #11 and #12). This reads two values, so P5.011 is incremented by 2 and then it reads Data array #13.

Writing to the data array									
Packet	Communi-cation Cmd	Start Address	Data Size	P5.011		P5.012		P5.013	
				Low bit	High bit	Low bit	High bit	Low bit	High bit
1	0x10	P5.011	6 words	11	0	100	0	200	0
2	0x10	P5.011	6 words	13	0	300	0	0	0
Reading the data array									
Packet	Communi-cation Cmd	Start Address	Data size	P5.011		P5.012		P5.013	
				Low-bit	High-bit	Low bit	High bit	Low bit	High bit
4	0x06	P5.011	-	11	0	-	-	-	-
5	0x03	P5.011	6 words	11	0	100	0	200	0
6	0x03	P5.011	6 words	13	0	300	0	0	0

Table 7.2.1.2 Channel 1 – reading and writing the data array

Parameter	Description	Example 1		Example 2	
P5.011 Read / write address	Specify the address for reading from or writing to the data array	200		797	
Parameter	**Description**	**Example 1**		**Example 2**	
		Address	Content	Address	Content
P5.100 Window #3 for reading / writing	Read from or write to the address specified by P5.011.	200	1234	797	5678
P5.101 Data array - Window #4 for reading / writing	Read from or write to the first address following the address specified by P5.011.	201	2345	798	6789
P5.102 Data array - Window #5 for reading / writing	Read from or write to the second address following the address specified by P5.011.	202	3456	799	7890
P5.103 Data array - Window #6 for reading / writing	Read from or write to the third address following the address specified by P5.011.	203	4567	x	0

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7.2.2 High-speed position capturing function (Capture)

The high-speed position capturing function (CAP) uses the external-triggered high speed digital input DI7 (with execution time of only 5 μs) to capture the position data of the motion axis and store it in the data array for further motion control. As the Capture function is executed by the hardware, there is no lag in the software, and it is able to capture the motion axis' position accurately. While the Capture function is enabled, the servo drive sends a DI7 signal for the capture signal (D17 is not user-defined).

The flow chart for high-speed position capturing is shown in Figure 7.2.2.1. The relevant parameters are defined as follows. P5.036 stores the start position for capturing in the data array; if it is not set, the default start position is #0. P5.038 sets the capturing amount. The amount has to be greater than 0, otherwise the Capture function is not executed. P1.019.X enables the cycle mode. When the last data is captured, the capturing amount is reset to 0 (P5.038 = 0), and the next cycle starts automatically to capture the set capturing amount. However, the start capturing position is still determined by P5.036; that is, the captured data in previous cycle is replaced by the data captured in the next cycle. P5.039 enables and disables the Capture function and other settings. See the following table for more information. To capture multiple position data, you can use P1.020 to set the masking range for capturing. This prevents the same position data being captured repeatedly because capturing more than once is not allowed in the masked area. You can set the Capture function in ASDA-Soft, as shown in figure 7.2.2.2.

P5.039	bit	Function	Description
X	0	Enable Capture function	When P5.038 > 0 and bit 0 = 1, the capturing starts and DO.CAP_OK is off. Each time a position is captured, value of P5.038 is decremented by 1. When P5.038 = 0, it means the capturing is finished, DO.CAP_OK is on, and bit 0 is reset to 0. If bit 0 is already 1, the written value must not be 1; you must write 0 to disable the Capture function.
	1	Reset position when first data is captured	If bit 1 = 1, after the first data is captured, set Capture axis' position to the value of P5.076.
	2	Enable Compare function after first data is captured	If bit 2 = 1, when the first data is captured, enable the Compare function (P5.059.X bit 0 = 1 and P5.058 resets to the previous value). If the Compare function is already enabled, then this bit function is invalid.
	3	Execute PR#50 after the last data is captured	If bit 3 = 1, execute PR#50 once all data are captured.
Y	-	Source of Capture axis	0: disabled 1: auxiliary encoder (CN5) 2: pulse command (CN1) 3: main motor encoder (CN2)
Z	-	Trigger logic	0: NO (normally open) 1 : NC (normally closed)
U	-	Minimum trigger interval (ms)	-

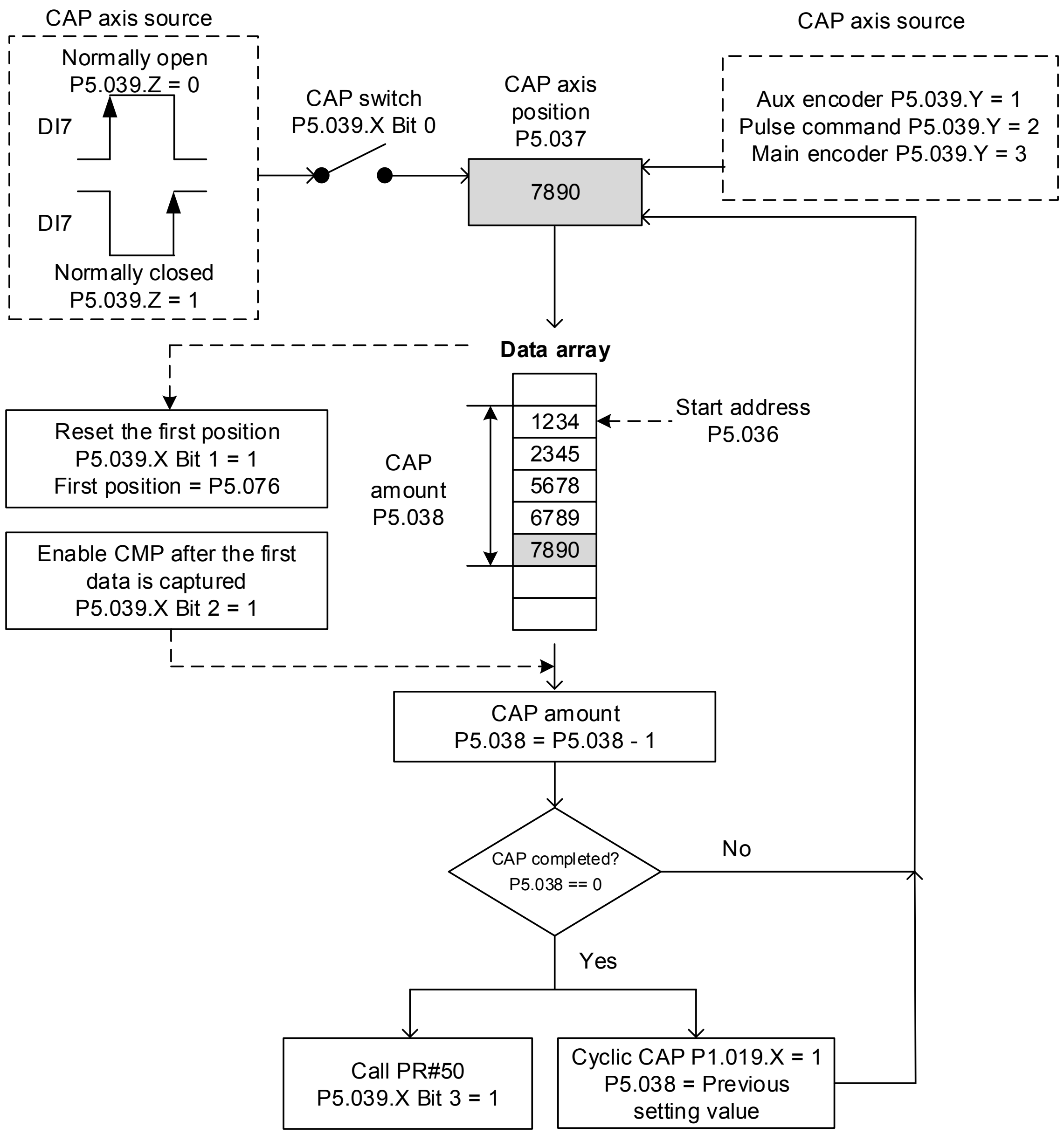

Figure 7.2.2.1 Flow chart for high-speed position capturing

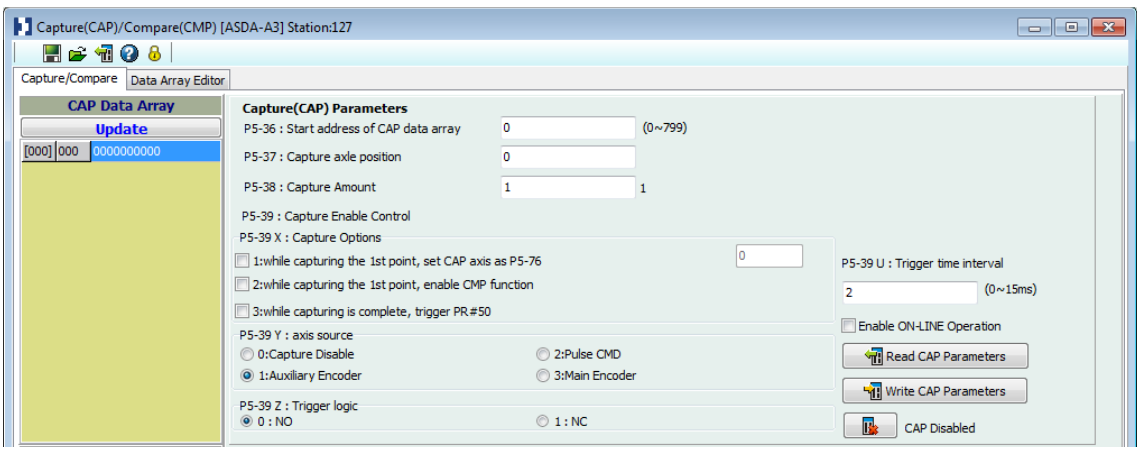

Figure 7.2.2.2 Capture Function screen in ASDA-Soft

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It is suggested that you use PR path programming to use the motion commands with the Capture function. You can use Write commands to set the high-speed position Capture function, as well as to execute motion commands once capturing is completed. See the example in Figure 7.2.2.3. PR#1 confirms that the Capture function is disabled (P5.039.X Bit 0 = 0). PR#2 sets the start position of data array to #100. PR#3 sets the capturing amount to 3. PR#4 sets the capturing axis' position to 0 for the first capture point. PR#5 sets the cyclic capture mode with delay time of 1 ms to ensure that the next PR path can be executed with the Capture function. PR#6 enables the Capture function and resets the first point; and once completed, continue executing PR#50. This selects the motor's encoder as the capturing axis, using 'normally closed' contact as the trigger logic with a trigger interval of 2 ms. PR#7 sets the Speed command to 50 rpm. PR#50 sets the capture Position command to 50000 PUU Once the command is completed, continue to PR#51 with the Speed command setting at 50 rpm.

From Figure 7.2.2.4, you see that after DI7 is triggered, the capturing axis is reset to 0 and the data stored in data array #100 because the Reset function for the first point is enabled, and P5.076 is set to 0. At the moment DI7 is triggered the second and third time, the position data is written to the data array #101 and #102. Once the first capture cycle is completed, DO: [0x16]CAP is set to on and then PR#50 (high speed position capture command) and PR#51 (motion with fixed speed) are executed. Then, the servo drive continues executing the next cycle; meanwhile, DO: CAP is set to off when procedure is completed and that the capturing amount is set to 3. When DI7 is triggered for the fourth time, the capture axis' position is not reset; the position data of the capturing axis is written to #100 again. Therefore, the data written in the previous cycle is replaced. At the moment DI7 is triggered the fifth and sixth time, the position of the capturing axis is stored in data array #101 and #102. As soon as the second capture cycle is finished, DO: [0x16]CAP is set to on and then PR#50 (high-speed position capture command) and PR#51 (motion with fixed speed) are executed.

When using Cyclic Capture mode (P1.019.X = 1), the Reset function is only valid for the first cycle. Executing the PR path is valid for every cycle; in other words, every time a cycle ends, PR#50 is executed. The first position data captured in every cycle is written to the data array set by P5.036, and then the other data is written in sequence. So, position data written in the previous cycle is always replaced by the position data of the next cycle.

7

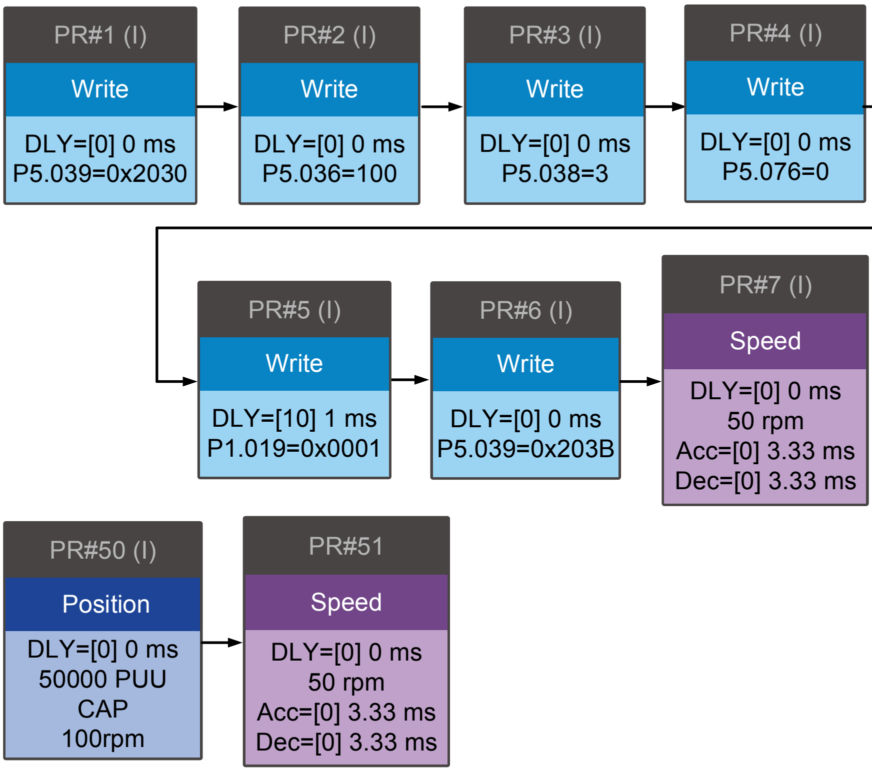

Figure 7.2.2.3 PR path with application of high-speed capture function

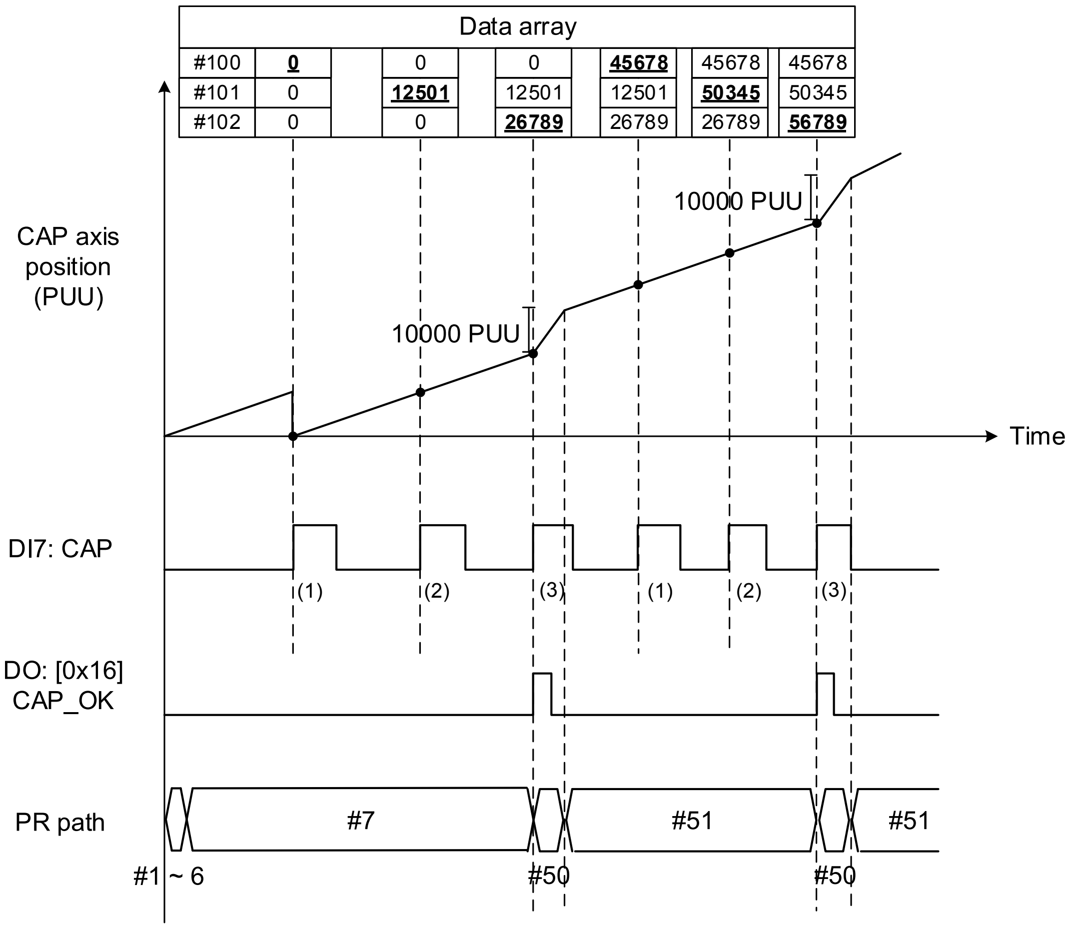

Figure 7.2.2.4 Application example for high-speed capturing function

7.2.3 High-speed position comparing function (Compare)

The purpose of high-speed position comparing (CMP) is to compare the instant position of the motion axis with the value saved in the data array. When the compare condition is fulfilled (DO4 with execution time of only 5 μs), a high-speed digital signal is sent immediately for motion control. Since this function is carried out by the hardware, there is no lag in the software and the position compare is more accurate on high speed motion axes. When the Compare function is enabled, the servo drive outputs DO4, which is not user-defined.

As shown in Figure 7.2.3.1 Flow chart for the high-speed Compare function, P5.056 stores the start position of the data array for comparing (default is #50 in the data array). You must write the position data to be compared to the data array before comparing. P5.058, the data size to be compared, must be greater than 0, or the function is invalid. P5.059 is the switch of the Compare function and for other settings. You can find more information in the table below. Please note that when the comparing source is the encoder, the pulse resolution of the comparing axis is set by P1.046 (numerator) and P1.097 (denominator) with default value of 2500 and 0 respectively; that is, the moving distance of the comparing axis is 10000 PUU per rotation of motor. The comparing position in the data array can be shifted using P1.023 (non-volatile) and P1.024 (volatile). You can reset P1.024 to 0 after the shift, and you can enable this function with P1.019.Z. You can also set the Compare function through ASDA-Soft, as shown in Figure 7.2.3.2.

P5.059	bit	Function	Description
X	0	Enable high-speed position compare function	When P5.058 is greater than 0 and bit 0 is set to 1, the comparing starts. The value of P5.058 decreases 1 every time a point in data array is compared. When P5.058 becomes 0, bit 0 is automatically cleared to 0. If bit 0 is 1, the new value to be written cannot be 1; you can only write 0 to disable the Compare function.
	1	Cycle mode	If bit 1 is set to 1 and all compare procedures are completed, P5.058 resets to the setting value and then the compare procedure starts again.
	2	Enable Capture function after data compared	If bit 2 is 1, after all comparing is done, enable the Capture function (Set P5.039.X bit 0 to 1, and set the previous value to P5.038 as the data size to be captured); if Capture function has been enabled, then this function is invalid.
	3	Reset position for the comparing axis to 0	If bit 3 is 1, set P5.057 to 0 once comparing is completed, the position for the comparing axis is reset to 0.
Y	-	Source setting of comparing axis	0: capturing axis 1: auxiliary encoder (CN5) 2: pulse command (CN1) 3: motor encoder (CN2) If capturing axis is selected, the source of the capturing axis (P5.039.Y) cannot be changed. If the motor encoder is selected, the pulse resolution is determined by P1.046 (Encoder pulse number output setting) and P1.097.

P5.059	bit	Function	Description
Z	-	Trigger logic	0: NO (normally open); 1：NC (normally closed)
U	-	Trigger PR path	If bit 0 is set to 1, PR#45 is triggered once the last data is compared.
CBA	-	Pulse output duration (ms)	-

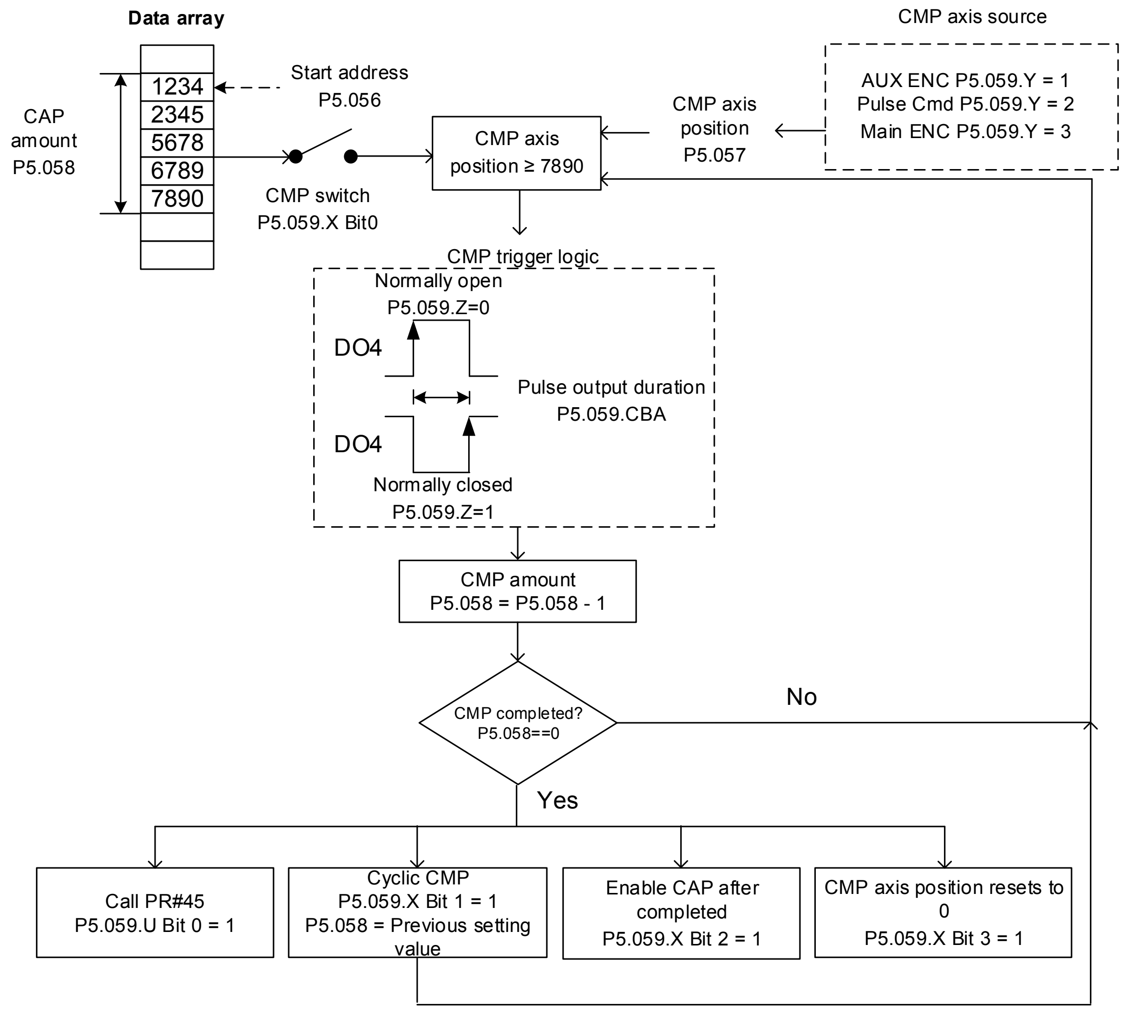

Figure 7.2.3.1 Flow chart for the high-speed position Compare function

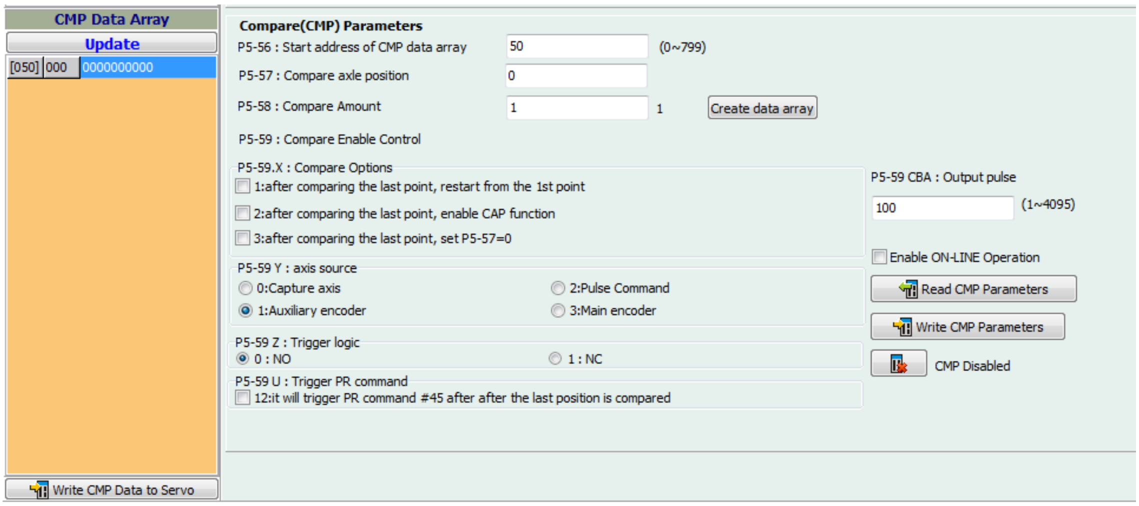

Figure 7.2.3.2 Compare Function screen in ASDA-Soft

It is suggested that you use PR path programming to use motion commands with the Compare function. You can use Write commands to edit the contents of the data array and set the high-speed position Compare function, as well as executing the motion command. As shown in Figure 7.2.3.3, you set the numerator (P1.046) and denominator (P1.097) for the encoder's pulse output (the default is based on the comparing axis runs of 10000 pulses per rotation of the motor). PR#1 - 3 use Write commands to edit data array #50 - 52. PR#4 confirms that the Compare function is disabled (P5.039.X Bit 0 = 0). PR#5 sets the start position to #50. PR#6 sets the comparing amount to 3 and sets a delay of 1 ms to ensure that the PR path using the Compare function can be executed. PR#7 enables the Compare function in Cycle mode which resets the comparing axis to 0 after the comparison is completed, and executes PR#45. It selects the motor encoder as the capturing axis, setting 'normally closed' as the trigger logic with pulse output duration of 100 ms. PR#8 sets the Speed command to 50 rpm. PR#45 sets the Incremental command to 50000 PUU and then PR#46 keeps the Speed command setting at 50 rpm.

From Figure 7.2.3.4, you see that when the comparing axis runs to 20000 pulses, it is identical to the contents of data array #50 and the first DO4 is set to on. When the comparing axis runs to 30000 pulses, it is identical to the contents of data array #51 and the second DO4 is set to on. While comparing axis runs to 40000 pulses, it is identical to the contents of data array #52 and the third DO4 is set to on. Once the first cycle completes, the comparing axis resets to 0 and executes PR#45 (Incremental command 50000 PUU), which is equivalent to a half turn of the motor. Therefore, the comparing axis outputs 5000 pulses, and after the position command completes, it executes the Speed command. Then the next comparing cycle starts. This is the same as the first cycle, and the comparing axis outputs DO4 signal at 20000, 30000, and 40000 pulses respectively and then it resets to 0 and executes PR#45.

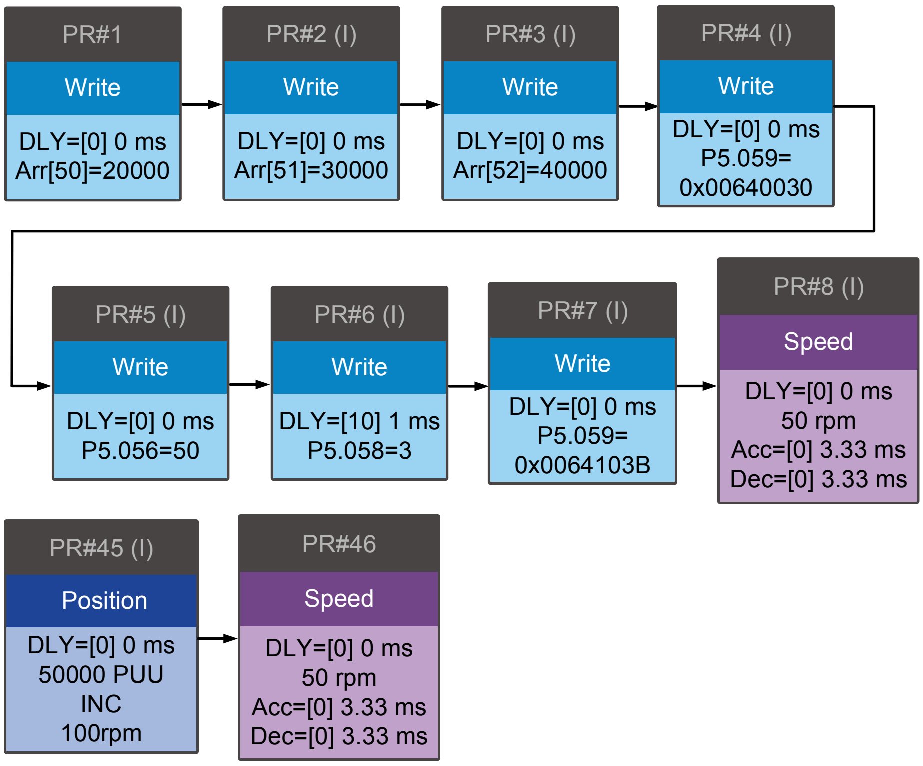

Figure 7.2.3.3 PR path using the Compare function

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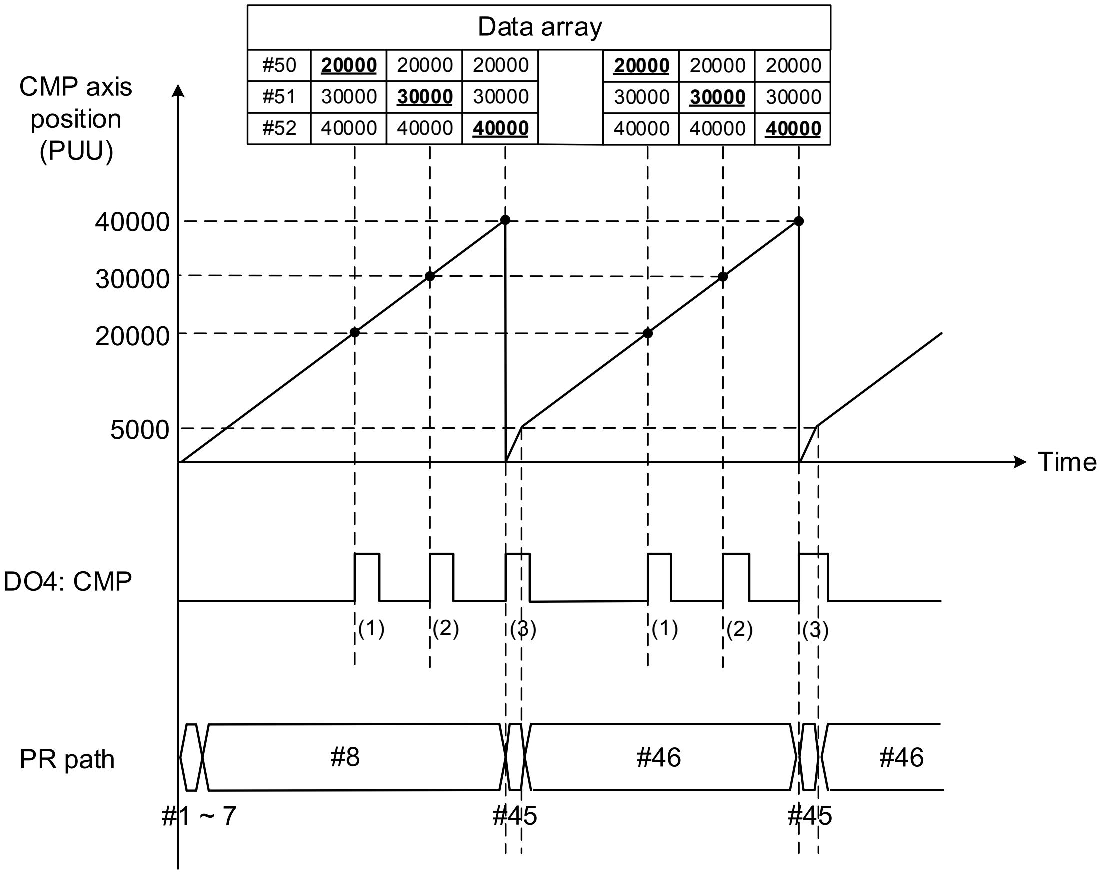

Figure 7.2.3.4 Timing of the Compare function

Parameters

8

This chapter introduces the parameter settings of the servo drive, as well as the descriptions for digital input (DI) and digital output (DO). You control the drive functions with these parameters and DI/O.

8

8.1 Parameter definitions

The servo drive parameters are divided into eight groups. The first character after the start code P is the group character and the following three characters are the parameter indicator. The communication address is the combination of the group number and the three-digit number, expressed in hexadecimal. The parameter groups are:

Group 0: Monitoring parameters	(Example: P0.xxx)
Group 1: Basic parameters	(Example: P1.xxx)
Group 2: Extension parameters	(Example: P2.xxx)
Group 3: Communication parameters	(Example: P3.xxx)
Group 4: Diagnosis parameters	(Example: P4.xxx)
Group 5: Motion control parameters	(Example: P5.xxx)
Group 6: PR parameters	(Example: P6.xxx)
Group 7: PR parameters	(Example: P7.xxx)

Control mode description:

PT: Position control (command input through terminal block)

PR: Position control (command sent from internal register)

S: Speed control

T: Torque control

DMC: DMCNET control

Special symbol description:

Icon of parameter property	Description
★	Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, P4.000, etc.
▲	Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.
•	Parameter changes become valid after cycling the power. For example, P1.000 and P3.000.
■	Parameter resets to its default value after cycling the power. For example, P2.031 and P3.006.

8.2 List of parameters

8

Monitor and general output parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P0.000★	Firmware version	Factory setting	-	O	O	O	O
P0.001■	Current drive alarm code (Seven-segment display)	-	-	O	O	O	O
P0.002	Drive status	00	-	O	O	O	O
P0.003	Analog output monitoring	01	-	O	O	O	O
P0.008★	Total servo drive operation time	0	hour	-	-	-	-
P0.009★	Status monitoring register 1	-	-	O	O	O	O
P0.010★	Status monitoring register 2	-	-	O	O	O	O
P0.011★	Status monitoring register 3	-	-	O	O	O	O
P0.012★	Status monitoring register 4	-	-	O	O	O	O
P0.013★	Status monitoring register 5	-	-	O	O	O	O
P0.017	Select content displayed by status monitoring register 1	0	-	-	-	-	-
P0.018	Select content displayed by status monitoring register 2	0	-	-	-	-	-
P0.019	Select content displayed by status monitoring register 3	0	-	-	-	-	-
P0.020	Select content displayed by status monitoring register 4	0	-	-	-	-	-
P0.021	Select content displayed by status monitoring register 5	0	-	-	-	-	-
P0.025	Mapping parameter #1	-	-	O	O	O	O
P0.026	Mapping parameter #2	-	-	O	O	O	O
P0.027	Mapping parameter #3	-	-	O	O	O	O
P0.028	Mapping parameter #4	-	-	O	O	O	O
P0.029	Mapping parameter #5	-	-	O	O	O	O
P0.030	Mapping parameter #6	-	-	O	O	O	O
P0.031	Mapping parameter #7	-	-	O	O	O	O
P0.032	Mapping parameter #8	-	-	O	O	O	O
P0.035	Target setting for mapping parameter P0.025	-	-	O	O	O	O
P0.036	Target setting for mapping parameter P0.026	-	-	O	O	O	O
P0.037	Target setting for mapping parameter P0.027	-	-	O	O	O	O
P0.038	Target setting for mapping parameter P0.028	-	-	O	O	O	O

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Monitor and general output parameters (continued)

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P0.039	Target setting for mapping parameter P0.029	-	-	O	O	O	O
P0.040	Target setting for mapping parameter P0.030	-	-	O	O	O	O
P0.041	Target setting for mapping parameter P0.031	-	-	O	O	O	O
P0.042	Target setting for mapping parameter P0.032	-	-	O	O	O	O
P0.046★	Servo drive digital output (DO) status	0	-	O	O	O	O
P1.101	Analog monitor output voltage 1	0	mV	O	O	O	O
P1.102	Analog monitor output voltage 2	0	mV	O	O	O	O

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, P4.000, etc.
(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.
(●) Parameter changes become valid after cycling the power. For example, P1.001 and P3.000.
(■) Parameter resets to its default value after cycling the power. For example, P2.031 and P3.006.

Filter and resonance suppression parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.006	Speed command smoothing constant (Low-pass filter)	0	ms	-	-	O	-
P1.007	Torque command smoothing constant (Low-pass filter)	0	ms	-	-	-	O
P1.008	Position command smoothing constant (Low-pass filter)	0	10 ms	O	O	-	-
P1.025	Low-frequency vibration suppression frequency (1)	1000	0.1 Hz	O	O	-	-
P1.026	Low-frequency vibration suppression gain (1)	0	-	O	O	-	-
P1.027	Low-frequency vibration suppression frequency (2)	1000	0.1 Hz	O	O	-	-
P1.028	Low-frequency vibration suppression gain (2)	0	-	O	O	-	-
P1.029	Auto low-frequency vibration suppression mode	0	-	O	O	-	-
P1.030	Low-frequency vibration detection	500	pulse	O	O	-	-
P1.034	S-curve acceleration constant	200	ms	-	-	O	-
P1.035	S-curve deceleration constant	200	ms	-	-	O	-
P1.036	S-curve acceleration / deceleration constant	0	ms	-	O	O	-
P1.062	Percentage of friction compensation	0	%	O	O	O	O
P1.063	Constant of friction compensation	1	ms	O	O	O	O
P1.068	Position command - Moving filter	4	ms	O	O	-	-
P1.075	Low-pass filter time constant for full- and half-closed loop control	100	ms	O	O	-	-
P1.089	First set of vibration elimination - Anti-resonance frequency	4000	0.1 Hz	O	O	-	-
P1.090	First set of vibration elimination - Resonance frequency	4000	0.1 Hz	O	O	-	-
P1.091	First set of vibration elimination - Resonance difference	10	0.1 dB	O	O	-	-

Filter and resonance suppression parameters (continued)

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.092	Second set of vibration elimination - Anti-resonance frequency	4000	0.1 Hz	O	O	-	-
P1.093	Second set of vibration elimination - Resonance frequency	4000	0.1 Hz	O	O	-	-
P1.094	Second set of vibration elimination - Resonance difference	10	0.1 dB	O	O	-	-
P2.023	Notch filter frequency (1)	1000	Hz	O	O	O	O
P2.024	Notch filter attenuation level (1)	0	-dB	O	O	O	O
P2.043	Notch filter frequency (2)	1000	Hz	O	O	O	O
P2.044	Notch filter attenuation level (2)	0	-dB	O	O	O	O
P2.045	Notch filter frequency (3)	1000	Hz	O	O	O	O
P2.046	Notch filter attenuation level (3)	0	-dB	O	O	O	O
P2.047	Auto resonance suppression mode	1	-	O	O	O	O
P2.048	Auto resonance detection level	100	-	O	O	O	O
P2.025	Resonance suppression low-pass filter	1.0 (panel / software)	1 ms (panel / software)	O	O	O	O
		10 (communication)	0.1 ms (communication)				
P2.049	Speed detection filter and jitter suppression	0	-	O	O	O	O
P2.095	Notch filter bandwidth (1)	5	-	O	O	O	O
P2.096	Notch filter bandwidth (2)	5	-	O	O	O	O
P2.097	Notch filter bandwidth (3)	5	-	O	O	O	O
P2.098	Notch filter frequency (4)	1000	Hz	O	O	O	O
P2.099	Notch filter attenuation level (4)	0	-dB	O	O	O	O
P2.100	Notch filter bandwidth (4)	5	-	O	O	O	O
P2.101	Notch filter frequency (5)	1000	Hz	O	O	O	O
P2.102	Notch filter attenuation level (5)	0	-dB	O	O	O	O
P2.103	Notch filter bandwidth (5)	5	-	O	O	O	O

Gain and switching parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.037	Load inertia ratio and load weight ratio to servo motor	6.0 (panel / software) 60 (communication)	1 times (panel / software) 0.1 times (communication)	O	O	O	O
P2.000	Position control gain	35	rad/s	O	O	-	-
P2.001	Position control gain rate of change	100	%	O	O	-	-
P2.002	Position feed forward gain	50	%	O	O	-	-
P2.003	Position feed forward gain smoothing constant	5	ms	O	O	-	-
P2.004	Speed control gain	500	rad/s	O	O	O	O
P2.005	Speed control gain rate of change	100	%	O	O	O	O
P2.006	Speed integral compensation	100	rad/s	O	O	O	O
P2.007	Speed feed forward gain	0	%	O	O	O	O
P2.026	Anti-interference gain	0	rad/s	O	O	O	O
P2.027	Gain switching condition and method selection	0	-	O	O	O	O
P2.028	Gain switching time constant	10	10 ms	O	O	O	O
P2.029	Gain switching condition	16777216	pulse kpps rpm	O	O	O	O
P2.031	Response bandwidth level	19	Hz	O	O	O	O
P2.032	Gain adjustment mode	1	-	O	O	O	O
P2.053	Position integral compensation	0	rad/s	O	O	O	O
P2.089	Command responsiveness gain	25	rad/s	O	O	-	-
P2.094▲	Special bit register 3	0x1000	-	O	O	O	-
P2.104	P/PI torque switching command condition	200	%	O	O	O	-
P2.105	Automatic gain adjustment level 1	11	-	O	O	-	-
P2.106	Automatic gain adjustment level 2	2000	-	O	O	-	-
P2.112▲	Special bit register 4	0x0008	-	O	O	O	-

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, P4.000, etc.
(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.
(●) Parameter changes become valid after cycling the power. For example, P1.001 and P3.000.
(■) Parameter resets to its default value after cycling the power. For example, P2.031 and P3.006.

Position control parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.001●	Input for control mode and control command	0	pulse rpm N-M	O	O	O	O
P1.002▲	Speed and torque limits	0	-	O	O	O	O
P1.003	Encoder pulse output polarity	0	-	O	O	O	O
P1.012 – P1.014	Internal torque limits 1 – 3	100	%	O	O	O	-
P1.044▲	E-Gear ratio (Numerator) (N1)	16777216	pulse	O	-	-	-
P1.045▲	E-Gear ratio (Denominator) (M)	100000	pulse	O	-	-	-
P1.046▲	Encoder pulse number output	2500	pulse	O	O	O	O
P1.055	Maximum speed limit	Rated speed of the model	rpm	O	O	O	O
P1.097▲	Encoder output denominator	0	-	O	O	O	O
P5.003	Deceleration time for auto-protection	EEEFEEFF	-	O	O	O	O
P5.020 – P5.035	Acceleration / deceleration times	200 – 30	ms	O	-	-	-
P5.016	Axis position - Motor encoder	0	PUU	O	O	O	O
P5.017	Axis position - Auxiliary encoder	0	pulse	O	O	O	O
P5.018	Axis position - Pulse command	0	pulse	O	O	O	O

Position control parameters - External pulse control command (PT mode)

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.000▲	External pulse input type	0x1042	-	O	-	-	-
P2.060	E-Gear ratio (Numerator) (N2)	16777216	pulse	O	-	-	-
P2.061	E-Gear ratio (Numerator) (N3)	16777216	pulse	O	-	-	-
P2.062	E-Gear ratio (Numerator) (N4)	16777216	pulse	O	-	-	-

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Position control parameters - Internal register control command (PR mode)

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P5.008	Forward software limit	$+2^{31}$	PUU	-	O	-	-
P5.009	Reverse software limit	-2^{31}	PUU	-	O	-	-
P6.002 – P7.099	Internal Position commands 1 – 99	0	-	-	O	-	-
P5.060 – P5.075	Internal Position commands control the movement speeds from 0 – 15	20 – 3000 (panel / software)	1 rpm (panel / software)	-	O	-	-
		200 – 30000 (communication)	0.1 rpm (communication)				
P5.004	Homing methods	0	-	-	O	-	-
P5.005	High speed homing (first speed setting)	100 (panel / software)	1 rpm (panel / software)	-	O	-	-
		1000 (communication)	0.1 rpm (communication)	-	O	-	-
P5.006	Low speed homing (second speed setting)	20 (panel / software)	1 rpm (panel / software)	-	O	-	-
		200 (communication)	0.1 rpm (communication)	-	O	-	-
P5.007	Trigger Position command (PR mode only)	0	-	-	O	-	-
P5.040 – P5.055	Delay times after position reached	0 – 5500	ms	-	O	-	-
P5.098	PR# triggered by event rising-edge	0	-	-	O	-	-
P5.099	PR# triggered by event falling-edge	0	-	-	O	-	-
P5.015	PATH#1 – PATH#2 Volatile setting	0x0	-	-	O	-	-

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, P4.000, etc.
(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.
(●) Parameter changes become valid after cycling the power. For example, P1.001 and P3.000.
(■) Parameter resets to its default value after cycling the power. For example, P2.031 and P3.006.

Speed control parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.001●	Input for control mode and control command	0	pulse rpm N-M	O	O	O	O
P1.002▲	Speed and torque limits	0	-	O	O	O	O
P1.003	Encoder pulse output polarity	0	-	O	O	O	O
P1.046▲	Encoder pulse number output	2500	pulse	O	O	O	O
P1.055	Maximum speed limit	rated	rpm	O	O	O	O
P1.009 – P1.011	Internal Speed commands 1 – 3	1000 – 3000	0.1 rpm	-	-	O	O
P1.012 – P1.014	Internal torque limits 1 – 3	100	%	O	O	O	O
P1.040	Maximum rotation speed for analog Speed command	3000	rpm	-	-	O	O
P1.041	Maximum output for analog Torque command	100	%	O	O	O	O
P1.076	Maximum speed for encoder output (OA, OB)	5500	rpm	O	O	O	O

Torque control parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.001●	Input for control mode and control command	0	pulse rpm N-M	O	O	O	O
P1.002▲	Speed and torque limits	0	-	O	O	O	O
P1.003	Encoder pulse output polarity	0	-	O	O	O	O
P1.046▲	Encoder pulse number output	2500	pulse	O	O	O	O
P1.055	Maximum speed limit	rated	rpm	O	O	O	O
P1.009 – P1.011	Internal speed limits 1 – 3	1000 – 3000	0.1 rpm	-	-	O	O
P1.012 – P1.014	Internal Torque commands 1 – 3	100	%	O	O	O	O
P1.040	Maximum rotation speed for analog Speed command	3000	rpm	-	-	O	O
P1.041▲	Maximum output for analog Torque command	100	%	O	O	O	O

Planning of digital input / output pin and output parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P0.053	Extensive range compare DO output - Filter time	0	ms	O	O	O	O
P0.054	General range compare DO output - First lower limit	0	-	O	O	O	O

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Planning of digital input / output pin and output parameters (continued)

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P0.055	General range compare DO output - First upper limit	0	-	O	O	O	O
P2.009	Response filter time of DI	2	ms	O	O	O	O
P2.010	DI1 functional planning	101	-	O	O	O	O
P2.011	DI2 functional planning	104	-	O	O	O	O
P2.012	DI3 functional planning	116	-	O	O	O	O
P2.013	DI4 functional planning	117	-	O	O	O	O
P2.014	DI5 functional planning	102	-	O	O	O	O
P2.015	DI6 functional planning	022	-	O	O	O	O
P2.016	DI7 functional planning	023	-	O	O	O	O
P2.017	DI8 functional planning	021	-	O	O	O	O
P2.018	DO1 functional planning	101	-	O	O	O	O
P2.019	DO2 functional planning	103	-	O	O	O	O
P2.020	DO3 functional planning	109	-	O	O	O	O
P2.021	DO4 functional planning	105	-	O	O	O	O
P2.022	DO5 functional planning	7	-	O	O	O	O
P2.036	DI9 functional planning	0	-	O	O	O	O
P2.037	DI10 functional planning	0	-	O	O	O	O
P2.038	VDI11 functional planning	0	-	O	O	O	O
P2.039	VDI12 functional planning	0	-	O	O	O	O
P2.040	VDI13 functional planning	0	-	O	O	O	O
P2.041	DO6 functional planning	0	-	O	O	O	O
P1.038	Zero speed range	10.0 (panel / software) 100 (communication)	1 rpm (panel / software) 0.1 rpm (communication)	O	O	O	O
P1.039	Target speed detection level	3000	rpm	O	O	O	O
P1.042	Enable delay time for magnetic brake	0	ms	O	O	O	O
P1.043	Disable delay time for magnetic brake	0	ms	O	O	O	O
P1.047	Speed reached (DO.SP_OK) range	10	rpm	-	O	-	O
P1.054	Pulse range for position reached	167772	pulse	O	-	-	O
P1.056	Motor output overload warning level	120	%	O	O	O	O

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, P4.000, etc.
(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.
(●) Parameter changes become valid after cycling the power. For example, P1.001 and P3.000.
(■) Parameter resets to its default value after cycling the power. For example, P2.031 and P3.006.

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Communication parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P3.000●	Address	0x7F	-	O	O	O	O
P3.001●	Transmission speed	0x0203	Bps	O	O	O	O
P3.002	Communication protocol	6	-	O	O	O	O
P3.003	Communication error handling	0	-	O	O	O	O
P3.004	Communication timeout	0	sec	O	O	O	O
P3.005	Communication mechanism	0	-	O	O	O	O
P3.006■	Digital input (DI) control switch	0	-	O	O	O	O
P3.007	Communication response delay time	0	1 ms	O	O	O	O
P3.009	Communication synchronization	0x5055 (CANopen)	-	-	-	-	-
		0x3511 (DMCNET)	-	-	-	-	-
P3.010	CANopen / DMCNET protocol	1	-	-	-	-	-
P3.011	CANopen / DMCNET options	0	-	-	-	-	-
P3.012	CANopen / DMCNET support	0	-	-	-	-	-

Diagnosis parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P4.000★	Fault record (N)	0	-	O	O	O	O
P4.001★	Fault record (N-1)	0	-	O	O	O	O
P4.002★	Fault record (N-2)	0	-	O	O	O	O
P4.003★	Fault record (N-3)	0	-	O	O	O	O
P4.004★	Fault record (N-4)	0	-	O	O	O	O
P4.005	Servo motor JOG control	20	rpm	O	O	O	O
P4.006▲■	Digital output register (readable and writable)	0	-	O	O	O	O
P4.007	Multi-function for digital input	0	-	O	O	O	O
P4.008★	Input status of servo drive panel (read-only)	-	-	O	O	O	O
P4.009★	Digital output status (read-only)	-	-	O	O	O	O
P4.010▲	Adjustment function	0	-	O	O	O	O
P4.011	Analog speed input (1) offset adjustment	Factory setting	-	O	O	O	O
P4.012	Analog speed input (2) offset adjustment	Factory setting	-	O	O	O	O

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Diagnosis parameters (continued)

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P4.013	Analog torque input (1) offset adjustment	Factory setting	-	O	O	O	O
P4.014	Analog torque input (2) offset adjustment	Factory setting	-	O	O	O	O
P4.015	Current encoder (V1 phase) offset adjustment	Factory setting	-	O	O	O	O
P4.016	Current encoder (V2 phase) offset adjustment	Factory setting	-	O	O	O	O
P4.017	Current encoder (W1 phase) offset adjustment	Factory setting	-	O	O	O	O
P4.018	Current encoder (W2 phase) offset adjustment	Factory setting	-	O	O	O	O
P4.019	IGBT NTC adjustment level (cannot reset)	Factory setting	-	O	O	O	-
P4.020	Offset adjustment for analog monitor output (Ch1)	0	mV	O	O	O	O
P4.021	Offset adjustment for analog monitor output (Ch2)	0	mV	O	O	O	O
P4.022	Analog speed input offset	0	mV	O	O	O	O
P4.023	Analog torque input offset	0	mV	O	O	O	O

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, P4.000, etc.
(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.
(●) Parameter changes become valid after cycling the power. For example, P1.001 and P3.000.
(■) Parameter resets to its default value after cycling the power. For example, P2.031 and P3.006.

8.3 Parameter descriptions

P0.xxx Monitoring parameters

P0.000★	**Firmware version**		**Address: 0000H 0001H**
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	-
Format:	DEC	Data size:	16-bit

Settings:

Displays the firmware version of the servo drive.

P0.001■	**Current drive alarm code (Seven-segment display)**		**Address: 0002H 0003H**
Default:	-	Control mode:	All
Unit:	-	Setting range:	0X0000: alarm clear (same as DI.ARST). 0x0001 - 0xFFFF: displays the alarm code (not writable).
Format:	HEX	Data size:	16-bit

Settings:

For the list of alarms, please refer to Section 11.1 Alarm list.

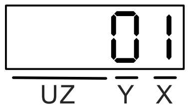
P0.002	**Drive status**		**Address: 0004H 0005H**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-300 to +127
Format:	DEC	Data size:	16-bit

Settings:

The panel displays some parameters. Input the monitoring variable to P0.002 in order to view changes to the variable on the panel. For the list of monitoring variables, please refer to Table 8.3 Monitoring variables descriptions.

P0.003	Analog output monitoring		Address: 0006H 0007H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0 – 77
Format:	HEX	Data size:	16-bit

Settings:



- X: MON2
- Y: MON1
- UZ: reserved

MON1 and MON2 value	Description	MON1 and MON2 value	Description
0	Motor speed (+/- 8 volts / Maximum speed)	4	Torque command (+/- 8 volts / Maximum Torque command)
1	Motor torque (+/- 8 volts / Maximum torque)	5	VBUS voltage (+/- 8 volts / 450V)
2	Pulse command frequency (+8 volts / 4.5 Mpps)	6	Reserved
3	Speed command (+/- 8 volts / Maximum Speed command)	7	Reserved

Note: please refer to parameters P1.004 and P1.005 for the proportional setting for the analog voltage output.

For example: when you set P0.003 to 01 (MON1 is the analog output of motor speed; MON2 is the analog output of motor torque):

MON1 output voltage = $8 \text{ x } \frac{\text{Motor speed}}{(\text{Maximum speed x } \frac{\text{P1.004}}{100})}$ (Unit: volts)

MON2 output voltage = $8 \text{ x } \frac{\text{Motor torque}}{(\text{Maximum torque x } \frac{\text{P1.005}}{100})}$ (Unit: volts)

P0.004 – P0.007	Reserved

P0.008★	Total servo drive operation time		Address: 0010H 0011H
Default:	0	Control mode:	All
Unit:	Hour	Setting range:	0 – 65535
Format:	DEC	Data size:	16-bit

Settings:

Displays the total servo drive operation time. The unit is in hours and durations of less than 1 hour are not recorded. The recorded hours are saved when the servo powers off.

D C B A

U Z Y X

DCBA	Servo on time	UZYX	Servo power applied time
h	High bit	L	Low bit

P0.009★■	Status monitoring register 1		Address: 0012H 0013H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-
Format:	DEC	Data size:	32-bit

Settings:

Set the value to be monitored in P0.017 through the drive panel or communication. Please refer to P0.002. To get the status, the communication port must read the communication address.

For example, if you set P0.017 to 3, when accessing P0.009, the panel displays the total number of feedback pulses of the motor encoder. If accessing the data through MODBUS communication, it reads two 16-bit values (0012H and 0013H) as a single 32-bit value. (0013H : 0012H) = (Hi-word : Low-word). Set P0.002 to 23 and the panel displays VAR-1 as the value of P0.009.

P0.010★■	Status monitoring register 2		Address: 0014H 0015H
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	DEC	Data size:	32-bit

Settings:

Set the value to be monitored in P0.018 through the drive panel or communication. Please refer to P0.002. To get the status, the communication port must read the communication address. Set P0.002 to 24 and the panel displays VAR-2 as the value of P0.010.

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P0.011★■	Status monitoring register 3		Address: 0016H 0017H
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	DEC	Data size:	32-bit

Settings:

Set the value to be monitored in P0.019 through the drive panel or communication. Please refer to P0.002. To get the status, the communication port must read the communication address. Set P0.002 to 25 and the panel displays VAR-3 as the value of P0.011.

P0.012★■	Status monitoring register 4		Address: 0018H 0019H
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	DEC	Data size:	32-bit

Settings:

Set the value to be monitored in P0.020 through the drive panel or communication. Please refer to P0.002. To get the status, the communication port must read the communication address. Set P0.002 to 26 and the panel displays VAR-3 as the value of P0.012.

P0.013★■	Status monitoring register 5		Address: 001AH 001BH
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	DEC	Data size:	32-bit

Settings:

Set the value to be monitored in P0.021 through the drive panel or communication. Please refer to P0.002. To get the status, the communication port must read the communication address.

P0.014 – P0.016	Reserved

P0.017	Select content displayed by status monitoring register 1		Address: 0022H 0023H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 – 127
Format:	DEC	Data size:	16-bit

Settings:

Please refer to Table 8.3 for the available values.

For example, if you set P0.017 to 07, then reading P0.009 displays the motor speed (rpm).

P0.018	Select content displayed by status monitoring register 2		Address: 0024H 0025H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 – 127
Format:	DEC	Data size:	16-bit

Settings:

Please refer to Table 8.3 for the available values.

P0.019	Select content displayed by status monitoring register 3		Address: 0026H 0027H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 – 127
Format:	DEC	Data size:	16-bit

Settings:

Please refer to Table 8.3 for the available values.

P0.020	Select content displayed by status monitoring register 4		Address: 0028H 0029H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 – 127
Format:	DEC	Data size:	16-bit

Settings:

Please refer to Table 8.3 for the available values.

P0.021	Select content displayed by status monitoring register 5		Address: 002AH 002BH
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 – 127
Format:	DEC	Data size:	16-bit

Settings:

Please refer to Table 8.3 for the available values.

P0.022 – P0.024	Reserved

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P0.025■	Mapping parameter #1		Address: 0032H 0033H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.035
Format:	HEX	Data size:	32-bit

Settings:

You can continuously read and write parameters faster if they are not in the same group. You can use P0.035 to specify the mapping parameter number through the panel or communication. The value of the parameter that is specified by P0.035 is shown in P0.025. Please refer to P0.035 for its settings.

P0.026■	Mapping parameter #2		Address: 0034H 0035H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.036
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.036.

P0.027■	Mapping parameter #3		Address: 0036H 0037H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.037
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.037.

P0.028■	Mapping parameter #4		Address: 0038H 0039H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.038
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.038.

P0.029■	Mapping parameter #5		Address: 003AH 003BH
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.039
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.039.

P0.030■	Mapping parameter #6		Address: 003CH 003DH
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.040
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.040.

P0.031■	Mapping Parameter #7		Address: 003EH 003FH
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.041
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.041.

P0.032■	Mapping parameter #8		Address: 0040H 0041H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.042
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.042.

P0.033 – P0.034	Reserved

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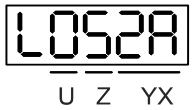
P0.035	Target setting for mapping parameter P0.025		Address: 0046H 0047H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:

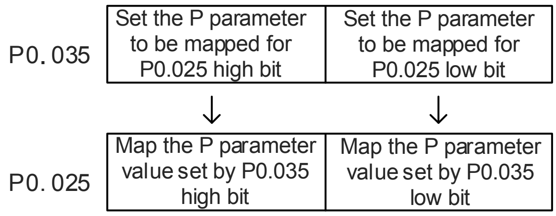
The formats of the high-bit parameter (PH) and the low-bit parameter (PL) are:



BA	Hexadecimal code for the parameter index	YX	Hexadecimal code for the parameter index
C	Hexadecimal code for the parameter group	Z	Hexadecimal code for the parameter group
D	N/A	U	N/A
h	High-bit	L	Low-bit

Select the data block to access the parameter correspondingto register 1. The mapping value is 32 bits and can map to two 16-bit parameters or one 32-bit parameter.

P0.035: (Mapping parameter: P0.035; Mapping content: P0.025)



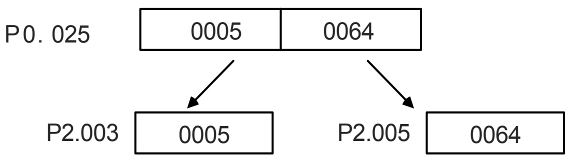
1. When PH does not equal PL, it indicates that the content of P0.025 includes two 16-bit parameters.

   Example: Target: set P2.003 to 0 in the mapping parameter and set P2.005 to 100.

   Setting: set the P0.035 high bit to 0203 (P2.003) and low bit to 0205 (P2.005).

   Thus, P0.035 = 0x02030205.

   Write: in the mapping content, set P0.025 to 0x00050064, and the values of P2.003 and P2.005 are:



2. When PH = PL = P, it indicates that P0.025 has one 32-bit parameter.

   Example: Target: set P6.010 to 0x00050064 in the mapping parameter.

   Setting: set both the high bit and low bit of P0.035 to 060A (P6.010).

   Thus, P6.010 = 0x060A060A.

P0.035	P6.010	P6.010

   Write: in the mapping content, set P0.025 to 0x00050064 and P6.010 changes immediately.

P0.036	**Target setting for mapping parameter P0.026**		**Address: 0048H 0049H**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:

	High-bit	Low-bit
P0.036	Position of mapping parameter	Position of mapping parameter
	↓	↓
P0.026	Content of mapping parameter	Content of mapping parameter

P0.037	**Target setting for mapping parameter P0.027**		**Address: 004AH 004BH**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:

	High-bit	Low-bit
P0.037	Position of mapping parameter	Position of mapping parameter
	↓	↓
P0.027	Content of mapping parameter	Content of mapping parameter

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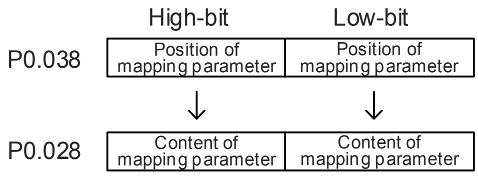
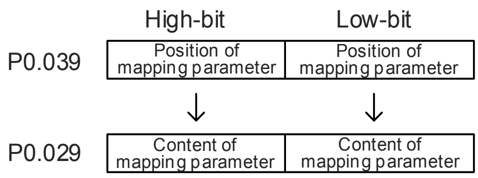
P0.038	Target setting for mapping parameter P0.028		Address: 004CH 004DH
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:



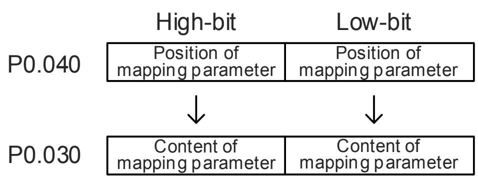
P0.039	Target setting for mapping parameter P0.029		Address: 004EH 004FH
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:



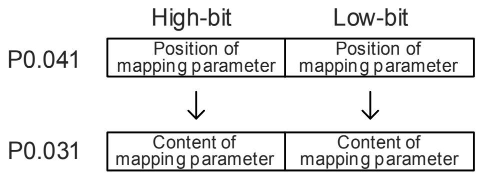
P0.040	Target setting for mapping parameter P0.030		Address: 0050H 0051H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:



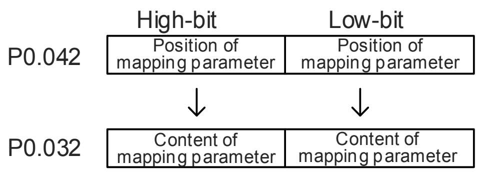
P0.041	Target setting for mapping parameter P0.031		Address: 0052H 0053H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:



P0.042	Target setting for mapping parameter P0.032		Address: 0054H 0055H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:



P0.043	Reserved

P0.044★■	Status monitoring register (for PC software)		Address: 0058H 0059H
Default:	0	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	DEC	Data size:	32-bit

Settings:

This setting is the same as P0.009.

P0.045■	Status monitoring register content selection (for PC software)		Address: 005AH 005BH
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 – 127
Format:	DEC	Data size:	16-bit

Settings:

This setting is the same as P0.017.

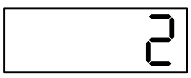
P0.046★■	Servo drive digital output (DO) status		Address: 005CH 005DH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x00 – 0xFF
Format:	HEX	Data size:	16-bit

Settings:

Bit	Function	Bit	Function
0	SRDY (servo ready)	8	HOME (homing completed)
1	SON (servo activated)	9	OLW (early warning for motor overload)
2	ZSPD (zero speed)	10	WARN (This DO is on when servo warning, CW, CCW, EMGS, undervoltage, communication error, etc. occurs.)
3	TSPD (target speed reached)	11	Reserved
4	TPOS (target position reached)	12	Reserved
5	TQL (torque limit activated)	13	Reserved
6	ALRM (servo alarm)	14	Reserved
7	BRKR (magnetic brake control output)	15	Reserved

P0.049■	Update encoder absolute position		Address: 0062H 0063H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x00 – 0x02
Format:	HEX	Data size:	16-bit

Settings:



X

- X: command processing

  0: N/A

  1: update the encoder data of P0.050 – P0.052

  2: update P0.050 – P0.052 and clear the position error. When the command takes effect, the motor's current position is set to the terminal point of the Position command.

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P0.050★■	Absolute coordinate system status		Address: 0064H 0065H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x00 – 0x1F
Format:	HEX	Data size:	16-bit

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit 0: 1 means the absolute position is lost; 0 means normal.

Bit 1: 1 means the battery is undervoltage; 0 means normal.

Bit 2: 1 means the absolute multiple turns is overflowing; 0 means normal.

Bit 3: 1 means the PUU is overflowing; 0 means normal.

Bit 4: 1 means the absolute coordinate has not been set; 0 means normal.

Bit 5 – Bit 15: reserved (0).

P0.051★■	Encoder absolute position - Multiple turns		Address: 0066H 0067H
Default:	0	Control mode:	All
Unit:	Rev	Setting range:	-32768 to +32767
Format:	DEC	Data size:	32-bit

Settings:

When you set P2.070 [Bit 1] to read the pulse number, this parameter displays the number of turns of the encoder (absolute position). When you set P2.070 [Bit 1] to read the PUU number, this parameter becomes invalid and displays 0.

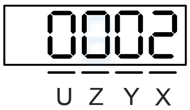
P0.052★■	Encoder absolute position - Pulse number or PUU within single turn		Address: 0068H 0069H
Default:	0	Control mode:	All
Unit:	Pulse or PUU	Setting range:	0 – 16777216-1 (pulse) -2147483648 to +2147483647 (PUU)
Format:	DEC	Data size:	32-bit

Settings:

When you set bit 1 of P2.070 to 1 to read the pulse number, this parameter displays the pulse number of the encoder’s absolute position within a single turn. When you set bit 1 of P2.070 to 0 to read the PUU number, this parameter displays the motor’s absolute position in PUU.

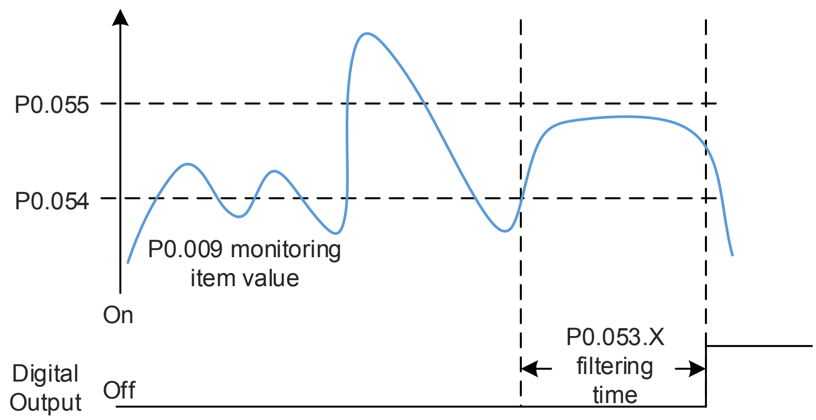
P0.053	General range compare DO output - Filter time		Address: 006AH 006BH
Default:	0x0000	Control mode:	All
Unit:	ms	Setting range:	0x0000 – 0x000F
Format:	HEX	Data size:	16-bit

Settings:



- X: first filter time
- Y – U: reserved

Example of the first filter:



P0.054	General range compare DO output - First lower limit		Address: 006CH 006DH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Whenever the value of P0.009 changes from outside the set range to inside the set range or vice versa, it displays, but only after the filter time set in P0.053.X.

P0.055	General range compare DO output - First upper limit		Address: 006EH 006FH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Whenever the value of P0.009 changes from outside the set range to inside the set range or vice versa, it displays, but only after the filter time set by P0.053.X.

P0.056 – P0.062	Reserved

P0.063	Duration of voltage exceeding 400V		Address: 007EH 007FH
Default:	0	Control mode:	All
Unit:	ms	Setting range:	0x00000000 – 0x7FFFFFFF
Format:	DEC	Data size:	32-bit

Settings:

Records the total time during which the voltage of the servo drive exceeded 400V.

