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Delta ASDA-E3C-E Servo Drive User Manual

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Preface

Thank you for purchasing this product. This manual provides information about the ASDA-E3C-E series servo drives (E3C-E) and the ECM-E3 series servo motors.

This manual includes:

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

Product features:

- New control algorithm: overcomes the problems of a lack of stiffness or flexibility in the machine structure.
- Auto tuning function: user-friendly and allows you to complete tuning easily.
- Gain adjustment function: automatically detects changes in the inertia and improves the control precision.

How to use this manual:

Use this manual as a reference when installing, setting up, using, and maintaining the servo drive. Before initiating the tuning or setup process, read Chapters 1 to 5.

Delta technical services:

Consult your Delta equipment distributor or Delta Customer Service Center if you encounter any problems.

Safety precautions

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

This product is used in industrial applications and should be installed in a control cabinet. Servo drives, wires, and motors should all be installed in an environment that complies UL 50 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 “STOP”, “DANGER”, and “WARNING” indicate:

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

Inspection

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

Installation

	Do not expose the product to an environment containing water vapor, corrosive gas, inflammable gas, or other foreign matter to reduce the risk of electric shock or fire.

Wiring

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

Operation

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

- To avoid accidents, remove all units during the first test run, so that the motor is operating without any load.
- If you fail to operate the servo motor properly after it is connected to the machine, it may damage the machine and lead to personal injury.
- In order to prevent danger, it is strongly recommended that you make sure the servo 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.

- Before operating the machine, change the servo 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.
- Ensure you can activate the emergency stop before operating the machine.
- When applying power, make sure the motor is not rotating because of inertia of the machine or other causes.

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 no touch the wiring terminals until the “CHARGE” indicator is off, since the residual voltage may cause electric shock.
- Do not disassemble the servo motor, or it may cause electric shock or personal injury.
- Do not change the wiring when the power is on, or it may cause electric shock or personal injury.
- Only qualified electricians can install, wire, repair, and maintain the servo drive and servo motor.

Main circuit wiring

Do not repeatedly turn the power on and off. If continuous power on and off is needed, wait at least one minute between intervals.

- 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).
- Use stranded wires and multi-core shielded-pair wires for signal cables and encoder cables. The maximum length of the signal cable is 3 meters (9.84 feet) and the maximum length of the encoder cable is 20 meters (65.62 feet).
- High voltage may remain in the servo drive after the power is turned off. Do not touch the terminals or perform wiring until the “CHARGE” indicator is off.
- When wiring, remove the pluggable terminal blocks from the servo drive.
- When inserting the wires, do not short-circuit the adjacent wires.
- Before applying power, 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 standard, the wires must comply with one of the following specifications to ensure proper grounding:
  1. Copper wire with a cross-sectional area of at least 10 mm^2.
  2. Aluminum wire with a cross-sectional area of at least 16 mm^2.
- Failure to comply with the specifications may result in personal injury.
- Before applying power, inspect and ensure that the wiring is correct.

Inspection and maintenance

Operating conditions:

- Average annual ambient temperature: 30°C (86°F)
- Average load rate: 80% or less
- Average operating time: 20 hours per day

Inspection frequency	Inspection item
Daily inspection	Check if the ambient temperature and humidity are normal.
	Check if the input voltage is normal.
	Check if there is any abnormal vibration or noise.
	Check if there is any abnormal smell.
	Check if the servo drive has any visible damage.
	Check if the ventilation slots are kept clear of dust and other foreign objects. *1
	Check if the wirings are damaged or disconnected.
	Check if any cable is loose or damaged.
Annual inspection	Check if any screw is loose or damaged.
	Check if the servo drive, motor, and control cabinet are properly grounded.
	Check if the color and temperature of the power input, power output, and regenerative terminals are normal. *2

Note:

1. Install dust filters on the control cabinet openings (where there are fans or ventilation slots), and clean the filters regularly. Install door seals on cabinet doors and rubber grommets on cable openings for better seal.
2. Check if the servo drive is properly wired. If the color of any terminal turns black or is abnormal, it is suggested that you replace the terminal.

Part replacement

Operating conditions:

- Average annual ambient temperature: 30°C (86°F)
- Average load rate: 80% or less
- Average operating time: 20 hours per day

Product	Part name	Suggested replacement cycle	Note
Servo drive	Electrolytic capacitor	Approx. 5 years	The replacement cycle varies depending on the ambient conditions and usage. Replace the part immediately when any error occurs.
	Cooling fan	2 to 3 years (10,000 to 30,000 hours)	
	Relay	Approx. 100,000 times	
	Soft start resistor	Approx. 20,000 times	
Battery box	Battery	Refer to Section 9.1.	
Servo motor	Bearing	20,000 hours	
	Oil seal	5,000 hours	

- When the suggested replacement cycle of a part is reached, consult the distributor or Delta for replacement suggestions.
- Do not attempt to disassemble or repair the product yourself.

Note: the content of this manual may be revised without prior notice. Refer to the latest information from Delta's website.

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1 Product Overview

Before using the servo drive, pay attention to the items to check after unpacking and the description of the nameplate and model number. You can find a suitable servo motor for your servo drive in the table in Section 1.3.

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1.1 Items to check after unpacking

A complete servo drive set includes:

(1) A servo drive.

(2) A pluggable terminal block:

Model	Connects to
220V	L1, L2 (power input), P, D, C (using the regenerative resistor; a terminal jumper is included), and U, V, W (connecting the motor power cable). Note: the design of this terminal block is different for 400 W / 750 W and 1 kW / 1.5 kW models; do not mix them up while using.
400V	R, S, T (power input), P, D, C (using the regenerative resistor; a terminal jumper is included), and U, V, W, PE (connecting the motor power cable).

(3) A CN1 connector.

(4) A CN10 connector (only comes with the -EF models).

(5) Two plastic levers.

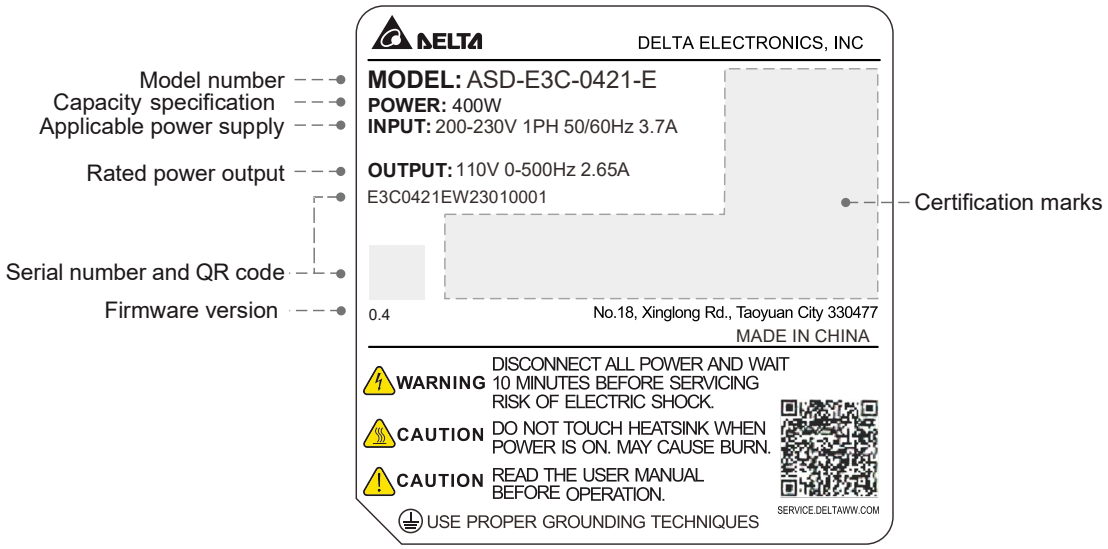
(6) A precaution sheet.

1.2 Model overview

1.2.1 Nameplate information

ASDA-E3C-E series servo drive

■ **Nameplate information**



■ **Serial number**

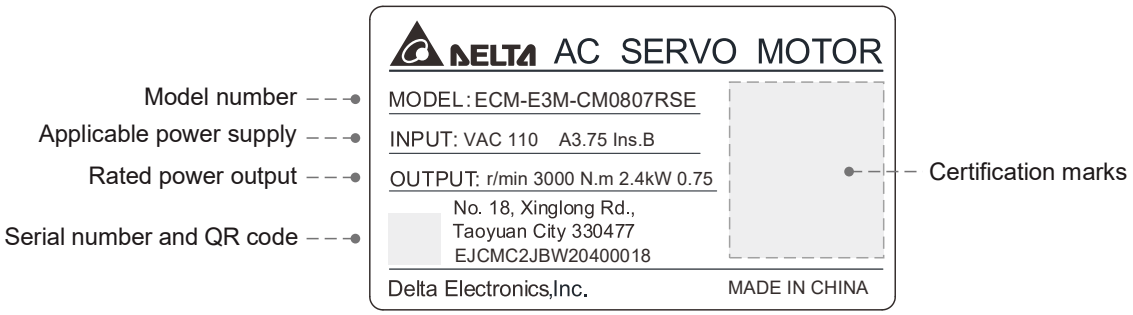
E3C0421E	W	23	01	0001
(1)	(2)	(3)	(4)	(5)

(1) Model number
(2) Manufacturing plant (T: Taoyuan; W: Wujiang)
(3) Year of production (23: year 2023)
(4) Week of production (from 1 to 52)
(5) Production sequence in a week (starting from 0001)

1

ECM-E3 series servo motor

■ Nameplate information



■ Serial number

EJCMC2JB	W	20	40	0018
(1)	(2)	(3)	(4)	(5)

(1) Model number
(2) Manufacturing plant (T: Taoyuan; W or Q: Wujiang)
(3) Year of production (20: year 2020)
(4) Week of production (from 1 to 52)
(5) Production sequence in a week (starting from 0001)

Note: the servo motor uses the certified voltage as the rated input voltage for operation, so the applicable power supply is 110V.

1.2.2 Model explanation

ASDA-E3C-E series servo drive

$$\underset{(1)}{\underline{\text{ASD}}} - \underset{(2)}{\underline{\text{E3C}}} - \underset{(3)}{\underline{04}}\ \underset{(4)}{\underline{21}} - \underset{(5)}{\underline{\text{E}}}$$

(1) Product name
ASD: AC servo drive

(2) Series
E3C: E3C series

(3) Rated power output

Code	Specification	Code	Specification
04	400 W	15	1.5 kW
07	750 W	20	2 kW
10	1 kW	30	3 kW

(4) Input voltage and phase
21: 220V, single-phase
43: 400V, three-phase

(5) Model type
E: EtherCAT model
E1: EtherCAT model with built-in regenerative resistor (only applicable to the 220V 400 W models)
EF: EtherCAT model with built-in STO function

Note: the model codes listed here are only for demonstration of the naming convention; some combinations of the model codes are not available. Contact the distributors for the models available for purchase.

1

ECM-E3 series servo motor

ECM - E 3 M - C M 08 07 R S E
(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)

(1) Product name
ECM: electronically commutated motor

(2) Servo type
E: basic type servo motor

(3) Series
3: 3rd series

(4) Inertia
L: low inertia
M: medium inertia
H: high inertia

(5) Rated voltage and speed
C: 220V and 3,000 rpm
E: 220V and 2,000 rpm
F: 220V and 1,500 rpm
J: 400V and 3,000 rpm
K: 400V and 2,000 rpm
L: 400V and 1,500 rpm

(6) Encoder type
A: 23-bit absolute optical encoder
(resolution of single turn: 23-bit; number of revolutions: 16-bit)
2: 23-bit incremental optical encoder (single-turn absolute)
P: 17-bit absolute magnetic encoder
(resolution of single turn: 17-bit; number of revolutions: 16-bit)
M: 17-bit incremental magnetic encoder (single-turn absolute)

(7) Motor frame size

Code	Specification	Code	Specification
04	40 mm	10	100 mm
06	60 mm	13	130 mm
08	80 mm	18	180 mm

(8) Rated power output

Code	Specification	Code	Specification
01	100 W	15	1.5 kW
02	200 W	18	1.8 kW
04	400 W	20	2 kW
07	750 W	30	3 kW
10	1 kW	-	-

(9) Shaft type and oil seal

	No brake With oil seal	With brake With oil seal
With keyway With screw hole	R	S

(10) Shaft diameter and connector type

S: standard shaft diameter and standard connectors

B: standard shaft diameter and bulkhead connectors

(11) Special code

E: standard products

Note: the model codes listed here are only for demonstration of the naming convention; some combinations of the model codes are not available. Contact the distributors for the models available for purchase.

1.3 Servo drive and motor combination table

1.3.1 220V models

1

Servo motor							Servo drive		
Model number	Rated / Max. speed (rpm)	Motor frame size (mm)	Rated power (W)	Inertia ($x10^{-4}kg \cdot m^2$) no brake / with brake	Rated / Max. current (Arms)	Rated / Max. torque (N·m)	Model number	Rated power (W)	Rated / Max. current (Arms)
ECM-E3L-C□0401□□E	3000 / 6000	40	100	0.0299 / 0.0315	0.857 / 3.44	0.32 / 1.12	ASD-E3C-0421-□	400	2.65 / 10.6
ECM-E3M-C□0602□□E	3000 / 6000	60	200	0.141 / 0.151	1.42 / 6.62	0.64 / 2.24	ASD-E3C-0421-□	400	2.65 / 10.6
ECM-E3M-C□0604□□E	3000 / 6000	60	400	0.254 / 0.264	2.40 / 9.47	1.27 / 4.45	ASD-E3C-0421-□	400	2.65 / 10.6
ECM-E3M-C□0807□□E	3000 / 6000	80	750	1.07 / 1.13	4.27 / 15.8	2.4 / 7.61	ASD-E3C-0721-□	750	5.1 / 14.14
						2.4 / 8.4	ASD-E3C-1021-□	1k	7.3 / 21.21
ECM-E3M-E□1310□□E	2000 / 3000	130	1k	7.79 / 7.94	5.96 / 19.9	4.77 / 14.3	ASD-E3C-1021-□	1k	7.3 / 21.21
ECM-E3M-E□1315□□E	2000 / 3000	130	1.5k	11.22 / 11.37	8.17 / 26.82	7.16 / 21.48	ASD-E3C-1521-□	1.5k	8.3 / 27
ECM-E3H-C□0602□□E	3000 / 6700	60	200	0.265 / 0.280	1.51 / 6.12	0.64 / 2.43	ASD-E3C-0421-□	400	2.65 / 10.6
ECM-E3H-C□0604□□E	3000 / 6700	60	400	0.523 / 0.538	2.21 / 8.46	1.27 / 4.83	ASD-E3C-0421-□	400	2.65 / 10.6
ECM-E3H-C□0807□□E	3000 / 6700	80	750	1.55 / 1.62	4.19 / 16.3	2.4 / 7.86	ASD-E3C-0721-□	750	5.1 / 14.14
						2.4 / 9.12	ASD-E3C-1021-□	1k	7.3 / 21.21
ECM-E3H-F□1308□□E	1500 / 4000	130	850	12.44 / 12.62	6.65 / 20.0	5.39 / 16.17	ASD-E3C-1021-□	1k	7.3 / 21.21
ECM-E3H-F□1313□□E	1500 / 4000	130	1.3k	18.00 / 18.14	7.70 / 23.9	8.34 / 25.02	ASD-E3C-1521-□	1.5k	8.3 / 27

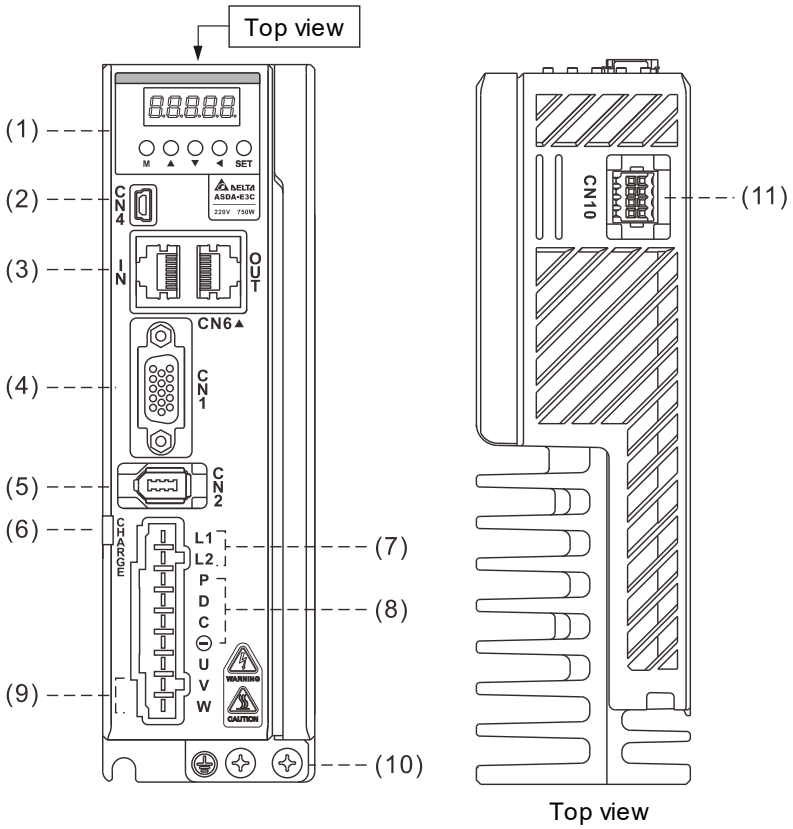
1.3.2 400V models

Servo motor							Servo drive		
Model number	Rated / Max. speed (rpm)	Motor frame size (mm)	Rated power (W)	Inertia ($x10^{-4}kg·m^2$) no brake / with brake	Rated / Max. current (Arms)	Rated / Max. torque (N·m)	Model number	Rated power (W)	Rated / Max. current (Arms)
ECM-E3M-J□0807□□E	3000 / 6000	80	750	1.07 / 1.13	2.15 / 7.90	2.4 / 7.61	ASD-E3C-1043-□	1k	3.37 / 7.07
						2.4 / 8.4	ASD-E3C-1543-□	1.5k	4.09 / 10.6
ECM-E3M-J□1010□□E	3000 / 6000	100	1k	2.78 / 3.06	3.03 / 9.21	3.18 / 7.4	ASD-E3C-1043-□	1k	3.37 / 7.07
						3.18 / 9.54	ASD-E3C-1543-□	1.5k	4.09 / 10.6
ECM-E3M-J□1015□□E	3000 / 6000	100	1.5k	3.69 / 3.97	3.73 / 11.4	4.77 / 13.08	ASD-E3C-1543-□	1.5k	4.09 / 10.6
						4.77 / 14.31	ASD-E3C-2043-□	2k	5.96 / 18.98
ECM-E3M-J□1020□□E	3000 / 6000	100	2k	4.68 / 4.95	5.00 / 15.3	6.37 / 19.11	ASD-E3C-2043-□	2k	5.96 / 18.98
ECM-E3M-K□1310□□E	2000 / 3000	130	1k	7.79 / 7.94	3.00 / 9.95	4.77 / 11.08	ASD-E3C-1043-□	1k	3.37 / 7.07
						4.77 / 14.3	ASD-E3C-1543-□	1.5k	4.09 / 10.6
ECM-E3M-K□1315□□E	2000 / 3000	130	1.5k	11.22 / 11.37	4.09 / 13.37	7.16 / 17.78	ASD-E3C-1543-□	1.5k	4.09 / 10.6
						7.16 / 21.48	ASD-E3C-2043-□	2k	5.96 / 18.98
ECM-E3M-K□1320□□E	2000 / 3000	130	2k	14.65 / 14.80	5.30 / 17.1	9.55 / 28.65	ASD-E3C-2043-□	2k	5.96 / 18.98
ECM-E3H-L□1308□□E	1500 / 4000	130	850	12.44 / 12.62	3.35 / 10.0	5.39 / 11.55	ASD-E3C-1043-□	1k	3.37 / 7.07
						5.39 / 16.17	ASD-E3C-1543-□	1.5k	4.09 / 10.6
ECM-E3H-L□1313□□E	1500 / 4000	130	1.3k	18.00 / 18.14	3.85 / 12.0	8.34 / 22.14	ASD-E3C-1543-□	1.5k	4.09 / 10.6
						8.34 / 25.02	ASD-E3C-2043-□	2k	5.96 / 18.98
ECM-E3H-L□1318□□E	1500 / 4000	130	1.8k	22.60 / 22.80	5.75 / 18.1	11.5 / 34.5	ASD-E3C-2043-□	2k	5.96 / 18.98
ECM-E3M-K□1820□□E	2000 / 3000	180	2k	29.11 / 30.38	5.7 / 18.1	9.55 / 28.65	ASD-E3C-2043-□	2k	5.96 / 18.98
ECM-E3M-L□1830□□E	1500 / 3000	180	3k	53.63 / 54.9	9.1 / 29.45	19.1 / 53.9	ASD-E3C-3043-□	3k	9.11 / 27.33
						19.1 / 57.29	-	-	-

1

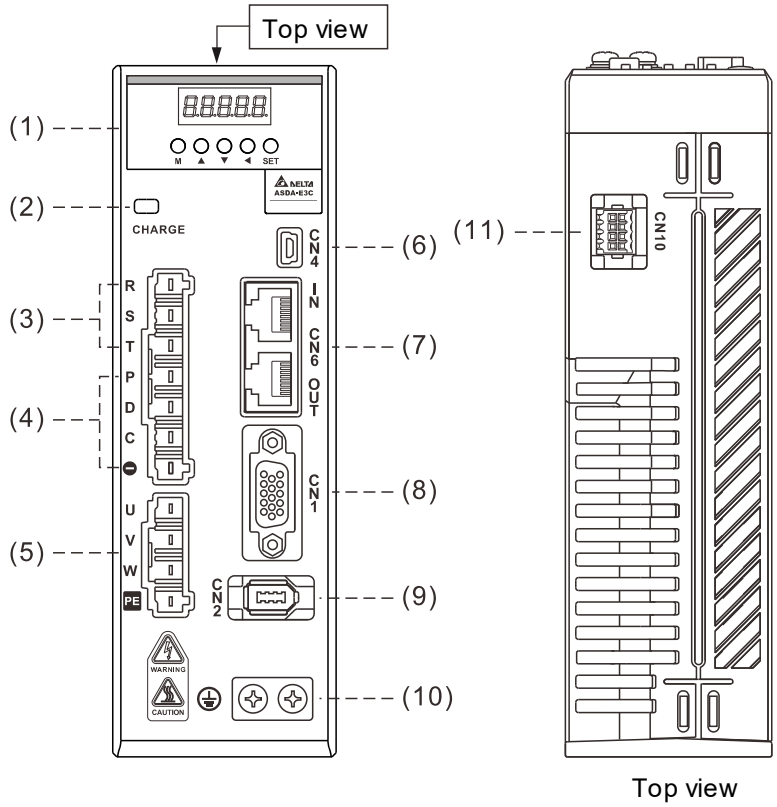
1.4 Description of the drive interface

1.4.1 220V models



No.	Name	Description
(1)	-	7-segment display.
(2)	CN4	Mini USB connector: connects to PC.
(3)	CN6	EtherCAT high-speed communication ports.
(4)	CN1	I/O signal interface: connects to PLC or controls I/O.
(5)	CN2	Encoder connector: connects to the encoder.
(6)	CHARGE	Power indicator.
(7)	L1, L2	Power input terminals: connect to commercial power supply (200 - 230 V_{AC}, 50/60 Hz).
(8)	Regenerative resistor	For using the built-in regenerative resistor, or connecting to an external regenerative resistor or an external power regenerative unit.
(9)	U, V, W	Servo drive current output terminals: connect to the motor power cable (U, V, W). Do not directly connect power to UVW. Incorrect wiring will cause damage to the servo drive.
(10)	Grounding screws	Connects to the ground wires of the power supply and servo motor.
(11)	CN10	STO terminal: only supported by -EF models.

1.4.2 400V models



No.	Name	Description
(1)	-	7-segment display.
(2)	CHARGE	Power indicator.
(3)	R, S, T	Power input terminals: connect to commercial power supply (380 - 440 V_{AC}, 50/60 Hz).
(4)	Regenerative resistor	For using the built-in regenerative resistor, or connecting to an external regenerative resistor or an external power regenerative unit.
(5)	U, V, W, PE	Servo drive current output terminals: connect to the motor power cable (U, V, W). Do not directly connect power to UVW. Incorrect wiring will cause damage to the servo drive. PE can be connected to the ground wire of the servo motor.
(6)	CN4	Mini USB connector: connects to PC.
(7)	CN6	EtherCAT high-speed communication ports.
(8)	CN1	I/O signal interface: connects to PLC or controls I/O.
(9)	CN2	Encoder connector: connects to the encoder.
(10)	Grounding screws	Connects to the ground wires of the power supply and servo motor.
(11)	CN10	STO terminal: only supported by -EF models.

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Installation

2

Follow the instructions in this chapter during installation. This chapter includes information about the circuit breaker, magnetic contactor, fuse, and the selection for EMI filter and regenerative resistor.

2.1 Ambient storage conditions ····· 2-2
2.2 Ambient installation conditions ····· 2-3
2.3 Mounting direction and space ····· 2-4
2.4 Safety precautions for using motors ····· 2-6
2.4.1 Troubleshooting for the motor operation and status ····· 2-8
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2.1 Ambient storage conditions

2

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

- Store the product in a temperature range of -20°C (-4°F) to +65°C (+149°F).
- Store the product in a relative humidity range of 0% to 90% (non-condensing).
- Avoid storing the product in an environment containing corrosive gas.

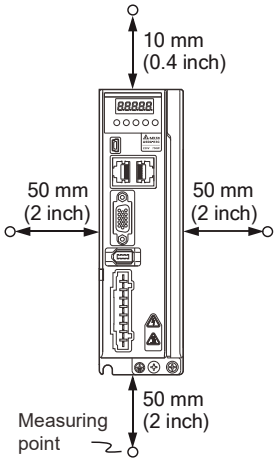
2.2 Ambient installation conditions

WARNING

E3C servo drive: the environment should be free of water, water vapor, dust, oily dust, corrosive and inflammable gas or liquids, airborne dust or metal particles, or devices that generate excessive heat. And the environment should be solid without vibration or interference of electromagnetic noise.

Motor: the ambient temperature for the ECM-E3 motors should be between -20°C (-4°F) and +60°C (+140°F)*. The environment should be free of water, water vapor, dust, oily dust, corrosive and inflammable gas or liquids, airborne dust or metal particles, or devices that generate excessive heat.

Note: if the ambient temperature for the location of the ECM-E3 motors is over 40˚C (104°F), refer to Section A.2.3 Power derating curves of the ECM-E3 motors.



- The ambient temperature for the servo drive is between 0°C (32°F) and 55°C (131°F). During long-term operation, it is advisable to keep the ambient temperature under 45°C (113°F) to ensure the servo drive's performance.
- If the ambient temperature is between 45°C (113°F) and 55°C (131°F), place the product in a well-ventilated environment and a **derating of 10% for every temperature increase of 5°C (9°F) is required**.
- The minimum requirements for airflow velocity:

Rated voltage of the servo drive	Minimum requirement for airflow velocity at 10 mm (0.4 inches) above the servo drive
220V	≥ 0.5 m/s
400V	≥ 1.0 m/s

- Mount the product vertically in the control cabinet (see the illustration of the correct mounting direction in Section 2.3).
- Install a fan at the top of the control cabinet for heat dissipation. Make sure the size of the cabinet and its ventilation condition can prevent the internal electrical devices from overheating.
- Check if the vibration of the machine affects the electrical devices in the control cabinet. Ensure that the temperature at the measuring points, which are 50 mm (2 inches) beneath and on both sides of the servo drive, is kept at or below 55°C (131°F), and the servo drive must be kept clear of heat sources.