P0.064 – P0.068	Reserved

P1.xxx Basic parameters

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P1.000▲	External pulse input type		Address: 0100H 0101H
Default:	0x1042	Control mode:	PT
Unit:	-	Setting range:	0x0000 – 0x11F2
Format:	HEX	Data size:	16-bit

Settings:

0020

U Z Y X

X	Command source	Z	Logic type	UY	Filter width

- X: command source

  0: AB phase pulse (4x)

  1: clockwise and counterclockwise pulse

  2: pulse + symbol

  Others: reserved

- Z: logic type

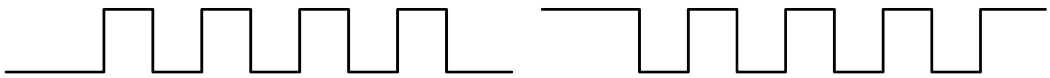
  0: positive logic

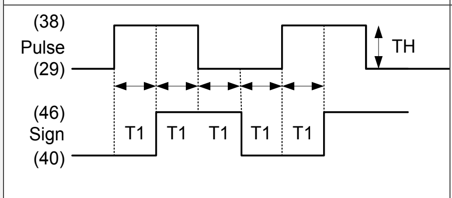
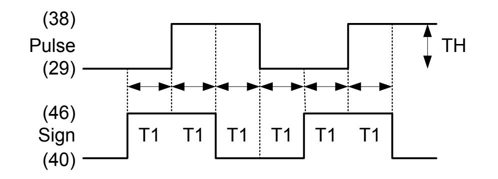
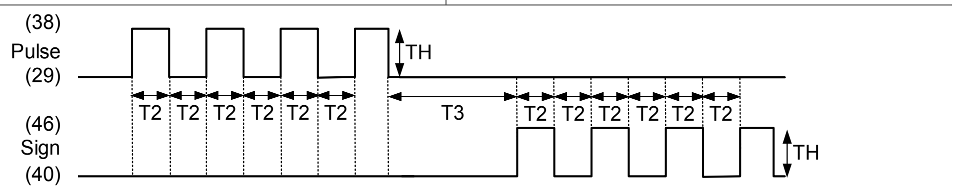
  1: negative logic

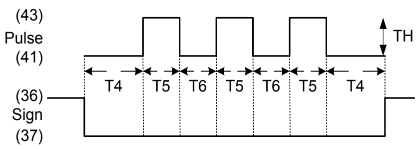
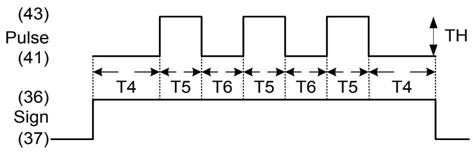
Digital circuits use 0 and 1 to represent the high and low voltage levels. In positive logic, 1 represents high voltage and 0 represents low voltage; in negative logic, 1 represents low voltage and 0 represents high voltage.

For example:

Positive logic Negative logic



<table>
<tr><th rowspan="2">Logic type</th><th rowspan="2">Pulse type</th><th colspan="2">Pulse input</th></tr>
<tr><th>Forward</th><th>Reverse</th></tr>
<tr><td rowspan="3">Z = 0</td><td></td><td>Pulse phase lead</td><td>Pulse phase lag</td></tr>
<tr><td>X = 0</td><td>
</td><td>
</td></tr>
<tr><td>X = 1</td><td colspan="2">
</td></tr>
</table>

Logic type	Pulse type	Pulse input	
		Forward	Reverse
		Sign = low	Sign = high
Z = 0	X = 2		

Pulse specification	Maximum input frequency	Minimum allowed time width					
		T1	T2	T3	T4	T5	T6
Differential signal	4 Mpps	62.5 ns	125 ns	250 ns	200 ns	125 ns	125 ns
Open-collector	200 Kpps	1.25 μs	2.5 μs	5 μs	5 μs	2.5 μs	2.5 μs

Pulse specification	Maximum input frequency	Voltage	Forward current
Differential signal	4 Mpps	5V	< 25 mA
Open-collector	200 Kpps	24V (maximum)	< 25 mA

- UY: filter width setting

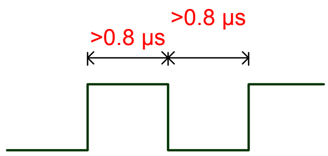
If the pulse frequency is too high, causing a pulse width smaller than the filter width, then this pulse gets filtered out as noise. Therefore, set the filter width smaller than the actual pulse width.

You should set the filter width as 4 times smaller than the actual pulse width.

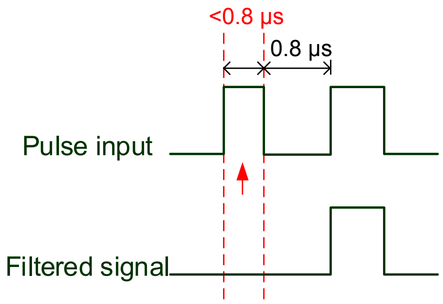
Y value	U = 0 Unit: μs (kHz)	U = 1 Unit: μs (kHz)
0	No filter function	No filter function
1	2 (250)	0.2 (2500)
2	3 (166)	0.3 (1666)
3	4 (125)	0.4 (1250)
4	5 (100)	0.5 (1000)
5	6 (83)	0.6 (833)
6	7 (71)	0.7 (714)
7	8 (62)	0.8 (625)
8	9 (55)	0.9 (555)
9	10 (50)	1 (500)
A	11 (45)	1.1 (454)
B	12 (41)	1.2 (416)
C	13 (38)	1.3 (384)
D	14 (35)	1.4 (357)
E	15 (33)	1.5 (333)

For example:

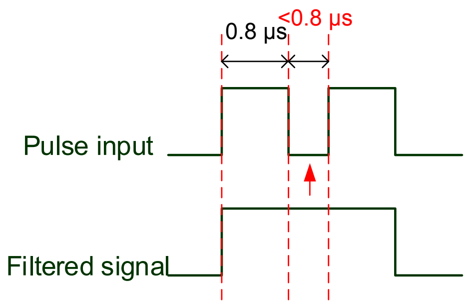
When U is set to 1 and Y is set to 1 (and filter width is therefore 0.2 μs), and when the high and low duty width of the command pulse are both larger than 0.8 μs (and filter width is 4 times 0.2 μs), then the pulse command is not filtered out.



When the high or low duty width of the pulse is smaller than the filter width, then it is filtered out.



If this first pulse width is shorter than 0.8 μs, it may be filtered, and thus two input pulses will be regarded as one pulse. If this pulse width is shorter than 0.2 μs, it will be filtered.



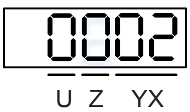
If this low level pulse width is shorter than 0.8 μs, it may be filtered, and thus two input pulses will be regarded as one pulse. If this low level pulse width is shorter than 0.2 μs, it will be filtered.

If you use an 125 ns (4 Mpps) input pulse, set the filter value Y to 0 to disable the filter function.

Note: when the high-speed pulse specification of the signal is 4 Mpps and the value of the filter is 0, then the pulse is not filtered.

P1.001●	**Input for control mode and control command**		**Address: 0102H 0103H**
Default:	0x0000 (Model: A3-M, A3-L) 0x000B (Model: A3-F)	Control mode:	All
Unit:	P (pulse); S (rpm); T (N-M)	Setting range:	0x0000 – 0x111F
Format:	HEX	Data size:	16-bit

Settings:



YX	Control mode setting	Z	Direction control	U	DIO value control

- YX: control mode setting

Mode	PT	PR	S	T	Sz	Tz
00	▲					
01		▲				
02			▲			
03				▲		
04					▲	
05						▲
Dual mode						
06	▲		▲			
07	▲			▲		
08		▲	▲			
09		▲		▲		
0A			▲	▲		
0B	DMCNET mode					
0C	CANopen mode					
Multi-mode						
0E	▲	▲	▲			
0F	▲	▲		▲		

PT: Position control mode; the command source is from the external pulse and the external analog voltage (*coming soon).

PR: Position control mode; the command source is from the 64 sets of internal registers which you can select with DI.POS0 – DI.POS6. Multiple homing methods are also available.

S: Speed control mode; the command source is from the external analog voltage and the internal register which you can select with DI.SPD0 and DI.SPD1.

T: Torque control mode; the command source is from the external analog voltage and the internal register which you can select with DI.TCM0 and DI.TCM1.

Sz: Speed control mode; the command source is from the zero speed and the internal speed register which you can select with DI.SPD0 and DI.SPD1.

Tz: Torque control mode; the command source is from the zero torque and the internal torque register which you can select with DI.TCM0 and DI.TCM1.

Dual mode: you can switch the mode with external DI. For example, you can use DI.S-P to switch the dual mode of PT/S (control mode setting: 06). Please refer to Table 8.1 for further information.

Multi-mode: you can switch the mode with external DI. For example, you can use DI.S-P and PT-PR to switch the multi-mode for PT/PR/S (control mode setting: 12). Please refer to Table 8.1 for further information.

CANopen mode: the command source is from the external fieldbus controller, which sends the command to the servo drive through direct communication.

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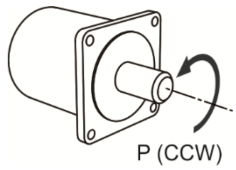
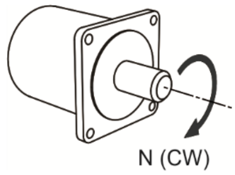
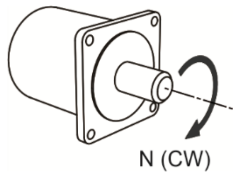
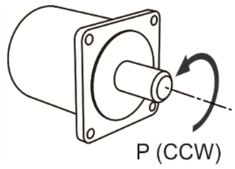
■ Z: direction control

	Z = 0	Z = 1
Forward direction		
Reverse direction		

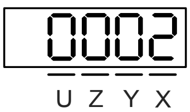
■ U: DIO value control

0: when switching modes, DIO settings (P2.010 – P2.022) remain the same.

1: when switching modes, DIO settings (P2.010 – P2.022) are reset to the default for each mode.

P1.002▲	**Speed and torque limits**		**Address: 0104H 0105H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	00 – 11
Format:	HEX	Data size:	16-bit

Settings:



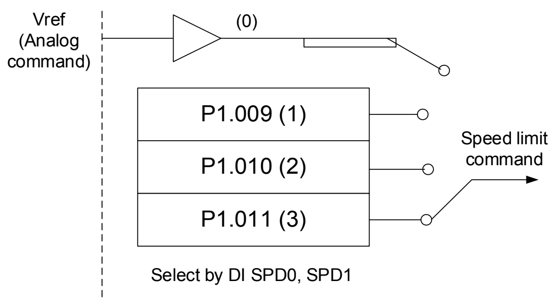
X	Disable / enable Speed Limit function	Y	Disable / enable Torque Limit function	UZ	Reserved

■ X: disable / enable Speed Limit function

0: disable Speed Limit function

1: enable Speed Limit function (only available in T / Tz mode)

See the diagram below for Speed Limit setting:

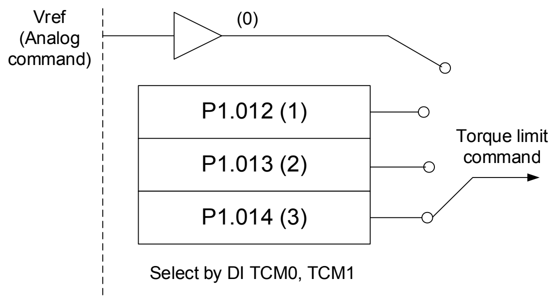


■ Y: disable / enable Torque Limit function

0: disable Torque Limit function

1: enable Torque Limit function

See the diagram below for Torque Limit setting:

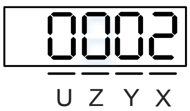


When using the Torque Limit function, you can set this parameter to 1 to limit the torque permanently without occupying a DI setting. Alternatively, you can enable or disable the limit function through DI.TRQLM, which is more flexible, but the setting then occupies a DI setting. You can enable the Torque Limit function by either P1.002 or DI.

- UZ: not in use

P1.003	Encoder pulse output polarity		Address: 0106H 0107H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0 – 13
Format:	HEX	Data size:	16-bit

Settings:



X	Polarity of monitor analog output	Y	Polarity of encoder pulse output	UZ	Reserved

- X: polarity of monitor analog output

  0: MON1(+), MON2(+)

  1: MON1(+), MON2(-)

  2: MON1(-), MON2(+)

  3: MON1(-), MON2(-)

- Y: polarity of encoder pulse output

  0: pulse output in forward direction

  1: pulse output in reverse direction

- UZ: reserved

P1.004	MON1 analog monitor output proportion		Address: 0108H 0109H
Default:	100	Control mode:	All
Unit:	% (full scale)	Setting range:	0 – 100
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P0.003 for the analog output setting.

Example 1:

If the requirement is for the motor to run at 1000 rpm, which corresponds to 8V, and its maximum speed is 5000 rpm, the setting is:

P1.004 = $\frac{\text{Required speed}}{\text{Maximum speed}} \times 100\% = \frac{1000\text{ rpm}}{5000\text{ rpm}} \times 100\% = 20\%$

Refer to the following example for the motor's current speed and relative voltage output:

Motor speed	MON1 analog monitor output
300 rpm	MON1 = 8V $\times \frac{\text{Current speed}}{\text{Maximum speed} \times \frac{\text{P1.004}}{100}} \times 100\%$ =8V $\times \frac{300\text{ rpm}}{5000\text{ rpm} \times \frac{20}{100}} \times 100\%$ = 2.4V
900 rpm	MON1 = 8V $\times \frac{\text{Current speed}}{\text{Maximum speed} \times \frac{\text{P1.004}}{100}} \times 100\%$ =8V $\times \frac{900\text{ rpm}}{5000\text{ rpm} \times \frac{20}{100}} \times 100\%$ = 7.2V

P1.005	MON2 analog monitor output proportion		Address: 010AH 010BH
Default:	100	Control mode:	All
Unit:	% (full scale)	Setting range:	0 – 100
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P0.004 for the analog output setting.

P1.006	Speed command smoothing constant (Low-pass filter)		Address: 010CH 010DH
Default:	0	Control mode:	S / Sz
Unit:	ms	Setting range:	0 – 1000
Format:	DEC	Data size:	16-bit

Settings:

0: disable this function

P1.007	Torque command smoothing constant (Low-pass filter)		Address: 010EH 010FH
Default:	0	Control mode:	T / Tz
Unit:	ms	Setting range:	0 – 1000
Format:	DEC	Data size:	16-bit

Settings:

0: disable this function

P1.008	Position command smoothing constant (Low-pass filter)		Address: 0110H 0111H
Default:	0	Control mode:	PT / PR
Unit:	10 ms	Setting range:	0 – 1000
Format:	DEC	Data size:	16-bit
Example:	11 = 110 ms		

Settings:

0: disable this function

P1.009	Internal Speed command 1 / internal speed limit 1		Address: 0112H 0113H
Default:	1000	Control mode:	S / Sz: internal Speed command 1 T / Tz: internal speed limit 1
Unit:	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	Setting range:	-60000 to +60000 (rotary motor)* -15999999 to +15999999 (linear motor)*
Format:	DEC	Data size:	32-bit
Example:	Internal Speed command: 120 = 12 rpm Internal speed limit: positive and negative values are identical. Please refer to the following descriptions.		

Settings:

Internal Speed command 1: first internal Speed command

Internal speed limit 1: first internal speed limit

Example of internal speed limit:

Speed limit value of P1.009	Valid speed range	Speed limit in forward direction	Speed limit in reverse direction
1000	-100 to +100 rpm	100 rpm	-100 rpm
-1000			

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P1.010	Internal Speed command 2 / internal speed limit 2		Address: 0114H 0115H
Default:	2000	Control mode:	S / Sz: internal Speed command 2 T / Tz: internal speed limit 2
Unit:	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	Setting range:	-60000 to +60000 (rotary motor)* -15999999 to +15999999 (linear motor)*
Format:	DEC	Data size:	32-bit
Example:	Internal Speed command: 120 = 12 rpm Internal speed limit: positive and negative values are identical. Please refer to the following descriptions.		

Settings:

Internal Speed command 2: second internal Speed command

Internal speed limit 2: second internal speed limit

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Example of internal speed limit:

Speed limit value of P1.010	Valid speed range	Speed limit in forward direction	Speed limit in reverse direction
1000	-100 to +100 rpm	100 rpm	-100 rpm
-1000			

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P1.011	Internal Speed command 3 / internal speed limit 3		Address: 0116H 0117H
Default:	3000	Control mode:	S / Sz: internal Speed command 3 T / Tz: internal speed limit 3
Unit:	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	Setting range:	-60000 to +60000 (rotary motor)* -15999999 to +15999999 (linear motor)*
Format:	DEC	Data size:	32-bit
Example:	Internal Speed command: 120 = 12 rpm Internal speed limit: positive and negative values are identical. Please refer to the following descriptions.		

Settings:

Internal Speed command 3: third internal Speed command

Internal speed limit 3: third internal speed limit

Example of internal speed limit:

Speed limit value of P1.011	Valid speed range	Speed limit in forward direction	Speed limit in reverse direction
1000	-100 to +100 rpm	100 rpm	-100 rpm
-1000			

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P1.012	Internal Torque command 1 / internal torque limit 1		Address: 0118H 0119H
Default:	100	Control mode:	T / Tz: internal Torque command 1 PT / PR / S / Sz: internal torque limit 1
Unit:	%	Setting range:	-400 to +400
Format:	DEC	Data size:	16-bit
Example:	Internal Torque command: 30 = 30% Internal torque limit: positive and negative values are identical. Please refer to the following descriptions.		

Settings:

Internal Torque command 1: first internal Torque command.

Internal torque limit 1: first internal torque limit

Example of internal torque limit:

Torque limit value of P1.012	Valid torque range	Torque limit in forward direction	Torque limit in reverse direction
30	-30 to +30%	30%	-30%
-30			

P1.013	Internal Torque command 2 / internal torque limit 2		Address: 011AH 011BH
Default:	100	Control mode:	T / Tz: internal Torque command 2 PT / PR / S / Sz: internal torque limit 2
Unit:	%	Setting range:	-400 to +400
Format:	DEC	Data size:	16-bit
Example:	Internal Torque command: 30 = 30% Internal torque limit: positive and negative values are identical. Please refer to the following descriptions.		

Settings:

Internal Torque command 2: second internal Torque command.

Internal torque limit 2: second internal torque limit.

Example of internal torque limit:

Torque limit value of P1.013	Valid torque range	Torque limit in forward direction	Torque limit in reverse direction
30	-30 to +30%	30%	-30%
-30			

P1.014	Internal Torque command 3 / internal torque limit 3		Address: 011CH 011DH
Default:	100	Control mode:	T / Tz: internal Torque command 3 PT / PR / S / Sz: internal torque limit 3
Unit:	%	Setting range:	-400 to +400
Format:	DEC	Data size:	16-bit
Example:	Internal Torque command: 30 = 30% Internal torque limit: positive and negative values are identical. Please refer to the following descriptions.		

Settings:

Internal Torque command 3: third internal Torque command.

Internal torque limit 3: third internal torque limit.

Example of internal torque limit:

Torque limit value of P1.014	Valid torque range	Torque limit in forward direction	Torque limit in reverse direction
30	-30 to +30%	30%	-30%
-30			

P1.015 – P1.018	Reserved

P1.019	Capture / Compare additional function settings		Address: 0126H 0127H
Default:	0x0000	Control mode:	ALL
Unit:	-	Setting range:	0x0000 – 0x0101
Format:	HEX	Data size:	16-bit

Settings:

0000

U Z Y X

X	Additional function for Capture	Z	Additional function for Compare
Y	Reserved	U	Reserved

- X: additional function for Capture

Bit	3	2	1	0

Bit	Function	Description
0	Cycle mode	Set this bit to 0 to disable this function. Set this bit to 1 to enable this function. If enabled, the E-Cam alignment correction is conducted when DI.ALGN is on.
1 – 3	Reserved	-

- Z: additional function for Compare

Bit	3	2	1	0

Bit	Function	Description
0	P1.024 is reset to 0 automatically	Set this bit to 0 to disable this function. Set this bit to 1, and P1.024 is reset to 0 automatically, but it only takes effect once.
1 – 3	Reserved	-

P1.020	Capture - Masking range		Address: 0128H 0129H
Default:	0	Control mode:	ALL
Unit:	Pulse unit of capture source	Setting range:	0 – 100000000
Format:	DEC	Data size:	32-bit

Settings:

When the Capture function is enabled and set to capture multiple points (P5.038 > 1), the system stops receiving the DI captured signal within this range once the data is captured. The DI captured signal received within this range is not recognized as valid. Use this function to avoid the system seeing noise as effective signals within the non-capture range. The masking range is defined as follows: (CAP_DATA – P1.020, CAP_DATA + P1.020).

P1.021 – P1.022	Reserved

P1.023	Compare - Data translation (non-volatile)		Address: 012EH 012FH
Default:	0	Control mode:	ALL
Unit:	Pulse unit of compare source	Setting range:	-10000000 to +100000000
Format:	DEC	Data size:	32-bit

Settings:

When using the Compare function, you can add the translation value to the data array to be used as the actual comparison data:

CMP_DATA = DATA_ARRAY[*] + P1.023 + P1.024

For example:

If the data array for comparison is DATA_ARRAY[100] = 2000 and P1.023 = 40,

Then the actual comparison value = 2000 + 40 = 2040.

Note:

1. This parameter is non-volatile.
2. P1.024: after the value takes effect, if P1.019.Z [Bit 0 = 1], then it automatically resets.
3. You can display CMP_DATA with the monitoring variable V25h (037).

P1.024■	Compare - Data translation (reset automatically)		Address: 0130H 0131H
Default:	0	Control mode:	ALL
Unit:	Pulse unit of compare source	Setting range:	-32768 to +32767
Format:	DEC	Data size:	16-bit

Settings:

When using the Compare function, you can add the translation value to the data array to be used as the actual comparison data:

CMP_DATA = DATA_ARRAY[*] + P1.023 + P1.024

Note:

1. This parameter is volatile.
2. After the parameter takes effect, if P1.019.Z [Bit 0 = 1], then it automatically resets.
3. You can display CMP_DATA with the monitoring variable V25h (037).

P1.025	Low-frequency vibration suppression frequency (1)		Address: 0132H 0133H
Default:	1000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 – 1000
Format:	DEC	Data size:	16-bit
Example:	150 = 15 Hz		

Settings:

Sets the first low-frequency vibration suppression frequency. When you set P1.026 to 0, the first low-frequency vibration suppression filter is disabled.

P1.026	Low-frequency vibration suppression gain (1)		Address: 0134H 0135H
Default:	0	Control mode:	PT / PR
Unit:	-	Setting range:	0 – 9
Format:	DEC	Data size:	16-bit

Settings:

To set the gain of the first low-frequency vibration suppression, increase the value to improve the position response. If you set the value too high, the motor may not operate smoothly. The suggested value is 1. Set P1.026 to 0 to disable the first low-frequency vibration suppression filter.

P1.027	Low-frequency vibration suppression frequency (2)		Address: 0136H 0137H
Default:	1000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 – 1000
Format:	DEC	Data size:	16-bit
Example:	150 = 15 Hz		

Settings:

Sets the second low-frequency vibration suppression frequency. Set P1.028 to 0 to disable the second low-frequency vibration suppression filter.

P1.028	Low-frequency vibration suppression gain (2)		Address: 0138H 0139H
Default:	0	Control mode:	PT / PR
Unit:	-	Setting range:	0 – 9
Format:	DEC	Data size:	16-bit

Settings:

To set the gain of the second low-frequency vibration suppression, increase the value to improve the position response. If you set the value too high, the motor may not operate smoothly. The suggested value is 1. Set P1.028 to 0 to disable the second low-frequency vibration suppression filter.

P1.029	**Auto low-frequency vibration suppression mode**		**Address: 013AH 013BH**
Default:	0	Control mode:	PT / PR
Unit:	-	Setting range:	0 – 1
Format:	DEC	Data size:	16-bit

Settings:

0: disable the automatic low-frequency vibration detection function.

1: disable the function automatically after vibration suppression. The value resets to 0 automatically.

Auto mode setting description:

When the value is 1, vibration suppression is in automatic mode. When the vibration cannot be detected or the vibration frequency is stable, the system resets the parameter to 0 and automatically saves the vibration suppression frequency to P1.025.

P1.030	**Low-frequency vibration detection**		**Address: 013CH 013DH**
Default:	800	Control mode:	PT / PR
Unit:	Pulse	Setting range:	1 – 8000
Format:	DEC	Data size:	16-bit

Settings:

When enabling automatic vibration suppression (P1.029 = 1), the system automatically finds the detection level. The lower the value, the more sensitive the detection, but the system may also misjudge noise or treat other low-frequency vibrations as frequencies to be suppressed. If the value is high, the system is less likely to misjudge, but if the vibration of the machine is small, the system may not properly detect low-frequency vibrations.

P1.031	**Reserved**

P1.032	**Motor stop mode**		**Address: 0140H 0141H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0 – 20
Format:	HEX	Data size:	16-bit

Settings:

0000

U Z Y X

X	Reserved	Y	Dynamic brake operation options	UZ	Reserved

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- Y: options for using the dynamic brake when the servo is in Servo Off state or an alarm (including EMGS) occurs

  0: use dynamic brake

  1: motor runs freely

  2: use dynamic brake first. Then let the motor run freely once the speed is slower than the value of P1.038

When the motor reaches PL (CCWL) or NL (CWL), please refer to P5.003 for setting the deceleration time. If you set the deceleraton time to 1 ms, the motor stops instantly.

P1.033	Reserved

P1.034	S-curve acceleration constant		Address: 0144H 0145H
Default:	200	Control mode:	S / Sz
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Acceleration constant:

P1.034, P1.035, and P1.036 represent the acceleration time for the Speed command from zero to the rated speed. You can set each parameter individually. When using an internal command, if you set P1.036 to 0, acceleration / deceleration follows a trapezoid-curve; when using an analog command, P1.036 must be larger than 0 so that the acceleration / deceleration follows a trapezoid-curve.

P1.035	S-curve deceleration constant		Address: 0146H 0147H
Default:	200	Control mode:	S / Sz
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Deceleration constant:

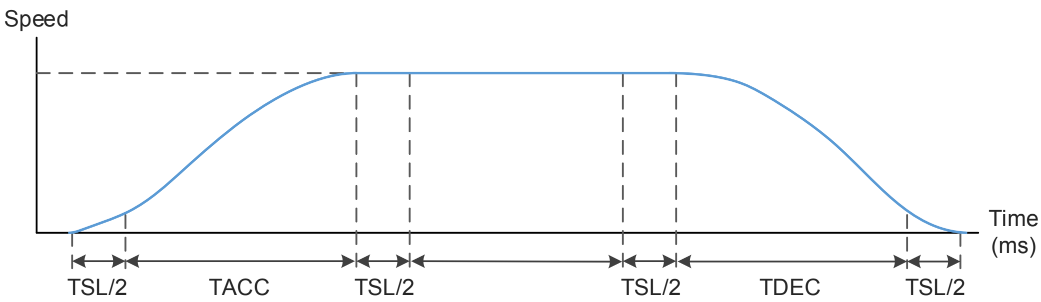
P1.034, P1.035, and P1.036 represent the deceleration time for the Speed command from the rated speed to zero. You can set each parameter individually. When using an internal command, if you set P1.036 to 0, acceleration / deceleration follows a trapezoid-curve; when using an analog command, P1.036 must be larger than 0 so that the acceleration / deceleration follows a trapezoid-curve.

P1.036	S-curve acceleration / deceleration constant		Address: 0148H 0149H
Default:	0	Control mode:	PR / S / Sz
Unit:	ms	Setting range:	0 – 65500
Format:	DEC	Data size:	16-bit

Settings:

0: disable this function.

Acceleration / deceleration constant of S-curve:



P1.034: set the acceleration time for the trapezoid-curve.

P1.035: set the deceleration time for the trapezoid-curve.

P1.036: set the smoothing time for the S-curve acceleration / deceleration.

You can set P1.034, P1.035, and P1.036 individually. Even if you set P1.036 to 0, the acceleration / deceleration still follows a trapezoid-curve.

Please note the following error compensation:

	P1.036 = 0	P1.036 = 1	P1.036 > 1
Smoothing function for S-curve	Disable	Disable	Enable
Following error compensation function	Disable	Enable	Determine by P2.068.X

P1.037	Load inertia ratio and load weight ratio to servo motor			Address: 014AH 014BH
Operation interface:	Panel / software	Communication	Control mode:	All
Default:	6.0	60	Data size:	16-bit
Unit:	1 times	0.1 times	-	-
Setting range:	0.0 – 200.0 (rotary motor)* 0.0 – 1633 (linear motor)*	0 – 2000 (rotary motor)* 0 – 1633 (linear motor)*		
Format:	One decimal	DEC	-	-
Example:	1.5 = 1.5 times	15 = 1.5 times	-	-

Settings:

Inertia ratio to servo motor (rotary motor): (J_load / J_motor)

J_motor: rotor inertia of the servo motor

J_load: total equivalent inertia of external mechanical load

Note: Rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

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P1.038	Zero speed range			Address: 014CH 014DH
Operation interface:	Panel / software	Communication	Control mode:	All
Default:	10.0	100	Data size:	16-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 – 200.0	0 – 2000	-	-
Format:	One decimal	DEC	-	-
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-

Settings:

Sets the range for the zero-speed signal (ZSPD). When the forward / reverse speed of the motor is slower than this value, the zero-speed signal is triggered and the digital output is enabled.

P1.039	Target speed detection level		Address: 014EH 014FH
Default:	3000	Control mode:	ALL
Unit:	rpm	Setting range:	0 – 30000 (rotary motor)* 0 – 15999 (linear motor)*
Format:	DEC	Data size:	16-bit

Settings:

When the target speed is reached, DO (TSPD) is enabled. When the forward / reverse speed of the motor is faster than this value, the target speed signal is triggered and the digital output is enabled.

Note: Rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P1.040	Maximum rotation speed for analog Speed command		Address: 0150H 0151H
Default:	3000	Control mode:	T / Tz
Unit:	rpm	Setting range:	0 – 5000
Format:	DEC	Data size:	32-bit

Settings:

Maximum rotation speed for analog Speed command:

Speed mode:

$$\text{Speed control command} = \frac{\text{Input voltage}\times\text{Setting}}{10}$$

Set the rotation speed corresponding to 10V (maximum voltage) for the analog Speed command.

If the value is 2000 and the external voltage input is 5V, then the speed control command is 1000 rpm.

$$\text{Speed control command} = \frac{5\text{V}\times 2000\text{ rpm}}{10} = 1000\text{ rpm}$$

Torque mode:

$$\text{Speed limit command} = \frac{\text{Input voltage}\times\text{Setting}}{10}$$

Set the rotation speed limit corresponding to 10V (maximum voltage) for the analog speed limit.

If the value is 2000 and the external voltage input is 5V, then the speed limit command = $\frac{5\text{V}\times 2000\text{ rpm}}{10}$ = 1000 rpm

P1.041▲	Maximum output for analog Torque command		Address: 0152H 0153H
Default:	100	Control mode:	All
Unit:	%	Setting range:	-1000 to +1000
Format:	DEC	Data size:	16-bit

Settings:

Maximum output for analog Torque command:

Torque mode:

Torque control command = $\frac{\text{Input voltage}\times\text{P1.041}}{10}$ (Unit: %)

Set the torque corresponding to 10V (maximum voltage) for the analog Torque command.

If the default value is 100 and the external voltage input is 10V, then the torque control command is 100% of the rated torque. If the external voltage input is 5V, then the torque control command is 50% of the rated torque.

When the external analog input is 10V, the torque control command = $\frac{10\text{V}\times 100}{10}$ = 100%

When the external analog input is 5V, the torque control command = $\frac{5\text{V}\times 100}{10}$ = 50%

Example:

If P1.041 = 10

When the external analog input is 10V, the torque control command = $\frac{10\text{V}\times 10}{10}$ = 10%

When the external analog input is 5V, the torque control command = $\frac{5\text{V}\times 10}{10}$ = 5%

In speed, PT, and PR modes:

Torque limit command = $\frac{\text{Input voltage}\times\text{Setting}}{10}$ (Unit: %)

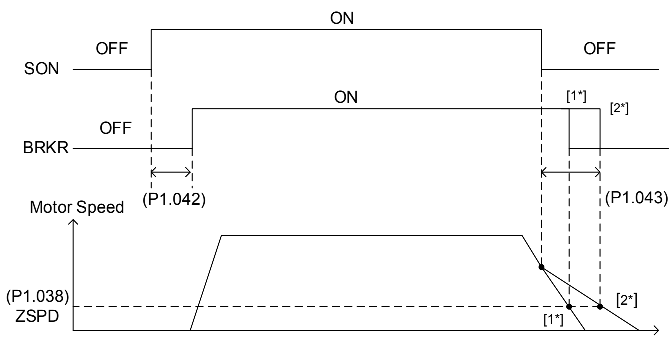
Set the torque limit corresponding to 10V (maximum voltage) for the analog torque limit.

Torque limit command = $\frac{10\text{V}\times 100}{10}$ = 100%

P1.042	Enable delay time for magnetic brake		Address: 0154H 0155H
Default:	0	Control mode:	All
Unit:	ms	Setting range:	0 – 1000
Format:	DEC	Data size:	16-bit

Settings:

Set the delay time from Servo On status to the activation of the magnetic brake signal (DO:0x08, BRKR).



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P1.043	Disable delay time for magnetic brake		Address: 0156H 0157H
Default:	0	Control mode:	All
Unit:	ms	Setting range:	-1000 to +1000
Format:	DEC	Data size:	16-bit

Settings:

Set the delay time from Servo Off status to the deactivation of the magnetic brake signal (DO:0x08, BRKR). For the detailed diagram, please refer to P1.042.

Note:

1. If the delay time specified in P1.038 has not passed yet and the motor speed is slower than the value of P1.038, the magnetic brake signal (BRKR) is deactivated.
2. If the delay time specified in P1.038 has passed and the motor speed is faster than the value of P1.038, the magnetic brake signal (BRKR) is deactivated.
3. If P1.043 is a negative value and the servo is off due to an alarm (except for AL022) or emergency stop, this setting does not function. This is equivalent to setting the delay time to 0.

P1.044▲	E-Gear ratio (Numerator) (N1)		Address: 0158H 0159H
Default:	16777216	Control mode:	PT / PR
Unit:	Pulse	Setting range:	1 to (2^{29}-1)
Format:	DEC	Data size:	32-bit

Settings:

For the E-Gear ratio setting, please refer to Section 6.2.5. Please refer to P2.060 – P2.062 for multiple E-Gear ratio (numerator) settings.

Note:

1. Do not change the setting in the Servo On state.
2. In communication mode (DMCNET / CANopen / EtherCAT), if you cycle the power to the drive, the E-Gear ratio is set to the default value of the communication protocol. Resetting to the default value results in the reconstruction of the absolute coordinate system, so you must re-do the homing procedure. If you do not want P1.044 to be reset to the default value, please set P3.012.Z to 1. For details, please refer to P3.012.

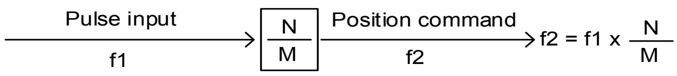
P1.045▲	E-Gear ratio (Denominator) (M)		Address: 015AH 015BH
Default:	100000	Control mode:	PT / PR
Unit:	Pulse	Setting range:	1 to (2^{31}-1)
Format:	DEC	Data size:	32-bit

Settings:

If the setting is incorrect, the servo motor is prone to sudden unintended acceleration.

Please follow the instructions below.

Setting of pulse input:



Command pulse input range: 1 / 4<Nx / M < 262144.

For the E-Gear ratio setting, please refer to Section 6.2.5.

Note:

1. Do not change the setting in the Servo On state.
2. In direct communication mode (DMCNET / CANopen / EtherCAT), if you cycle the power to the drive, the E-Gear ratio is set to the default value of the communication protocol. Resetting to the default value results in the reconstruction of the absolute coordinate system, so you must re-do the homing procedure. If you do not want P1.045 to be reset to the default value, please set P3.012.Z to 1. For details, please refer to P3.012.

P1.046▲	**Encoder pulse number output**		**Address: 015CH 015DH**
Default:	2500	Control mode:	All
Unit:	Pulse	Setting range:	20 – 320000
Format:	DEC	Data size:	32-bit

Settings:

The number of single-phase pulse outputs per revolution; the maximum output frequency of the hardware is 19.8 MHz.

Note: the following circumstances may result in exceeding the maximum allowable output pulse frequency of the drive, causing AL018:

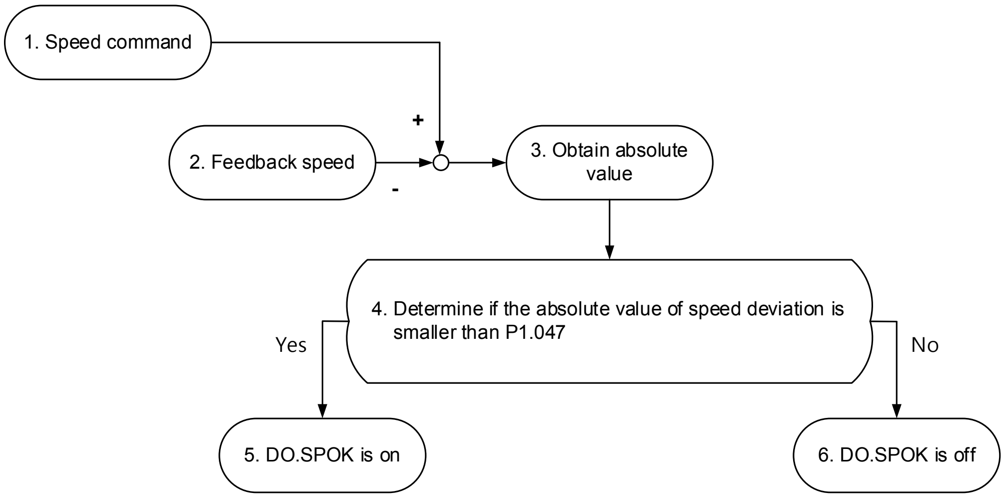
1. Encoder error
2. The motor speed is faster than P1.076
3. $\frac{\text{Motor speed}}{60}$ x P1.046 x 4 > 19.8 x 10^6

P1.047	**Speed reached (DO.SP_OK) range**		**Address: 015EH 015FH**
Default:	10	Control mode:	S / Sz
Unit:	rpm	Setting range:	0 – 300
Format:	DEC	Data size:	16-bit

Settings:

When the deviation between the Speed command and the motor feedback speed is less than this parameter, the digital output DO.SP_OK (DO code 0x19) is on.

Diagram:

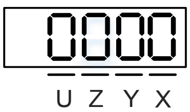


1. Speed command: command that you input without acceleration / deceleration, not the command from the front end speed circuit. Its source is from the register.
2. Feedback speed: the actual speed of the motor which has been filtered.
3. Obtain the absolute value.
4. Determine whether the absolute value of the speed deviation is smaller than the parameter value: If you set the parameter to 0, the output is always off. If the absolute value is smaller than the parameter, the DO output is on, otherwise it is off.

P1.048	**Speed reached (DO.SP_OK) operation selection**		**Address: 0160H 0161H**
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 – 0x0011
Format:	HEX	Data size:	16-bit

Settings:

Control selection of digital output DO.MC_OK (DO code: 0x17).



X	DO output hold option	Y	Position deviation alarm AL380 option	UZ	Reserved

- X: DO output hold option

  0: output status is not retained

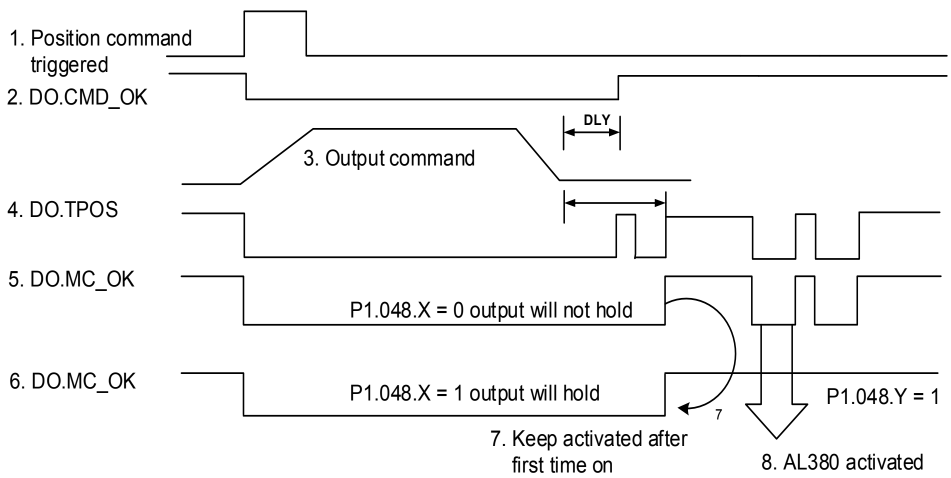
  1: output status is retained

- Y: position deviation alarm AL380 option

  0: AL380 not functioning

  1: AL380 functioning

Diagram:



Description:

1. Command triggered: new PR command is effective. Command 3 starts and clears signals 2, 4, 5, and 6 simultaneously. Command triggering source: DI.CTRG, DI.EV1/EV2, P5.007 (triggered through software), etc.
2. DO.CMD_OK: command 3 is completed and it can set the delay time (DLY).
3. Command output: output the profile of the Position command based on the acceleration / deceleration setting.
4. DO.TPOS: position error of the servo drive is within the range set in P1.054.
5. DO.MC_OK: Position command output and servo positioning completed, which indicate that DO.CMD_OK and DO.TPOS are both on.
6. DO.MC_OK (retains digital output status): same as 5, except that once this DO is on, its status is kept regardless of the signal 4 status.
7. Can only select one of signal 5 or signal 6 to output, and the choice is specified in P1.048.X.
8. Position deviation: when number 7 occurs, if signal 4 (or 5) is off, it means the position has deviated and AL380 can be triggered. This alarm may be set with P1.048.Y.

P1.049	**Accumulated time to reach desired speed**		**Address: 0162H 0163H**
Default:	0	Control mode:	S / Sz
Unit:	ms	Setting range:	0 – 65535
Format:	DEC	Data size:	16-bit

Settings:

In Speed mode, when the deviation between the Speed command and the motor feedback speed is less than the range in P1.047 and the difference reaches the time in P1.049, the digital output DO.SP_OK (DO code 0x19) is on. If the difference exceeds the range set in P1.047 at any time, the system recalculates the duration.

P1.050 – P1.051	**Reserved**

P1.052	Regenerative resistor value		Address: 0168H 0169H
Default:	Determined by the model. Please refer to the following table.	Control mode:	All
Unit:	Ohm	Setting range:	Please refer to the note below.
Format:	DEC	Data size:	16-bit

Settings:

Model	Default (Ω)	Model	Default (Ω)
1.5 kW or below	100	2 – 3 kW (included)	20

Please refer to the instructions for P1.053 for the setting to use when connecting the regenerative resistor through a different method.

Note:

Setting range for 220V

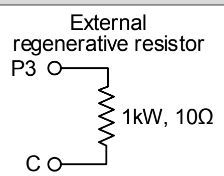
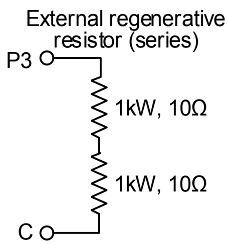
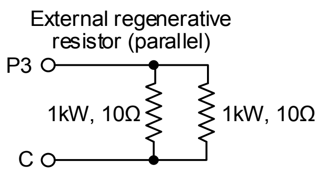
Model	Setting range	Model	Setting range
400 W or below	20 – 750	2 – 3 kW	10 – 750
750 W – 1.5 kW	20 – 750	-	-

P1.053	Regenerative resistor capacity		Address: 016AH 016BH
Default:	Determined by the model. Please refer to the following table.	Control mode:	All
Unit:	Watt	Setting range:	0 – 6000
Format:	DEC	Data size:	16-bit

Settings:

Model	Default (Watt)	Model	Default (Watt)
200 W or below	0	2 – 3 kW (included)	80
400 W – 1.5 kW	40	-	-

Setting the parameter value when connecting the regenerative resistor with different methods:

External regenerative resistor	Setting
	Setting: P1.052 = 10 (Ω) P1.053 = 1000 (W)
	Setting: P1.052 = 20 (Ω) P1.053 = 2000 (W)
	Setting: P1.052 = 5 (Ω) P1.053 = 2000 (W)

P1.054	Pulse range for position reached		Address: 016CH 016DH
Default:	167772	Control mode:	PT / PR
Unit:	Pulse	Setting range:	0 – 16777216
Format:	DEC	Data size:	32-bit

Settings:

In Position (PT) mode, when the deviation pulse number is smaller than the range of P1.054, DO.TPOS is on.

In Position Register (PR) mode, when the deviation between the target position and the actual motor position is smaller than the range of P1.054, DO.TPOS is on. For example, for a rotary motor, if P1.054 = 167772 and the deviation is less than 167772 pulses, which equals 0.01 turns (167772/16777216 = 0.01), then DO.TPOS is on.

P1.055	Maximum speed limit		Address: 016EH 016FH
Default:	Same as the rated speed of each model	Control mode:	All
Unit:	rpm	Setting range:	10 to maximum speed
Format:	DEC	Data size:	16-bit

Settings:

Set the maximum speed of the servo motor. The default is the rated speed.

P1.056	Motor output overload warning level		Address: 0170H 0171H
Default:	120	Control mode:	All
Unit:	%	Setting range:	0 – 120
Format:	DEC	Data size:	16-bit

Settings:

When the value is 0 – 100 and the servo motor continuously outputs load that is higher than the setting (P1.056), the pre-warning for overload (DO is set to 10, OLW) occurs. If the value is over 100, this function is disabled.

P1.057	Motor crash protection (torque percentage)		Address: 0172H 0173H
Default:	0	Control mode:	All
Unit:	%	Setting range:	0 – 300
Format:	DEC	Data size:	16-bit

Settings:

Set the protection level. For the percentage of rated torque, set the value to 0 to disable the function. Set the value to 1 or above to enable the function.

8

P1.058	Motor crash protection (protection time)		Address: 0174H 0175H
Default:	1	Control mode:	All
Unit:	ms	Setting range:	1 – 1000
Format:	DEC	Data size:	16-bit

Settings:

Set the protection time: when the motor reaches the protection level and exceeds the protection time, AL030 occurs.

Note: this function is only suitable for non-contactable uses, such as electrical discharge machines (please set P1.037 correctly).

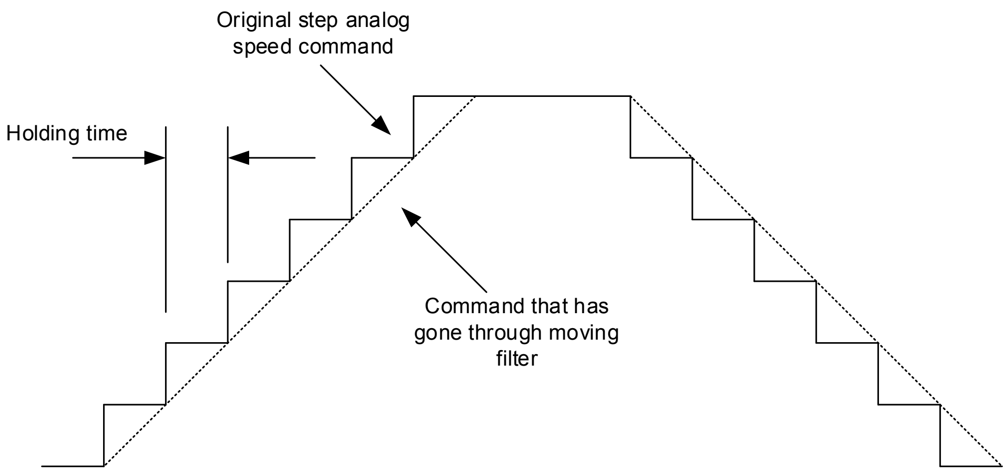
P1.059	Speed command - moving filter			Address: 0176H 0177H
Operation interface:	Panel / software	Communication	Control mode:	S
Default:	0.0	0	Data size:	16-bit
Unit:	1 ms	0.1 ms	-	-
Format:	One decimal	DEC	-	-
Setting range:	0.0 – 4.0	0 – 40	-	-
Example:	1.5 = 1.5 ms	15 = 1.5 ms	-	-

Settings:

0: disable moving filter

P1.006 is the low-pass filter and P1.059 is the moving filter. The difference between them is that the moving filter can smooth the command at the beginning and end of the step, while the low-pass filter can only smooth the command at the end.

Therefore, if the speed loop receives the command from the controller for the position control loop, then the low-pass filter is recommended. If the setting is only for the speed control, then use the moving filter for better smoothing.



P1.060 – P1.061	Reserved

P1.062	Percentage of friction compensation		Address: 017CH 017DH
Default:	0	Control mode:	PT / PR / S / Sz
Unit:	%	Setting range:	0 – 100
Format:	DEC	Data size:	16-bit

Settings:

The level of friction compensation. For the percentage of rated torque, set the value to 0 to disable the function; set the value to 1 or above to enable the function.

P1.063	Constant of friction compensation		Address: 017EH 017FH
Default:	1	Control mode:	PT / PR / S / Sz
Unit:	ms	Setting range:	1 – 1000
Format:	DEC	Data size:	16-bit

Settings:

Set the smoothing constant of friction compensation.

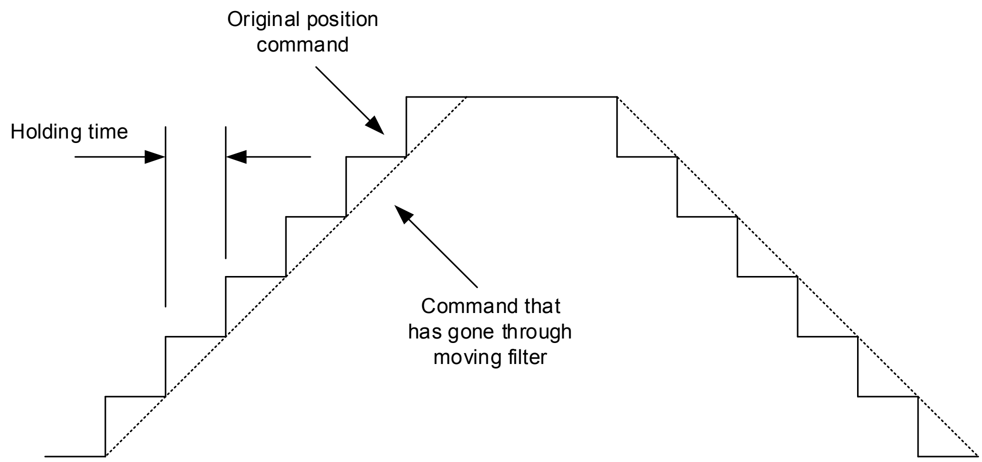
P1.064 – P1.067	Reserved

P1.068	Position command - Moving filter		Address: 0188H 0189H
Default:	4	Control mode:	PT / PR
Unit:	ms	Setting range:	0 – 100
Format:	DEC	Data size:	16-bit

Settings:

0: disable this function

The moving filter activates the smoothing function at the beginning and end of the step, but it also delays the command.



P1.069 – P1.071	Reserved

P1.072	Resolution of linear scale for full-closed loop control		Address: 0190H 0191H
Default:	5000	Control mode:	PT
Unit:	pulse / rev	Setting range:	200 – 1280000
Format:	DEC	Data size:	32-bit

Settings:

A/B pulse corresponding to a full-closed loop when the motor runs a cycle (after quadruple frequency).

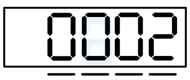
P1.073	Error protection range for full-closed loop control		Address: 0192H 0193H
Default:	30000	Control mode:	PT
Unit:	Pulse (based on the feedback of full-closed loop)	Setting range:	1 to (2^{31}-1)
Format:	DEC	Data size:	32-bit

Settings:

When the deviation between the linear scale A/B Counter and the encoder feedback position is excessive, it may be a result from the connector being loose or other mechanical problems. When the deviation is greater than the value of P1.073, AL040 (excessive deviation of full closed-loop position control) occurs.

P1.074	Full-closed loop control for linear scale		Address: 0194H 0195H
Default:	0x0000	Control mode:	PT
Unit:	-	Setting range:	0000h – F132h
Format:	HEX	Data size:	16-bit

Settings:



U Z Y X

X	Full-closed loop control switch	Z	Positive / negative direction selection of linear scale feedback
Y	Selection of OA / OB / OZ output source	U	Linear scale filter function

- X: full-closed loop / Gantry function switch

  0: disable full-closed loop / Gantry function

  1: enable full-closed loop function

  2: enable synchronous control function

- Y: selection of OA / OB / OZ output source

  0: motor encoder is the output source

  1: liner scale encoder is the output source

  2: CN1 pulse command is the output source

  3: reserved

- Z: positive / negative direction selection of linear scale feedback

  0: positive direction when A phase leads B phase of linear scale

  1: positive direction when B phase leads A phase of linear scale

- U: linear scale filter function

  0: bypass

  1: 6.66 M

  2: 1.66 M

  3: 833 K

  4: 416 K

  5 – F: reserved

P1.075	Low-pass filter time constant for full- and half-closed loop control		Address: 0196H 0197H
Default:	100	Control mode:	PT
Unit:	ms	Setting range:	0 – 1000
Format:	DEC	Data size:	16-bit

Settings:

When the stiffness of the mechanical system between full- and half-closed loops is insufficient, set the proper time constant to enhance the stability of the system. In other words, temporarily create the half-closed loop effect, and after stabilizing, the full-closed loop effect is created. When the stiffness is sufficient, set to bypass.

Set the value to 0 to disable the low-pass filter (bypass) function.

If the stiffness of the mechanical system is high, decrease the value of P1.075, or set the value to 0 to disable. If the stiffness of the mechanical system is low, increase the value of P1.075.

P1.076▲	Maximum speed for encoder output (OA, OB)		Address: 0198H 0199H
Default:	5500	Control mode:	All
Unit:	rpm	Setting range:	0 – 6000
Format:	DEC	Data size:	16-bit

Settings:

Input the actual maximum speed of the motor as the reference value to activate the smoothing function. When you set the value to 0, the smoothing function is disabled.

P1.077 – P1.080	Reserved

8

P1.081	Second set of maximum rotation speed for analog Speed command		Address: 01A2H 01A3H
Default:	Motor rated speed	Control mode:	S / T
Unit:	rpm / 10V	Setting range:	0 – 50000
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P1.040.

P1.082	Filter switching time between P1.040 and P1.081		Address: 01A4H 01A5H
Default:	0	Control mode:	S
Unit:	ms	Setting range:	0 – 1000 (0: disable this function)
Format:	DEC	Data size:	16-bit

Settings:

0: disable filter switching time

P1.083	Abnormal analog input voltage level		Address: 01A6H 01A7H
Default:	0	Control mode:	S
Unit:	ms	Setting range:	0 – 12000 (0: disable this function)
Format:	DEC	Data size:	16-bit

Settings:

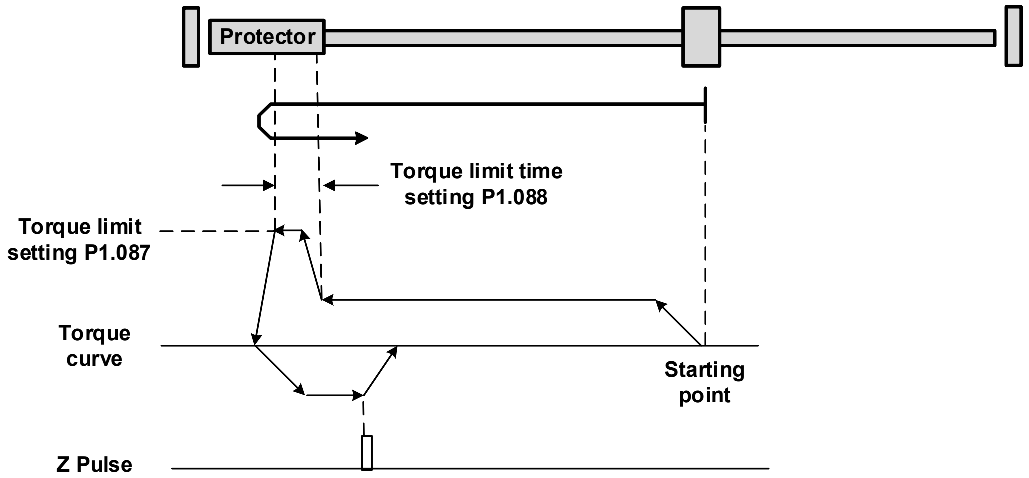
When the analog input voltage is too high for more than 50 ms, AL042 occurs. The comparison value for this parameter is the original analog input voltage which has not been changed by an offset value through P4.022 (analog speed input offset).

P1.084 – P1.086	Reserved

P1.087	Torque limit		Address: 01AEH 01AFH
Default:	1	Control mode:	PR
Unit:	%	Setting range:	1 – 300
Format:	DEC	Data size:	16-bit

Settings:

The Torque limit is only for Torque limit homing mode. As shown in the following diagram, when the homing command is triggered, the motor runs in one direction until it reaches the collision protector. After reaching the collision protector, the servo drive outputs a larger motor current to counter the external force from the collision protector. The servo drive uses the motor current and the Torque limit time to determine homing, and then it runs in the opposite direction to find the Z pulse.



P1.088	Torque limit time		Address: 01B0H 01B1H
Default:	2000	Control mode:	PR
Unit:	ms	Setting range:	2 – 2000
Format:	DEC	Data size:	16-bit

Settings:

Set the Torque limit time for Torque limit homing mode. Please refer to P1.087 for the timing diagram of Torque limit homing mode.

P1.089	First set of vibration elimination - Anti-resonance frequency		Address: 01B2H 01B3H
Default:	4000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 – 4000
Format:	DEC	Data size:	16-bit

Settings:

Anti-resonance frequency for the first set of low frequency vibration elimination.

Use this function in flexible machines with low rigidity. The definition of a flexible machine is one for which when the target position is reached, due to lack of rigidity, the machine vibrates and needs more time to become stable. A3 provides two sets of vibration elimination. The first set is P1.089 – P1.091, and the second set is P1.092 – P1.094. The vibration elimination setting must be obtained through the system module, and is needed to enable the low-frequency analysis options. For details, please refer to the ASDA-Soft software instructions.

Vibration elimination takes effect only when you enable the two dimensional control function P2.094 [Bit 12]. After enabling the vibration elimination function, turn on the first set of vibration elimination with P2.094 [Bit 8] and the second set with P2.094 [Bit 9].

Example:

1. Set P2.094 = 0x11☐☐to enable the first set.
2. Set P2.094 = 0x12☐☐to enable the second set.
3. Set P2.094 = 0x13☐☐to enable the first and second set.

8

P1.090	First set of vibration elimination - Resonance frequency		Address: 01B4H 01B5H
Default:	4000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 – 4000
Format:	DEC	Data size:	16-bit

Settings:

Anti-resonance frequency for the first set of low frequency vibration elimination.

P1.091	First set of vibration elimination - Resonance difference		Address: 01B6H 01B7H
Default:	10	Control mode:	PT / PR
Unit:	0.1 dB	Setting range:	10 – 4000
Format:	DEC	Data size:	16-bit

Settings:

Attenuation rate for the first set of low frequency vibration elimination.

P1.092	Second set of vibration elimination - Anti-resonance frequency		Address: 01B8H 01B9H
Default:	4000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 – 4000
Format:	DEC	Data size:	16-bit

Settings:

Setting method is the same as for the first set of vibration elimination P1.089.

P1.093	Second set of vibration elimination - Resonance frequency		Address: 01BAH 01BBH
Default:	4000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 – 4000
Format:	DEC	Data size:	16-bit

Settings:

Anti-resonance frequency for the second set of low frequency vibration elimination.

P1.094	Second set of vibration elimination - Resonance difference		Address: 01BCH 01BDH
Default:	10	Control mode:	PT / PR
Unit:	0.1 dB	Setting range:	10 – 4000
Format:	DEC	Data size:	16-bit

Settings:

Attenuation rate for the second set of low frequency vibration elimination.

P1.095 – P1.096	Reserved

P1.097▲	Encoder output denominator		Address: 01C2H 01C3H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 – 160000
Format:	DEC	Data size:	32-bit

Settings:

When P1.097 = 0, OA/OB pulse output refers to the value of P1.046.

Example 1:

When P1.097 = 0 and P1.046 = 2500

OA/OB output is P1.046 multiplied by 4 times the frequency, which is 10,000 pulses.

When P1.097 has been set (in other words, the value is not 0), the OA/OB pulse output is calculated with the numerator and denominator of P1.046 and P1.097 and then converted into 4 times the frequency.

Example 1:

When P1.097 = 5 and P1.046 = 2500

OA/OB output = $\frac{2500}{5}$ = 500 pulses

Example 2:

When P1.097 = 7 and P1.046 = 2500

OA/OB output = $\frac{2500}{7}$ = 357.142857 pulses

P1.098	Disconnection detection protection (UVW) response time		Address: 01C4H 01C5H
Default:	0	Control mode:	All
Unit:	ms	Setting range:	0, 100 – 800
Format:	DEC	Data size:	16-bit

Settings:

When the disconnection detection protection (UVW) function is enabled (P2.065 [bit 9] = 1), this parameter indicates the response time of the detection mode. Set P1.098 to 0 to use the servo's default response time.

When P1.098 is not set to 0, the range should be between 100 – 800 for the detection response time.

Note:

1. If it is necessary to shorten the response time, it is recommended that you use this parameter.
2. When the servo is on and has not started running, it is recommended that you set this parameter if you need to detect disconnection.

P1.099 – P1.100	Reserved

8

P1.101■	Analog monitor output voltage 1		Address: 01CAH 01CBH
Default:	0	Control mode:	ALL
Unit:	mV	Setting range:	-10000 to +10000
Format:	DEC	Data size:	16-bit

Settings:

When you select 6 for the monitor source for P0.003 [YX], then the analog monitor output voltage refers to the voltage value of P1.101.

P1.102■	Analog monitor output voltage 2		Address: 01CCH 01CDH
Default:	0	Control mode:	ALL
Unit:	mV	Setting range:	-10000 to +10000
Format:	DEC	Data size:	16-bit

Settings:

When you select 7 for the monitor source of P0.003 [YX], then the analog monitor output voltage refers to the voltage value of P1.102.

8

P2.xxx Extension parameters

P2.000	Position control gain		Address: 0200H 0201H
Default:	35	Control mode:	PT / PR
Unit:	rad/s	Setting range:	0 – 2047
Format:	DEC	Data size:	16-bit

Settings:

Increasing the value of the position control gain can enhance the position response and reduce the position errors. If you set the value too high, it may cause vibration and noise.

P2.001	Position control gain rate of change		Address: 0202H 0203H
Default:	100	Control mode:	PT / PR
Unit:	%	Setting range:	10 – 500
Format:	DEC	Data size:	16-bit

Settings:

Adjust the rate of change of position control gain according to the gain switching condition.

P2.002	Position feed forward gain		Address: 0204H 0205H
Default:	50	Control mode:	PT / PR
Unit:	%	Setting range:	0 – 100
Format:	DEC	Data size:	16-bit

Settings:

If the position control command changes position smoothly, increasing the gain value can reduce position following errors. If it does not change smoothly, decreasing the gain value can reduce mechanical vibration. This gain parameter is disabled when the two dimensional control function is on (P2.094 [Bit 12] = 1).

P2.003	Position feed forward gain smoothing constant		Address: 0206H 0207H
Default:	5	Control mode:	PT / PR
Unit:	ms	Setting range:	2 – 100
Format:	DEC	Data size:	16-bit

Settings:

If the position control command changes position smoothly, decreasing the smoothing constant value can reduce the position following errors. If it does not change smoothly, increasing the smoothing constant value can reduce mechanical vibration.

8

P2.004	Speed control gain		Address: 0208H 0209H
Default:	500	Control mode:	All
Unit:	rad/s	Setting range:	0 – 8191
Format:	DEC	Data size:	16-bit

Settings:

Increasing the speed control gain can enhance the speed response. If you set the value too high, it may cause vibration and noise.

P2.005	Speed control gain rate of change		Address: 020AH 020BH
Default:	100	Control mode:	All
Unit:	%	Setting range:	10 – 500
Format:	DEC	Data size:	16-bit

Settings:

Adjust the rate of change for the speed control gain according to the gain switching condition.

P2.006	Speed integral compensation		Address: 020CH 020DH
Default:	100	Control mode:	All
Unit:	%	Setting range:	0 – 1023
Format:	DEC	Data size:	16-bit

Settings:

Increasing the value of the integral speed control can enhance speed response and reduce the deviation in speed control. If you set the value too high, it may cause vibration and noise.

P2.007	Speed feed forward gain		Address: 020EH 020FH
Default:	0	Control mode:	All
Unit:	%	Setting range:	0 – 100
Format:	DEC	Data size:	16-bit

Settings:

If the speed control command changes speed smoothly, increasing the gain value can reduce the speed following error. If it does not change smoothly, decreasing the gain value can reduce mechanical vibration.

P2.008■	Special parameter write-in function		Address: 0210H 0211H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 – 65535
Format:	DEC	Data size:	16-bit

Settings:

Special parameter write-in function:

Code	Function
10	Reset parameter (power back on after reset).
20	P4.010 is writable.
22	P4.011 – P4.021 are writable.
30, 35	Save Compare, Capture, and E-Cam data.
406	Enable forced DO mode.
400	When forced DO mode is enabled, switch back to the normal DO mode.

Note: A3-L does not support the E-Cam function.

P2.009	DI response filter time		Address: 0212H 0213H
Default:	2	Control mode:	All
Unit:	ms	Setting range:	0 – 20
Format:	DEC	Data size:	16-bit

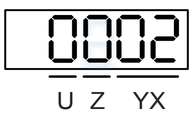
Settings:

When environmental interference is high, increasing this value can enhance the control stability.

If you set the value too high, it impacts the response time.

P2.010	DI1 functional planning		Address: 0214H 0215H
Default:	0x0101	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:



- YX: input function selection

  Please refer to Table 8.1

- Z: input contact: A or B contact

  0: set this input contact to be normally closed (B contact)

  1: set this input contact to be normally open (A contact)

- U: not in use

When these parameters are modified, please re-start the servo drive to ensure it functions normally.

Use P3.006 to change the source for the digital signal, either through an external terminal block or communication parameter P4.007.

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P2.011	**DI2 functional planning**		**Address: 0216H 0217H**
Default:	0x0104	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.010.

P2.012	**DI3 functional planning**		**Address: 0218H 0219H**
Default:	0x0116	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.010.

P2.013	**DI4 functional planning**		**Address: 021AH 021BH**
Default:	0x0117	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.010.

P2.014	**DI5 functional planning**		**Address: 021CH 021DH**
Default:	0x0102	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.010.

8

P2.015	**DI6 functional planning**		**Address: 021EH 021FH**
Default:	0x0022	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.010.

P2.016	**DI7 functional planning**		**Address: 0220H 0221H**
Default:	0x0023	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.010.

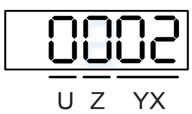
P2.017	**DI8 functional planning**		**Address: 0222H 0223H**
Default:	0x0022	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.010.

P2.018	**DO1 functional planning**		**Address: 0224H 0225H**
Default:	0x0101	Control mode:	All
Unit:	-	Setting range:	0 – 0x013F (last two codes are DO code)
Format:	HEX	Data size:	16-bit

Settings:



- YX: output function selection

  Please refer to Table 8.2.

- Z: output contact: A or B contact

  0: set this output contact to be normally closed (B contact)

  1: set this output contact to be normally open (A contact)

- U: not in use

When these parameters are modified, please re-start the servo drive to ensure it functions normally.

8

P2.019	DO2 functional planning		Address: 0226H 0227H
Default:	0x0103	Control mode:	All
Unit:	-	Setting range:	0 – 0x013F (last two codes are DO code)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.018.

P2.020	DO3 functional planning		Address: 0228H 0229H
Default:	0x0109	Control mode:	All
Unit:	-	Setting range:	0 – 0x013F (last two codes are DO code)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.018.

P2.021	DO4 functional planning		Address: 022AH 022BH
Default:	0x0105	Control mode:	All
Unit:	-	Setting range:	0 – 0x013F (last two codes are DO code)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.018.

P2.022	DO5 functional planning		Address: 022CH 022DH
Default:	0x0007	Control mode:	All
Unit:	-	Setting range:	0 – 0x013F (last two codes are DO code)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.018.

P2.023	Notch filter frequency (1)		Address: 022EH 022FH
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 – 5000
Format:	DEC	Data size:	16-bit

Settings:

The first resonance frequency setting. Set P2.024 to 0 to disable this function. P2.043 and P2.044 are the second Notch filter parameters.

8

P2.024	Notch filter attenuation level (1)			Address: 0230H 0231H
Default:	0	Control mode:	All	
Unit:	-dB	Setting range:	0 – 40	
Format:	DEC	Data size:	16-bit	

Settings:

This is the first Notch filter attenuation level. For example, an attenuation level of 5 indicates -5 dB. Set this parameter to 0 to disable the Notch filter function.

P2.025	Resonance suppression low-pass filter			Address: 0232H 0233H
Operation interface:	Panel / software	Communication	Control mode:	All
Default:	1.0	10	Data size:	16-bit
Unit:	1 ms	0.1 ms	-	-
Setting range:	0.0 – 100.0	0 – 1000	-	-
Format:	One decimal	DEC	-	-
Example:	1.5 = 1.5 ms	15 = 1.5 ms	-	-

Settings:

Set the time constant for the low-pass filter for resonance suppression. Set this parameter to 0 to disable the low-pass filter.

P2.026	Anti-interference gain			Address: 0234H 0235H
Default:	0	Control mode:	All	
Unit:	rad/s	Setting range:	0 – 1023	
Format:	DEC	Data size:	16-bit	

Settings:

Increasing this parameter can increase the damping of the speed loop. Setting the value of P2.026 to equal P2.006 is recommended. Please see the following for setting P2.026:

1. In Speed mode, increase the value of this parameter to reduce speed overshoot.
2. In Position mode, decrease the value of this parameter to reduce position overshoot.

P2.027	Gain switching condition and method selection			Address: 0236H 0237H
Default:	0x0000	Control mode:	All	
Unit:	-	Setting range:	0000h – 0x0018	
Format:	HEX	Data size:	16-bit	

Settings:

0002

U Z Y X

X	Gain switching condition	Y	Gain switching method	UZ	Reserved

- X: gain switching condition

0: disable gain switching function	5: signal of gain switching (GAINUP) is off
1: signal of gain switching (GAINUP) is on	6: in position control mode, position error is smaller than P2.029
2: in position control mode, position error is larger than P2.029	7: frequency of Position command is smaller than P2.029
3: frequency of Position command is larger than P2.029	8: rotation speed of servo motor is slower than P2.029
4: rotation speed of servo motor is faster than P2.029	

- Y: gain switching method

  0: gain rate switching

  1: integrator switching (P controller switches to PI controller)

Value	Control mode P	Control mode S	Gain switching
0	P2.000 x 100% P2.004 x 100%	P2.004 x 100%	Before switching
	P2.000 x P2.001 P2.004 x P2.005	P2.004 x P2.005	After switching
1	P2.006 x 0%; P2.026 x 0%		Before switching
	P2.006 x 100%; P2.026 x 100%		After switching

- UZ: not in use

P2.028	**Gain switching time constant**		**Address: 0238H 0239H**
Default:	10	Control mode:	All
Unit:	ms	Setting range:	0 – 1000
Format:	DEC	Data size:	16-bit
Example:	15 = 150 ms		

Settings:

Controls the smoothing gain. Set this parameter to 0 to disable this function.

P2.029	**Gain switching condition**		**Address: 023AH 023BH**
Default:	16777216	Control mode:	All
Unit:	pulse; kpps; rpm	Setting range:	0 – 50331648
Format:	DEC	Data size:	32-bit

Settings:

You determine the gain switching (pulse error, kpps, rpm) by the selection of gain switching condition (P2.027).

P2.030■	Auxiliary function		Address: 023CH 023DH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-8 to +8
Format:	DEC	Data size:	16-bit

Settings:

Value	Function
0	Disable all functions described below
1	Switch servo to Servo On state
2 – 4	(Reserved)
5	This setting does not retain its value after powering off. When there is no need to save the data, this setting can avoid continually writing the parameters into EEPROM and shortening the lifetime of the EEPROM. You must set this parameter when using communication control.
6	This setting enables command simulation mode. In this mode, the external Servo On signal cannot work and the DSP Error (variable 0x6F) is read as 0. P0.001 only shows the external error code (positive / negative limit, emergency stop, etc). DO.Ready is on, commands are accepted in each mode and can be observed through the scope software, but the motor does not operate. Use this mode to examine command accuracy.
7	High-speed oscilloscope: disable Time-Out function (for PC software).
8	Back up all current parameter values to EEPROM, so that the values are retained after cycling the power. The panel displays ‘to.rom’ during execution. This feature can also be executed when servo is in the Servo On state.
-1, -5, -6, -7	Disable the functions of 1, 5, 6, and 7.
-2 to -4, -8	(Reserved)

Note: please set the value to 0 during normal operation. The value returns to 0 automatically after cycling the power.

P2.031	Frequency response level		Address: 023EH 023FH
Default:	19	Control mode:	All
Unit:	-	Setting range:	1 – 50
Format:	DEC	Data size:	16-bit

Settings:

In gain adjustment mode (P2.032), you can adjust the servo frequency with the frequency response level parameter (P2.031). When you increase the frequency response level (P2.031), the servo frequency increases as well. Please refer to Chapter 5 for adjustment details.

8

P2.032	Gain adjustment mode		Address: 0240H 0241H
Default:	0x0001	Control mode:	All
Unit:	-	Setting range:	0 – 4
Format:	HEX	Data size:	16-bit

Settings:

The servo drive provides three gain adjustment modes for fine tuning. You only need to increase or decrease the frequency response level (P2.031) to tune the machine. The gain adjustment mode must be set when the simple mode is off (P2.033 U = 0). Recommendations for tuning the machine are in Section 5.1.

Value	Adjustment mode	Inertia estimation	Parameter	
			Manual	Auto
0	Manual	Fixed set value of P1.037	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102	N/A
1	Gain adjustment mode 1	Real-time estimation	P2.031	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102
2	Gain adjustment mode 2	Fixed set value of P1.037	P1.037 P2.031	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102
3	Gain adjustment mode 3 (only two dimensional control function is enabled)	Fixed set value of P1.037	P1.037 P2.031 P2.089	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.098, P2.099, P2.101, P2.102
4	Gain adjustment mode 4	Reset to gain default value		

Note: when the two dimensional control function is turned off (P2.094 [Bit 12] = 0), the effect of gain adjustment mode 3 is equivalent to gain adjustment mode 2, so setting P2.089 is invalid in that scenario.

P2.033	Reserved

P2.034	Speed command error warning		Address: 0244H 0245H
Default:	5000	Control mode:	S / Sz
Unit:	rpm	Setting range:	1 – 30000 (rotary motor) 1 – 15999 (linear motor)
Format:	DEC	Data size:	16-bit

Settings:

In Speed mode, this parameter sets the acceptable difference between the command speed and the feedback speed. If the difference is greater than this value, AL007 occurs.

P2.035	Excessive deviation of Position command warning		Address: 0246H 0247H
Default:	50331648	Control mode:	PT / PR
Unit:	pulse	Setting range:	1 – 1677721600
Format:	DEC	Data size:	32-bit

Settings:

In Position mode, this parameter sets the acceptable difference between the command position and the feedback position. If the difference is greater than this value, AL009 occurs.

P2.036	DI9 functional planning		Address: 0248H 0249H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.010.

P2.037	DI10 functional planning		Address: 024AH 024BH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.010.

P2.038	VDI11 functional planning		Address: 024CH 024DH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

8

Settings:

Please refer to the description of P2.010. Virtual digital input is useful when triggering communication or when DI points are insufficient. You can set the DI to be used as soon as power is on when the contact would be normally closed for virtual digital input, such as Servo On.

P2.039	**VDI12 functional planning**		**Address: 024EH 024FH**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.038.

P2.040	**VDI13 functional planning**		**Address: 0250H 0251H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0 – 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.038.

P2.041	**DO6 functional planning**		**Address: 0252H 0253H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0 – 0x013F (last two codes are DO code)
Format:	HEX	Data size:	16-bit

Settings:

Please refer to the description of P2.018.

P2.042	**Reserved**

P2.043	**Notch filter frequency (2)**		**Address: 0256H 0257H**
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 – 5000
Format:	DEC	Data size:	16-bit

Settings:

The second setting for resonance frequency. This function is disabled if P2.044 is 0.

P2.044	Notch filter attenuation level (2)		Address: 0258H 0259H
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 – 40
Format:	DEC	Data size:	16-bit

Settings:

The second Notch filter attenuation level. A value of 5 indicates -5 dB. Set this parameter to 0 to disable the Notch filter.

P2.045	Notch filter frequency (3)		Address: 025AH 025BH
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 – 5000
Format:	DEC	Data size:	16-bit

Settings:

The third setting for resonance frequency. This function is disabled if P2.046 is 0.

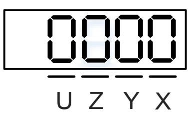
P2.046	Notch filter attenuation level (3)		Address: 025CH 025DH
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 – 40
Format:	DEC	Data size:	16-bit

Settings:

The third Notch filter attenuation level. A value of 5 indicates -5 dB. Set this parameter to 0 to disable the Notch filter.

P2.047	Auto resonance suppression mode		Address: 025EH 025FH
Default:	0x0001	Control mode:	All
Unit:	-	Setting range:	0x0000 – 0x01F2
Format:	DEC	Data size:	16-bit

Settings:



X	Auto resonance suppression function	Z	Fixed resonance suppression parameter
Y	Fixed resonance suppression parameter	U	Reserved

- X: auto resonance suppression function

  0: disable auto resonance suppression. After the function is disabled, the existing resonance suppression parameter values do not change.

  1: auto resonance suppression. When the servo determines it is stable, meaning that resonances have been suppressed, and there is no other resonance, and there is no other interference that is affecting the operation, or any other factors, then the servo automatically saves the resonance suppression data, and resets the value to 0. If the servo is unstable, cycle the power or set this value to 1 again for the servo to re-estimate.

- Y: fixed resonance suppression parameter

  In auto resonance suppression, set the Notch filters to use manual resonance suppression.

Bit	3	2	1	0

Bit	Function	Description
0	Notch 1 auto / manual setting	0: auto resonance suppression 1: manually set the first set of resonance suppression parameters
1	Notch 2 auto / manual setting	0: auto resonance suppression 1: manually set the second set of resonance suppression parameters
2	Notch 3 auto / manual setting	0: auto resonance suppression 1: manually set the third set of resonance suppression parameters
3	Notch 4 auto / manual setting	0: auto resonance suppression 1: manually set the fourth set of resonance suppression parameters

- Z: fixed resonance suppression parameter

  In auto resonance suppression, set the Notch filters to use manual resonance suppression.

Bit	3	2	1	0

Bit	Function	Description
0	Notch 5 auto / manual setting	0: auto resonance suppression 1: manually set the fifth set of resonance suppression parameters

Example: if P2.047 = 0x0021, and the auto resonance suppression function is enabled, the servo searches for the point of resonance and suppresses it. When you set Y to 2, you manually set the second set of resonance suppression parameters. Then, if the servo finds 2 resonance points, it writes data for the 1st point to the 1st set of resonance suppression parameters and the data for the 2nd point to the 3rd set of resonance suppression parameters. That is, it skips the 2nd set of parameters.

P2.048	Auto resonance detection level		Address: 0260H 0261H
Default:	100	Control mode:	All
Unit:	-	Setting range:	1 – 1000
Format:	DEC	Data size:	16-bit

Settings:

The smaller this parameter value, the more sensitive it is to resonance. If P2.048 is larger, the resonance sensitivity is lower; on the other hand, if P2.048 is smaller, the resonance sensitivity is higher.

P2.049	Speed detection filter and jitter suppression			Address: 0262H 0263H
Operation interface:	Panel / software	Communication	Control mode:	All
Default:	1.0	10	Data size:	16-bit
Unit:	1 ms	0.1 ms	-	-
Setting range:	0.0 – 100.0	0 – 1000	-	-
Format:	One decimal	DEC	-	-
Example:	1.5 = 1.5 ms	15 = 1.5 ms	-	-

Settings:

Set the filter for speed estimation.

P2.050	Pulse Clear mode		Address: 0264H 0265H
Default:	0x0000	Control mode:	PT
Unit:	-	Setting range:	0 – 1
Format:	HEX	Data size:	16-bit

Settings:

Please refer to Table 8.1 for digital input. Set digital input (DI) as CCLR to enable the Pulse Clear function. If this DI is on, the accumulated position error is reset to 0.

0: CCLR is rising-edge triggered.

1: CCLR is action-level triggered.

P2.051	Reserved

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P2.052▲	Indexing coordinates scale		Address: 0268H 0269H
Default:	1000000000	Control mode:	All
Unit:	PUU	Setting range:	0 – 1000000000
Format:	DEC	Data size:	32-bit

Settings:

Set the scale of the indexing coordinates, indexing command position, and indexing feedback position.

If the value is too small, it may cause errors in the indexing coordinates.

The ranges of values for P2.052 are:

P2.052 > 1.05 x Maximum motor speed (rpm) x $\frac{16777216}{60000}$ x $\frac{\text{P1.045}}{\text{P1.044}}$

P2.052 > 146.8 x Maximum motor speed (rpm) x $\frac{\text{P1.045}}{\text{P1.044}}$

P2.053	Position integral compensation		Address: 026AH 026BH
Default:	0	Control mode:	All
Unit:	rad/s	Setting range:	0 – 1023
Format:	DEC	Data size:	16-bit

Settings:

Increase the position control integral to reduce position steady-state errors. If the value is too high, it may cause position overshoot and noise.

P2.054▲	Synchronous speed control gain		Address: 026CH 026DH
Default:	0	Control mode:	All
Unit:	rad/s	Setting range:	0 – 8191
Format:	DEC	Data size:	16-bit

Settings:

Increase the synchronous speed control to enhance the speed following between two motors.

If the value is too high, it may cause vibration and noise.

P2.055▲	Synchronous speed integral compensation		Address: 026EH 026FH
Default:	0	Control mode:	All
Unit:	rad/s	Setting range:	0 – 1023
Format:	DEC	Data size:	16-bit

Settings:

Increase the synchronous speed integral compensation to enhance the speed following and reduce the speed errors between two motors. If the value is too high, it may cause vibration and noise.

P2.056▲	Synchronous position integral compensation		Address: 0270H 0271H
Default:	0	Control mode:	All
Unit:	rad/s	Setting range:	0 – 1023
Format:	DEC	Data size:	16-bit

Settings:

Increase synchronous speed integral compensation to enhance the speed following and reduce the speed error between two motors. If the value is too high, it may cause vibration and noise. It is recommended that you set this value to the same value as P2.006.

P2.057▲	Synchronous control bandwidth		Address: 0272H 0273H
Default:	0	Control mode:	All
Unit:	Hz	Setting range:	0 – 1023
Format:	DEC	Data size:	16-bit

Settings:

If you are unsure about setting P2.054 – P2.056, set the value of synchronous control bandwidth instead so that the value corresponds to P2.054 – P2.056.

1. When the synchronous control bandwidth is greater than the servo bandwidth, the synchronous following is better.
2. When the servo bandwidth is greater than the synchronous control bandwidth, the single-axis motion following is better.

When the servo bandwidth plus the synchronous control bandwidth (P2.057) is greater than the system's allowable bandwidth, however, it causes system resonance.

Note: when increasing the bandwidth of both speed loop and synchronous control, the response of P2.025 must be faster than the setting of both bandwidths. Therefore, decrease P2.025 as needed.

P2.058	Synchronous speed error low-pass filter		Address: 0274H 0275H
Default:	0	Control mode:	All
Unit:	0.1 ms	Setting range:	0 – 1000
Format:	DEC	Data size:	16-bit
Example:	15 = 1.5 ms		

Settings:

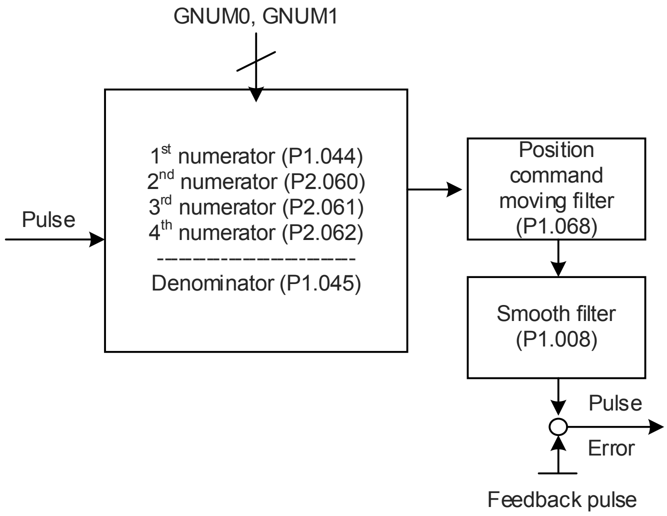
When the synchronous control is affected by low resolution, meaning that noise (less sharp and rough sound) is generated, use low-pass filter suppression. This filter must be faster than the synchronous control bandwidth.

P2.059	Reserved

P2.060	**E-Gear ratio (Numerator) (N2)**		**Address: 0278H 0279H**
Default:	16777216	Control mode:	PT
Unit:	pulse	Setting range:	1 to (2^{29}-1)
Format:	DEC	Data size:	32-bit

Settings:

The numerator of the E-Gear ratio can be selected with DI.GNUM0 and DI.GNUM1 (please refer to Table 8.1). If DI.GNUM0 and DI.GNUM1 are not both defined, P1.044 is the default numerator of the E-Gear ratio. Please switch DI.GNUM0 and DI.GNUM1 only when the servo is stopped in order to avoid mechanical vibration.



P2.061	**E-Gear ratio (Numerator) (N3)**		**Address: 027AH 027BH**
Default:	16777216	Control mode:	PT
Unit:	pulse	Setting range:	1 to (2^{29}-1)
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P2.060.

P2.062	**E-Gear ratio (Numerator) (N4)**		**Address: 027CH 027DH**
Default:	16777216	Control mode:	PT
Unit:	pulse	Setting range:	1 to (2^{29}-1)
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P2.060.

P2.063 – P2.064	**Reserved**

P2.065	Special bit register		Address: 0282H 0283H
Default:	0	Control mode:	PT / PR / S / Sz
Unit:	-	Setting range:	0 – 0xFFFF
Format:	-	Data size:	-

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit 0 – Bit 2, Bit 4, Bit 5, Bit 7, and Bit 14: reserved, please set to 0.

Bit 3: set the method for regenerative energy consumption.

0: determined by the servo's internal algorithm.

1: determined by the DC bus voltage.

Bit 6: in PT mode, set the pulse error (pulse frequency is too high) protection function.

0: enable the pulse error protection function.

1: disable the pulse error protection function.

Bit 8: U, V, W wiring error detection function.

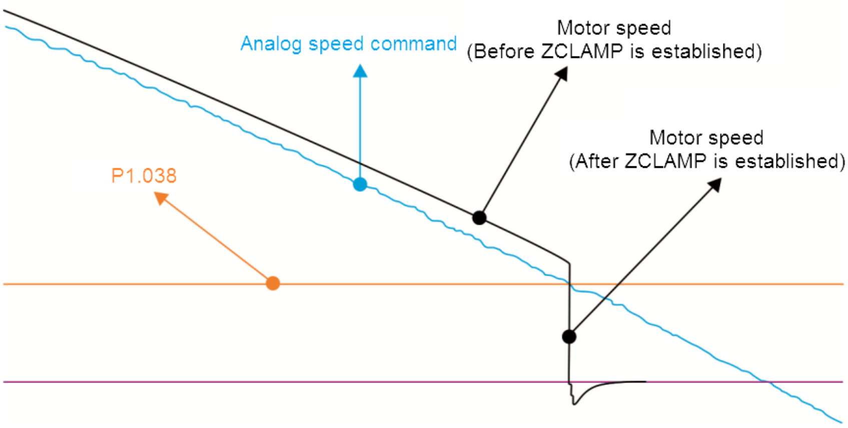
1: enable the U, V, W wiring error detection function.

Bit 9: U, V, W wiring cut-off detection function.

1: enable the U, V, W wiring cut-off detection function.

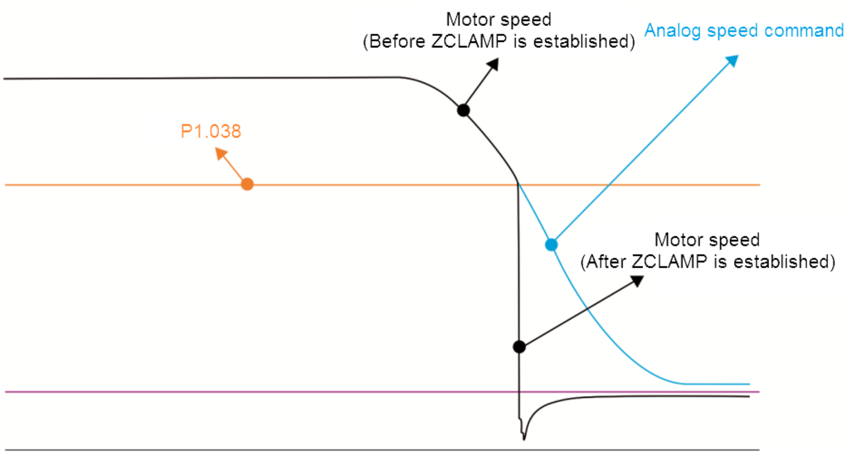
Bit 10: ZCLAMP function selection. The ZCLAMP function is enabled when the following conditions are met. Condition 1: Speed mode; Condition 2: DI.ZCLAMP is on; Condition 3: motor speed is slower than the value of P1.038.

0: command source is the analog voltage. The ZCLAMP function uses the analog Speed command without acceleration / deceleration to determine if this function should be enabled. The motor is clamped at the position where ZCLAMP conditions are met.

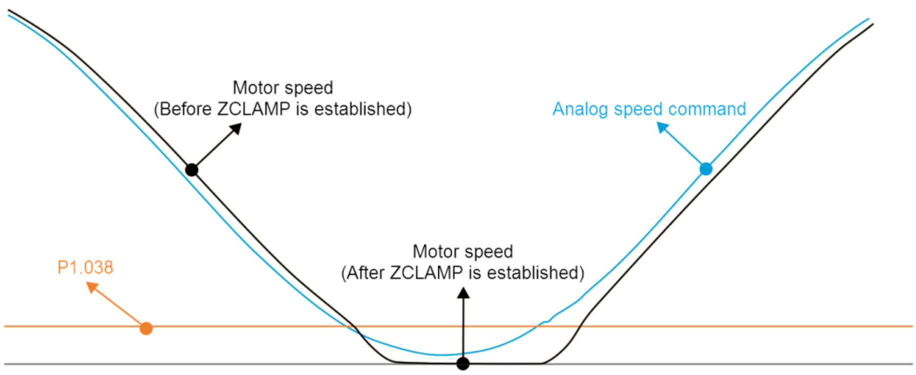


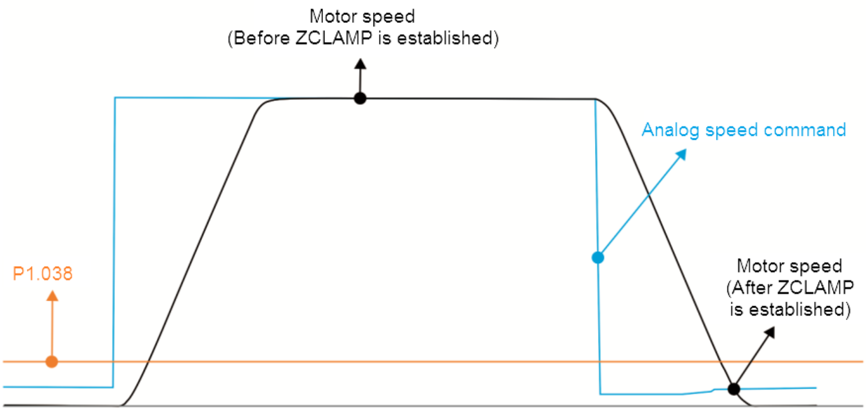
0: command source is the internal register. ZCLAMP function uses the register Speed command with acceleration / deceleration to determine if this function should be enabled. The motor is clamped at the position where ZCLAMP conditions are met.

8

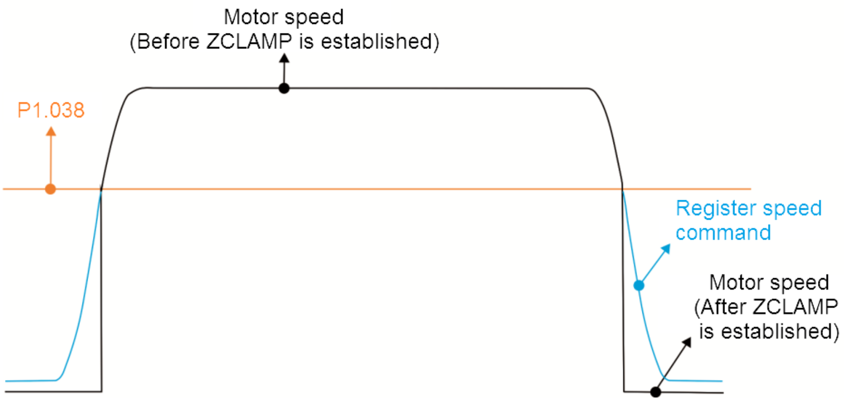


1: command source is the analog voltage. ZCLAMP function uses the analog Speed command without acceleration / deceleration to determine if this function is enabled. When ZCLAMP conditions are met, the motor speed decelerates to 0 rpm by S-curve deceleration. If ZCLAMP conditions are not met, the motor follows the analog Speed command through the S-curve.





1: command source is the internal register. ZCLAMP function uses the register Speed command with acceleration / deceleration to determine if this function should be enabled. When ZCLAMP conditions are met, the motor speed is set to 0 rpm.



Bit 11: enable pulse inhibit function.

0: disable NL / PL pulse inhibit function. In PT mode, the external Position pulse command is input to the servo drive under any condition.

1: enable NL / PL pulse inhibit function. In PT mode, if NL exists, the external NL pulse is not input to the servo drive and the PL Pulse command is accepted. In PT mode, if PL exists, the external PL pulse is not input to the servo drive and the NL pulse command is accepted.

Note: in DMCNET mode, if both NL and PL exist, neither pulse command is input to the servo drive.

Bit 12: Loss phase detection function

0: enable loss phase (AL022) detection.

1: disable loss phase (AL022) detection.

Bit 13: Encoder output error detection function

0: enable encoder output error (AL018) detection function.

1: disable encoder output error (AL018) detection function.

Bit 15: Friction compensation mode selection

0: if the speed is slower than the value of P1.038, the compensation value remains unchanged.

1: if the speed is slower than the value of P1.038, the compensation value becomes 0.

P2.066	Special bit register 2		Address: 0284H 0285H
Default:	0x0000	Control mode:	PT / PR / S / Sz
Unit:	-	Setting range:	0x0000 – 0x182F
Format:	HEX	Data size:	16-bit

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit 0 – 1, Bit 3, Bit 6 – 8, Bit 10 – 15: reserved

Bit 2: cancel low-voltage error latch function.

0: enable the low-voltage error latch function; the error is not cleared automatically.

1: disable the low-voltage error latch function; the error is cleared automatically.

Bit 4: disable AL044 detection (servo function overload warning).

0: enable AL044 detection.

1: disable AL044 detection.

Bit 5: enable AL041 disconnection detection of linear scale (only when the full-closed loop control function is activated).

0: enable AL041 detection.

1: disable AL041 detection.

Bit 9: set AL003 as a warning or an alarm.

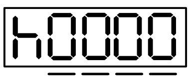
0: set AL003 as WARN.

1: set AL003 as ALM.

P2.067	Reserved

P2.068	Following error compensation switch		Address: 0288H 0289H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	0x00000000 – 0x00002101
Format:	HEX	Data size:	32-bit

Settings:



D C B A

U Z Y X

A	Reserved	X	Following error compensation switch
B	Reserved	Y	Reserved
C	Reserved	Z	DI.STP triggering method
D	Reserved	U	Speed unit in Speed mode
H	High bit	L	Low bit

- X: following error compensation switch (functions under the condition of P1.036 > 1)

  0: disable following error compensation.

  1: enable following error compensation.

- Y: reserved

- Z: DI.STP triggering method

  0: DI.STP is rising-edge triggered.

  1: DI.STP is level triggered.

- U: reserved

P2.069●	Absolute encoder		Address: 028AH 028BH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0 – 1
Format:	HEX	Data size:	16-bit

Settings:

0000

U Z Y X

X	Set up operation mode	Z	Index coordinates function setting when overflow occurs
Y	Y: Pulse command setting when absolute position is lost	U	Reserved

- X: set up operation mode

  0: Incremental type; an absolute type motor can be operated as an incremental type

  1: Absolute type. This setting is only applicable to an absolute type motor. If it is used on an incremental type motor, AL069 occurs.

- Y: Pulse command setting when absolute position is lost

  0: when AL060 or AL06A occurs, the system cannot accept a pulse command.

  1: when AL060 or AL06A occurs, the system can accept a pulse command.

- Z: index coordinates function when an overflow occurs

  0: index coordinates are lost when an overflow occurs.

  1: index coordinates are not affected by overflow, but absolute coordinates are not retained.

- U: reserved

Note:

1. This function is coming soon.
2. Changes to this setting are effective only after power is cycled to the servo drive.

P2.070	Read data selection		Address: 028CH 028DH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x00 – 0x07
Format:	HEX	Data size:	16-bit

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit 0: DI/DO data unit setting

0: PUU

1: Pulse

Bit 1: communication data unit setting

0: PUU

1: Pulse

Bit 2: overflow warning setting

0: overflow warning, including AL289 (PUU) and AL062 (pulse)

1: no overflow warning

Bit 3 – Bit15: reserved; set to 0

P2.071■	Absolute position homing		Address: 028EH 028FH
Default:	0x0	Control mode:	All
Unit:	-	Setting range:	0 – 1
Format:	HEX	Data size:	16-bit

Settings:

When P2.071 is 1, the current absolute position of the encoder is the home position.

Clearing this function is enabled by setting P2.008 to 271.

P2.072	Reserved

P2.073	E-Cam alignment - Operation		Address: 0292H 0293H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0x5F3F6F5F
Format:	HEX	Data size:	32-bit

Settings:

D C B A

UZ YX

BA	PR number	YX	Range of filter (0 – 95%)
DC	Masking range (0 – 95%)	UZ	Maximum allowable correction rate (0 – 100%)
h	High bit	L	Low bit

■ YX: range of filter (0 – 95%)

When DI.ALGN is triggered, the E-Cam alignment function is enabled. The system detects the current E-Cam position. When the differnce between the current E-Cam position and its previous alignment position is less than the parameter's range as a percentage, the filter function is enabled. Otherwise, the system uses the new position to do the alignment.

YX	00	01 – 5F
Function	Filter disabled	| Error | <= (1 to YX)%: filter enabled

Note: using the filter allows the alignment to be more stable and reduces any position errors caused by DI noise and so the operation can be smoother.

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- UZ: maximum allowable correction rate (0 – 100%)

  When alignment correction is enabled, the limitation of the maximum allowable correction rate (C) is defined as follows:

  ｜C｜<= (P5.084 / P5.083) x P2.073.UZ %

  Note: when the alignment error is too large, correcting this error once may cause motor vibration or overloading. Using this parameter can divide the alignment correction into several stages to smooth the process, but it may need more time to complete the alignment correction.

- BA: PR number (PR#0 – PR#99)

  After each alignment, any shortage of pulse numbers from the slave axis is stored in a specified PR. This PR can compensate for the slave position at the appropriate timing point. If BA is set to 0, any shortage of pulse numbers is not stored in PR.

  Note: the format of this parameter is HEX. Thus, to set PR#11, write 0B to BA.

- DC: masking range (0 – 95%)

  When DI.ALGN is triggered, the next alignment action is allowed only after the increasing pulses of the master axis are greater than the distance (M) masking.

  M >= (P5.084 / P5.083) x P2.073.DC %

  Note:

  1. This masking function only allows increasing pulse input, and does not work for decreasing pulse input.
  2. The E-Cam function is not supported by the model A3-L.

P2.074	**E-Cam alignment - DI delay time**		**Address: 0294H 0295H**
Default:	0.000	Control mode:	PR
Unit:	ms (minimum scale is μs)	Setting range:	-25.000 to +25.000 (includes 3 decimal places)
Format:	DEC	Data size:	16-bit

Settings:

This parameter offsets the alignment target to resolve DI delays. The setting works as follows:

P2.074 = P2.009 (DI response filter time) + sensor's delay time

Note: the E-Cam function is not supported by the model A3-L.

P2.075■	E-Cam alignment - Alignment target position		Address: 0296H 0297H
Default:	0	Control mode:	PR
Unit:	Pulse unit of master axis	Setting range:	0 to (P5.084 / P5.083) -1
Format:	DEC	Data size:	32-bit

Settings:

Set the alignment target position for E-Cam alignment (master axis pulse).

Note:

1. The E-Cam function is not supported by the model A3-L.
2. When the input value is within the setting range, but if changes in the value of P5.084 or P5.083 causes the value to exceed the range, this parameter is automatically reset to 0.

P2.076■	E-Cam alignment - Control switch		Address: 0298H 0299H
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 – 0x6FF7
Format:	HEX	Data size:	16-bit

Settings:

X	E-Cam alignment control	UZ	Alignment forward direction allowable rate (0 – 100%)
Y	Filter intensity (0 – F)	-	-

■ X: E-Cam alignment control

Bit	3	2	1	0

Bit	Function	Description
0	Enable alignment	Set this bit to 0 to disable this function; set this bit to 1 to enable this function. If enabled, the E-Cam alignment correction is executed when DI.ALGN is on.
1	Trigger PR immediately	Set this bit to 1 to enable this function. When the E-Cam alignment is executing, the correction is stored in the PR data location specified by P2.073, which triggers the PR immediately. Set this bit to 0 to disable this function. When the E-Cam alignment is executing, it does not trigger PR immediately to compensate the correction. You must use the PR (P5.088.BA) when E-Cam disengages in order to execute it.
2	Position of the mark	0: if the mark is on the master axis, the position of the mark is not affected when aligning. 1: if the mark is on the slave axis, the position of the mark is affected when aligning.
3	Reserved	-

- Y: filter intensity (0 – F)

  Indicates average of 2^(value). Set to 0 to disable the filter. When the value of Y increases, the correction is slower which can avoid large amounts of correction during E-Cam adjustment. This can also avoid disturbances caused by sensor noise for a smoother operation. Setting P2.076 too high causes the alignment to not work properly. The recommended value is 3.

  Example: when the filter intensity value is 3, the actual filter intensity = 2^3 = 8.

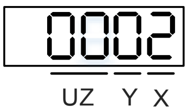
- UZ: alignment forward direction allowable rate (0 – 100%)

Value	Alignment direction	Value	Alignment direction
0	Backward alignment only	80	Forward 80%, backward 20%
30	Forward 30%, backward 70%	>= 100	Forward alignment only
50	Alignment with the shortest distance	-	-

Note: the E-Cam function is not supported by model A3-L.

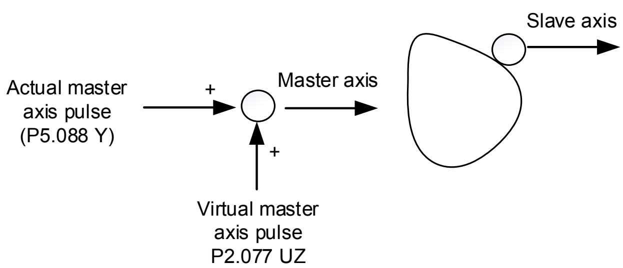
P2.077■	E-Cam master axis – Pulse masking		Address: 029AH 029BH
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 – 0xFF7D
Format:	HEX	Data size:	16-bit

Settings:



X	Pulse masking function of master axis / Continuous operation of master axis / JOG function of master axis	UZ	Alignment forward direction allowable rate (0 – 100%)
Y	Masking pulse adjusting lead		

- X: pulse masking function of master axis / Continuous operation of master axis / JOG function of master axis



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X	Function	Actual master axis pulse	Virtual pulse	Description
0	Function disabled	Receive actual master axis pulse	N/A	E-Cam is driven by the actual master axis pulse.
1	Stops operation			E-Cam stops operating, but the masked master pulse continues to be stored in the internal variable.
2	Continuous forward running	Masked	Virtual pulse function enabled	The source of the E-Cam master axis is the virtual pulse frequency in kpps, set by P2.077.UZ. This function continues to operate. To stop it, set X to 1.
3	Continuous reverse running			
4	Forward JOG			The source of the E-Cam master axis is the virtual pulse number in pulses, set by P2.077.UZ. It only refers to the pulse number set by UZ during JOG operation.
5	Reverse JOG			
6 – 8	-	-	-	Reserved
9	Pulse masking of master axis	Receive actual master axis pulse	N/A	E-Cam is driven by the actual master pulse and the pulse record is stored in the internal variables.
A	Continuous forward running		Virtual pulse function enabled	The source of the E-Cam master axis is the frequency transmitted by the actual master axis (P5.088 Y) plus the virtual pulse frequency in kpps, set by P2.077.UZ. This function continues to operate. To stop it, set X to 9.
B	Continuous reverse running			
C	Forward JOG			The source of the E-Cam master axis is the pulse transmitted by the actual master axis (P5.088 Y) plus the virtual pulse number in pulses, set by P2.077.UZ. This function is often used during JOG operation.
D	Reverse JOG			

- Y: masking pulse adjusting lead

Bit	Function	Description
0	Function disabled	Virtual pulse number is not written to P5.087 (initial lead).
1	Write the lead	Write the virtual pulse number to P5.087 (initial lead).
2	Write to ROM	Set the virtual pulse number to P5.087 (initial lead) and write this value to EEPROM.
3		
4	Plus one cycle	Write the virtual pulse number plus the pulse number of one cycle (P5.084 / P5.083) to P5.087 (initial lead).
5		
6	Plus one cycle and write to ROM	Write the virtual pulse number plus the pulse number of one cycle (P5.084 / P5.083) to P5.087 (initial lead). Then write this value to EEPROM.
7		
8 – 15	Reserved	-

- UZ: pulse data when master axis performs continuous forward / reverse running or JOG function.

  Example:

  Initiate masking ▶ UZYX = 0x0001

  Continuous forward running at 20 kpps ▶ UZYX = 0x1402

  Continuous reverse running at 32 kpps ▶ UZYX = 0x2003

  Forward JOG for 255 pulses ▶ UZYX = 0xFF04

  Reverse JOG for 18 pulses ▶ UZYX = 0x1205

  Complete and adjust for lead ▶ UZYX = 0x0020 (Write to EEPROM)

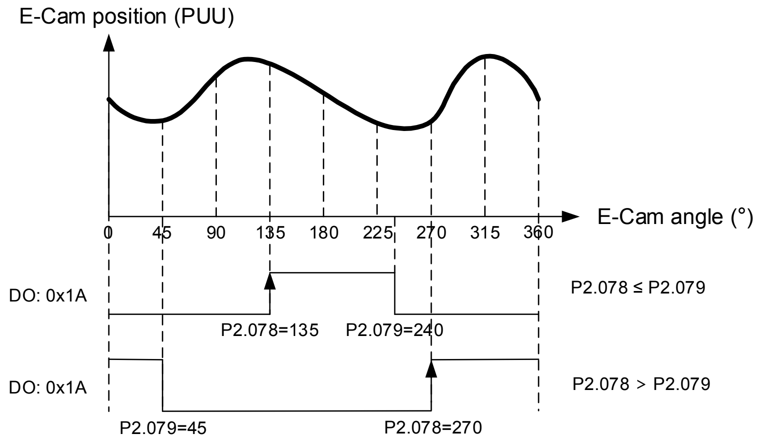
  Disable this function ▶ UZYX = 0x0000

Note: the E-Cam function is not supported by the model A3-L.

P2.078	E-Cam: DO.CAM_Area#2 rising-edge phase		Address: 029CH 029DH
Default:	270	Control mode:	PR
Unit:	degree	Setting range:	0 – 360
Format:	DEC	Data size:	16-bit

Settings:

The relationship between DO.CAM_Area2 and the parameter values is shown below. When E-Cam is not engaged, this signal is always off.



Note: the E-Cam function is not supported by the model A3-L.

P2.079	E-Cam: DO.CAM_Area#2 falling-edge phase		Address: 029EH 029FH
Default:	360	Control mode:	PR
Unit:	degree	Setting range:	0 – 360
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P2.078 for the relationship between DO.CAM_Area2 and its parameters.

Note: the E-Cam function is not supported by the model A3-L.

P2.080 – P2.088	Reserved

P2.089	Command responsiveness gain		Address: 02B2H 02B3H
Default:	25	Control mode:	PT / PR
Unit:	rad/s	Setting range:	1 – 2000
Format:	DEC	Data size:	16-bit

Settings:

Increasing this gain speeds up the responsiveness of the Position command and shortens the tuning time, but when the gain is too large, it causes position overshoot which leads to machine jitter.

P2.090 – P2.092	Reserved

P2.093	STO FDBK control		Address: 02BAH 02BBH
Default:	0x0010	Control mode:	All
Unit:	rad/s	Setting range:	0x0010 – 0x0023
Format:	HEX	Data size:	16-bit

Settings:

- X: logic selection

  0: Logic A

  1: Logic B

  2: Logic C

  3: Logic D
- Y: FDBK action

  1: FDBK no latch

  2: FDBK latch
- Z: reserved
- U: reserved

P2.094▲	Special bit register 3		Address: 02BCH 02BDH
Default:	0x1000	Control mode:	PT / PR / S / Sz
Unit:	-	Setting range:	0x0000 – 0xF3A6
Format:	HEX	Data size:	16-bit

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 15 – 13	Reserved	-
Bit 12	Two dimensional control function	0: disable two dimensional control function 1: enable two dimensional control function
Bit 11 – 10	Reserved	-
Bit 9	Second set of vibration elimination	0: disable second set of vibration elimination 1: enable second set of vibration elimination (P1.092 – P1.094) Vibration elimination takes effect only when the two dimensional control function P2.094 [Bit 12] is enabled.
Bit 8	First set of vibration elimination	0: disable first set of vibration elimination 1: enable first set of vibration elimination (P1.089 – P1.091) Vibration elimination takes effect only when the two dimensional control function P2.094 [Bit 12] is enabled.
Bit 7 – 6	Reserved	-
Bit 5	Cancel AL016 IGBT overheat alarm	0: enable AL016 IGBT overheat alarm 1: disable AL016 IGBT overheat alarm
Bit 4	Dynamic brake options	0: disable new dynamic brake 1: enable new dynamic brake, and force use of the DC Bus voltage to determine the timing of regenerative energy loss
Bit 3 – 0	Reserved	-

P2.095	Notch filter bandwidth (1)		Address: 02BEH 02BFH
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 – 10
Format:	DEC	Data size:	16-bit

Settings:

The first value of resonance width. This function is disabled if P2.024 is 0. P2.023, P2.024, and P2.095 are the first set of Notch filter parameters.

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P2.096	Notch filter bandwidth (2)		Address: 02C0H 02C1H
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 – 10
Format:	DEC	Data size:	16-bit

Settings:

The second value of resonance width. This function is disabled if P2.044 is 0. P2.043, P2.044, and P2.096 are the second set of Notch filter parameters.

P2.097	Notch filter bandwidth (3)		Address: 02C2H 02C3H
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 – 10
Format:	DEC	Data size:	16-bit

Settings:

The third value of resonance width. This function is disabled if P2.046 is 0. P2.045, P2.046, and P2.097 are the third set of Notch filter parameters.

P2.098	Notch filter frequency (4)		Address: 02C4H 02C5H
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 – 5000
Format:	DEC	Data size:	16-bit

Settings:

The fourth value of resonance frequency. This function is disabled if you set P2.099 to 0. P2.098, P2.099, and P2.100 are the fourth set of Notch filter parameters.

P2.099	Notch filter attenuation level (4)		Address: 02C6H 02C7H
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 – 40
Format:	DEC	Data size:	16-bit

Settings:

The fourth Notch filter attenuation level. The Notch filter is disabled if you set this parameter to 0. For example, if you set the attenuation level to 5, then the value is -5 dB.

P2.100	Notch filter bandwidth (4)		Address: 02C8H 02C9H
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 – 10
Format:	DEC	Data size:	16-bit

Settings:

The fourth value of resonance width. This function is disabled if you set P2.099 to 0. P2.098, P2.099, and P2.100 are the fourth set of Notch filter parameters.

P2.101	Notch filter frequency (5)		Address: 02CAH 02CBH
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 – 5000
Format:	DEC	Data size:	16-bit

Settings:

The fifth value of resonance frequency. This function is disabled if you set P2.102 to 0. P2.101, P2.102, and P2.103 are the fifth set of Notch filter parameters.

P2.102	Notch filter attenuation level (5)		Address: 02CCH 02CDH
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 – 40
Format:	DEC	Data size:	16-bit

Settings:

The fifth Notch filter attenuation level. The Notch filter function is disabled if you set this parameter to 0. For example, if you set the attenuation level to 5, then the value is -5 dB.

P2.103	Notch filter bandwidth (5)		Address: 02CEH 02CFH
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 – 10
Format:	DEC	Data size:	16-bit

Settings:

The fifth value of resonance width. This function is disabled if you set P2.102 to 0. P2.101, P2.102, and P2.103 are the fifth set of Notch filter parameters.

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P2.104	P/PI torque switching command condition		Address: 02D0H 02D1H
Default:	200	Control mode:	PT / PR / S / Sz
Unit:	[%]	Setting range:	1 – 800
Format:	DEC	Data size:	16-bit

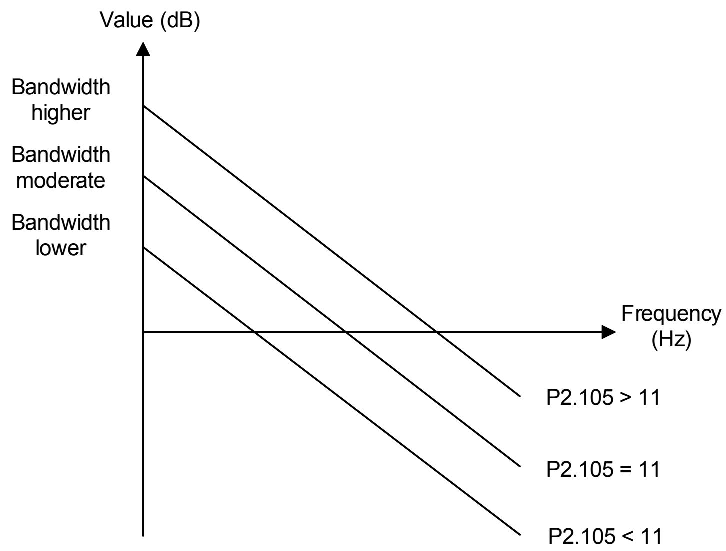
Settings:

When the Torque command exceeds P2.104, the speed controller gain is switched from PI to P in order to reduce response overshoot.

P2.105	Automatic gain adjustment level 1		Address: 02D2H 02D3H
Default:	11	Control mode:	PT / PR
Unit:	-	Setting range:	1 – 21
Format:	DEC	Data size:	16-bit

Settings:

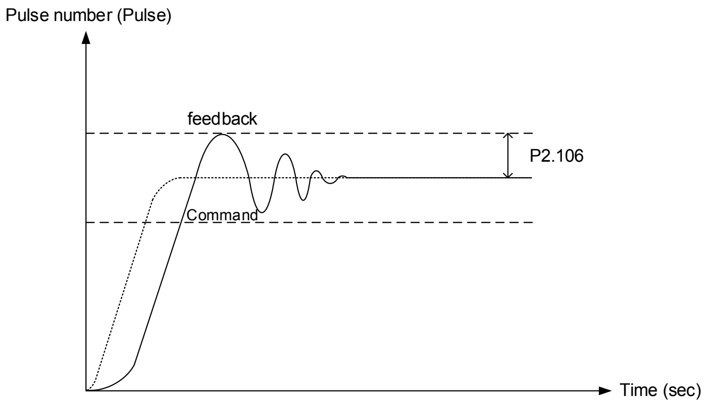
Use this parameter to adjust the bandwidth when auto-tuning. If the value is larger, the bandwidth after auto-tuning is higher, but if the bandwidth margin is insufficient, it may cause machine jitter. If the value is too low, the bandwidth after auto-tuning is lower, but the response is slower.



P2.106	Automatic gain adjustment level 2		Address: 02D4H 02D5H
Default:	2000	Control mode:	PT / PR
Unit:	Pulse number	Setting range:	1 – 50331648
Format:	DEC	Data size:	16-bit

Settings:

Use this parameter to adjust the maximum allowable overshoot when auto-tuning. The overshoot range is set for either the user or the machine. If the value is larger, the maximum overshoot allowed by auto-tuning is greater, but the response is faster. If the value is smaller, the maximum overshoot allowed by auto-tuning is smaller, but the response is slower.



P2.107 – P2.111	Reserved

P2.112▲	Special bit register 4		Address: 02E0H 02E1H
Default:	0x000C	Control mode:	PT / PR / S / Sz
Unit:	-	Setting range:	0x0000 – 0x001F
Format:	HEX	Data size:	16-bit

Settings:

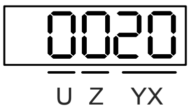
Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 15 – 4	Reserved	-
Bit 3	Auto gain adjustment mode	0: reserved 1: cycle adjustment
Bit 2	Reserved	-
Bit 1	Enable AL089	0: disable AL089 1: enable AL089
Bit 0	Maximum voltage of analog output monitoring	Analog output monitoring, ±8V or ±10V 0: ±8V 1: ±10V

P3.xxx Communication parameters

P3.000	**Address**		**Address: 0300H 0301H**
Default:	0x7F	Control mode:	All
Unit:	-	Setting range:	0x01 – 0x7F
Format:	HEX	Data size:	16-bit

Settings:

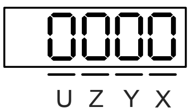


YX	Communication address setting	UZ	Reserved

When using RS-485 to communicate, one servo drive can set only one address. Setting more than one addresses causes abnormal communications. This address represents the absolute address of the servo drive in the communication network. It is also applicable to RS-485, CANopen, and DMCNET. When the communication address of MODBUS is 0xFF, the servo drive automatically receives and and replies to data regardless of the address, but P3.000 cannot be set to 0xFF.

P3.001	**Transmission speed**		**Address: 0302H 0303H**
Default:	0x0203	Control mode:	All
Unit:	Bps	Setting range:	0x000 – 0x3405
Format:	HEX	Data size:	16-bit

Settings:



Transmission speed is divided into U, Z, Y, and X (hexadecimal):

	U	Z	Y	X
Communication port	DMCNET	CANopen / DMCNET	-	RS-485
Range	0 – 3	0 – 4	0	0 – 5

■ Definition of X value

0: 4800	1: 9600	2: 19200
3: 38400	4: 57600	5: 115200

■ Definition of Z value*3

0: 125 Kbit/s	1: 250 Kbit/s	2: 500 Kbit/s
3: 800 Kbit/s	4: 1.0 Mbit/s	-

■ Definition of U value

0: use Delta's controller, such as PLC or HMI
3: use Delta's motion card

Note:

1. If this parameter is set through CANopen, only Z can be set and the others remain unchanged.
2. The communication speed of USB is set at 1.0 Mbit/s and it cannot be changed.
3. After the Z value is set, cycle the power to take effect.

P3.002	**Communication protocol**		**Address: 0304H 0305H**
Default:	0x6	Control mode:	All
Unit:	Bps	Setting range:	0 – 8
Format:	HEX	Data size:	16-bit

Settings:

0: 7, N, 2 (MODBUS, ASCII)	1: 7, E, 1 (MODBUS, ASCII)	2: 7, O, 1 (MODBUS, ASCII)
3: 8, N, 2 (MODBUS, ASCII)	4: 8, E, 1 (MODBUS, ASCII)	5: 8, O, 1 (MODBUS, ASCII)
6: 8, N, 2 (MODBUS, RTU)	7: 8, E, 1 (MODBUS, RTU)	8: 8, O, 1 (MODBUS, RTU)

P3.003	**Communication error handling**		**Address: 0306H 0307H**
Default:	0x0	Control mode:	All
Unit:	-	Setting range:	0 – 1
Format:	HEX	Data size:	16-bit

Settings:

0: display warning and let motor continue operating.

1: display warning and let motor decelerate to a stop. Deceleration time is set in P5.003.B.

P3.004	**Communication timeout**		**Address: 0308H 0309H**
Default:	0x0	Control mode:	All
Unit:	sec	Setting range:	0 – 20
Format:	DEC	Data size:	16-bit

Settings:

If the value is not 0, enable communication timeout immediately. To disable this function, set the value to 0.

P3.005★	**Reserved**

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P3.006	Digital input (DI) control switch		Address: 030CH 030DH
Default:	0x0	Control mode:	All
Unit:	-	Setting range:	0x0000 – 0x1FFF
Format:	HEX	Data size:	16-bit

Settings:

Source of the DI that controls the switch. Each bit of this parameter determines one input source of DI signal:

Bit0 – Bit9 correspond to DI1 – DI10. Bit10 – Bit12 correspond to VDI11 – VDI13.

The setting of bit is as follows:

0: DI status is controlled by the external hardware.

1: DI status is controlled by P4.007.

For more information on DI, please see:

DI1 – DI8: P2.010 – P2.017

DI9 – DI10: P2.036 – P2.037

VDI11 – VDI13: P2.038 – P2.040

P3.007	Communication response delay time		Address: 030EH 030FH
Default:	0	Control mode:	All
Unit:	0.5 ms	Setting range:	0 – 1000
Format:	DEC	Data size:	16-bit

Settings:

Delay the time of communication response from servo drive to controller.

P3.008	Reserved

P3.009	Communication synchronization		Address: 0312H 0313H
Default:	0x5055 (CANopen) 0x3511 (DMCNET)	Control mode:	CANopen / DMCNET
Unit:	-	Setting range:	Shown as below
Format:	HEX	Data size:	16-bit

Settings:

The synchronous setting is divided into E, T, D, and M (hexadecimal):

Digit	E	T	D	M
Function	Range of synchronous error	Target value	Deadband	-
Range	1 – 9	0 – 9	0 – F	-

The slave synchronizes with the master via SYNC. The definition is as follows:

M: reserved.

D: set the size of deadband (Unit: usec). If the deviation between the SYNC reaching time and the target value does not exceed the deadband, a correction is not needed.

T: target value of SYNC arrival time. Standard value is 500 usec, but you should use the target value. Target value = 400 + 10 x T. For example, if T = 5, the target value will be 450.

E: if the deviation between SYNC arrival time and the target value is smaller than the range, it means the synchronization is successful (unit: 10 μs).

P3.010	**CANopen / DMCNET protocol**		**Address: 0314H 0315H**
Default:	0x1	Control mode:	CANopen / DMCNET
Unit:	-	Setting range:	0x0000 – 0xFFFF
Format:	HEX	Data size:	16-bit

Settings:

Communication protocol is divided into U, Z, Y, and X (hexadecimal):

Bit	U	Z	Y	X
Function	PDO alarm is cleared automatically or not	Torque source limited	-	-
Range	0 – 1	0 – 1	-	-

Definition is as follows:

X: reserved.

Y: reserved.

Z: torque source limited (only functions in mode B).

0: torque source limited to communication commands.

1: torque source limited to DI commands.

U*[1]: 0: if PDO error occurs, it must be cleared by AlarmReset.

1: if PDO error disappears, it automatically clears the alarm.

Note: the current firmware does not have this feature. It is expected to have this feature added in the near future.

P3.011	**CANopen / DMCNET options**		**Address: 0316H 0317H**
Default:	0x0	Control mode:	CANopen / DMCNET
Unit:	-	Setting range:	Shown as below
Format:	HEX	Data size:	16-bit

Settings:

Communication setting is divided into X, Y, Z, and U (hexadecimal):

Digit	U	Z	Y	X
Function	Undefined	Undefined	Undefined	Parameter is saved in EEPROM or not
Range	0 – 1	0 – F	0 – F	0 – 1

Definition is as follows:

X: 1: when writing parameters via CANopen / DMCNET PDO, parameters are saved in EEPROM;

0: parameters are not saved in EEPROM.

Y: undefined

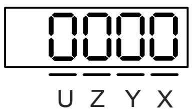
Z: undefined

U: undefined

Note: if you set X to 1 and continuously writes parameters through DMCNET PDO, it will shorten the lifetime of the EEPROM.

P3.012	CANopen / DMCNET support		Address: 0318H 0319H
Default:	0x0	Control mode:	CANopen / DMCNET
Unit:	-	Setting range:	0x0000 – 0x0111
Format:	HEX	Data size:	16-bit

Settings:



Digit	U	Z	Y	X
Function	Reserved	Load in CANopen / DMCNET values	Reserved	Reserved
Range	-	0 – 1	-	-
Control mode	-	CANopen mode 0x0B=0x0C DMCNET mode 0x0B	-	-

There are X and Y settings (Hexadecimal) for CANopen Quick Stop mode, which is only suitable in CANopen control mode 0x0B (Set P1.001 to b).

X: reserved

Y: reserved

Z: P parameters are overwritten by the CANopen / DMCNET parameters.

Z = 0: when cycling the power on the servo drive or resetting the communication, P parameters in the following table load the values in CANopen / DMCNET mode.

Z = 1: when cycling the power on the servo drive or resetting the communication, P parameters in the following table retain the same settings and do not load the values in CANopen / DMCNET mode.

CANopen mode:

Variables during initialization	P3.012.Z = 0	P3.012.Z = 1	Note
P1.032	0x0010	EEPROM	
P2.035	50331648	EEPROM	
P1.047	100	EEPROM	
P1.049	0	EEPROM	
P1.038	100	EEPROM	
Home offset	0	EEPROM	Used in HM mode
P1.044	1	EEPROM	
P1.045	1	EEPROM	

DMCNET mode:

Variables during initialization	P3.012.Z = 0	P3.012.Z = 1	Note
P1.032	0x0010	EEPROM	
P2.035	50331648	EEPROM	
P1.047	100	EEPROM	
P1.049	0	EEPROM	
P1.038	100	EEPROM	
Home offset	0	Undefined	Used in HM mode
Acc	200	Undefined	Used in PV, PP mode
Dec	200	Undefined	Used in PV, PP mode
Torque slope	200	Undefined	Used in PT mode
P1.044	1	EEPROM	
P1.045	1	EEPROM	

Methods to write parameters to EEPROM (even when power is off):

SDO: parameters are stored in EEPROM when written.

PDO: please refer to the setting of P3.011 X. (X = 1: when writing parameters via PDO, parameters are stored in EEPROM; X = 0: when setting parameters via PDO, parameters are not stored in EEPROM.)

Note: in CANopen mode, when using OD 1010 Store Parameter and P3.012 Z = 0, the default value is different from the value shown above. Please refer to CANopen Standard for further information.

P3.013 – P3.038	**Reserved**

8

P4.xxx Diagnosis parameters

P4.000★	Fault record (N)		Address: 0400H 0401H
Default:	0x0	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit

Settings:

The last abnormal status record.

Low word (LXXXX): the alarm number.

High word (hYYYY): the error code corresponding to CANopen / DMCNET.

P4.001★	Fault record (N-1)		Address: 0402H 0403H
Default:	0x0	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit

Settings:

The second to last abnormal status record.

Low word (LXXXX): the alarm number.

High word (hYYYY): the error code corresponding to CANopen / DMCNET.

P4.002★	Fault record (N-2)		Address: 0404H 0405H
Default:	0x0	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit

Settings:

The third to last abnormal status record.

Low word (LXXXX): the alarm number.

High word (hYYYY): the error code corresponding to CANopen / DMCNET.

P4.003★	Fault record (N-3)		Address: 0406H 0407H
Default:	0x0	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit

Settings:

The fourth to last abnormal status record.

Low word (LXXXX): the alarm number.

High word (hYYYY): the error code corresponding to CANopen / DMCNET.

P4.004★	Fault record (N-4)		Address: 0408H 0409H
Default:	0x0	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit

Settings:

The fifth to last abnormal status record.

Low word (LXXXX): the alarm number.

High word (hYYYY): the error code corresponding to CANopen / DMCNET.

P4.005	Servo motor JOG control		Address: 040AH 040BH
Default:	20	Control mode:	All
Unit:	rpm	Setting range:	0 – 5000 (rotary motor) 0 – 50000 (linear motor)
Format:	DEC	Data size:	16-bit

Settings:

The control methods are as follows:

1. Operation test:

   After the JOG speed is set by P4.005, the panel displays the JOG symbol. Pressing the UP key controls JOG operation in the positive direction; pressing the DOWN key controls JOG operation in the negative direction. Stop pressing to stop the JOG operation. If there is any error in this setting, then the motor cannot operate. The maximum JOG speed is the maximum speed of the servo motor.

2. DI control:

   If you set the DI to JOGU and JOGD (refer to Table 8.1), then the JOG operation in the positive or negative direction is controlled with this DI.

3. Communication control:

1 – 5000: JOG speed	4998: JOG operation in positive direction
4999: JOG operation in negative direction	0: stop operation

Note: when using communication to write values, and the frequency is high, please set P2.030 to 5.

P4.006▲■	Digital output register (readable and writable)		Address: 040CH 040DH
Default:	0x0	Control mode:	All
Unit:	-	Setting range:	0 – 0xFFFF
Format:	HEX	Data size:	16-bit

8

Settings:

bit 00: corresponds to DO code = 0x30	bit 08: corresponds to DO code = 0x38
bit 01: corresponds to DO code = 0x31	bit 09: corresponds to DO code = 0x39
bit 02: corresponds to DO code = 0x32	bit 10: corresponds to DO code = 0x3A
bit 03: corresponds to DO code = 0x33	bit 11: corresponds to DO code = 0x3B
bit 04: corresponds to DO code = 0x34	bit 12: corresponds to DO code = 0x3C
bit 05: corresponds to DO code = 0x35	bit 13: corresponds to DO code = 0x3D
bit 06: corresponds to DO code = 0x36	bit 14: corresponds to DO code = 0x3E
bit 07: corresponds to DO code = 0x37	bit 15: corresponds to DO code = 0x3F

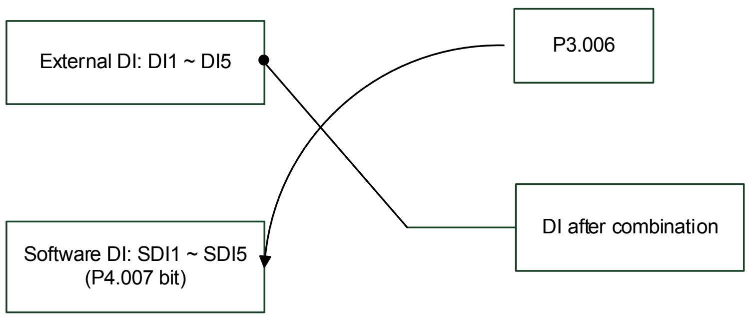
If you set P2.018 to 0x0130, then the output of DO#1 is the bit 0 status of P4.006, and so forth.

You can set DO Code (0x30 – 0x3F) through communication DO, and then write to P4.006.

P4.007■	**Multi-function for digital input**		**Address: 040EH 040FH**
Default:	0x0	Control mode:	All
Unit:	-	Setting range:	0 – 3FFF
Format:	HEX	Data size:	16-bit

Settings:

The source of the DI input signal can be the external terminal (DI1 – DI5) or the software (SDI1 – SDI5 corresponding to Bit 0 – 4 of P4.007), which is determined by P3.006. If the corresponding bit of P3.006 is 1, which means the source is the software SDI (P4.007); if the corresponding bit is 0, then the source is the hardware DI. See the figure below:



Read parameters: shows the DI status after combining external DI and software DI.

Write parameters: writes the software SDI status. This function is the same whether using the panel or communication to set the parameter.

For example: the value of P4.007 is 0x0011 which means DI1 and DI5 are on; the value of P4.007 is 0x0011 means that the software SDI1 and SDI5 are on. Please refer to P2.010 – P2.014 for more information on digital input pins (DI1 – DI5).

P4.008★	Input status of servo drive panel (read-only)		Address: 0410H 0411H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Read-only
Format:	HEX	Data size:	16-bit

Settings:

Use this communication parameter to read and check that the five keys (MODE, UP, DOWN, SHIFT, and SET) can function normally.

P4.009★	Digital output status (read-only)		Address: 0412H 0413H
Default:	-	Control mode:	All
Unit:	-	Setting range:	0 – 0x1F
Format:	HEX	Data size:	16-bit

Settings:

There is no difference whether reading by panel or through communication.

P4.010■	Adjustment function		Address: 0414H 0415H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 – 6
Format:	DEC	Data size:	16-bit

Settings:

0: reserved	4: execute current encoder (W phase) offset adjustment
1: execute analog speed input offset adjustment	5: execute 1 – 4 offset adjustment
2: execute analog torque input offset adjustment	6: execute IGBT ADC adjustment
3: execute current encoder (V phase) offset adjustment	7 – 14: reserved

Note: The adjustment function must be enabled by setting P2.008. When adjusting, the external analog voltage wiring connected to the torque needs to be removed completely and must be in Servo Off status.

P4.011	Analog speed input (1) offset adjustment		Address: 0416H 0417H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

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P4.012	Analog speed input (2) offset adjustment		Address: 0418H 0419H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.013	Analog torque input (1) offset adjustment		Address: 041AH 041BH
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.014	Analog torque input (2) offset adjustment		Address: 041CH 041DH
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.015	Current encoder (V1 phase) offset adjustment		Address: 041EH 041FH
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.016	Current encoder (V2 phase) offset adjustment		Address: 0420H 0421H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.017	Current encoder (W1 phase) offset adjustment		Address: 0422H 0423H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.018	Current encoder (W2 phase) offset adjustment		Address: 0424H 0425H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.019	IGBT NTC adjustment level (cannot reset)		Address: 0426H 0427H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	1 – 4
Format:	DEC	Data size:	16-bit

Settings:

Please cool down the drive to 25 °C before changing.

8

P4.020	Offset adjustment for analog monitor output (Ch1)		Address: 0428H 0429H
Default:	0	Control mode:	All
Unit:	mV	Setting range:	-800 to +800
Format:	DEC	Data size:	16-bit

Settings:

Offset adjustment value (cannot reset).

P4.021	Offset adjustment for analog monitor output (Ch2)		Address: 042AH 042BH
Default:	0	Control mode:	All
Unit:	mV	Setting range:	-800 to +800
Format:	DEC	Data size:	16-bit

Settings:

Offset adjustment value (cannot reset).

P4.022	Analog speed input offset		Address: 042CH 042DH
Default:	0	Control mode:	S
Unit:	mV	Setting range:	-5000 to +5000
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset.

P4.023	Analog torque input offset		Address: 042EH 042FH
Default:	0	Control mode:	T
Unit:	mV	Setting range:	-5000 to +5000
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset.

P4.024	Level of undervoltage error		Address: 0430H 0431H
Default:	160	Control mode:	All
Unit:	V (rms)	Setting range:	140 – 190
Format:	DEC	Data size:	16-bit

Settings:

When the voltage of the DC BUS is lower than P4.024* $\sqrt{2}$, the undervoltage alarm occurs.

P5.xxx Motion control parameters

P5.000★■	Firmware subversion		Address: 0500H 0501H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	-
Format:	DEC	Data size:	32-bit

Settings:

The low bit is the subversion of the firmware.

P5.001 – P5.002	Reserved

P5.003	Deceleration time for auto-protection		Address: 0506H 0507H
Default:	0xEEEFEEFF	Control mode:	All
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

The parameter setting is divided into D, C, B, A, W, Z, Y, X (hexadecimal), including:

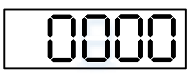
1. Deceleration time when activating the auto-protection function: OVF (DO.0x11, Position command / feedback overflows), CTO (communication timeout AL020), SPL, SNL, PL, NL
2. Deceleration time for stop command: STP

Digit	D	C	B	A	W	Z	Y	X
Function	STP	PFQS	CTO	OVF	SNL	SPL	N	PL
Range	0 – F	0 – F	0 – F	0 – F	0 – F	0 – F	0 – F	0 – F

Use 0 – F to index the deceleration time of P5.020 – P5.035. For example: if you set X to A, then the deceleration time of PL is determined by P5.030.