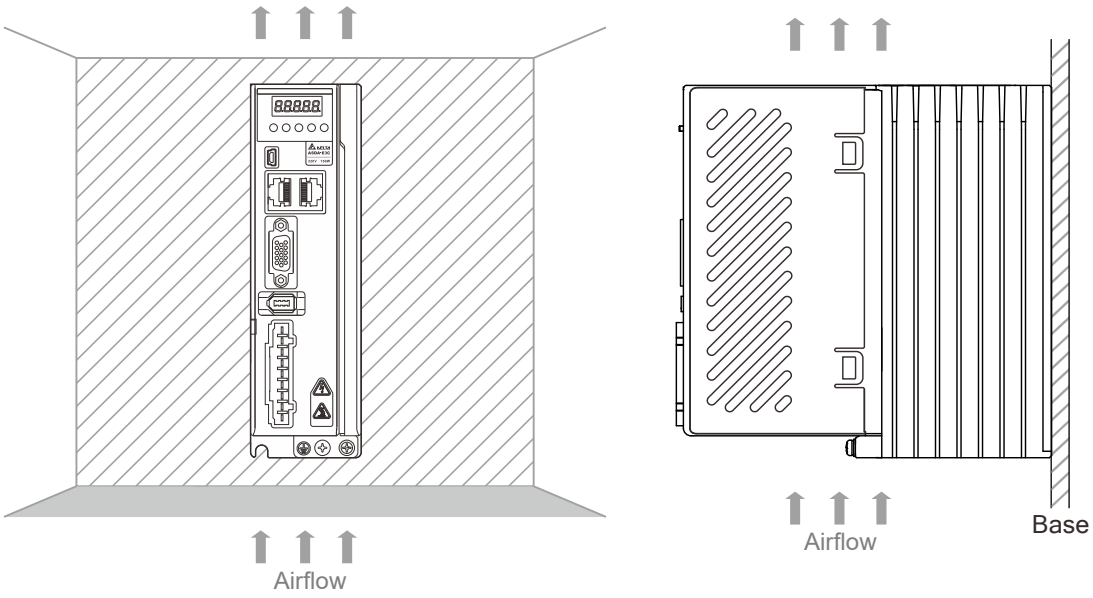
2.3 Mounting direction and space

Precautions:

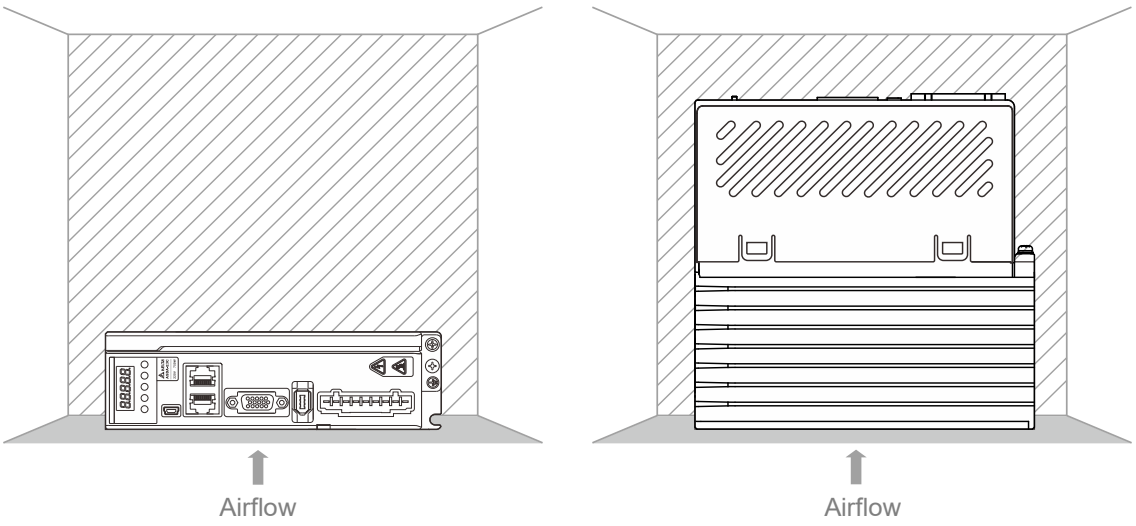
2

- Mount the servo drive in the correct direction according to the following illustrations with the base of the heat sink perpendicular to the wall. Incorrect mounting direction may result in malfunction.
- For better ventilation and cooling, allow sufficient space between the AC servo drive and the adjacent objects and the wall, or overheating may result in malfunction.
- Do not block the ventilation slots of the servo drive, and do not mount the servo drive in the incorrect direction, or it may result in malfunction.

Correct

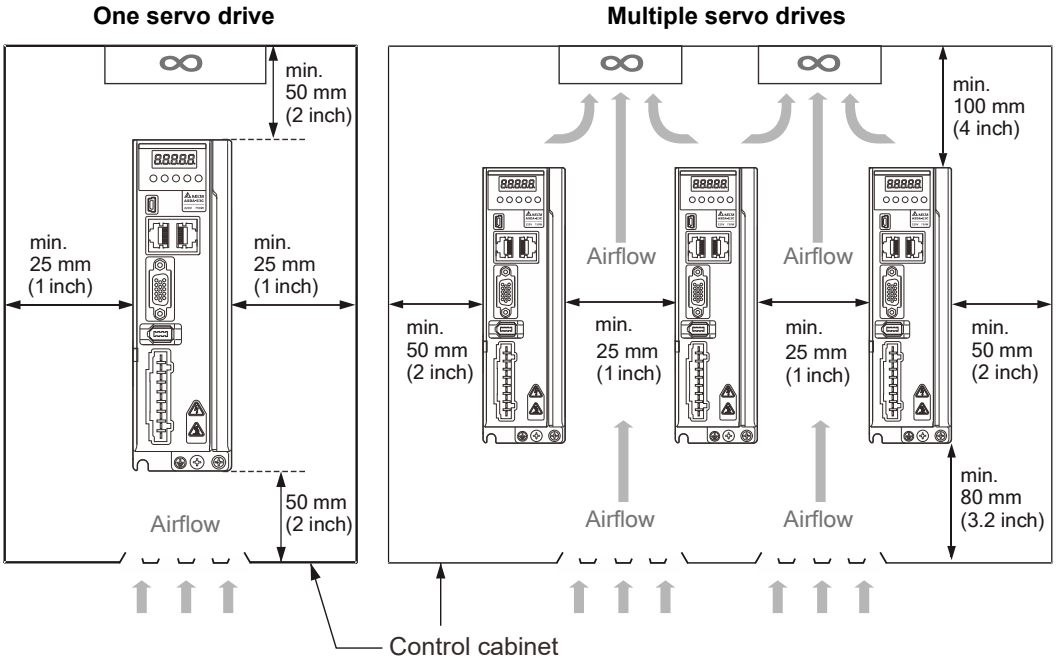


Incorrect



Heat dissipation requirements

- In order to have adequate airflow for ventilation, leave the suggested clearances when installing one or multiple servo drives.
- Avoid mounting one servo drive above another, or the drives at the bottom generate heat which rises and causes temperature increase of the drives mounted above.



Note: the preceding diagrams are not accurately scaled. Refer to the annotations on the diagrams.

2.4 Safety precautions for using motors

The Delta AC servo motor is designed for industrial applications. It is necessary to fully understand the motor specifications and the content of the user manual. For your safety and correct use, read the precautions carefully before installing the motor on any equipment.

The safety precautions are as follows:

Handling, mounting, and storage

- When taking out or placing the servo motor, hold the whole motor instead of holding the cable or the motor shaft only.
- Do not hit the motor shaft. Impact force will damage the shaft and the encoder that is attached to the rear end of the shaft.
- Keep the axial or radial load on the shaft within the allowable range listed in the specifications.
- The shaft of the servo motor is not water- or oil-proof. Do not use, install, or store the servo motor in an environment that contains water, oily liquids, corrosive and inflammable gases, or an environment with high humidity.
- The material of the motor shaft is not rustproof. Although rustproof oil has been applied to the shaft during the manufacturing process, you must check the shaft condition every three months and apply rustproof oil again if storing the motor for more than six months.
- Ensure that the storage environment of the servo motor conforms to the specifications in the user manual.
- The encoder attached to the motor is easily damaged; take the necessary measures to avoid electromagnetic interference, vibration, and abnormal temperature changes.
- The magnetic field range for placing or installing the motor should be below 10 mT.

Wiring

- If the current exceeds the maximum current in the specifications, the internal parts of the motor may lose their magnetism. Contact the distributor or local Delta sales representative if this problem occurs.
- Check if the motor wiring and the voltage of the motor brake are correct. Also, make sure that the wiring of the encoder power and signal cables is correct. Incorrect wiring will lead to abnormal operation, malfunction, or damage of the motor.
- 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 test because it may damage the encoder.
- When the motor or brake is undergoing high voltage tests, cut off the external power supply for the controller. To maintain the product lifespan, do not perform this kind of test unless necessary.

Operation

- AC servo motor operation is controlled by the servo drive. Do not directly connect a commercial power supply (100/200V, 50/60 Hz) to the servo motor circuit, or the motor cannot operate normally and may be permanently damaged.
- Follow the motor specifications when using the product. The motor temperature during operation must not exceed the specified range.
- The material of the motor shaft is not rustproof. To ensure a longer motor life, apply rustproof oil during operation.
- The built-in brake is for holding, not for stopping the motor. Note that the built-in brake is not a device for safely stopping the machine. Install another safety device to stop the machine. When the built-in brake is holding the motor, rotation backlash can still occur and the maximum rotation is 1° to 2°. Besides, when a motor with a brake is operating, the brake lining sometimes generates a noise (a swishing or clicking sound) caused by the structure of brake module, which is not a malfunction. It will not affect the motor's function.
- When using a servo motor with a brake, do not use the built-in brake for dynamic braking.
- If any odor, noise, smoke, heat, or abnormal vibration occurs during motor operation, stop the motor and turn off the power immediately.
- If the servo drive is installed in a high-radiation environment, the motor may generate louder noises, but the motor performance will not be affected.

Others

- Delta AC servo motors have no user-replaceable parts.
- Do not disassemble the motor or change its parts, or it will void the warranty.
- Do not disassemble the motor by yourself, or it may lead to permanent malfunction or damage.
- Do not splash any water or oil on the product.

2.4.1 Troubleshooting for the motor operation and status

When the servo motor makes abnormal noises:

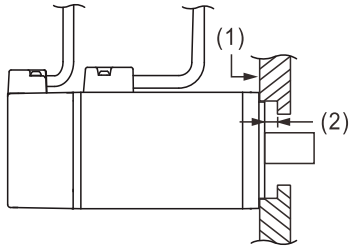
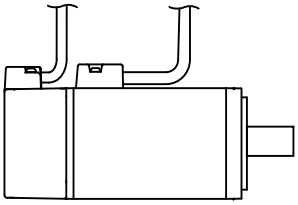
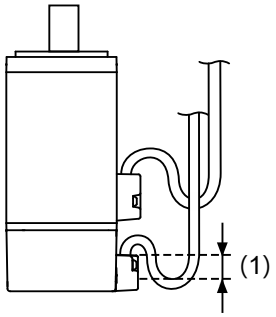
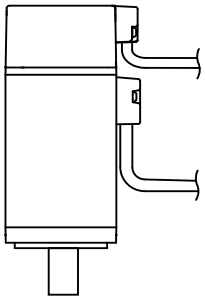
Possible cause	Checking method	Corrective action
There is a source of vibration in the connecting components.	Check if there is any foreign object, damage, or deformation in the movable parts of the connecting component.	Replace the connecting components (such as the coupling) or contact the manufacturer.
The encoder is subject to excessive vibration or shocks.	1. Check if the servo motor has been subject to impact force or vibration which causes damage to the encoder. 2. Remove and shake the motor to see if there are any abnormal noises (disk damage). 3. Visually inspect if there's dust on the encoder's rear cover (encoder damage).	Replace the servo motor.

When the servo motor is overheating:

Possible cause	Checking method	Corrective action
Mounting surface of the servo motor has poor thermal conductivity.	Measure the temperatures of the servo motor frame and the mounting surface (metal). The temperature difference should not exceed 20°C (36°F).	Make sure the installation surface is flat. Any substance (such as paint or gasket) between the mounting surface and motor surface can cause poor heat dissipation. Remove the substances or use other methods to improve heat dissipation (such as forced air cooling for the servo motor).

2.4.2 Mounting directions and precautions for the servo motor

You can install the servo motor horizontally or vertically.

Mounting direction	Precautions
Horizontal / Vertical 	When securing the motor, ensure sufficient contact (1) between the flange face and the mounting surface, and keep enough space (2) between the flange's raised face and the mounting surface. This can prevent interference or an excessive gap between mating surfaces from causing damage to the motor's mounting holes.
Horizontal 	If you are using a servo motor with an oil seal, refer to Section 2.4.5 for oil and water prevention measures for the servo motor.
Vertical - shaft end up 	■ When wiring, you need to install an oil trap (marked as (1) in the figure on the left) to prevent water vapor from entering the motor. ■ When installing the servo motor in a machine (such as in a gearbox), you must adhere to the measures in Section 2.4.5 to prevent oil and gas from entering the servo motor.
Vertical - shaft end down 	If you are using a servo motor with an oil seal, refer to Section 2.4.5 for oil and water prevention measures for the servo motor.

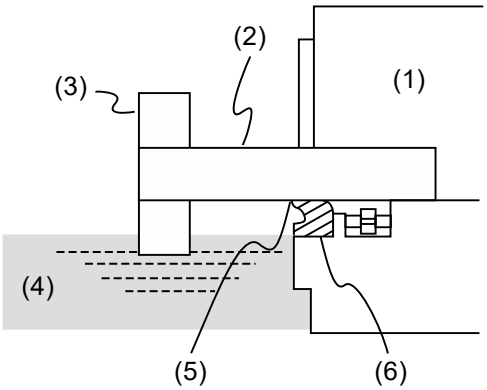
Note: if you desire to install gears on the servo motor, follow the manufacturer's instructions for installation.

2.4.3 Precautions for using servo motor with oil seal

This section defines the operating conditions for using the servo motor with an oil seal:

2

- In the operating environment, keep the oil level lower than the oil seal lip. If the oil seal lip is lower than the oil level, the oil will enter the servo motor and cause damage to the motor.

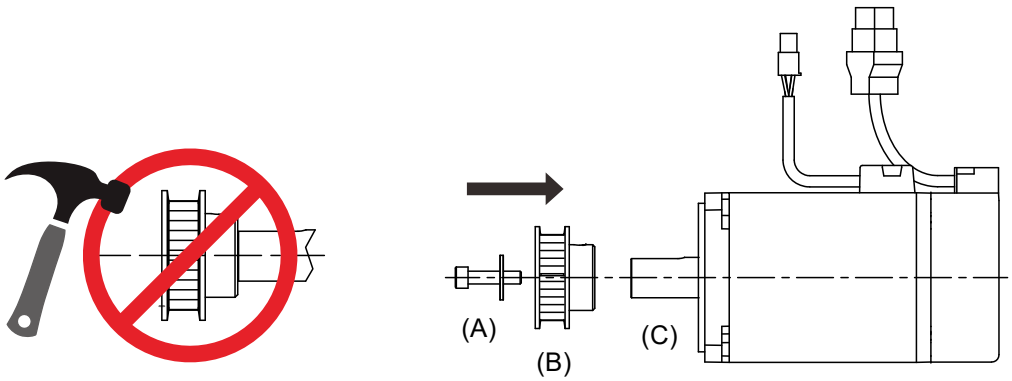


(1) Servo motor; (2) Motor shaft; (3) Gear; (4) Oil; (5) Oil seal lip; (6) Oil seal

- The oil seal cannot be submerged in liquid. It can only withstand splashes of oil.
- The oil seal lip cannot be soaked in oil.

2.4.4 Precautions for installing servo motor accessories

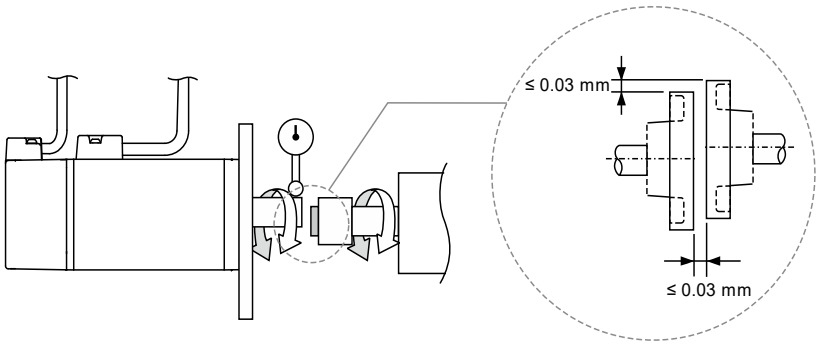
- Wipe off the rustproof coating or oil on the motor shaft.
- If you use a servo motor with a keyway, install the attached key or a key matching the specified dimensions on the motor shaft.
- When installing the key or the motor shaft accessories (such as a belt pulley or gear) to the servo motor, do not apply excessive impact force to the keyway, the accessories (A and B) installed to the motor shaft, or the motor shaft (C). Instead, secure the key or motor shaft accessories using a screwdriver and a screw.



(A) Screw and washer; (B) Belt pulley; (C) Servo motor shaft

Installation safety precautions for coupling applications

- It is suggested that you use the flexible couplings specifically designed for servo motors, especially the double spring couplings, which provide some buffer tolerance during eccentric motion and deflection of the motor. Select a coupling of appropriate size for the operating conditions. Improper use or connection may cause damage to the motor.
- Use a dial gauge or other methods to ensure the centering precision is within the specifications. If you are not allowed to use the dial gauge or other methods in the environment, slide the coupling along both shafts and adjust it until it does not get stuck.



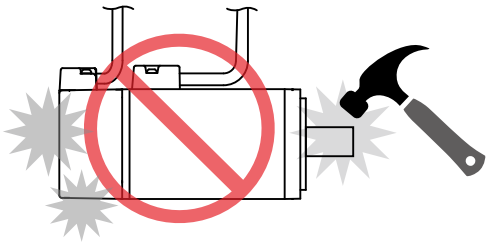
As shown in the previous figure, the distance is measured at four different positions on the circumference for centering precision. The difference between the maximum and minimum measurements should be 0.03 mm or less. Even within this range, you can make adjustments to increase the centering precision.

Important: when you are doing the measurements, rotate the coupling and motor shafts together.

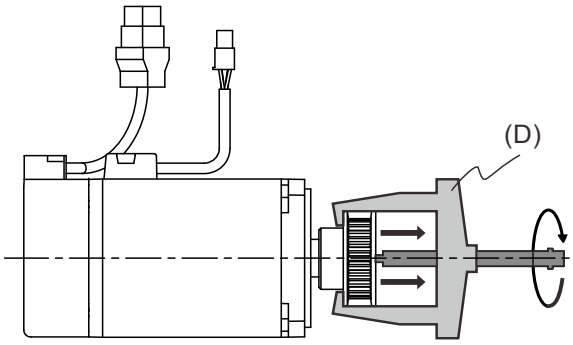
2

Installation / disassembly safety precautions for motor shaft accessories

- When connecting the shafts, make sure that the required centering precision is reached. If the shafts are not correctly centered, vibration may damage the bearings and encoder.
- When installing the coupling, do not apply excessive force to the shafts or the area around the encoder, as the impact may damage the encoder.



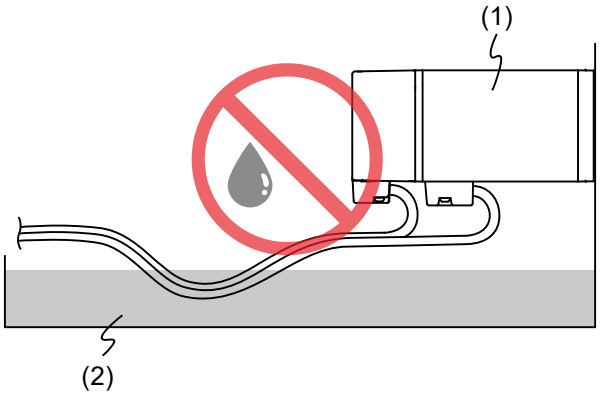
- If the coupling makes any abnormal noise, realign the shafts until the noise disappears.
- Ensure the axial load and radial load are within the specifications. Refer to the specifications for the maximum axial load (N) and maximum radial load (N) for each servo motor.
- Use a bearing puller (D) to remove the motor shaft accessories (such as a coupling, gear or belt pulley). Do not tug or apply excessive force.



2.4.5 Oil and water prevention measures for the servo motor

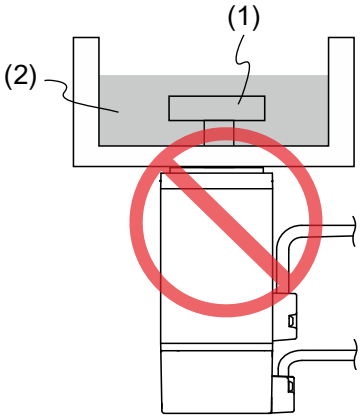
Follow these precautions and do not allow water, oil, or other foreign objects to enter the servo motor.

- Do not submerge the cables in oil or water.



(1) Servo motor; (2) Oil

- If oil or water is unavoidable, use oil-resistant cables. Delta does not provide oil-resistant cables.
- If the servo motor must be mounted with the shaft end up, do not use it in a machine, gearbox, or other environment where the servo motor may have contact with oil or water.



(1) Gear; (2) Oil

- Do not use the servo motor in an environment with cutting fluids. The sealing materials, coated colloids, cables, or other components may be affected or even deteriorated depending on the cutting fluid types.
- Do not continuously expose the servo motor to oil mist, water vapor, oil, water, or grease.

If you cannot avoid using the servo motor under the preceding conditions, take prevention measures to avoid dirt and water from entering the machine.

2.4.6 Measures to suppress temperature increase of the servo motor

- When installing the servo motor, pay attention to the cooling conditions (such as size of the heat sink) provided in the specifications of each servo motor type.
- The heat generated during motor operation is dissipated to the heat sink through the motor mounting surface. Therefore, if the surface area of the heat sink is too small, the temperature of the servo motor may increase abnormally.
- If it is difficult to apply large heat sinks in the operating environment or if the ambient air temperature or altitude exceeds the given specifications, take the following measures:
  1. Reduce the full-load rating of the servo motor. For more details, refer to the specifications of each servo motor type. When selecting servo motors, consider motors with the power capacity 1 to 2 levels higher.
  2. Reduce the acceleration and deceleration of the work cycle to lower the motor load.
  3. Apply external forced air cooling to the servo motor by using cooling fans or other methods.

Important: do not place a gasket or other insulating materials between the servo motor and heat sink, as it may cause motor temperature increase and poor noise immunity, and result in malfunction.

2.5 Specifications for the circuit breaker, magnetic contactor and fuse

220V models

Servo drive model	Circuit breaker	Magnetic contactor	Fuse (Class T)
ASD-E3C-0421-☐	10 A	10 A	10 A
ASD-E3C-0721-☐	10 A	10 A	20 A
ASD-E3C-1021-☐	15 A	15 A	30 A
ASD-E3C-1521-☐	20 A	20 A	30 A

Note:
1. Operation mode: standard.
2. If the servo drive is equipped with a residual-current device (RCD) for electricity leakage protection, select an RCD with current sensitivity of at least 200 mA and with minimum 0.1 sec working time to avoid incorrect operation.
3. Select the Type B residual-current device (RCD) with time delay, as the system ground wire may contain DC electricity.
4. Use the fuse and circuit breaker that comply with the UL / CSA standard.
5. If authority in the country may designate I△n and maximum fault loop impedance, you shall follow the rule in such a case. Otherwise, follow the maximum fault loop impedance in this table:

Servo drive model	Maximum fault loop impedance	
	TN system	TT system
ASD-E3C-0421-EF	1.3Ω	139Ω
ASD-E3C-0721-EF	0.85Ω	139Ω
ASD-E3C-1021-EF	0.75Ω	139Ω
ASD-E3C-1521-EF	0.75Ω	139Ω

400V models

Servo drive model	Circuit breaker	Magnetic contactor	Fuse (Class T)
ASD-E3C-1043-☐	10 A	10 A	10 A
ASD-E3C-1543-☐	15 A	15 A	15 A
ASD-E3C-2043-☐	20 A	20 A	20 A
ASD-E3C-3043-☐	35 A	35 A	35 A

Note:
1. Operation mode: standard.
2. If the servo drive is equipped with a residual-current device (RCD) for electricity leakage protection, select an RCD with current sensitivity of at least 200 mA and with minimum 0.1 sec working time to avoid incorrect operation.
3. Select the Type B residual-current device (RCD) with time delay, as the system ground wire may contain DC electricity.
4. Use the fuse and circuit breaker that comply with the UL / CSA standard.
5. If authority in the country may designate I△n and maximum fault loop impedance, you shall follow the rule in such a case. Otherwise, follow the maximum fault loop impedance in this table:

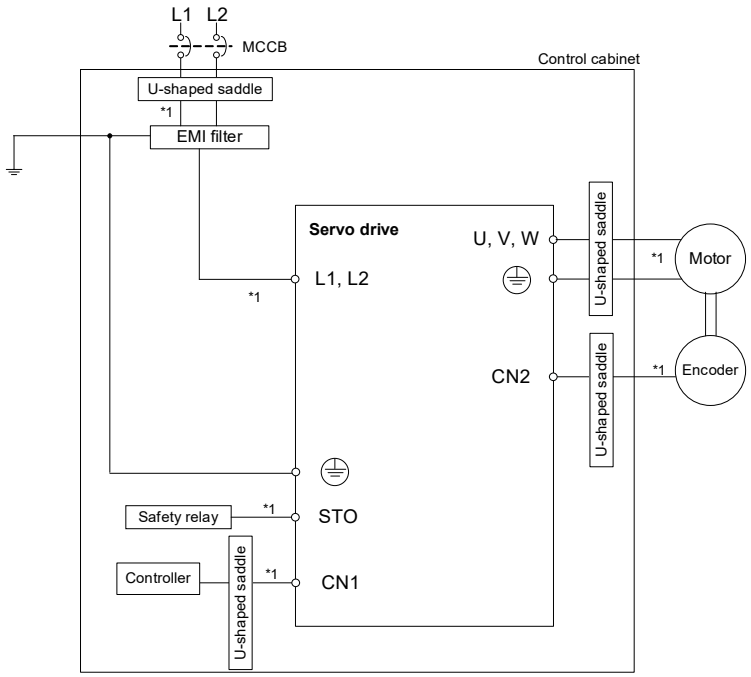
Servo drive model	Maximum fault loop impedance	
	TN system	TT system
ASD-E3C-1043-EF	0.85Ω	220Ω
ASD-E3C-1543-EF	0.85Ω	220Ω
ASD-E3C-2043-EF	0.85Ω	220Ω
ASD-E3C-3043-EF	0.73Ω	220Ω

2.6 Installation requirements for EMC

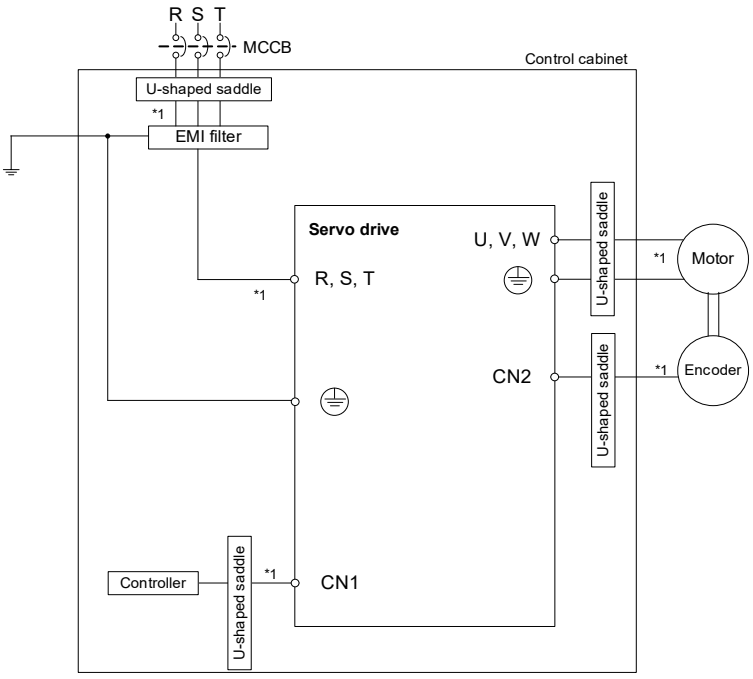
2

This section illustrates the installation requirements for passing the EMC test. Note that the EMC rating varies based on the installation structure or wiring. Delta servo products are designed in accordance with the EMC standards. Refer to the following diagram for the standard installation, through which Delta servo products passed the EMC test.

220V models



400V models



Note:
1. Use shielded wires.

2.6.1 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 correctly installed and used, you can eliminate much of the interference. For optimal performance, it is recommended that you use Delta's EMI filter for suppressing the interference.

220V models

Power	Servo drive model	Recommended EMI filter
400 W	ASD-E3C-0421-☐	EMF023A21A
750 W	ASD-E3C-0721-☐	EMF023A21A
1 kW	ASD-E3C-1021-☐	EMF023A21A
1.5 kW	ASD-E3C-1521-☐	EMF023A21A

400V models

Power	Servo drive model	Recommended EMI filter
1 kW	ASD-E3C-1043-☐	EMF018A43A
1.5 kW	ASD-E3C-1543-☐	EMF018A43A
2 kW	ASD-E3C-2043-☐	EMF018A43A
3 kW	ASD-E3C-3043-☐	EMF018A43A

General precautions for installation

To ensure the best performance of the EMI filter, apart from the installation and wiring instructions of the servo drive in the user manual, pay attention to these precautions:

- The servo drive and EMI filter must be mounted on the same metal plate.
- The wiring should be as short as possible.
- The metal plate must be well grounded.
- It is recommended that you install one servo drive with one EMI filter.

Refer to the following standards for more specifications of EMI filter installation:

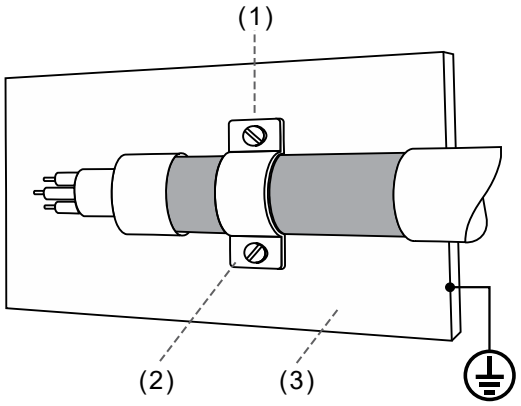
- EN 61000-6-4: 2001
- EN 61800-3: 2004 PDS of category C2
- EN 55011: 2007 + A2: 2007) (Group 1, Class A)

2

Motor power cable selection and installation precautions

The selection of motor power cable (refer to Appendix B Accessories) and installation accuracy determine the performance of the EMI filter. Follow these precautions:

- Use a cable that has braided shielding (the effect of double shielding is better).
- The shield on both ends of the motor power cable should be grounded with the shortest distance and the largest contact area.
- Remove the protective paint on the U-shaped saddle and metal plate to ensure good contact. See the following figure.
- Correctly connect the braided shielding of the motor power cable and the metal plate: fix the braided shielding on both ends of the motor power cable with the U-shaped saddle and metal plate. See the following figure.



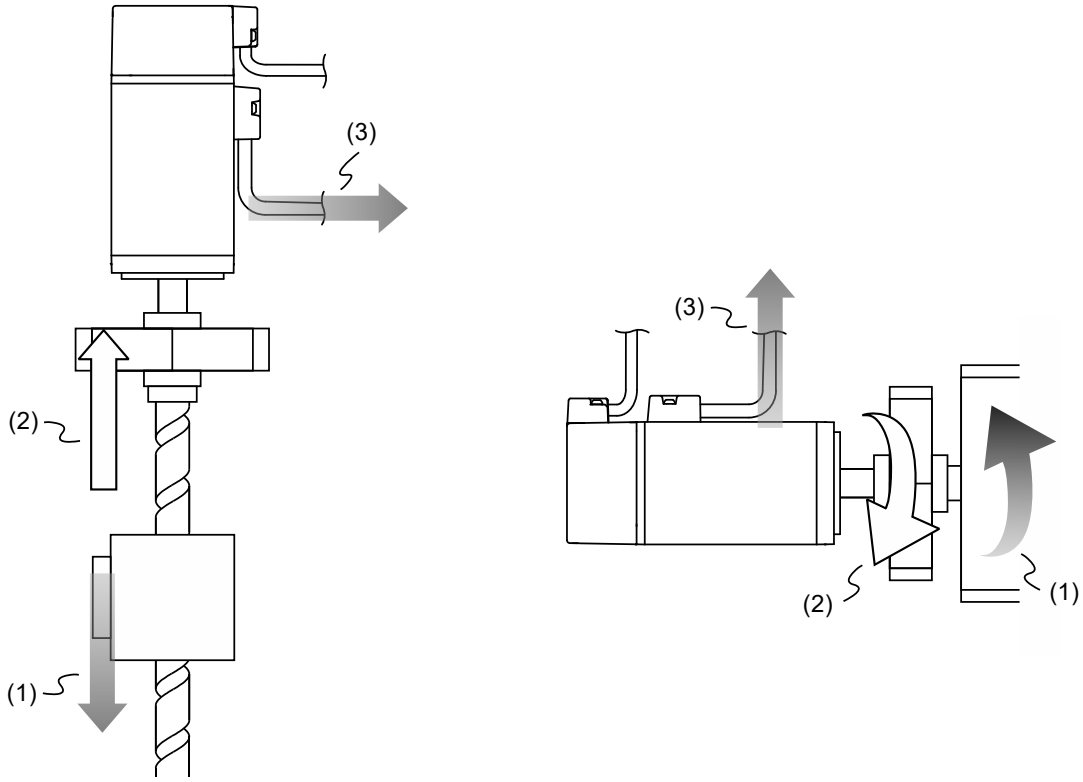
(1) Remove the protective paint on the U-shaped saddle and metal plate to ensure good contact

(2) U-shaped saddle

(3) Well-grounded metal plate

2.7 Selecting the regenerative resistor

Some of the Delta servo drive models have a built-in regenerative resistor, and you can use an external regenerative resistor if needed. When the direction of torque is opposite to the moving direction of the object, the energy generated returns to the servo drive from the load. This energy is turned into electricity in the capacitor of the DC Bus and thus increases the voltage. When the voltage reaches the DC Bus protection value, the excess energy is consumed by a regenerative resistor. Refer to the following table to select a suitable regenerative resistor.



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

220V models

E3C-E / E3C-EF:

Servo drive model	Specifications of the built-in regenerative resistor		Capacity of the built-in regenerative resistor (Watt)	Minimum allowable resistance value (reference for external resistor) (ohm)
	Resistance (ohm)	Capacity (Watt)		
ASD-E3C-0421-☐	-	-	-	60
ASD-E3C-0721-☐	100	36	18	60
ASD-E3C-1021-☐	100	40	20	30
ASD-E3C-1521-☐	100	40	20	30

E3C-E1:

Servo drive model	Specifications of the built-in regenerative resistor		Capacity of the built-in regenerative resistor (Watt)	Minimum allowable resistance value (reference for external resistor) (ohm)
	Resistance (ohm)	Capacity (Watt)		
ASD-E3C-0421-E1	100	36	18	60

2

400V models

E3C-E / E3C-EF:

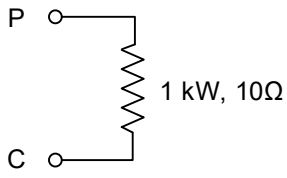
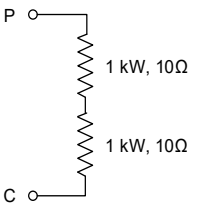
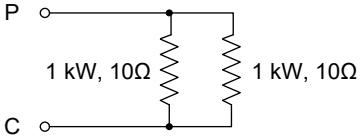
Servo drive model	Specifications of the built-in regenerative resistor		Capacity of the built-in regenerative resistor (Watt)	Minimum allowable resistance value (reference for external resistor) (ohm)
	Resistance (ohm)	Capacity (Watt)		
ASD-E3C-1043-☐	100	80	40	80
ASD-E3C-1543-☐	100	80	40	60
ASD-E3C-2043-☐	50	80	40	45
ASD-E3C-3043-☐	50	80	40	40

When the regenerative energy exceeds the capacity of the built-in regenerative resistor, use an external regenerative resistor. Pay special attention to the following when using a regenerative resistor:

- Correctly set the resistance value (P1.052) and capacity (P1.053) for the regenerative resistor; otherwise, it might affect the performance.
- When using an external regenerative resistor, ensure the total resistance value is no less than the minimum allowable resistance value of the servo drive.

  The general application is to connect multiple resistors in series. If the resistance value exceeds the setting range, you can reduce the value by connecting the resistors in parallel. If you want to connect the resistors in parallel to increase the capacity of the regenerative resistors, make sure the resistance value meets the requirements.

  See the following for connecting the regenerative resistors in series and in parallel.

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

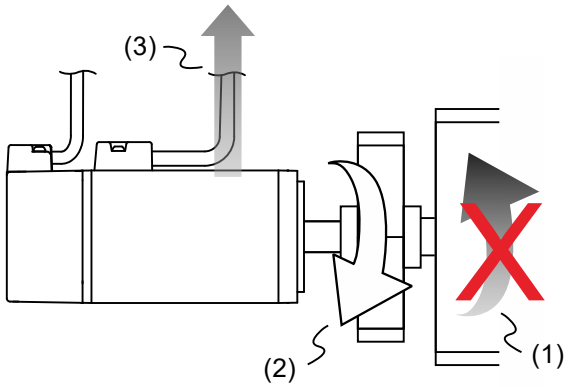
- Normally, if the average regenerative energy is within the rated capacity of regenerative resistor, the temperature of the resistor can increase to 120°C (248°F) or even higher when the motor continues to return the regenerative energy. For safety reasons, apply forced cooling to reduce the temperature of the regenerative resistor. Alternatively, you can use the regenerative resistors equipped with thermal switches. Contact the manufacturer for the load characteristics of the regenerative resistor.

When installing an external regenerative resistor, connect the resistor to P and C contacts, and leave the P and D contacts open. Choose the external regenerative resistors of the resistance values specified in the table on page 19. For easy calculation of the required regenerative resistor capacity, disregard the energy consumed by IGBT and choose the capacity of the external regenerative resistor according to the selected rotary motor.

Rotary motor:

Selecting the regenerative energy

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



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

(3) Regenerative energy generated when the motor decelerates

If the motor is making a reciprocating motion, the regenerative resistor consumes the excess return energy. Refer to the table on next page when making calculations and selecting the required regenerative resistor.

220V models

Power	Servo drive model	Maximum regenerative energy that can be absorbed by the capacitor Ec (joule)
400 W	ASD-E3C-0421-☐	8.42
750 W	ASD-E3C-0721-☐	17.47
1 kW	ASD-E3C-1021-☐	26.21
1.5 kW	ASD-E3C-1521-☐	26.21

400V models

Power	Servo drive model	Maximum regenerative energy that can be absorbed by the capacitor Ec (joule)
1 kW	ASD-E3C-1043-☐	14.66
1.5 kW	ASD-E3C-1543-☐	17.47
2 kW	ASD-E3C-2043-☐	31.2
3 kW	ASD-E3C-3043-☐	31.2

2

Assuming that the load inertia is N times the motor inertia, when the motor decelerates from operation speed to a stop, the regenerative energy is (N + 1) × Eo and the regenerative resistor needs to consume (N + 1) × Eo - Ec joules. Assuming that the reciprocating motion cycle is T sec, then the required capacity of regenerative resistor = 2 × ((N + 1) × Eo - Ec) / T.

The calculation is as follows:

Step	Item	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 reciprocating motion cycle (T).	Manual input.
3	Set the rotation speed (wr).	Manual input or read motor operation speed with P0.002 (Drive status).
4	Set the ratio (N) of load inertia to the motor inertia.	Manual input or read the ratio with P0.002 (Drive status).
5	Calculate the maximum regenerative energy (Eo).	Eo = Rotor inertia × (rotation speed (wr))^2 / 182
6	Check the maximum regenerative energy that can be absorbed by the drive (Ec).	Refer to the table on the preceding page.
7	Calculate the required capacity of the regenerative resistor.	2 × ((N + 1) × Eo - Ec) / T
8	Set parameters according to the resistor specification	Set P1.052 and P1.053 correctly.

Example:

For the 400 W motor (ECM-E3M-CA0604RSE), its rotor inertia is 0.254 × 10^{-4}. When the reciprocating motion cycle (T) is 0.4 sec, the motor operation speed is 3,000 rpm, and the load inertia is 15 times the motor inertia:

The maximum regenerative energy (Eo) = (0.254 × 10^{-4}) x $(3000)^2$ / 182 = 1.26 joules

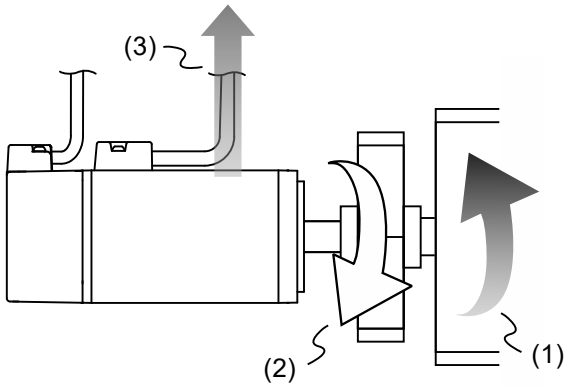
The regenerative energy that can be absorbed by the drive (Ec) = 8.42 joules (listed in the table on the preceding page).

The required capacity of the regenerative resistor:

$$\frac{2 \times ((N + 1) \times Eo - Ec)}{T} = \frac{2 \times ((15 + 1) \times 1.26 - 8.42)}{0.4} = 58.7 \text{ W}$$

From the preceding calculation, the required capacity of the regenerative resistor is 58.7 W. Since the 400 W servo drive does not have a built-in regenerative resistor, an **external** regenerative resistor of 120 W is needed. In general, the built-in regenerative resistor can meet the requirement when the external load is not too great.

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



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

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

Example:

For the 400 W motor (ECM-E3M-CA0604RSE), when the torque of the external load is +70% of the rated torque (1.27 N·m) with the rotation speed up to 3,000 rpm, the required external regenerative resistor is: $2 \times (0.7 \times 1.27) \times (\frac{3000 \times 2 \times \pi}{60}) = 558$ W.

Therefore, a regenerative resistor of 560 W and 60Ω* is needed.

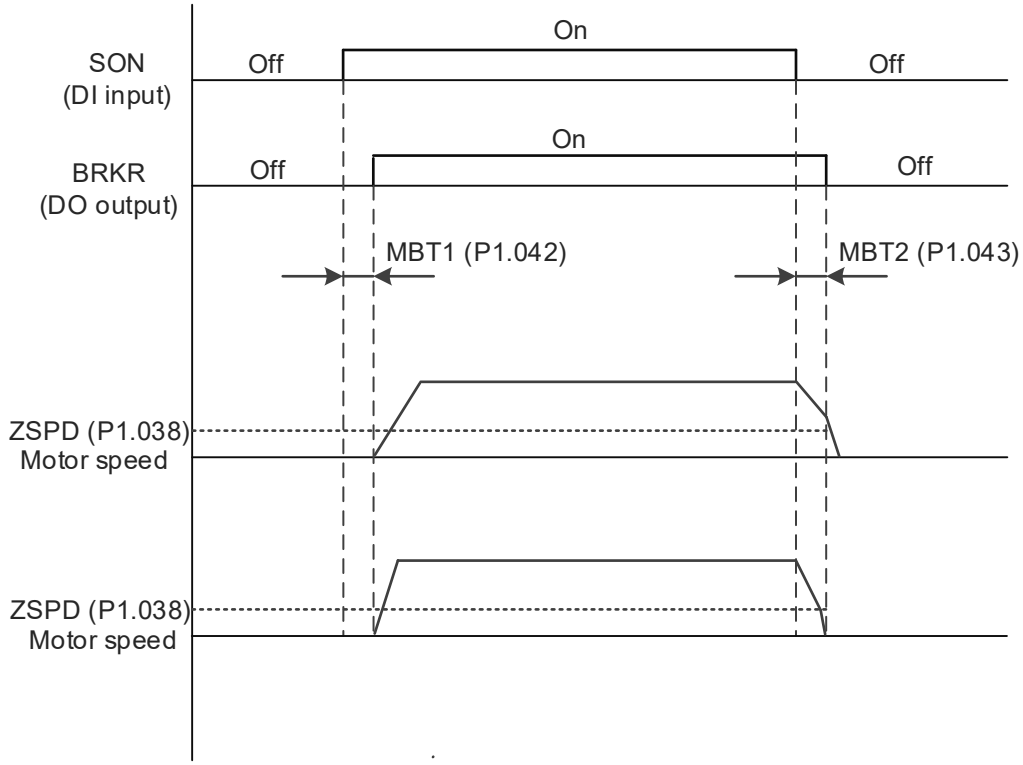
Note: the minimum allowable resistance value is 60Ω for the external resistor of the 400 W servo drive.

2.8 The use of electromagnetic brake

2

An electromagnetic brake is usually used for motions in the Z-axis direction to prevent the machine from falling because of gravity. This reduces the need for the motor to continuously produce excessive counteracting force; otherwise, excessive heat could be generated and thus shorten motor life. To avoid incorrect operation, the electromagnetic brake can be enabled only when the servo is switched off. The drive controls the electromagnetic brake with DO. If DO.BRKR is set to Off, it means the electromagnetic brake is not operating and the motor is held; if DO.BRKR is set to On, it means the electromagnetic brake is operating and the motor can run freely. You can use MBT1 (P1.042) and MBT2 (P1.043) for the delay time settings.

Timing diagram of electromagnetic brake control:

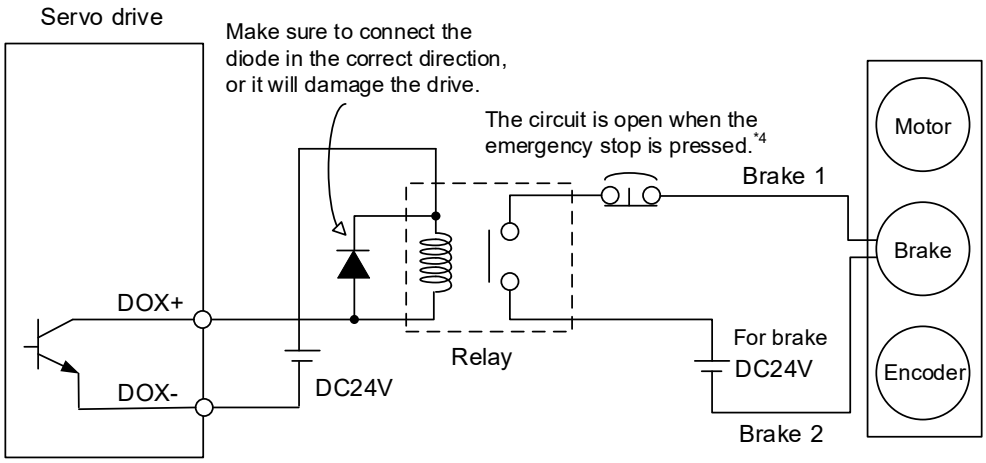


Output timing of the DO.BRKR signal:

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

When the motor runs normally (Servo On), DO.BRKR (0x08) should be set to On, it means the electromagnetic brake is operating and the motor can run freely. Use the emergency stop button in an emergency to cut off the circuit and set DI.EMGS (0x21) to On. Then, AL013 is triggered, and the motor is immediately stopped.

Wiring of the electromagnetic brake:



Note:
1. Refer to Chapter 3 Wiring.
2. Power supply for the brake is 24 V_{DC}; do not share the same power supply with control signals.
3. There is no polarity for the brake coil.
4. Pressing the emergency stop button during motor operation may cause damage to the brake.

Calculate the brake's rated current (ECM-E3M-CA0604RSE is used as an example here).

Brake power consumption (at 20°C (68°F)) = 7.6 W (refer to Appendix A Specifications), so the brake's rated current = $\frac{7.6\ W}{24V}$ = 0.32 A.

2.9 The use of cable

Precautions:

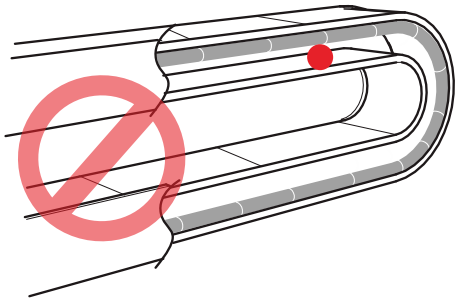
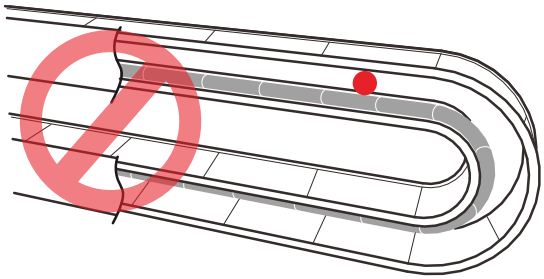
- Prevent the termination point between the connector and the cable from being subject to weight (including that of the attachments) or bending stress.
- If bending the cable is required, start bending it at least 20 mm (0.79 inches) from the termination point between the connector and the cable. The suggested bend radius is greater than 10 times the cable outer diameter.
- Avoid scraping, crushing, or stepping on the cable. This can damage the inner wires even when the cable seems intact on the outside.
- Do not twist the cable when installing.
- Inappropriate installation and wrong usage shorten the cable lifespan.

Standard cable:

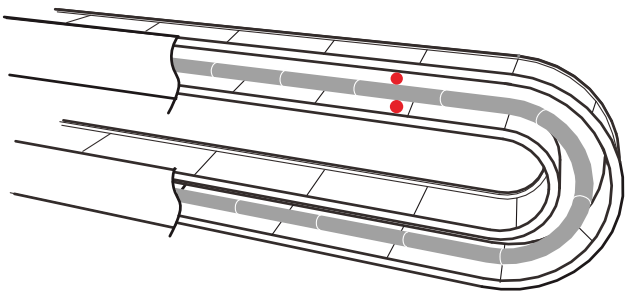
- Do not use a standard cable when the application requires the cable to move or bend. If required, use a flexible cable instead.

Flexible cable:

- Do not fix the cable on or near the bending part, otherwise the cable may break.
- After cable fixation, make sure the cable can be moved with ease, so that it does not create excessive tension on the bending or fixation part.
- Excessive cable length causes unnecessary bending, while insufficient cable length leads to breakage due to the excessive tension on the cable fixation part. Estimate the suitable cable length by dragging the cable carrier to the longest and shortest possible lengths.

Cable is too long	Cable is too short
	

Appropriate cable length, with clearance on both sides of cable



- When installing the cable carrier, avoid contact between the cables. Do not stack the cables one above the other; use dividers to prevent cable entanglement instead.
- Do not bend the flexible cable under any normal circumstances. Refer to Section 3.1.6.5 for the detailed flexible cable specifications.

Wiring

3

This chapter illustrates the power supply circuit, connectors, and wiring for each control mode of the E3C-E servo drive.

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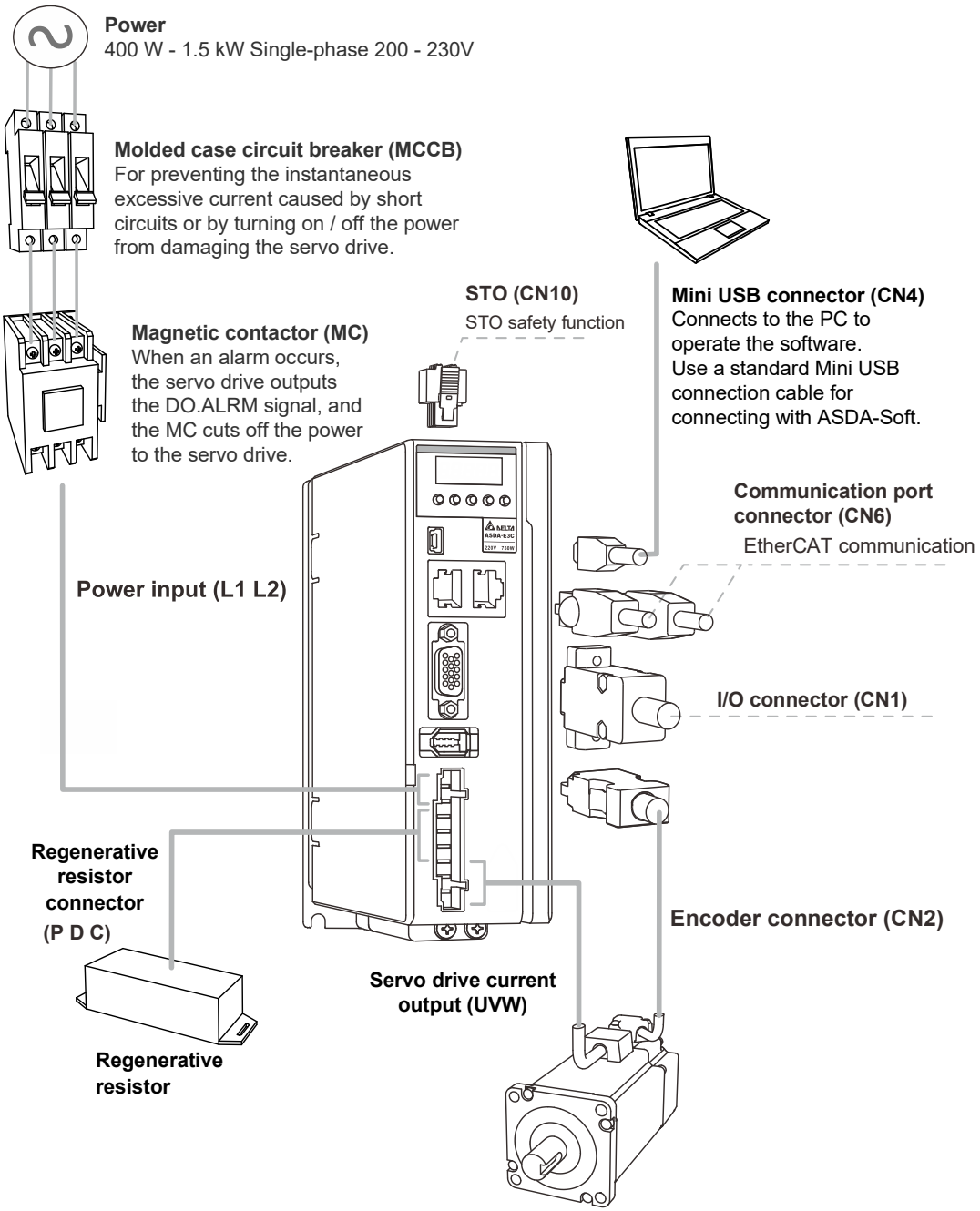
3.1 System connection

3.1.1 220V models servo system connection

3.1.1.1 Connecting to peripheral devices



Installation precautions:

1. Make sure the power supply and wiring for the L1, L2 terminals are correct. Refer to the specifications of the servo drives in Appendix A for the correct voltage input to avoid any damage to the servo drive and dangerous operating conditions.
2. Make sure the U, V, W terminals are correctly wired to avoid abnormal operation of the motor.
3. When an external regenerative resistor is used, P and D contacts should be left open, and the external regenerative resistor should connect to P and C contacts. When the built-in regenerative resistor is used, P and D contacts should be short-circuited, and P and C contacts should be left open.
4. When an alarm occurs or the system is under emergency stop status, use DO.ALRM or DO.WARN to switch off the magnetic contactor (MC) to cut off the power to the servo drive.