P5.004	Homing methods		Address: 0508H 0509H
Default:	0x0	Control mode:	PR
Unit:	-	Setting range:	0 – 0x128
Format:	HEX	Data size:	16-bit

Settings:



U Z Y X

X	Homing method	Z	Limit setting
Y	Z pulse setting	U	Reserved

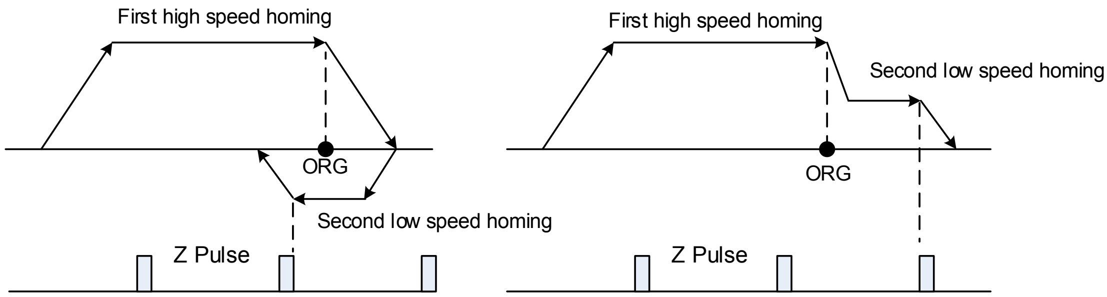
Definition of each setting value:

<table>
<tr><th>W</th><th>Z</th><th>Y</th><th>X</th></tr>
<tr><td>Reserved</td><td>Limit setting</td><td>Z pulse setting</td><td>Homing method</td></tr>
<tr><td rowspan="12">-</td><td>0 – 1</td><td>0 – 2</td><td>0 – 8</td></tr>
<tr><td>-</td><td rowspan="2">Y = 0: return to Z pulse
Y = 1: go forward to Z pulse
Y = 2: do not look for Z pulse</td><td>X = 0: homing in forward direction and define PL as homing origin</td></tr>
<tr><td>-</td><td>X = 1: homing in reverse direction and define NL as homing origin</td></tr>
<tr><td rowspan="9">When encounter limit:
Z = 0: show error
Z = 1: reverse direction</td><td rowspan="7">Y = 0: return to Z pulse
Y = 1: go forward to Z pulse
Y = 2: do not look for Z pulse</td><td>X = 2: homing in forward direction, ORG: OFF→ON as homing origin</td></tr>
<tr><td>X = 3: homing in reverse direction, ORG: OFF→ON as homing origin</td></tr>
<tr><td>X = 4: look for Z pulse in forward direction and define it as homing origin</td></tr>
<tr><td>X = 5: look for Z pulse in reverse direction and define it as homing origin</td></tr>
<tr><td>X = 6: homing in forward direction, ORG: ON→OFF as homing origin</td></tr>
<tr><td>X = 7: homing in reverse direction, ORG: ON→OFF as homing origin</td></tr>
<tr><td>X = 8: define current position as the origin</td></tr>
<tr><td rowspan="2">Y = 0: return to Z pulse
Y = 2: do not look for Z pulse</td><td>X = 9: look for the collision point in forward direction and define it as the origin</td></tr>
<tr><td>X = A: look for the collision point in reverse direction and define it as the origin</td></tr>
</table>

P5.005	High speed homing (first speed setting)			Address: 050AH 050BH
Operation interface:	Panel / software	Communication	Control mode:	PR (set with P5.004)
Default:	100.0	1000	Data size:	32-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.1 – 6000.0 (rotary motor)* 0.1 – 1599999.9 (linear motor)*	1 – 60000 (rotary motor)* 1 – 15999999 (linear motor)*		
Format:	DEC	DEC	-	-
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-

Settings:

The first speed setting for high speed homing.



Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.006	Low speed homing (second speed setting)			Address: 050CH 050DH
Operation interface:	Panel / software	Communication	Control mode:	PR (set with P5.004)
Default:	20.0	200	Data size:	32-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.1 – 6000.0 (rotary motor)* 0.1 – 1599999.9 (linear motor)*	1 – 60000 (rotary motor)* 1 – 15999999 (linear motor)*		
Format:	DEC	DEC	-	-
Example:	1.5 = 1.5 rpm	150 = 1.5 rpm	-	-

Settings: the second speed setting for low speed homing.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.007■	Trigger Position command (PR mode only)		Address: 050EH 050FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	0 – 1000
Format:	DEC	Data size:	16-bit

Settings:

Set P5.007 to 0 to start homing

Set P5.007 to 1 – 99 to execute the specified PR procedure, which is the same as using DI.CTRG+POSn.

You cannot set P5.007 to 100 – 999 as the value exceeds the valid range.

Example: to trigger PR#2

Method 1	Trigger by DI: Register Position command selection 1 – 64 Bit1 (DI:0x12) + Trigger command (DI:0x08)
Method 2	By P5.007: Set P5.007 to 2 to start executing PR#2

Write 1000 to execute stop command which is the same as DI.STOP.

When reading P5.007, if the command is incomplete, the drive reads the current command (1 – 99). If the command is completed, the drive reads the current command +10000. If the command is completed, DO.TPOS is on, and motor position is reached, the drive reads the current command +20000. Commands triggered by DI are also applicable.

Example:

If the value read is 3, it means PR#3 is incomplete. If the value read is 10003, it means PR#3 completed, but the motor has not reached the target position yet. If the value read is 20003, it means PR#3 completed and the motor reached the target position.

P5.008	Forward software limit		Address: 0510H 0511H
Default:	2147483647	Control mode:	PR
Unit:	PUU	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

In PR mode, if the motor rotates in the forward direction and its feedback position exceeds the value of P5.008, AL283 occurs.

P5.009	Reverse software limit		Address: 0512H 0513H
Default:	2147483647	Control mode:	PR
Unit:	PUU	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

In PR mode, if the motor rotates in the reverse direction and its feedback position exceeds the value of P5.009, AL285 occurs.

8

P5.010★■	Data array - Data size		Address: 0514H 0515H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Read-only
Format:	DEC	Data size:	16-bit

Settings:

Data size (N x 32 bits) means size N of data array.

P5.011■	Data array - Address for reading and writing		Address: 0516H 0517H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 to (value set by P5.010 minus 1)
Format:	DEC	Data size:	16-bit

Settings:

Specify the address in the data array when reading and writing data. Please refer to Chapter 7 for detailed instructions.

P5.012■	Data array – Window #1 for reading and writing		Address: 0518H 0519H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Window #1: when reading the parameter using the panel, the value set by P5.011 does not add 1, but reading or writing by other methods adds 1. Please refer to Chapter 7 Data array for detailed instructions.

P5.013■	Data array – Window #2 for reading and writing		Address: 051AH 051BH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Window #2: when reading and writing the parameter with the panel or through communication, the value set by P5.011 adds 1, but the panel is write-protected. Please refer to Chapter 7 Data array for detailed instructions.

P5.014	Reserved

8

P5.015■	PATH#1 – PATH#2 Volatile setting		Address: 051EH 051FH
Default:	0x0	Control mode:	All
Unit:	-	Setting range:	0x0 – 0x0011
Format:	HEX	Data size:	16-bit

Settings:

This parameter allows you to write data to the target continuously through communication.

0000

U Z Y X

X	PATH#1 Volatile setting	UZ	Reserved
Y	PATH#2 Volatile setting		Reserved

- X: PATH#1 Volatile setting

  0: non-volatile

  1: volatile

- Y: PATH#2 Volatile setting

  0: non-volatile

  1: volatile

P5.016■	Axis position – Motor encoder		Address: 0520H 0521H
Default:	0	Control mode:	All
Unit:	PUU	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Read: feedback position of the motor encoder, which is the monitoring variable 000 (00h) + offset value.

Write: you can write any value to the parameter, and it will neither change monitoring variable 000 (00h) nor affect the positioning coordinate system. It is only for observation when adjusting the offset value.

P5.017	Axis position – Auxiliary encoder		Address: 0522H 0523H
Default:	0	Control mode:	All
Unit:	Pulse number	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Pulse count from the auxiliary encoder (linear scale).

P5.018	Axis position – Pulse command		Address: 0524H 0525H
Default:	0	Control mode:	All
Unit:	Pulse number	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Pulse count from the pulse command.

P5.019	E-Cam curve scaling		Address: 0526H 0527H
Default:	1.000000	Control mode:	PR
Unit:	0.000001 times, which is 1 / (10^6)	Setting range:	-2147.000000 to +2147.000000
Format:	DEC	Data size:	32-bit
Example:	1100000 = 1.1 times		

Settings:

Use this parameter to magnify or reduce the E-Cam table without changing its value.

Example: the data in the table is 0, 10, 20, 30, 40, 20, magnification x 2.000000 equals the data: 0, 20, 40, 60, 80, 40, magnification x 1.000000.

This enables the operation of E-Cam with the same pulse frequency of the master axis.

Magnification enlarges both the route of E-Cam operation and the speed.

Note:

1. E-Cam function is not supported by the model A3-L.
2. This parameter can be set at any time, but the time when it becomes effective is determined by P5.088.X[Bit2].

P5.020	Acceleration / deceleration time (Number #0)		Address: 0528H 0529H
Default:	200	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

The duration of acceleration and deceleration in PR mode, which is the length of time to accelerate from 0 to 3000 rpm.

P5.021	Acceleration / deceleration time (Number #1)		Address: 052AH 052BH
Default:	300	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.022	Acceleration / deceleration time (Number #2)		Address: 052CH 052DH
Default:	500	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.023	Acceleration / deceleration time (Number #3)		Address: 052EH 052FH
Default:	600	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.024	Acceleration / deceleration time (Number #4)		Address: 0530H 0531H
Default:	800	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.025	Acceleration / deceleration time (Number #5)		Address: 0532H 0533H
Default:	900	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.026	Acceleration / deceleration time (Number #6)		Address: 0534H 0535H
Default:	1000	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.027	Acceleration / deceleration time (Number #7)		Address: 0536H 0537H
Default:	1200	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.028	Acceleration / deceleration time (Number #8)		Address: 0538H 0539H
Default:	1500	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.029	Acceleration / deceleration time (Number #9)		Address: 053AH 053BH
Default:	2000	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.030	Acceleration / deceleration time (Number #10)		Address: 053CH 053DH
Default:	2500	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.031	Acceleration / deceleration time (Number #11)		Address: 053EH 053FH
Default:	3000	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

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P5.032	Acceleration / deceleration time (Number #12)		Address: 0540H 0541H
Default:	5000	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.033	Acceleration / deceleration time (Number #13)		Address: 0542H 0543H
Default:	8000	Control mode:	PR
Unit:	ms	Setting range:	1 – 65500
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.034	Acceleration / deceleration time (Number #14)		Address: 0544H 0545H
Default:	50	Control mode:	PR
Unit:	ms	Setting range:	1 – 1500
Format:	DEC	Data size:	16-bit

Settings:

This parameter is for the deceleration time for auto protection, and the default value of this is small (shorter deceleration time).

P5.035	Acceleration / deceleration time (Number #15)		Address: 0546H 0547H
Default:	30	Control mode:	PR
Unit:	ms	Setting range:	1 – 1200
Format:	DEC	Data size:	16-bit

Settings:

This parameter is for the deceleration time for auto protection, and the default value of this is small (shorter deceleration time).

P5.036	Capture - Start address of data array		Address: 0548H 0549H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 to (value set by P5.010 minus 1)
Format:	DEC	Data size:	16-bit

Settings:

The first data Capture obtained is saved at this address for the data array. Please note that this parameter is only writable when Capture stops (please refer to P5.039).

P5.037■	Capture - Axis position		Address: 054AH 054BH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Displays the axis position of Capture pulse source. Please note that this parameter is only writable when Capture stops (please refer to P5.039). If the source is the main encoder, this parameter is write-protected and the Capture axis position is the feedback position of the motor (monitoring variable 00h).

P5.038■	Capture - Number of capturing times		Address: 054CH 054DH
Default:	1	Control mode:	All
Unit:	-	Setting range:	1 to (value set by P5.010 minus value set by P5.036)
Format:	DEC	Data size:	16-bit

Settings:

When Capture stops, this parameter indicates the number of data expected to be captured (readable and writable). When Capture activates, this parameter indicates the remaining number of data to be captured (read-only); each time it captures one data, the value of P5.038 decrements by one until the value is 0, indicating that capturing is completed.

Note:

1. The total number of data from Compare, Capture, and E-Cam cannot exceed 800.
2. A3L does not support the E-Cam function.

P5.039■	Capture - Activate CAP control		Address: 054EH 054FH
Default:	0x2010	Control mode:	All
Unit:	-	Setting range:	0x0000 – 0xF13F
Format:	HEX	Data size:	16-bit

Settings:

0000

U Z Y X

X	Capture setting	Z	Triggering logic
Y	Axis source of Capture	U	Trigger minimum interval

■ X: Capture setting

bit	3	2	1	0
X function	Execute PR when finishing capturing	After capturing the first data, activate Compare	Reset position after first data	Activate Capture
Description	Execute PR＃50 when finishing Capture	Invalid when Compare is activated	After capturing the first data, reset the position coordinate	Start capturing when set to 1; after finishing capturing, this bit is cleared automatically

■ Y: axis source of Capture

0: Capture is not working

1: AUX ENC (CN5)

2: Pulse command (CN1)

3: Main encoder (CN2)

Note: when the source of Compare is the Capture axis, the source Y of Capture cannot be changed.

■ Z: triggering logic

0: NO (normally open)

1: NC (normally closed)

■ U: trigger minimum interval (unit: ms)

Note: please refer to Chapter 7 for detailed instructions.

P5.040	Delay time after position reached (Number #0)		Address: 0550H 0551H
Default:	0	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The first delay time of PR mode.

P5.041	Delay time after position reached (Number #1)		Address: 0552H 0553H
Default:	100	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The second delay time of PR mode.

P5.042	Delay time after position reached (Number #2)		Address: 0554H 0555H
Default:	200	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The third delay time of PR mode.

P5.043	Delay time after position reached (Number #3)		Address: 0556H 0557H
Default:	400	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The fourth delay time of PR mode.

P5.044	Delay time after position reached (Number #4)		Address: 0558H 0559H
Default:	500	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The fifth delay time of PR mode.

P5.045	Delay time after position reached (Number #5)		Address: 055AH 055BH
Default:	800	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The sixth delay time of PR mode.

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P5.046	Delay time after position reached (Number #6)		Address: 055CH 055DH
Default:	1000	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The seventh delay time of PR mode.

P5.047	Delay time after position reached (Number #7)		Address: 055EH 055FH
Default:	1500	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The eighth delay time of PR mode.

P5.048	Delay time after position reached (Number #8)		Address: 0560H 0561H
Default:	2000	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The ninth delay time of PR mode.

P5.049	Delay time after position reached (Number #9)		Address: 0562H 0563H
Default:	2500	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The tenth delay time of PR mode.

P5.050	Delay time after position reached (Number #10)		Address: 0564H 0565H
Default:	3000	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The eleventh delay time of PR mode.

P5.051	Delay time after position reached (Number #11)		Address: 0566H 0567H
Default:	3500	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The twelfth delay time of PR mode.

P5.052	Delay time after position reached (Number #12)		Address: 0568H 0569H
Default:	4000	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The thirteenth delay time of PR mode.

P5.053	Delay time after position reached (Number #13)		Address: 056AH 056BH
Default:	4500	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The fourteenth delay time of PR mode.

P5.054	Delay time after position reached (Number #14)		Address: 056CH 056DH
Default:	5000	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The fifteenth delay time of PR mode.

P5.055	Delay time after position reached (Number #15)		Address: 056EH 056FH
Default:	5500	Control mode:	PR
Unit:	ms	Setting range:	0 – 32767
Format:	DEC	Data size:	16-bit

Settings:

The sixteenth delay time of PR mode.

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P5.056	Compare - Start address of data array		Address: 0570H 0571H
Default:	50	Control mode:	All
Unit:	-	Setting range:	0 to (value of P5.010 minus 1)
Format:	DEC	Data size:	16-bit

Settings:

The address of data array where the first Compare data is saved. Please note that this parameter is only writable when Compare stops (please refer to P5.059).

P5.057■	Compare - Axis position		Address: 0572H 0573H
Default:	0	Control mode:	All
Unit:	Pulse from Compare axis	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Displays the axis position of the Compare pulse source. Please note that this parameter is only writable when Compare stops (please refer to P5.059).

Note:

1. This parameter is write-protected when the source of Compare axis is the Capture axis (P5.059.Y = 0).
2. When the Compare axis source is the Main Encoder, P5.057 is also write-protected. The pulse resolution is determined by P1.046. When you set P5.059.Y to the Main Encoder, this parameter is set to the feedback position of the motor (monitoring variable 00h). When the motor feedback position is redefined due to homing or Capture, the value will be different from the parameter value. In this case, set P5.059.Y to 0, then set P5.059.Y to 3, to reset the parameter to the motor feedback position.

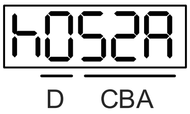
P5.058■	Compare - Compare amount		Address: 0574H 0575H
Default:	1	Control mode:	All
Unit:	-	Setting range:	1 to (value set by P5.010 minus value set by P5.056)
Format:	DEC	Data size:	16-bit

Settings:

When Compare is not in operation, the parameter indicates the number of data expected to be compared (readable and writable). When Compare is in operation, this parameter indicates the remaining number of data to be compared. Each time it compares one data, the value of P5.058 decrements by one until the value is 0 indicating that comparing is completed (read-only).

P5.059■	Compare - Activate CMP control		Address: 0576H 0577H
Default:	0x00640010	Control mode:	All
Unit:	-	Setting range:	0x00010000 – 0x0FFF313F
Format:	HEX	Data size:	32-bit

Settings:



CBA	Duration of pulse output (unit: 1 ms)	X	Compare setting
D	N/A	Y	Compare axis source
-	-	Z	Triggering logic
-	-	U	Trigger PR
h	High bit	L	Low bit

■ X: Compare setting

bit	3	2	1	0
X function	Compare axis position returns to 0	After finishing comparing, activate Capture	Cycle mode	Activate Compare
Description	As soon as the last data is compared, Compare axis position (P5.057) returns to 0	Invalid when Capture is activated	Does not stop	Start comparing when set to 1; after finishing comparing, this bit is cleared automatically

■ Y: Compare axis source

0: when selecting Capture axes, the source of CAP cannot be changed

1: AUX ENC (CN5)

2: Pulse command (CN1)

3: Main encoder (CN2)

Note: when the source of Compare is Capture axis, the source Y of Capture cannot be changed.

■ Z: triggering logic

0: NO (normally open)

1: NC (normally closed)

■ U: trigger PR

bit	3	2	1	0
U function	-	-	-	Trigger PR
Description	-	-	-	When you set this bit to 1, PR#45 is triggered after the last compare is completed

■ CBA: duration of pulse output (unit: 1 ms).

Note: please refer to Chapter 7 for detailed instructions.

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P5.060	Target speed setting #0			Address: 0578H 0579H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	20.0	200	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-

Settings:

First target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.061	Target speed setting #1			Address: 057AH 057BH
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	50.0	500	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Second target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.062	Target speed setting #2			Address: 057CH 057DH
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	100.0	1000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Third target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.063	Target speed setting #3			Address: 057EH 057FH
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	200.0	2000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Fourth target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.064	Target speed setting #4			Address: 0580H 0581H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	300.0	3000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Fifth target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.065	Target speed setting #5			Address: 0582H 0583H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	500.0	5000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Sixth target speed of PR mode.

Note: rotary motor means a for permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

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P5.066	Target speed setting #6			Address: 0584H 0585H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	600.0	6000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Seventh target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.067	Target speed setting #7			Address: 0586H 0587H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	800.0	8000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Eighth target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.068	Target speed setting #8			Address: 0588H 0589H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	1000.0	10000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Ninth target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.069	Target speed setting #9			Address: 058AH 058BH
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	1300.0	13000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Tenth target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.070	Target speed setting #10			Address: 058CH 058DH
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	1500.0	15000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0–6000.0 (rotary motor)* 0.0–1599999.9 (linear motor)*	0–60000 (rotary motor)* 0–15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Eleventh target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.071	Target speed setting #11			Address: 058EH 058FH
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	1800.0	18000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Twelfth target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

8

P5.072	Target speed setting #12			Address: 0590H 0591H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	2000.0	20000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Thirteenth target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.073	Target speed setting #13			Address: 0592H 0593H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	2300.0	23000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Fourteenth target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.074	Target speed setting #14			Address: 0594H 0595H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	2500.0	25000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Fifteenth target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.075	Target speed setting #15			Address: 0596H 0597H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	3000.0	30000	Data size:	16-bit
Unit:	1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*	0.1 rpm (rotary motor)* 10^{-6} m/s (linear motor)*		
Setting range:	0.0 – 6000.0 (rotary motor)* 0.0 – 1599999.9 (linear motor)*	0 – 60000 (rotary motor)* 0 – 15999999 (linear motor)*		
Format:	DEC		-	-
Example:	1 = 1 rpm	10 = 1 rpm	-	-

Settings:

Sixteenth target speed of PR mode.

Note: rotary motor means a permanent-magnet synchronous rotary motor; linear motor means a permanent-magnet synchronous linear motor.

P5.076	Capture - Reset position after first data		Address: 0598H 0599H
Default:	0	Control mode:	All
Unit:	Unit from Capture source	Setting range:	-1073741824 to +1073741823
Format:	DEC	Data size:	32-bit

Settings:

If the position reset function is enabled (P5.039.X [Bit1] = 1), after the first position data is captured, the servo resets the coordiates of the first point, which is defined by this parameter.

P5.077■	E-Cam: position for synchronous Capture axis (SYNC CAP AXES)		Address: 059AH 059BH
Default:	0	Control mode:	All
Unit:	Pulse	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

The position of this axis synchronizes with the CAP signal. Thus, when CAP operates every two times, the distance along this axis is the value of P5.078. There is no accumulative error and it only operates in a single direction. The Capture synchronous axis can be the position source for the master.

Note: A3-L does not support the E-Cam function.

P5.078	E-Cam: interval between each synchronous Capture action		Address: 059CH 059DH
Default:	100	Control mode:	All
Unit:	Pulse	Setting range:	10 – 100000000
Format:	DEC	Data size:	32-bit

8

Settings:

Interval between two capturing actions. The new value can only be written to the parameter when Capture is not in operation (P5.039.X0 set to 0).

Note: A3-L does not support the E-Cam function.

P5.079■	**E-Cam: following error for synchronous Capture axis**		**Address: 059EH 059FH**
Default:	0	Control mode:	All
Unit:	Pulse	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

When the synchronous Capture axis is operating, the synchronous error should be 0. This parameter shows this error value.

Synchronous error equals the output value of the synchronous axis minus the value of the synchronous axis or the accumulated amount of P5.077 minus (P5.078 x Number of capturing times). Each time when capturing data, the synchronous axis operates and this parameter updates once. This parameter can be written to as well. It indicates the offset of the synchronous axis. When the synchronous capture axis is the master for the rotary shear, modifying this parameter can shift the cutting position to the left and right.

Note: A3-L does not support the E-Cam function.

P5.080	**E-Cam: maximum correction rate for synchronous Capture axis**		**Address: 05A0H 05A1H**
Default:	10	Control mode:	All
Unit:	%	Setting range:	0 – 90
Format:	DEC	Data size:	16-bit

Settings:

This parameter limits the percentage (%) of synchronous adjustment.

Correction rate = Pulse number output by the synchronous axis / Pulse number input by the synchronous axis

(100 - P5.080) % < Correction rate < (100 + P5.080) %

When the correction rate is bigger, the synchronous error falls to 0 faster, but the speed change is more drastic. When the correction rate is smaller, the synchronous error becomes 0 slower, but the speed change is smoother. In the rotary shear application, after adjusting the synchronous error of P5.079, the bigger the parameter value is, the faster the cutting position reaches the target position. However, the speed will not be synchronized.

Note: A3-L does not support the E-Cam function.

P5.081	E-Cam: start address for data array		Address: 05A2H 05A3H
Default:	100	Control mode:	PR
Unit:	-	Setting range:	0 to (800 minus value set by P5.082)
Format:	DEC	Data size:	16-bit

Settings:

The first data in the E-Cam table is saved at the address of the data array. This parameter can be set at any time, but will be effective only when status changes from pre-engaged to engaged.

Note: A3-L does not support the E-Cam function.

P5.082	E-Cam: area number N		Address: 05A4H 05A5H
Default:	5	Control mode:	PR
Unit:	-	Setting range:	5 – 720
Format:	DEC	Data size:	16-bit

Settings:

Indicates that the E-Cam curve is divided into N areas, and the table includes N+1 data. This parameter is only writable when E-Cam stops (please refer to P5.088.X [Bit0] = 0). Its range must be smaller than or equal to P5.010 minus P5.081, and P5.082 x P5.084 must be smaller than or equal to 2147483647.

Note: A3-L does not support the E-Cam function.

P5.083	E-Cam: Master gear ratio setting - Cycle number (M)		Address: 05A6H 05A7H
Default:	1	Control mode:	PR
Unit:	-	Setting range:	1 – 32767
Format:	DEC	Data size:	16-bit

Settings:

When receiving the pulse number defined by P5.084 from the master axis, E-Cam rotates the number of cycles defined by P5.083 (One cycle of E-Cam = Rotate from 0° – 360°). This parameter is only writable when E-Cam stops (P5.088.X [Bit0] = 0).

Note: A-3L does not support the E-Cam function.

P5.084	E-Cam: Master gear ratio setting - Pulse number (P)		Address: 05A8H 05A9H
Default:	3600	Control mode:	PR
Unit:	-	Setting range:	10 – 1073741823
Format:	DEC	Data size:	32-bit

8

Settings:

When receiving the pulse number defined by P5.084 from the master axis, E-Cam rotates the number of cycles defined by P5.083 (One cycle of E-Cam = Rotate from 0° – 360°). This parameter can be modified at any time. Its range must be the value of P5.082 x P5.083 smaller than or equal to P5.084, and P5.082 x P5.084 must be smaller than or equal to 2147483647.

Note: A3-L does not support the E-Cam function.

P5.085	**E-Cam: engaged area number**		**Address: 05AAH 05ABH**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	0 to (setting value of P5.082 minus 1)
Format:	DEC	Data size:	16-bit

Settings:

The area number of E-Cam when E-Cam engaged (area number in E-Cam table).

Note: A3-L does not support the E-Cam function.

P5.086■	**E-Cam: Master axis position**		**Address: 05ACH 05ADH**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Position counter of the E-Cam Master. This parameter is only writable when E-Cam stops (please refer to P5.088.X [Bit0] =0).

Note: A3-L does not support the E-Cam function.

P5.087	**E-Cam: Lead pulse before engaged**		**Address: 05AEH 05AFH**
Default:	0	Control mode:	PR
Unit:	Unit from master axis	Setting range:	-1073741824 to +1073741823
Format:	DEC	Data size:	32-bit

Settings:

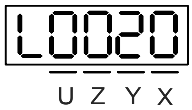
When the condition to engage E-Cam (P5.088.Z) is met, the pulse number from the master axis has to exceed the value of this parameter for the E-Cam to fully engage. This parameter can be written via virtual master pulse function (refer to description of P2.077).

Note: A3-L does not support the E-Cam function.

P5.088■	E-Cam: activate E-Cam control		Address: 05B0H 05B1H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x0 – 0x203FF257
Format:	HEX	Data size:	32-bit

Settings:

Format of this parameter: (High word h) S0BA : (Low word L) UZYX



BA	PR path to execute	X	Activation setting of E-Cam function
C	Reserved	Y	Command source
D	E-Cam status display	Z	Engaging condition
-	-	U	Disengaging condition

Definition as follows:

■ X: E-Cam command

Description of each bit:

Bit	Function	Description
0	E-Cam activation	0: E-Cam is disabled 1: E-Cam is enabled (relevant parameters cannot be modified once E-Cam is enabled)
1	E-Cam does not disengage when servo is off	0: when the servo is stopped by alarm or servo is off, the clutch disengages 1: when the servo stops because of alarm or servo is off, the clutch can remain engaged. When the servo switches to on again, E-Cam can operate directly. It can return to the correct E-Cam position by macro #D.
2	P5.019 is effective immediately	0: P5.019 is effective after next engagement 1: P5.019 is effective immediately
3	Reserved	-

■ Y: command source

0: capture axis

1: auxiliary encoder

2: pulse command

3: PR command

4: time axis (1 ms)

5: synchronous capture axis (P5.077)

6: analog channel 1 (Virtual axis, Unit: 1M pulse/s per 10V)

- Z: engaging time

  0: immediately

  1: trigger DI.CAM

  2: any one position data is captured

- U: disengaging condition (2, 4, and 6 cannot be selected at the same time)

U	Disengagement condition	Action after disengaged
0	Never disengage	-
1	DI.CAM OFF	In **stop** status
2	Master axis reaches the setting value of P5.089 (Sign indicates the direction)	In **stop** status
6	Same as 2, but the speed remains when disengaging and the engaged length slightly exceeds P5.089. This is suitable for when calling the next PR Position command right after disengaging.	
4	Master axis exceeds the value of P5.089 (sign indicates the direction)	Return to **pre-engaged** status Lead pulse is P5.092
8	When U = 1, 2 or 6: disable E-Cam after disengaging	Set X to 0
	When U = 4: Avoid jittering when it returns to pre-enagaged status	N/A

- BA: auto execute the specified PR path

  When disengaging condition (P5.088.U ＝ 2, 4, 6) is met, a PR 00 – 3F (hexadecimal; 00 means no action) is executed automatically.

- C: reserved

- D: display engage status (Read-only)

  0: stop status

  1: engage status

  2: pre-engage status

Note: A3-L does not support the E-Cam function.

P5.089	**E-Cam: data of disengaging time**		**Address: 05B2H 05B3H**
Default:	0	Control mode:	PR
Unit:	Unit for by master axis	Setting range:	-1073741824 to +1073741823
Format:	DEC	Data size:	32-bit

Settings:

When the pulse number of the master axis reaches the value set by P5.089, the clutch disengages based on the disengage timing setting (P5.088.U).

Note: A3-L does not support the E-Cam function.

P5.090	E-Cam: DO.CAM_Area rising-edge phase		Address: 05B4H 05B5H
Default:	270	Control mode:	PR
Unit:	Degree	Setting range:	0 – 360
Format:	DEC	Data size:	16-bit

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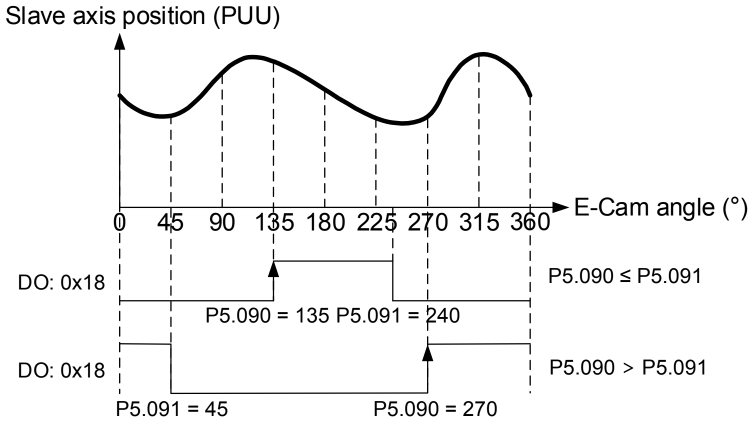
Settings:

See the correlation between DO.CAM_Area and parameters in the figure below.

When E-Cam is disengaged, DO.CAM_Area is always off.



Note: A3-L does not support the E-Cam function.

P5.091	E-Cam: DO.CAM_Area falling-edge phase		Address: 05B6H 05B7H
Default:	360	Control mode:	PR
Unit:	Degree	Setting range:	0 – 360
Format:	DEC	Data size:	16-bit

Settings:

Please refer to P5.090 for the correlation between DO.CAM_Area and parameters.

Note: A3-L does not support the E-Cam function.

P5.092	E-Cam: pre-engaged length for each cycle		Address: 05B8H 05B9H
Default:	0	Control mode:	PR
Unit:	Unit from master axis	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

This parameter goes with the selection of P5.088.U = 4 (E-Cam disengages if it exceeds the moving distance): after disengaging, it does not enter stop status, but instead enters pre-engaged status. The lead pulse is determined by this parameter. The pulse number from the master axis has to exceed the value of this parameter for the E-Cam to engage again.

Note: A3-L does not support the E-Cam function.

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P5.093	Motion control macro command: command parameter #4		Address: 05BAH 05BBH
Default:	0	Control mode:	All
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Before executing the macro command, you must set the relevant parameter #4 in advance.

The function of the parameter is determined by the macro command. Not every macro command requires this parameter.

Note: A3-L does not support the E-Cam function and macros with E-Cam settings.

P5.094	Motion control macro command: command parameter #3		Address: 05BCH 05BDH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Before executing the macro command, you must set the relevant parameter #3 in advance.

The function of the parameter is determined by the macro command. Not every macro command requires this parameter.

Note: A3-L does not support the E-Cam function and macros with E-Cam settings.

P5.095	Motion control macro command: command parameter #2		Address: 05BEH 05BFH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Before executing the macro command, you must set the relevant parameter #2 in advance.

The function of the parameter is determined by the macro command. Not every macro command requires this parameter.

Note: A3-L does not support the E-Cam function and macros with E-Cam settings.

P5.096	Motion control macro command: command parameter #1		Address: 05C0H 05C1H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Before executing the macro command, you must set the relevant parameter # 1 in advance.

The function of the parameter is determined by the macro command. Not every macro command requires this parameter.

Note: A3-L does not support the E-Cam function and macros with E-Cam settings.

P5.097■	Motion control macro command: issue command / execution result		Address: 05C2H 05C3H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 – 0x099F
Format:	HEX	Data size:	16-bit

Settings:

Write: used to issue macro command (0CBAh).

Read: used to examine the execution result of macro command. If successful, the result is returned to 1CBAh.

If the command issues 0001, 1001h is returned if successful; and Fxxxh if unsuccessful (depending on the command description). If you execute a command that is not supported, the failure code F001h is returned.

The command codes are listed in the following table:

Command code 0003h	Motion parameter protection: password setting, protection activation.
Macro parameters	P5.093 = parameter write-protected level (0 – 1) (0: no protection, 1: enable protection) P5.094 = protection level of data array (-1 to 7) 0: password protection of all data array 1: password protection of data array #100 – #799 2: password protection of data array #200 – #799 3: password protection of data array #300 – #799 4: password protection of data array #400 – #799 5: password protection of data array #500 – #799 6: password protection of data array #600 – #799 7: no password protection of data array P5.095 = set new password (1 – 16777215) P5.096 = confirm new password (1 – 16777215) Note: P5.095 must equal to P5.096 to be successfully set and the password must be set within the allowable range.
This function can only be executed prior to activating the parameter protection function. When the protection function has been activated, the failure code is returned if this function is executed repeatedly.	
Failure code F031h	Protection function has been activated and cannot be set repeatedly
Failure code F032h	Wrong password: P5.095 does not equal to P5.096
Failure code F033h	Password value exceeds the allowable range (1 – 16777215)
Failure code F034h	Protection level P5.094 exceeds the allowable range (-1 to 7)
Failure code F035h	Protection level P5.093 exceeds the allowable range (0 – 1)
Success code 1003h	-

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Command code 0004h	Motion parameter protection: unlock protection
Macro parameters	P5.096 = enter password (1 – 16777215)

This function can only be executed when the parameter protection function has been activated. When the protection function has been unlocked, the failure code is returned if this function is executed repeatedly. If the wrong password is entered, failure code Ennn is returned. nnn indicates the remaining attempts to enter the password. The number decrements by one after each failed attempt. When the number displays 0, it indicates the maximum number of failed password attempts has been reached and it is locked.

Failure code F041h	Protection function is unlocked and cannot be unlocked repeatedly
Failure code F043h	Password value exceeds the allowable range (1 – 16777215)
Failure code F044h	Exceeded maximum failed password attempts: locked. Can only be unlocked by resetting the parameter (P2.008 = 10), but this also resets all parameters to the default values.
Failure code Ennnh	Incorrect password setting: failed to unlock nnn: remaining attempts to enter the password. The number decrements by one after each failed attempt. When the number displays 0, it is locked and does not allow further attempts.
Success code 1004h	-

Command code 0006h	Build up the E-Cam table: rotary shear, including synchronous area (7 areas)
General parameters	P5.081 = Address of table (data array) P5.082 = 7 (This macro is fixed to 7 areas, 8 points) P1.044 and P1.045 = E-Gear ratio (must be set up in advance)
Macro parameters	P5.094 = A (deceleration ratio: numerator) x C (cutting count) P5.095 = B (deceleration ratio: denominator) P5.096 = 1000000 x R x V Note: R (cutting ratio) = L (target cutting length) / ℓ (perimeter of cutter) Allowable cutting ratio: (0.3 – 2.5) times V (speed factor) = target cutting speed / speed of delivered product V = 1.0: when cutting, the speed of cutter is same as the delivered product V = 1.1: when cutting, the speed of cutter is 10% faster than the delivered product V = 0.9: when cutting, the speed of cutter is 10% slower than the delivered product

This macro calculates the data for the E-Cam table according to the above parameters, and stores them in the data array specified by P5.081. Parameters listed above are relevant to the E-Cam table calculation. Please correctly set up the parameters prior to execution.

After this macro is executed, if the above parameters have been modified, the E-Cam table must be recreated and you must execute this macro again. Data in E-Cam table is changed after executing this macro; thus, do not execute the macro when E-Cam is in engaged status.

In E-Cam applications, parameters (such as P5.083 and P5.084) that are irrelevant to this macro are not listed here. Set up the parameters according to the actual application. Please refer to sections about E-Cam in Chapter 7. After executing this macro, the E-Cam table is not saved to EEPROM automatically.

Failure code F061h	When creating the table, E-Cam is in engaged status. To issue this command, E-Cam needs to disengage first.
Failure code F062h	Value of P5.094 exceeds the range: (1 – 65535)
Failure code F063h	Value of P5.095 exceeds the range: (1 – 65535)
Failure code F064h	Value of P5.096 exceeds the range: (300000 – 2500000)
Failure code F065h	Address specified by P5.081 is too long and the space of data array is insufficient.
Failure code F066h	Value of P5.082 must be set to 7. Otherwise the command cannot be executed.
Failure code F067h	Data calculation error. Please decrease the value of P1.044 and P1.045, but maintain the same proportions.

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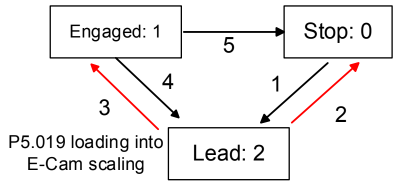
Command code 0007h	Build up the E-Cam table: rotary shear (multi-dimensional control)
General parameters	P5.081 = address of table (data array) P5.082 = N (30 – 72) (area number of E-Cam) P1.044 and P1.045 = E-Gear ratio (must be set up in advance).
Macro parameters	P5.093.H16 (high 16-bit) = S P5.093.L16 (low 16-bit) = W Note: S (curve level) = 1 – 4 levels; W (degree of waiting area) = -1 to +170 degrees (W = -1 is available in firmware version V1.038 (sub29) or later versions) P5.094 = Y (degree of synchronous area) = 0 – 330 degrees P5.095.H16 (high 16-bit) = A x C P5.095.L16 (low 16-bit) = B Note: A (deceleration ratio: numerator), C (cutting count) B (deceleration ratio: denominator) P5.096 = 1000000 x R x V
	Note: R (cutting ratio) = L (target cutting length) / ℓ (length of cutter) Allowable cutting ratio: (0.05 – 5.0) times V (speed factor) = target cutting speed / speed of delivered product V = 1.0: when cutting, the speed of cutter is same as the delivered product V = 1.1: when cutting, the speed of cutter is 10% faster than the delivered product V = 0.9: when cutting, the speed of cutter is 10% slower than the delivered product Note: W´ ＝ 180 + 360/N – 360/R + Y/2 P5.093.L16 < W´, E-Cam table is in error (failure code F07Ah) P5.093.L16 = W´, initial speed is 0 in E-Cam table P5.093.L16 > W´, initial speed > 0 in E-Cam table

This macro calculates the data for the E-Cam table according to the above parameters, and stores them in the data array specified by P5.081. Parameters listed above are relevant to the E-Cam table calculation. Please correctly set up the parameters prior to execution. After this macro is executed, if the above parameters have been modified, the E-Cam table must be recreated and you must execute this macro again. Data in E-Cam table is changed after executing this macro; thus, do not execute when E-Cam is in engaged status. In E-Cam applications, parameters (such as P5.083 and P5.084) that are irrelevant to this macro are not listed here. Set up the parameters according to the actual application. Please refer to sections about E-Cam. After executing this macro, the E-Cam table is not saved to EEPROM automatically.

Failure code F071h	When creating the table, E-Cam is in engaged status. To issue this command, E-Cam must disengage first.
Failure code F072h	Degree of synchronous area of P5.094 exceeds the range: (0 – 330)
Failure code F073h	Curve level of P5.093.H16 exceeds the range: (1 – 4)
Failure code F074h	Degree of waiting area of P5.093.L16 exceeds the range: (0 – 170)
Failure code F075h	Value of P5.096 exceeds the range: (50000 – 5000000)
Failure code F076h	Area number of E-Cam of P5.082 exceeds the range: (30 – 72)
Failure code F077h	Address specified by P5.081 is too long and the space of data array is insufficient.
Failure code F078h	Data calculation error. Please decrease the setting value of P1.044 and P1.045, but maintain the same proportions.
Failure code F079h	Acceleration degree is too small; please decrease the value for waiting area (W), synchronous area (Y), or curve level (S).
Failure code F07Ah	Waiting area is too small; please increase the value for waiting area (W) or decrease the value for synchronous area (Y).

Command code 0008h	E-Cam curve scaling (P5.019) is effective immediately.
Macro parameters	N/A

This macro can be triggered when E-Cam is engaged, and P5.019 becomes effective immediately. Normally, E-Cam scaling is only loaded into the system by P5.019 at the point when E-Cam engages (see below: transition 3). It cannot be changed in the engaged condition. E-Cam scaling can only be changed after one E-Cam cycle to ensure that the E-Cam can return to the original position without accumulative error.



If necessary in the application, there are two ways to change the setting of E-Cam curve scaling immediately:

1. **P5.088.X2 = 1:** when E-Cam is engaged, set up this bit at the same time, this causes each change in P5.019 to be enabled immediately.
2. **Use macro #8:** each time that this macro command is triggered, the function of P5.019 is enabled immediately. However, if the value of P5.019 is changed and this macro is not triggered, then the function of P5.019 is not enabled immediately. This macro command has to be triggered again to enable the function of P5.019.

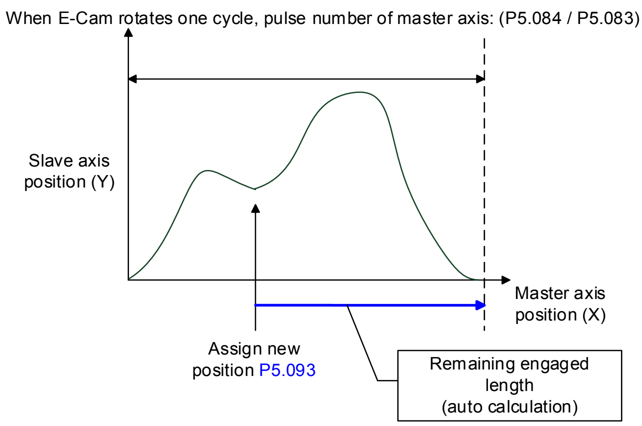
Failure code	N/A

Command code 000Ch	Change position X where E-Cam is engaged: E-Cam disengages after rotating one cycle in the forward direction.
General parameters	N/A
Macro parameters	P5.093 = new engaged position X, Unit: pulse number of master axis. Monitoring variable 062(3Eh): displays the current engaged position (X) of master axis.

This macro command can change the engaged position immediately even when E-Cam is engaged. It automatically calculates the remaining engaged length so that E-Cam disengages after rotating one cycle (360°) in the forward direction. However, you must set P5.088.U to 2, 4, or 6; otherwise, E-Cam does not disengage.

E-Cam disengages when an alarm occurs or power supply is cut off. If you want E-Cam to re-engage at the last disengaged position and continue its remaining cycle, it is recommended that you record the last disengaged position (X) and then resume the operation of this macro command. Please note that when E-Cam is disengaged, the servo position might shift slightly, causing position error when E-Cam re-engages.

The engaged direction is in the forward direction (master axis operates in forward direction):



Note: when using this macro command, it is recommended that you execute the macro command before operating the master axis.

Failure code F0C1h	When executing this macro command, E-Cam is not in engaged status. Engaged position can only be modified when E-Cam is engaged.
Failure code F0C2h	Value of P5.093 is in error. The value cannot be less than 0.
Failure code F0C3h	Value of P5.093 is in error. The value has to be less than the value of (P5.084 / P5.083).
Command code 000Dh	Calculate the error between E-Cam and indexing coordinates for PR positioning.

8

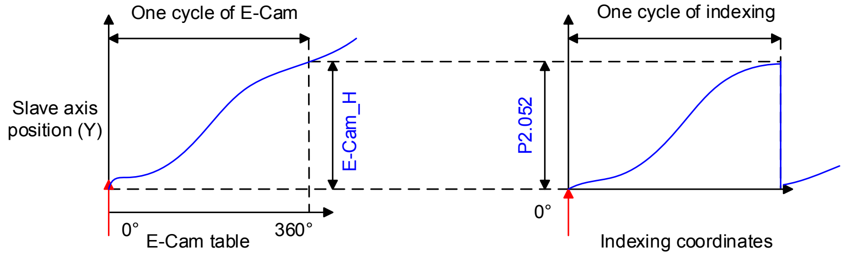
General parameters	N/A
Macro parameters	P5.093.Low_Word = DCBA : UZYX (8 digits, HEX) YX (PR number) = 0 – 0X3F (invalid when value is 0) Value of UZ has to be set to 0 BA (function of P5.095): 0 (use avoid point); 1 (use allowable forward rate) DC (inhibit reverse rotation): 0 (invalid), 1 (inhibit reverse rotation) P5.095: avoid point (cannot pass this point) = 0 – 100 (%) of E-Cam cycle or allowable forward rate 0 – 100 (%)

Monitoring variable 091(5Bh): displays the current indexing coordinate position (PUU).

When E-Cam is engaged and the motor is stopped due to Servo Off or an alarm, it causes position error between the actual position and the E-Cam position. After changing back to Servo On, you can use this macro command to calculate the correction value and write the value into the specified PR for incremental positioning, so that the motor can return to the correct E-Cam position.

When using this macro command:

1. Set P5.088.X1 to 1 to keep E-Cam engaged when Servo Off and continue to calculate E-Cam position.
2. Height of indexing coordinate and E-Cam coordinate should be the same: P2.052 = ECAM_H (moving distance when E-Cam operates one cycle).
3. E-Cam table scaling P5.019 must be 1.0 time.
4. When E-Cam is engaged for the first time, 0 degrees in the E-Cam table should point to 0 degrees in the indexing coordinate. You can achieve this alignment by executing homing.
5. You can only use this macro command for a periodic cycle and when each cycle starts from the same position.

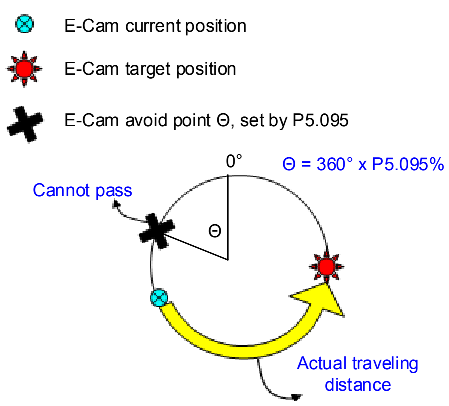


Note:

1. ECAM_H (height of E-Cam table) = E-Cam table (last point minus first point)
2. Indexing coordinate = remainder of (absolute coordinate / P2.052)
3. Use PR command via incremental positioning control

Due to the cyclic operation of E-Cam, the motor travels to the specified position either in the forward or reverse direction. However, the moving distance is usually different between them. Thus, you can use the position of the avoid point to determine whether to operate in the forward or reverse direction.

***Avoid point:** the point that cannot be passed when executing macro PR positioning. Please see below for details.

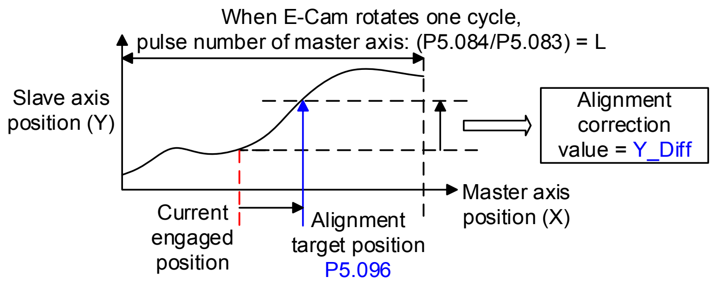


(Continued)

Failure code F0D1h	When executing this macro command, E-Cam is not in engaged status. E-Cam should be engaged.
Failure code F0D2h	P5.093.YX (PR number) exceeds the range: 1 – 0x3F
Failure code F0D3h	P5.095 (allowable forward rate) exceeds the range: 0 – 100 (%)
Failure code F0D5h	Position correction value does not exist. This macro command might be triggered twice.
Failure code F0D6h	When servo switches to on state again, E-Cam is not engaged.
Failure code F0D7h	Height (Y axis) of E-Cam table does not equal to the value of P2.052.
Failure code F0D8h	E-Cam table scaling does not equal to 1.
Failure code F0D9h	Values of P5.093.BA and P5.095 exceed the range: 0 – 1.
Failure code F0DAh	P5.093.DC (reverse inhibit) exceeds the range: 0 – 1.
Failure code F0DBh	The reverse inhibit function has failed. Do not use macro command #D and #10h consecutively.

Command code 000Eh	Perform E-Cam alignment immediately and write the correction value into the specified PR.
Macro parameters	P5.093 = DCBA : UZYX (8 digits, HEX) YX (PR number) = 0 – 0x3F (invalid when value is 0). UZ (maximum allowable correction rate) = 0 – 0x64 (%) A (trigger specified PR directly) = 1: on, 0: off DCB = must be set to 0. P5.094 (DI delay time compensation) = -25000 to +25000 (unit: usec). P5.095 (allowable forward rate)= 0 – 100 (%) P5.096 (target position of alignment X) (unit: pulse number of master axis) = 0 to (P5.084/P5.083) - 1.
Monitoring variable 062(3Eh): displays the current engaged position (X) of master axis.	

This macro command can move the engaged position to the **alignment target position X** when E-Cam is engaged, and then write the **alignment correction value** into the specified PR.
You can use this macro command: during E-Cam operation (E-Cam is engaged), if you want to quickly align the E-Cam position with the mechanical referral point, you can use the sensor to trigger DI.EVx to execute this macro command.
After E-Cam alignment completes, the engaged position moves to the new position. The excessive or insufficient moving distance after E-Cam operates one cycle is called the **alignment correction value** which is written into the PR specified by P5.093.YX. You can use the PR incremental command to execute this alignment correction so that the E-Cam slave axis position remains and offset the phase of E-Cam to align with the referral position of the machine. For some applications when PR is not needed, set P5.093.YX to 0. Please note that PR can only be executed when triggered by the host controller. This macro command is only for setting the value.



*P5.093.UZ is able to limit the maximum correction rate. The alignment target position ★ will be different from P5.096.

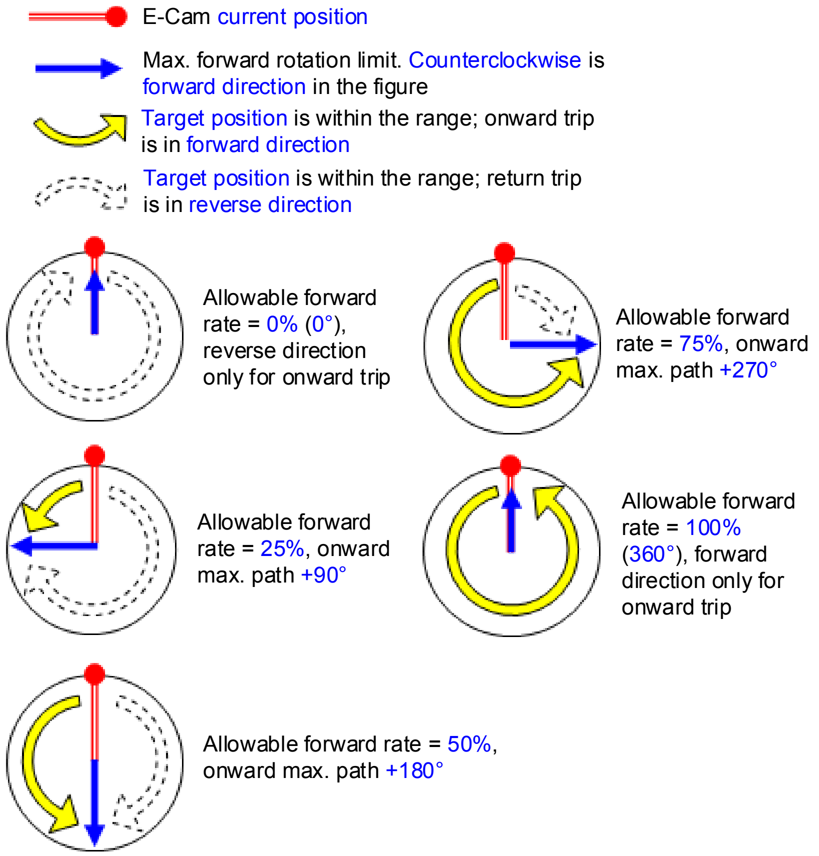
|Alignment target position ★ - Current engaged position| / L <= P5.093.UZ %

*DI time delay compensation can be set by P5.094 to correct the error caused by different speed of motion.

Due to cyclic operation, when E-Cam moves from current position to the target position, it can either rotate in the forward or reverse direction. However, the moving distance is usually different between them. Thus, you can use the allowable forward rate to determine whether to operate in the forward or reverse rotation.

(Continued)

***Allowable forward rate:** the allowable maximum proportion of the **forward path**. Please see below for details.



Failure code F0E1h	When executing this macro command, E-Cam is not in engaged status. E-Cam has to be engaged to execute the alignment correction.
Failure code F0E2h	P5.093.YX (PR number) exceeds the range: 0 – 0x3F
Failure code F0E3h	P5.093.UZ (maximum alignment correction rate) exceeds the range: 0 – 0x64 (%)
Failure code F0E4h	P5.094 (DI delay time compensation) exceeds the range: -10000 to +10000
Failure code F0E5h	P5.095 (allowable forward rate) exceeds the range: 0 – 100 (%)
Failure code F0E6h	P5.096 (alignment target position) exceeds the range: 0 to (P5.084/P5.083) - 1

Command code 000Fh	Calculate the moving distance between current and target position of E-Cam for PR positioning.
General parameters	N/A
Macro parameters	P5.093.Low_Word = UZYX (4 digits, HEX) YX (PR number of onward trip) = 0 – 0X3F (invalid when value is 0). UX (PR number of return trip) = 0 – 0X3F (invalid when value is 0). P5.093.Hi_Word = must be set to 0. P5.095 (allowable forward rate) = 0 – 100 (%) P5.096 (target position X) (unit: pulse number of master axis) = 0 to (P5.084 / P5.083) - 1.

Monitoring variable 062(3Eh): displays the current engaged position (X) of master axis.

When E-Cam is engaged, this macro command calculates the moving distance between the **current** and **target engaged position (X)** and writes the value into the specified PR.
You can use this macro command: during E-Cam operation, if you want to move the slave axis to the specified position when the master axis stops but is still in engaged status. This macro command can calculate the correct **moving distance** (Y_Drift) **of the onward trip** for the PR incremental command.

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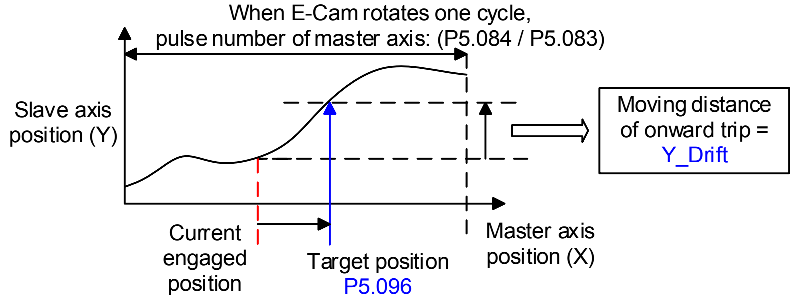
(Continued)

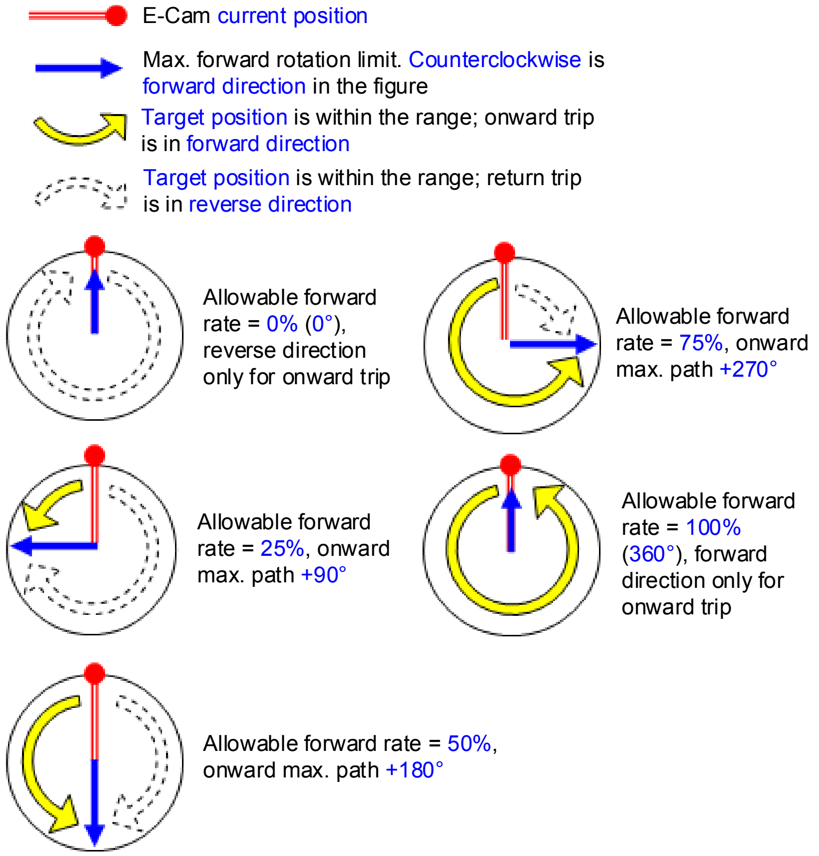
When the master axis resumes operation, use another PR for the **moving distance of the return trip** (-Y_Drift) to return to the original position **(moving distance of onward trip + moving distance of return trip = 0)**. E-Cam position remains the same.



Note: regardless of onward trip or return trip, use the PR command through incremental positioning control.

Due to cyclic operation, when E-Cam moves from current position to the target position, it can either rotate in the forward or reverse direction. However, the moving distance is usually different between them. Thus, you can use the allowable forward rate to determine whether to operate in forward or reverse rotation.

***Allowable forward rate:** the allowable maximum proportion of **forward path**. Please see below for details.



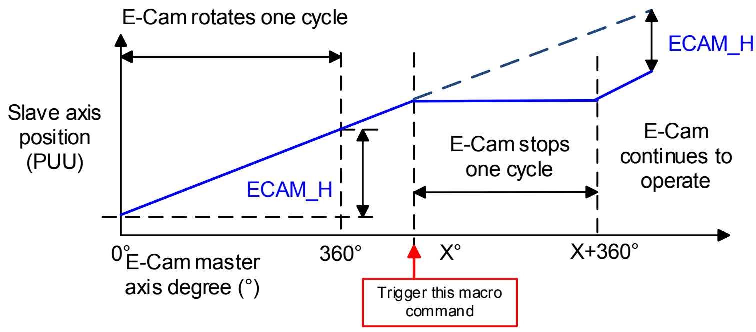
Failure code F0F1h	When executing this macro command, E-Cam is not in engaged status. Engaged position can only be modified when E-Cam is engaged.
Failure code F0F2h	P5.093.YX (PR number of onward trip) exceeds the range: 0 – 0x3F
Failure code F0F3h	P5.093.UZ (PR number of return trip) exceeds the range: 0 – 0x3F
Failure code F0F5h	P5.095 (allowable forward rate) exceeds the range: 0 – 100 (%)
Failure code F0F6h	P5.096 (target position) exceeds the range: 0 to (P5.084/P5.083) - 1

Command code 0010h	E-Cam pauses for one cycle and resumes operation at next cycle.
General parameters	N/A
Macro parameters	P5.093 must be set to 0.

After E-Cam is engaged, this macro command can pause the slave axis for one distance cycle regardless of the current E-Cam degree. The following conditions have to be met when using this macro command:

1. E-Cam must be in the engaged status.
2. E-Cam must be the forward operation curve (including straight line) so it can pause.

As shown in the figure below, by triggering this macro command, E-Cam pauses for one cycle regardless of the degree (X) of E-Cam's current location.



Note:

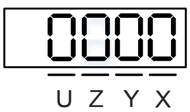
1. ECAM_H (E-Cam pause distance) = E-Cam table (Last point minus first point) x P5.019 (effective scaling).
2. This function is accumulative. If the command is triggered for N times consecutively, it pauses the E-Cam for N cycles. Please note that the **accumulated pause distance** cannot exceed (2^31), otherwise the macro command is disabled.
3. When E-Cam resumes operation, the **accumulated pause distance** is cleared to 0.

Failure code F101h	When executing this macro command, E-Cam is not in the engaged status. E-Cam should be engaged.
Failure code F102h	Value of P5.093 is incorrect: must be set to 0.
Failure code F103h	E-Cam must operate in the forward direction. Please check the E-Cam table and make sure P5.019 > 0.
Failure code F104h	Accumulated pause distance exceeds 2^31. Do not execute this macro command consecutively.

Note: A3L does not support the E-Cam function.

P5.098	PR# triggered by event rising-edge		Address: 05C4H 05C5H
Default:	0x0	Control mode:	PR
Unit:	-	Setting range:	0x0000 – 0xDDDD
Format:	HEX	Data size:	16-bit

Settings:



X	PR triggered by EV1 rising-edge	Z	PR triggered by EV3 rising-edge
Y	PR triggered by EV2 rising-edge	U	PR triggered by EV4 rising-edge

- X: PR triggered when EV1 is on

  0: no action

  1 – D: execute PR# 51 – 63

- Y: PR triggered when EV2 is on

  0: no action

  1 – D: execute PR# 51 – 63

- Z: PR triggered when EV3 is on

  0: no action

  1 – D: execute PR# 51 – 63

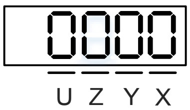
- U: PR triggered when EV4 is on

  0: no action

  1 – D: execute PR# 51 – 63

P5.099	**PR# triggered by event falling-edge**		**Address: 05C6H 05C7H**
Default:	0x0	Control mode:	PR
Unit:	-	Setting range:	0x0000 – 0xDDDD
Format:	HEX	Data size:	16-bit

Settings:



X	PR triggered by EV1 falling-edge	Z	PR triggered by EV3 falling-edge
Y	PR triggered by EV2 falling-edge	U	PR triggered by EV4 falling-edge

- X: PR triggered when EV1 is off

  0: no action

  1 – D: execute PR# 51 – 63

- Y: PR triggered when EV2 is off

  0: no action

  1 – D: execute PR# 51 – 63

- Z: PR triggered when EV3 is off

  0: no action

  1 – D: execute PR# 51 – 63

- U: PR triggered when EV4 is off

  0: no action

  1 – D: execute PR# 51 – 63

P5.100■	Data array - Window #3 for reading / writing		Address: 05C8H 05C9H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Window #3: when reading or writing the parameter by any method, the value set by P5.011 does not increase by 1. Please refer to Chapter 7 Data array for detailed instructions.

P5.101■	Data array - Window #4 for reading / writing		Address: 05CAH 05CBH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Window #4: when reading or writing the parameter by any method, the value set by P5.011 does not increase by 1. Please refer to Chapter 7 Data array for detailed instructions.

P5.102■	Data array - Window #5 for reading / writing		Address: 05CCH 05CDH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Window #5: when reading or writing the parameter by any method, the value set by P5.011 does not increase by 1. Please refer to Chapter 7 Data array for detailed instructions.

P5.103■	Data array - Window #6 for reading / writing		Address: 05CEH 05CFH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

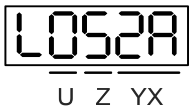
Window #6: when reading or writing the parameter by any method, the value set by P5.011 does not increase by 1. Please refer to Chapter 7 Data array for detailed instructions.

P6.xxx PR parameters

P6.000	Homing definition		Address: 0600H 0601H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFF3F
Format:	HEX	Data size:	32-bit

Settings:

Homing definition:



A	DEC2: deceleration time selection of second homing	YX	PATH: path type
B	DLY: select 0 – F for delay time	Z	ACC: select 0 – F for acceleration time
C	N/A	U	DEC1: deceleration time selection of first homing
D	BOOT	-	-

- YX: PATH: path type

  0x0: stop: homing complete and stop.

  0x1 – 0x63: auto: homing complete and execute the specified path (Path#1 – Path#99).

- Z: ACC: select 0 – F for acceleration time

  0 – F: corresponds to P5.020 – P5.035

- U: DEC1: deceleration time selection of first homing

  0 – F: corresponds to P5.020 – P5.035

- A: DEC2: deceleration time selection of second homing

  0 – F: corresponds to P5.020 – P5.035

- B: DLY: select 0 – F for delay time

  0 – F: corresponds to P5.040 – P5.055

- D: BOOT: when the drive is powered on, whether to search for the origin.

  0: do not execute homing

  1: execute homing automatically (servo switches to Servo On status for the first time after applying power)

Apart from the above definitions, the related settings for homing also include:

1. P5.004 homing methods.
2. P5.005 – P5.006 speed setting of searching for the origin.
3. P6.001: ORG_DEF is the coordinate of the origin and may not be 0. This function is used as a traversal of the coordinate.

Note:

1. After the origin is found (sensor or Z), it has to decelerate to a stop. The stop position exceeds the origin by a short distance:

   If returning to the origin is not needed, set PATH to 0;

   If returning to the origin is needed, set PATH to a non-zero value and set PABS = ORG_DEF.

   Example:

   Upon completion of P6.000 = 0x1, automatically execute Path#1.

   Set from absolute position (ABS) to 0 as the route of Path#1 (set P6.002 & P6.003).

2. If the origin is found (sensor or Z), and you want it to move an offset S and define the coordinate as P after moving, then PATH = non-zero and set ORG_DEF = P - S, and this absolute Position command = P.

P6.001	**Origin definition**		**Address: 0602H 0603H**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Origin definition.

P6.002	**PATH#1 definition**		**Address: 0604H 0605H**
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Format of this parameter: (High word h) DCBA : (Low word L) UZYX

High word Low word

D C B A U Z Y X

A	SPD, Target speed index*[1]	X	TYPE, Path type
B	DLY, Delay time index	Y	OPT, Option
C	AUTO*[1]	Z	ACC, Acceleration time index*[1]
D	Reserved	U	DEC, Deceleration time index*[1]

Definitions are as follows:

■ YX

Y: OPT, Option				X: TYPE, Path type
BIT 3	BIT 2	BIT 1	BIT 0	
-	UNIT	AUTO	INS	1: SPEED, constant speed control.
CMD		OVLP	INS	2: SINGLE, positioning control. It stops when finished.
				3: AUTO, positioning control. It loads the next path automatically when finished.
-	-	-	INS	7: JUMP, jump to the specified path.
-	ROM	AUTO	INS	8: write specified parameter to specified path.
DIR		OVLP	INS	A: indexing position control.
-	-	-	-	Statement / arithmetic operation

TYPE path type: when executing 1 – 3, it can be interrupted and stopped by DO.STP (stop) and software limits.

INS: executing this path interrupts the previous path.

OVLP: allows overlapping of the next path. Overlapping is not allowed in Speed mode. When overlapping in Position mode, DLY has no function.

AUTO: once current PR path is finished, load the next path automatically.

CMD: please refer to Chapter 7 PR command description.

■ UZ

U: DEC, Deceleration time	Z: ACC, Acceleration time	Corresponding parameters	Default value (ms)
0	0	P5.020	200
1	1	P5.021	300
2	2	P5.022	500
3	3	P5.023	600
4	4	P5.024	800
5	5	P5.025	900
6	6	P5.026	1000
7	7	P5.027	1200
8	8	P5.028	1500
9	9	P5.029	2000
10	10	P5.030	2500
11	11	P5.031	3000
12	12	P5.032	5000
13	13	P5.033	8000
14	14	P5.034	50
15	15	P5.035	30

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- A: SPD, target speed index

A	Corresponding parameters	Default value (ms)
0	P5.060	20
1	P5.061	50
2	P5.062	100
3	P5.063	200
4	P5.064	300
5	P5.065	500
6	P5.066	600
7	P5.067	800
8	P5.068	1000
9	P5.069	1300
10	P5.070	1500
11	P5.071	1800
12	P5.072	2000
13	P5.073	2300
14	P5.074	2500
15	P5.075	3000

- B: DLY, Delay time index

B	Corresponding parameters	Default value (ms)
0	P5.040	0
1	P5.041	100
2	P5.042	200
3	P5.043	400
4	P5.044	500
5	P5.045	800
6	P5.046	1000
7	P5.047	1500
8	P5.048	2000
9	P5.049	2500
10	P5.050	3000
11	P5.051	3500
12	P5.052	4000
13	P5.053	4500
14	P5.054	5000
15	P5.055	5500

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- C: AUTO: once current PR path is finished, load the next path automatically.

  This function is only enabled when X = A indexing position control.

  Description of each bit:

Bit 2	AUTO	0: disable auto function 1: once current PR path is finished, load next path automatically
Bit 0 – 1	Reserved	-

Note: the parameter format definition [C, A, U, Z] is different from the above table when the path type is [7]: write the specified parameter to the specified path, and [8]: statement / arithmetic operation. Please refer to Chapter 7 for detailed instructions.

P6.003	PATH#1 data		Address: 0606H 0607H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

P6.002 defines the property of the target point; P6.003 defines the target position of P6.002 or the target path for the Jump command.