3.1.1.2 Connectors and terminals of the servo drive

<table>
<tr><th>Terminal</th><th>Name</th><th colspan="3">Description</th></tr>
<tr><td>L1, L2</td><td>Power input</td><td colspan="3">Connect to single-phase AC power.
(Refer to the model specification for the proper input voltage.)</td></tr>
<tr><td rowspan="5">U, V, W</td><td rowspan="5">Terminals for motor connection</td><td colspan="3">Connect to the servo motor.</td></tr>
<tr><td>Terminal</td><td>Wire color</td><td>Description</td></tr>
<tr><td>U</td><td>Red</td><td rowspan="3">Connection terminals for the three-phase main power cable to the motor.</td></tr>
<tr><td>V</td><td>White</td></tr>
<tr><td>W</td><td>Black</td></tr>
<tr><td rowspan="3">P, D, C, ⊖</td><td rowspan="3">Terminals for the regenerative resistor or power regenerative unit</td><td colspan="2">Use the built-in resistor</td><td>Short-circuit P & D contacts, and leave P & C contacts open.</td></tr>
<tr><td colspan="2">Use an external resistor</td><td>Connect the resistor to P & C contacts, and leave P & D contacts open.</td></tr>
<tr><td colspan="2">Use an external power regenerative unit</td><td>Connect the power regenerative unit to P & ⊖ contacts, and leave P & D contacts and P & C contacts open.</td></tr>
<tr><td>⏚</td><td>Ground terminals</td><td colspan="3">Connect to the ground wires for the power and servo motor.</td></tr>
<tr><td>CN1</td><td>I/O signal interface</td><td colspan="3">Connect to the controller. Refer to Section 3.2 for more information.</td></tr>
<tr><td>CN2</td><td>Encoder connector</td><td colspan="3">Connect to the encoder. Refer to Section 3.3 for more information.</td></tr>
<tr><td>CN4</td><td>Mini USB connector</td><td colspan="3">Connect to PC or laptop. Refer to Section 3.4 for more information.</td></tr>
<tr><td>CN6</td><td>EtherCAT communication ports</td><td colspan="3">For EtherCAT communication. Refer to Section 3.5 for more information.</td></tr>
<tr><td>CN10</td><td>STO terminal</td><td colspan="3">STO function. Refer to Section 3.6 for more information.</td></tr>
</table>

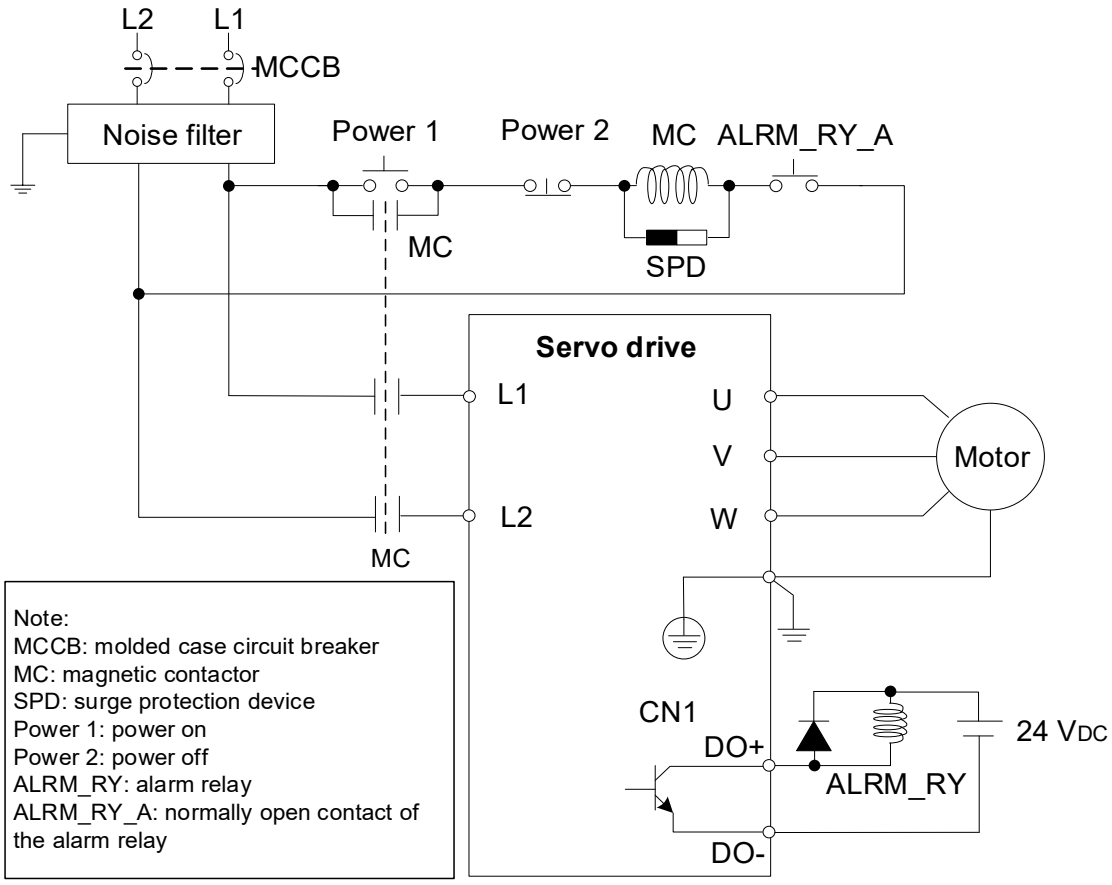
Pay special attention to the following when wiring:

1. When the power is off, do not touch L1, L2, and U, V, W, and P, D, C, ⊖ wires since the built-in capacitor of the servo drive can still contain a dangerously large amount of electric charge. Wait until the “CHARGE” indicator is off.
2. Separate the L1, L2 power cable and the UVW power cable from other signal cables. The separation distance should be at least 30 cm (11.8 inches).
3. For the encoder cable used to connect CN2, use a twisted-pair cable with metal braided shielding that conforms to the UL2464 standard.
4. Do not use any external capacitors, or it may damage the servo drive.

3.1.1.3 Wiring for power supply

The servo drive only supports single-phase wiring for the power supply.

In the following diagram, Power 1 and ALRM_RY_A are normally open contacts, and Power 2 is a normally closed contact. MC (magnetic contactor) is the power relay and the contact for the power input.

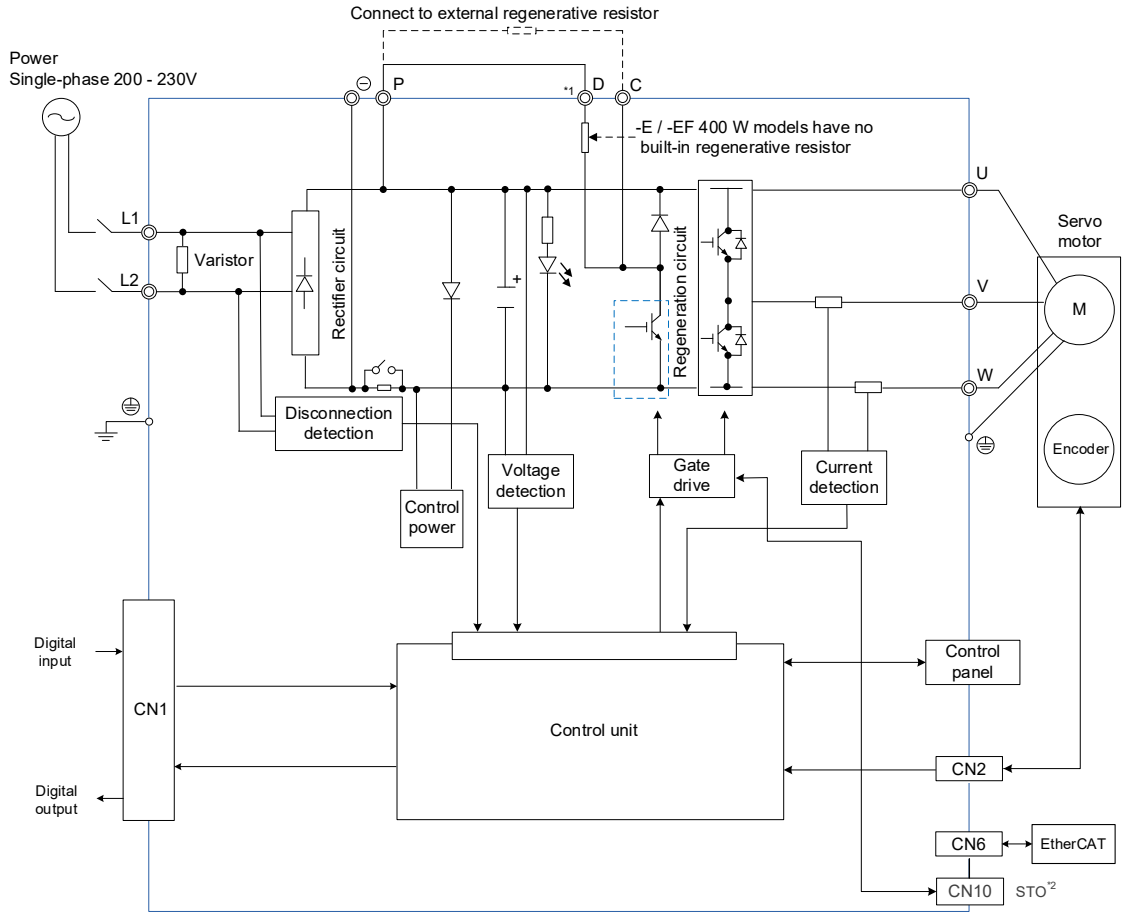


Note: perform wiring according to the actual DO parameter configurations of each model.

3

3.1.1.4 Wiring diagrams for the servo system

400 W - 1.5 kW models

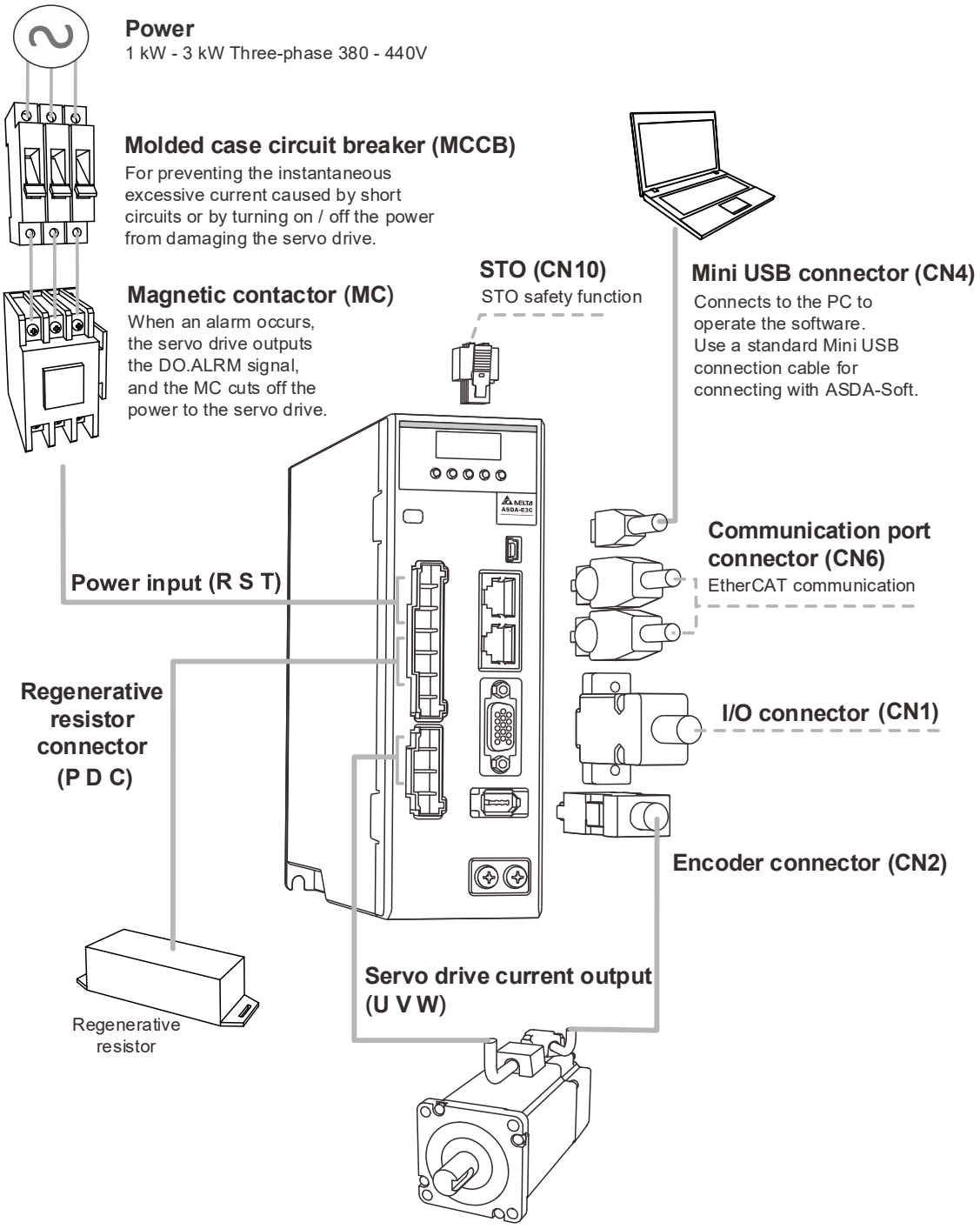


Note:

1. The D contact in -E / -EF 400 W models has no function.
2. STO function is available on -EF models only.

3.1.2 400V models servo system connection

3.1.2.1 Connecting to peripheral devices



3.1.2.2 Connectors and terminals of the servo drive

<table>
<tr><th>Terminal</th><th>Name</th><th colspan="3">Description</th></tr>
<tr><td>R, S, T</td><td>Power input</td><td colspan="3">Connect to three-phase AC power.
(Refer to the model specification for the proper input voltage.)</td></tr>
<tr><td rowspan="5">U, V, W</td><td rowspan="5">Terminals for motor connection</td><td colspan="3">Connect to the servo motor.</td></tr>
<tr><td>Terminal</td><td>Wire color</td><td>Description</td></tr>
<tr><td>U</td><td>Red</td><td rowspan="3">Connection terminals for the three-phase main power cable to the motor.</td></tr>
<tr><td>V</td><td>White</td></tr>
<tr><td>W</td><td>Black</td></tr>
<tr><td rowspan="3">P, D, C, ⊖</td><td rowspan="3">Terminals for the regenerative resistor or power regenerative unit</td><td colspan="2">Use the built-in resistor</td><td>Short-circuit P & D contacts, and leave P & C contacts open.</td></tr>
<tr><td colspan="2">Use an external resistor</td><td>Connect the resistor to P & C contacts, and leave P & D contacts open.</td></tr>
<tr><td colspan="2">Use an external power regenerative unit</td><td>Connect the power regenerative unit to P & ⊖ contacts, and leave P & D contacts and P & C contacts open.</td></tr>
<tr><td>⏚</td><td>Ground terminals</td><td colspan="3">Connect to the ground wires for the power and servo motor.</td></tr>
<tr><td>CN1</td><td>I/O signal interface</td><td colspan="3">Connect to the controller. Refer to Section 3.2 for more information.</td></tr>
<tr><td>CN2</td><td>Encoder connector</td><td colspan="3">Connect to the encoder. Refer to Section 3.3 for more information.</td></tr>
<tr><td>CN4</td><td>Mini USB connector</td><td colspan="3">Connect to PC or laptop. Refer to Section 3.4 for more information.</td></tr>
<tr><td>CN6</td><td>EtherCAT communication ports</td><td colspan="3">For EtherCAT communication. Refer to Section 3.5 for more information.</td></tr>
<tr><td>CN10</td><td>STO terminal</td><td colspan="3">STO function. Refer to Section 3.6 for more information.</td></tr>
</table>

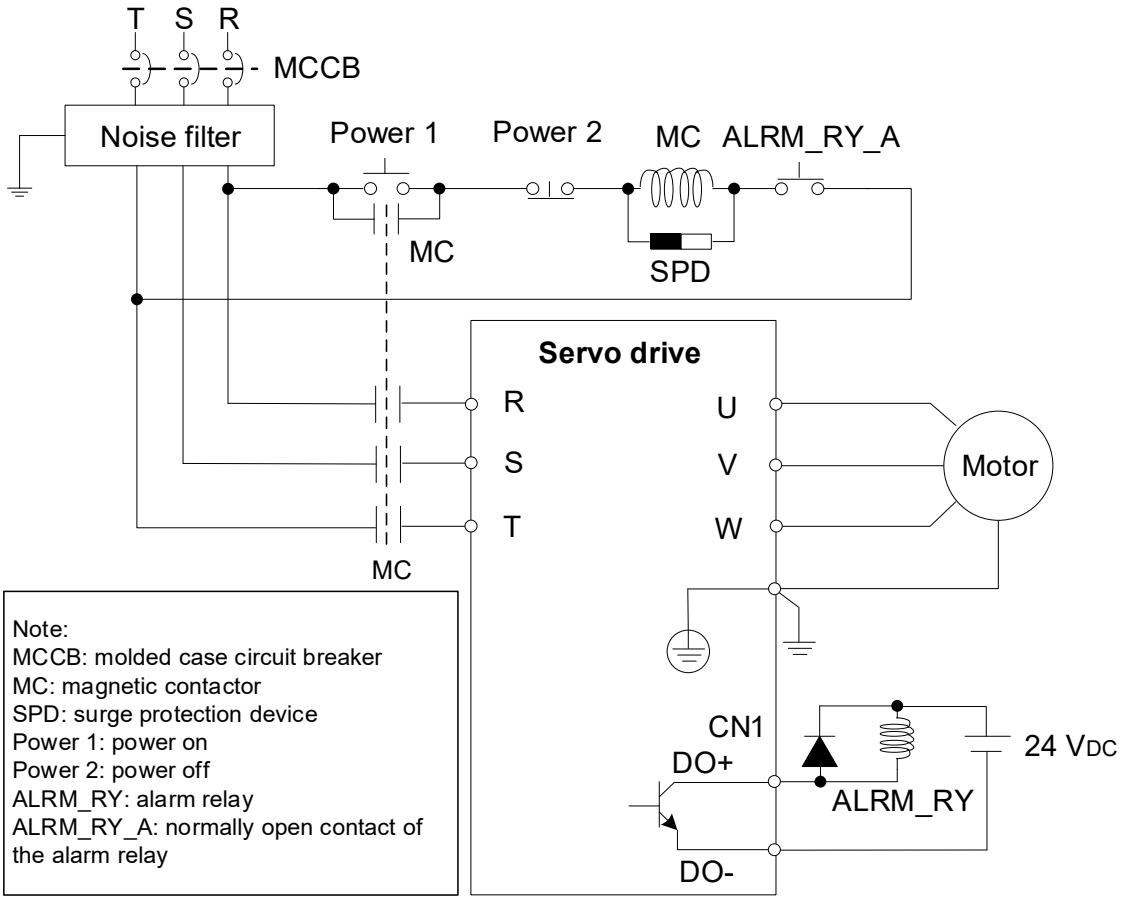
Pay special attention to the following when wiring:

1. When the power is off, do not touch R, S, T, and U, V, W, and P, D, C, ⊖ wires since the built-in capacitor of the servo drive can still contain a dangerously large amount of electric charge. Wait until the “CHARGE” indicator is off.
2. Separate the RST power cable and the UVW power cable from other signal cables. The separation distance should be at least 30 cm (11.8 inches).
3. For the encoder cable used to connect CN2, use a twisted-pair cable with metal braided shielding that conforms to the UL2464 standard.
4. Do not use any external capacitors, or it may damage the servo drive.

3.1.2.3 Wiring for power supply

The servo drive only supports single-phase wiring for the power supply.

In the following diagram, Power 1 and ALRM_RY_A are normally open contacts, and Power 2 is a normally closed contact. MC (magnetic contactor) is the power relay and the contact for the power input.

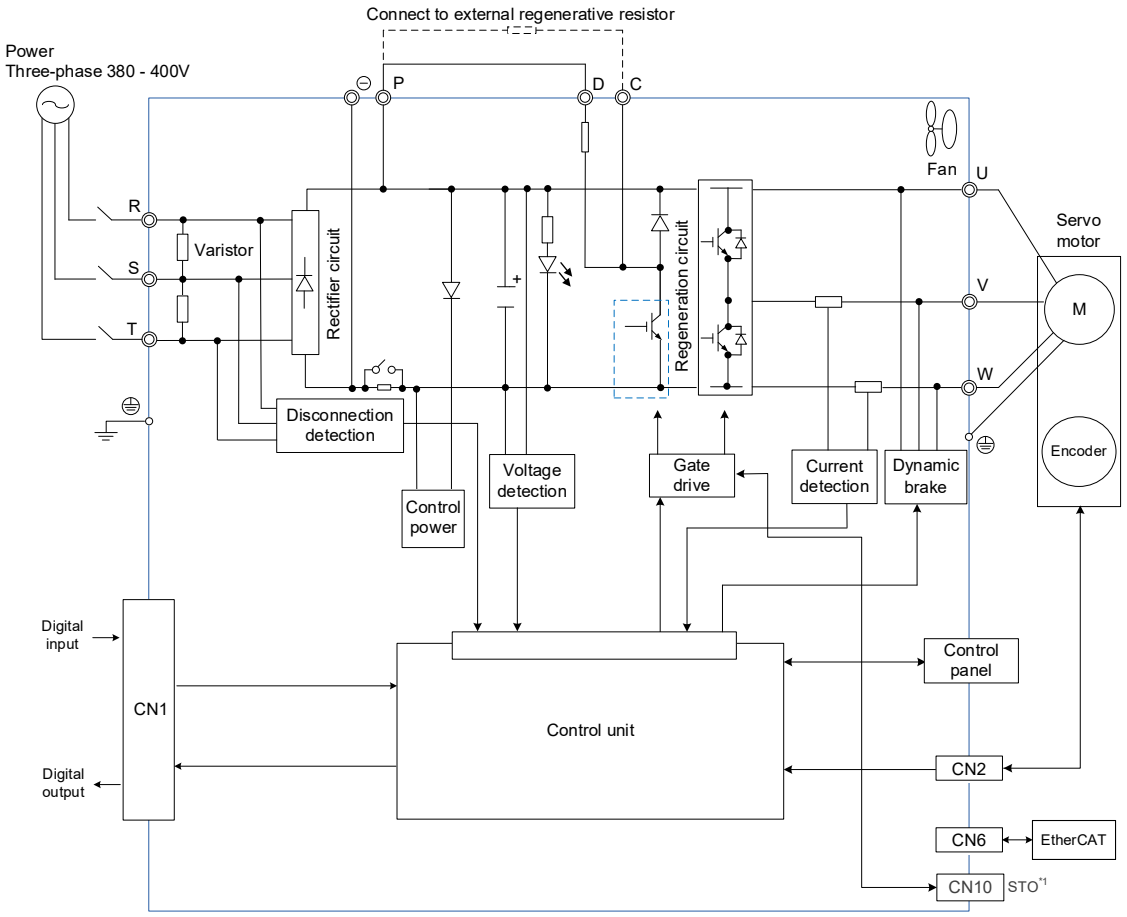


Note: perform wiring according to the actual DO parameter configurations of each model.

3

3.1.2.4 Wiring diagrams for the servo system

1 kW - 3 kW models

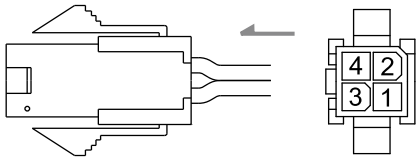
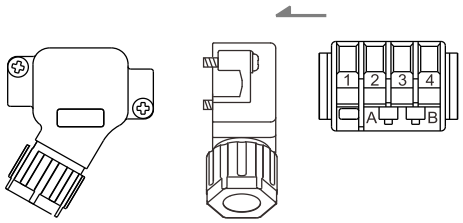
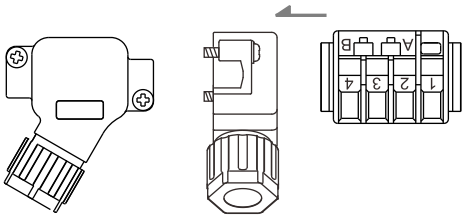


Note:

1. STO function is available on -EF models only.

3.1.3 Power connector specifications

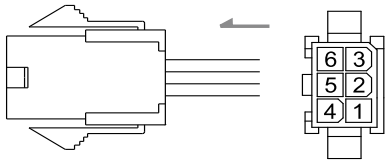
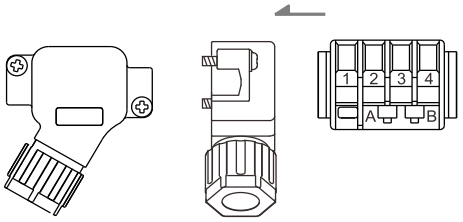
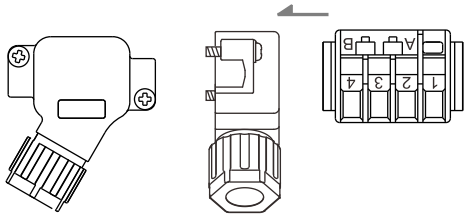
3.1.3.1 F40 - F80 motors – Power connectors

Connector type Model number	Applicable model Model number	UVW power connector - no brake
Standard ACS3-CAPW1000	ECM-E3 ECM-E3□-□□△△□□RS□ △△ = 04, 06, 08	
Bulkhead - cable exit direction towards motor shaft ACS3-AFPWSS00	ECM-E3 ECM-E3□-□□△△□□RB□ △△ = 04, 06, 08	
Bulkhead - cable exit direction towards encoder ACS3-ABPWSS00	ECM-E3 ECM-E3□-□□△△□□RB□ △△ = 04, 06, 08	

Pin assignment			
U (Red)	V (White)	W (Black)	FG (Yellow / Green)
1	2	3	4

Note: all bulkhead connectors are with brakes. Do not wire Pin A and Pin B when using the motors without brakes.

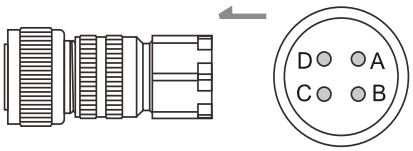
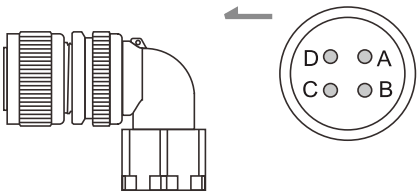
3

Connector type Model number	Applicable model Model number	UVW power connector - with brake
Standard ACS3-CAPW2000	ECM-E3 ECM-E3□-□□△△□□SS□ △△ = 04, 06, 08	
Bulkhead - cable exit direction towards motor shaft ACS3-AFPWSS00	ECM-E3 ECM-E3□-□□△△□□SB□ △△ = 04, 06, 08	
Bulkhead - cable exit direction towards encoder ACS3-ABPWSS00	ECM-E3 ECM-E3□-□□△△□□SB□ △△ = 04, 06, 08	

Pin assignment						
Connector type	U (Red)	V (White)	W (Black)	FG (Yellow / Green)	BRAKE1 (Brown)	BRAKE2 (Blue)
Standard	1	2	4	5	3	6
Bulkhead	1	2	3	4	A	B

Note: power supply for the brake is 24 V_{DC}; do not share the same power supply with other signals. The brake coil has no polarity; its pin symbols are BRAKE1 and BRAKE2.

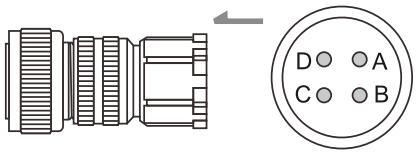
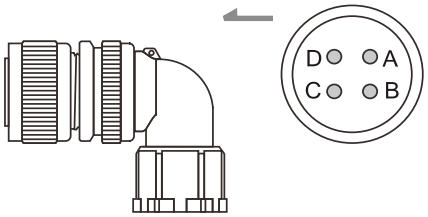
3.1.3.2 F100 - F130 motors – Power connectors

Connector type Model number	Applicable model Model number	UVW power connector - no brake
Military - straight 3106A-18-10S ACS3-CAPWA000	ECM-E3 ECM-E3□-□□△△□□□S□ △△ = 10, 13	
Military - right angle 3108A-18-10S ACS3-CRPWA000	ECM-E3 ECM-E3□-□□△△□□□S□ △△ = 10, 13	

Pin assignment			
U (Red)	V (White)	W (Black)	FG (Yellow / Green)
A	B	C	D

Note: see Section 3.1.3.4 for the brake connectors.

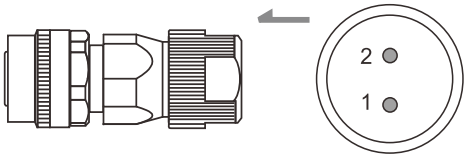
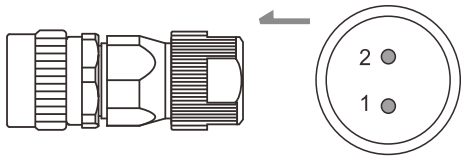
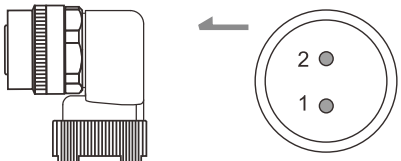
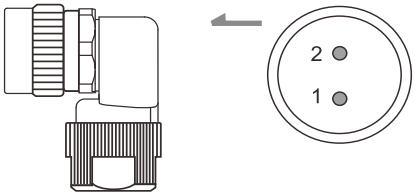
3.1.3.3 F180 motors – Power connectors

Connector type Model number	Applicable model Model number	UVW power connector - no brake
Military - straight 3106A-22-22S ACS3-CAPWC000	ECM-E3 ECM-E3□-□□△△□□□S□ △△ = 18	
Military - right angle 3108A-22-22S ACS3-CRPWC000	ECM-E3 ECM-E3□-□□△△□□□S□ △△ = 18	

Pin assignment			
U (Red)	V (White)	W (Black)	FG (Yellow / Green)
A	B	C	D

Note: see Section 3.1.3.4 for the brake connectors.

3.1.3.4 F100 - F180 motors – Brake connectors

Connector type Model number	Applicable model Model number	Brake connector
Military - straight CMV1-SP2S [bayonet] ACS3-CABRA000	ECM-E3 ECM-E3□-□□△△□□S□□ △△ = 10, 13, 18	
Military - straight [threaded, M17.5] ACS3-CABRM000	ECM-E3 ECM-E3□-□□△△□□S□□ △△ = 10, 13, 18	
Military - right angle CMV1-AP2S [bayonet] ACS3-CRBRA000	ECM-E3 ECM-E3□-□□△△□□S□□ △△ = 10, 13, 18	
Military - right angle [threaded, M17.5] ACS3-CRBRM000	ECM-E3 ECM-E3□-□□△△□□S□□ △△ = 10, 13, 18	

Pin assignment	
BRAKE1 (Red)	BRAKE2 (Black)
1	2

Note:

1. Power supply for the brake is 24 V_{DC}; do not share the same power supply with other signals. The brake coil has no polarity.
2. Motors with bayonet receptacles are not compatible with threaded military connectors. Refer to Section B.11 for details.

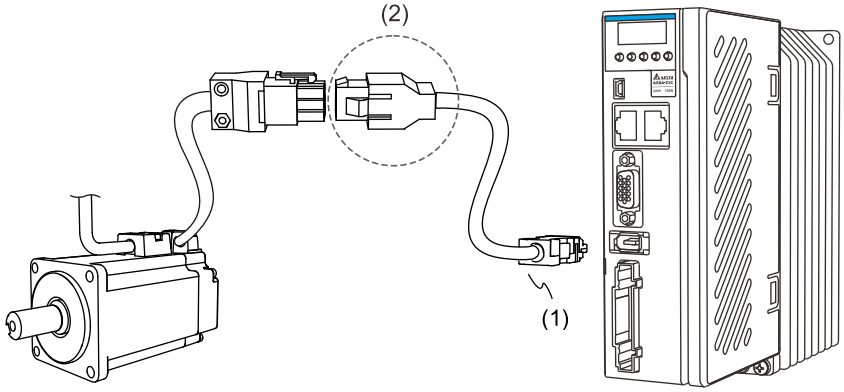
3.1.4 Encoder connector specifications

Select the corresponding encoder connector according to the motor frame size.

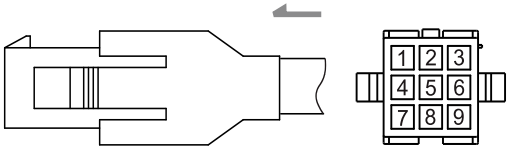
3

3.1.4.1 F40 - F80 motors – Encoder connectors

Standard connector



(1) CN2 connector; (2) Standard connector

Connector type Model number	Applicable model Model number	Encoder connector
Standard ACS3-CAEN0000	ECM-E3 ECM-E3□-□□△△□□□S□ △△ = 04, 06, 08	

Note:

1. See Section 3.3 for the pin assignment of the encoder connectors.
2. We recommend using the connector with tin-plated terminals since the connector of the encoder cable from the servo motor side is also tin-plated.

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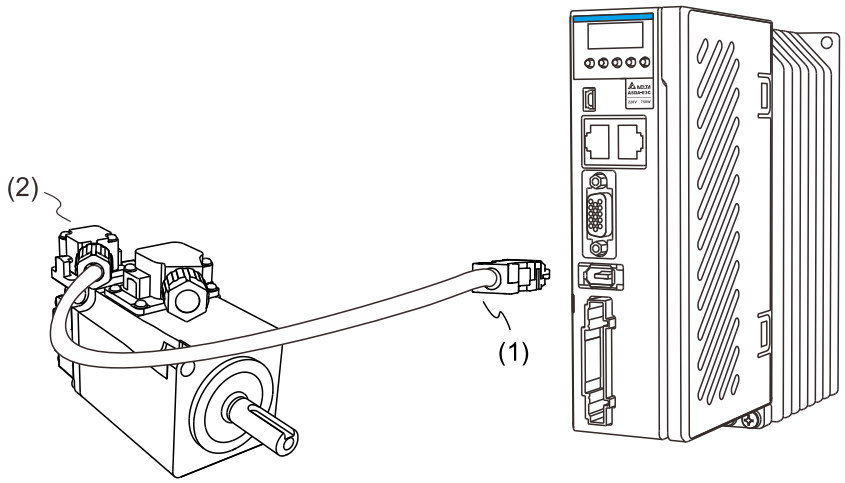
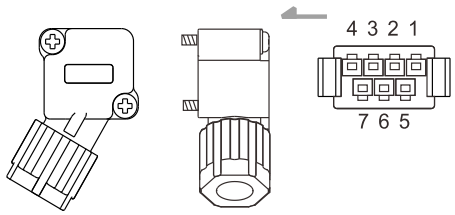
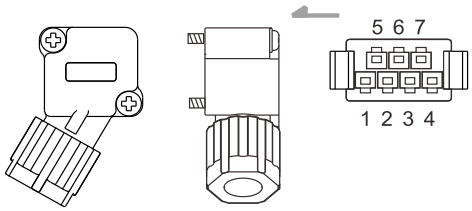
Bulkhead connector



(1) CN2 connector ; (2) Bulkhead connector (cable exit direction towards motor shaft)

Connector type Model type	Applicable model Model number	Encoder connector
Bulkhead - cable exit direction towards motor shaft ACS3-AFEASA00	ECM-E3 ECM-E3□-□□△△□□□B□ △△ = 04, 06, 08	
Bulkhead - cable exit direction towards encoder ACS3-AFEASA00	ECM-E3 ECM-E3□-□□△△□□□B□ △△ = 04, 06, 08	

Note: see Section 3.3 for the pin assignment of the encoder connectors.

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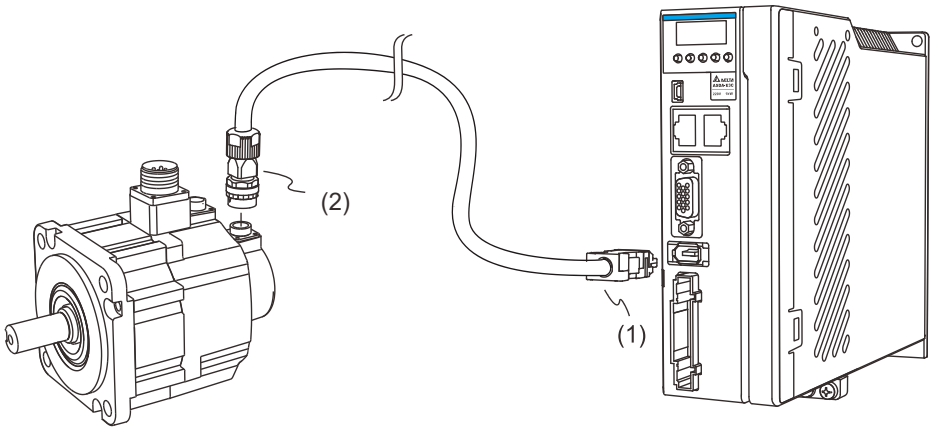
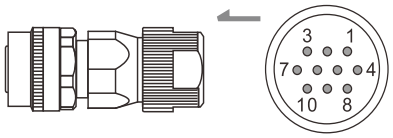
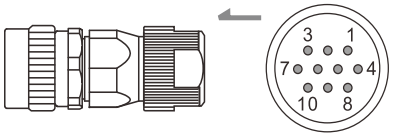
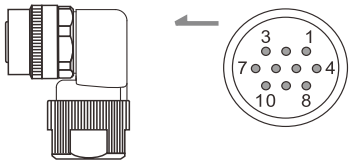
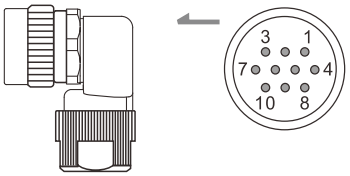
3.1.4.2 F100 - F180 motors – Encoder connectors



(1) CN2 connector; (2) Military connector

Connector type Model number	Applicable model Model number	Encoder connector
Military - straight CMV1-SP10S [bayonet] ACS3-CAENA000	ECM-E3 ECM-E3□-□□△△□□□□□ △△ = 10, 13, 18	
Military - straight [threaded, M17.5] ACS3-CAENM000	ECM-E3 ECM-E3□-□□△△□□□□□ △△ = 10, 13, 18	
Military - right angle CMV1-AP10S [bayonet] ACS3-CRENA000	ECM-E3 ECM-E3□-□□△△□□□□□ △△ = 10, 13, 18	
Military - right angle [threaded, M17.5] ACS3-CRENM000	ECM-E3 ECM-E3□-□□△△□□□□□ △△ = 10, 13, 18	

Note:

1. See Section 3.3 for the pin assignment of the encoder connectors.
2. Motors with bayonet receptacles are not compatible with threaded military connectors. Refer to Section B.11 for details.

3.1.5 Wire selection

3.1.5.1 Wire and terminal specifications

Use wire ferrules, and the suggested brand is K.S. Terminals Inc. The following table is the suggested wire specifications.

1. The shield should be connected to the ground terminal ⏚.
2. When wiring, use the wires suggested in this section to avoid danger.
3. Do not use bare wires for wiring, or the loose wires may cause accidents.

Servo drive model	L1, L2		U, V, W		P, D, C, ⊖	
	Wire spec.	Wire ferrule	Wire spec.	Wire ferrule	Wire spec.	Wire ferrule
ASD-E3C-0421	20 AWG 0.52 mm^2	E0508	18 AWG 0.82 mm^2	E1008	14 AWG 2.1 mm^2	E2508
ASD-E3C-0721	16 AWG 1.3 mm^2	E1508	18 AWG 0.82 mm^2	E1008	14 AWG 2.1 mm^2	E2508
ASD-E3C-1021	14 AWG 2.1 mm^2	E2508	14 AWG 2.1 mm^2	E2508	14 AWG 2.1 mm^2	E2508
ASD-E3C-1521	14 AWG 2.1 mm^2	E2508	14 AWG 2.1 mm^2	E2508	14 AWG 2.1 mm^2	E2508

Servo drive model	R, S, T		U, V, W		P, D, C, ⊖	
	Wire spec.	Wire ferrule	Wire spec.	Wire ferrule	Wire spec.	Wire ferrule
ASD-E3C-1043	14 AWG 2.1 mm^2	E2508	14 AWG 2.1 mm^2	E2508	14 AWG 2.1 mm^2	E2508
ASD-E3C-1543	14 AWG 2.1 mm^2	E2508	14 AWG 2.1 mm^2	E2508	14 AWG 2.1 mm^2	E2508
ASD-E3C-2043	14 AWG 2.1 mm^2	E2508	14 AWG 2.1 mm^2	E2508	14 AWG 2.1 mm^2	E2508
ASD-E3C-3043	14 AWG 2.1 mm^2	E2508	14 AWG 2.1 mm^2	E2508	14 AWG 2.1 mm^2	E2508

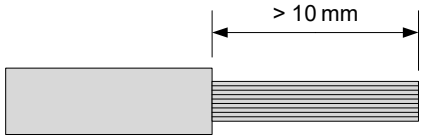
3.1.5.2 Crimping the wire ferrules

- Do not use bare wires for wiring, or the loose wires may cause accidents.
- Use a crimping tool to properly crimp the ferrules and wires.

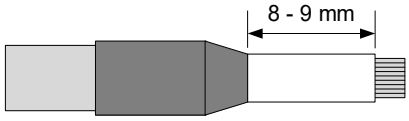
3

Crimping the wire ferrules

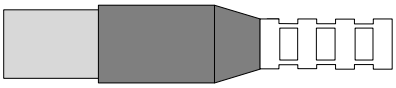
Use a ferrule with the barrel length of **8 - 9 mm (0.31 - 0.35 inches)** and the wires of corresponding specifications for the drives. If the barrel length is shorter than 8 mm, the wire may fall off and cause danger.



Step 1: strip the wire insulation to expose the conductor for more than 10 mm (0.39 inches).



Step 2: insert the wire into the ferrule.



Step 3: use a ferrule crimper to crimp the barrel. Cut off the exposed conductor; the remaining length of the exposed part should be shorter than 0.5 mm (0.02 inches).

Wire specifications for the attached terminals of Delta connectors

The following table shows the Delta connectors with terminals attached and the applicable wire specifications. Refer to the actual product specification when wiring.

Connector type	Connector model	Applicable wire spec.
Standard	ACS3-CAPW1000	24 - 18 AWG (0.21 mm² - 0.82 mm²)
	ACS3-CAPW2000	24 - 18 AWG (0.21 mm² - 0.82 mm²)
	ACS3-CAEN0000	26 - 22 AWG (0.13 mm² - 0.32 mm²)
Bulkhead - cable exit direction towards motor shaft	ACS3-AFPWSS00	UVW: 20 - 18 AWG (0.52 mm² - 0.82 mm²) Brake: 26 - 22 AWG (0.13 mm² - 0.32 mm²)
Bulkhead - cable exit direction towards encoder	ACS3-ABPWSS00	
Bulkhead - cable exit direction towards motor shaft / towards encoder	ACS3-AFEASA00	26 - 22 AWG (0.13 mm² - 0.32 mm²)

3.1.5.3 Encoder cable specifications

Item	Standard cable	Flexible cable
Model number	ACS3-CAEN01XX ACS3-CAEA01XX ACS3-CAENA1XX ACS3-CAEAA1XX ACS3-CRENA1XX ACS3-CREAA1XX ACS3-CAENM1XX ACS3-CAEAM1XX ACS3-CRENM1XX ACS3-CREAM1XX	ACS3-CAEF01XX ACS3-CAEB01XX ACS3-CAEFA1XX ACS3-CAEBA1XX ACS3-CREFA1XX ACS3-CREBA1XX ACS3-CAEFM1XX ACS3-CAEBM1XX ACS3-CREFM1XX ACS3-CREBM1XX
Cable specification	UL2464 (Temp. rating: 80°C / 176°F)	UL2464 (Temp. rating: 80°C / 176°F)
DC+5V, GND	AWG#22-2C (0.32 mm²) Outer diameter of insulated wire: Φ1.3 mm	AWG#22-2C (0.32 mm²) Outer diameter of insulated wire: Φ1.3 mm
T+, T-	AWG#24-2P (0.21 mm²) Outer diameter of insulated wire: Φ1.1 mm	AWG#24-2P (0.21 mm²) Outer diameter of insulated wire: Φ1.1 mm
Cable outer diameter	Φ7 mm	
Max. allowable wiring length	20 m	
Standard length provided by Delta	L = 3 m, 5 m, 10 m, 20 m	

Note:
1. Use a shielded twisted-pair cable to reduce the noise interference.
2. The shield should connect to the ground terminal ⏚.
3. When wiring, use the wires suggested in this section to avoid danger.

Item	Standard cable	Flexible cable
Model number	ACS3-AFEASIXX ACS3-ABEASIXX ACS3-AFEASAXX ACS3-ABEASAXX	ACS3-AFERSIXX ACS3-ABERSIXX ACS3-AFERSAXX ACS3-ABERSAXX
Cable specification	UL20276 (Temp. rating: 80°C / 176°F)	UL20276 (Temp. rating: 80°C / 176°F)
DC+5V, GND	AWG#22-2C (0.32 mm²) Outer diameter of insulated wire: Φ1.3 mm	AWG#22-2C (0.32 mm²) Outer diameter of insulated wire: Φ1.3 mm
T+, T-	AWG#26-2P (0.13 mm²) Outer diameter of insulated wire: Φ1.1 mm	AWG#26-2P (0.13 mm²) Outer diameter of insulated wire: Φ1.1 mm
Cable outer diameter	Φ5.8 - 6.2 mm	
Max. allowable wiring length	20 m	
Standard length provided by Delta	L = 3 m, 5 m, 10 m, 20 m	

Note:
1. Use a shielded twisted-pair cable to reduce the noise interference.
2. The shield should connect to the ground terminal ⏚.
3. When wiring, use the wires suggested in this section to avoid danger.
4. The encoder adapter cables share the same wire specifications with the encoder cables, except that their lengths are specified in Section B.6.

3.1.5.4 Power cable specifications

F40 - F80 motors

Item	Standard cable	Flexible cable
Model number	ACS3-CAPW11XX	ACS3-CAPF11XX
Cable specification	UL2517 (Temp. rating: 105°C / 221°F)	UL2517 (Temp. rating: 105°C / 221°F)
UVW wire	AWG#18-4C (0.82 mm²) Outer diameter of insulated wire: Φ2.1 mm Voltage rating: 300 V_{AC}	AWG#18-4C (0.82 mm²) Outer diameter of insulated wire: Φ2.1 mm Voltage rating: 300 V_{AC}
Brake wire	AWG#22-2C (0.32 mm²) Outer diameter of insulated wire: Φ1.6 mm Voltage rating: 300 V_{AC}	AWG#22-2C (0.32 mm²) Outer diameter of insulated wire: Φ1.6 mm Voltage rating: 300 V_{AC}
Cable outer diameter	Power cable without brake: Φ7.7 mm; power cable with brake: Φ8.6 mm	
Max. allowable wiring length	20 m	
Standard length provided by Delta	L = 3 m, 5 m, 10 m, 20 m	

Item	Standard cable	Flexible cable
Model number	ACS3-AFPWSRXX ACS3-AFPWSSXX ACS3-ABPWSRXX ACS3-ABPWSSXX	ACS3-AFPRSRXX ACS3-AFPRSSXX ACS3-ABPRSRXX ACS3-ABPRSSXX
Cable specification	UL2517 (Temp. rating: 105°C / 221°F)	UL2517 (Temp. rating: 105°C / 221°F)
UVW wire	AWG#20-4C (0.52 mm²) Outer diameter of insulated wire: Φ1.55 mm Voltage rating: 300 V_{AC}	AWG#20-4C (0.52 mm²) Outer diameter of insulated wire: Φ1.55 mm Voltage rating: 300 V_{AC}
Brake wire	AWG#24-2C (0.21 mm²) Outer diameter of insulated wire: Φ1.12 mm Voltage rating: 300 V_{AC}	AWG#24-2C (0.21 mm²) Outer diameter of insulated wire: Φ1.12 mm Voltage rating: 300 V_{AC}
Cable outer diameter	Φ6.0 - 6.8 mm	
Max. allowable wiring length	20 m	
Standard length provided by Delta	L = 3 m, 5 m, 10 m, 20 m	

Note: the power adapter cables share the same wire specifications with the power cables, except that their lengths are specified in Section B.3.

Item	Standard cable	Flexible cable
Model number	ACS3-CAPW21XX ACS3-CAPW31XX	ACS3-CAPF21XX ACS3-CAPF31XX
Cable specification	UL2586 (Temp. rating: 105°C / 221°F)	UL2586 (Temp. rating: 105°C / 221°F)
UVW wire	AWG#18-4C (0.82 mm²) Outer diameter of insulated wire: Φ2.1 mm Voltage rating: 600 V_{AC}	AWG#18-4C (0.82 mm²) Outer diameter of insulated wire: Φ2.1 mm Voltage rating: 600 V_{AC}
Brake wire	AWG#22-2C (0.32 mm²) Outer diameter of insulated wire: Φ1.6 mm Voltage rating: 600 V_{AC}	AWG#22-2C (0.32 mm²) Outer diameter of insulated wire: Φ1.6 mm Voltage rating: 600 V_{AC}
Cable outer diameter	Power cable without brake: Φ7.7 mm; power cable with brake: Φ8.6 mm	
Max. allowable wiring length	20 m	
Standard length provided by Delta	L = 3 m, 5 m, 10 m, 20 m	

Item	Standard cable	Flexible cable
Model number	ACS3-AFPWSAXX ACS3-AFPWSBXX ACS3-ABPWSAXX ACS3-ABPWSBXX	ACS3-AFPRSAXX ACS3-AFPRSBXX ACS3-ABPRSAXX ACS3-ABPRSBXX
Cable specification	UL2586 (Temp. rating: 105°C / 221°F)	UL2586 (Temp. rating: 105°C / 221°F)
UVW wire	AWG#20-4C (0.52 mm²) Outer diameter of insulated wire: Φ1.7 mm Voltage rating: 600 V_{AC}	AWG#20-4C (0.52 mm²) Outer diameter of insulated wire: Φ1.7 mm Voltage rating: 600 V_{AC}
Brake wire	AWG#24-2C (0.21 mm²) Outer diameter of insulated wire: Φ1.35 mm Voltage rating: 600 V_{AC}	AWG#24-2C (0.21 mm²) Outer diameter of insulated wire: Φ1.35 mm Voltage rating: 600 V_{AC}
Cable outer diameter	Φ6.0 - 6.8 mm	
Max. allowable wiring length	20 m	
Standard length provided by Delta	L = 3 m, 5 m, 10 m, 20 m	

Note:
1. Apart from these specifications, refer to Section 2.6.1 for the motor power cable selection and installation precautions.
2. The power adapter cables share the same wire specifications with the power cables, except that their lengths are specified in Section B.3.

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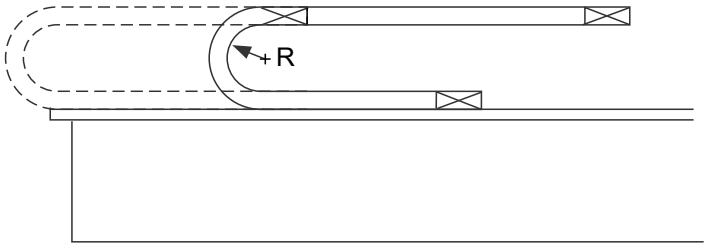
F100 - F130 motors

Item		Standard cable	Flexible cable
Power cable	Model number	ACS3-CAPWA3XX ACS3-CRPWA3XX	ACS3-CAPFA3XX ACS3-CRPFA3XX
	Specification	UL2586 (Temp. rating: 105°C / 221°F) AWG#14-4C (2.1 mm²) Outer diameter of insulated wire: Φ2.8 mm Cable outer diameter: Φ9.5 mm Voltage rating: 600 V_{AC}	UL2586 (Temp. rating: 105°C / 221°F) AWG#14-4C (2.1 mm²) Outer diameter of insulated wire: Φ2.8 mm Cable outer diameter: Φ9.5 mm Voltage rating: 600 V_{AC}
Brake cable	Model number	ACS3-CABRA1XX ACS3-CRBRA1XX ACS3-CABRM1XX ACS3-CRBRM1XX	ACS3-CABFA1XX ACS3-CRBFA1XX ACS3-CABFM1XX ACS3-CRBFM1XX
	Specification	UL2517 (Temp. rating: 105°C / 221°F) AWG#20-2C (0.52 mm²) Outer diameter of insulated wire: Φ1.8 mm Cable outer diameter: Φ5.5 mm Voltage rating: 300 V_{AC}	UL2517 (Temp. rating: 105°C / 221°F) AWG#20-2C (0.52 mm²) Outer diameter of insulated wire: Φ1.8 mm Cable outer diameter: Φ5.5 mm Voltage rating: 300 V_{AC}
Max. allowable wiring length		20 m	
Standard length provided by Delta		L = 3 m, 5 m, 10 m, 20 m	

3.1.5.5 Flexible cable specifications

Delta provides two types of power and encoder cables: standard cables and flexible cables. When connecting cables to the moving parts of a machine, use a flexible cable. Refer to the following table for flexible cable specifications.