P6.004	PATH#2 definition		Address: 0608H 0609H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.005	PATH#2 data		Address: 060AH 060BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.006	PATH#3 definition		Address: 060CH 060DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.007	PATH#3 data		Address: 060EH 060FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.008	PATH#4 definition		Address: 0610H 0611H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.009	PATH#4 data		Address: 0612H 0613H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.010	PATH#5 definition		Address: 0614H 0615H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

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P6.011	PATH#5 data		Address: 0616H 0617H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.012	PATH#6 definition		Address: 0618H 0619H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.013	PATH#6 data		Address: 061AH 061BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.014	PATH#7 definition		Address: 061CH 061DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.015	PATH#7 data		Address: 061EH 061FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.016	PATH#8 definition		Address: 0620H 0621H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.017	PATH#8 data		Address: 0622H 0623H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.018	PATH#9 definition		Address: 0624H 0625H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.019	PATH#9 data		Address: 0626H 0627H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.020	PATH#10 definition		Address: 0628H 0629H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

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P6.021	PATH#10 data		Address: 062AH 062BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.022	PATH#11 definition		Address: 062CH 062DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.023	PATH#11 data		Address: 062EH 062FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.024	PATH#12 definition		Address: 0630H 0631H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.025	PATH#12 data		Address: 0632H 0633H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.026	PATH#13 definition		Address: 0634H 0635H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.027	PATH#13 data		Address: 0636H 0637H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.028	PATH#14 definition		Address: 0638H 0639H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.029	PATH# 14 data		Address: 063AH 063BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.030	PATH#15 definition		Address: 063CH 063DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

8

P6.031	PATH#15 data		Address: 063EH 063FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.032	PATH#16 definition		Address: 0640H 0641H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.033	PATH#16 data		Address: 0642H 0643H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.034	PATH#17 definition		Address: 0644H 0645H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.035	PATH#17 data		Address: 0646H 0647H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.036	PATH#18 definition		Address: 0648H 0649H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.037	PATH#18 data		Address: 064AH 064BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.038	PATH#19 definition		Address: 064CH 064DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.039	PATH#19 data		Address: 064EH 064FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.040	PATH#20 definition		Address: 0650H 0651H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

8

P6.041	PATH#20 data		Address: 0652H 0653H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.042	PATH#21 definition		Address: 0654H 0655H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.043	PATH#21 data		Address: 0656H 0657H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.044	PATH#22 definition		Address: 0658H 0659H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.045	PATH#22 data		Address: 065AH 065BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

8

P6.046	PATH#23 definition		Address: 065CH 065DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.047	PATH#23 data		Address: 065EH 065FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.048	PATH#24 definition		Address: 0660H 0661H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.049	PATH#24 data		Address: 0662H 0663H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.050	PATH#25 definition		Address: 0664H 0665H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

8

P6.051	PATH#25 data		Address: 0666H 0667H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.052	PATH#26 definition		Address: 0668H 0669H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.053	PATH#26 data		Address: 066AH 066BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.054	PATH#27 definition		Address: 066CH 066DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.055	PATH#27 data		Address: 066EH 066FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.056	PATH#28 definition		Address: 0670H 0671H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.057	PATH#28 data		Address: 0672H 0673H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.058	PATH#29 definition		Address: 0674H 0675H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.059	PATH#29 data		Address: 0676H 0677H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.060	PATH#30 definition		Address: 0678H 0679H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

8

P6.061	PATH#30 data		Address: 067AH 067BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.062	PATH#31 definition		Address: 067CH 067DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.063	PATH#31 data		Address: 067EH 067FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.064	PATH#32 definition		Address: 0680H 0681H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.065	PATH#32 data		Address: 0682H 0683H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.066	PATH#33 definition		Address: 0684H 0685H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.067	PATH#33 data		Address: 0686H 0687H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.068	PATH#34 definition		Address: 0688H 0689H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.069	PATH#34 data		Address: 068AH 068BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.070	PATH#35 definition		Address: 068CH 068DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

8

P6.071	PATH#35 data		Address: 068EH 068FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.072	PATH#36 definition		Address: 0690H 0691H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.073	PATH#36 data		Address: 0692H 0693H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.074	PATH#37 definition		Address: 0694H 0695H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.075	PATH#37 data		Address: 0696H 0697H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.076	PATH#38 definition		Address: 0698H 0699H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.077	PATH#38 data		Address: 069AH 069BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.078	PATH#39 definition		Address: 069CH 069DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.079	PATH#39 data		Address: 069EH 069FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.080	PATH#40 definition		Address: 06A0H 06A1H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

8

P6.081	PATH#40 data		Address: 06A2H 06A3H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.082	PATH#41 definition		Address: 06A4H 06A5H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.083	PATH#41 data		Address: 06A6H 06A7H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.084	PATH#42 definition		Address: 06A8H 06A9H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.085	PATH#42 data		Address: 06AAH 06ABH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.086	PATH#43 definition		Address: 06ACH 06ADH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.087	PATH#43 data		Address: 06AEH 06AFH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.088	PATH# 44 definition		Address: 06B0H 06B1H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.089	PATH#44 data		Address: 06B2H 06B3H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.090	PATH# 45 definition		Address: 06B4H 06B5H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

8

P6.091	**PATH#45 data**		**Address: 06B6H 06B7H**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.092	**PATH#46 definition**		**Address: 06B8H 06B9H**
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.093	**PATH#46 data**		**Address: 06BAH 06BBH**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.094	**PATH#47 definition**		**Address: 06BCH 06BDH**
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.095	**PATH#47 data**		**Address: 06BEH 06BFH**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.096	PATH#48 definition		Address: 06C0H 06C1H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.097	PATH#48 data		Address: 06C2H 06C3H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P6.098	PATH#49 definition		Address: 06C4H 06C5H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P6.099	PATH#49 data		Address: 06C6H 06C7H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

8

P7.xxx PR parameters

P7.000	PATH#50 definition		Address: 0700H 0701H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.001	PATH#50 data		Address: 0702H 0703H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.002	PATH#51 definition		Address: 0704H 0705H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.003	PATH#51 data		Address: 0706H 0707H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.004	PATH#52 definition		Address: 0708H 0709H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.005	PATH#52 data		Address: 070AH 070BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.006	PATH#53 definition		Address: 070CH 070DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.007	PATH#53 data		Address: 070EH 070FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.008	PATH#54 definition		Address: 0710H 0711H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.009	PATH#54 data		Address: 0712H 0713H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

8

P7.010	PATH#55 definition		Address: 0714H 0715H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.011	PATH#55 data		Address: 0716H 0717H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.012	PATH#56 definition		Address: 0718H 0719H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.013	PATH#56 data		Address: 071AH 071BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.014	PATH#57 definition		Address: 071CH 071DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.015	**PATH#57 data**		**Address: 071EH 071FH**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.016	**PATH#58 definition**		**Address: 0720H 0721H**
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.017	**PATH#58 data**		**Address: 0722H 0723H**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.018	**PATH#59 definition**		**Address: 0724H 0725H**
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.019	**PATH#59 data**		**Address: 0726H 0727H**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

8

P7.020	PATH#60 definition		Address: 0728H 0729H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000to – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.021	PATH#60 data		Address: 072AH 072BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.022	PATH#61 definition		Address: 072CH 072DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.023	PATH#61 data		Address: 072EH 072FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.024	PATH#62 definition		Address: 0730H 0731H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

8

P7.025	PATH#62 data		Address: 0732H 0733H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.026	PATH#63 definition		Address: 0734H 0735H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.027	PATH#63 data		Address: 0736H 0737H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.028	PATH#64 definition		Address: 0738H 0739H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.029	PATH#64 data		Address: 073AH 073BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.030	PATH#65 definition		Address: 073CH 073DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.031	PATH#65 data		Address: 073EH 073FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.032	PATH#66 definition		Address: 0740H 0741H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.033	PATH#66 data		Address: 0742H 0743H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.034	PATH#67 definition		Address: 0744H 0745H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.035	PATH#67 data		Address: 0746H 0747H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.036	PATH#68 definition		Address: 0748H 0749H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.037	PATH#68 data		Address: 074AH 074BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.038	PATH#69 definition		Address: 074CH 074DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.039	PATH#69 data		Address: 074EH 074FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.040	PATH#70 definition		Address: 0750H 0751H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.041	PATH#70 data		Address: 0752H 0753H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.042	PATH#71 definition		Address: 0754H 0755H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.043	PATH#71 data		Address: 0756H 0757H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.044	PATH#72 definition		Address: 0758H 0759H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.045	PATH#72 data		Address: 075AH 075BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.046	PATH#73 definition		Address: 075CH 075DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.047	PATH#73 data		Address: 075EH 075FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.048	PATH#74 definition		Address: 0760H 0761H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.049	PATH#74 data		Address: 0762H 0763H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

8

P7.050	PATH#75 definition		Address: 0764H 0765H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.051	PATH#75 data		Address: 0766H 0767H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.052	PATH#76 definition		Address: 0768H 0769H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.053	PATH#76 data		Address: 076AH 076BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.054	PATH#77 definition		Address: 076CH 076DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.055	PATH#77 data		Address: 076EH 076FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.056	PATH#78 definition		Address: 0770H 0771H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.057	PATH#78 data		Address: 0772H 0773H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.058	PATH#79 definition		Address: 0774H 0775H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.059	PATH#79 data		Address: 0776H 0777H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

8

P7.060	PATH#80 definition		Address: 0778H 0779H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.061	PATH#80 data		Address: 077AH 077BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.062	PATH#81 definition		Address: 077CH 077DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.063	PATH#81 data		Address: 077EH 077FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.064	PATH#82 definition		Address: 0780H 0781H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.065	PATH#82 data		Address: 0782H 0783H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.066	PATH#83 definition		Address: 0784H 0785H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.067	PATH#83 data		Address: 0786H 0787H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.068	PATH#84 definition		Address: 0788H 0789H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.069	PATH#84 data		Address: 078AH 078BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

8

P7.070	PATH#85 definition		Address: 078CH 078DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.071	PATH#85 data		Address: 078EH 078FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.072	PATH#86 definition		Address: 0790H 0791H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.073	PATH#86 data		Address: 0792H 0793H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.074	PATH#87 definition		Address: 0794H 0795H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

8

P7.075	PATH#87 data		Address: 0796H 0797H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.076	PATH#88 definition		Address: 0798H 0799H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.077	PATH#88 data		Address: 079AH 079BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.078	PATH#89 definition		Address: 079CH 079DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.079	PATH#89 data		Address: 079EH 079FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

8

P7.080	PATH#90 definition		Address: 07A0H 07A1H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.081	PATH#90 data		Address: 07A2H 07A3H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.082	PATH#91 definition		Address: 07A4H 07A5H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.083	PATH#91 data		Address: 07A6H 07A7H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.084	PATH#92 definition		Address: 07A8H 07A9H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

8

P7.085	PATH#92 data		Address: 07AAH 07ABH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.086	PATH#93 definition		Address: 07ACH 07ADH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.087	PATH#93 data		Address: 07AEH 07AFH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.088	PATH#94 definition		Address: 07B0H 07B1H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.089	PATH#94 data		Address: 07B2H 07B3H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

8

P7.090	PATH#95 definition		Address: 07B4H 07B5H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.091	PATH#95 data		Address: 07B6H 07B7H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.092	PATH#96 definition		Address: 07B8H 07B9H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.093	PATH#96 data		Address: 07BAH 07BBH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.094	PATH#97 definition		Address: 07BCH 07BDH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.095	PATH#97 data		Address: 07BEH 07BFH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.096	PATH#98 definition		Address: 07C0H 07C1H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.097	PATH#98 data		Address: 07C2H 07C3H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

P7.098	PATH#99 definition		Address: 07C4H 07C5H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 – 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Please refer to the description of P6.002.

P7.099	PATH#99 data		Address: 07C6H 07C7H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Please refer to the description of P6.003.

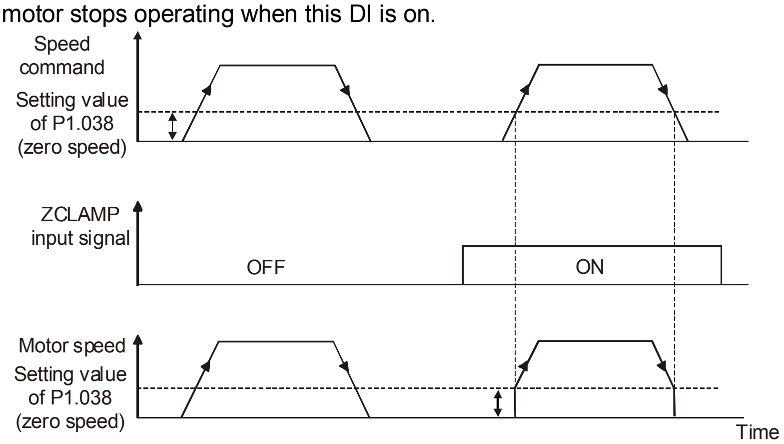
Table 8.1 Digital input (DI) descriptions

Value: 0x01			
DI name	Description	Triggering method	Control mode
SON	When this DI is on, servo is activated (Servo On).	Level triggered	ALL

Value: 0x02			
DI name	Description	Triggering method	Control mode
ARST	After the alarm is cleared, the drive shows that the alarm is cleared when this DI is on.	Rising-edge triggered	ALL

Value: 0x03			
DI name	Description	Triggering method	Control mode
GAINUP	In Speed and Position modes, when this DI is on (P2.027 set to 1), the gain switches to the original gain multiplied by the switching rate.	Level triggered	PT, PR, S

Value: 0x04			
DI name	Description	Triggering method	Control mode
CCLR	Clear pulse counter and P2.050. Set DI.CCLR to 0 to clear position pulse deviation (applicable to PT mode). When this DI is on, the accumulative pulse deviation of the drive is cleared to 0.	Rising-edge triggered, level triggered	PT, PR

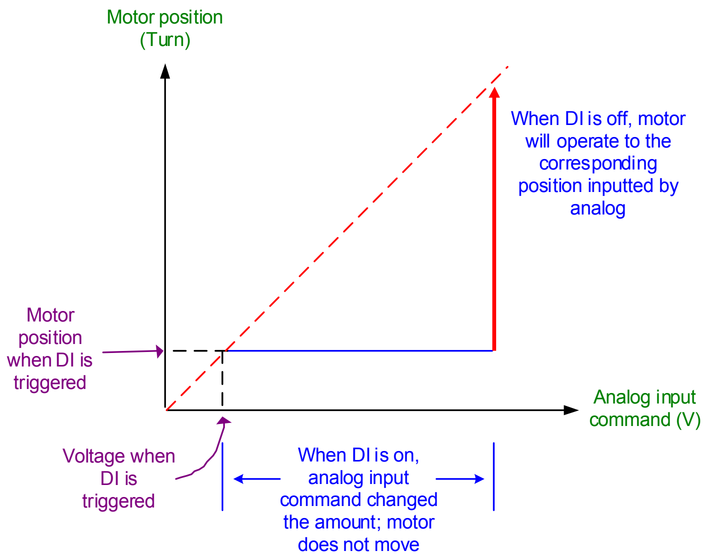
Value: 0x05			
DI name	Description	Triggering method	Control mode
ZCLAMP	When the speed is slower than the setting of zero speed (P1.038), the motor stops operating when this DI is on.  	Level triggered	S

Value: 0x06			
DI name	Description	Triggering method	Control mode
CMDINV	In Speed mode, input command is set to the reverse direction when this DI is on.	Level triggered	S, T

Value: 0x08			
DI name	Description	Triggering method	Control mode
CTRG	In PR mode, after selecting the PR command (POS0 – 6), the motor operates according to the command issued by the register when this DI is on.	Rising-edge triggered	PR

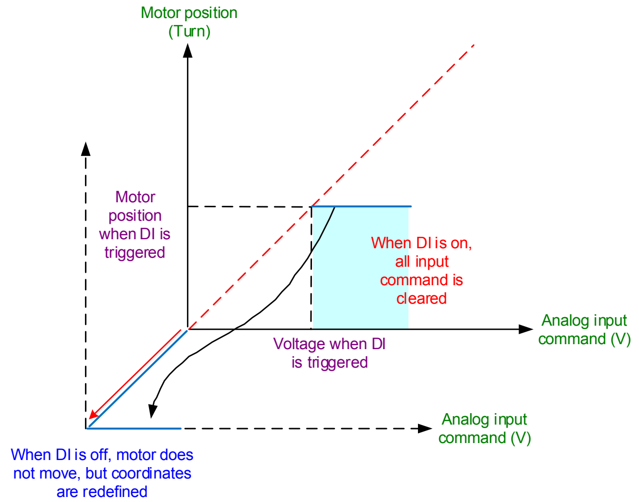
Value: 0x09			
DI name	Description	Triggering method	Control mode
TRQLM	In Speed and Position modes, motor torque is limited when this DI is on, and source of the torque limit command is the internal register or analog voltage.	Level triggered	PT, PR, S

Value: 0x0A			
DI name	Description	Triggering method	Control mode
CTRY	After this DI is on, it temporarily disables the monitoring function of the gantry (synchronous motion) when P1.074 = 2 (gantry function enabled). The axis that receives this DI stops calculating or monitoring the deviation of the two axes.	Rising-edge triggered	PT

<table>
<tr><th colspan="4">Value: 0x0C</th></tr>
<tr><th>DI name</th><th>Description</th><th>Triggering method</th><th>Control mode</th></tr>
<tr><td>VPL</td><td>Latch function of analog Position command. If this DI is on, position of the motor is held at the current position when the DI is triggered. During this DI is on, the motor does not operate even when there is a change in the analog command. When this DI is off, the motor completes the command that was changed during the time DI was on.

</td><td>Level triggered</td><td>PT</td></tr>
</table>

8

Value: 0x0D			
DI name	Description	Triggering method	Control mode
VPL	Clear function of analog Position command. If this DI is on, the position of the motor is held at the current position when DI is triggered. Despite the change in the analog command during DI is on, the motor remains at the current position even when the DI is off. However, the position that the motor remains at corresponds to the new analog command. Thus, the analog input command redefines the coordinate system of the motor.	Level triggered	PT



Value: 0x10			
DI name	Description	Triggering method	Control mode
SPDLM	In Torque mode, motor speed is limited when this DI is on, and the limited Speed command is the internal register or analog voltage command.	Level triggered	T

Value: 0x11, 0x12, 0x13, 0x1A, 0x1B, 0x1C, 0x1E			
DI name	Description	Triggering method	Control mode
POS0 POS1 POS2 POS3 POS4 POS5 POS6	PR command selection (1 – 99)	Level triggered	PR

Position command	POS 6	POS 5	POS 4	POS 3	POS 2	POS 1	POS 0	CTRG	Corres-ponding para-meter
Homing	0	0	0	0	0	0	0	↑	P6.000 P6.001
PR 1	0	0	0	0	0	0	1	↑	P6.002 P6.003
-									
PR 50	0	1	1	0	0	1	0	↑	P6.098 P6.099
PR 51	0	1	1	0	0	1	1	↑	P7.000 P7.001
-									
PR 99	1	1	0	0	0	1	1	↑	P7.098 P7.099

Value: 0x1D			
DI name	Description	Triggering method	Control mode
ABSE	When DI.ABSE is on, it is in absolute mode and can enable the functions of DI.ABSQ, DI.ABSC, DI.ABSR, DI.ABSD, and DI.ABSC at the same time. When DI.ABSE is on, the functions of DI4, DO2, and DO3 are no longer the ones assigned by the parameter. The DI4 function will be DI.ASDQ, DO2 will be DI.ABSR, and DO3 will be DI.ABSD. In addition, DI pins of DI.ABSC can be assigned by parameters.	Level triggered	All

Value: 0x1F			
DI name	Description	Triggering method	Control mode
ABSC	When DI.ABSC is on, the number of turns stored in absolute encoder are cleared. But this DI is only valid when DI.ABSE is on.	Rising-edge triggered	All

Value: when DI.ABSE is on, the DI.ABSQ from DI4 replaces the DI4 function from P2.013			
DI name	Description	Triggering method	Control mode
ABSQ always input by DI4	During I/O transmission, the controller sends the handshaking signal. When DI.ABSQ is off, the controller issues the request; when DI.ABSQ is on, the controller has processed the ABSD signal. This DI is only valid when DI.ABSE is on. Please refer to Diagram 10.3.4 for a detailed description.	Rising- and falling-edge triggered	All

<table>
<tr><th colspan="4">Value: 0x14, 0x15</th></tr>
<tr><th>DI name</th><th>Description</th><th>Triggering method</th><th>Control mode</th></tr>
<tr><td>SPD0
SPD1</td><td>Register Speed command selection (1 – 4)
<table>
<tr><th rowspan="2">Speed command number</th><th colspan="2">DI signal of CN1</th><th rowspan="2" colspan="3">Command source</th><th rowspan="2">Content</th><th rowspan="2">Range</th></tr>
<tr><th>SPD1</th><th>SPD0</th></tr>
<tr><td>S1</td><td>0</td><td>0</td><td>Mode</td><td>Sz</td><td>N/A</td><td>Speed command is 0</td><td>0</td></tr>
<tr><td>S2</td><td>0</td><td>1</td><td rowspan="3" colspan="3">Register parameter</td><td>P1.009</td><td>+/- 6000 rpm (rotary)
+/- 15999999 (linear)</td></tr>
<tr><td>S3</td><td>1</td><td>0</td><td>P1.010</td><td>+/- 6000 rpm (rotary)
+/- 15999999 (linear)</td></tr>
<tr><td>S4</td><td>1</td><td>1</td><td>P1.011</td><td>+/- 6000 rpm (rotary)
+/- 15999999 (linear)</td></tr>
</table>
Note: rotary means a permanent-magnet synchronous rotary motor; linear means a permanent-magnet synchronous linear motor.</td><td>Level triggered</td><td>S</td></tr>
</table>

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Value: 0x16, 0x17			
DI name	Description	Triggering method	Control mode
TCM0 TCM1	Register Torque command selection (1 – 4)	Level triggered	T

Torque command number	DI signal of CN1		Command source			Content	Range
	TCM1	TCM0					
T1	0	0	Mode	Tz	N/A	Torque command is 0	0
T2	0	1	Register parameter			P1.012	+/- 300%
T3	1	0				P1.013	+/- 300%
T4	1	1				P1.014	+/- 300%

Value: 0x18			
DI name	Description	Triggering method	Control mode
S-P	In Position and Speed modes, if DI is off, it is in Speed mode; if DI is on, it is in Position mode. In PT / PR / S mode, PT or PR are selected with DI.PT-PR (0x2B).	Level triggered	Dual mode

Value: 0x19			
DI name	Description	Triggering method	Control mode
S-T	In Speed and Torque modes, if DI is off, it is in Speed mode; if DI is on, it is in Torque mode.	Level triggered	Dual mode

Value: 0x20			
DI name	Description	Triggering method	Control mode
T-P	In Position and Torque modes, if DI is off, it is in Torque mode; if DI is on, it is in Position mode. In PT / PR / T modes, PT or PR are selected with DI.PT-PR (0x2B).	Level triggered	Dual mode

Value: 0x21			
DI name	Description	Triggering method	Control mode
EMGS	When this DI is on, the motor stops immediately.	Level triggered	All

Value: 0x22			
DI name	Description	Triggering method	Control mode
NL (CWL)	Reverse inhibit limit (contact B)	Level triggered	All

Value: 0x23			
DI name	Description	Triggering method	Control mode
PL (CCWL)	Forward inhibit limit (contact B)	Level triggered	All

Value: 0x24			
DI name	Description	Triggering method	Control mode
ORGP	During homing, when this DI is triggered, the servo uses the position as the homing origin. Please refer to the setting of P5.004.	Rising- and falling-edge triggered	PR

Value: 0x27			
DI name	Description	Triggering method	Control mode
SHOM	During homing, when this DI is on, it activates the function to search for the origin. Please refer to the setting of P5.004.	Rising-edge triggered	PR

Value: 0x2B			
DI name	Description	Triggering method	Control mode
PT-PR	Use this DI to select the command source in PT-PR dual mode or PT-PR-S multiple mode. If this DI is off, it is in PT mode; if this DI is on, it is in PR mode.	Level triggered	Dual mode

Value: 0x35			
DI name	Description	Triggering method	Control mode
ALGN	When E-Cam alignment function is enabled (P2.076.bit0 = 1 & P2.076.bit1 = 1), it executes alignment correction when this DI is on.	Rising-edge triggered	PR

Value: 0x36			
DI name	Description	Triggering method	Control mode
CAM	E-Cam engaging control. Please refer to the setting of P5.088 U, Z value.	Rising- and falling-edge triggered	PR

Value: 0x37			
DI name	Description	Triggering method	Control mode
JOGU	When this DI is on, motor JOGs in the forward direction.	Level triggered	All

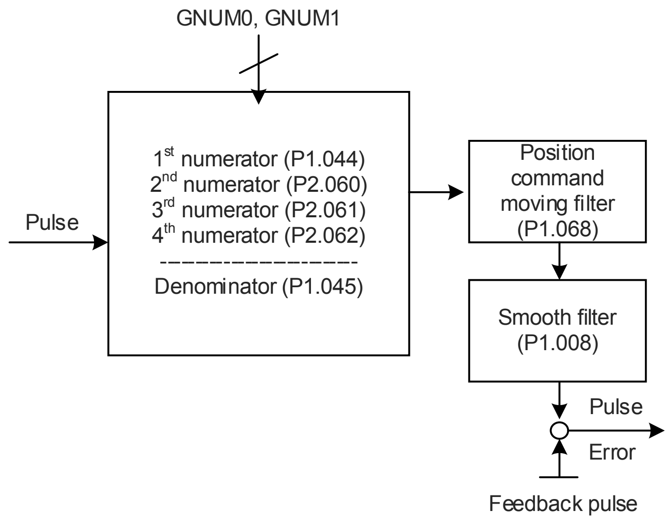
Value: 0x38			
DI name	Description	Triggering method	Control mode
JOGD	When this DI is on, motor JOGs in the reverse direction.	Level triggered	All

Value: 0x39			
DI name	Description	Triggering method	Control mode
EV1	Event trigger command #1. Please refer to the setting of P5.098 and P5.099.	Rising- and falling-edge triggered	PR

Value: 0x3A			
DI name	Description	Triggering method	Control mode
EV2	Event trigger command #2. Please refer to the setting of P5.098 and P5.099.	Rising- and falling-edge triggered	PR

Value: 0x3B			
DI name	Description	Triggering method	Control mode
EV3	Event trigger command #3. Please refer to the setting of P5.098 and P5.099.	Rising- and falling-edge triggered	PR

Value: 0x3C			
DI name	Description	Triggering method	Control mode
EV4	Event trigger command #4. Please refer to the setting of P5.098 and P5.099.	Rising- and falling-edge triggered	PR

Value: 0x43, 0x44			
DI name	Description	Triggering method	Control mode
GNUM0 GNUM1	E-Gear ratio (Numerator) selection 0 E-Gear ratio (Numerator) selection 1  	Level triggered	PT

Value: 0x45			
DI name	Description	Triggering method	Control mode
INHP	In Position mode, the external pulse input command has no function when this DI is on. Note: this function has to be set to DI8 to ensure immediate pulse inhibition.	Level triggered	PT

Value: 0x46			
DI name	Description	Triggering method	Control mode
STP	Motor stops.	Rising-edge triggered	PR

Value: 0x47			
DI name	Description	Triggering method	Control mode
PFQS	Use this DI to set the emergency stop for deceleration time. The value for deceleration time is same as P5.003. If this DI is triggered, AL35F occurs and the motor starts decelerating. When the speed reaches 0, AL3CF occurs and servo is switched to Servo Off. Please reset the alarm to switch the drive to the Servo On state.	Rising-edge triggered	PT, PR, T, S

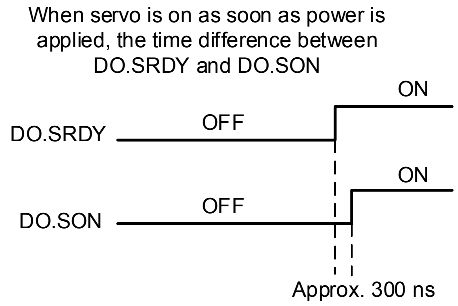
Note: when P2.010 – P2.017, P2.036 – P2.040 are set to 0, the input function is disabled.

Table 8.2 Digital output (DO) descriptions

Value: 0x01

DO name	Description	Triggering method	Control mode
SRDY	When the control and main circuit power is applied to the drive, this DO is on if no alarm occurs.	Level triggered	All

Value: 0x02

DO name	Description	Triggering method	Control mode
SON	When the servo is activated (Servo On), this DO is on if no alarm occurs.  	Level triggered	All

Value: 0x03

DO name	Description	Triggering method	Control mode
ZSPD	When the motor speed is slower than the value of the zero speed (P1.038), this DO is on.	Level triggered	All

Value: 0x04

DO name	Description	Triggering method	Control mode
TSPD	When the motor speed is faster than the target speed setting (P1.039), this DO is on.	Level triggered	All

Value: 0x05

DO name	Description	Triggering method	Control mode
TPOS	When the deviation pulse number is smaller than the position range setting (setting value of P1.054), this DO is on.	Level triggered	PT, PR

Value: 0x06

DO name	Description	Triggering method	Control mode
TQL	When it is in torque limit, this DO is on.	Level triggered	All (Except for T and Tz)

Value: 0x07

DO name	Description	Triggering method	Control mode
ALRM	When an alarm occurs, this DO is on (except for forward / reverse limit, communication error, undervoltage, and fan error).	Level triggered	All

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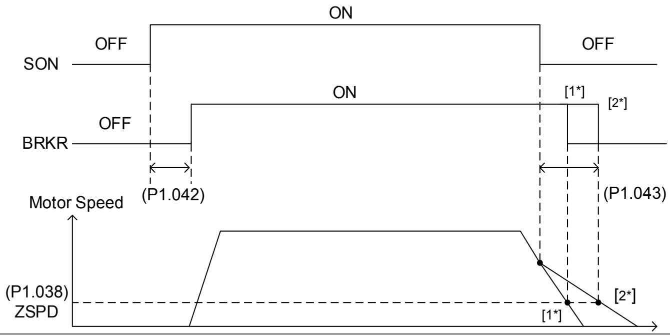
Value: 0x08			
DO name	Description	Triggering method	Control mode
BRKR	When the magnetic brake control signal is detected, please adjust the settings of parameters P1.042 and P1.043. 	Level triggered	All

Value: 0x09			
DO name	Description	Triggering method	Control mode
HOME	When homing is completed, it means the position coordinate system and position counter are defined and this DO is on. When applying to power, this DO is off; when homing is completed, this DO is on. During operation, this DO is on until the position counter overflows (including commands or feedback). Then, this DO turns off. When the homing command is triggered, this DO is off; after homing is completed, this DO is on.	Level triggered	PR

Value: 0x0D			
DO name	Description	Triggering method	Control mode
ABSW	When there are absolute encoder alarms, this DO is on.	-	All

Value: 0x0E			
DO name	Description	Triggering method	Control mode
IDXD	Indexing coordinate is defined. When homing is completed, indexing coordinate is defined as well.	-	PR

Value: 0x10			
DO name	Description	Triggering method	Control mode
OLW	This DO is on when the overload level setting is reached. $\mathbf{t}_{OL}$ = Overload allowable time of the servo x value for the overload warning level (P1.056). When the overload accumulative time exceeds $\mathbf{t}_{OL}$, it sends the overload pre-warning (OLW). However, if the overload accumulative time exceeds the overload allowable time of the servo, it sends the overload error (ALRM). For example: the value of the overload pre-warning is 60%. (P1.056 = 60) When the output average load of the servo drive is 200% and the output time exceeds 8 seconds, the overload alarm (AL006) occurs. $\mathbf{t}_{OL}$ = Duration of the output average load of the servo is 200% x overload warning level parameter = 8 sec x 60% = 4.8 sec Result: when the output average load of the servo drive is 200% for over $\mathbf{t}_{OL}$ = 4.8 seconds, this overload warning DO is on (DO code is set to 10). If the duration exceeds 8 seconds, then the overload alarm (AL006) occurs and sends the overload error (ALRM).	Level triggered	All

Value: 0x11			
DO name	Description	Triggering method	Control mode
WARN	Warning outputs (forward / reverse limit, communication error, undervoltage, and fan error).	Level triggered	All

Value: 0x12			
DO name	Description	Triggering method	Control mode
OVF	Position command / feedback overflows.	Level triggered	PT, PR

Value: 0x13			
DO name	Description	Triggering method	Control mode
SNL (SCWL)	Software limit (reverse limit).	Level triggered	PR

Value: 0x14			
DO name	Description	Triggering method	Control mode
SPL (SCCWL)	Software limit (forward limit).	Level triggered	PR

Value: 0x15			
DO name	Description	Triggering method	Control mode
Cmd_OK	When the Position command is completed and enters DMCNET mode, this DO is on. When the Position command is executing, this DO is off; after the command completes, this DO is on. This DO only indicates that the command is completed, but the motor positioning may not be completed yet. Please refer to DO.TPOS.	Level triggered	PR

Value: 0x16			
DO name	Description	Triggering method	Control mode
CAP_OK	Capture procedure is completed.	Level triggered	All

Value: 0x17			
DO name	Description	Triggering method	Control mode
MC_OK	When DO.Cmd_OK and DO.TPOS are both on, then this DO is on. Please refer to P1.048.	Level triggered	PR

Value: 0x18			
DO name	Description	Triggering method	Control mode
CAM_AREA	Master position of the E-Cam is in the setting area.	Level triggered	PR

Value: 0x19			
DO name	Description	Triggering method	Control mode
SP_OK	Motor speed reaches the target speed: in Speed mode, when the deviation between the speed feedback and the command is smaller than the value of P1.047, this DO is on.	Level triggered	S, Sz

Value: 0x2C			
DO name	Description	Triggering method	Control mode
Zon1	When the value of the item monitored by P0.009 ranges between the value of P0.054 and P0.055, then this DO is on.	-	All

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Value: when DI.ABSE is on, DI.ABSR triggered by DO2 will replace the DO2 assigned by P2.019			
DO name	Description	Triggering method	Control mode
ABSR always output by DO2	When DO.ABSR is off, it indicates the servo drive can receive request issued by DI.ABSQ; when DO.ABSR is on, it indicates that after receiving the request, the data has been prepared and the ABSD data is valid so that the controller can access the ABSD data. This output is only valid when DI.ABSE is on. Please refer to Diagram 10.3.6. for a detailed description.	Level triggered	All

Value: when DI.ABSE is on, DI.ABSD triggered by DO3 will replace the DO3 assigned by P2.020			
DO name	Description	Triggering method	Control mode
ABSD always output by DO3	DO pin of ABS data. The data is valid when DO.ABSR is on. This output is only valid when DI.ABSE is on. Please refer to Diagram 10.3.6.1 for a detailed description.	Level triggered	All

Value: 0x30			
DO name	Description	Triggering method	Control mode
SPO_0	Output bit 00 of P4.006.	Level triggered	All

Value: 0x31			
DO name	Description	Triggering method	Control mode
SPO_1	Output bit 01 of P4.006.	Level triggered	All

Value: 0x32			
DO name	Description	Triggering method	Control mode
SPO_2	Output bit 02 of P4.006.	Level triggered	All

Value: 0x33			
DO name	Description	Triggering method	Control mode
SPO_3	Output bit 03 of P4.006.	Level triggered	All

Value: 0x34			
DO name	Description	Triggering method	Control mode
SPO_4	Output bit 04 of P4.006.	Level triggered	All

Value: 0x35			
DO name	Description	Triggering method	Control mode
SPO_5	Output bit 05 of P4.006.	Level triggered	All

Value: 0x36			
DO name	Description	Triggering method	Control mode
SPO_6	Output bit 06 of P4.006.	Level triggered	All

Value: 0x37			
DO name	Description	Triggering method	Control mode
SPO_7	Output bit 07 of P4.006.	Level triggered	All

Value: 0x38			
DO name	Description	Triggering method	Control mode
SPO_8	Output bit 08 of P4.006.	Level triggered	All

Value: 0x39			
DO name	Description	Triggering method	Control mode
SPO_9	Output bit 09 of P4.006.	Level triggered	All

Value: 0x3A			
DO name	Description	Triggering method	Control mode
SPO_A	Output bit 10 of P4.006.	Level triggered	All

Value: 0x3B			
DO name	Description	Triggering method	Control mode
SPO_B	Output bit 11 of P4.006.	Level triggered	All

Value: 0x3C			
DO name	Description	Triggering method	Control mode
SPO_C	Output bit 12 of P4.006.	Level triggered	All

Value: 0x3D			
DO name	Description	Triggering method	Control mode
SPO_D	Output bit 13 of P4.006.	Level triggered	All

Value: 0x3E			
DO name	Description	Triggering method	Control mode
SPO_E	Output bit 14 of P4.006.	Level triggered	All

Value: 0x3F			
DO name	Description	Triggering method	Control mode
SPO_F	Output bit 15 of P4.006.	Level triggered	All

Note: the output function is disabled when P2.018 – P2.022 are set to 0.

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Table 8.3 Monitoring variables descriptions

Item	Description
Monitoring code	Each monitoring variable has a code, and you can use P0.002 to set the code and monitor the variable.
Format	Each monitoring variable is stored in the 32-bit format (long integer) of the servo drive.
Category	Basic variables / expansion variables: 1. Basic variables: variables (P0.002 = 0 – 26) within the cycle; in monitoring mode, you can display the variables by using the UP / DOWN keys on the panel. 2. Expansion variables: variables other than basic variables. (P0.002 = 27 – 127)
Monitoring method	Panel display / mapping: 1. Panel display: monitor with the panel 2. Mapping: monitor variables or parameters by mapping parameters
Panel display	1. Use the MODE key to switch to the monitor mode and press the UP / DOWN keys to select the variable to monitor. 2. Input the variable code to monitor into P0.002 and start monitoring. Press the SHIFT key on the panel to switch between high and low digit display; Press the SET key on the panel to switch between decimal and hexadecimal display.
Mapping	1. Parameters that support monitoring variable mapping: for P0.009 – P0.013, please refer to Section 8.3 Parameter descriptions. 2. You can read monitoring variables through communication using mapping parameters. 3. The value of the mapping parameter (P0.009 – P0.013) is the content of the basic variables (17h, 18h, 19h, 1Ah). To monitor P0.009, set P0.017 to the value to read (please refer to P0.002). You can read the data specified by P0.017 through communication or the monitor panel (set P0.002 to 23). When the panel displays “VAR-1”, it indicates the content value of P0.009.

The property code of each monitoring variable is described in the following table:

Property	Description
B	BASE: basic variables, you can select with the UP / DOWN keys on the panel.
D1 D2	Decimal place displayed on panel: D1 indicates 1 decimal place, D2 indicates 2 decimal places.
Dec	Only decimal display is available on the panel, and you cannot switch to hexadecimal display by pressing the SET key.
Hex	Only hexadecimal display is available on the panel, and you cannot switch to decimal display by pressing the SET key.

Monitoring variables are described in the following table by the code sequence:

Code	Variable name / property	Description
000 (00h)	Feedback position (PUU) B	Current feedback position of the motor encoder. Unit: Pulse of User Unit (PUU).
001 (01h)	Position command (PUU) B	Current coordinate of the Position command. Unit: Pulse of User Unit (PUU). PT mode: number of pulse commands received by the drive. PR mode: absolute coordinates of the Position command.
002 (02h)	Position deviation (PUU) B	Deviation between the Position command and the feedback position. Unit: Pulse of User Unit (PUU).
003 (03h)	Feedback position (pulse) B	Current feedback position of the motor encoder. Unit: Encoder unit (pulse).
004 (04h)	Position command (pulse) B	Current coordinate of the Position command. Unit: Encoder unit (pulse). This is the command after passing E-Gear.
005 (05h)	Position deviation (pulse) B	Deviation between the Position command and the feedback position. Unit: Encoder unit (pulse).
006 (06h)	Pulse command frequency B	Frequency of the pulse command received by the drive. Unit: Kpps. Applicable to PT / PR mode.
007 (07h)	Speed feedback B D1 Dec	Current motor speed. Unit: 0.1 rpm. The low-pass filter has been applied to this value to make it more stable.

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Code	Variable name / property	Description
008 (08h)	Speed command (analog) B D2 Dec	Speed command from the analog channel. Unit: 0.01 Volt.
009 (09h)	Speed command (integrated) B	Integrated Speed command. Unit: 1 rpm. Source includes analog, register, or position loop.
010 (0Ah)	Torque command (analog) B D2 Dec	Torque command from the analog channel. Unit: 0.01 Volt.
011 (0Bh)	Torque command (integrated) B	Integrated Torque command. Unit: percentage (%). Source includes analog, register, or speed loop.
012 (0Ch)	Average load rate B	Average load rate from the drive. Unit: percentage (%).
013 (0Dh)	Peak load rate B	Maximum load rate from the drive. Unit: percentage (%).
014 (0Eh)	DC Bus voltage B	Rectified capacitor voltage. Unit: Volt.
015 (0Fh)	Load inertia ratio B D1 Dec	Ratio of the load inertia to the motor inertia. Unit: 0.1 times.
016 (10h)	IGBT temperature B	Temperature of IGBT. Unit: °C.
017 (11h)	Resonance frequency B Dec	Resonance frequency of the system consists of two groups of frequencies: F1 and F2 When monitoring from the panel, press the SHF key to switch between F1 and F2: F2 displays zero decimal places, F1 displays 1 decimal place. When reading by communication (mapping parameter): Low word displays frequency F2. High word displays frequency F1.
018 (12h)	Z phase offset B Dec	Offset value between motor position and Z phase, range: -5000 to +5000. Where it overlaps with Z phase, the value is 0; the greater the value, the greater the offset.
019 (13h)	Mapping parameter content #1 B	Returns the value of P0.025 which is mapped by P0.035.
020 (14h)	Mapping parameter content #2 B	Returns the value of P0.026 which is mapped by P0.036.
021 (15h)	Mapping parameter content #3 B	Returns the value of P0.027 which is mapped by P0.037.
022 (16h)	Mapping parameter content #4 B	Returns the value of P0.028 which is mapped by P0.038.
023 (17h)	Mapping monitoring variable #1 B	Returns the value of P0.009 which is mapped by P0.017.
024 (18h)	Mapping monitoring variable #2 B	Returns the value of P0.020 which is mapped by P0.018.
025 (19h)	Mapping monitoring variable #3 B	Returns the value of P0.011 which is mapped by P0.019.
026 (1Ah)	Mapping monitoring variable #4 B	Returns the value of P0.012 which is mapped by P0.020.
028 (1Ch)	Alarm code	Alarm code in DMCNET mode (applicable to A3-F).
029 (1Dh)	Auxiliary encoder feedback (PUU)	Position feedback from the auxiliary encoder (CN5) (applicable to A3-F).
030 (1Eh)	Auxiliary encoder position deviation (PUU)	Position deviation between the position feedback and the command from the auxiliary encoder (CN5) (applicable to A3-F).

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Code	Variable name / property	Description
031 (1Fh)	Main / auxiliary encoder position deviation (PUU)	Feedback position deviation between main encoder and auxiliary encoder (applicable to A3-F).
035 (23h)	Indexing coordinate command	Current command for the indexing coordinates. Unit: Pulse of User Unit (PUU).
037 (25h)	Compare data of Compare	The actual Compare data is the Compare data plus a specified value: CMP_DATA = DATA_ARRAY[*] + P1.023 + P1.024.
038 (26h)	Voltage level of the battery	Voltage level of the battery in an absolute encoder. To display the voltage level, you must enable the absolute encoder setting (P2.069).
039 (27h)	DI status (Integrated) Hex	Integrated DI status of the drive. Each bit corresponds to one DI channel. Source includes Hardware channel / P4.007, which is determined by P3.006.
040 (28h)	DO status (Hardware) Hex	Actual status from the DO hardware. Each bit corresponds to one DI channel.
041 (29h)	Status of the drive	Returns P0.046. Please refer to the description of this parameter.
043 (2Bh)	CAP data capturing	The latest data captured by CAP hardware. Note: CAP can continuously capture multiple points.
048 (30h)	Auxiliary encoder CNT	Pulse counts from the auxiliary encoder (CN5).
049 (31h)	Pulse command CNT	Pulse counts from the pulse command (CN1).
050 (32h)	Speed command (integrated) D1 Dec	Integrated Speed command. Unit: 0.1 rpm. Source includes analog, register, or position loop.
051 (33h)	Speed feedback (immediate) D1 Dec	Current actual motor speed. Unit: 0.1 rpm.
053 (35h)	Torque command (integrated) D1 Dec	Integrated Torque command. Unit: 0.1%. Source includes analog, register, or speed loop.
054 (36h)	Torque feedback D1 Dec	Current actual motor torque. Unit: 0.1%.
055 (37h)	Current feedback D2 Dec	Current actual motor current. Unit: 0.01 ampere (Amp).
056 (38h)	DC Bus voltage D1 Dec	Rectified capacitor voltage. Unit: 0.1 Volt.
059 (3Bh)	Pulse of E-Cam master axis (accumulative)	Accumulative pulse number of the E-Cam master axis. Same as P5.086. A3-L does not support the E-Cam function.
060 (3Ch)	Pulse of E-Cam master axis (incremental)	Incremental pulse number of the E-Cam master axis. The increment per ms. A3-L does not support the E-Cam function.
061 (3Dh)	Pulse of E-Cam master axis (lead pulse)	The lead pulse of the E-Cam master axis which determines the engaging condition. When disengaged: lead pulse = P5.087 or P5.092; when the value is 0, E-Cam engages. When engaged: lead pulse = P5.089; when the value is 0, it disengages. A3-L does not support the E-Cam function.
062 (3Eh)	Position of E-Cam master axis	Position of the E-Cam which corresponds to the master axis pulse, and can be used to find the phase of the E-Cam. Unit: same as the master axis pulse; when the incremental pulse number of the master axis is P, E-Cam rotates M cycles (P5.083＝M, P5.084＝P). A3-L does not support the E-Cam function.
063 (3Fh)	Position of E-Cam slave axis	Position of the E-Cam slave axis and can be found from the E-Cam table. Unit: PUU A3-L does not support the E-Cam function.

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Code	Variable name / property	Description
064 (40h)	Endpoint register of PR command	In PR mode, the endpoint of the Position command (Cmd_E).
065 (41h)	Output register of PR command	In PR mode, the accumulative output of the Position command.
067 (43h)	PR target speed	Target speed specified in the PR path. Unit: PPS (Pulse Per Second).
072 (48h)	Speed command (analog) B D1 Dec	Speed command from the analog channel. Unit: 0.1 rpm.
081 (51h)	Capture synchronous axis Incremental pulse input	When Capture synchronous axis is enabled, the actual Mark distance can be measured by the received pulse number between two Captures.
084 (54h)	Capture synchronous axis Pulse number of synchronous deviation	When Capture synchronous axis is enabled, the accumulative deviation between the actual output pulse and the target pulse. This value is close to 0 if synchronization is reached.
091 (5Bh)	Indexing coordinate feedback	Immediate feedback position of the indexing coordinates. Unit: Pulse of User Unit (PUU).
096 (60h)	Drive firmware version Dec	Includes 2 versions: DSP and CPLD When monitoring from the panel, press the SHF key to switch between DSP and CPLD: DSP displays zero decimal places, CPLD displays 1 decimal place. When reading by communication (mapping parameter): Low word returns the DSP version number. High word returns the CPLD version number.
111 (6Fh)	Error code of the servo drive	Error code from the servo drive: control loop of the servo only, not including the motion controller.
112 (70h)	CANopen SYNC TS (unfiltered)	The time the servo drive receives the SYNC signal (TimeStamp) Unit: usec
113 (71h)	CANopen SYNC TS (filtered)	The time the servo drive receives the SYNC signal that has gone through the low-pass filter. Unit: usec
116 (74h)	Deviation between position and Z phase of auxiliary encoder (pulse)	Deviation between the current position of the auxiliary encoder and the Z phase position of the auxiliary encoder (applicable to A3-F).
120 (78h)	Communication error rate	When this value continues to increase, it indicates that there is communication interference. In an interference-free environment, this value should not increase.
123 (7Bh)	Value returned when monitoring by panel	Monitoring value displayed when returned to the monitoring panel.

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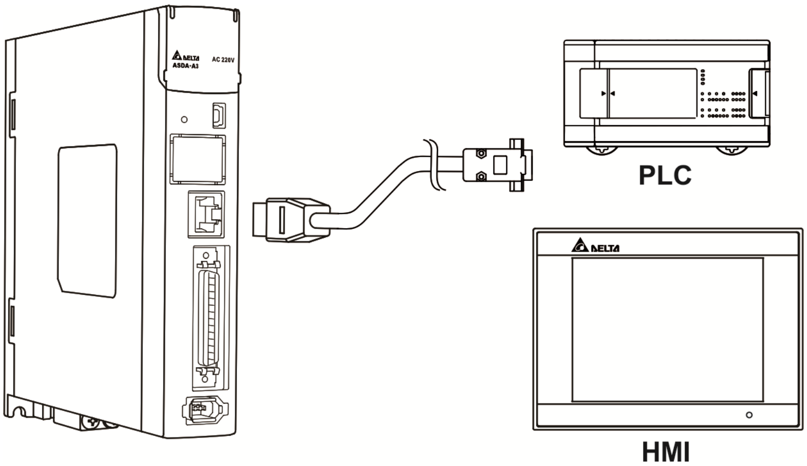
MODBUS Communication 9

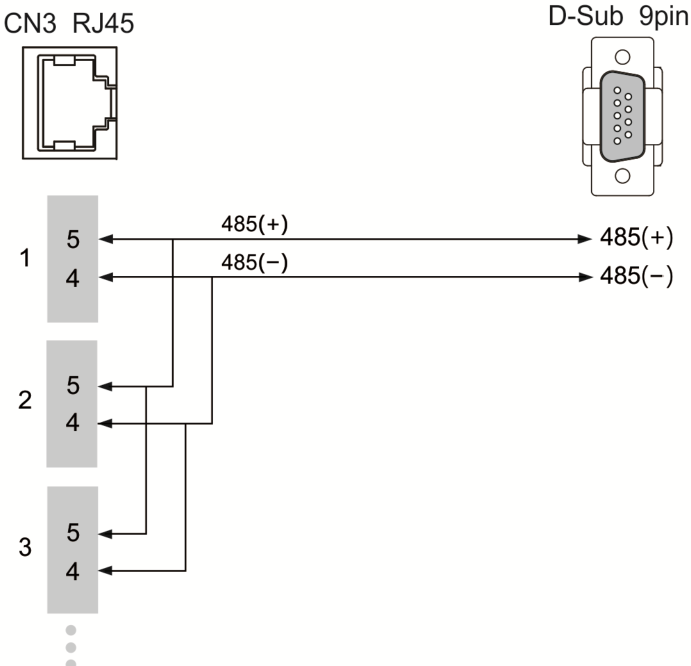
This chapter describes the MODBUS communication which you use for setting, reading and writing general parameters. For the motion control network, please refer to the related DMCNET, CANopen and EtherCAT documentation. The details of ASCII, RTU and TCP modes are also provided in this chapter.

9

9.1 RS-485 communication interface (hardware)

The ASDA-A3 series servo drive supports RS-485 serial communication that you can use to access and change the parameters of the servo system. See the following description of the wiring:





Note:

1. The cable length can be up to 100 meters when the servo drive is installed in a quiet environment. If the transmission speed is over 38400 bps, however, a 15 meter cable is recommended to ensure data transmission accuracy.
2. The numbers on the above figure represent the pin number of each connector.
3. Please use 12 V_{DC} for the power supply.
4. When using RS-485 communication, you may connect up to 32 servo drives. You can install a repeater to connect more servo drives (the maximum is 127).
5. Please refer to Chapter 3, Wiring for CN3 pin assignment.

9.2 RS-485 communication parameter settings

The required parameters for a single servo drive connection are: P3.000 (Address setting), P3.001 (Transmission speed) and P3.002 (Communication protocol). P3.003 (Communication error disposal), P3.004 (Communication timeout setting), P3.006 (Digital input (DI) control switch) and P3.007 (Communication delay time) are optional settings.

Please refer to Chapter 8 for detailed descriptions of the relevant parameters.

Parameter	Function
P3.000	Address setting
P3.001	Transmission speed
P3.002	Communication protocol

9.3 MODBUS communication protocol

There are two modes of MODBUS network communication: ASCII (American Standard Code for Information Interchange) and RTU (Remote Terminal Unit). You can set both communication protocols (ASCII and RTU) with the P3.002 parameter. The ASDA-A3 servo drive also supports these functions: accessing data (03H), writing one character (06H) and writing multiple characters (10H). Please refer to the following descriptions.

Code Description

ASCII mode:

In ASCII mode, data is transmitted in ASCII (American Standard Code for Information Interchange) format. For instance, when transmitting “64H” between two stations (master and slave), the master sends 36H to represent “6” and 34H to represent “4”.

The ASCII codes for the digits 0 to 9 and the characters A to F are as follows:

Character	‘0’	‘1’	‘2’	‘3’	‘4’	‘5’	‘6’	‘7’
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H
Character	‘8’	‘9’	‘A’	‘B’	‘C’	‘D’	‘E’	‘F’
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

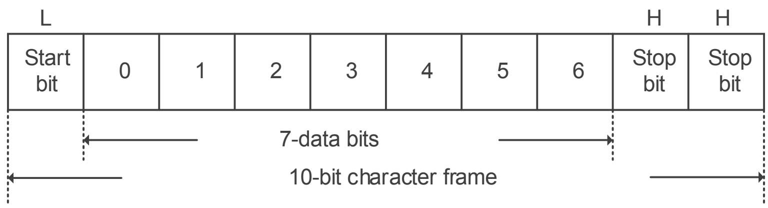
RTU mode:

Every 8-bit data frame consists of two 4-bit characters (hexadecimal). For example, if “64H” is transmitted between two stations using RTU, it is transmitted directly, which is more efficient than ASCII mode.

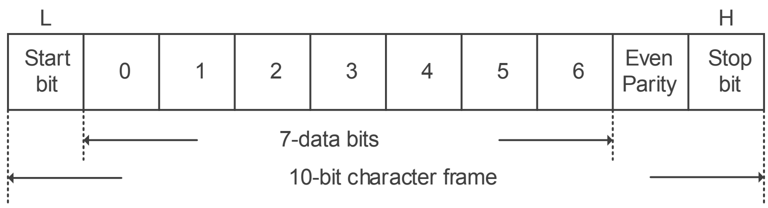
Characters are encoded into the frames and transmitted in series. The method for checking each type of frame is as follows.

10-bit character frame (for 7-bit character)

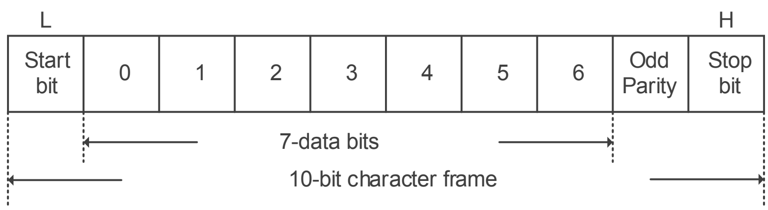
7N2



7E1

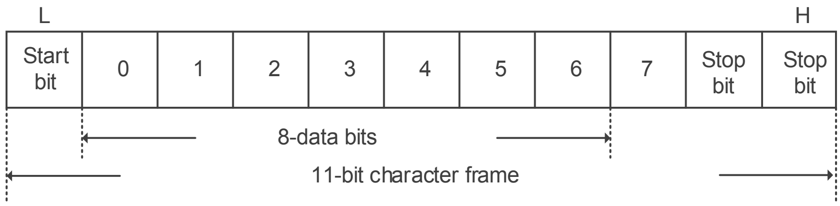


7O1

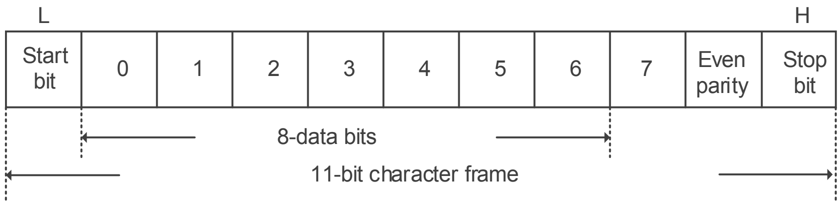


11-bit character frame (for 8-bit character)

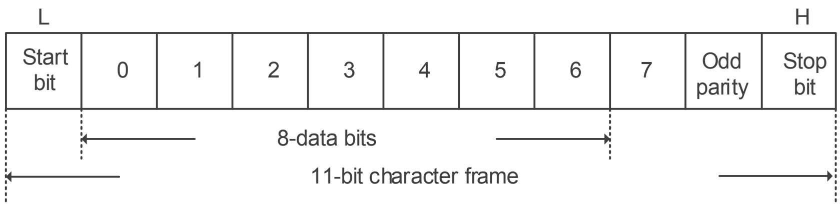
8N2



8E1



8O1



9

Communication data structure

Definitions for the data frames in the two modes are as follows:

ASCII mode:

Start	Start character ":" (3AH)
Slave Address	Communication address: 1 byte consists of 2 ASCII codes
Function	Function code: 1 byte consists of 2 ASCII codes
Data (n-1)	Data content: n word = 2n-byte consists of n x 4 ASCII codes, n ≤ 10
…….	
Data (0)	
LRC	Error check: 1 byte consists of 2 ASCII codes
End 1	End code 1: (0DH) (CR)
End 0	End code 0: (0AH) (LF)

The start character in ASCII communication mode is the colon ":" (ASCII code: 3AH). The ADR is two characters in ASCII code. The end code is CR (Carriage Return) and LF (Line Feed). The codes for data such as communication address, function code, data content and error checking (LRC: Longitudinal Redundancy Check)), are between the start character and the end code.

RTU mode:

Start	A silent interval of more than 10 ms
Slave Address	Communication address: 1 byte
Function	Function code: 1 byte
Data (n-1)	Data content: n-word = 2n-byte, n ≤ 10
…….	
Data (0)	
CRC	Error check: 1 byte
End 1	A silent interval of more than 10 ms

The start and end of the communication in RTU mode are silent intervals. The codes for data such as communication address, function code, data content and error checking code (CRC (Cyclical Redundancy Check)), are between the start interval and the end interval.

Example 1: function code 03H, accessing multiple words:

The master issues a command to the first slave and reads two continuous words starting from the start data address 0200H. In the response message from the slave, the content of the start data address 0200H is 00B1H, and the content of the second data address is 1F40H. The maximum allowable data in one single access is 10. The calculation of the LRC and CRC codes is described below.

ASCII mode:

Command Message (Master):

Start	‘:’
Slave Address	‘0’
	‘1’
Function	‘0’
	‘3’
Start Data Address	‘0’
	‘2’
	‘0’
	‘0’
Data Number (Word)	‘0’
	‘0’
	‘0’
	‘2’
LRC Check	‘F’
	‘8’
End 1	(0DH) (CR)
End 0	(0AH) (LF)

Response Message (Slave):

Start	‘:’
Slave Address	‘0’
	‘1’
Function	‘0’
	‘3’
Data Number (In byte)	‘0’
	‘4'
Content of Start Data Address 0200H	‘0’
	‘0’
	‘B’
	‘1’
Content of Second Data Address 0201H	‘1’
	‘F’
	‘4’
	‘0’
LRC Check	‘E’
	‘8’
End 1	(0DH) (CR)
End 0	(0AH) (LF)

RTU mode:

Command Message (Master):

Slave Address	01H
Function	03H
Start Data Address	02H (High)
	00H (Low)
Data Number (In word)	00H
	02H
CRC Check Low	C5H (Low)
CRC Check High	B3H (High)

Response Message (Slave):

Slave Address	01H
Function	03H
Data Number (In byte)	04H
Content of Start Data Address 0200H	00H (High)
	B1H (Low)
Content of Second Data Address 0201H	1FH (High)
	40H (Low)
CRC Check Low	A3H (Low)
CRC Check High	D4H (High)

Note: A silent interval of 10 ms is required before and after each transmission in RTU mode.

Example 2: function code 06H, writing single word:

The master issues a command to the first slave and writes data 0064H to address 0200H. The slave sends a response message to the master after writing is completed. The calculation of LRC and CRC is described below.

ASCII mode:

Command Message (Master):

Start	‘:’
Slave Address	‘0’
	‘1’
Function	‘0’
	‘6’
Start Data Address	‘0’
	‘2’
	‘0’
	‘0’
Data Content	‘0’
	‘0’
	‘6’
	‘4’
LRC Check	‘9’
	‘3’
End 1	(0DH) (CR)
End 0	(0AH) (LF)

Response Message (Slave):

Start	‘:’
Slave Address	‘0’
	‘1’
Function	‘0’
	‘6’
Start Data Address	‘0’
	‘2'
	‘0’
	‘0’
Data Content	‘0’
	‘0’
	‘6’
	‘4’
LRC Check	‘9’
	‘3’
End 1	(0DH) (CR)
End 0	(0AH) (LF)

RTU mode:

Command Message (Master):

Address	01H
Slave Function	06H
Start Data Address	02H (High)
	00H (Low)
Data Content	00H (High)
	64H (Low)
CRC Check Low	89H (Low)
CRC Check High	99H (High)

Response Message (Slave):

Address	01H
Slave Function	06H
Start Data Address	02H (High)
	00H (Low)
Data Content	00H (High)
	64H (Low)
CRC Check Low	89H (Low)
CRC Check High	99H (High)

Note: A silent interval of 10 ms is required before and after each transmission in RTU mode.

Example 3: function code 10H, writing multiple words:

The master issues a command to the 1st slave and writes data 0BB8H and 0000H to the start data address 0112H. In other words, 0BB8H is written into 0112H and 0000H is written into 0113H. The maximum allowable data in one single access is 8. The slave sends a response message to the master after the writing is completed. The calculation of LRC and CRC is described below.

9

ASCII mode:

Command Message (Master):

Start	‘:’
Slave Address	‘0’
	‘1’
Function	‘1’
	‘0’
Start Data Address	‘0’
	‘1’
	‘1’
	‘2’
Data Number (In words)	‘0’
	‘0’
	‘0’
	‘2’
Data Number (In bytes)	‘0’
	‘4’
Content of the 1st Data Frame	‘0’
	‘B’
	‘B’
	‘8’
Content of the 2nd Data Frame	‘0’
	‘0’
	‘0’
	‘0’
LRC Check	‘1’
	‘3’
End 1	(0DH) (CR)
End 0	(0AH) (LF)

Response Message (Slave):

Start	‘:’
Slave Address	‘0’
	‘1’
Function	‘1’
	‘0’
Start Data Address	‘0’
	‘1’
	‘1’
	‘2’
Data Number	‘0’
	‘0’
	‘0’
	‘2’
LRC Check	‘D’
	‘A’
End 1	(0DH) (CR)
End 0	(0AH) (LF)

9

RTU mode:

Command Message (Master):

Slave Address		01H
Function		10H
Start Data Address		01H (High)
		12H (Low)
Data Number (In words)		00H (High)
		02H (Low)
Data Number (In bytes)		04H
Content of the 1st Data Frame		0BH (High)
		B8H (Low)
Content of the 2nd Data Frame		00H (High)
		00H (Low)
CRC Check Low		FCH (Low)
CRC Check High		EBH (High)

Response Message (Slave):

Slave Address	01H
Function	10H
Start Data Address	01H (High)
	12H (Low)
Data Number (In words)	00H (High)
	02H (Low)
CRC Check Low	E0H (Low)
CRC Check High	31H (High)

Note: A silent interval of 10 ms is required before and after transmission in RTU mode.

LRC and CRC transmission error check

The error check in ASCII mode is LRC (Longitudinal Redundancy Check). In RTU mode, it is CRC (Cyclical Redundancy Check). See the details below.

LRC (ASCII mode):

Start	‘:’
Slave Address	‘7’
	‘F’
Function	‘0’
	‘3’
Start Data Address	‘0’
	‘5’
	‘C’
	‘4’
Data Number	‘0’
	‘0’
	‘0’
	‘1’
LRC Check	‘B’
	‘4’
End 1	(0DH) (CR)
End 0	(0AH) (LF)

To calculate the LRC: add all the bytes, round down the carry and take the two’s complement. For example:

7FH + 03H + 05H + C4H + 00H + 01H = 14CH, round down the carry 1 and take 4CH.

The two’s complement of 4CH is B4H.

9

CRC (RTU mode):

To calculate the CRC value:

Step 1: Load a 16-bit register of FFFFH, which is called the “CRC” register.

Step 2: (The low byte of the CRC register) XOR (The first byte of the command), and save the result in CRC register.

Step 3: Check the least significant bit (LSB) of the CRC register. If the bit is 0, right move one bit; If the bit is 1, then right move one bit and (CRC register) XOR (A001H). Repeat this step 8 times.

Step 4: Repeat the procedure from step 2 and step 3 until all bytes have been processed. The content of the CRC register is the CRC value.

After calculating the CRC value, fill in the low word of the CRC value in the command message, and then the high word. For example, if the result of CRC calculation is 3794H, put 94H in the low word and put 37H in the high word as shown below:

ARD	01H
CMD	03H
Start Data Address	01H (High)
	01H (Low)
Data Number (In words)	00H (High)
	02H (Low)
CRC Check Low	94H (Low)
CRC Check High	37H (High)

9

CRC program example:

This function calculates the CRC value in the C language. It needs two parameters:

```
unsigned char* data;
unsigned char length
// The function returns the CRC value as a type of unsigned integer.
unsigned int crc_chk(unsigned char* data, unsigned char length) {
     int j;
     unsigned int reg_crc=0xFFFF;

     while( length-- ) {
          reg_crc^= *data++;
          for (j=0; j<8; j++ ) {
               if( reg_crc & 0x01 ) { /*LSB(bit 0 ) = 1 */
                    reg_crc = (reg_crc >> 1)^0xA001;
               } else {
                    reg_crc = (reg_crc >> 1);
               }
          }
     }
     return reg_crc;
}
```

Example of a PC communication program:

```
#include<stdio.h>
#include<dos.h>
#include<conio.h>
#include<process.h>
#define PORT 0x03F8     /*  the address of COM 1  */
#define THR 0x0000
#define RDR 0x0000
#define BRDL 0x0000
#define IER 0x0001
#define BRDH 0x0001
#define LCR 0x0003
#define MCR 0x0004
#define LSR 0x0005
#define MSR 0x0006
unsigned char rdat[60];
/* read 2 data from address 0200H of ASD with address 1 */
unsigned char
tdat[60]={':','0','1','0','3','0','2','0','0','0','0','0','2','F','8','\r','\n'};
void main() {
int I;
outportb(PORT+MCR,0x08);          /*  interrupt enable  */
outportb(PORT+IER,0x01);               /*  interrupt as data in  */
outportb(PORT+LCR,( inportb(PORT+LCR) | 0x80 ) );
/*  the BRDL/BRDH can be access as LCR.b7 == 1  */
outportb(PORT+BRDL,12);
```

9

```
outportb(PORT+BRDH,0x00);
outportb(PORT+LCR,0x06);          /* set prorocol
                                       <7,E,1> = 1AH,     <7,O,1> = 0AH
                                       <8,N,2> = 07H      <8,E,1> = 1BH
                                       <8,O,1> = 0BH                        */

for( I = 0; I<=16; I++ ) {
     while( !(inportb(PORT+LSR) & 0x20) );  /*  wait until THR empty  */
     outportb(PORT+THR,tdat[I]);            /*  send data to THR  */
}
I = 0;
while( !kbhit() ) {
     if( inportb(PORT+LSR)&0x01 ) {  /*  b0==1, read data ready  */
          rdat[I++] = inportb(PORT+RDR); /*   read data from RDR  */
     }
}
}
```

9.4 Setting and accessing communication parameters

Please refer to Chapter 8 for the descriptions of the parameters that you can write or read through the communication interface.

The ASDA-A3 servo drive parameters are divided into eight groups: Group 0 (Monitoring parameters), Group 1 (Basic parameters), Group 2 (Extension parameters), Group 3 (Communication parameters), Group 4 (Diagnosis parameters), Group 5 (Motion control parameters) and Group 6 and Group 7 (PR parameters).

Setting parameters through communication:

You can set parameters through communication:

Group 0, except (P0.000 ~ P0.001), (P0.008 ~ P0.013) and (P0.046).

Group 1

Group 2

Group 3

Group 4, except (P4.000 ~ P4.004) and (P4.008 ~ P4.009).

Group 5, except (P5.010), (P5.016) and (P5.076).

Group 6

Group 7

Please note the following additional details:

P3.001: when changing to a new communication speed, the next data is written in the new transmission speed after the new speed is set.

P3.002: when changing to a new communication protocol, the next data is written with the new communication protocol after the new protocol is set.

P4.005: JOG control parameters. Please refer to Chapter 8 for detailed descriptions.

P4.006: Force Digital Output (DO) contact control. You can use this parameter to test the DO contact. Set P4.006 to 1, 2, 4, 8, 16, and 32 to test DO1, DO2, DO3, DO4, DO5 and DO6 respectively. Then, set P4.006 to 0 to complete the test.

P4.010: Calibration functions. First set P2.008 to 20 (14H in hexadecimal format) to enable this function.

P4.011 ~ P4.021: these parameters are for adjusting the hardware offset. The parameters were adjusted before delivery, so changing these parameters is not recommended. If it is necessary, set P2.008 to 22 (16H in hexadecimal format) first.

Accessing parameters through communication:

You can read the values from parameters through communication: Group 0 ~ Group 7.

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Absolute System 10

This chapter introduces the absolute servo system, including the wiring and installation of the absolute encoder, the steps to set up the system, and the procedures for initializing and operating the system for the first time.

Note

A complete absolute servo system includes an ASDA-A3 servo drive, an absolute motor, and a backup battery box. The backup battery supplies power to the system so that the encoder continues to operate even when the power is off. In addition, the absolute encoder can continuously record the motor's actual position at any time, even when the motor shaft is rotated after the power is off. The absolute servo system must be used only with an absolute motor. If the servo is set up with other types of motors and the system is enabled, AL069 occurs.