R = bend radius of the cable

Item	Specification
Bend radius	10 times the cable outer diameter
Number of bending times	10 million times*1
Speed	3 m/s
Acceleration	15 m/s^2

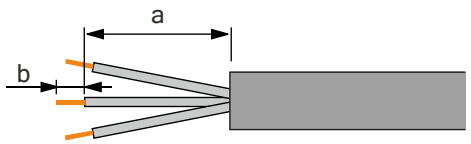
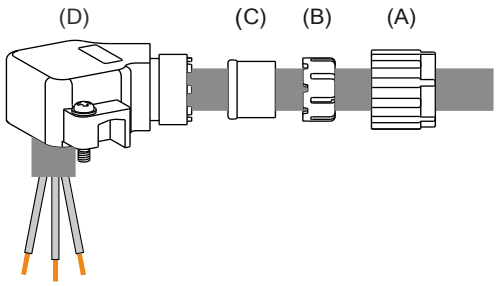
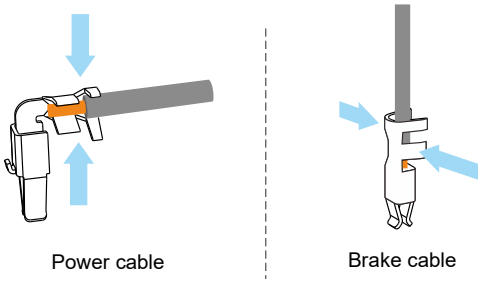
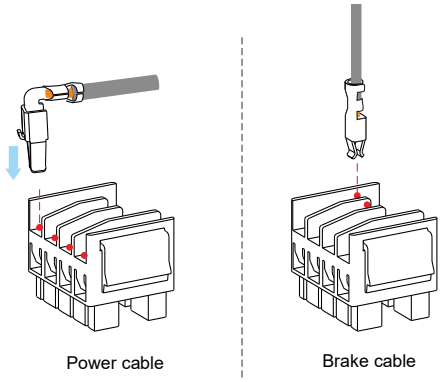
Note:
1. Bending the cable into a curve and then straightening it is considered as one time.
2. For precautions relevant to the use of cables, refer to Section 2.9.

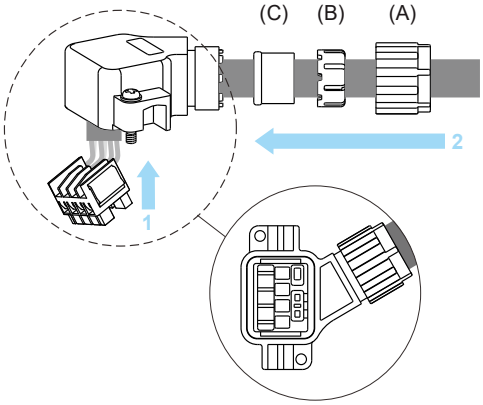
3

3.1.6 Waterproof connector wiring instructions

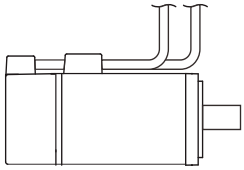
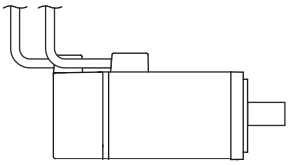
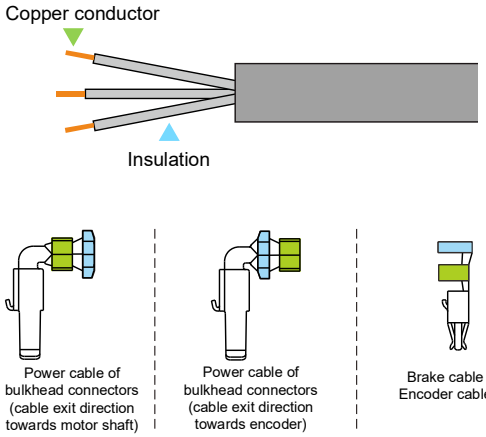
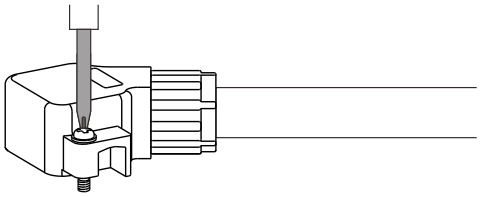
3.1.6.1 F40 - F80 motors – Power / Encoder / Brake connectors

The example here uses the **bulkhead connector - cable exit direction towards motor shaft**:

Bulkhead connector		
Step 1		Strip the cable; the exposed wire length (a) should be 15 mm (0.59 inches) and the conductor length (b) should be as follows: ■ For encoder cables / brake cables: 1.5 - 1.8 mm (0.059 - 0.071 inches) ■ For power cables of bulkhead connectors (cable exit direction towards motor shaft): 2 - 2.2 mm (0.079 - 0.087 inches) ■ For power cables of bulkhead connectors (cable exit direction towards encoder): 1.8 - 2 mm (0.071 - 0.079 inches)
Step 2		Place the (A) sealing nut, (B) compression ring, (C) rubber ring (with the bulge side towards the housing), and (D) housing on the cable in sequence. Important: use the rubber ring corresponding to the cable in order to meet the IP67 standard.
Step 3		Crimp the terminal.
Step 4		Plug the terminal into the connector. ■ Refer to Section 3.1.3 for pin assignment of power connectors. ■ Refer to Section 3.3 for pin assignment of encoder connectors.

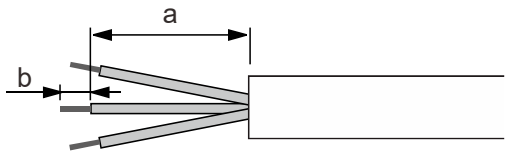
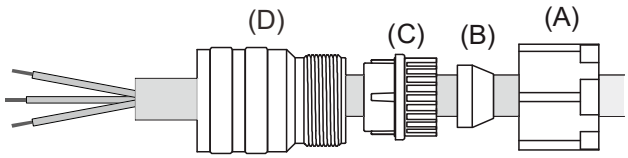
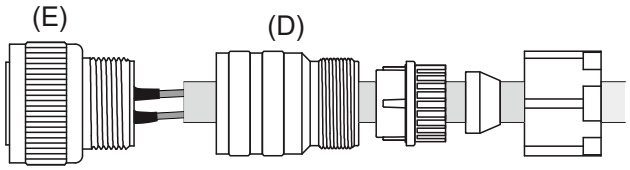
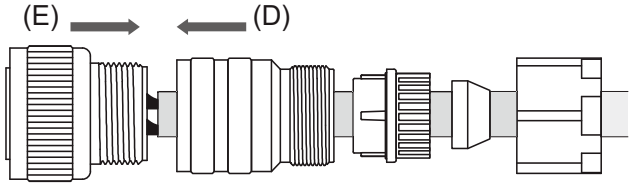
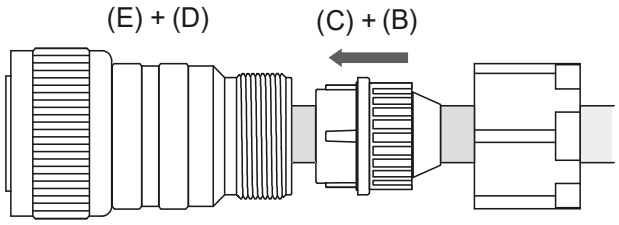
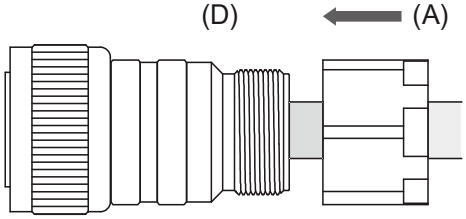
Bulkhead connector		
Step 5		Put the connector in the housing, and secure the (C) rubber ring, (B) compression ring, and (A) sealing nut to the housing in sequence. Use a wrench to lock the sealing nut to the housing to complete the wiring.

Precautions:

Cable exit direction towards motor shaft	Cable exit direction towards encoder	
		Illustrations for the cable exit direction.
		The green highlighted area on the terminal is where you crimp the copper conductor. The blue highlighted area on the terminal is where you crimp the wire insulation. Refer to Section 3.1.5.2 for the wire specifications of terminals.
		It is advisable to tighten the connector to the motor at the torque of 0.15 ± 0.015 N·m. Use the M2 screw for tightening.

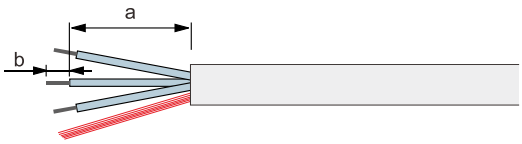
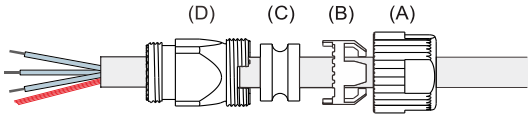
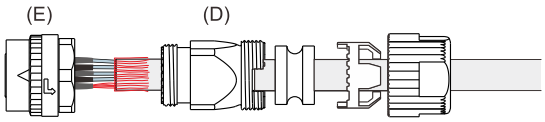
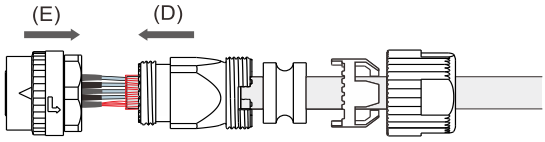
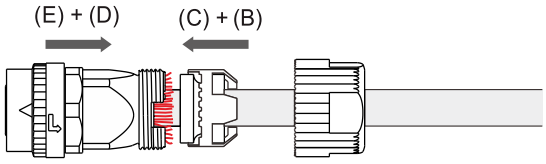
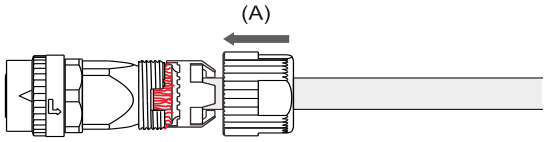
3

3.1.6.2 F100 - F130 motors – Power connectors

Military connector		
Step 1		Strip the cable; the exposed wire length (a) should be 23 - 27 mm (0.9” - 1.06”) for straight connectors and 28 - 32 mm (1.1” - 1.26”) for right angle connectors, and the tinned conductor length (b) should be 3 - 5 mm (0.12” - 0.2”).
Step 2		Place the (A) sealing nut, (B) rubber ring, (C) black compression ring, and (D) straight or right angle connector on the cable in sequence. Important: use the rubber ring corresponding to the cable in order to meet the IP67 standard.
Step 3		Refer to Section 3.1.3 for pin assignment of power connectors. Important: it is suggested that you use 20 mm (0.79”) heat shrink for straight connectors, and 25 mm (0.98”) heat shrink for right angle connectors.
Step 4		Tighten (D) and (E) with adequate torque. For the torque value, refer to Section 3.1.6.4.
Step 5		Place (B) in (C), and then place (C) + (B) in (D).
Step 6		Tighten (A) and (D) at the torque of 10 N·m.

3.1.6.3 F100 - F180 motors – Brake / Encoder connectors

The example here uses the **encoder connector**. For brake connectors, disregard the descriptions about metal shield.

Brake / Encoder connector		
Step 1		Strip the cable and expose the wires covered by the metal shield. The exposed wire length (a) should be 12 mm (0.47”) for straight connectors and 17 mm (0.67”) for right angle connectors, and the tinned conductor length (b) should be 2 mm (0.08”).
Step 2		Place the (A) sealing nut, (B) compression ring, (C) rubber ring, and (D) straight or right angle connector on the cable in sequence. Important: use the rubber ring corresponding to the cable in order to meet the IP67 standard.
Step 3		■ The pins of brake connectors have no polarity. ■ Refer to Section 3.3 for pin assignment of encoder connectors. Separate the metal shield into two strands. Solder one strand of the metal shield to the solder cup, and then fold back the other strand. Important: it is suggested that you use 8 mm (0.31”) heat shrink.
Step 4		Tighten (D) and (E) with adequate torque. For the torque value, refer to Section 3.1.6.4.
Step 5		Place (C) in (B), and then place (C) + (B) in (D).
Step 6		Tighten (A) and (D) at the torque of 2.1 N·m to join the folded metal shield and the metal case together. This increases the contact area of the ground terminal and reduces the interference.

3.1.6.4 Waterproof connector installation and wiring specifications

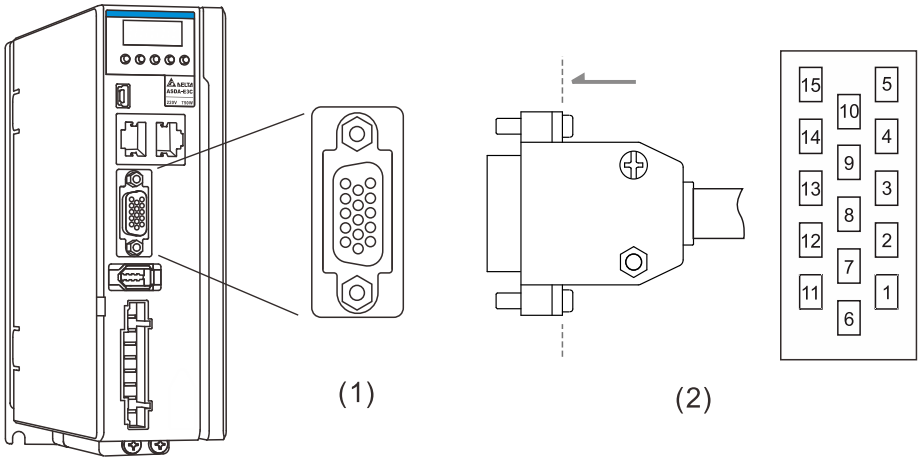
When mating, ensure the connector is fully locked and the diameter of the wire matches that of the rubber ring. If you choose a wire of smaller diameter and a rubber ring of larger diameter, the combination does not meet the IP67 standard. When selecting the wires, refer to Section 3.1.5.

Motor frame size	Connector type	Connector model	Rubber ring diameter (mm)	Torque for tightening the connector
F40 - F80	Bulkhead - cable exit direction towards motor shaft	ACS3-AFPWSS00	Φ6.0 - Φ6.8	0.4 - 0.6 N·m
	Bulkhead - cable exit direction towards encoder	ACS3-ABPWSS00	Φ6.0 - Φ6.8	0.4 - 0.6 N·m
	Bulkhead - cable exit direction towards motor shaft / towards encoder	ACS3-AFEASA00	Φ5.8 - Φ6.2	0.4 - 0.6 N·m
F100 - F130	Military - straight	ACS3-CAPWA000	Two sets of rubber rings attached Φ9 - Φ10 and Φ11 - Φ12	8 - 9 N·m (Φ9 - Φ10) 9 - 10 N·m (Φ11 - Φ12)
	Military - right angle	ACS3-CRPWA000		
F100 - F130	Military - straight CMV1-SP2S [bayonet]	ACS3-CABRA000	Φ5.5 - Φ7.5	4 - 5 N·m
	Military - right angle CMV1-AP2S [bayonet]	ACS3-CRBRA000		
	Military - straight [threaded, M17.5]	ACS3-CABRM000	Φ5.5 - Φ7.5	4 - 5 N·m
	Military - right angle [threaded, M17.5]	ACS3-CRBRM000	Φ5.5 - Φ7.5	4 - 5 N·m
	Military - straight CMV1-SP10S [bayonet]	ACS3-CAENA000	Φ5.5 - Φ7.5	4 - 5 N·m
	Military - right angle CMV1-AP10S [bayonet]	ACS3-CRENA000		
	Military - straight [threaded, M17.5]	ACS3-CAENM000	Φ5.5 - Φ7.5	4 - 5 N·m
	Military - right angle [threaded, M17.5]	ACS3-CRENM000	Φ5.5 - Φ7.5	4 - 5 N·m

3.2 Wiring for the CN1 I/O connector

3.2.1 CN1 I/O connector

Users can define the functions of the 6 inputs and 3 outputs. The pin assignments are shown as follows.



(1) CN1 connector (female); (2) CN1 connector (male)

Note: the tightening torque of the CN1 connector is 2 - 2.5 kgf-cm (1.7 - 2.2 lbf-in).

Pin assignment:

Pin	Signal	Description	Pin	Signal	Description
1	COM+	Power input (24V ± 10%)	9	DO1+	Digital output
2	DI1-	Digital input	10	DO2-	Digital output
3	DI2-	Digital input	11	DO2+	Digital output
4	DI3-	Digital input	12	DO3-	Digital output
5	DI4-	Digital input	13	DO3+	Digital output
6	DI5-	Digital input	14	NC	-
7	DI6-	Digital input	15	NC	-
8	DO1-	Digital output	-	-	-

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

3.2.2 CN1 I/O connector signal description

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

Signal		Pin No.	Description
Power	COM+	1	NPN: COM+ is the positive terminal of the DI voltage source and requires an external power supply (24V ± 10%). PNP: COM+ is the negative terminal of the DI voltage source and requires an external power supply (24V ± 10%).
Others	NC	14, 15	No connection. This is for internal use only. Do not connect to NC, or it may damage the servo drive.

There are various control modes available (refer to Section 6.1) and the DI/DO signal configuration differs for each mode. This servo drive provides user-defined DI/DO signals for you to set the functions based on the application requirements. Refer to Chapter 8 for Table 8.1 Digital input (DI) descriptions and Table 8.2 Digital output (DO) descriptions. The default DI/DO signal configuration for each control mode includes the most commonly used functions and meets the requirements for general applications. To reset the DI/DO signals to the default values of each corresponding mode, set P1.001.U to 1 and cycle the power to the servo drive.

See the following tables for the default DI/DO signals of each control mode:

Control mode			
PR, S / Sz, T / Tz, communication mode, dual mode			
DI	Default Name	DO	Default Name
1	0x01 SON	1	0x01 SRDY
2	0x22 NL	2	0x07 ALRM
3	0x23 PL	3	0x00 -
4	0x21 EMGS	-	- -
5	0x00 -	-	- -
6	0x00 -	-	- -

Note: refer to Chapter 8 for the description of each DI/DO signal.

If the default DI/DO functions cannot meet the application requirement, you can refer to the following tables and specify the DI/DO functions by setting the DI and DO codes to the corresponding parameters.

Signal		CN1 Pin No.	Corresponding parameter	Signal		CN1 Pin No.	Corresponding parameter
Standard DI	DI1-	2	P2.010	Standard DI	DI4-	5	P2.013
	DI2-	3	P2.011		DI5-	6	P2.014
	DI3-	4	P2.012		DI6-	7	P2.015

Signal		CN1 Pin No.	Corresponding parameter	Signal		CN1 Pin No.	Corresponding parameter
Standard DO	DO1+	9	P2.018	Standard DO	DO3+	13	P2.020
	DO1-	8			DO3-	12	
	DO2+	11	P2.019		-	-	-
	DO2-	10			-	-	

3.2.3 CN1 wiring diagrams

Caution: when the drive connects to an inductive load, you must install the diode.

3

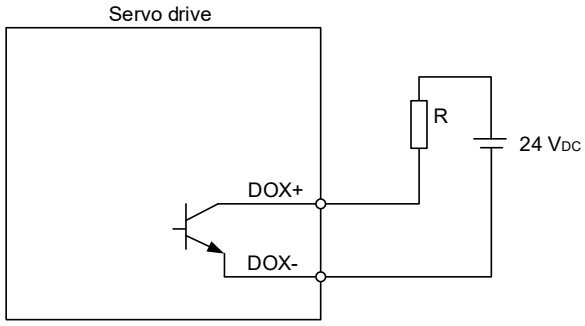
DO specification:

Permissible current: 40 mA and below; surge current: 100 mA and below; maximum voltage: 30V.

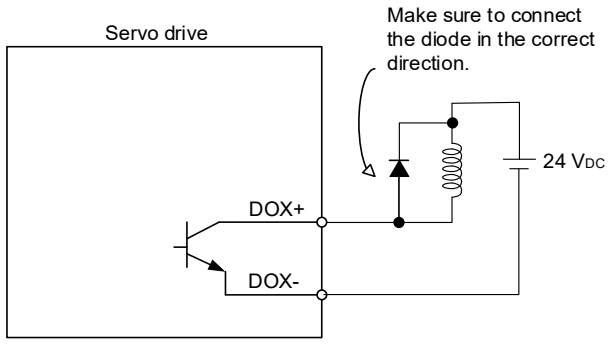
Diode specification:

1A or above, 500V or above (such as the 1N4005 diode).

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.



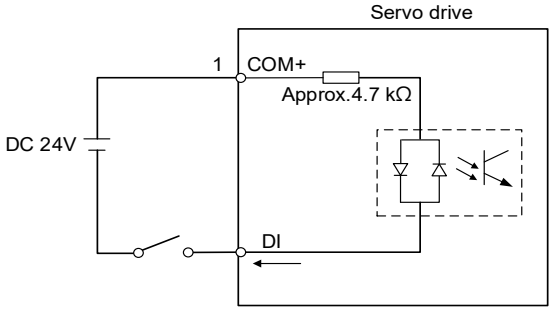
DI wiring - input signals by relay or open collector transistor.

Conditions of DI On / Off:

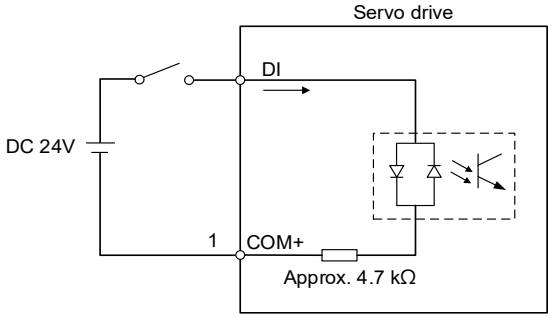
On: 15V - 24V; input current = 3 mA.

Off: 5V or below; the input current must not be higher than 0.5 mA.

C7: NPN transistor (SINK mode)

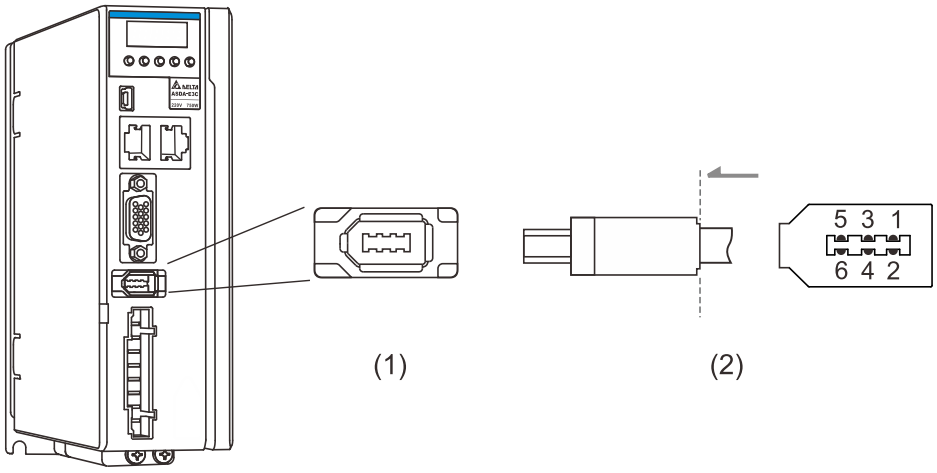


C8: PNP transistor (SOURCE mode)



3.3 Wiring for the CN2 encoder connector

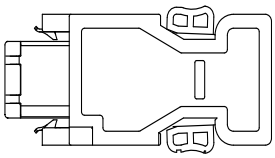
The wiring of the CN2 encoder connector is shown as follows:



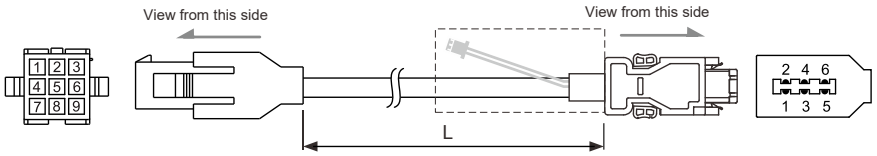
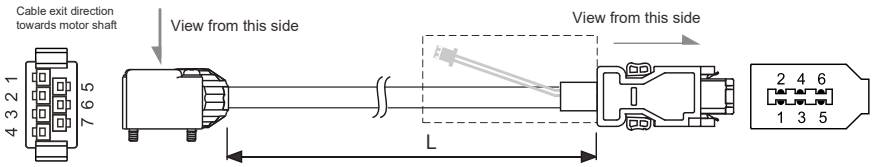
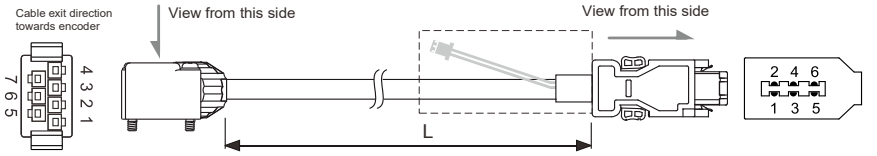
(1) CN2 connector (female); (2) CN2 connector (male)

WARNING

- DO NOT connect to Pin 3 and Pin 4 of the servo drive CN2 connector. These pins are for internal use only. Wiring them will cause damage to the internal circuit.
- When an absolute encoder is used, the battery supplies power directly to the encoder, so wiring the battery wires to the servo drive CN2 connector is not required.
- Use a twisted-pair cable with metal braided shielding that conforms to the UL2464 standard. When selecting the wires, refer to Section 3.1.5.
- Separate L1, L2 / R, S, T wires and U, V, W wires from the encoder cable. The separation distance should be at least 30 cm (11.8 inches).

CN2 connector	Connector type Model number
	IEEE 1394 ACS3-CNENC200

3.3.1 F40 - F80 motors – Encoder cables

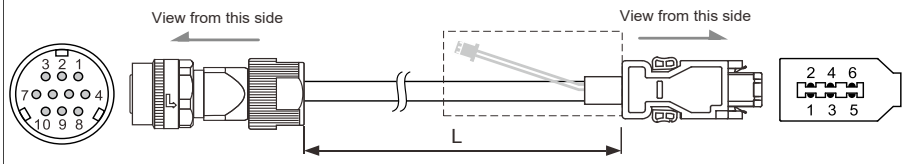
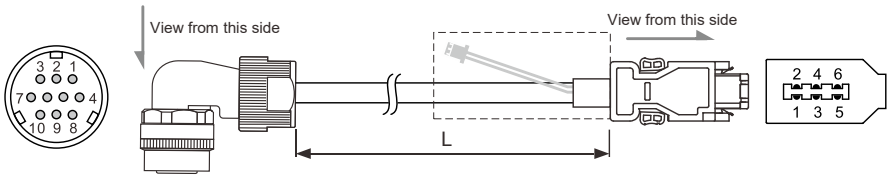
Encoder cables	
Standard connector	
Bulkhead connector - cable exit direction towards motor shaft	
Bulkhead connector - cable exit direction towards encoder	

Note: only the absolute encoder cables have the battery box connection wire.

Pin assignment:

Encoder cable connector				CN2 of servo drive		Description
Motor with cables		Motor with bulkhead connectors				
Standard	Wire color	Bulkhead	Wire color	Pin No.	Signal	
7	Brown	3	Red	1	DC+5V	+5V power supply
8	Blue	4	Orange	2	GND	Power ground
-	-	-	-	3	-	**Do not connect these pins. They are for internal use only.**
-	-	-	-	4	-	
1	White	1	Blue	5	T+	Serial communication signal (+)
4	White/Red	2	Purple	6	T-	Serial communication signal (-)
9	-	7	-	Case	Shielding	Shielding
2	Red	5	Brown	-	-	+3.6V battery
5	Black	6	Black	-	-	Battery ground

3.3.2 F100 - F130 motors – Encoder cables

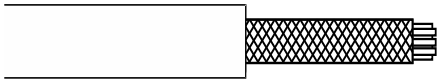
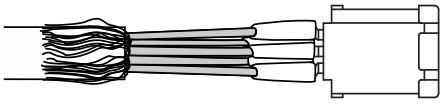
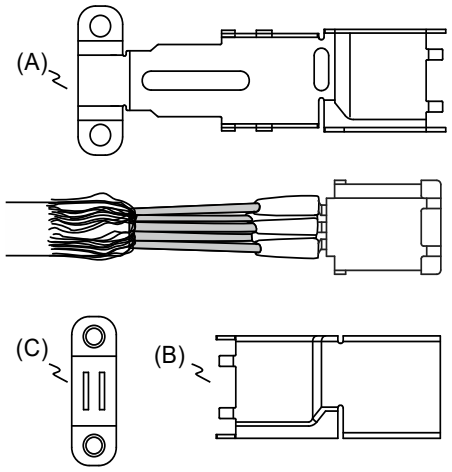
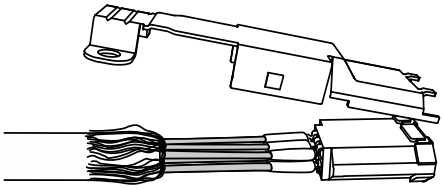
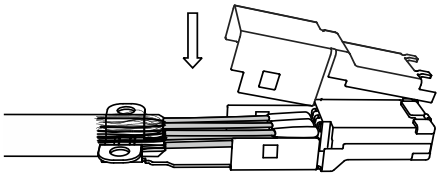
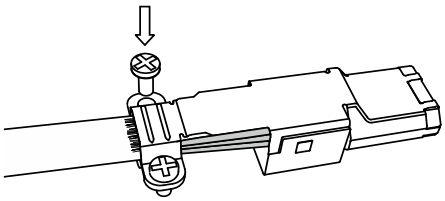
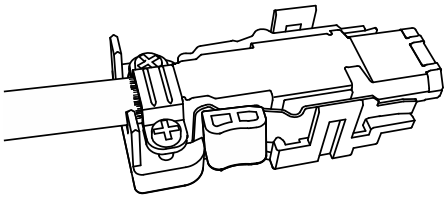
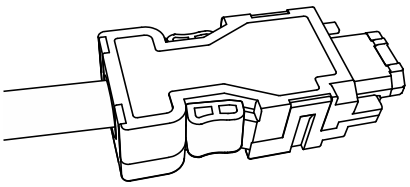
Encoder cable	
Military connector - straight	
Military connector - right angle	

Note: only the absolute encoder cables have the battery box connection wire.

Pin assignment:

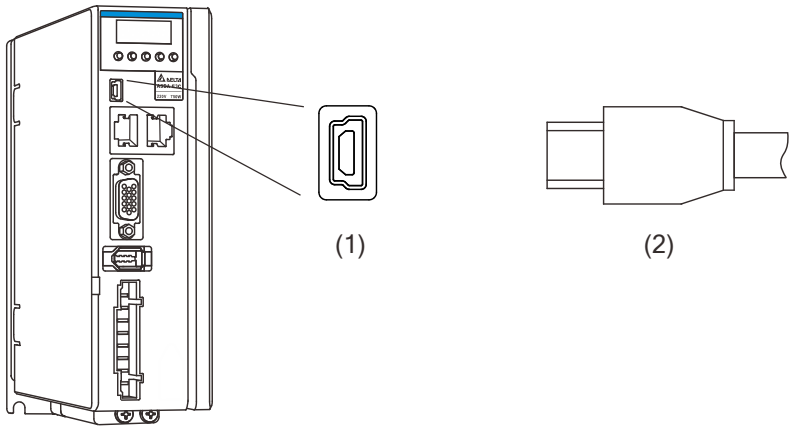
Encoder cable connector		CN2 of servo drive		Description
Military connector	Wire color	Pin No.	Signal	
4	Brown	1	+5V	+5V power supply
9	Blue	2	GND	Power ground
-	-	3	-	**Do not connect these pins. They are for internal use only.**
-	-	4	-	
1	White	5	T+	Serial communication signal (+)
2	White / Red	6	T-	Serial communication signal (-)
10	-	Case	Shielding	Shielding
6	Red	-	-	+3.6V battery
5	Black	-	-	Battery ground

3.3.3 Making a shielded cable for CN2 connector

Step 1		Strip the cable and expose the wires covered by the metal shield. The exposed wire length should be 20 - 30 mm (0.79 - 1.18 inches).
Step 2		Unravel the metal shield and fold it back. Refer to the pin assignment in the preceding tables to connect the wires.
Step 3		You need the following items to assemble the connector: (A) Big metal case (B) Small metal case (C) U-shaped bracket
Step 4		Place the big metal case to cover the exposed metal shield. Make sure the metal shield is completely covered to maintain the integrity of the shielding.
Step 5		Fasten the small metal case on the other side.
Step 6		Align the (C) U-shaped bracket with the bracket of (A) big metal case, flip the assembly over, and then secure (A) and (C) together with screws.
Step 7		Fit one side of the plastic case over the metal cases.
Step 8		Place and fasten the other side of the case to complete assembling the connector.

3.4 Wiring for CN4 connector (Mini USB)

The CN4 is a serial communication port through which you can connect the servo drive to a PC and operate the servo drive with the software. This is a Type B Mini USB port that is compatible with the USB 2.0 specification. When there is high interference during operation, installing the USB isolator (Delta model number: UC-ADP01-A) is required.



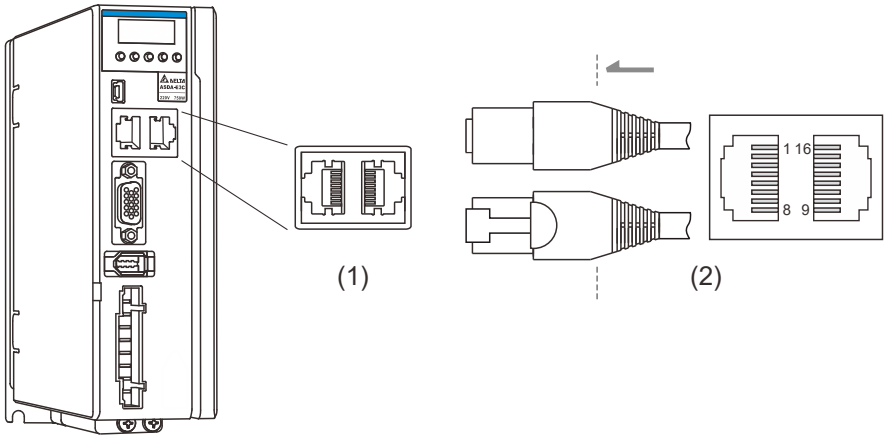
(1) Mini USB connector (female); (2) Mini USB connector (male)

ATTENTION

E3C-E models do not support USB power supply.

3.5 Wiring for the CN6 connector

The CN6 connector provides two EtherCAT ports for connecting multiple servo drives, with one way in and the other way out.



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

Pin assignment:

Transmission port	Pin No.	Signal	Function description
IN	1	TX+	Transmit +
	2	TX-	Transmit -
	3	RX+	Receive +
	4	-	Reserved
	5	-	Reserved
	6	RX-	Receive -
	7	-	Reserved
	8	-	Reserved
OUT	9	TX+	Transmit +
	10	TX-	Transmit -
	11	RX+	Receive +
	12	-	Reserved
	13	-	Reserved
	14	RX-	Receive -
	15	-	Reserved
	16	-	Reserved

Note: the IN port is for connecting the controller or the previous servo drive, and the OUT port is for connecting the next servo drive or not connecting to other devices. Incorrect wiring will lead to communication error.

Set P0.002 to 124 for monitoring the EtherCAT network and connection status through the panel:

■ X & Y: network status for OUT and IN ports

X & Y	Status	Description
0	No connection	Network connection is not established.
1	Network is connected	Network connection is established.

■ Z: EtherCAT error status

Z	Status	Description
0	No error	No error has occurred.
1	Error	Error occurs in the controller or servo drive.

■ U: EtherCAT connection status

U	Status	Description
0	Init	After the servo drive is powered on and the initialization is complete, the communication has not yet started, but the controller can access the servo drive's register.
1	Pre-Operational	The controller can exchange data through the mailbox.
2	Safe-Operational	The servo drive can use the SDO and TxPDO data packets to exchange data with the controller.
3	Operational	SDO, TxPDO, and RxPDO data packets can be transmitted.

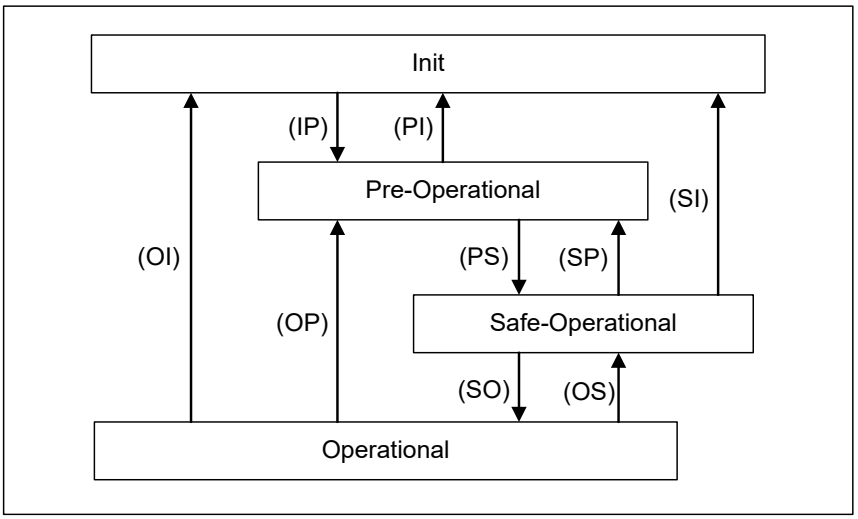
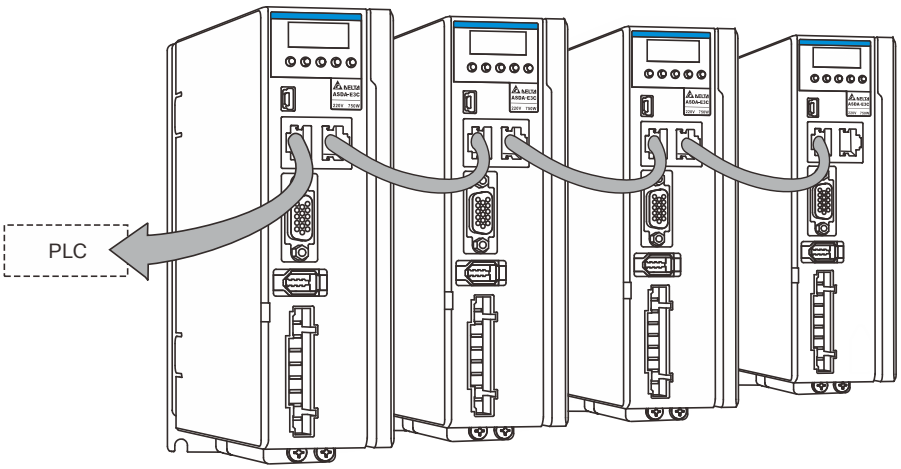


Figure 3.6.1 EtherCAT State Machine

Connecting multiple servo drives:



Note:
1. When multiple servo drives are connected, the maximum distance between each drive is 50 m (164.04 ft)
2. Use CAT5e STP cables.
3. It is suggested that you use a Beckhoff network cable (model number: ZB9020).
4. Make sure the wiring is correct. The IN port is for connecting the controller or the previous servo drive, and the OUT port is for connecting the next servo drive or not connecting to any devices.

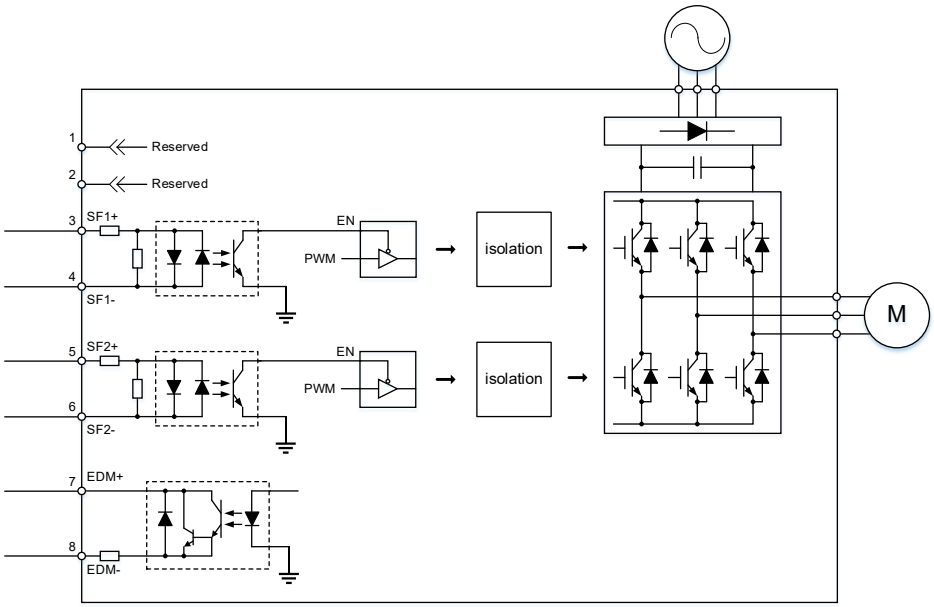
3.6 CN10 STO terminal (SIL3)

The STO function descriptions in this section are applicable to the servo drives certified by TÜV SÜD.

Note: only the E3C-EF models support the STO function; STO certification is in progress.

3.6.1 Introduction to STO

The STO function stops the current to the motor immediately. The dual-channel input signals (SF1 and SF2 signals) stop the servo drive from supplying power to the motor.



Note: for this servo drive, the “safe state” is defined as “power to the motor being cut off”. If a fault or danger is diagnosed, set the servo drive to the safe state.

3.6.2 Precautions for using STO function

Read the following safety precautions carefully to ensure system safety.

- Only qualified personnel who fully understand the safety standards can design, install, and operate the system after reading this operation manual.
- Use products with safety certifications or machines compliant with safety specifications to build a safe electrical circuit.
- Before installing and wiring, read the operation manuals of all the peripheral devices carefully.
- If the motor is moved by external forces when the STO function is activated, take safety measures such as using the mechanical brake.
- Evaluate the risk of using the machine or the connecting devices.

3.6.3 Potential risks of STO

After the STO function is activated, the servo drive can no longer control the motor. Hence, you must evaluate all the potential risks that may result from the activation of the STO function to ensure safety. Delta is not liable for any mechanical damage or personal injury caused by the potential risks.

- Do not touch the servo drive after activating the STO function. The STO function stops the servo drive from supplying power to the motor but does not cut off the power to the servo drive. Thus, there is a potential risk of electric shock.
- When maintaining the servo drive, use the molded-case circuit breaker (MCCB) or magnetic contactor (MC) to cut off the power to the servo drive.
- When the STO function is activated, the servo drive can no longer stop or decelerate the motor.
- The STO function cuts off the power to the motor, but the motor can still be moved by other external forces.
- When installing the machine or changing the servo drive, ensure to check if the STO function works normally.
- The motor may move due to malfunction of the power device, and the maximum moving range is 180 electrical degrees.
- Supply power to the STO input signals with a single power source. If you use a split power supply, the leakage current may result in STO misoperation. In addition, the STO function must be powered by the safety extra-low voltage (SELV) power source with reinforced insulation.
- The EDM output signals are not safety output signals, which are used only for failure monitoring. Incorrect use of the EDM signals may result in personal injury. When an STO failure is detected with the EDM signals, keep the STO input signals off.
- To avoid malfunction caused by accumulated errors, you must check the safety functions at least once every 3 months.

3.6.4 Safety parameters

To comply with the EN ISO 13849-1 PL e and IEC 61508 SIL3 standards, you have to monitor the EDM signals with the controller. If you do not monitor the EDM signals, the system only meets the IEC 61508 SIL2 standard. Refer to the following tables for the related standards.

Standard		Certification body
Functional Safety	IEC / EN 61508: 2010	
Machinery Directive	EN IEC 62061: 2021	
	EN 61800-5-2: 2016 / EN 61800-5-2: 2017	
	EN ISO 13849-1: 2015	
EMC for Functional Safety	IEC / EN 61326-3-1: 2017	
	IEC 61000-6-7: 2014 / EN 61000-6-7: 2015	

Note: Functional Safety application in progress.

Item	Description	Standard	EDM signal monitoring with controller	No EDM signal monitoring
Safety function	Safety function	IEC / EN 61800-5-2	STO	STO
HFT	Hardware fault tolerance	IEC / EN 61508	1	1
Subsystem	Subsystem	IEC / EN 61508	Type A	Type A
SIL	Safety integrity level	IEC / EN 61508	SIL3	SIL2
		EN IEC 62061	maximum SIL3	maximum SIL2
PFH	Probability of dangerous failure per hour [h^{-1}]	IEC / EN 61508 EN IEC 62061	$1.61x10^{-9}$ [1/h] (1.61% of SIL3)	$1.66x10^{-9}$ [1/h] (0.166% of SIL2)
Response time	Response time	IEC / EN 61508	≤ 10 ms	≤ 10 ms
Category	Category	EN ISO 13849-1: 2015	Category 3	Category 3
PL	Performance level	EN ISO 13849-1: 2015	PL e	PL d
$MTTF_d$	Mean time to dangerous failure	EN ISO 13849-1: 2015	High	High
DC	Diagnostic coverage	EN ISO 13849-1: 2015	Medium	Low
Mission time	Mission time	EN ISO 13849-1: 2015	20 years	20 years

3.6.5 How does the STO function work?

The STO function utilizes two independent circuits for interrupting the power to the motor, so the motor is free from torque force. The following table details how this function works.

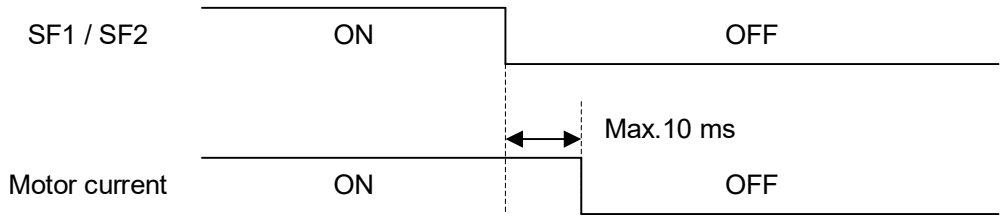
Signal		Status of opto-isolator			
STO	SF1+ SF1-	ON	ON	OFF	OFF
	SF2+ SF2-	ON	OFF	ON	OFF
Servo drive output status		Ready	Torque off (SF2 lost)	Torque off (SF1 lost)	Torque off (STO activated)
Diagnostic output (EDM)		OFF	OFF	OFF	ON
Alarm		N/A	AL502	AL501	AL500

Note:

1. AL500 is triggered only when P1.120 is set to 1 or 3.
2. Definition of STO signal status: ON = 24V; OFF = 0V.
3. Definition of EDM signal status: OFF = open (open circuit); ON = close (closed circuit).
4. The status of the EDM signals changes at once according to the status of the safety signals (SF1 and SF2 signals).

3.6.5.1 Response time

When either SF1 signal or SF2 signal becomes OFF, the circuit cuts off the current to the motor within 10 ms.

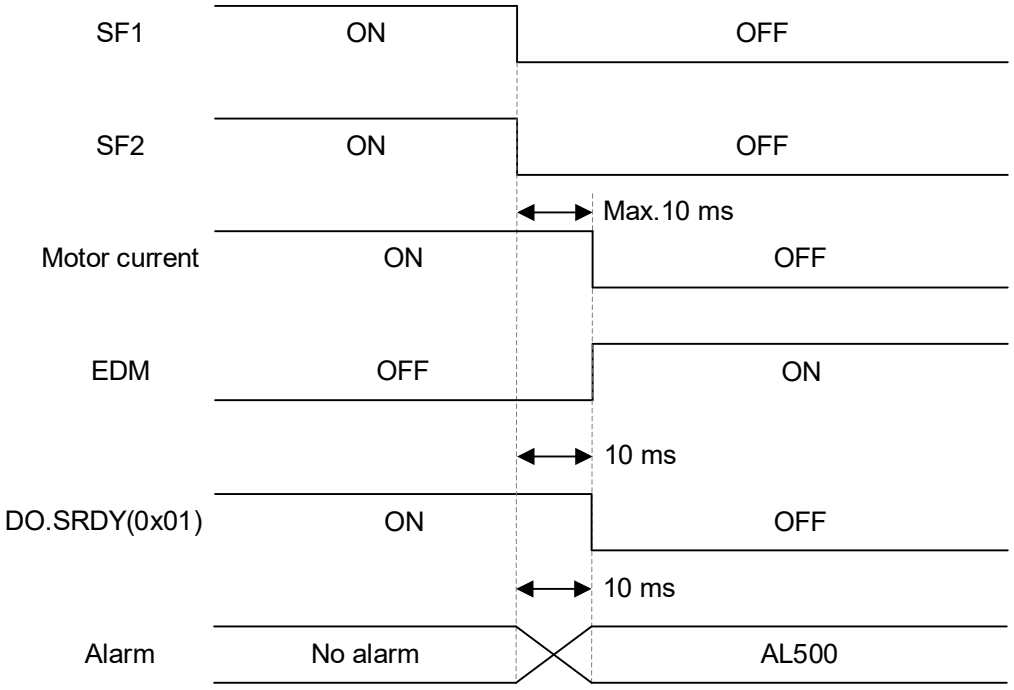


3.6.5.2 Alarm triggering

(1) AL500 (STO function is activated)

When both SF1 and SF2 signals become OFF, the servo drive keeps displaying AL500, refer to the following diagram.

You can set P1.120 for the panel to display “AL500” or “-STO-“.

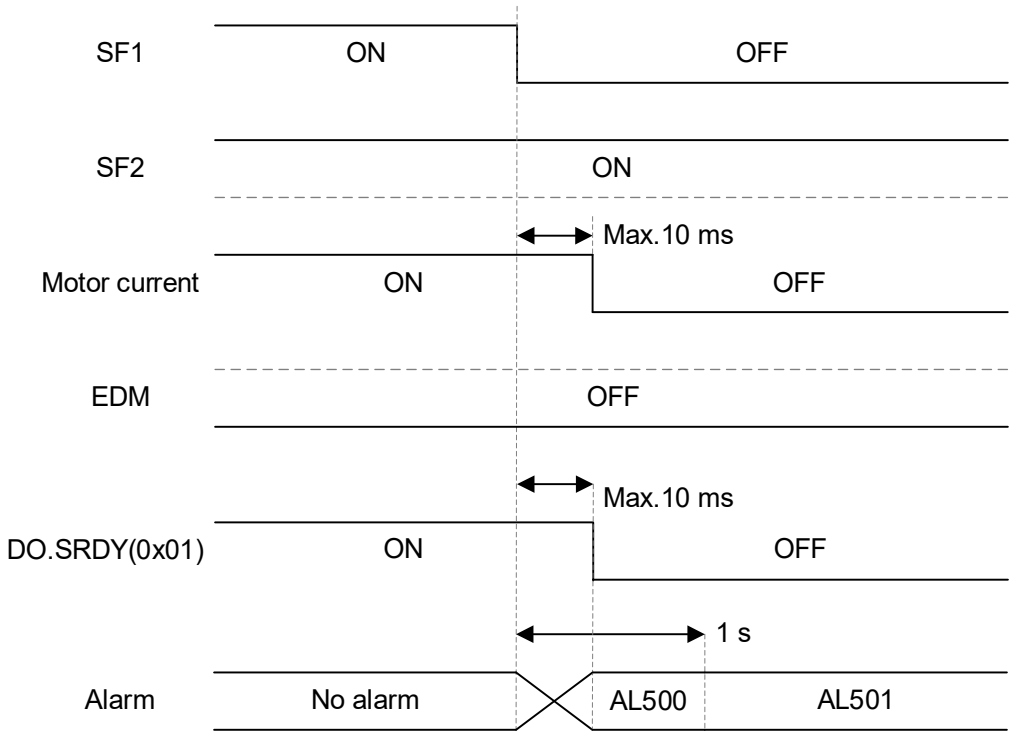


In addition, when either SF1 or SF2 signal becomes OFF, AL500 is also triggered. See the descriptions of AL501 and AL502 for details.

(2) AL501 (SF1 lost) / AL502 (SF2 lost) (signal loss or signal error)

When either SF1 signal or SF2 signal becomes OFF, the STO function is activated, the circuit cuts off the current to the motor within 10 ms, and the servo drive is Off, triggering AL500. After 1 second, AL501 or AL502 is triggered. The following diagram illustrates how AL501 is triggered.

You can set P1.120 for the panel to display “AL500” or “-STO-“.



Note: when SF1 becomes OFF, AL501 occurs. When SF2 becomes OFF, AL502 occurs.

3.6.5.3 STO deactivation settings

Set P1.120 to choose the way to deactivate the STO function.

P1.120	STO deactivation settings		Address: 01F0H 01F1H
Default:	3	Control mode:	All
Unit:	-	Setting range:	0 to 3
Format:	DEC	Data size:	16-bit
Model:	E3C-EF		

Settings:

The servo state when STO is activated and the way to deactivate STO for restarting the servo vary with the setting of P1.120. Descriptions for each setting value are as follows. For more details, refer to the signal timing diagrams in Section 3.6.5.3.

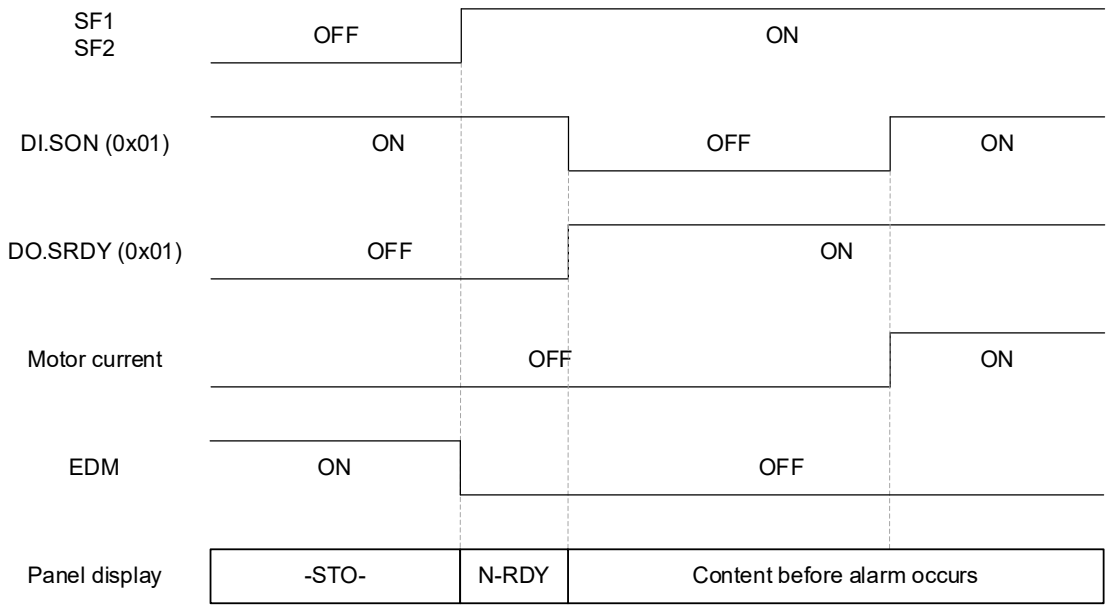
0: to deactivate STO and restart the servo, send the Servo Off command first and then the Servo On command.

1: to deactivate STO and restart the servo, clear the alarm first, and send the Servo Off command and then the Servo On command.

2: the servo restarts after STO is deactivated.