When using an absolute motor connected to power, the motor speed should not exceed 250 rpm. When operating with the battery, make sure the maximum speed does not exceed 200 rpm.

To determine whether your motor is an absolute type, check the model name as shown below:

ECM-A3 series servo motor

ECM－A3 □－□ Y □□□□□□□

Y: Absolute motor

ECMC series servo motor

ECMA - □ W □□□□□□

W: Absolute motor

Install the battery properly with the encoder cable. One servo drive uses one single battery box; two servo drives can share one double battery box. Please use Delta's encoder cable to connect to the battery box. See the following section for the specifications of the battery box and its accessories.

10.1 Battery box (absolute type) and wiring

10.1.1 Specifications

Precautions

Please carefully read through the following safety precautions. Use batteries only in accordance with the specifications so as to avoid damage or dangerous conditions.

WARNING

- The installation location must be free of all water, corrosive and inflammable gas.
- Correctly place the battery into the battery box to avoid short circuiting.
- Do not short circuit the positive and negative electrodes of the battery, and do not install the battery in reverse direction.
- Only use new batteries to avoid losing power or shortening the life of the batteries.
- Please follow the instructions when wiring the battery box to avoid dangerous conditions.

STOP

- Do not place the battery in a high-temperature environment over 100°C, as this may cause a fire or an explosion.
- The batteries are non-rechargeable. Do not charge the batteries as this might result in an explosion.
- Do not directly weld on the surface of the battery.

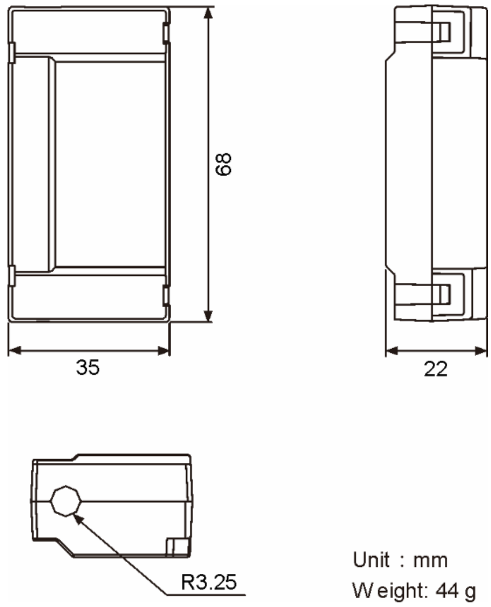
Battery specifications

Item	Li/SOCl2 Cylindrical Battery
Type	ER14505
Delta part number	ASD-CLBT0100
International standard size	AA
Standard voltage	3.6V
Standard capacity	2700 mAh
Maximum continuous discharge current	100 mA
Maximum pulse current	200 mA
Dimensions (D x H)	14.5 x 50.5 mm
Weight	Approx. 19 g
Operating temperature	-40 to +85°C

10.1.2 Battery box dimensions

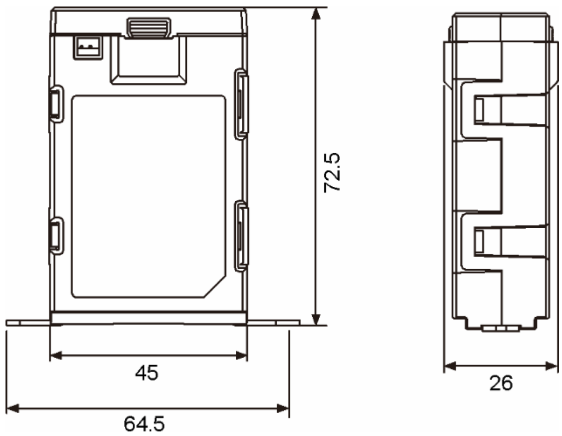
Single battery box

Delta part number: ASD-MDBT0100



Double battery box

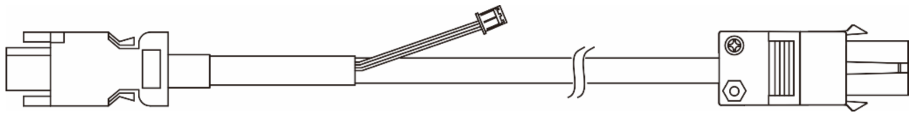
Delta part number: ASD-MDBT0200



10.1.3 Connection cable for the absolute encoder

A. Quick connector

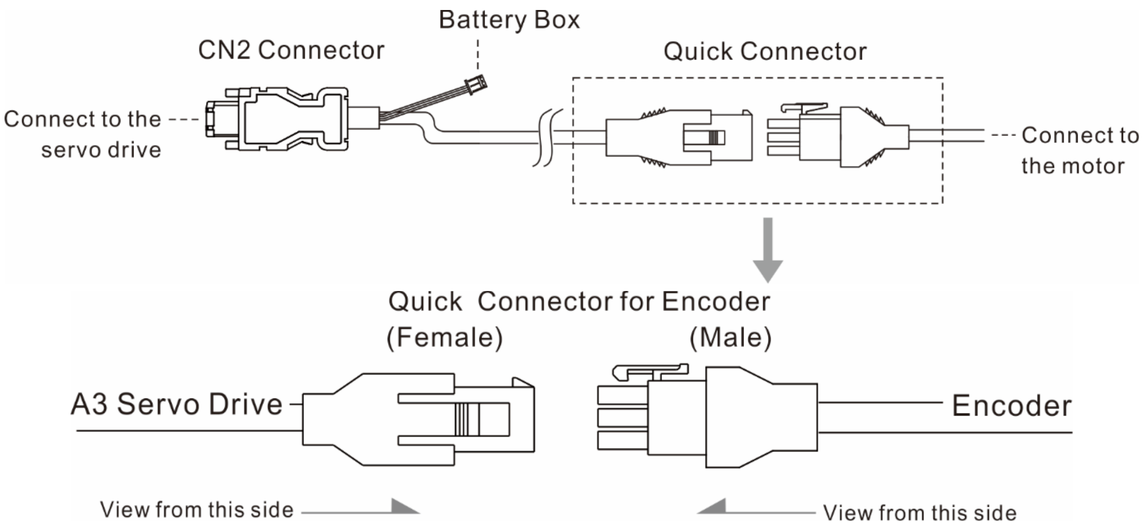
Delta part number: ACS3-CAEA1003, ACS3-CAEA1005



Title	Model name	L	
		mm	inch
1	ACS3-CAEA1003	3000 ± 100	118 ± 4
2	ACS3-CAEA1005	5000 ± 100	197 ± 4

Connection method:

Note Please follow the instructions below when connecting the cable. Incorrect wiring may result in an explosion.



1 White T+	2 Red BAT+	3 Reserved
4 White / Red T-	5 Black BAT-	6 Reserved
7 Brown +5 V_{DC}	8 Black / Black & White GND	9 Shield

3 Reserved	2 Orange BAT+	1 White T+
6 Reserved	5 Gray BAT-	4 White / Red T-
9 Shield	8 Blue GND	7 Brown +5 V_{DC}

The colors of the servo drive wires are for reference only. Please refer to the actual servo drive.

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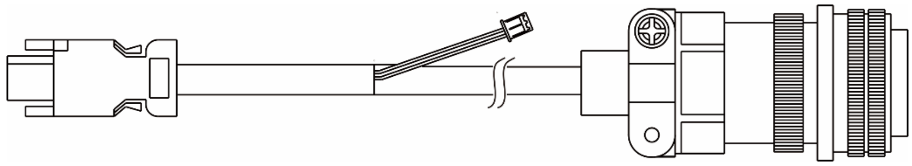
B. Military connector

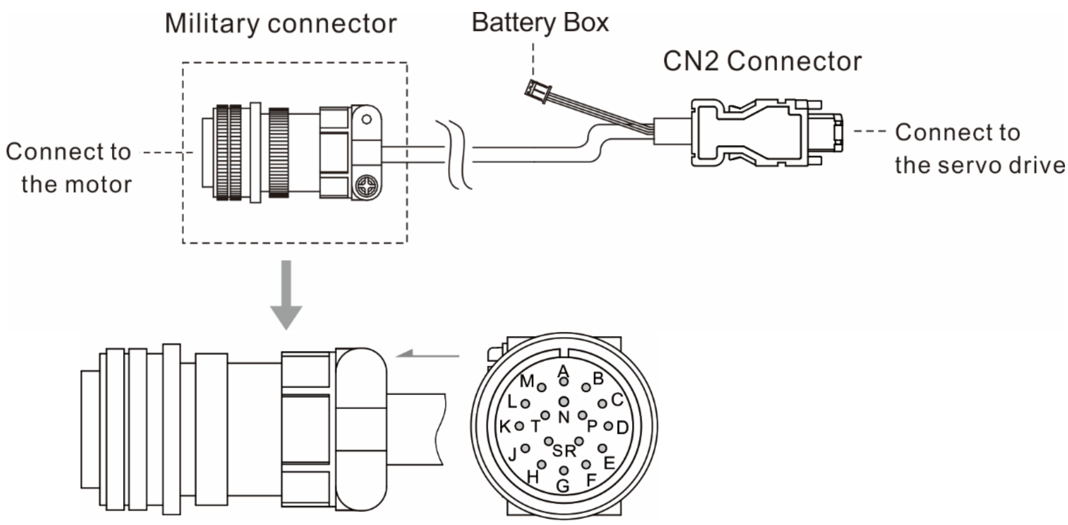
Delta part number: ACS3-CAEA3003, ACS3-CAEA3005



Title	Model name	L	
		mm	inch
1	ACS3-CAEA3003	3000 ± 100	118 ± 4
2	ACS3-CAEA3005	5000 ± 100	197 ± 4

Connection method:

Note Please follow the instructions below when connecting the cable. Incorrect wiring may result in an explosion.

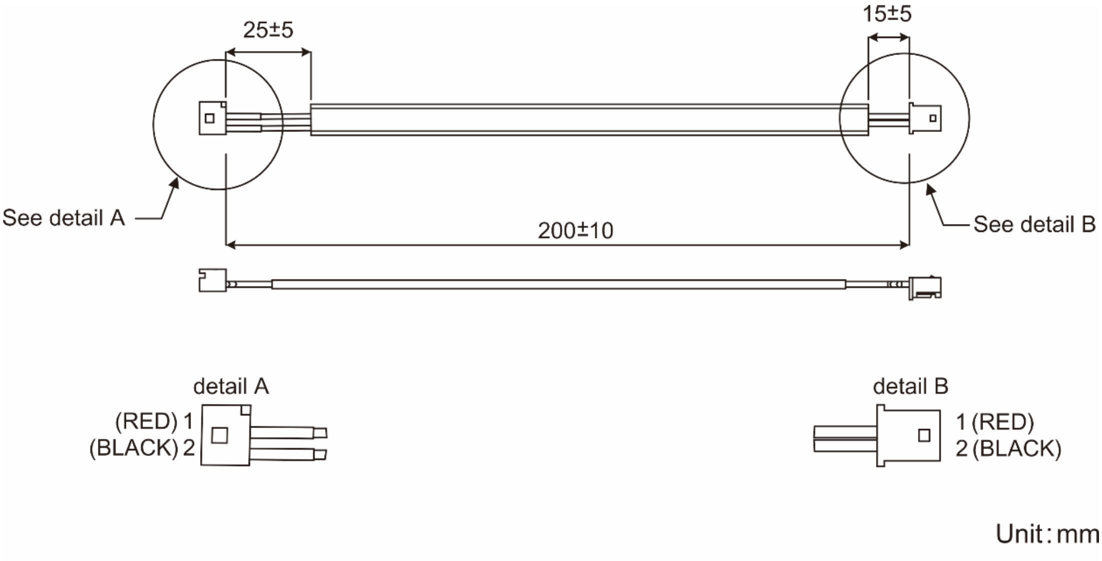


Pin No.	Terminal	Color
A	T+	White
B	T -	White / Red
C	BAT+	Red
D	BAT-	Black
S	+5 V_{DC}	Brown
R	GND	Blue
L	BRAID SHIELD	–

10.1.4 Battery box cable

Battery box cable AW (Battery connection cable to the encoder; Unit: mm)

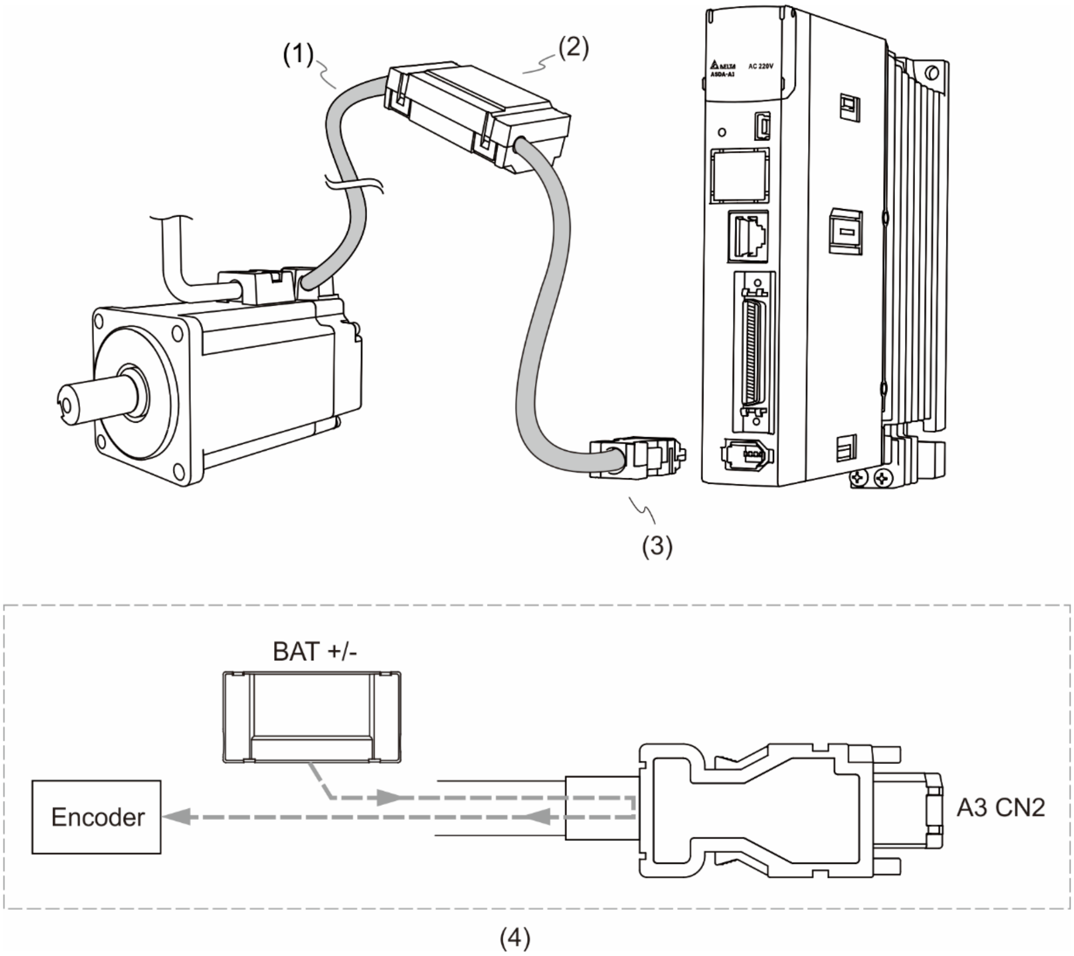
Delta part number: 3864573700



10.2 Installation

10.2.1 Installing the battery box in the servo system

Single battery box (standard wiring)



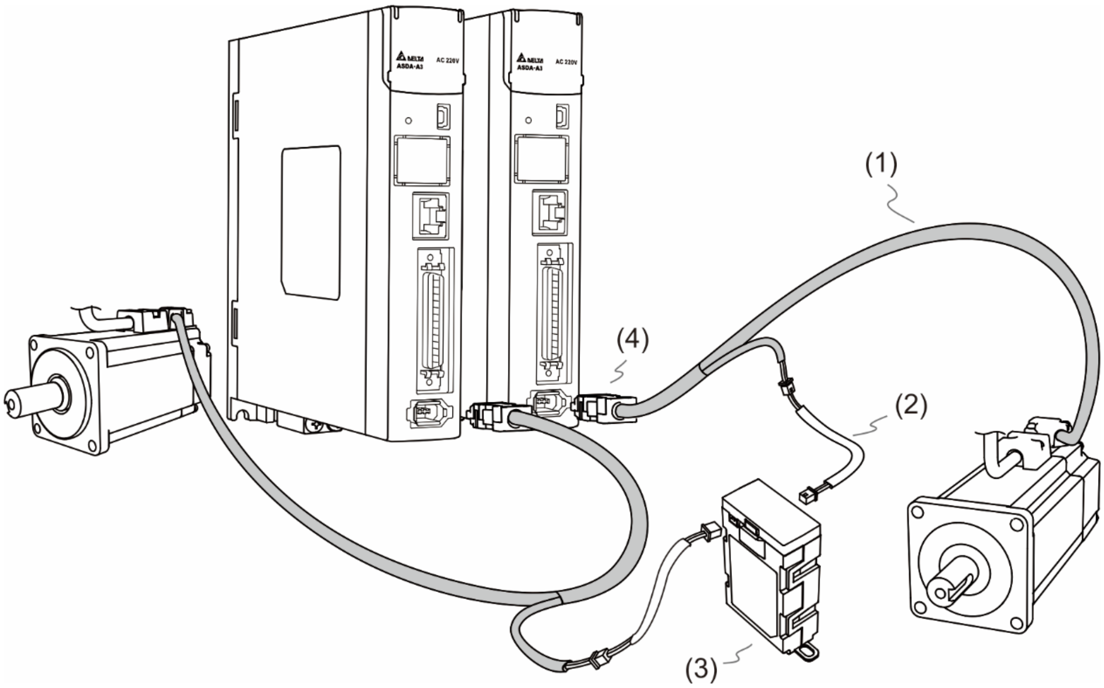
(1) Encoder cable; (2) Single battery box (absolute type); (3) CN2 connector; (4) Battery box wiring

Pin assignment of CN2:

The end that connects to the encoder			The end that connects to the servo drive		
Military connector	Quick connector	Color	Pin No.	Symbol	Description
A	1	White	5	T+	Serial communication signal (+)
B	4	White / Red	6	T-	Serial communication signal (-)
S	7	Brown	1	+5V	Power +5V
R	8	Blue	2	GND	Power ground
L	9	-	Case	Shielding	Shielding

Note: when using an absolute encoder, the battery supplies power directly to the encoder. Thus, wiring the CN2 connector to the servo drive is not required. Please refer to the wiring description in Section 3.1.5 Specifications of encoder connector for details.

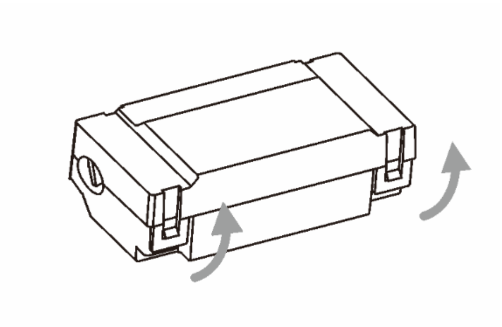
Double battery box (connects to CN2)



(1) Encoder cable; (2) Battery box cable AW; (3) Double battery box (absolute type); (4) CN2 connector

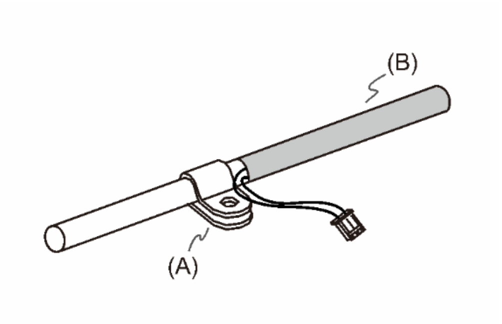
10.2.2 Installing and replacing a battery

Single battery box



Step 1:

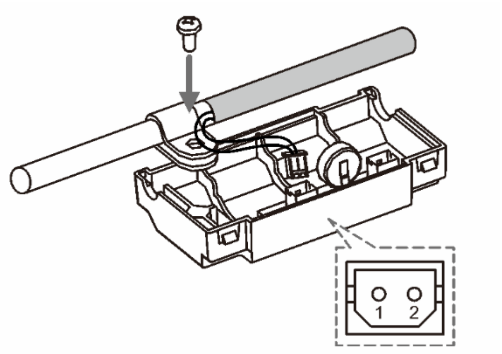
Loosen the hooks on both sides to open the lid of the battery box.



Step 2:

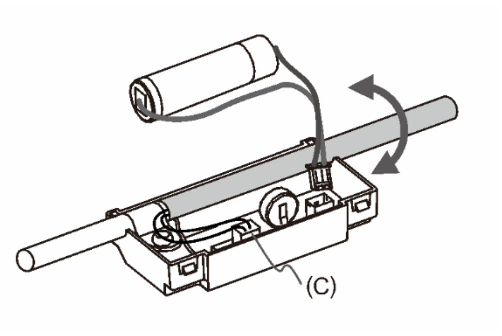
Attach the metal clip to the connection cable. Please note that the metal clip should be placed close to the heat shrink.

(A) Metal clip; (B) Heat shrink



Step 3:

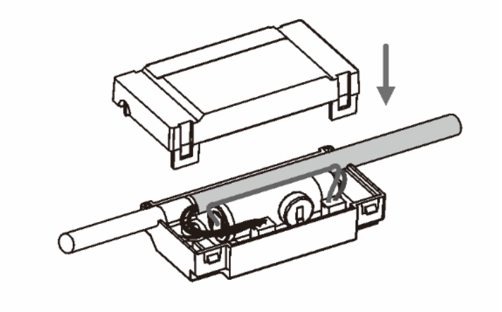
Plug in the connection cable and tighten the screw.



Step 4:

Install a new battery and connect it to the cable.

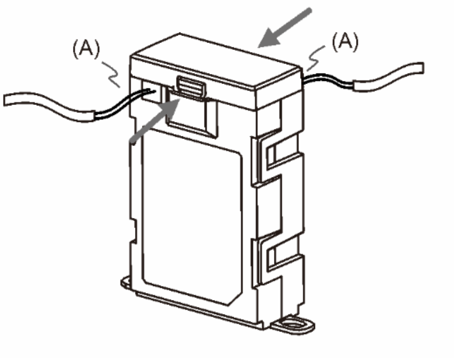
(C) Please replace the battery only when the main power to the servo drive is still on. Do not remove the power cable, or else the system might lose data.



Step 5:

Place the cable into the box and close the lid.

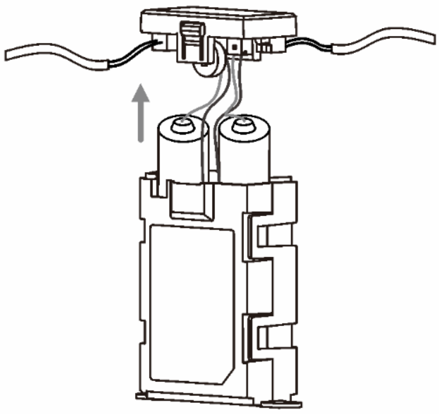
Double battery box



Step 1:

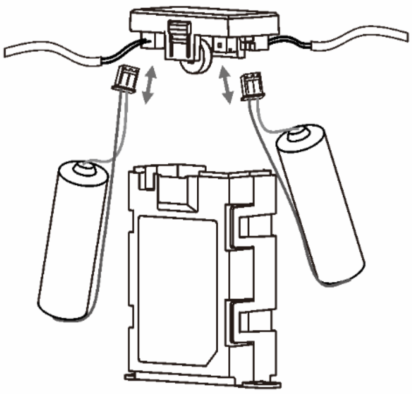
Loosen the hooks on both sides to open the lid of the battery box.

(A) Please replace the batteries only when the main power to the servo drive is on. Do not remove the power cables, or else the system might lose data.



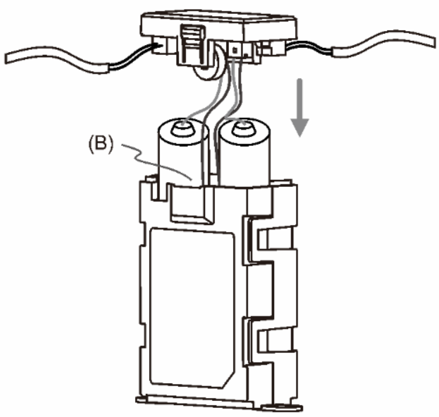
Step 2:

Lift the cover and pull out the batteries.



Step 3:

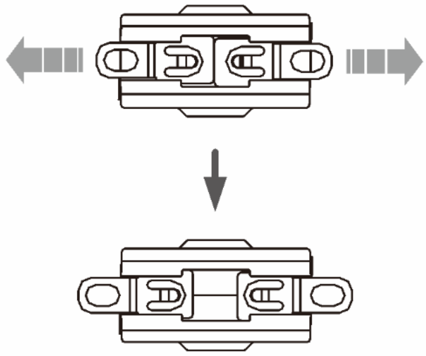
Disconnect the connectors and remove the old batteries. Replace them with the new batteries and reconnect the battery cables. Replace the new batteries within ten minutes to avoid data loss.



Step 4:

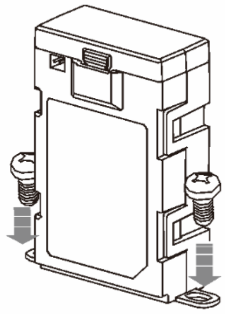
Close the lid.

(B) Place the cables toward the inside of the box so that the batteries both fit inside the box.



Step 5:

Pull the clips at the bottom of the battery box outwards.



Step 6:

Tighten the screws to secure the battery box.

Note: to avoid data loss, please replace the battery when any of the following circumstances occurs:

1. The servo drive shows alarm AL061, which means the voltage is too low. Please refer to Chapter 11 for more information. 2. You can use P0.002 (monitoring variable 26H) to check the battery power. When it displays 31, it means the voltage is under 3.1V. When the voltage is under 2.7V, the motor’s position record might be lost if the drive operates under battery power, so you should perform the homing procedure after installing a new battery. You should replace the battery when the main power is connected to the servo drive.

10.3 System initialization and operating procedures

10.3.1 System initialization

After the servo system resumes operation, the host controller can acquire the motor's current absolute position either with communication (such as RS-485) or DI/DO. Delta's absolute system provides two types of position value for the host controller: pulse and PUU.

AL060 occurs when you initialize the absolute system for the first time because the coordinate system has not been created. Clear the alarm by setting up the coordinate system. Insufficient battery power or the failure of the main power supply also causes loss of the coordinate system and the re-occurrence of AL060. In the absolute system, when the number of motor rotations exceeds the range -32768 to 32767, AL062 occurs. When the PUU position value goes outside the range -2147483648 to 2147483647, AL289 occurs.

Except for the alarms mentioned above, you can use P2.070 to set up Delta's absolute servo system. You can choose not to show AL062 and AL289 if the absolute coordinate system overflows when the number of rotations exceeds the range -32768 to 32767 or when the PUU exceeds the range -2147483648 to 2147483647. For example, you might do this on a system that uses incremental commands to operate in a single direction.

P2.070 setting:

1. Initialize the absolute coordinates. When the coordinate setting is complete, AL06A (or AL060) is automatically cleared. There are two ways for you to initialize the host controller coordinates: DI (please refer to Section 10.3.4) or setting parameters (please refer to Section 10.3.5).
2. When the system is powered on again, you can access the host controller's absolute position either with DI/DO (please refer to Section 10.3.6) or with direct communication (please refer to Section 9.2.6). Based on the setting of P2.070, the host controller can select the requested value, either the PUU (please refer to Section 10.3.3) or the pulse value of 16777216, within a single turn (please refer to Section 10.3.2).

10.3.2 Pulse number

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When the motor is running in the clockwise direction, the cycle number is expressed as a negative value. When the motor runs in the counterclockwise direction, the cycle number is expressed as a positive value. The range of the number of rotations is between -32768 and +32767, and AL062 occurs once the number exceeds the range. To clear the alarm, you must re-initialize the coordinate system. If P2.070 has been set to ignore the AL062 alarm, then the system shows no error. If the system is operating in the counterclockwise direction and it reaches 32,767 turns, the value jumps to -32768 once it reaches the target position in the next cycle, and the value keeps increasing to -32768, -32767, -32766, and so on. When the system is operating in the clockwise direction, the value jumps to 32767 in the next cycle after reaching -32768.

In addition to the cycle counter, there are 16,777,216 pulses (0 – 16777215) in one rotation. Please pay attention to the motor's running direction. You can read the cycle number and the pulse number either with communication or DI/DO. Pulse number = m (cycle number) x 16777216 + pulse number (0 – 16777215). The conversions between pulse number and PUU are as follows:

When the rotation direction is defined as CCW in P1.001, then the PUU number = pulse number × $\frac{\mathbf{P1.045}}{\mathbf{P1.044}}$ + P6.001.

When the rotation direction is defined as CW in P1.001, then the PUU number = (-1) × pulse number × $\frac{\mathrm{P1.045}}{\mathrm{P1.044}}$ + P6.001.

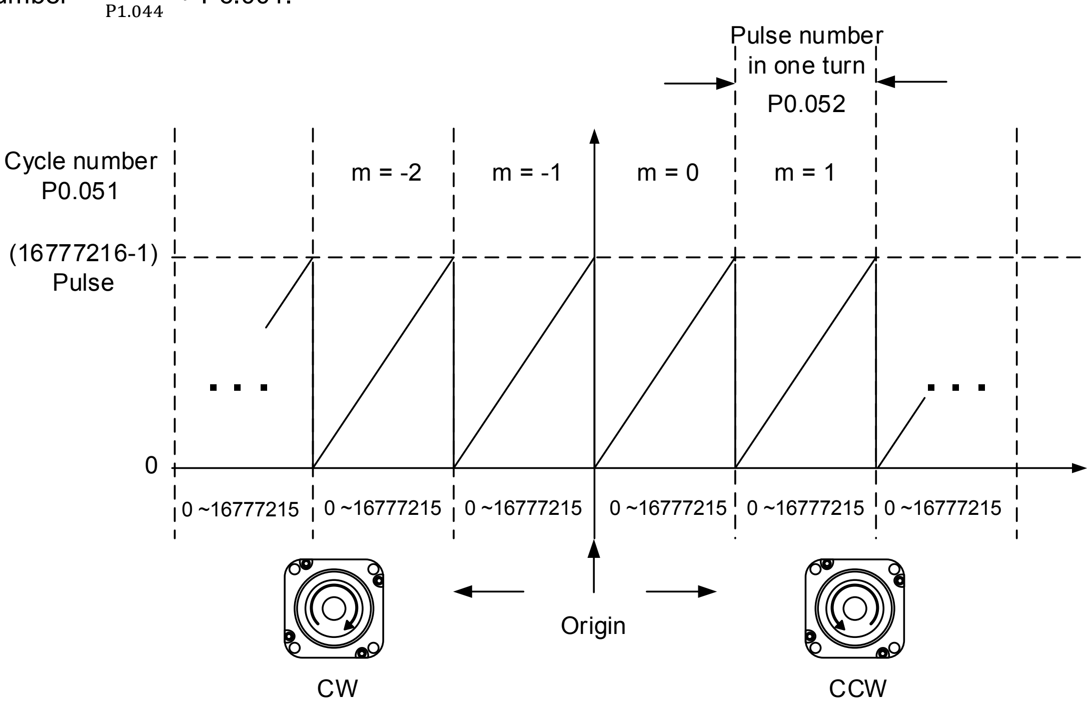


Figure 10.3.2.1 Absolute position for PUU number

10.3.3 PUU number

The PUU number is a 32-bit absolute value with positive and negative signs. When the motor is running in the forward direction, the PUU number increases; when it is running in the reverse direction, the PUU number decreases. The forward direction does not mean the motor is running clockwise; the direction is defined by P1.001.Z. The maximum range of the cycle number is -32768 to +32767. AL062 occurs when the number of cycles overflows the range. If the PUU number exceeds the range -2147483648 to 2147483647, the position counter overflows and AL289 occurs. Re-initialize the system to clear these alarms (AL062 or AL289). You can determine whether or not to show AL062 and AL289 when the position overflows through P2.070. When reaching the maximum PUU number in the forward direction, the value changes from 2147483647 to -2147483648, -2147483647, 2147483647, and so on. The value changes the other way when the motor operates in the reverse direction. See the following examples:

Example 1:

When P1.044 = 16777216 and P1.045 = 100000, the motor needs 100,000 PUU to run a cycle. 2,147,483,647 ÷ 100,000 ≒ 21,474.8, so once the motor runs over 21,474.8 (< 32,767) cycles in the forward direction, AL289 occurs.

Example 2:

When P1.044 = 16777216 and P1.045 = 10000, the motor needs 10,000 PUU to run a cycle. 2,147,483,647 ÷ 10,000 ≒ 214,748.3, so once the motor runs over 32,767 (< 214,748.3) cycles in the forward direction, AL062 occurs.

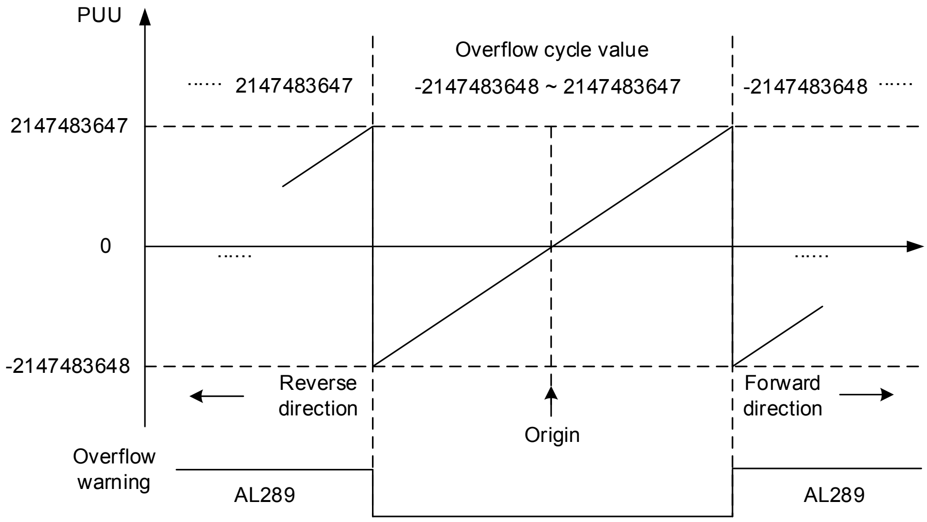


Figure 10.3.3.1 Absolute position for PUU number

Note: after initializing the absolute coordinate system, any change to P1.001.Z or E-Gear ratio (P1.044 and P1.045) changes the original setting of the absolute coordinate system. If the above parameters are changed, please re-initialize the coordinate system.

10

10.3.4 Initializing the absolute coordinates with DI/DO

When the servo system is controlled by the host controller, you can reset the absolute coordinate system with DI/DO. To initialize the coordinate system, set DI.ABSE to on and switch DI.ABSC from off to on. At that point, the pulse number is set to 0 and the PUU number is the value of P6.001. Please refer to the following diagram for detailed descriptions.

Note: (1), (2), and (3) represent the required delay time between triggering DI.ABSE and DI.ABSC to enable the function.

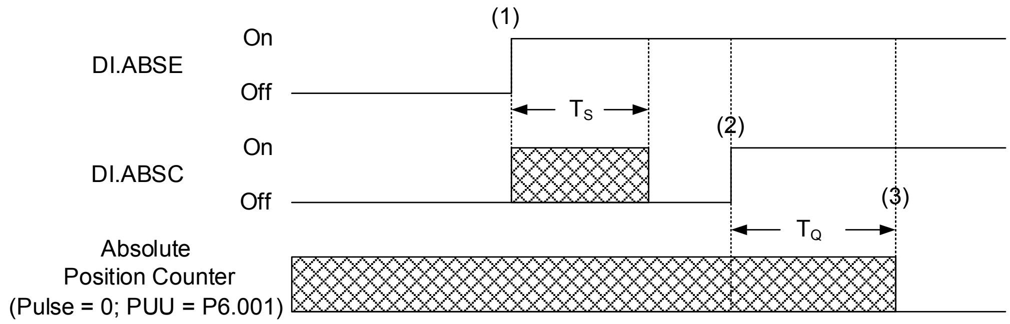


Figure 10.3.4.1 Timing diagram for initializing the absolute coordinate system with DI/DO

The following table describes the T_S and T_Q delay time after triggering DI.ABSE and DI. ABSC.

	$T_{S(ms)}$	$T_{Q(ms)}$
Min (T_S, T_Q)	Value of P2.009 + 2	
Max	P2.009 + 10	

Description:

1. When DI.ABSE turns on, it has to wait for T_S ms before proceeding to the next step.
2. After reaching T_S, the host controller starts to reset the coordinate system. When DI.ABSC turns on and remains on for T_Q ms, the pulse number is set to zero and the PUU number is set to the value of P6.001.

10.3.5 Initializing the absolute coordinates with parameters

Set P2.071 to 1 to initialize the coordinates through the panel or with communication. As soon as P2.071 is set to 1, the absolute coordinate system resets. Since the write-protect function of P2.071 is protected by P2.008, you must set P2.008 to 271 first. In other words, the sequence is: set P2.008 to 271, then set P2.071 to 1.

10.3.6 Reading the absolute position with DI/DO

10

Set P2.070 Bit 0 to 0 so that you can read the PUU number with DI/DO.

See the descriptions below:

Bit 79 – Bit 64	Bit 63 – Bit 32	Bit 31 – Bit 16	Bit 15 – Bit 0
Check Sum	Encoder PUU -2147483648 to +2147483647	0	Encoder status (P0.050)

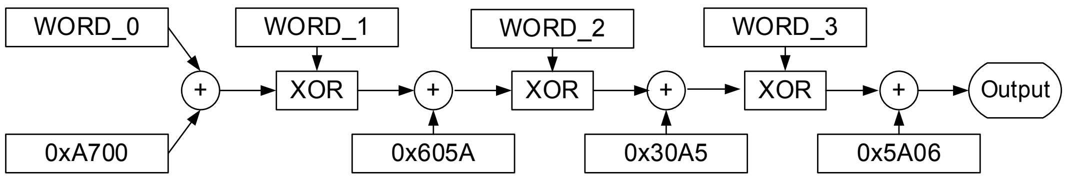
Set P2.070 Bit 0 to 1 so that you can read the pulse number with DI/DO.

See the descriptions below:

Bit 79 – Bit 64	Bit 63 – Bit 32	Bit 31 – Bit 16	Bit 15 – Bit 0
Check Sum	Pulse number in one rotation 0 to 16777215 (=16777216-1)	Encoder turn -32768 to +32767	Encoder status

Description:

Check Sum = (((((((WORD_0+0xA700) XOR WORD_1)+0x605A) XOR WORD_2)+0x30A5) XOR WORD_3)+0x5A06)



Note:

1. This algorithm has no positive or negative sign.
2. 0xA700, 0x605A, 0x30A5, and 0x5A06 are the constants for hexadecimal format.
3. WORD_0: encoder status (Bit 15 – 0)

   WORD_1: encoder turn (Bit 31 – 16)

   WORD_2: encoder pulse number (Bit 47 – 32)

   WORD_3: encoder pulse number (Bit 63 – 48)

10

You can read the pulse number or PUU number with DI/DO and P2.070.

See the timing diagram below:

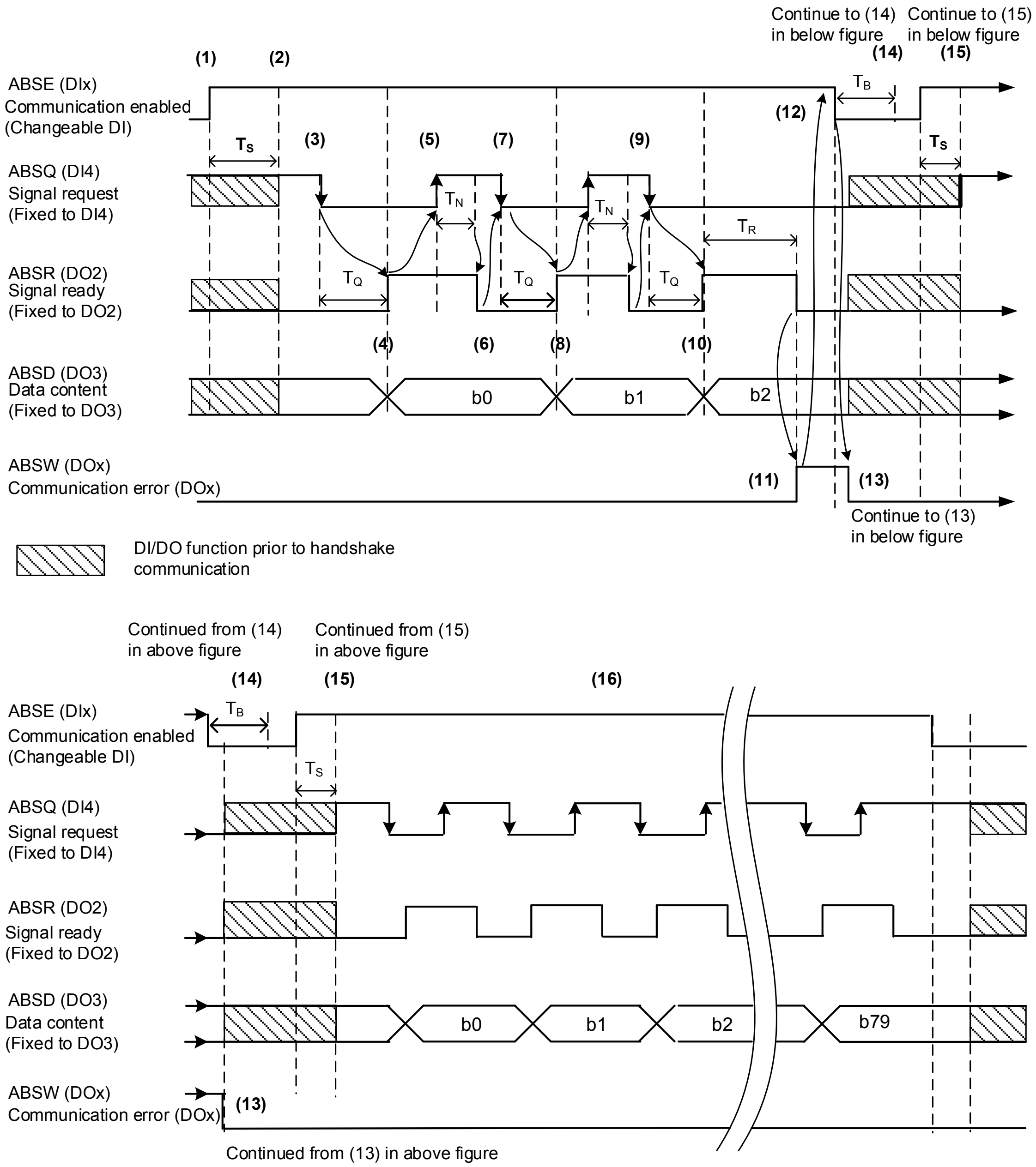


Figure 10.3.6.1 Timing diagram - use DI/DO to read the absolute position

The following table explains the delay time when reading the absolute position with DI/DO.

	$T_{R(ms)}$	$T_{S(ms)}$	$T_{Q(ms)}$	$T_{Nms)}$	$T_{B(ms)}$
Min	-	P2.009 + 2			
Max	200	P2.009 + 10			

Descriptions:

(1) When handshake communication starts, the ABSE signal is triggered.

(2) After the T_S delay time (make sure the signal is on), the functions for DI4, DO2, and DO3 are switched to ABSQ, ABSR, and ABSD, respectively. If DI4 was in the high-level state before, it remains in the high-level state when switched to ABSQ (logic high-level signal). DI4, DO2, and DO3 are dual-function DI/DO, which means DI4, DO2, and DO3 share the same DI with ABSQ, ABSR, and ABSD. Please pay special attention when switching functions or set the DI/DO to 0 to disable the dual-function of DI/DO.

(3) If DI4 is set to high and switched to ABSQ after the T_S delay time, when the host controller resets this signal to low, the new signal is interpreted as the data access command.

(4) After the T_Q time, the handshake data is ready and the absolute position is sent to ABSD. Now the servo drive turns on the ABSR signal, and the host controller can access the data. If the host controller still cannot detect the ABSR status while it is changing to high after the maximum T_Q time (refer to Figure 10.3.6.1), there may be a communication error.

(5) Once the ABSR signal is set high, the host controller accesses the data, and the ABSQ signal is set high to notify the servo drive that data was read.

(6) When ABSQ is high, the ABSR signal is set low after the T_N time in order to send the data for the next bit.

(7) When ABSR is low, ABSQ is also set low and the servo drive needs to send the data for the next bit.

(8) Repeat step (3) – (4). Send the absolute position to ABSD for the next bit communication.

(9) Repeat step (5) – (7). The host controller has read and received the data.

(10) The third bit data is ready.

(11) After the T_R waiting time, if the host controller has not read the data and turned on the ABSQ signal, the servo drive sends the ABSW signal (communication error) and stops the handshake communication.

(12) When the host controller receives the communication error signal, ABSE is set low and prepares to re-start the handshake communication.

(13) ABSW resumes at low after the servo drive receives the ABSE signal.

(14) The host controller resumes communication after T_B time.

(15) Repeat step (1).

(16) If no error occurs, the host controller completes 80 bits (0 – 79) of the handshake communication with the servo drive.DI4, DO2, and DO3 then resume their original functions.

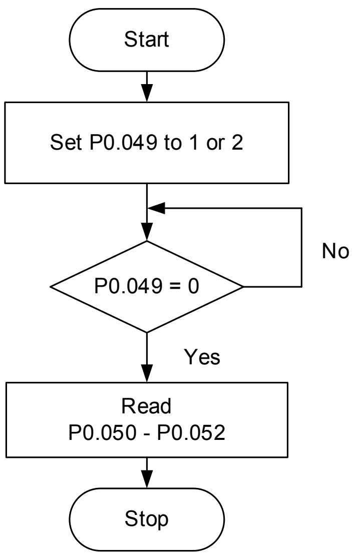
Note: if ABSE is set low first and then changed to high, but ABSW does not return to high, it means some other errors exist. Please check for the following possible warnings: absolute position lost, low battery voltage level, or absolute position overflows. Restart a new communication cycle after those errors have been cleared.

10.3.7 Reading the absolute position with communication

You can access the data of the absolute encoder through two communication methods: instant access or parameter access. Instant access refers to reading the motor's feedback position as soon as power is sent to the servo. When you set the status monitoring register 1 to the motor's feedback pulse number (P0.017 = 0), you can access the motor's current position by reading P0.009. Parameter access means the motor's position is temporarily stored in parameters. Once you set P0.049 with communication, the encoder's status, absolute position (cycle number), and pulse number (or PUU) are stored in P0.050, P0.051, and P0.052 respectively. You can choose to read the pulse number or PUU through P2.070 Bit 1. Even when the motor is stopped, it still moves slightly forward and backward. When you set P0.049 to 1, the encoder continues to read the exact position where the motor stops without changing anything else. On the other hand, when you set P0.049 to 2, the encoder updates the motor's current position on the servo drive, which clears the position error.

For example, the motor's current position is 20000, but it varies between 19999 and 20001. If you send the command to read the motor's position when it stops at 20001, the motor's position is updated to 20001. After all positions are updated in P0.050 – P0.052, P0.049 is automatically reset to 0. At that point, the controller can access the values of P0.050 – P0.052.

P0.050 shows the status of the absolute encoder. When it shows absolute position lost or overflow, that indicates that the absolute position is invalid. You must re-do the homing procedure and re-initialize the absolute coordinates.



10.4 List of absolute parameters, DI/DO, and alarms

Relevant parameters (please refer to Chapter 8 for detailed information):

Parameter	Function
P0.002	Drive status
P0.049	Update encoder absolute position
P0.050	Absolute coordinate system status
P0.051	Encoder absolute position - Multiple turns
P0.052	Encoder absolute position - Pulse number or PUU within single turn
P2.069	Absolute encoder
P2.070	Read data selection
P2.071	Absolute position homing

Relevant DI/DO (please refer to Chapter 8 for detailed information):

Value	DI name	Value	DO name
0x1D	ABSE	When DI.ABSE is on, ABSR is output by DO2, which is no longer configured by P2.019.	ABSR always output by DO2
When DI.ABSE is on, ABSQ is input by DI4, which is no longer configured by P2.013.	ABSQ always input by DI4	When DI.ABSE is on, ABSD is output by DO3, which is no longer configured by P2.012.	ABSD always output by DO3
0x1F	ABSC	0x0D	ABSW

Relevant alarms (please refer to Chapter 11 for detailed information):

Display	Alarm name
AL060	Absolute position is lost
AL061	Encoder undervoltage
AL062	Number of turns for the absolute encoder overflows
AL069	Wrong motor type
AL072	Encoder overspeed
AL073	Encoder memory error
AL074	Absolute encoder single turn position error
AL075	Absolute encoder position error
AL077	Encoder computing error
AL079	Encoder parameter error
AL07B	Encoder memory busy
AL07C	Command to clear the absolute position is issued when the motor speed is over 200 rpm
AL07D	Servo drive power is cycled before AL07C is cleared
AL07E	Encoder clearing procedure error
AL289	Feedback position counter overflows

Troubleshooting 11

This chapter provides alarm descriptions and the corrective actions you can use for troubleshooting.

There are four types of alarms: General, STO, Communication, and Motion control.

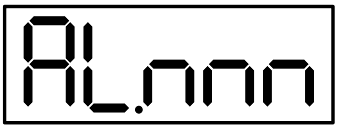
General type: alarms caused by hardware or encoder signal errors.

STO type: alarms caused by STO errors.

Communication type: alarms caused by CANopen or DMCNET errors.

Motion control type: alarms caused by motion control command (in PR mode) errors.

AL.nnn is the alarm format on the 7-segment display.



11.1 Alarm list

General type:

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL001	Overcurrent	○			○
AL002	Overvoltage	○			○
AL003	Undervoltage		○		○
AL004	Motor combination error	○			○
AL005	Regeneration error	○			○
AL006	Overload	○			○
AL007	Excessive deviation of speed command	○			○
AL008	Abnormal pulse command	○			○
AL009	Excessive deviation of position command	○			○
AL011	Encoder error	○			○
AL012	Adjustment error	○			○
AL013	Emergency stop		○		○
AL014	Reverse limit error		○	○	
AL015	Forward limit error		○	○	
AL016	IGBT overheat	○			○
AL017	Abnormal EEPROM	○			○
AL018	Abnormal encoder signal output	○			○
AL019	Serial communication error	○			○
AL020	Serial communication timeout		○	○	
AL022	RST leak phase		○		○
AL023	Early overload warning		○	○	
AL024	Encoder initial magnetic field error	○			○
AL025	Encoder internal error	○			○
AL026	Encoder unreliable internal data	○			○
AL027	Internal motor error	○			○
AL028	Encoder voltage error or encoder internal error	○			○
AL029	Gray code error	○			○
AL030	Motor crash error	○			○
AL031	Motor power cable incorrect wiring or disconnection	○			○
AL034	Encoder internal communication error	○			○
AL035	Encoder temperature exceeds the protective range	○			○

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General type (continued):

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL040	Excessive deviation of full closed-loop position control	○			○
AL041	Linear scale communication is cut off	○			○
AL042	Analog input voltage is too high	○			○
AL044	Servo function overload warning		○	○	
AL045	E-Gear ratio value error	○			○
AL060	Absolute position lost		○	○	
AL061	Encoder undervoltage		○	○	
AL062	Mult-turn overflow in absolute encoder		○	○	
AL067	Encoder temperature warning		○	○	
AL068	Absolute data transmitted with I/O is in error		○	○	
AL069	Wrong motor type	○			○
AL06A	Absolute position is lost / Absolute position is not initialized		○	○	
AL070	Encoder did not complete the command issued by servo drive		○	○	
AL072	Encoder overspeed	○			○
AL073	Encoder memory error	○			○
AL074	Absolute encoder single turn position error	○			○
AL075	Absolute encoder position error	○			○
AL077	Encoder computing error	○			○
AL079	Encoder parameter error	○			○
AL07B	Encoder memory busy	○			○
AL07C	Command to clear the absolute position is issued when the motor speed is over 200 **rpm**		○	○	
AL07D	Servo drive power is cycled before AL07C is cleared	○			○
AL07E	Encoder clearing procedure error	○			○
AL07F	Encoder version error	○			○
AL083	Servo drive outputs excessive current	○			○
AL085	Regeneration error	○			○
AL086	Input voltage is too high	○			○
AL088	Servo function overload warning	○			○
AL089	Current detection interference		○	○	
AL08A	Auto-tuning function - Command error		○	○	
AL08B	Auto-tuning function - Inertia estimation error		○	○	
AL08C	Auto-tuning function - Pause time is too short		○	○	

General type (continued):

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL095	Regenerative resistor disconnected		○	○	
AL099	DSP firmware update	○			○
AL521	Vibration elimination parameter error	○			○

Note: if the servo drive shows an alarm that is not in this table, please contact the local distributor or technician.

STO type:

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL500	STO function is enabled	○			○
AL501	STO_A lost (signal loss or signal error)	○			○
AL502	STO_B lost (signal loss or signal error)	○			○
AL503	STO self-diagnostic error	○			○

Note: if the servo drive shows an alarm that is not in this table, please contact the local distributor or technician.

Communication type:

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL111	Buffer overflow occurs when receiving CANopen SDO	○		○	
AL112	Buffer overflow occurs when receiving CANopen PDO	○		○	
AL121	Object's index does not exist when CANopen PDO is received	○		○	
AL122	Object's sub-index does not exist when CANopen PDO is received	○		○	
AL123	Data size error occurs when CANopen PDO is received	○		○	
AL124	Data range error occurs when CANopen PDO is received	○		○	
AL125	CANopen object is read-only and write-protected	○		○	
AL126	Specified object does not support PDO mapping	○		○	
AL127	CANopen PDO is write-protected when servo is on	○		○	
AL128	Error occurs when reading CANopen PDO from EEPROM	○		○	
AL129	Error occurs when writing CANopen PDO to EEPROM	○		○	
AL130	Accessing address of EEPROM is out of range when using CANopen PDO	○		○	
AL131	CRC of EEPROM calculation error occurs when using CANopen PDO	○		○	
AL132	Parameter is write-prohibited when using CANopen PDO	○		○	
AL180	CANopen heartbeat or NodeGuarding error	○			○
AL185	CAN Bus hardware error	○			○

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Communication type (continued):

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL186	CAN Bus off	○		○	
AL201	Error occurs when loading CANopen data	○			○
AL301	CANopen synchronization failure		○	○	
AL302	Synchronization signal for CANopen sent too soon		○	○	
AL303	CANopen synchronization signal timeout		○	○	
AL304	Invalid CANopen IP command		○	○	
AL305	SYNC period error		○	○	
AL401	NMT reset command is received while the servo is on	○			○

Note: if the servo drive shows an alarm that is not in this table, please contact the local distributor or technician.

Motion control type:

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL207	Parameter group of PR#8 is out of range		○	○	
AL209	Parameter number of PR#8 is out of range		○	○	
AL213	Parameter setting of PR#8 is in error		○	○	
AL215	Write parameters: read-only		○	○	
AL217	Write parameters: parameter locked		○	○	
AL231	Monitoring item for PR Write command is out of range		○	○	
AL235	Absolute positioning command error		○	○	
AL237	Indexing coordinate is undefined		○	○	
AL283	Software positive limit		○	○	
AL285	Software negative limit		○	○	
AL289	Feedback position counter overflows		○	○	
AL380	Position offset alarm for DO.MC_OK		○	○	
AL3F1	Absolute index coordinate undefined	○			○
AL400	Index coordinate error	○			○
AL404	Value of PR special filter setting is too high	○			○
AL555	System failure	○			○
AL809	PR arithmetic operation parameter error or secondary platform error	○			○

Note: if the servo drive shows an alarm that is not in this table, please contact the local distributor or technician.

11.2 Causes and corrective actions

General type:

AL001 Overcurrent	
Trigger condition and causes	Condition: main circuit current is over 1.5 times of the maximum instantaneous current of the motor. Causes: 1. Motor has a short-circuit or fault to ground (frame). 2. Motor wiring is wrong. 3. IGBT is abnormal. 4. Parameter setting is wrong. 5. Control command setting is wrong.
Checking methods and corrective actions	1. Check the connection between the motor and servo drive and make sure that the wire is not short-circuited. Do not expose the metal part of the wiring. Check if you have followed the wiring sequence of the motor and servo drive as described in this manual. 2. If the temperature of the heat sink is abnormal, please send the servo drive back to the distributor or contact Delta. Check if the setting value is much greater than the default. It is suggested that you reset the servo drive to the factory default settings and then modify the settings one by one. 3. Check if the target Torque/Speed/Position commanded changes greatly. If so, please modify the rate of change in the command or enable the filter.
How to clear the alarm?	DI.ARST

AL002 Overvoltage	
Trigger condition and causes	Condition: main circuit voltage exceeds the rated value. Causes: 1. The input voltage of the main circuit is higher than the rated voltage. 2. Wrong power input (wrong power system). 3. Malfunction of the servo drive hardware.
Checking methods and corrective actions	1. Use a voltmeter to check if the input voltage of the main circuit is within the rated range (refer to Appendix A Specifications). Use the right voltage source or connect the regulator in series. Use a voltmeter to check if the power system complies with the specifications. If not, use the right voltage source or connect the transformer in series. 2. Check if the input voltage of the main circuit is within the rated range. If the issue persists, please send the servo drive back to the distributor or

	contact Delta.
How to clear the alarm?	DI.ARST

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AL003 Under voltage	
Trigger condition and causes	Condition: main circuit voltage is below the rated value. By default, AL003 is defined as a warning. To define it as an alarm, set P2.066 [Bit 9]. Causes: 1. The input voltage of main circuit is lower than the permissible rated value. 2. No power is supplied to the main circuit. 3. Wrong power input (wrong power system).
Checking methods and corrective actions	1. Check that the voltage wiring is correct and the input voltage for the main circuit is normal. 2. Cycle the servo drive power and use a voltmeter to check the main circuit voltage. 3. Use a voltmeter to check if the power system complies with the specifications. Check if using the right voltage source or the transformer is connected in series.
How to clear the alarm?	AL003 is cleared according to the setting of P2.066 [Bit2] 1. If P2.066 [Bit2] is set to 0, use DI.ARST to clear the alarm after the voltage is back in the normal range. 2. If P2.066 [Bit2] is set to 1, the alarm is automatically cleared once the voltage is back in the normal range.

AL004 Motor combination error	
Trigger condition and causes	Condition: wrong motor is used with the servo drive. Causes: 1. Motor combination error (the servo drive connects to the wrong motor.) 2. The encoder is loose. 3. The encoder is damaged.
Checking methods and corrective actions	1. Use the right motor. 2. Check and re-install the encoder connector. 3. If the encoder (motor) is not operating properly, please replace the motor.
How to clear the alarm?	Cycle power on the servo drive.

AL005 Regeneration error	
Trigger condition and causes	Condition: an error occurs during regeneration. Causes: 1. You selected a wrong regeneration resistor or the external regeneration resistor is not connected. 2. P1.053 (regenerative resistor capacity) is not set to 0 when the regenerative resistor is not connected 3. Parameter setting error (P1.052, P1.053).
Checking methods and corrective actions	1. Re-calculate the value for the regenerative resistor and reset the value of P1.052 and P1.053. If you cannot clear the alarm, please send the servo drive back to Delta. 2. Set P1.053 to 0 if not using a regenerative resistor. 3. Correctly set the parameters for the regenerative resistor, (P1.052) and the regenerative resistor capacity (P1.053).
How to clear the alarm?	DI.ARST

AL006 Overload	
Trigger condition and causes	Condition: overload of motor and servo drive. Causes: 1. The load is over the rated range and the servo drive is in a persistent overload condition. 2. The control system parameter is wrong. 3. Incorrect wiring of motor and encoder. 4. Encoder malfunction.
Checking methods and corrective actions	1. Set P0.002 to 11 to monitor the servo drive status. Check if the average torque [%] is continuously over 100%. If so, please increase the motor capacity or reduce the load. Refer to Load and operation time in Appendix A for more details. (A) Check if there is any mechanical vibration. (B) Acceleration/deceleration constant is set too high. 2. Check if the wiring of UVW and the encoder cables is correct. 3. Send the servo drive back to distributors or contact Delta.
How to clear the alarm?	DI.ARST

AL007 Excessive speed deviation	
Trigger condition and causes	Condition: deviation from the Speed command and the feedback speed exceeds the allowable range (P2.034). Causes: 1. A drastic change in speed. 2. Incorrect setting for P2.034.
Checking methods and corrective actions	1. Use the signal detector to check if the input analog voltage signal is normal. If not, adjust the signal changing rate or enable the filter function. 2. Check and make sure the value of P2.034 (over-speed warning) is correct.
How to clear the alarm?	DI.ARST

AL008 Abnormal pulse command	
Trigger condition and causes	Condition: the input frequency for the pulse command is over the allowable value for the hardware interface. Cause: the pulse command frequency is higher than the rated input frequency.
Checking methods and corrective actions	Use the scope to check if the input frequency is higher than the rated frequency. Correctly set the input pulse frequency.
How to clear the alarm?	DI.ARST

AL009 Excessive Position command deviation	
Trigger condition and causes	Condition: Deviation of position command and feedback exceeds the allowable range (P2.035). Causes: 1. The maximum position deviation is set too low. 2. Gain value is set too low. 3. Torque limit is set too low. 4. Excessive external load. 5. Improper setting for the E-gear ratio.
Checking methods and corrective actions	1. Check the value of the maximum deviation (P2.035 excessive position deviation warning condition). 2. Check if the gain value is appropriate for the application. 3. Check if the torque limit setting is appropriate for the application. 4. Check the external load. Reduce the external load or re-evaluate the motor capacity if necessary.

	5. Check if the settings for P1.044 and P1.045 are appropriate for the application and set the correct values.
How to clear the alarm?	DI.ARST

AL011 Encoder error	
Trigger condition and causes	Condition: the encoder produces abnormal pulses. Causes: 1. Encoder wiring is wrong. 2. Encoder connector is loose. 3. Poor wiring of the encoder. 4. Connection to the encoder is cut off due to interference. 5. Encoder is damaged.
Checking methods and corrective actions	1. Check if the wiring follows the instructions in the user manual. If not, connect the wiring correctly. 2. Check if the CN2 connector and the encoder connector are loose. If so, reconnect the connectors. 3. Check both of the connections between the encoder and CN2 of the servo drive to see if there is any poor wiring or damaged wires. If so, please replace the connector and cable. 4. Please check the communication error status by setting P0.002 to -80. If the value continuously increases, it means there is interference. Please check the following: ■ Make sure the servo motor is well grounded. Please connect the ground of UVW connector (Green) to the heat sink of the servo drive. ■ Check if the connection for the encoder signal cable is normal. Make sure that you separate the encoder signal cable from the main power circuit cable to avoid interference. ■ Use shielded cable for the encoder. 5. If you took all corrective actions but the issue persists, please replace the motor.
How to clear the alarm?	Re-power on the servo drive.

AL012 Adjustment error	
Trigger condition and causes	Condition: the calibration value exceeds the allowable value during electric calibration. Causes:

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	1. The analog input contact is not correctly set to zero. 2. The detection device is damaged.
Checking methods and corrective actions	1. Check if the voltage at the analog input contact is the same as the ground voltage. 2. Reset the power supply. If the issue persists, please send the servo drive back to the distributor or contact Delta.
How to clear the alarm?	Remove the connection cable for CN1 and then execute auto calibration.

AL013 Emergency stop	
Trigger condition and causes	The emergency stop button is pressed.
Checking methods and corrective actions	Check the emergency stop state and make sure it is off.
How to clear the alarm?	DI.EMGS.

AL014 Reverse limit error	
Trigger condition and causes	Condition: reverse limit switch is triggered. Causes: 1. Reverse limit switch is triggered. 2. Servo system is unstable.
Checking methods and corrective actions	1. Check the reverse limit switch and make sure it is off. 2. Check the parameter setting and the load inertia. If the setting is wrong, please modify the parameter value or re-estimate the motor capacity.
How to clear the alarm?	Reset the alarm or switch the servo drive off.

AL015 Forward limit error	
Trigger condition and causes	Condition: forward limit switch is activated. Causes: 1. Forward limit switch is activated. 2. Servo system is unstable.
Checking methods and corrective actions	1. Check the forward limit switch and make sure it is off. 2. Check the parameter setting and the load inertia. If the setting is wrong, please modify the parameter value or re-estimate the motor capacity.
How to clear the alarm?	Reset the alarm or switch the servo drive off.

AL016 IGBT overheat	
Trigger condition and causes	Condition: temperature of IGBT is too high. Causes: 1. The load is over the rated range and the servo drive is in a persistent overload condition. 2. Motor has a short-circuit or fault to ground (frame).
Checking methods and corrective actions	1. Check if the motor is overloaded or over-current. Then try increasing the motor's capacity or reducing the load. 2. Check if the wiring of servo drive output is correct.
How to clear the alarm?	DI.ARST

AL017 Abnormal EEPROM	
Trigger condition and causes	Condition: error occurs when DSP accesses EEPROM. Causes: 1. Parameter writing error or the value exceeds the permissible range. This error occurs when parameters are restored to the default and servo drive type is incorrect. 2. Data in ROM is damaged or there is no data in ROM. This occurs when the system is in Servo On status. If this alarm occurs, please send the servo drive back to the distributor or contact Delta.
Checking methods and corrective actions	Press the SHIFT key on the panel and “EXGAB” is displayed. X = 1, 2, 3 G = Group No. of the parameter AB = Parameter No. in hexadecimal format If the panel displays E320A, this is parameter P2.010; if E3610 is displayed, this is P6.016. Please check the value for the displayed parameter. 1. Press the SHIFT key to display the parameter code. If this alarm occurs when power is supplied to the drive, it means a parameter value has exceeded the range. You can modify the value and then cycle the power. If the error occurs during normal operation, it means an error occurred when writing the parameter. 2. Press the SHIFT key on the panel and E100X is displayed. If this alarm occurs while parameters are being restored to the default, it means the servo model type setting is incorrect. Please correct it. 3. Press the SHIFT key on the panel and E0001 is displayed. If this alarm occurs while power is being supplied, it is usually because the data in ROM is damaged or there is no data in the ROM. Please send it back to

	the distributor or Delta.
How to clear the alarm?	If this alarm occurs when the drive is started, please reset the parameters and then cycle the power. If the alarm occurs during operation, please reset the alarm.

AL018 Abnormal encoder signal output	
Trigger condition and causes	Condition: output frequency of the encoder is higher than the rated output frequency of the hardware. Causes: 1. Pulse resolution of the encoder is set too high. 2. There is interference or cable damage causing communication error. 3. Encoder error.
Checking methods and corrective actions	1. The setting of P1.076 and P1.046 should follow these requirements: P1.076 > motor speed and $\frac{\text{Motor speed}}{60} \times \text{P1} - 46 \times 4 < 19.8 \times 10^{6}$ 2. Please check the communication error status by setting P0.002 to -80. If the value continuously increases, it means there is interference. Please check the following: (A) Make sure the servo motor is properly grounded and connect the UVW connector (color green) to the heat sink of the servo drive. (B) Check if the connection of encoder signal cable is normal. Make sure that you separate the encoder signal cable from the main power circuit cable to avoid interference. (C) Use shielded cable for the encoder. 3. Check the error log (P4.000—P4.005) and see if an alarm has occurred (AL011, AL024, AL025, and AL026). Use the checking methods and corrective actions to clear the alarm if any of them occurs.
How to clear the alarm?	1. DI.ARST 2. Please send the product to the distributor or Delta.

AL019 Serial communication error	
Trigger condition and causes	Condition: RS-485 communication error. Causes: 1. Improper setting of the communication parameters. 2. Incorrect communication address. 3. Incorrect communication value.

Checking methods and corrective actions	1. Check the values of the communication parameters. Then correctly set P3.003 and P3.004 or restore the value to default. 2. Check and correctly set the communication address. 3. Check and correctly set the accessing value.
How to clear the alarm?	DI.ARST

AL020 Serial communication timeout	
Trigger condition and causes	Condition: RS-485 communication error. Causes: 1. Improper setting of the timeout parameter (P5.003). 2. Servo drive has not received the communication command for a long time and has timed out (please refer to P5.003).
Checking methods and corrective actions	1. Check and make sure the value for the communication timeout parameter is correct. 2. Check if the communication cable is loose or broken and is correctly wired.
How to clear the alarm?	DI.ARST

AL022 RST leak phase	
Trigger condition and causes	Condition: RST power cable is loose or there is no power. The default setting of AL022 is a warning. To set AL022 as an alarm, you can set P2.066 [Bit 12]. Cause: RST leak phase.
Checking methods and corrective actions	Check if the RST power cable is loose or there is no power. This alarm occurs when the 1.5 kW (or below) A3 servo drive is not connected to the three-phase power supply. For 2 kW (or above) A3 servo drives, the alarm occurs when one single phase is not connected to the power supply. Correctly connect the power to the servo drive. If the issue persists, please send your A3 servo drive back to the distributor or contact Delta.
How to clear the alarm?	DI.ARST

AL023 Early overload warning	
Trigger condition and causes	Early overload warning
Checking methods and corrective actions	1. Check if your servo drive is overloaded and refer to the corrective actions for AL006 for troubleshooting. 2. Check if the value of P1.056 is set too low. If yes, please increase the value, which should be over 100 to disable the warning function.

How to clear the alarm?	DI.ARST

AL024 Encoder initial magnetic field error	
Trigger condition and causes	Condition: the magnetic field of the encoder U, V, W signal is in error. Cause: the initial magnetic field of the encoder is in error (Signal U, V, W of the encoder magnetic field is in error.)
Checking methods and corrective actions	1. Make sure the servo motor is properly grounded and connect the UVW connector (color green) to the heat sink of the servo drive. 2. Make sure the encoder cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder. If the issue persists, please send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Re-power on the servo drive.

AL025 Encoder internal error	
Trigger condition and causes	Condition: internal memory and counter of the encoder are in error. Causes: 1. Internal encoder error (internal memory and counter are in error). 2. When applying power, the motor rotates because of inertia of the machinery or other causes.
Checking methods and corrective actions	1. (A) Make sure the servo motor is properly grounded and connect the UVW connector (color green) to the A3 servo drive heat sink. (B) Make sure the encoder cable is separated from the power supply or any high-current cables to avoid interference. (C) Use shielded cable for the encoder. 2. Make sure the motor shaft does not move when power is turned on.
How to clear the alarm?	Cycle the power to the servo drive.

AL026 Encoder unreliable internal data	
Trigger condition and causes	Condition: internal data error occurs three consecutive times. Causes: 1. External interference. 2. Malfunction of encoder hardware.

Checking methods and corrective actions	To correct the interference, check the following descriptions: 1. Make sure the servo motor is properly grounded and connect the UVW connector (color green) to the A3 servo drive heat sink. 2. Make sure the encoder cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder. 4. Set P0.002 to -80 by using the panel to monitor the communication error status. If the value is greater than 0 and the value increases continuously, please check steps 1—3 again. If the value is 0, send the motor back to the distributor or contact Delta.
How to clear the alarm?	Re-power on the servo drive.

AL027 Internal motor error	
Trigger condition and causes	Condition: encoder reset error. Cause: encoder reset.
Checking methods and corrective actions	1. Check if the encoder cable is firmly connected. 2. Check if the power supply for the encoder is stable and make sure to use shielded cable. 3. Check if the operation temperature is over 95℃. Identify the cause for the high temperature and do not restart operation before the temperature falls back into the allowable range. If issue persists, please send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Re-power on the servo drive.

AL028 Encoder voltage error or encoder internal error	
Trigger condition and causes	Condition: servo drive charging circuit is not removed so the battery voltage is higher than the specification (>3.8 V) or the encoder signal is in error. Causes: 1. Voltage level of the battery is too high. 2. Internal encoder error.
Checking methods and corrective actions	1. Follow the testing procedure for over-voltage/over-current and troubleshoot. This automatically clears AL028. (A) Check the servo drive charging circuit. Avoid incorrect wiring; if Pin 1 (5V) of CN2 is connected to BAT+, it means the power (5V) of the servo drive is being charged to the battery. (B) Check if the battery is correctly installed (voltage > 3.8V). 2. Make sure the encoder is the absolute type. Check and remove the

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	cause for the alarm. If the issue persists, please send your servo drive back to the distributor or contact Delta. (A) Make sure the servo motor is properly grounded and connect the UVW connector (color green) to the servo drive heat sink. (B) Make sure the encoder cable is separated from the power supply or any high-current cables to avoid interference. (C) Use shielded cable for the encoder. If issue persists, please send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL029 Gray code error	
Trigger condition and causes	Absolute position error.
Checking methods and corrective actions	Cycle the power to the servo drive to operate the motor. Then check if the alarm occurs again. If the issue persists, please replace the encoder.
How to clear the alarm?	Re-power on the servo drive.

AL030 Motor crash error	
Trigger condition and causes	Condition: when the motor hits the device, the torque reaches the value of P1.057 and lasts for the time set by P1.058. Causes: 1. Check if the function of motor crash protection (P1.057) is enabled. If so, please set P1.057 to 0. 2. Check if the value of P1.057 is set too low and the time set by P1.058 is too short. Please set P1.057 according to the actual torque. Incorrect values might inadvertently trigger the signal or lose the protection function.
Checking methods and corrective actions	Cycle power on the servo drive to operate the motor and check if the alarm occurs again. If the issue persists, please replace the encoder.
How to clear the alarm?	DI.ARST

AL031 Motor power cable incorrect wiring or disconnection	
Trigger condition and causes	Condition: incorrect wiring or disconnection of the power cable U, V, W, and GND. Causes: Incorrect wiring or disconnection of motor power cable U, V, W. The switch for cut-off detection is set by P2.065 Bit 9, which default is set to disable.

Checking methods and corrective actions	Check if the motor power cable (U, V, W, GND) is firmly connected. Please connect wiring and ground properly by following the instructions in this user manual.
How to clear the alarm?	Cycle power on the servo drive.

AL034 Encoder internal communication error	
Trigger condition and causes	Condition: 1. Internal communication error for the absolute type encoder. 2. Internal error for the other type of encoder. Cause: encoder internal communication error.
Checking methods and corrective actions	1. Check the battery wiring. Then wire it again and cycle power on the system. 2. Internal communication error for the absolute type encoder occurs. Please replace the motor.
How to clear the alarm?	Cycle power on the servo drive.

AL035 Encoder temperature exceeds the protective range	
Trigger condition and causes	Condition: encoder temperature is over the maximum of 100℃. Cause: encoder temperature is over 100℃.
Checking methods and corrective actions	Set P0.002 to 120d in order to read the temperature and check if it is below 100℃. If the encoder temperature is higher than 100℃, please improve the heat dissipation or reduce the operating load. If the temperature difference between the motor and the displayed temperature value is over 30℃, please send the motor back to the distributor.
How to clear the alarm?	After the temperature detector shows a temperature below 100℃, please cycle power on the servo drive.

AL040 Excessive deviation of full closed-loop position control	
Trigger condition and causes	Excessive deviation of full closed-loop position control
Checking methods and corrective actions	1. Check the value for P1.073. If the value is too low, please set a higher value. 2. Make sure the connector is firmly connected and there is no problem in connecting the mechanism.
How to clear the alarm?	DI.ARST

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AL041 Linear scale communication is cut off	
Trigger condition and causes	Linear scale communication is cut off.
Checking methods and corrective actions	Make sure the wiring for the linear scale is correct.
How to clear the alarm?	DI.ARST

AL042 Analog input voltage is too high	
Trigger condition and causes	Analog input voltage for the speed command is higher than the level specified by P1.083.
Checking methods and corrective actions	Check if the voltage source for the speed command is correct. Check the setting value of P1.083 and set it to 0 when this function is not required.
How to clear the alarm?	DI.ARST

AL044 Servo function overload warning	
Trigger condition and causes	Condition: when the motor controlling function of servo drive is overloaded, the motion control function is affected, causing PR or E-Cam operation to be in error. Cause: Servo function overload warning.
Checking methods and corrective actions	1. Check if the filter is enabled and see if enabling the filter is necessary. 2. Set P2.066 Bit4 to 1 to disable this alarm.
How to clear the alarm?	1. Disable the filter if it is not required, such as the low-pass filter (P1.006 – P1.008), moving filter (P1.068), low-frequency vibration suppression (P1.025 – P1.028), vibration elimination (elasticity compensation, P1.089 – P1.094), or Notch filter (5 sets). 2. Set P2.066 Bit4 to 1 and cycle power on the servo drive.

AL045 E-Gear ratio value error	
Trigger condition and causes	Condition: when the value of the E-Gear ratio exceeds the range (1/50 – 25600), this alarm occurs once power to the servo drive is cycled. Cause: when the servo drive is powered on, E-Gear ratio value is in error.
Checking methods and corrective actions	Check if the value for the E-gear ratio is within the allowable range (1/50 – 25600). Correct the value and then cycle power on the servo drive.
How to clear the alarm?	Cycle power on the servo drive after the value is corrected.

AL060 Absolute position is lost	
Trigger condition and causes	Condition: losing number of revolutions because of low battery voltage or loss of the power. Causes: 1. Voltage level of the battery is too low. 2. The battery is replaced when the main power of the servo drive is off. 3. The battery is not installed when the absolute function is enabled. 4. Poor connection or disconnection of the battery power circuit.
Checking methods and corrective actions	1. Check if the battery voltage is below 2.8V; execute homing after changing the battery. Please refer to Chapter 10 Absolute servo system for more details about initializing the absolute coordinate system. 2. Do not change or remove the battery when the ASDA-A3 servo drive's main power is off. To execute homing again, please refer to Chapter 10 for absolute coordinate initialization. 3. Please follow the instructions below: (A) Install the battery. (B) Check the connection between the battery power source and the servo drive. (C) Check the encoder wiring. 4. Connect or correct the wiring so that the battery power is supplied to the encoder and then execute homing again. (A) Check the encoder wiring. (B) Check the connection between the battery box and servo drive.
How to clear the alarm?	Cycle power on the servo drive.

AL061 Encoder undervoltage	
Trigger condition and causes	Condition: voltage level of the absolute encoder battery is lower than the allowable value (3.1V). Cause: voltage level of the battery is too low.
Checking methods and corrective actions	1. Check the panel to see if the battery voltage is less than 3.1V. 2. Measure the battery voltage and see if it is less than 3.1V. If the voltage is too low, replace the battery when the main power is on.
How to clear the alarm?	The alarm is cleared automatically.

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AL062 Number of turns for the absolute encoder overflows	
Trigger condition and causes	Condition: the number of turns for the absolute encoder exceeds the range: -32768 to +32767. Cause: motor's rotation cycle exceeds the allowable range.
Checking methods and corrective actions	Check if the motor's number of turns while operating is within the range between -32768 and +32767. If not, please execute homing again.
How to clear the alarm?	Cycle power on the servo drive.

AL067 Encoder temperature warning	
Trigger condition and causes	Condition: the encoder temperature is over 85℃ (warning level), but still under 100℃, which is within the protective range. Cause: encoder temperature warning (85℃ -- 100℃).
Checking methods and corrective actions	Set P0.002 to 120d and check if the encoder temperature is identical to the motor temperature. If the encoder temperature is too high, please improve the heat dissipation or reduce the operating load. If the temperature difference between the encoder and motor is over 30℃, please send the motor back to the distributor.
How to clear the alarm?	Cycle power on the servo drive.

AL068 Absolute data transmitted with I/O is in error	
Trigger condition and causes	Condition: the sequence is wrong when reading the absolute position with DIO. Causes: 1. Time sequence is wrong. 2. Reading timeout.
Checking methods and corrective actions	1. Correct the time sequence for reading the data with DIO: (A) DI.ABSQ switches to off after DO.ABSR is off. (B) DI.ABSQ switches to on after DO.ABSR is on. 2. Check the duration from when DO.ABSR switches on to the time that DI.ABSQ switches on and see if this duration is over 200 ms. The correct procedure should be: when DO.ABSR switches on and after the bit data of absolute position is ready, read DO.ABSD within 200 ms and switch DI.ABSQ on. Then inform the servo drive that data reading is complete.
How to clear the alarm?	Cycle power on the servo drive.

AL069 Wrong motor type	
Trigger condition and causes	Incremental motor does not support the absolute function.
Checking methods and corrective actions	1. Check to see if your servo motor has an incremental or absolute encoder. 2. Check the setting of P2.069 and correctly set the value. Set P2.069 to 0 if your encoder does not use the absolute function.
How to clear the alarm?	Set P2.069 to 0 and then cycle power on the servo drive.

AL06A Absolute position is lost / Absolute position is not initialized	
Trigger condition and causes	Condition: 1. Motor in use for the first time. 2. Power supply of the servo drive is cut off and the battery is drained, or the battery has been replaced and the absolute position is lost. Cause: the motor is used for the first time or the absolute position is lost due to changing the battery.
Checking methods and corrective actions	Check if the absolute position is correctly initialized (see Section 10.3.1).
How to clear the alarm?	This alarm is cleared after you complete the initialization of the absolute position.

AL070 Encoder does not complete the command issued by servo drive	
Trigger condition and causes	Command is not completed when the barcode is written to the encoder.
Checking methods and corrective actions	Check if the wiring is correct and firmly connected. If not, please correctly connect the wiring again.
How to clear the alarm?	Cycle power on the servo drive.

AL072 Encoder overspeed	
Trigger condition and causes	When encoder is powered by the servo drive: over 8800 rpm; When encoder is powered by the battery: over 10000 rpm.
Checking methods and corrective actions	1. Check if the motor is well grounded; make sure the power cable is grounded to the heat sink of the servo drive. 2. Make sure the encoder cable is separated from the power supply or any high-current cable to avoid interference. 3. Use shielded cable for the encoder and pull out the shielded mesh and

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	ground it. 4. Check the motor speed and make sure it is within the rated range. If issue persists, please send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Re-power on the servo drive.

AL073 Encoder memory error	
Trigger condition and causes	An error occurs when the encoder is reading data from, or writing data to EEPROM.
Checking methods and corrective actions	1. Check if the motor is well grounded; make sure the power cable is grounded to the servo drive heat sink. 2. Make sure the encoder cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder and pull out the shielded mesh and ground it. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, please send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Re-power on the servo drive.

AL074 Absolute encoder single turn position error	
Trigger condition and causes	Absolute encoder single turn position error.
Checking methods and corrective actions	1. Check if the motor is well grounded; make sure the power cable is grounded to the servo drive heat sink. 2. Make sure the encoder cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder and pull out the shielded mesh and ground it. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, please send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL075 Absolute encoder position error	
Trigger condition and causes	Absolute encoder position error.
Checking methods and corrective actions	1. Check if the motor is well grounded; make sure the power cable is grounded to the heat sink of the servo drive. 2. Make sure the encoder cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder and pull out the shielded mesh and ground it. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, please send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL077 Encoder computing error	
Trigger condition and causes	Encoder internal error (internal computing error).
Checking methods and corrective actions	1. Check if the motor is well grounded; make sure the power cable is grounded to the heat sink of the servo drive. 2. Make sure the encoder cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder and pull out the shielded mesh and ground it. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, please send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL079 Encoder parameter error	
Trigger condition and causes	The encoder is not cycled after the parameter is written, so the parameter value is not updated.
Checking methods and corrective actions	Check if the parameter is written to the encoder. If so, please cycle power on the encoder to update the parameter.
How to clear the alarm?	Cycle power on the servo drive.

AL07B Encoder memory busy	
Trigger condition and causes	Encoder memory is busy.
Checking methods and corrective actions	1. Check if the motor is well grounded; make sure the power cable is grounded to the heat sink of the servo drive. 2. Make sure the encoder cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder and pull out the shielded mesh and ground it. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, please send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL07C Command to clear the absolute position is issued when the motor speed is over 200 rpm	
Trigger condition and causes	The command to clear the absolute position is issued when the motor speed is over 200 rpm.
Checking methods and corrective actions	Check if a command to clear the absolute position is issued while motor speed is over 200 rpm. If so, follow the procedure for clearing the absolute position to clear this alarm. Do not issue a command to clear the absolute position when the motor speed is over 200 rpm.
How to clear the alarm?	Cycle power on the servo drive.

AL07D Servo drive power is cycled before AL07C is cleared	
Trigger condition and causes	AL07C occurs and is not cleared before the power is cycled on the servo drive, and the motor stops operating.
Checking methods and corrective actions	Use DI.ARST to clear the alarm. Once this alarm is cleared, AL07C occurs. Please follow the checking and troubleshoot methods to clear that alarm.
How to clear the alarm?	Cycle power on the servo drive.

AL07E Encoder clearing procedure error	
Trigger condition and causes	The time to clear the encoder exceeds the limit.
Checking methods and corrective actions	If the issue persists, set P0.002 to -81 to check the communication quality with the encoder. If communication is normal, use DI.ARST to clear this alarm.
How to clear the alarm?	Cycle power on the servo drive.

AL07F Encoder version error	
Trigger condition and causes	The encoder version read by the servo drive is wrong.
Checking methods and corrective actions	N/A
How to clear the alarm?	Replace the motor immediately.

AL083 Servo drive outputs excessive current	
Trigger condition and causes	Condition: during general operation, this alarm occurs when the servo drive outputs current that is over the allowable level specified by the firmware. This alarm protects IGBT from overheating or burning out because of the high current. Causes: 1. UVW cable is short-circuited. 2. Motor wiring is wrong. 3. Interference on the analog signal GND for the servo drive.
Checking methods and corrective actions	1. Check the connection between the motor power cable and its connector. If metal wire is exposed or the wire is torn, the UVW cable can short-circuit. In this case, please replace the UVW cable and prevent the metal conductor from being exposed. 2. Refer to Chapter 3 Wiring and check the following: (A) If you do not use the Delta standard power cable, make sure the UVW wiring sequence is correct. (B) Make sure the UVW wiring between the servo drive and the motor is correctly connected. 3. Check if the analog signal GND is mistakenly connected to another ground signal (incorrect connection can cause interference). DO NOT use a common ground for the analog signal and GND. Follow the wiring instructions in Chapter 3.
How to clear the alarm?	DI.ARST

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AL085 Regeneration error	
Trigger condition and causes	Condition: regeneration control error. Cause: regenerative resistor is not operating, but the generative voltage remains at 400V for a period of time.
Checking methods and corrective actions	Check the connections for the regenerative resistor, re-calculate the value for the regenerative resistor, and reset the value of P1.052 and P1.053. If this does not clear the alarm, please send the servo drive back to Delta.
How to clear the alarm?	DI.ARST

AL086 Input voltage is too high	
Trigger condition and causes	Condition: when the servo drive detects no regenerative power, but other regenerative energy (such as interference) is input to the servo drive, or voltage input is higher than the permissible rated voltage. Causes: 1. Other energy (such as interference) is input to the servo drive or the input voltage is higher than the permissible rated value. 2. Malfunction of the servo drive hardware.
Checking methods and corrective actions	1. Use a voltmeter to measure if the input voltage from the power source is within the permissible rated value (see the servo drive specifications). If the voltage exceeds the rated value, please remove the interference source. 2. If the voltmeter detects that the voltage from the main circuit is within the permissible rated range, but the issue persists, then the servo drive may be malfunctioning.
How to clear the alarm?	1. Use the correct voltage source or connect the voltage regulator in series.

AL088 Servo function overload warning	
Trigger condition and causes	Condition: too many motor control functions on the servo drive are enabled. Cause: Servo function overload warning.
Checking methods and corrective actions	If using a filter, see if using this filter is necessary.

How to clear the alarm?	Disable the filter if not required, such as low-pass filter (P1.006 — P1.008), moving filter (P1.068), low-frequency vibration suppression (P1.025 — P1.028), vibration elimination (elasticity compensation) (P1.089 — P1.094), or Notch filter (5 sets).

AL089 Current detection interference	
Trigger condition and causes	Condition: current detection interference. Cause: current detection in the servo drive is affected by an external interference source.
Checking methods and corrective actions	Check the environment around the servo drive to see if there is any interference source.
How to clear the alarm?	1. Remove or reposition the interference source. 2. Set P2.112 [Bit 1] to 0 to disable AL089. 3. If the issue persists, please send the servo drive back to the distributor or contact Delta.

AL08A Auto-tuning function - Command error	
Trigger condition and causes	Condition: no command is issued when the servo drive starts the auto-tuning procedure. Causes: 1. When the command source is the controller, neither the controller nor the position register issue the command. 2. When command source is the servo drive, position 1 and 2 specify the same position. 3. The signal cable is not connected or incorrectly connected so that the servo drive cannot receive the command.
Checking methods and corrective actions	1. Make sure a command is being issued. 2. Make sure the wiring between the controller and servo drive is correct.
How to clear the alarm?	DI.ARST

AL08B Auto-tuning function - Inertia estimation error	
Trigger condition and causes	Condition: inertia estimation error occurs when the servo drive starts the auto-tuning procedure. Causes: 1. Acceleration/deceleration time is too long. 2. Rotation speed is too slow. 3. Inertia of the machine is too large.

	4. Inertia variation is too drastic.
Checking methods and corrective actions	1. The acceleration/deceleration time for the motor to rotate from 0 rpm to 3000 rpm must be within 1.5 sec. 2. The slowest speed must be no less than 200 rpm; above 500 rpm is suggested. 3. The load inertia must be no more than 50 times the motor inertia. 4. Avoid applications that require drastic variation in the inertia.
How to clear the alarm?	DI.ARST

AL08C Auto-tuning function - Pause time is too short	
Trigger condition and causes	Condition: the pause time is too short when the controller is the command source in the auto-tuning procedure. The auto-tuning algorithm requires a certain amount of time to perform the calculation. The tuning result is affected if the pause time is too short. Cause: pause time in the cycle is too short.
Checking methods and corrective actions	1. For a reciprocating motion between two points, pausing is required on the return, which has to be longer than 1 sec. 2. For rotation in a single direction, pause time is required when the motor rotates a certain number of cycles (> 2 cycles).
How to clear the alarm?	DI.ARST

AL095 Regenerative resistor disconnected	
Trigger condition and causes	The value of P1.053 (capacity of regenerative resistor) is not 0 and the external regenerative resistor or the brake is not connected. Only servo drives of 5.5 kW or above that have built-in regenerative resistors show this alarm.
Checking methods and corrective actions	1. If the regenerative brake is required, please connect the regenerative resistor. Once you connect the resistor, make sure that the value of P1.053 is correct. 2. If not using the regenerative brake, set P1.053 (capacity of regenerative resistor) to 0. If the issue persists, please send the servo drive back to the distributor or contact Delta.
How to clear the alarm?	DI.ARST

AL099 DSP firmware update	
Trigger condition and causes	EEPROM is not reset after DSP firmware is updated.
Checking methods and corrective actions	Check if the firmware is updated. Set P2.008 to 30 first and then set it to 28. Next, cycle power on the servo drive.
How to clear the alarm?	Set P2.008 to 30 and then 28. Cycle power on the servo drive.

AL521 Vibration elimination parameter error	
Trigger condition and causes	Condition: the value for the vibration elimination parameter (elasticity compensation) is not appropriate. Causes: 1. The value of vibration suppression (elasticity compensation) is incorrect. 2. The Bode plot is in error due to other variables while the operation system is analyzing the program.
Checking methods and corrective actions	Perform system analysis again and correctly set the value for the vibration elimination parameter.
How to clear the alarm?	1. Perform system analysis again and correctly set the value for the vibration elimination parameter. 2. If the issue persists, please disable the vibration elimination function P2.094 [Bit 8] & [Bit 9].

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STO type:

AL500 STO function is enabled	
Trigger condition and causes	Safe torque off function (STO) is enabled.
Checking methods and corrective actions	Safe torque off function (STO) is enabled. Please check why it is enabled.
How to clear the alarm?	1. Use DI.ARST or 0x6040.Fault Reset, or set P0.001 to 0. 2. If not using STO, plug the short circuit device into CN10 or wiring to short circuit the block. Follow the instructions in Section 3.9.3 for the STO wiring.

AL501 STO_A loss (signal loss or signal error)	
Trigger condition and causes	Loss of STO_A signal or STO_A and STO_B signals are not synchronized for more than 1 sec.
Checking methods and corrective actions	Make sure the wiring of STO_A is correct.
How to clear the alarm?	Cycle power on the servo drive.

AL502 STO_B loss (signal loss or signal error)	
Trigger condition and causes	Loss of STO_B signal or STO_A and STO_B signals are not synchronized for more than 1 sec.
Checking methods and corrective actions	Make sure the wiring of STO_B is correct.
How to clear the alarm?	Cycle power on the servo drive.

AL503 STO self-diagnostic error	
Trigger condition and causes	An error occurs during STO self-diagnosis.
Checking methods and corrective actions	Make sure the wiring of STO_A and STO_B are correct.
How to clear the alarm?	If the wiring is correct, it might be that the STO circuit is causing the error. Please contact the distributor.

Communication Type:

AL111 Buffer overflow occurs when receiving CANopen SDO	
Trigger condition and causes	SDO Rx Buffer overflow (receives more than two SDOs within 1 ms).
Checking methods and corrective actions	Check if the servo drive (master) receives or sends more than one SDO within 1 ms.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL112 Buffer overflow occurs when receiving CANopen PDO	
Trigger condition and causes	PDO Rx Buffer overflow (receives more than two PDOs of COBID within 1 ms)
Checking methods and corrective actions	Check if the servo drive (master) receives or sends more than one PDO of COBID within 1 ms.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL121 Object's index does not exist when CANopen PDO is received	
Trigger condition and causes	When the servo drive receives the PDO from the controller, the specified object's index number is incorrect so that the servo drive cannot identify it.
Checking methods and corrective actions	1. Check if the object's index for PDO mapping for the controller is correct. 2. If the index number is correct, it means this specified object is not supported by the servo drive. Please check if it is necessary to use this object, or if you can substitute a different object.
How to clear the alarm?	NMT: reset node or 0x6040 (Fault Reset)..

AL122 Object's sub-index does not exist when CANopen PDO is received	
Trigger condition and causes	When the servo drive receives the PDO from the controller, the specified object's sub-index number is incorrect so that the servo drive cannot identify it.
Checking methods and corrective actions	1. Check if the object's sub-index for PDO mapping for the controller is correct. 2. If the sub-index number is correct, it means this specified object is not supported by the servo drive. Please check if it is necessary to use this object, or if you can substitute a different object.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset.).

AL123 Data size error occurs when CANopen PDO is received	
Trigger condition and causes	Data length in the message does not match the length of the specified object.
Checking methods and corrective actions	Check if the data length for PDO mapping is changed when the servo drive receives or sends PDO.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL124 Data range error occurs when CANopen PDO is received	
Trigger condition and causes	The data value in the message is out of range for the specified object.
Checking methods and corrective actions	Check if the written range is wrong when the servo drive receives or sends PDO.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL125 CANopen object is read-only and write-protected	
Trigger condition and causes	The specified object in the message is read-only and write-protected.
Checking methods and corrective actions	Check if the object for the PDO mapping is read-only.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL126 Specified object does not support PDO mapping	
Trigger condition and causes	The specified object in the message does not support PDO mapping.
Checking methods and corrective actions	Check if the specified object allows PDO mapping when PDO is receiving or sending.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL127 CANopen PDO is write-protected when servo drive is on	
Trigger condition and causes	The specified object in the message is write-protected when the servo drive is on.
Checking methods and corrective actions	Make sure no PDO is written when servo drive is on.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL128 Error occurs when reading CANopen PDO from EEPROM	
Trigger condition and causes	An error occurs when loading the default value from ROM at start-up. All objects of CAN automatically return to the default value.
Checking methods and corrective actions	When PDO is receiving or sending, check if the error occurs because the specified object reads from EEPROM.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL129 Error occurs when writing CANopen PDO to EEPROM	
Trigger condition and causes	An error occurs when saving the current parameter value into ROM.
Checking methods and corrective actions	When PDO is receiving or sending, check if the error occurs because the specified object is written to EEPROM.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL130 Accessing address of EEPROM is out of range when using CANopen PDO	
Trigger condition and causes	The quantity of the data in the ROM is greater than the allowable space specified by the firmware. It is probably because the firmware has been updated, but the data in the ROM was stored by the old version of the firmware.
Checking methods and corrective actions	Check if the addressing in EEPROM exceeds the range for the specified object during PDO receiving or sending.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL131 CRC of EEPROM calculation error occurs when using CANopen PDO	
Trigger condition and causes	The data in ROM is damaged; all CANopen objects are automatically restored to default values.
Checking methods and corrective actions	Check if the specified object causes a CRC calculation error in EEPROM when PDO is being received or sent. Usually, this alarm is caused by an error in DSP.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL132 Parameter is write-prohibited when using CANopen PDO	
Trigger condition and causes	When using CAN object to write data to the parameter, the parameter is currently write-prohibited.
Checking methods and corrective actions	Please refer to the specified parameter description to write data to the parameter.

How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

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AL180 CANopen heartbeat or NodeGuarding error	
Trigger condition and causes	CANopen communication is cut off resulting in Heartbeat or NodeGuarding error.
Checking methods and corrective actions	1. Check if the CANopen communication is normal. 2. Check if the wiring is correctly connected.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL185 CAN Bus hardware error	
Trigger condition and causes	Condition: CAN Bus is cut off or Rx/Tx Counter error occurs more than 128 times. Cause: CAN Bus hardware error.
Checking methods and corrective actions	1. Check if the communication cable for CAN Bus is connected. 2. Check the communication quality; it is suggested that you use common grounding and shielded cable.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL186 CAN Bus Off	
Trigger condition and causes	Transmission error in CAN data.
Checking methods and corrective actions	1. Check if the cable is well connected and whether there is any noise inference. Replace the communication cable or eliminate the noise if necessary. 2. There are an excessive number of the slave stations, and the communication cycle is too short. Please lengthen the communication cycle.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL201 Error occurs when loading CANopen data	
Trigger condition and causes	Condition: an error has occurred when loading data from EEPROM. Cause: initialization error of CANopen data.
Checking methods and corrective actions	1. If the alarm is cleared after cycling power on the servo drive, it means the error occurs at the moment when reading the data. 2. If the issue persists after cycling power on the servo drive, it means the data in the EEPROM is damaged and you need to write the correct value again. See the following methods: (A) To write the default value, set P2.008 to 30 and then 28, or use CANopen object 0x1011 to complete the setting. (B) To write the current value, set CANopen object 0x1010 to complete the setting. Please refer to CANopen technical guide for ASDA-A2.
How to clear the alarm?	DI.ARST or CANopen 0x1011 (restore default parameter)

AL301 CANopen synchronization failure	
Trigger condition and causes	Condition: the servo drive fails to synchronize with the controller in CANopen IP mode. Cause: CANopen synchronization failure.
Checking methods and corrective actions	1. Make sure the communication between the servo drive and the controller is good. 2. After eliminating any problems that you find, allow the controller to re-send the SYNC signal and ensure that it is sent successfully. 3. Modify the setting for P3.009 (setting the default value is suggested).
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL302 Synchronization signal of CANopen is sent too soon	
Trigger condition and causes	Condition: when using CANopen, the synchronization signal is received too soon. Cause: the synchronization signal of CANopen is sent too soon.
Checking methods and corrective actions	1. Make sure the setting of synchronization cycle (0x1006) is identical to that of the controller. 2. Modify the setting of P3.009 (using the default value is suggested). 3. Ensure the correct time sequence of sending packets from the controller. A drift or delay in packet sending time causes synchronization failure.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

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AL303 CANopen synchronization signal timeout	
Trigger condition and causes	Condition: in CANopen IP mode, the synchronization with the controller failed. Cause: timeout of CANopen synchronization signal.
Checking methods and corrective actions	1. Make sure the communication quality is good. 2. Make sure the setting of synchronization cycle (0x1006) is identical to that of the controller. 3. Modify the setting of P3.009 (using default value is suggested). 4. Ensure the correct time sequence for sending packets from the controller. A drift or delay in packet sending time causes synchronization failure.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL304 Invalid CANopen IP command	
Trigger condition and causes	Condition: command cannot be sent when in CANopen IP mode. Cause: invalid CANopen IP command.
Checking methods and corrective actions	The computing time in IP mode takes too long. Please disable the USB monitoring function.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL305 SYNC period error	
Trigger condition and causes	Condition: CANopen 301 Obj 0x1006 Data Error Cause: SYNC period error.
Checking methods and corrective actions	Check the value of 0x1006. If it is smaller than or equal to 0, the alarm occurs.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL401 NMT reset command is received while servo is on	
Trigger condition and causes	NMT reset command is received while servo drive is on.
Checking methods and corrective actions	Check if the NMT reset command is received while the servo drive is on. Use NMT.reset or 0x6040 (fault reset).
How to clear the alarm?	DI.ARST

Motion control type:

AL207 Parameter group of PR#8 is out of range	
Trigger condition and causes	Condition: parameter group for PR#8, P_Group, is out of range. Cause: the group for PR#8 command source exceeds the range.
Checking methods and corrective actions	Writing parameter using PR procedure: the parameter group of command source exceeds the range. Please check the setting.
How to clear the alarm?	DI.ARST or set P0.001 to 0.

AL209 Parameter number of PR#8 is out of range	
Trigger condition and causes	Condition: parameter number for PR#8 is out of range. Cause: parameter number is out of range.
Checking methods and corrective actions	Writing parameter using PR procedure: parameter number of PR#8 is out of range. Please check the setting.
How to clear the alarm?	DI.ARST or set P0.001 to 0.

AL213 Parameter setting of PR#8 is in error	
Trigger condition and causes	Condition: when using PR#8 to write parameters, the parameter value is incorrect. Cause: parameter value of PR#8 is in error.
Checking methods and corrective actions	Make sure the parameter value is within the correct range.
How to clear the alarm?	DI.ARST or set P0.001 to 0.

AL215 Write parameters: read-only	
Trigger condition and causes	Condition: write parameters using PR procedure: the parameter is read-only. Cause: an error occurs when writing parameters with PR#8 command.
Checking methods and corrective actions	The specified parameter is read-only.
How to clear the alarm?	DI.ARST or set P0.001 to 0.

AL217 Write parameters: parameter locked	
Trigger condition and causes	Condition: write parameters using PR procedure: the parameter is write-protected when the servo drive is on or the parameter's value exceeds the range. Condition: an error occurs when writing parameters with PR#8 command.
Checking methods and corrective actions	Please write the parameters when the servo drive is off and make sure the parameter's value is within the range.
How to clear the alarm?	Modify the PR command and the parameter.

AL231 Monitoring item for PR Write command is out of range	
Trigger condition and causes	Condition: the value of the monitoring item for PR#8, Sys_Var, exceeds the range. Cause: the value for the monitoring item is out of range.
Checking methods and corrective actions	Please check the code range when writing the monitoring code and make sure it is within the allowable range.
How to clear the alarm?	Reset the alarm or set P0.001 to 0.

AL235 Absolute positioning command error	
Trigger condition and causes	Condition: execute a position command after the feedback position counter overflows. Cause: feedback position counter overflows.
Checking methods and corrective actions	Incremental system: When the motor keeps operating in one direction, this leads to overflow of the position feedback register (FB_PUU), and the coordinate system cannot display the correct position. Executing a positioning command after overflow results in an error. Please use the scope to check if the feedback position has overflowed and then execute the homing procedure. Absolute system: This error occurs when executing the absolute positioning command in the following situations: 1. Feedback position register (FB_PUU) overflows. 2. Setting for P1.001.Z changes, but homing has not been completed yet. 3. E-Gear ratio (P1.044 and P1.045) changes, but homing has not been completed yet. 4. The function to return to the original point is triggered, but homing has not been completed yet. 5. When AL060 or AL062 occurs, please use the scope to check if the

	feedback position has overflowed. Check steps 1—4 above and perform the homing procedure.
How to clear the alarm?	Perform homing procedure.

AL237 Indexing coordinate is undefined	
Trigger condition and causes	Condition: using the indexing function and execute positioning command before defining the start point of the indexing coordinate. Cause: The servo drive cannot identify this coordinate system.
Checking methods and corrective actions	Check if the indexing coordinate has been defined: 1. Perform the homing procedure before using the indexing function. 2. After alarm occurs, use DI.ARST or set P0.001 to 0 to clear the alarm. 3. This alarm is also cleared when you power on the servo.
How to clear the alarm?	DI.ARST or set P0.001 to 0.

AL283 Software positive limit	
Trigger condition and causes	Condition: the target position specified by the command exceeds the software positive limit. Cause: reaching the software positive limit.
Checking methods and corrective actions	When you enable the software positive limit function, this alarm is determined by the command instead of by the feedback position. The alarm may occur while the actual position is still within the allowable range. The software positive limit is determined by the Position command instead of the actual feedback position because the command is sent before the feedback is received. That is, the actual position may have not reached the limit when the limit protection has been triggered. To fix this, you can set a proper deceleration time to satisfy the application requirement. Please see description for P5.003.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL285 Software negative limit	
Trigger condition and causes	Condition: target position specified by the command is less than the software negative limit. Cause: the software negative limit is triggered.
Checking methods and corrective actions	The software negative limit is determined by the Position command instead of the actual feedback position because the command is sent before the feedback is received. That is, the actual position may have not reached the limit when the limit protection has been triggered. To fix this, you can set a

	proper deceleration time for the application. Please refer to the description for P5.003.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL289 Feedback position counter overflows	
Trigger condition and causes	Feedback position counter overflows.
Checking methods and corrective actions	1. Please set the gear ratio according to the total traveling distance of the absolute motor and the actual application requirements to avoid the feedback position counter overflow. 2. If P2.069.Z is set to 1 (prevent index coordinate overflow function), please set P2.070 bit 2 to 1.
How to clear the alarm?	NMT: reset node or 0x6040 (fault reset).

AL380 Position offset alarm for DO.MC_OK	
Trigger condition and causes	DO.MC_OK is on and then goes off.
Checking methods and corrective actions	Please refer to the description of P1.048. After DO.MC_OK is on, DO.MC_OK goes off because DO.TPOS turns off. There might be an external force causing the position deviation of the motor after positioning is completed. You can disable this alarm by setting P1.048.Y to 0.
How to clear the alarm?	DI.ARST or set P0.001 to 0.

AL3F1 Absolute index coordinate undefined	
Trigger condition and causes	Condition: in communication mode (CANopen, DMCNET, and EtherCAT), an absolute positioning command is issued before absolute coordinate system is created. Causes: 1. The absolute coordinate system has not been created. 2. Overflow occurs since the motor keeps rotating in the same direction.
Checking methods and corrective actions	1. Create an absolute coordinate system. 2. Set the coordinate system origin again.
How to clear the alarm?	Set the origin again.

AL400 Index coordinate error	
Trigger condition and causes	Condition: P1.044 x P2.052 x 4 has to be less than 2^31. Cause: value of P2.052 is set too low and causes the index coordinate error.
Checking methods and corrective actions	Check if the value of P2.052 is within the allowable setting range. If the setting value is too low, an index coordinate error occurs. Please adjust the value of P2.052.
How to clear the alarm?	DI.ARST

AL404 Value of PR special filter setting is too high	
Trigger condition and causes	Condition: the value of the PR special filter (P1.022) is set too high so that the following error exceeds the range. Cause: following error of internal position exceeds the allowable range.
Checking methods and corrective actions	Check the setting of P1.022. If the value is too high, the following error exceeds the allowable range faster. Please adjust the value of P1.022.
How to clear the alarm?	DI.ARST

AL555 System failure	
Trigger condition and causes	DSP processing error.
Checking methods and corrective actions	If this alarm occurs, please send the servo drive directly back to Delta without making any modification.
How to clear the alarm?	N/A

AL809 PR Arithmetic operation parmeter error or secondary platform error	
Trigger condition and causes	Condition: an error occurs when the servo drive decodes the motion command. Cause: The PR arithmetic operation parameters have to be compiled by the ASDA-Soft software before being downloaded to the servo drive. Directly editing the PR arithmetic operation parameters through the panel or controller without recompiling the parameters in ASDA-Soft triggers AL809.
Checking methods and corrective actions	1. Make sure you edit PR arithmetic operation parameters through ASDA-Soft. Do not directly modify these parameters with the panel or controller. 2. If this alarm occurs when the servo is not in PR mode, please save the parameter file and contact the distributor.

	3. For advanced users: you can save the scope screenshot when the alarm occurs. Set P5.007 and P0.001 for the two channels to monitor the status and save the scope.
How to clear the alarm?	Cycle power on the servo drive.

Specifications Appendix A

A

A.1 ASDA-A3 series servo drive

A.1.1 Specification of the ASDA-A3 servo drive

ASDA-A3			100 W	200 W	400 W	750 W	1 kW	1.5 kW	2 kW	3 kW
			01	02	04	07	10	15	20	30
Power	Phase / Voltage		Single-phase / Three-phase 220 V_{AC}						Three-phase 220 V_{AC}	
Power	Permissible voltage		Single-phase / Three-phase 200 – 230 V_{AC}, -15% to 10%						Three-phase 200 – 230 V_{AC}, -15% to 10%	
Power	Input current (3 PH) Unit: Arms		0.67	1.34	2.67	5.01	6.68	10.02	13.36	20.05
Power	Input current (1 PH) Unit: Arms		1.16	2.31	4.63	8.68	11.57	17.36	-	-
Power	Continuous output current Unit: Arms		0.9	1.55	2.6	5.1	7.3	8.3	13.4	19.4
Power	Max. instantaneous output current: Arms		3.54	7.07	10.61	21.21	24.75	35.36	53.03	70.71
Cooling method			Air convection cooling			Fan cooling				
Encoder resolution			24-bit (16777216 p/rev)							
Main circuit control			SVPWM control							
Control mode			Manual / Auto							
Regenerative resistor			N/A		Built-in					
Position control mode	Pulse type (except DMCNET mode)		Pulse + Direction, A phase + B phase, CCW pulse + CW pulse							
Position control mode	Max. input pulse frequency (except DMCNET mode)		Pulse + Direction: 4 Mpps; CCW pulse + CW pulse: 4 Mpps; A phase + B phase: single-phase 4 Mpps; Open collector: 200 Kpps							
Position control mode	Command source		External pulse (except DMCNET mode) / Register							
Position control mode	Smoothing strategy		Low-pass and P-curve filter							
Position control mode	E-Gear ratio		E-gear ratio: N/M multiple (1 / 4 < N / M < 262144) N: 1 – 536870911 / M: 1 – 2147483647							
Position control mode	Torque limit		Parameter settings							
Position control mode	Feed forward compensation		Parameter settings							
Speed control mode	Analog command input (except DMCNET mode)	Voltage range	0 to ±10 V_{DC}							
Speed control mode	Analog command input (except DMCNET mode)	Resolution	15-bit							
Speed control mode	Analog command input (except DMCNET mode)	Input resistance	1 MΩ							
Speed control mode	Analog command input (except DMCNET mode)	Time constant	25 μs							
Speed control mode	Speed control range[*1]		1: 6000							
Speed control mode	Command source		External analog command (except DMCNET mode) / Register							
Speed control mode	Smoothing strategy		Low-pass and S-curve filter							
Speed control mode	Torque limit		Parameter settings / Analog input (except DMCNET mode)							
Speed control mode	Bandwidth		Maximum 3.1 kHz (closed-loop)							

ASDA-A3			100 W	200 W	400 W	750 W	1 kW	1.5 kW	2 kW	3 kW
			01	02	04	07	10	15	20	30
	Speed accuracy*2		±0.01% at 0 to 100% load fluctuation							
			±0.01% at ±10% power fluctuation							
			±0.01% at 0 ˚C to 50 ˚C ambient temperature fluctuation							
Torque control mode	Analog command input (except DMCNET mode)	Voltage range	0 to ±10 V_{DC}							
		Input resistance	1 MΩ							
		Time constant	25 μs							
	Command source		External analog command (except DMCNET mode) / Register							
	Smoothing strategy		Low-pass filter							
	Speed limit		Parameter settings / Analog input (except DMCNET mode)							
Analog monitor output			Monitor signal can be set by parameters (voltage output range: ± 8V); resolution:10-bit							
Digital input / output	Input		Servo on, Fault reset, Gain switch, Pulse clear, Zero clamp, Command input reverse control, Internal position command trigger, Torque limit, Speed limit, Internal position command selection, Motor stop, Speed command selection, Speed / position mode switching, Speed/torque mode switching, Torque / position mode switching, PT / PR command switching, Emergency stop, Positive / negative limit, Original point, Forward/reverse operation torque limit, Homing activated, E-CAM engage, Forward/reverse JOG input, Event trigger, E-Gear N selection, Pulse input prohibition *DMCNET mode is not included for the DI mentioned above. When using DMCNET mode, it is suggested that you use communication for DI input. DI only supports emergency stop, forward / reverse limit and homing.							
	Output		A, B, Z line driver output							
			Servo on, Servo ready, Zero speed, Target speed reached, Target position reached, Torque limiting, Servo alarm, Brake control, Homing completed, Early warning for overload, Servo warning, Position command overflows, Software negative limit (reverse direction), Software positive limit (forward direction), Internal position command completed, Capture procedure completed, Servo procedure completed, Master position area of E-CAM							
Protective function			Overcurrent, Overvoltage, Undervoltage, Overheat, Regeneration error, Overload, Excessive speed deviation, Excessive position deviation, Encoder error, Adjustment error, Emergency stop, Negative / positive limit error, Excessive deviation of full-closed loop control, Serial communication error, Rst leak phase, Serial communication timeout, Short-circuit protection for terminals U, V, W and CN1, CN2, CN3							
Communication interface			RS-485 / CANopen / USB							

A

ASDA-A3		100 W	200 W	400 W	750 W	1 kW	1.5 kW	2 kW	3 kW
		01	02	04	07	10	15	20	30
Environment	Installation site	Indoors (avoid direct sunlight), no corrosive vapor (avoid fumes, flammable gases, and dust)							
	Altitude	Altitude 1000 m or lower above sea level							
	Atmospheric pressure	86 – 106 kPa							
	Operating temperature	0˚C – 55˚C (If operating temperature is above 45˚C, forced cooling is required)							
	Storage temperature	-20˚C to 65˚C							
	Humidity	Under 0 – 90% RH (non-condensing)							
	Vibrating	9.80665m/s2 (1 G) less than 20 Hz, 5.88 m/s2 (0.6 G) 20 to 50 Hz							
	IP rating	IP20							
	Power system	TN system[*3*4]							
	Approvals	IEC/EN 61800-5-1, UL 508C							

Note:

*1. Within the rated load, the speed ratio is: the minimum speed (smooth operation) / rated speed.

*2. Within the rated speed, the velocity correction ratio is: (rotational speed with no load – rotational speed with full load) / rated speed.

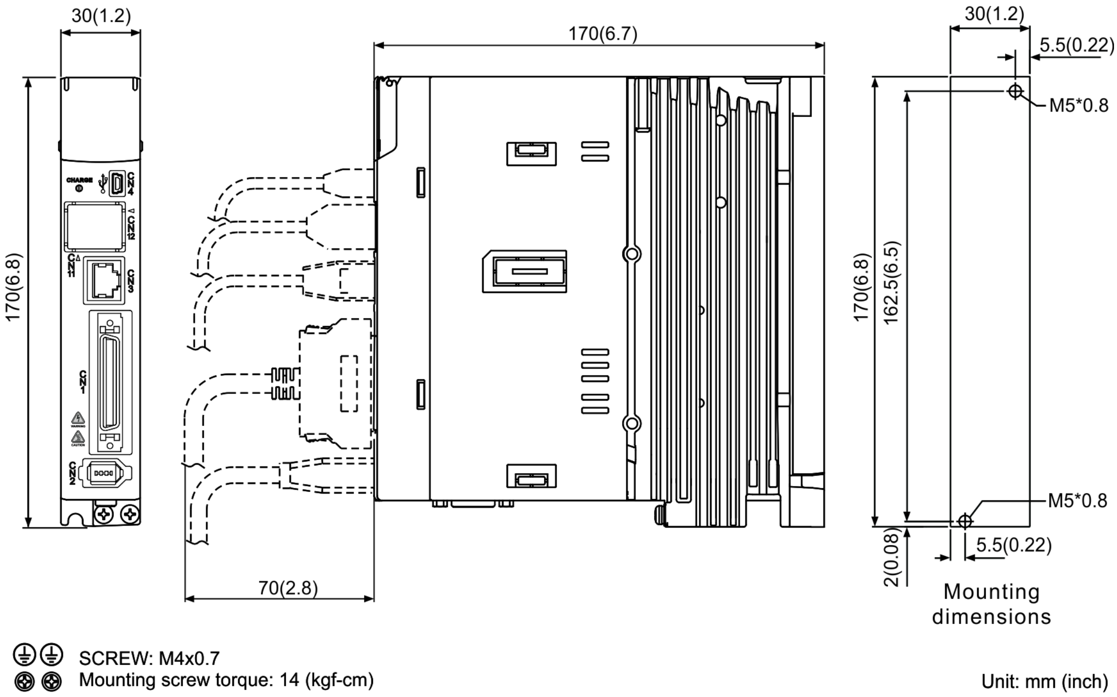
*3. TN system: the neutral point of the power system connects directly to the ground. The exposed metal components connect to the ground through the protective ground conductor.

*4. Please use a single-phase three-wire power system for the single-phase power model.

A

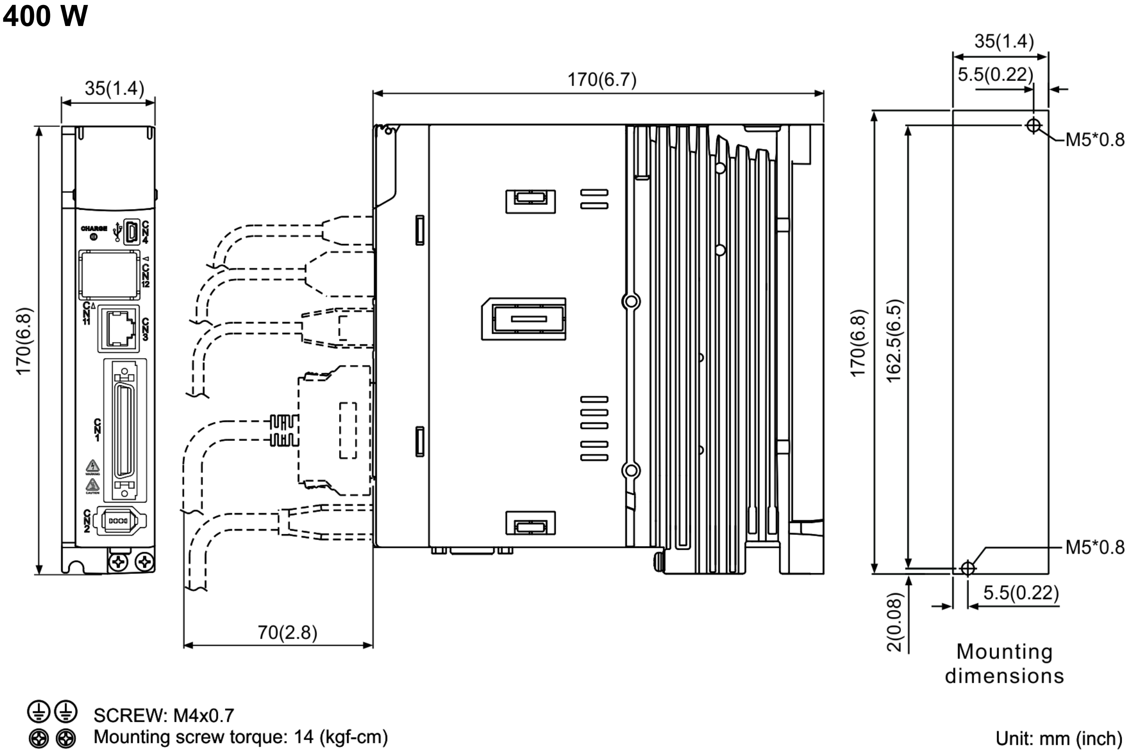
A.1.2 Dimensions of the servo drive

100 W / 200 W



Weight	0.84 kgf (1.85 lbf)

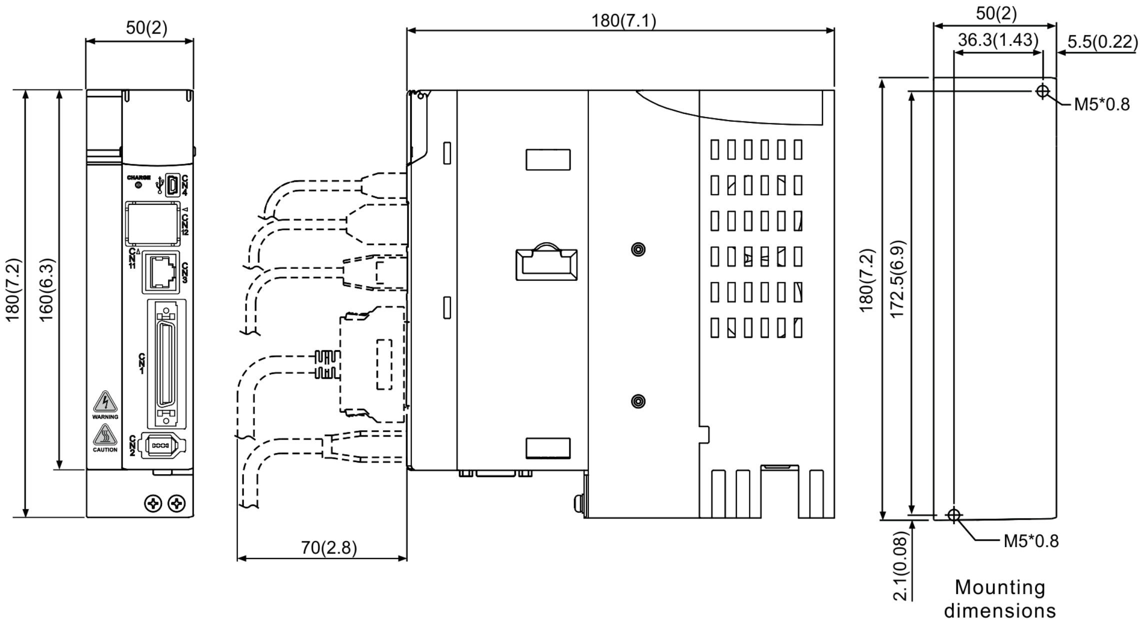
400 W



Weight	0.92 kgf (2.03 lbf)

A

750 W / 1 kW / 1.5 kW

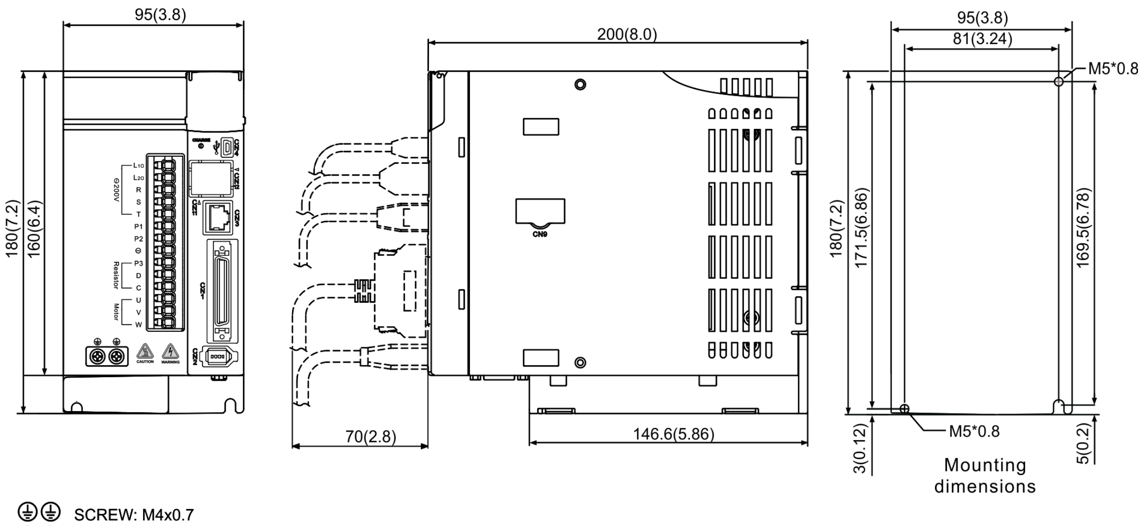


SCREW: M4x0.7
Mounting screw torque: 14 (kgf-cm)

Unit: mm (inch)

Weight	1.3 kgf (2.87 lbf)

2 kW / 3 kW



SCREW: M4x0.7
Mounting screw torque: 14 (kgf-cm)

Unit: mm (inch)

Weight	2.7 kgf (5.95 lbf)

Note: dimensions and weights of the servo drive may be updated without prior notice.

A.2 ECM-A3 series servo motor

ECM-A3 series servo motor

ECM	-	A	3	H	-	C	Y	06	04	R	S	1
(1)		(2)	(3)	(4)		(5)	(6)	(7)	(8)	(9)	(10)	(11)

(1) Product name

ECM: Electronic Commutation Motor

(2) Motor type

A: AC Servo Motor

(3) Name of the Series

3: A3 series

(4) Inertia type

H: high inertia

L: low inertia

(5) Rated voltage and speed

C: Rated voltage: 200V; Speed: 3,000 rpm

(6) Encoder type

Y: Absolute type (resolution of single turn: 24-bit; multiple turns: 16-bit)

(7) Motor frame size

04: 40 mm

06: 60 mm

08: 80 mm

(8) Rated power output

Number	Specification	Number	Specification
0F	50 W	04	400 W
01	100 W	07	750 W
02	200 W	-	-

A

(9) Shaft type and oil seal

	w/o brake w/o oil seal	with brake w/o oil seal	w/o brake with oil seal	with brake with oil seal
Round shaft (with fixed screw holes)	-	-	C*	D*
Keyway (with fixed screw holes)	P*	Q*	R	S

Note: * signifies that this motor model is coming soon.

(10) Shaft diameter

S: standard

7: specific (14 mm)

(11) Special code

1: standard

A.2.1 ECM-A3L low inertia series servo motor

A

ECM-A3L	040F	0401	0602	0604	0804	0807
Rated power (kW)	0.05	0.1	0.2	0.4	0.4	0.75
Rated torque (N-m)*1	0.159	0.32	0.64	1.27	1.27	2.39
Max. torque (N-m)	0.557	1.12	1.92	3.82	3.82	7.17
Rated speed (rpm)	3000					
Max. speed (rpm)	6000					
Rated current (A)	0.67	0.89	1.45	2.65	2.6	5.1
Max. instantaneous current (A)	2.62	3.5	5.0	8.5	8.6	15.9
Power rating (kW/s)	10.9	25.3	45.5	107.5	45.4	111.4
Rotor inertia (× 10^{-4}kg.m^2)	0.0231	0.0405	0.09	0.15	0.355	0.513
Mechanical constant (ms)	1.31	0.817	0.64	0.41	0.68	0.40
Torque constant-KT (N-m/A)	0.237	0.36	0.44	0.48	0.49	0.469
Voltage constant-KE (mV/(rpm))	9.28	13.6	16.4	18.0	17.9	17
Armature resistance (Ohm)	11.9	9.47	4.9	2.27	1.6	0.6
Armature inductance (mH)	18.6	16.2	18.52	10.27	10.6	4.6
Electric constant (ms)	1.56	1.71	3.78	4.52	6.63	7.67
Insulation class	Class A (UL), Class B (CE)					
Insulation resistance	> 100 MΩ, DC 500V					
Insulation strength	1.8k Vac, 1 sec					
Weight (w/o brake) (kg)	0.38	0.5	1.1	1.4	2.05	2.8
Weight (with brake) (kg)	0.68	0.8	1.6	1.9	2.85	3.6
Max. radial loading (N)	78	78	245	245	392	392
Max. axial loading (N)	54	54	74	74	147	147
Power rating (kW/s) (with brake)	10.3	24.5	37.24	89.6	41.0	95.4
Rotor inertia (× 10^{-4}kg.m^2) (with brake)	0.0246	0.0418	0.12	0.18	0.393	0.599
Mechanical constant (ms) (with brake)	1.39	0.826	0.88	0.47	0.75	0.47
Brake holding torque [Nt-m (min)] *2	0.32	0.32	1.3	1.3	2.5	2.5
Brake power consumption (at 20˚C)[W]	7.3	7.3	7.2	7.2	8.4	8.4
Brake release time [ms (Max)]	5	5	20	20	20	20
Brake pull-in time [ms (Max)]	25	25	50	50	70	70
Vibration grade (μm)	V15					
Operating temperature (˚C)	0˚C – 40˚C					
Storage temperature (˚C)	-10˚C to 80˚C					

ECM-A3L	040F	0401	0602	0604	0804	0807
Operating humidity	20 – 90%RH (non-condensing)					
Storage humidity	20 – 90%RH (non-condensing)					
Vibration capacity	2.5 G					
IP rating	IP67 (when using waterproof connectors, or when an oil seal is fitted to the rotating shaft (for an oil seal model))					
Approvals						

Note:

*1. The rated torque is the continuous permissible torque between 0˚C – 40˚C operating temperature which is suitable for the following heat sink dimensions.

ECM-A3L_ _ 04 / 06 / 08: 250 mm x 250 mm x 6 mm

Material: aluminum - F40, F60, F80

*2. The built-in servo motor brake is only for clamping purposes. Do not use it to decelerate or stop the motor.

A

A.2.2 ECM-A3H high inertia series servo motor

ECM-A3H	040F	0401	0602	0604	0804	0807
Rated power (kW)	0.05	0.1	0.2	0.4	0.4	0.75
Rated torque (N-m)[*1]	0.159	0.32	0.64	1.27	1.27	2.39
Max. torque (N-m)	0.557	1.12	2.24	4.45	4.44	8.36
Rated speed (rpm)	3000					
Max. speed (rpm)	6000					
Rated current (A)	0.67	0.9	1.45	2.65	2.6	4.5
Max. instantaneous current (A)	2.68	3.52	5.4	9.9	9.4	16.6
Power rating (kW/s)	5.89	13.8	16.4	35.8	17. 5	37.8
Rotor inertia (× 10^{-4}kg.m^2)	0.043	0.0742	0.25	0.45	0.92	1.51
Mechanical constant (ms)	2.49	1.38	1.37	0.96	1.31	0.91
Torque constant-KT (N-m/A)	0.241	0.356	0.44	0.48	0.49	0.53
Voltage constant-KE (mV/(rpm))	9.54	13.2	16.4	17.2	17.9	18.7
Armature resistance (Ohm)	12.5	8.34	3.18	1.68	1.19	0.57
Armature inductance (mH)	13.3	11	8.15	4.03	4.2	2.2
Electric constant (ms)	1.07	1.32	2.14	2.40	3.53	3.86
Insulation class	Class A (UL), Class B (CE)					
Insulation resistance	> 100 MΩ, DC 500V					
Insulation strength	1.8k Vac, 1 sec					
Weight (w/o brake) (kg)	0.38	0.5	1.1	1.4	2.05	2.8
Weight (with brake) (kg)	0.68	0.8	1.6	1.9	2.85	3.6
Max. radial loading (N)	78	78	245	245	392	392
Max. axial loading (N)	54	54	74	74	147	147
Power rating (kW/s) (with brake)	5.68	13.6	15.17	34.32	15.1	34.4
Rotor inertia (× 10^{-4}kg.m^2) (with brake)	0.0446	0.0755	0.28	0.48	1.07	1.66
Mechanical constant (ms) (with brake)	2.58	1.4	1.52	1.01	1.53	1
Brake holding torque [Nt-m (min)][*2]	0.32	0.32	1.3	1.3	2.5	2.5
Brake power consumption (at 20˚C)[W]	7.3	7.3	7.2	7.2	8.4	8.4
Brake release time [ms (Max)]	5	5	20	20	20	20
Brake pull-in time [ms (Max)]	25	25	50	50	70	70
Vibration grade (μm)	V15					
Operating temperature (˚C)	0˚C – 40˚C					
Storage temperature (˚C)	-10˚C to 80˚C					

ECM-A3H	040F	0401	0602	0604	0804	0807
Operating humidity	20 – 90%RH (non-condensing)					
Storage humidity	20 – 90%RH (non-condensing)					
Vibration capacity	2.5 G					
IP rating	IP67 (when using waterproof connectors, or when an oil seal is fitted to the rotating shaft (for an oil seal model))					
Approvals	CE					

Note:

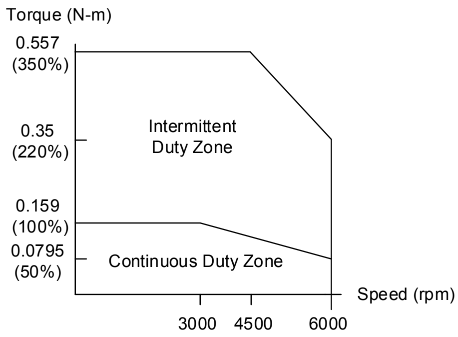
*1. The rated torque is the continuous permissible torque between 0 – 40˚C operating temperature which is suitable for the following heat sink dimensions.

ECM-A3L_ _ 04 / 06 / 08: 250 mm x 250 mm x 6 mm

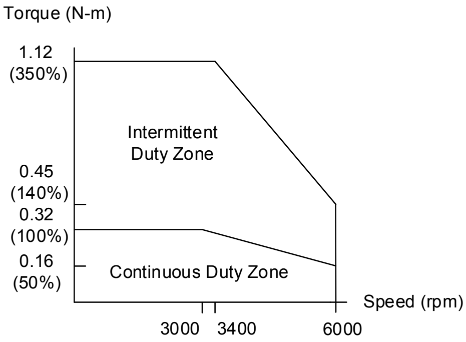
Material: Aluminum - F40, F60, F80

*2. The built-in servo motor brake is only for clamping purposes. Do not use it to decelerate or stop the motor.

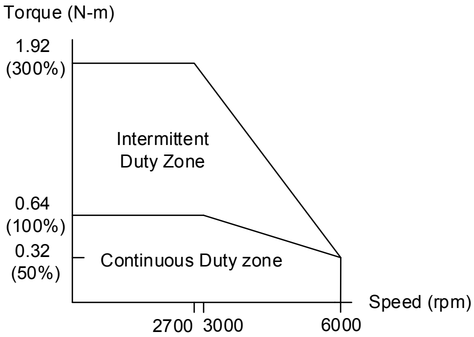
A.2.3 Torque features (T-N curves)



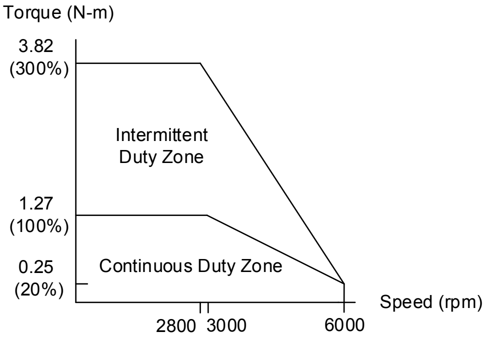
ECM-A3L-C△040F□S1



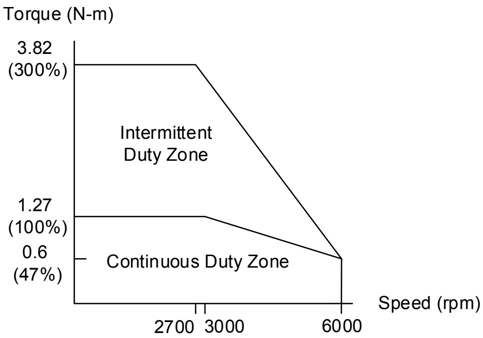
ECM-A3L-C△0401□S1



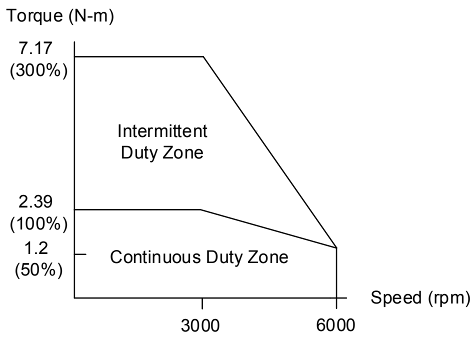
ECM-A3L-C△0602□S1



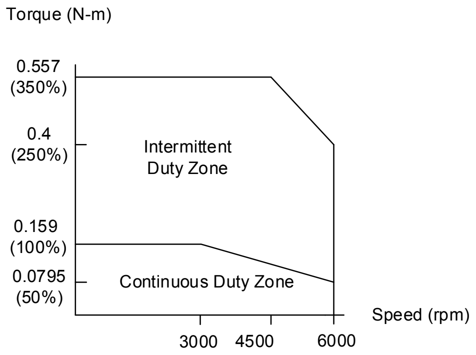
ECM-A3L-C△0604□S1



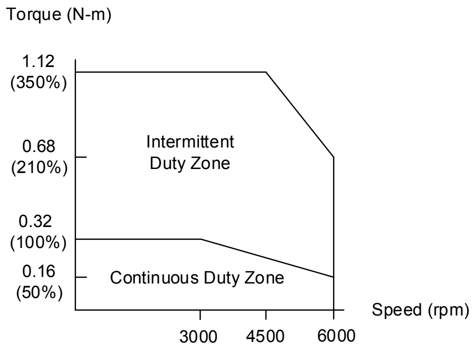
ECM-A3L-C△0804□S1



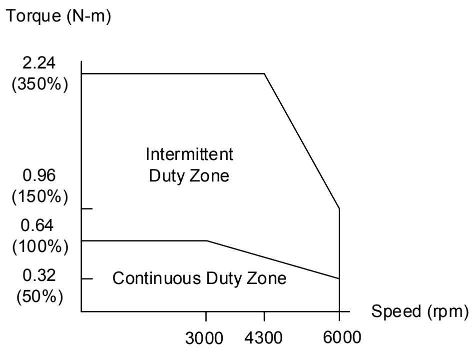
ECM-A3L-C△0807□S1



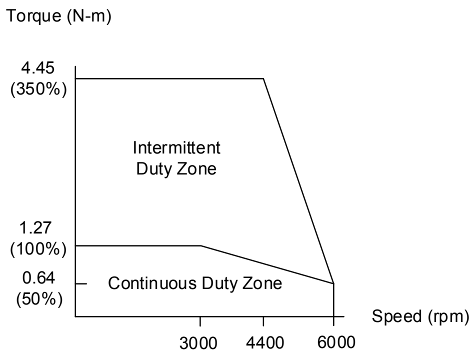
ECM-A3H-C△040F□S1



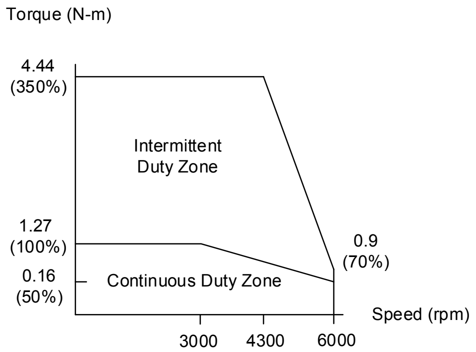
ECM-A3H-C△0401□S1



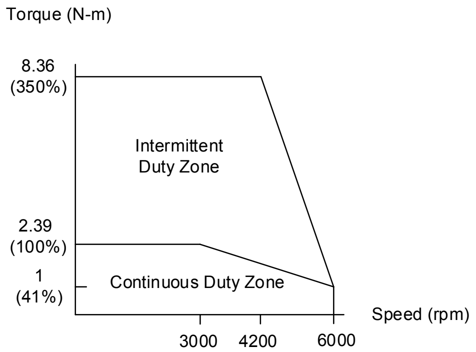
ECM-A3H-C△0602□S1



ECM-A3H-C△0604□S1



ECM-A3H-C△0804□S1



ECM-A3H-C△0807□S1

Note: △ in motor model name represents the encoder type; □ represents the shaft type and oil seal.

A.2.4 Overload features

Definition of overload protection

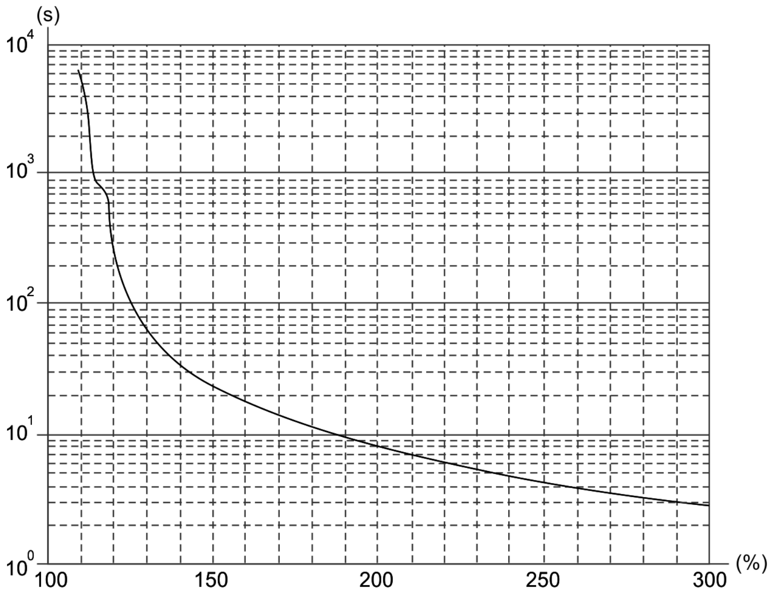
The overload protection prevents the motor from overheating.

Causes of overloading

1. The motor's rated torque exceeds the rated range and the operation time is too long.
2. The inertia ratio is too high and the motor frequently accelerates and decelerates.
3. An incorrect connection between the power cable and the encoder wiring.
4. Incorrect servo gain setting causes resonance in the motor.
5. You operate a motor with a built-in brake without releasing the brake.

Graph of load and operating time

Low inertia (ECM-A3L series)



Load	Operating time
120%	263.8 s
140%	35.2 s
160%	17.6 s
180%	11.2 s
200%	8 s
220%	6.1 s
240%	4.8 s
260%	3.9 s
280%	3.3 s
300%	2.8 s

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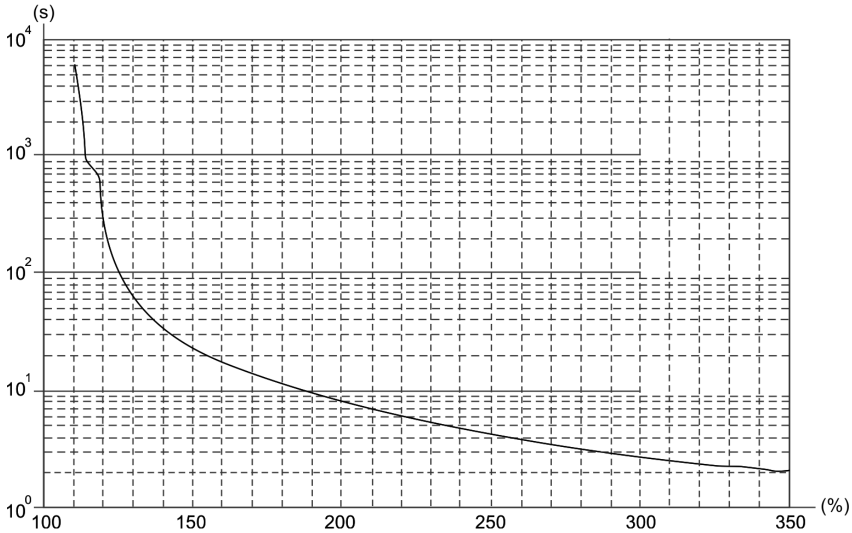
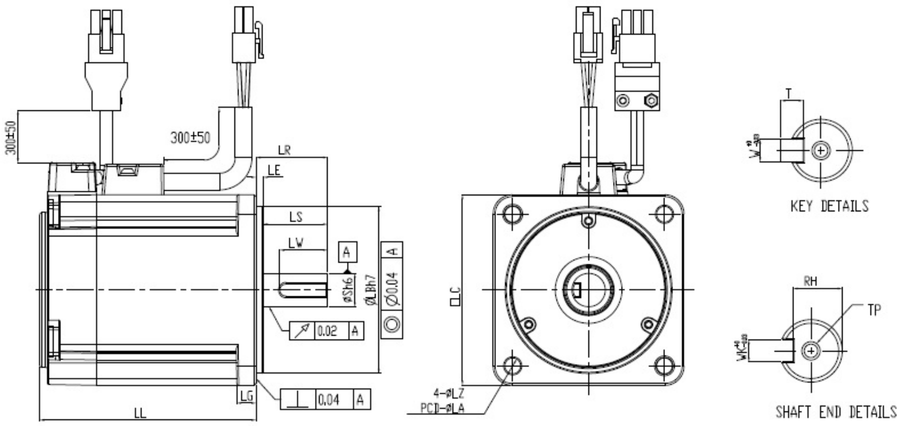
High inertia (ECM-A3H series)



Load	Operating time
120%	263.8 s
140%	35.2 s
160%	17.6 s
180%	11.2 s
200%	8 s
220%	6.1 s
240%	4.8 s
260%	3.9 s
280%	3.3 s
300%	2.8 s
350%	2.1 s

A.2.5 Dimensions of ECM-A3L/A3H series servo motor

Motor frame size: 80 mm and below



Model	C[1]040F[2]S[3]	C[1]0401[2]S[3]	C[1]0602[2]S[3]	C[1]0604[2]S[3]	C[1]0804[2]7[3]	C[1]0807[2]S[3]
LC	40	40	60	60	80	80
LZ	4.5	4.5	5.5	5.5	6.6	6.6
LA	46	46	70	70	90	90
S	$8(^{+0}_{-0.009})$	$8(^{+0}_{-0.009})$	$14(^{+0}_{-0.011})$	$14(^{+0}_{-0.011})$	$14(^{+0}_{-0.011})$	$19(^{+0}_{-0.013})$
LB	$30(^{+0}_{-0.021})$	$30(^{+0}_{-0.021})$	$50(^{+0}_{-0.025})$	$50(^{+0}_{-0.025})$	$70(^{+0}_{-0.030})$	$70(^{+0}_{-0.030})$
LL (w/o brake)	70.6	85.3	84	106	93.7	115.8
LL (with brake)	105.4	120.1	117.6	139.7	131.2	153.2
LS	21.5	22.5	27	27	27	37
LR	25	25	30	30	30	40
LE	2.5	2.5	3	3	3	3
LG	5	5	7.5	7.5	8	8
LW	16	16	20	20	20	25
RH	6.2	6.2	11	11	11	15.5
WK	3	3	5	5	5	6
W	3	3	5	5	5	6
T	3	3	5	5	5	6
TP	M3 Depth 6	M3 Depth 6	M4 Depth 8	M4 Depth 8	M4 Depth 8	M6 Depth 10

Note: [1] in motor model name represents the encoder type; [2] represents the shaft type and oil seal; [3] represents a special code.

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A.3 ECMC series servo motor

ECMC series servo motor

ECM	C	-	C	W	13	08	R	S
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)

(1) Product name

ECM: Electronic Commutation Motor

(2) Motor type

C: High-Precision AC Servo Motor (recommended for CNC applications)

(3) Series

C: Rated voltage: 200V; Speed: 3,000 rpm

E: Rated voltage: 200V; Speed: 2,000 rpm

F: Rated voltage: 200V; Speed: 1,500 rpm

(4) Encoder type

W: Absolute type (resolution of single turn: 22-bit; multiple turns: 16-bit)

(5) Motor frame size

10: 100 mm

13: 130 mm

18: 180 mm

(6) Rated power output

Number	Specification	Number	Specification
08	850 W	18	1.8 kW
10	1.0 kW	20	2.0 kW
13	1.3 kW	30	3.0 kW
15	1.5 kW	-	-

(7) Shaft type and oil seal

	w/o brake w/o oil seal	with brake w/o oil seal	w/o brake with oil seal	with brake with oil seal
Round shaft (with fixed screw holes)	-	-	C	D
Keyway (with fixed screw holes)	P	Q	R	S

(8) Shaft diameter

S: standard

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A.3.1 ECMC series servo motor with frame size 100 – 180

ECMC	C$\boxed{1}$10	E$\boxed{1}$13			F$\boxed{1}$13			E$\boxed{1}$18		F$\boxed{1}$18
	10	10	15	20	08	13	18	20	30	30
	Medium inertia				High inertia			Medium inertia		
Rated power (kW)	1.0	1.0	1.5	2.0	0.85	1.3	1.8	2.0	3.0	3.0
Rated torque (N-m)[*1]	3.18	4.77	7.16	9.55	5.41	8.34	11.48	9.55	14.32	19.10
Max. torque (N-m)	9.54	14.3	21.5	28.7	13.8	23.3	28.7	28.7	43	57.3
Rated speed (rpm)	3000	2000			1500			2000		1500
Max. speed (rpm)	5000	3000			3000			3000		3000
Rated current (A)	7.3	5.6	8.3	11.01	7.1	12.6	13	11.22	16.1	19.4
Max. instantaneous current (A)	21.9	16.8	24.9	33	19.4	38.6	36	33.7	48.3	58.2
Power rating (kW/s)	38.1	27.1	45.9	62.5	21.52	34.78	53	26.3	37.3	66.4
Rotor inertia (× 10^{-4}kg.m^2)	2.65	8.41	11.2	14.6	13.6	20	24.9	34.7	55	55
Mechanical constant (ms)	0.74	1.51	1.10	0.96	2.43	1.62	1.7	1.62	1.06	1.28
Torque constant-KT (N-m/A)	0.44	0.85	0.87	0.87	0.76	0.66	0.88	0.85	0.89	0.98
Voltage constant-KE (mV/(rpm))	16.8	31.9	31.8	31.8	29.2	24.2	32.2	31.4	32.0	35
Armature resistance (Ohm)	0.20	0.47	0.26	0.174	0.38	0.124	0.185	0.119	0.052	0.077
Armature inductance (mH)	1.81	5.99	4.01	2.76	4.77	1.7	2.6	2.84	1.38	1.27
Electric constant (ms)	9.3	12.9	15.3	15.9	12.6	13.7	14.1	23.9	26.4	16.5
Insulation class	Class A (UL), Class B (CE)									
Insulation resistance	> 100 MΩ, DC 500V									
Insulation strength	1.8k Vac, 1 sec									
Weight (w/o brake) (kg)	4.3	7.0	7.5	7.8	8.6	9.4	10.5	13.5	18.5	18.5
Weight (with brake) (kg)	4.7	8.4	8.9	9.2	10	10.8	11.9	17.5	22.5	22.5
Max. radial loading (N)	490							1176	1470	
Max. axial loading (N)	98							490		
Power rating (kW/s) (with brake)	30.4	24.9	43.1	57.4	19.8	32.7	50.3	24.1	35.9	63.9
Rotor inertia (× 10^{-4}kg.m^2) (with brake)	3.33	9.14	11.9	15.9	14.8	21.3	26.2	37.76	57.1	57.1
Mechanical constant (ms) (with brake)	0.93	1.64	1.19	1.05	2.65	1.73	1.79	1.77	1.10	1.33
Brake holding torque [Nt-m (min)][*2]	8	10						25		
Brake power consumption (at 20˚C)[W]	18.7	19						20.4		

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ECMC	C$\boxed{1}$10	E$\boxed{1}$13			F$\boxed{1}$13			E$\boxed{1}$18		F$\boxed{1}$18
	10	10	15	20	08	13	18	20	30	30
	Medium inertia				High inertia			Medium inertia		
Brake release time [ms (max.)]	10									
Brake pull-in time [ms (Max)]	70									
Vibration grade (μm)	V15									
Operating temperature (˚C)	0˚C – 40˚C (32˚F – 104˚F)									
Storage temperature (˚C)	-10˚C to 80˚C (-14˚F to 176˚F)									
Operating humidity	20 – 90%RH (non-condensing)									
Storage humidity	20 – 90%RH (non-condensing)									
Vibration capacity	2.5 G									
IP rating	IP65 (when using waterproof connectors, or when an oil seal is fitted to the rotating shaft (for an oil seal model))									
Approvals	CE c UL® US									

Note:

*1. $\boxed{1}$ in motor model names represents the encoder type.

*2. The rated torque is the continuous permissible torque between 0 – 40˚C operating temperature which is suitable for the following heat sink dimensions.

ECMA-_ _ 10：300 mm x 300 mm x 12 mm

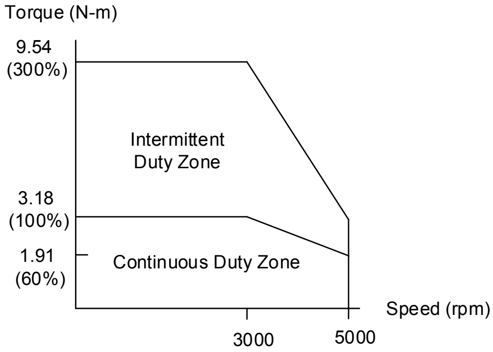
ECMA-_ _ 13：400 mm x 400 mm x 20 mm

ECMA-_ _ 18：550 mm x 550 mm x 30 mm

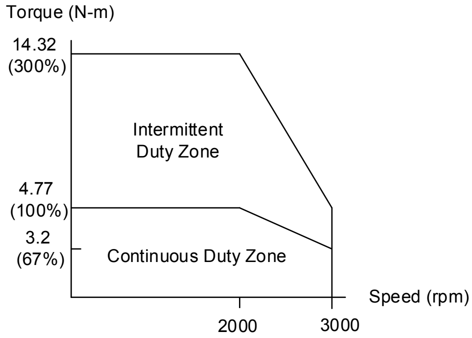
Material: aluminum – F100, F130, F180

3. The built-in servo motor brake is only for clamping purposes. Do not use it to decelerate or stop the motor.

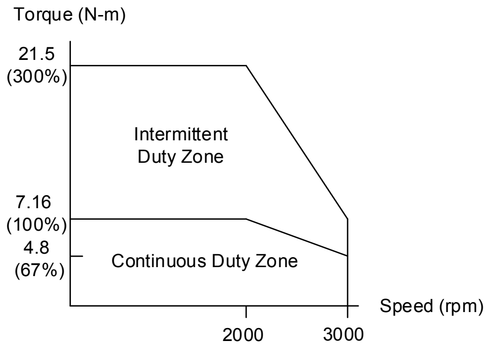
A.3.2 Torque features (T-N curves)



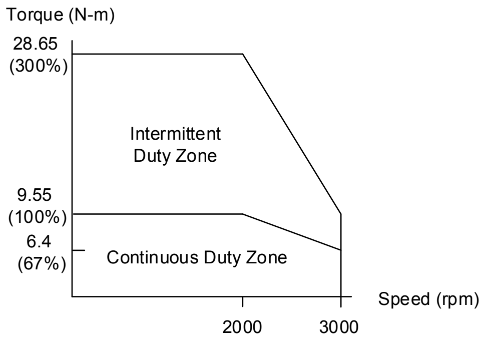
ECMC-C△1010□S



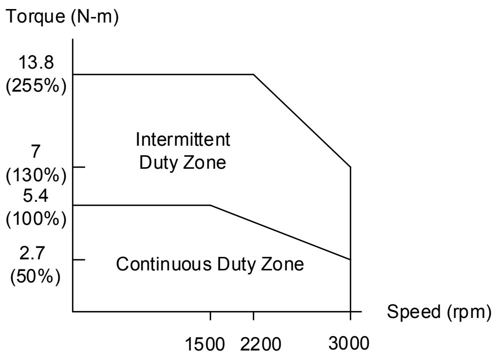
ECMC-E△1310□S



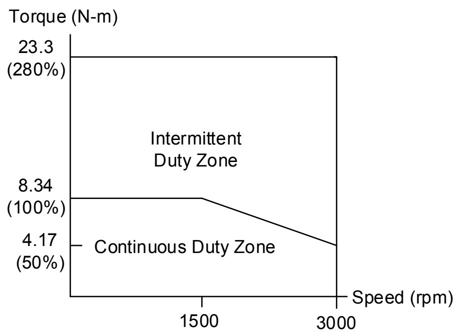
ECMC-E△1315□S



ECMC-E△1320□S



ECMC-F△□1308S



ECMC-F△1313□S

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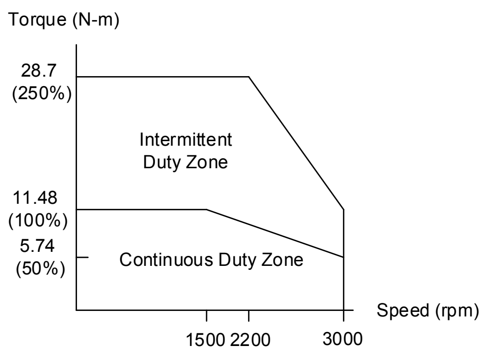
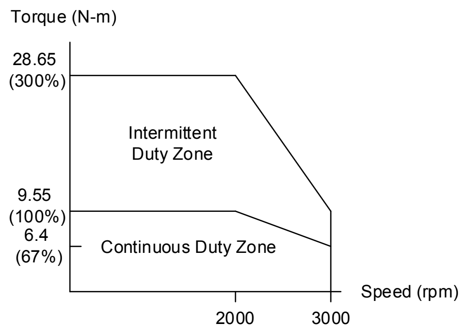
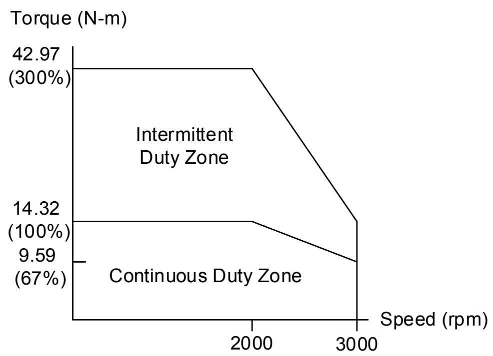


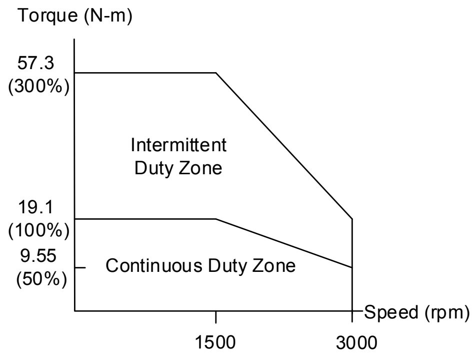
ECMC-F△1318□S



ECMC-E△1820□S



ECMC-E△1830□S



ECMC-F△1830□S

Note: △ in motor model name represents the encoder type; □ represents the shaft type and oil seal.

A.3.3 Overload features

A

Definition of overload protection

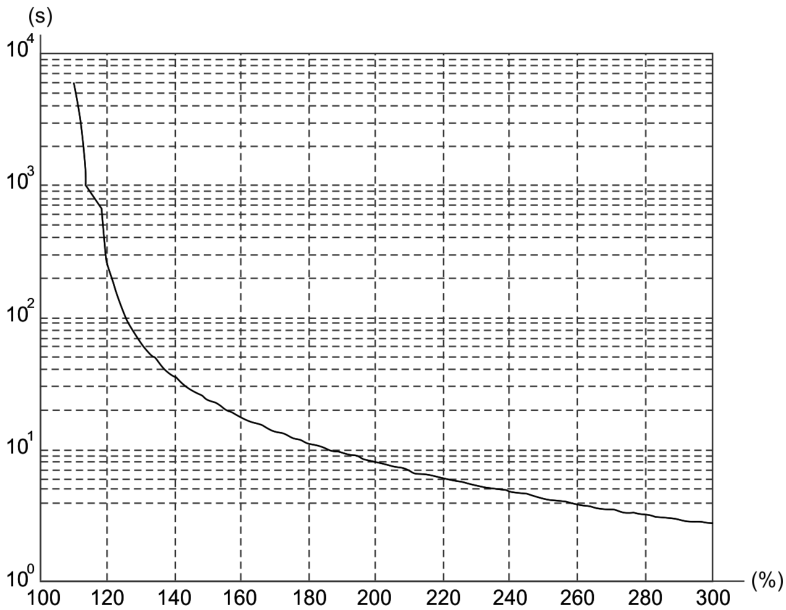
The overload protection prevents the motor from overheating.

Causes of overloading

1. The motor's rated torque exceeds the rated range and the operation time is too long.
2. The inertia ratio is set too high and the motor frequently accelerates and decelerates.
3. An incorrect connection between the power cable and the encoder wiring.
4. Incorrect servo gain setting causes resonance in the motor.
5. You operate a motor with a built-in brake without releasing the brake.

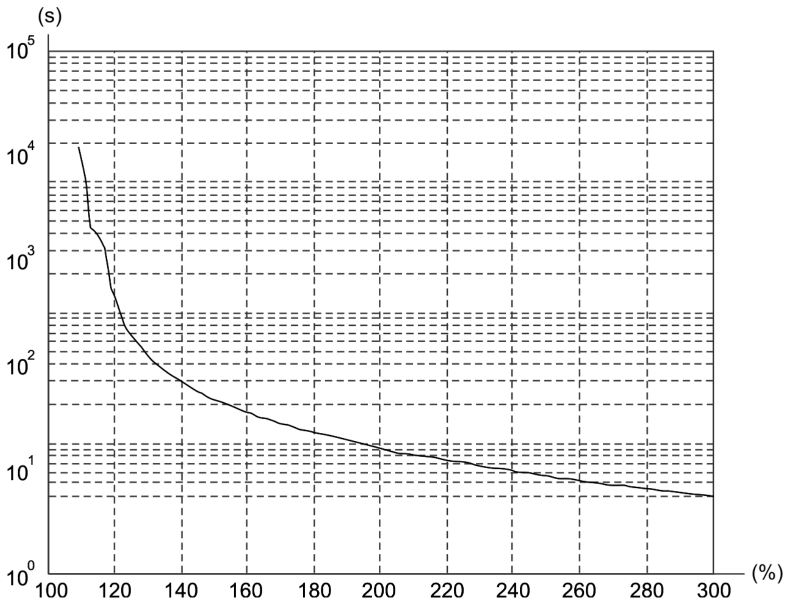
Graph of load and operating time

Low inertia (ECMC C series)



Load	Operating time
120%	263.8 s
140%	35.2 s
160%	17.6 s
180%	11.2 s
200%	8 s
220%	6.1 s
240%	4.8 s
260%	3.9 s
280%	3.3 s
300%	2.8 s

Medium and medium-high inertia (ECMC E, F series)

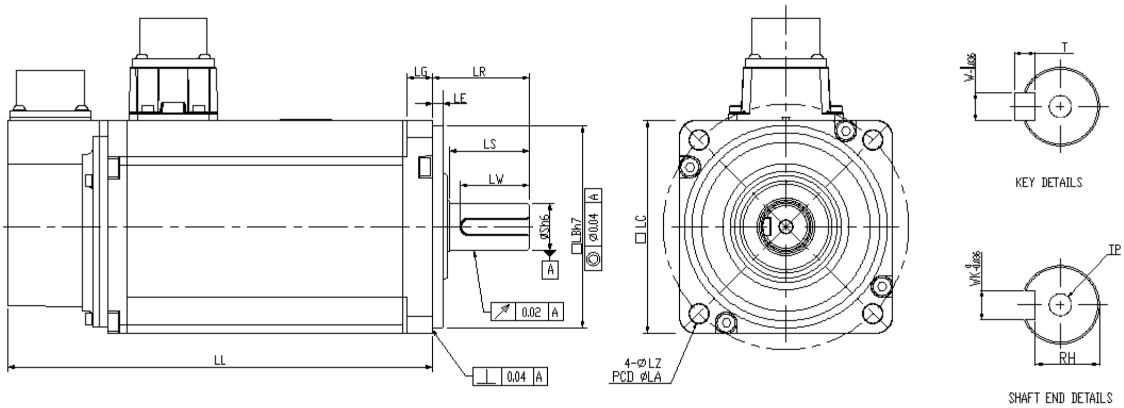


Load	Operating time
120%	527.6 s
140%	70.4 s
160%	35.2 s
180%	22.4 s
200%	16 s
220%	12.2 s
240%	9.6 s
260%	7.8 s
280%	6.6 s
300%	5.6 s

A

A.3.4 Dimensions of ECMC series servo motor

Motor frame size: 100 mm / 130 mm / 180 mm



Model	C[1]1010[2]S	E[1]1310[2]S	E[1]1315[2]S	E[1]1320[2]S	F[1]1308[2]S	F[1]1313[2]S	F[1]1318[2]S
LC	100	130	130	130	130	130	130
LZ	9	9	9	9	9	9	9
LA	115	145	145	145	145	145	145
S	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$
LB	$95(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$
LL (w/o brake)	153.3	147.5	167.5	187.5	152.5	187.5	202
LL (with brake)	192.5	183.5	202	216	181	216	230.7
LS	37	47	47	47	47	47	47
LR	45	55	55	55	55	55	55
LE	5	6	6	6	6	6	6
LG	12	11.5	11.5	11.5	11.5	11.5	11.5
LW	32	36	36	36	36	36	36
RH	18	18	18	18	18	18	18
WK	8	8	8	8	8	8	8
W	8	8	8	8	8	8	8
T	7	7	7	7	7	7	7
TP	M6 Depth 20	M6 Depth 20	M6 Depth 20	M6 Depth 20	M6 Depth 20	M6 Depth 20	M6 Depth 20

Note: [1] in motor model name represents the encoder type; [2] represents the shaft type and oil seal.

Model	E$\boxed{1}$1820$\boxed{2}\boxed{3}$	E$\boxed{1}$1830$\boxed{2}\boxed{3}$	F$\boxed{1}$1830$\boxed{2}\boxed{3}$
LC	180	180	180
LZ	13.5	13.5	13.5
LA	200	200	200
S	$35(^{+0}_{-0.016})$	$35(^{+0}_{-0.016})$	$35(^{+0}_{-0.016})$
LB	$114.3(^{+0}_{-0.035})$	$114.3(^{+0}_{-0.035})$	$114.3(^{+0}_{-0.035})$
LL (w/o brake)	169	202.1	202.1
LL (with brake)	203.1	235.3	235.3
LS	73	73	73
LR	79	79	79
LE	4	4	4
LG	20	20	20
LW	63	63	63
RH	30	30	30
WK	10	10	10
W	10	10	10
T	8	8	8
TP	M12 Depth 25	M12 Depth 25	M12 Depth 25

Note: $\boxed{1}$ in motor model name represents the encoder type; $\boxed{2}$ represents the shaft type and oil seal; $\boxed{3}$ represents a special code.

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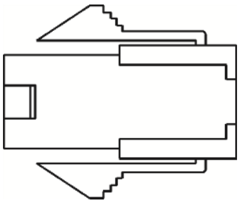
Accessories Appendix B

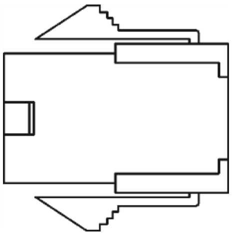
B

B.1 Power connector

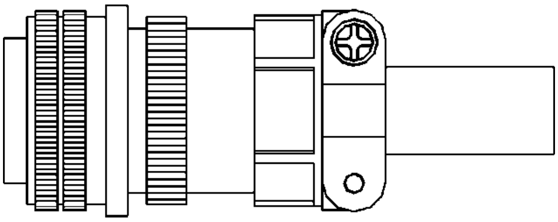
Delta part number: ASDBCAPW0000 (for 200V servo drives)



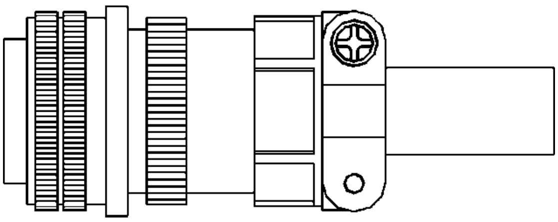
Delta part number: ASDBCAPW0100 (for 200V servo drives with brake contact)



Delta part number: ASD-CAPW1000

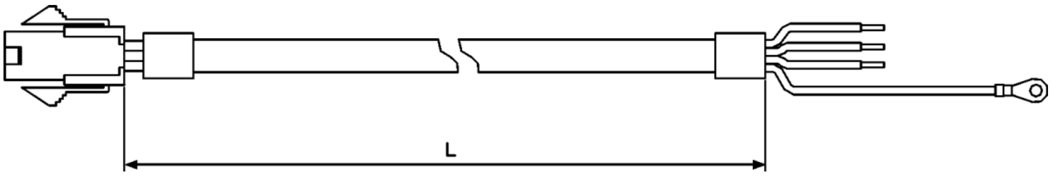


Delta part number: ASD-CAPW2000



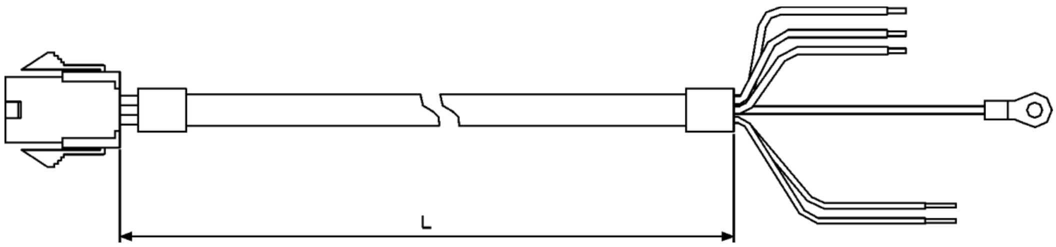
B.2 Power cable

Delta part number: ACS3-CAPW1103, ACS3-CAPW1105 (for 200V series servo drives)



Part No.	L	
	mm	inch
ACS3-CAPW1103	3000 ± 100	118 ± 4
ACS3-CAPW1105	5000 ± 100	197 ± 4

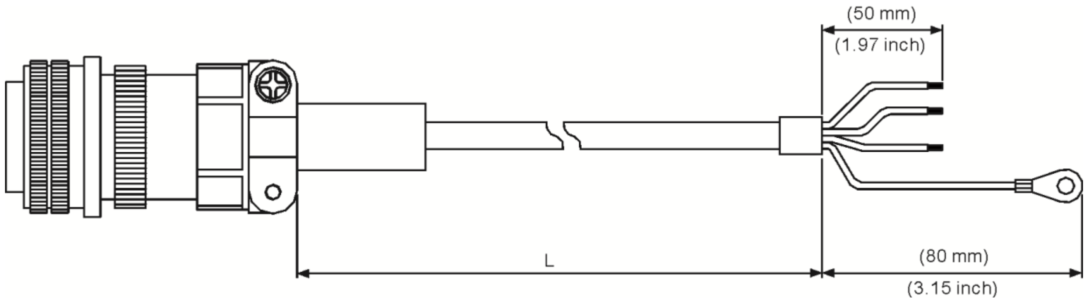
Delta part number: ACS3-CAPW2103, ACS3-CAPW2105 (for 200V series servo drives and comes with a brake cable)



Part No.	L	
	mm	inch
ACS3-CAPW2103	3000 ± 100	118 ± 4
ACS3-CAPW2105	5000 ± 100	197 ± 4

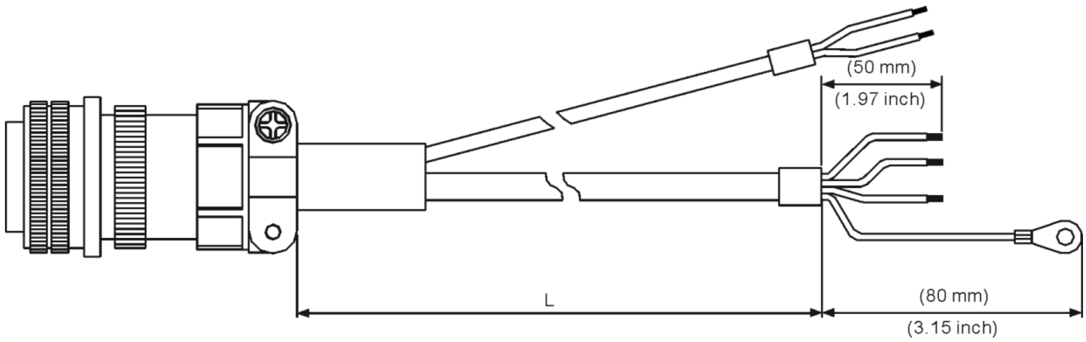
B

Delta part number: ACS3-CAPW1203, ACS3-CAPW1205



Part No.	Straight	L	
		mm	inch
ACS3-CAPW1203	3106A-20-18S	3000 ± 100	118 ± 4
ACS3-CAPW1205	3106A-20-18S	5000 ± 100	197 ± 4

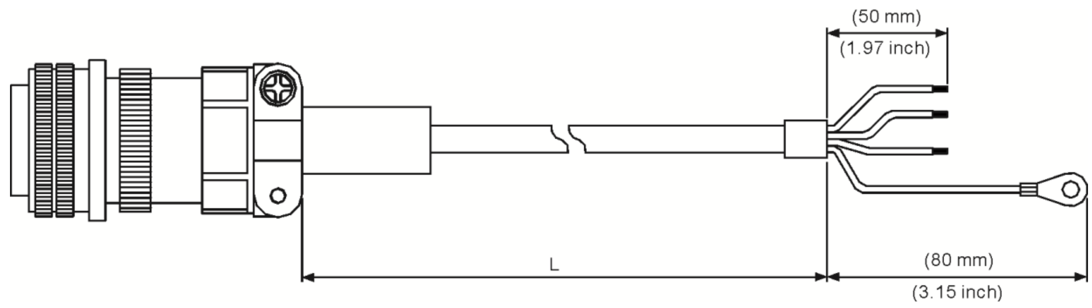
Delta part number: ACS3-CAPW2203, ACS3-CAPW2205 (with brake cable)



Part No.	Straight	L	
		mm	inch
ACS3-CAPW2203	3106A-20-18S	3000 ± 100	118 ± 4
ACS3-CAPW2205	3106A-20-18S	5000 ± 100	197 ± 4

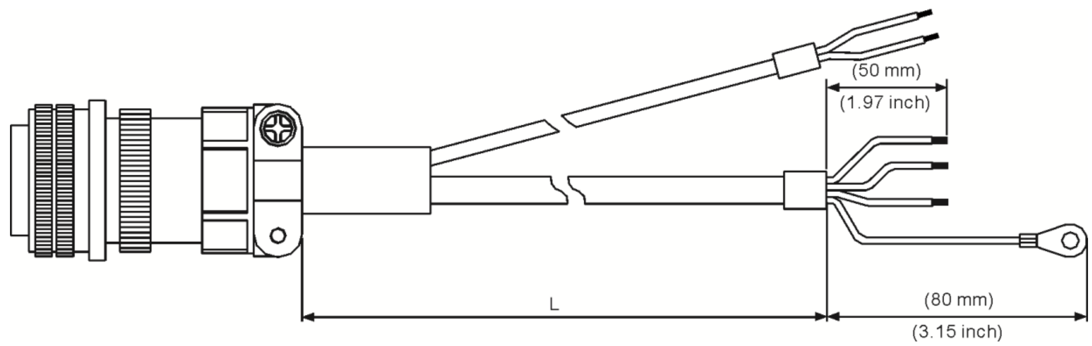
B

Delta part number: ACS3-CAPW1303, ACS3-CAPW1305



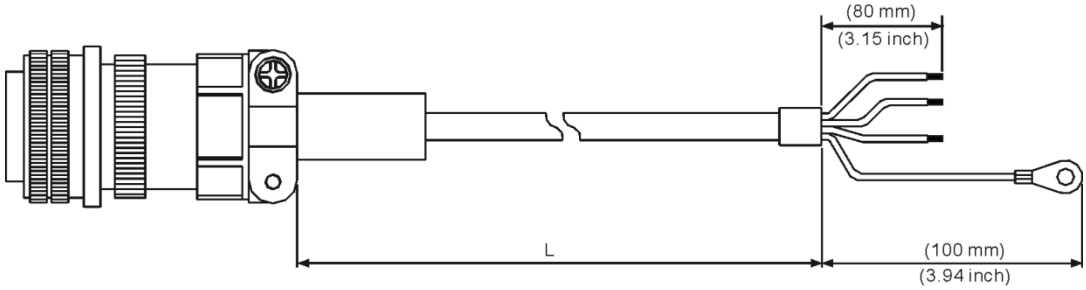
Part No.	Straight	L	
		mm	inch
ACS3-CAPW1303	3106A-20-18S	3000 ± 100	118 ± 4
ACS3-CAPW1305	3106A-20-18S	5000 ± 100	197 ± 4

Delta part number: ACS3-CAPW2303, ACS3-CAPW2305 (with brake cable)



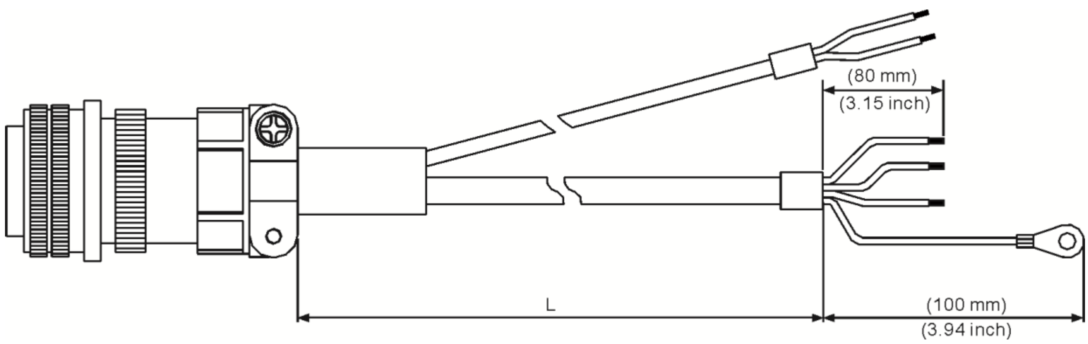
Part No.	Straight	L	
		mm	inch
ACS3-CAPW2303	3106A-20-18S	3000 ± 100	118 ± 4
ACS3-CAPW2305	3106A-20-18S	5000 ± 100	197 ± 4

Delta part number: ACS3-CAPW1403, ACS3-CAPW1405



Part No.	Straight	L	
		mm	inch
ACS3-CAPW1403	3106A-24-11S	3000 ± 100	118 ± 4
ACS3-CAPW1405	3106A-24-11S	5000 ± 100	197 ± 4

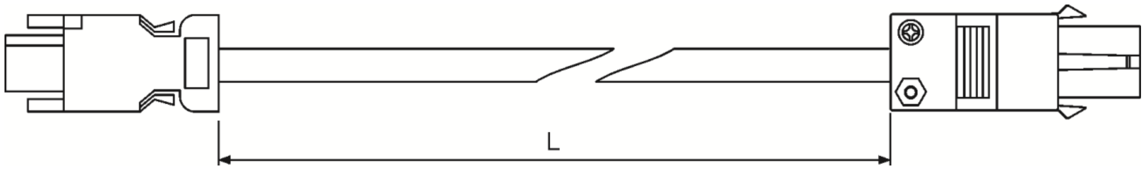
Delta part number: ACS3-CAPW2403, ACS3-CAPW2405 (with brake cable)



Part No.	Straight	L	
		mm	Inch
ACS3-CAPW2403	3106A-24-11S	3000 ± 100	118 ± 4
ACS3-CAPW2405	3106A-24-11S	5000 ± 100	197 ± 4

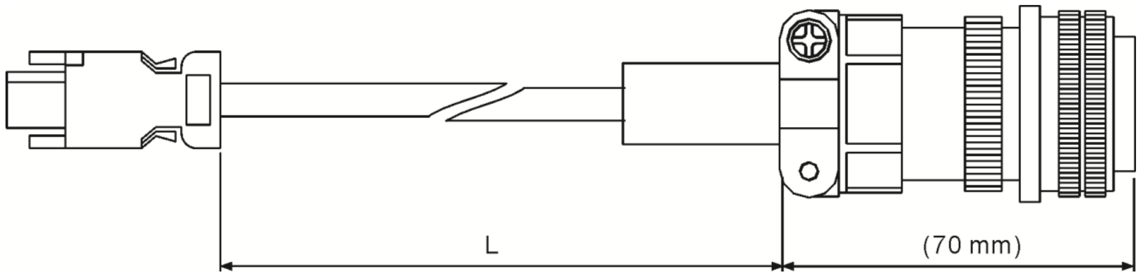
B.3 Encoder cable (incremental type)

Delta part number: ACS3-CAEN1003, ACS3-CAEN1005



Part No.	L	
	mm	inch
ACS3-CAEN1003	3000 ± 100	118 ± 4
ACS3-CAEN1005	5000 ± 100	197 ± 4

Delta part number: ACS3-CAEN3003, ACS3-CAEN3005

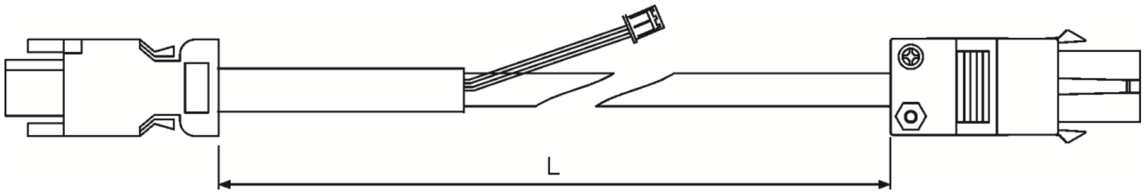


Part No.	Straight	L	
		mm	inch
ACS3-CAEN3003	3106A-20-29S	3000 ± 100	118 ± 4
ACS3-CAEN3005	3106A-20-29S	5000 ± 100	197 ± 4

B

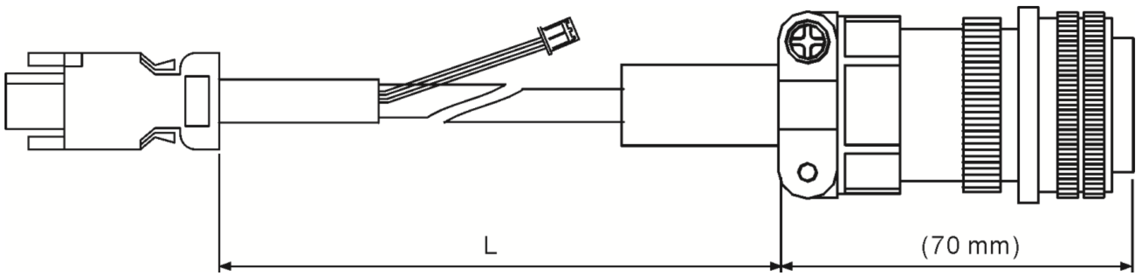
B.4 Encoder cable (absolute type)

Delta part number: ACS3-CAEA1003, ACS3-CAEA1005



Model name	L	
	mm	inch
ACS3-CAEA1003	3000 ± 100	118 ± 4
ACS3-CAEA1005	5000 ± 100	197 ± 4

Delta part number: ACS3-CAEA3003, ACS3-CAEA3005



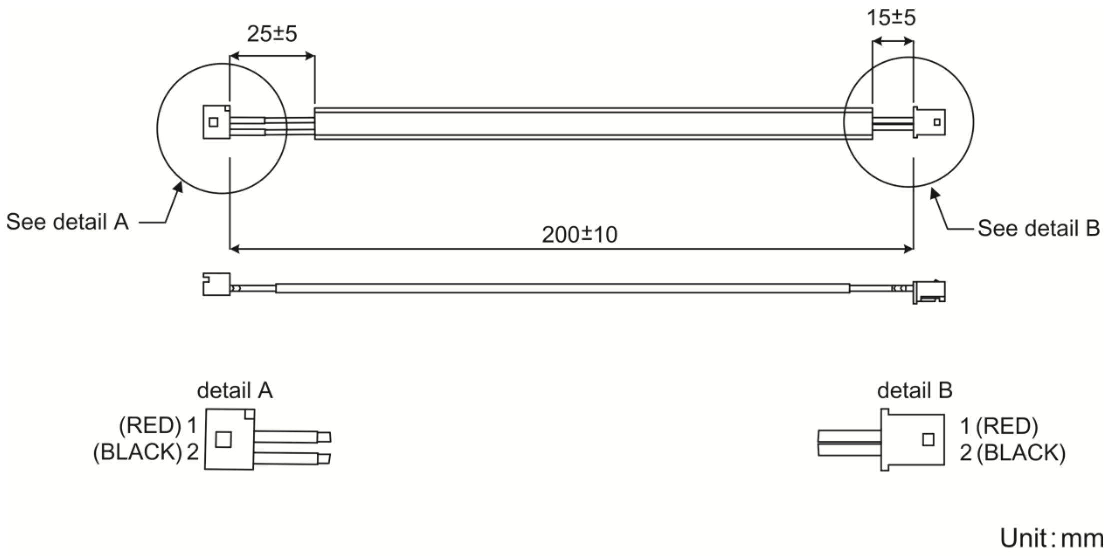
Model name	Straight	L	
		mm	inch
ACS3-CAEA3003	3106A-20-29S	3000 ± 100	118 ± 4
ACS3-CAEA3005	3106A-20-29S	5000 ± 100	197 ± 4

B

B.5 Battery box cable AW

Battery box cable that connects to the encoder

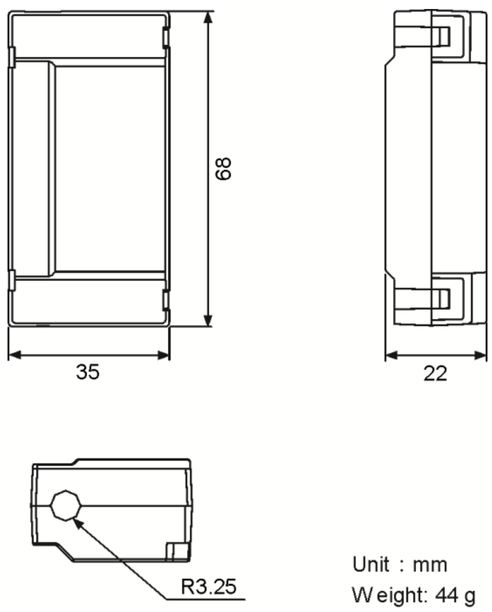
Delta part number: 3864573700



B.6 Battery box (absolute type)

Single battery box

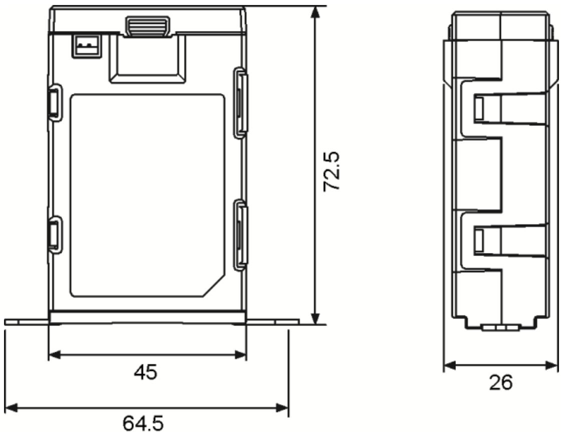
Delta part number: ASD-MDBT0100



B

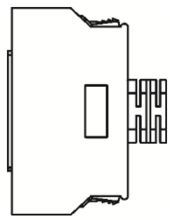
Double battery box

Delta part number: ASD-MDBT0200



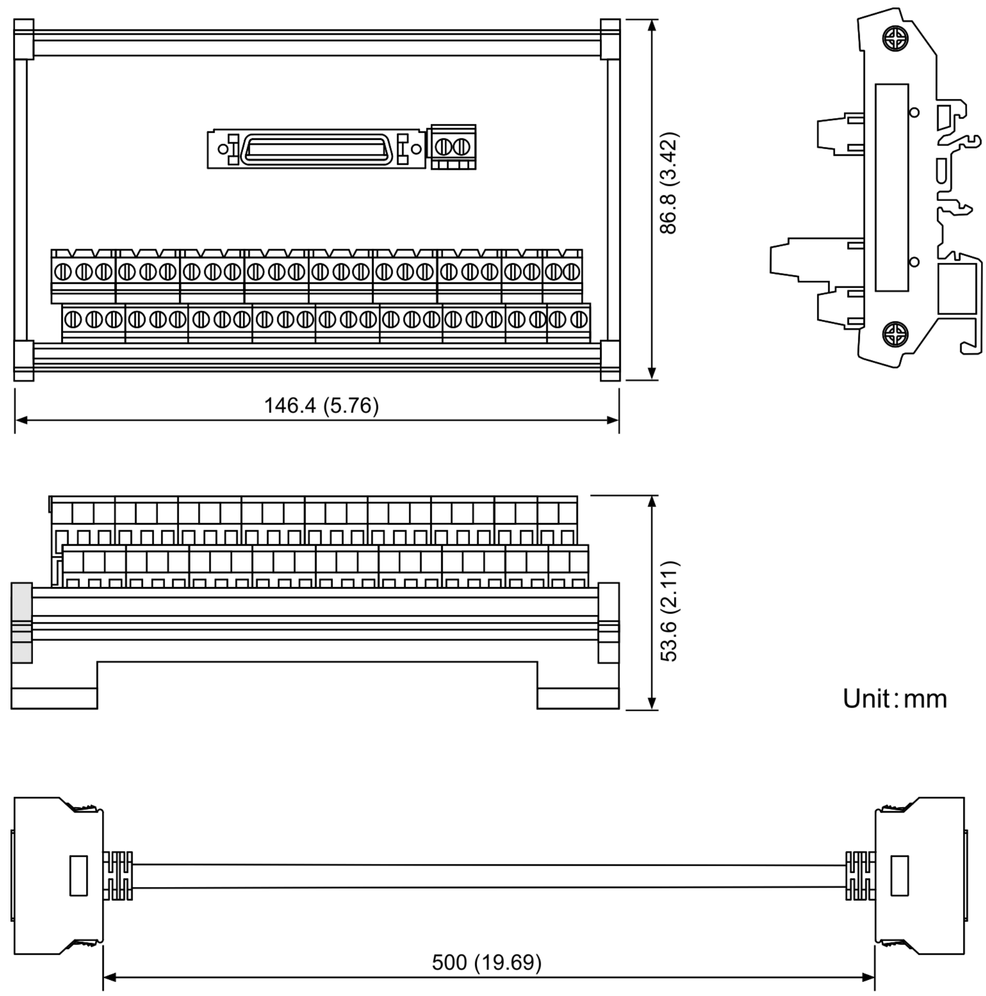
B.7 I/O signal connector

Delta part number: ACS3-CNADC150



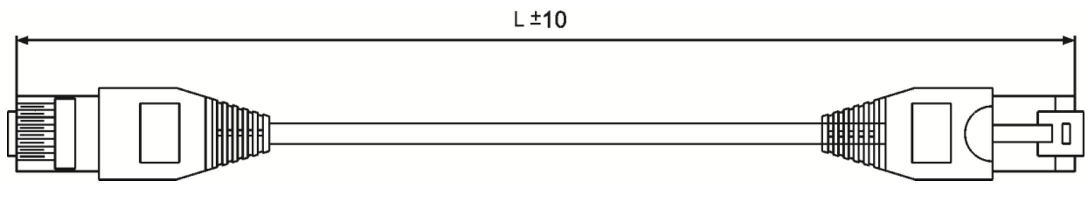
B.8 Terminal block module

Delta part number: ACS3-MDTB5000



B.9 CANopen communication cable

Delta part number: UC-CMC030-01A, UC-CMC050-01A



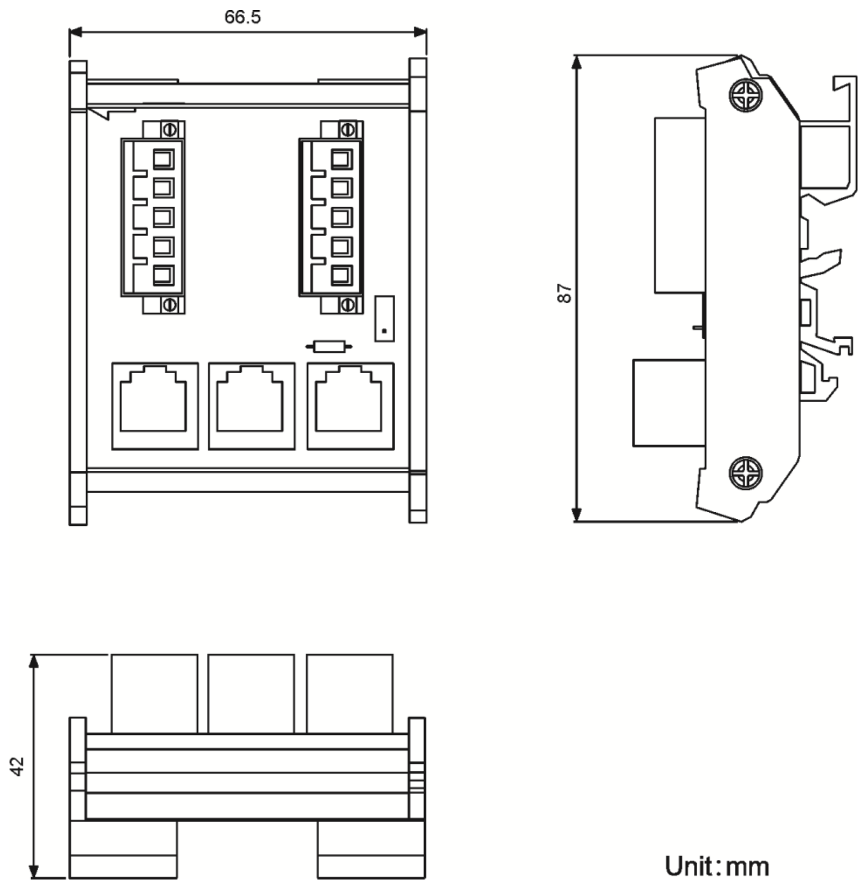
Part No.	L	
	mm	inch
UC-CMC030-01A	300 ± 10	11 ± 0.4
UC-CMC050-01A	500 ± 10	19 ± 0.4

Note: Please refer to Delta PLC/HMI Cable Selection Guide for cables of other length.

B

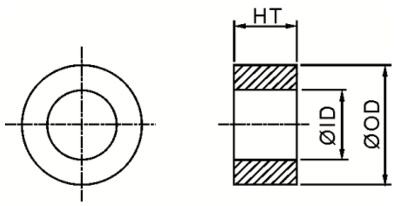
B.10 CANopen distribution box

Delta part number: TAP-CN03



B.11 Ferrite ring

Delta part number: ASD-ACFC7K00



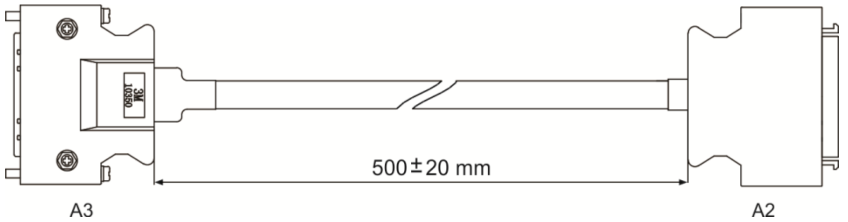
Model name	Outer diameter	Inner diameter	Height
ASD-ACFC7K00	68.0 ± 0.6	44.0 ± 0.6	13.5 ± 0.5

B

B.12 A3 / A2 conversion cable

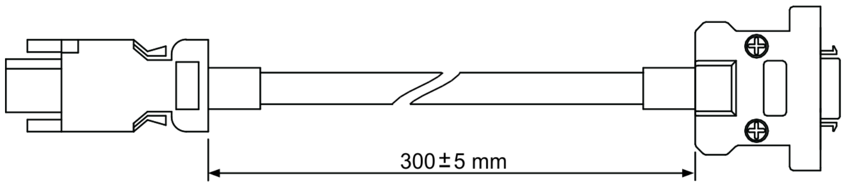
A3 / A2_CN1_conversion cable

Delta part number: 3081709800



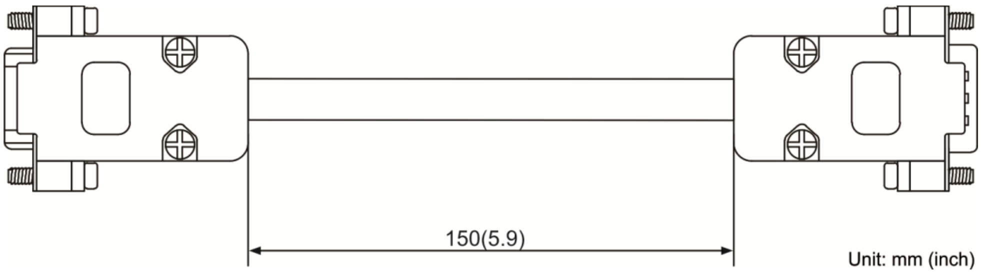
A3 / A2_CN2_conversion cable

Delta part number: 3081709600



A3 / A2_CN5_conversion cable

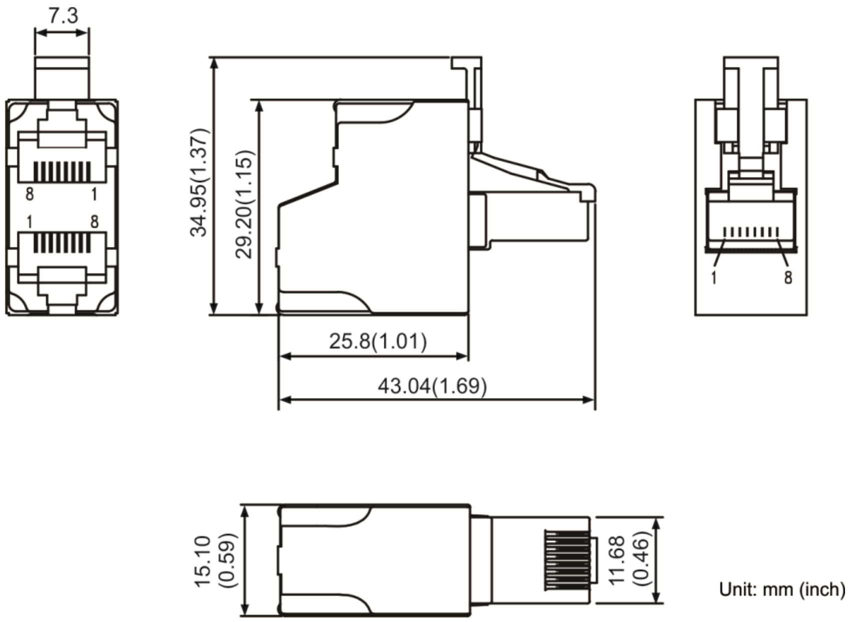
Delta part number: 3081709700



B

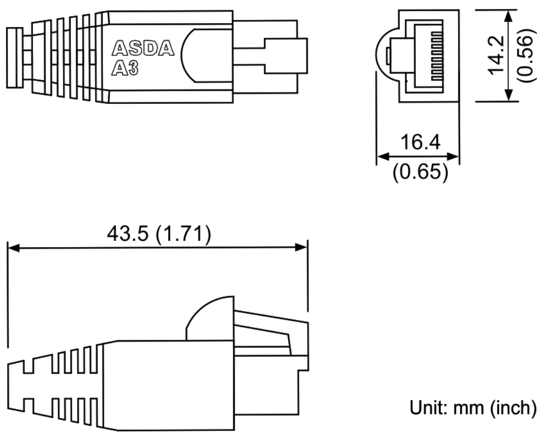
B.13 A3 CN3 RS-485 / CANOpen connector

Delta part number: ACS3-CNADC3RC



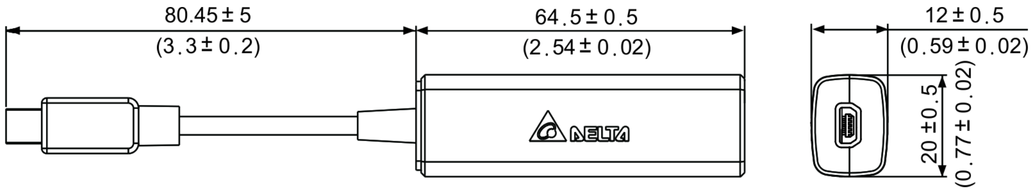
B.14 A3 CN3 RS-485 / CANOpen terminal resistor

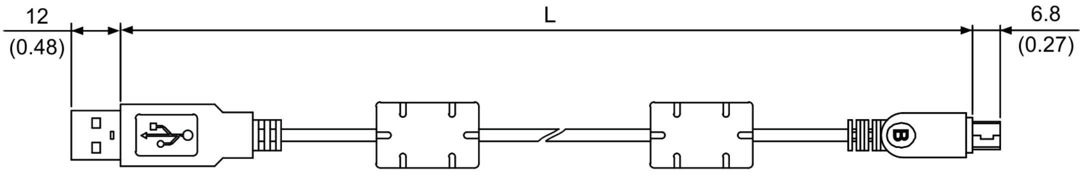
Delta part number: ACS3-CNADC3TR



B.15 CN4 Mini USB module

Delta part number: UC-PRG015-01B, UC-PRG030-01B





Part No.	L	
	mm	inch
UC-PRG015-01B	1500 ± 100	59 ± 4
UC-PRG030-01B	3000 ± 100	118 ± 4

B

B.16 Optional accessories

100 W servo drive and 50 W / 100 W low / high inertia servo motor

Servo drive	ASD-A3-0121-□
Motor model name	ECM-A3L-C△040F□S1, ECM-A3L-C△0401□S1, ECM-A3H-C△040F□S1, ECM-A3H-C△0401□S1
Motor power cable (without brake)	ACS3-CAPW110X
Power connector (without brake)	ASDBCAPW0000
Motor power cable (with brake)	ACS3-CAPW210X
Power connector (with brake)	ASDBCAPW0100
Encoder cable (incremental type)	ACS3-CAEN100X
Encoder cable (absolute type)	ACS3-CAEA100X
Encoder connector	MEC-TAXX09S

(X = 3 indicates that the cable length is 3 m; X = 5 indicates that the cable length is 5 m)

200 W servo drive and 200 W low / high inertia servo motor

Servo drive	ASD-A3-0221-□
Motor model name	ECM-A3L-C△0602□S1, ECM-A3H-C△0602□S1
Motor power cable (without brake)	ACS3-CAPW110X
Power connector (without brake)	ASDBCAPW0000
Motor power cable (with brake)	ACS3-CAPW210X
Power connector (with brake)	ASDBCAPW0100
Encoder cable (incremental type)	ACS3-CAEN100X
Encoder cable (absolute type)	ACS3-CAEA100X
Encoder connector	MEC-TAXX09S

(X = 3 indicates that the cable length is 3 m; X = 5 indicates that the cable length is 5 m)

B

400 W servo drive and 400 W low / high inertia servo motor

Servo drive	ASD-A3-0421-□
Motor model name	ECM-A3L-C△0604□S1, ECM-A3L-C△0804□S1, ECM-A3H-C△0604□S1, ECM-A3H-C△0804□S1
Motor power cable (without brake)	ACS3-CAPW110X
Power connector (without brake)	ASDBCAPW0000
Motor power cable (with brake)	ACS3-CAPW210X
Power connector (with brake)	ASDBCAPW0100
Encoder cable (incremental type)	ACS3-CAEN100X
Encoder cable (absolute type)	ACS3-CAEA100X
Encoder connector	MEC-TAXX09S

(X = 3 indicates that the cable length is 3 m; X = 5 indicates that the cable length is 5 m)

750 W servo drive and 750 W low / high inertia servo motor

Servo drive	ASD-A3-0721-□
Motor model name	ECM-A3L-C△0807□S1, ECM-A3H-C△0807□S1
Motor power cable (without brake)	ACS3-CAPW110X
Power connector (without brake)	ASDBCAPW0000
Motor power cable (with brake)	ACS3-CAPW210X
Power connector (with brake)	ASDBCAPW0100
Encoder cable (incremental type)	ACS3-CAEN100X
Encoder cable (absolute type)	ACS3-CAEA100X
Encoder connector	MEC-TAXX09S

(X = 3 indicates that the cable length is 3 m; X = 5 indicates that the cable length is 5 m)

B

1 kW servo drive and 1 kW medium inertia / 850 W high inertia servo motor

Servo drive	ASD-A3-1021-☐
Motor model name	ECMC-CW1010☐S, ECMC-EW1310☐S, ECMC-FW1308☐S
Motor power cable (without brake)	ACS3-CAPW120X
Motor power cable (with brake)	ACS3-CAPW220X
Power connector	ASD-CAPW1000
Encoder cable (incremental type)	ACS3-CAEN300X
Encoder cable (absolute type)	ACS3-CAEA300X
Encoder connector	MEC-TA0917S

(X = 3 indicates that the cable length is 3 m; X = 5 indicates that the cable length is 5 m)

1.5 kW servo drive and 1.5 kW medium inertia servo motor

Servo drive	ASD-A3-1521-☐
Motor model name	ECMC-CW1315☐S
Motor power cable (without brake)	ACS3-CAPW120X
Motor power cable (with brake)	ACS3-CAPW220X
Power connector	ASD-CAPW1000
Encoder cable (incremental type)	ACS3-CAEN300X
Encoder cable (absolute type)	ACS3-CAEA300X
Encoder connector	MEC-TA0917S

(X = 3 indicates that the cable length is 3 m; X = 5 indicates that the cable length is 5 m)

2 kW servo drive and 2 kW medium inertia and 1.3 kW / 1.8 kW high inertia servo motor

Servo drive	ASD-A3-2023-☐
Motor model name	ECMC-EW1320☐S, ECMC-FW1313☐S, ECMC-FW1318☐S
Motor power cable (without brake)	ACS3-CAPW130X
Motor power cable (with brake)	ACS3-CAPW230X
Power connector	ASD-CAPW1000
Encoder cable (incremental type)	ACS3-CAEN300X
Encoder cable (absolute type)	ACS3-CAEA300X
Encoder connector	MEC-TA0917S

(X = 3 indicates that the cable length is 3 m; X = 5 indicates that the cable length is 5 m)

2 kW servo drive and 2 kW medium inertia servo motor

Servo drive	ASD-A3-2023-☐
Motor model name	ECMC-EW1820☐S
Motor power cable (without brake)	ACS3-CAPW140X
Motor power cable (with brake)	ACS3-CAPW240X
Power connector	ASD-CAPW2000
Encoder cable (incremental type)	ACS3-CAEN300X
Encoder cable (absolute type)	ACS3-CAEA300X
Encoder connector	MEC-TA0917S

(X = 3 indicates that the cable length is 3 m; X = 5 indicates that the cable length is 5 m)

3 kW servo drive and 3 kW medium inertia servo motor

Servo drive	ASD-A3-3023-☐
Motor model name	ECMC-EW1830☐S, ECMC-FW1830☐S
Motor power cable (without brake)	ACS3-CAPW140X
Motor power cable (with brake)	ACS3-CAPW240X
Power connector	ASD-CAPW2000
Encoder cable (incremental type)	ACS3-CAEN300X
Encoder cable (absolute type)	ACS3-CAEA300X
Encoder connector	MEC-TA0917S

(X = 3 indicates that the cable length is 3 m; X = 5 indicates that the cable length is 5 m)

Note:

1. (☐) at the end of the servo drive model names represents the ASDA-A3 model number. For the actual model name, please refer to the ordering information for the product that you purchased.
2. (△) in the motor model names represents the encoder type. Please refer to Chapter 1 for more information.
3. (☐) in the motor model names represents the brake or keyway / oil seal.

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Revision History

Release date	Version	Chapter	Revision contents
April, 2017	V1.0 (First edition)		
December, 2017	V2.0 (Second edition)		
		8.2	Change the parameter default value of P1.000, P1.030, P2.031, and P2.047. Change the parameter format of P2.031.
		3.1.4	Add notes for the UVW connector illustration (angle of viewing).
		3.9 & 3.10	Add notes for the STO connector: STO certification application in progress.
		9.1	Correct the pin numbers in the figure of RS-485 communication interface.

For relevant information about [ASDA-A3], please refer to:

(1) ASDA-A2 User Manual (issued on 9th February, 2017)

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