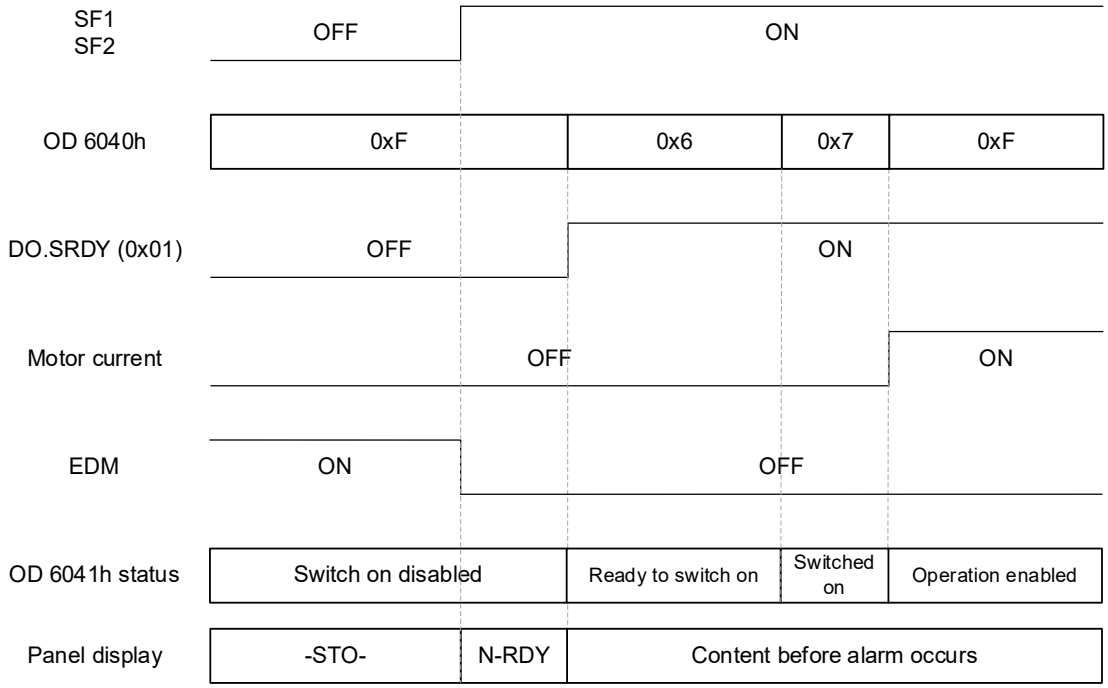
3: to deactivate STO and restart the servo, clear the alarm first.

(1) When P1.120 = 0 and the Servo On / Off command is sent with external DI

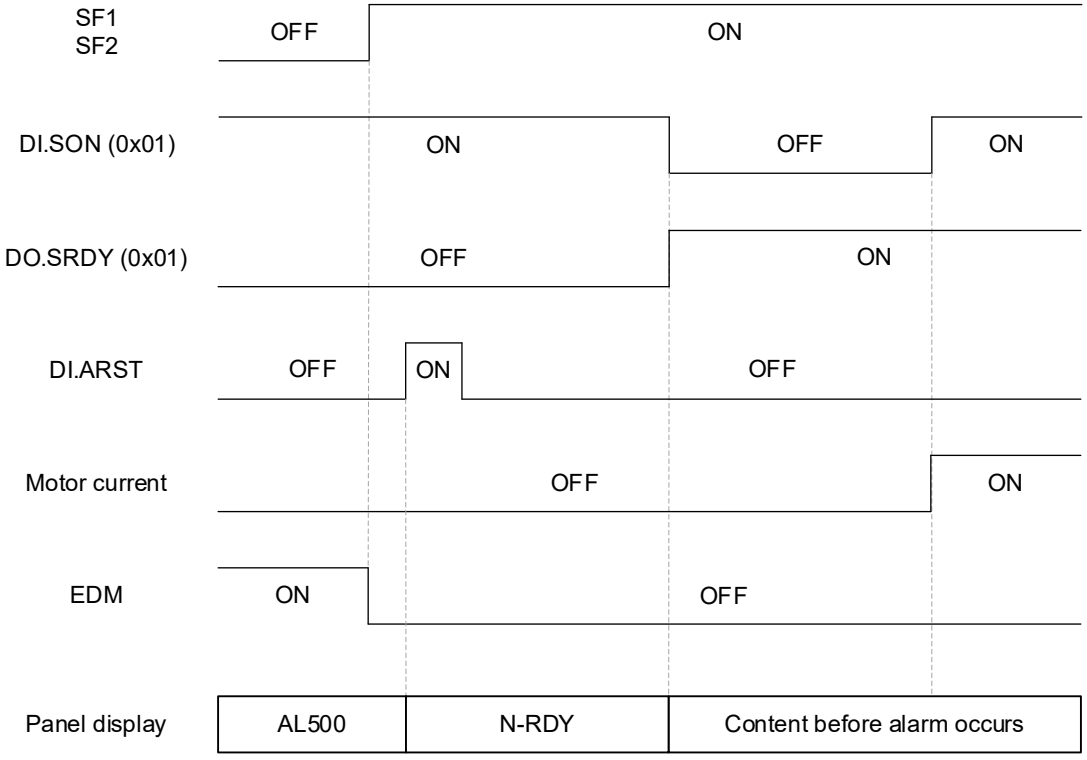


Note: DI.SON is invalid in communication modes, and thus you have to switch the drive to Servo On with the controller.

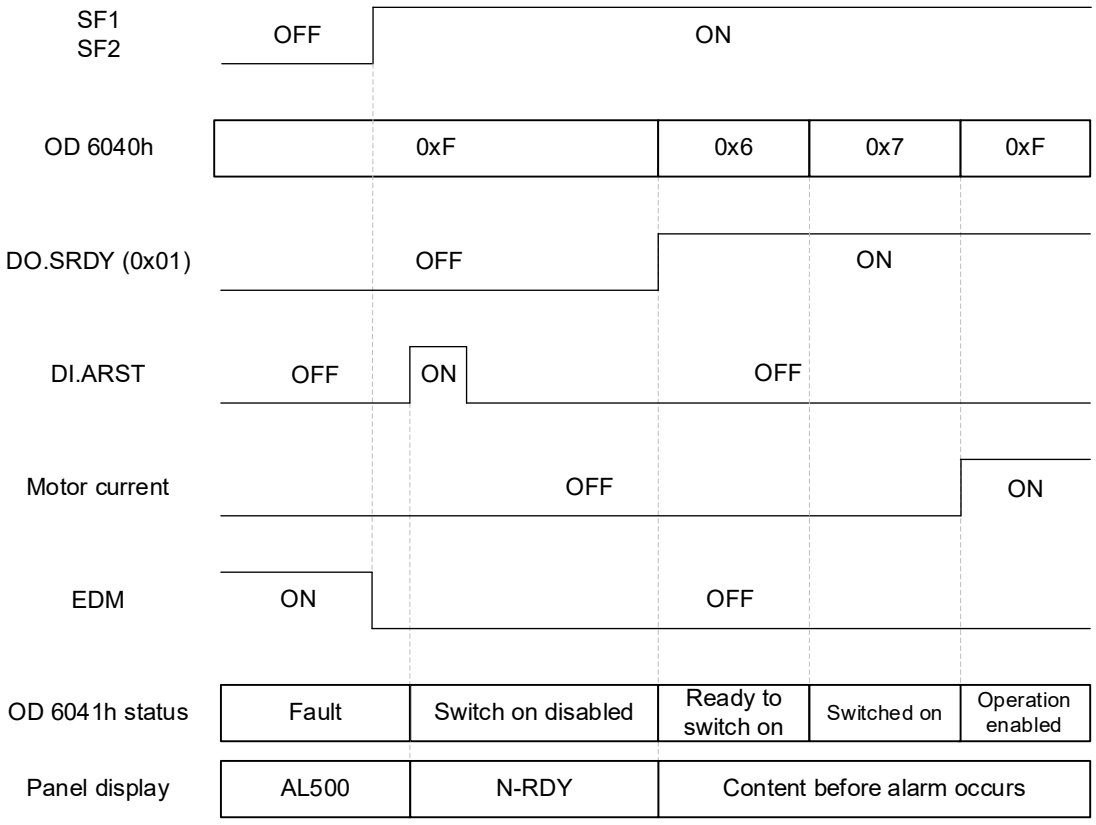
(2) When P1.120 = 0 and the Servo On / Off command is sent through EtherCAT communication



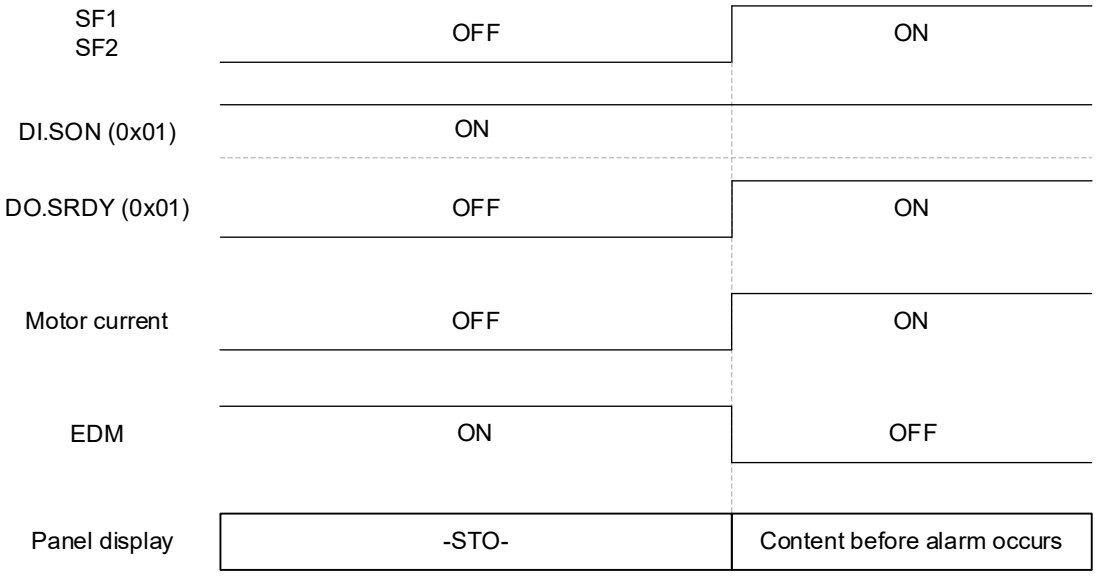
(3) When P1.120 = 1 and the Servo On / Off command is sent with external DI



(4) When P1.120 = 1 and the Servo On / Off command is sent through EtherCAT communication

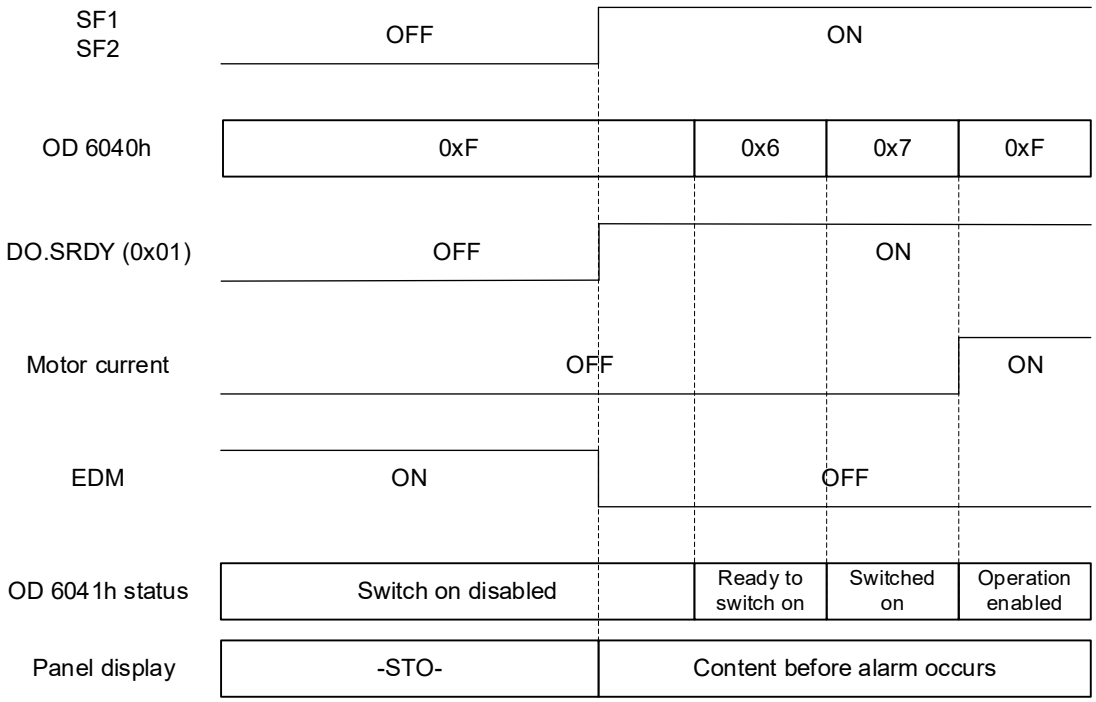


(5) When P1.120 = 2 and the Servo On / Off command is sent with external DI



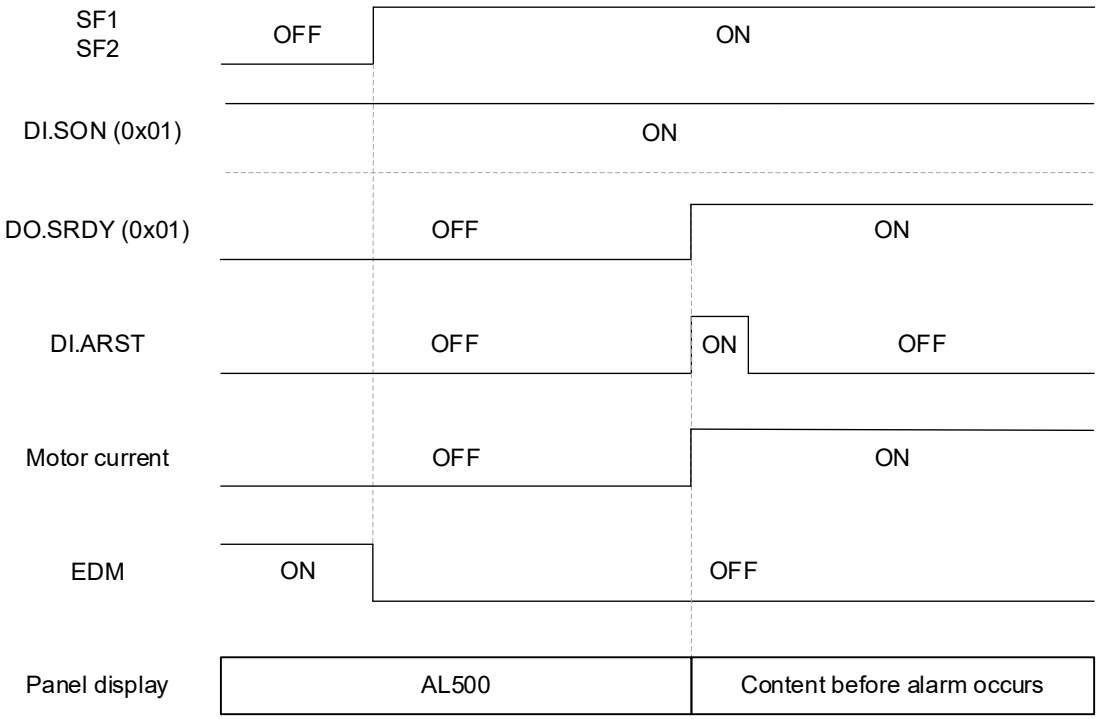
Note: if you switch the STO signals to ON when the servo drive sends the position or speed command to the motor, it may cause drastic motor rotation. Before switching the STO signals to ON, check if there is any command input and ensure personal safety.

(6) When P1.120 = 2 and the Servo On / Off command is sent through EtherCAT communication



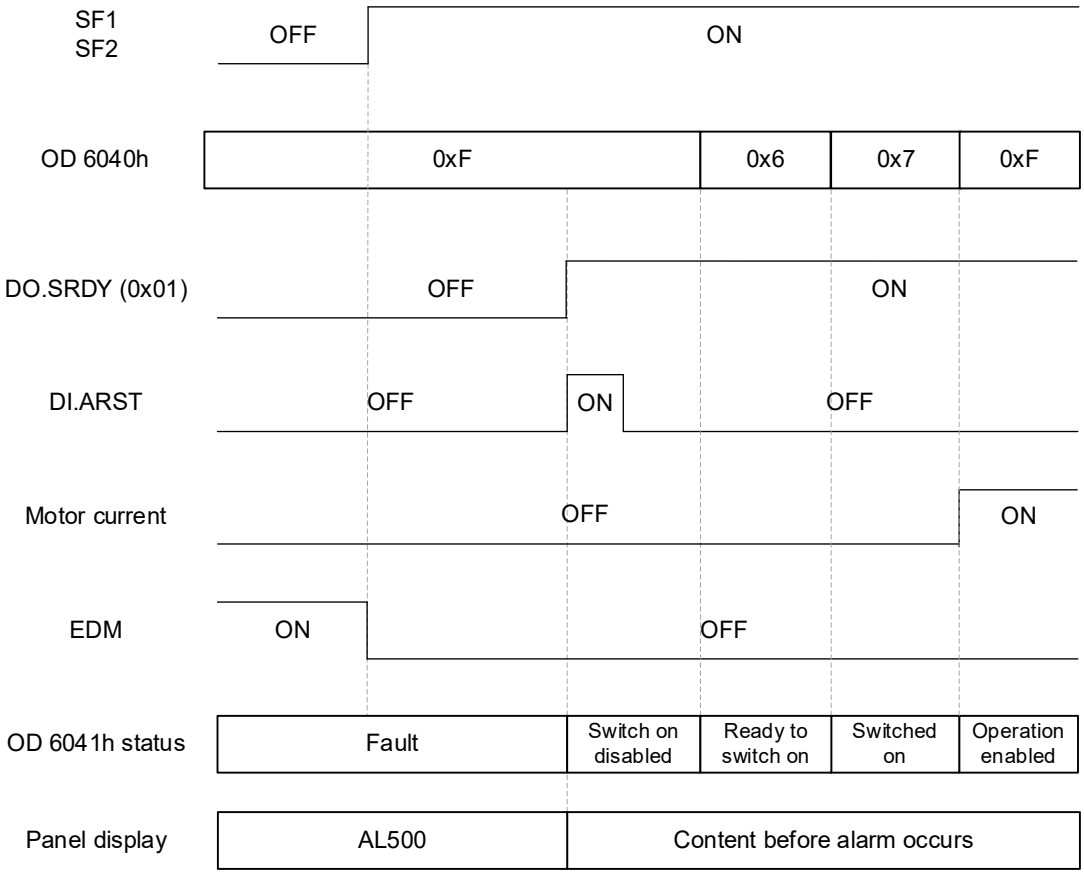
Note: if you switch the STO signals to ON when the servo drive sends the position or speed command to the motor, it may cause drastic motor rotation. Before switching the STO signals to ON, check if there is any command input and ensure personal safety.

(7) When P1.120 = 3 and the Servo On / Off command is sent with external DI



3

(8) When P1.120 = 3 and the Servo On / Off command is sent through EtherCAT communication

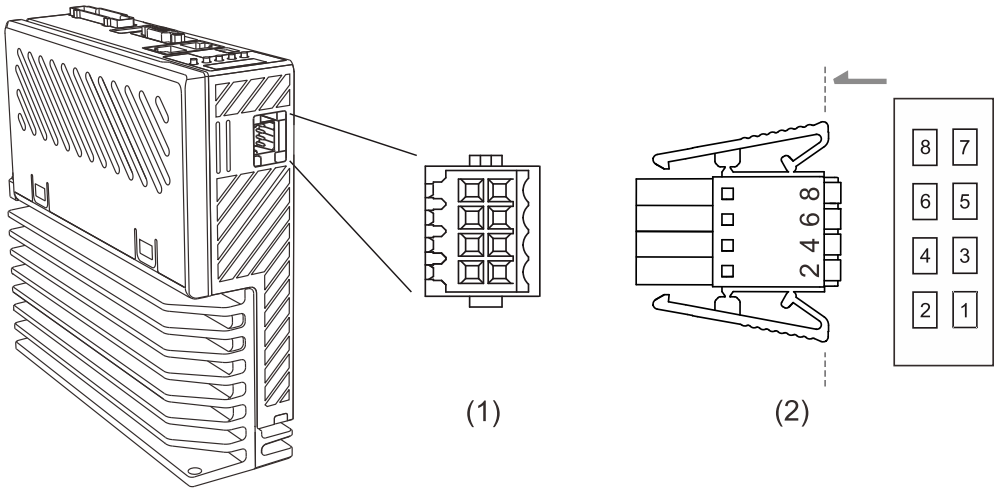


3.6.6 Wiring for STO

For STO wiring, the recommended wire specification is 0.11 - 0.52 mm^2 (30 - 20 AWG).

3.6.6.1 CN10 STO terminal

This terminal provides the STO function.

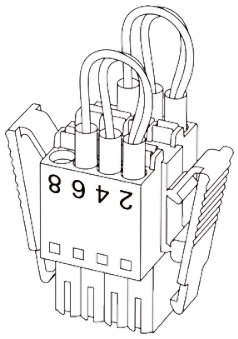


(1) CN10 STO connector (female); (2) CN10 STO connector (male)

Pin assignment:

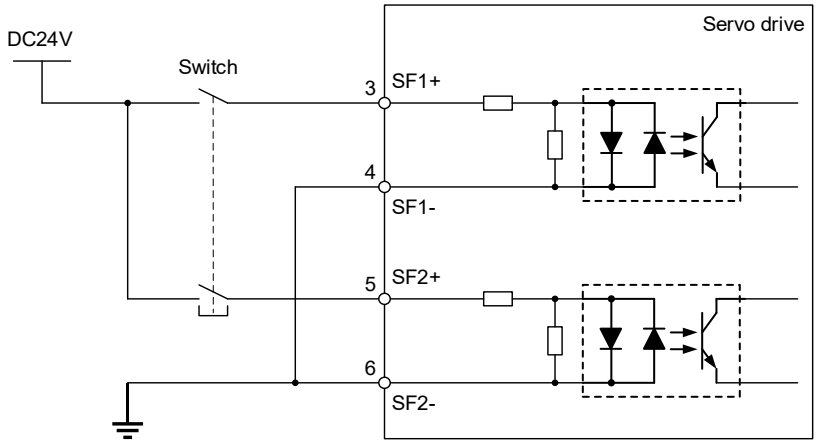
Pin No.	Signal	Description	Function
1	-	Reserved	For deactivating the STO function; refer to Section 3.6.6.3 for the wiring diagram. Do not connect these two pins if using the STO function is required.
2	-	Reserved	
3	SF1+	STO input SF1+	Input signal for the STO function. ON (close): servo drive is in normal operation OFF (open): STO is activated
4	SF1-	STO input SF1-	
5	SF2+	STO input SF2+	Input signal for the STO function. ON (close): servo drive is in normal operation OFF (open): STO is activated
6	SF2-	STO input SF2-	
7	EDM+	Diagnostic output+	Monitoring outputs for STO input status and STO circuit failure.
8	EDM-	Diagnostic output-	

If you do not need the STO function, plug in the STO connector that comes with the servo drive. The factory-installed jumper wires on the STO connector are shown in the figure on the right. If the wiring is removed, refer to the wiring information in Section 3.6.6.3 Not using the STO function.



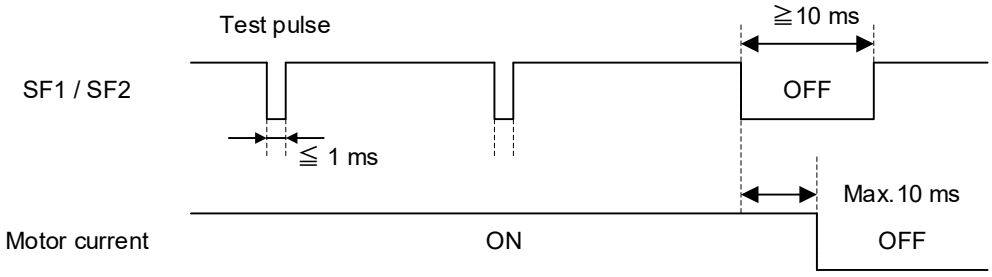
3.6.6.2 Input / output signal specification

(1) Safety input signals (SF1+, SF1-, SF2+, SF2-)

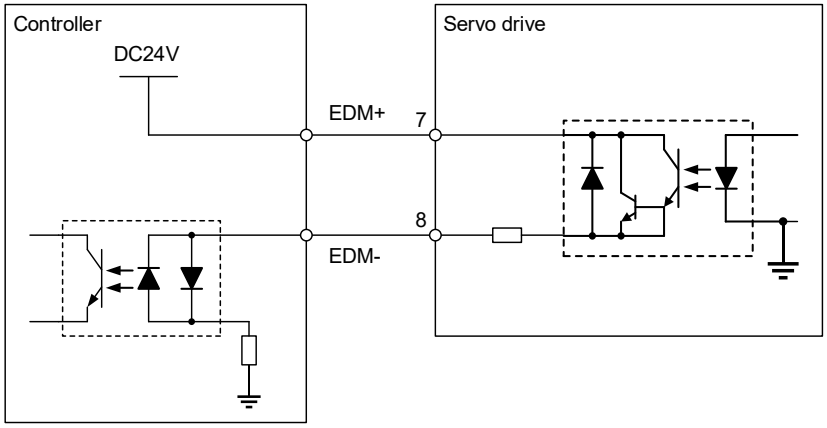


Item	Specification	Note
Internal impedance	5.6 kΩ	-
Operable voltage	DC24V ± 20%	Use the SELV power source.
Maximum delay time	10 ms	The time duration from STO signal Off to STO function activated.

■ The OFF time duration of the external test pulse input should be 1 ms or less.



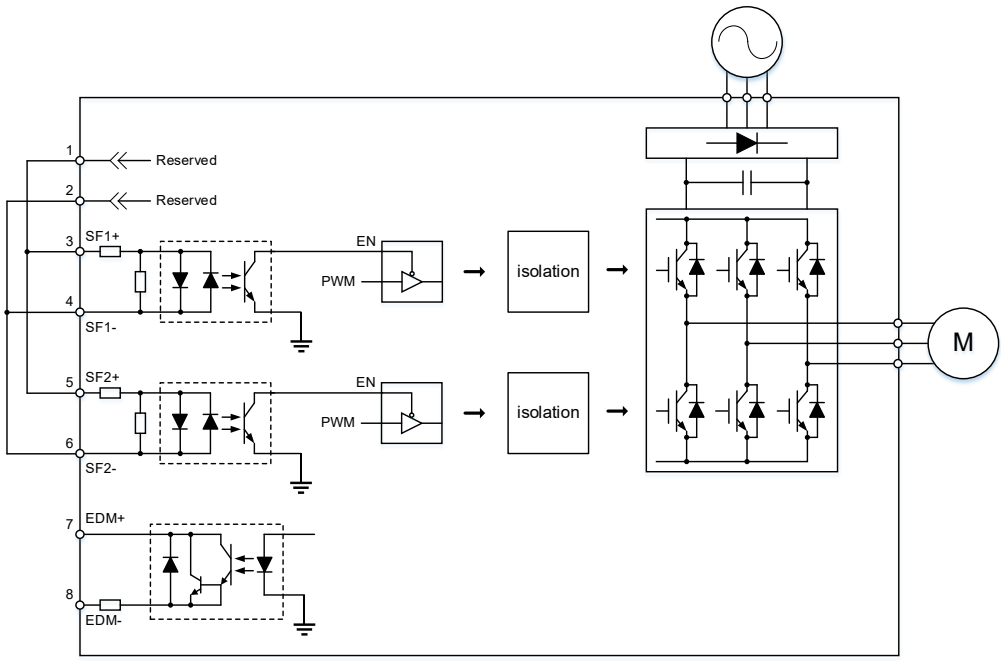
(2) Diagnostic output signal (EDM+, EDM-)



Item	Specification	Note
Maximum allowable voltage	DC24V	Use the SELV power source.
Maximum allowable current	50 mA	-
Maximum voltage drop	1.5V	When the current is 50 mA.

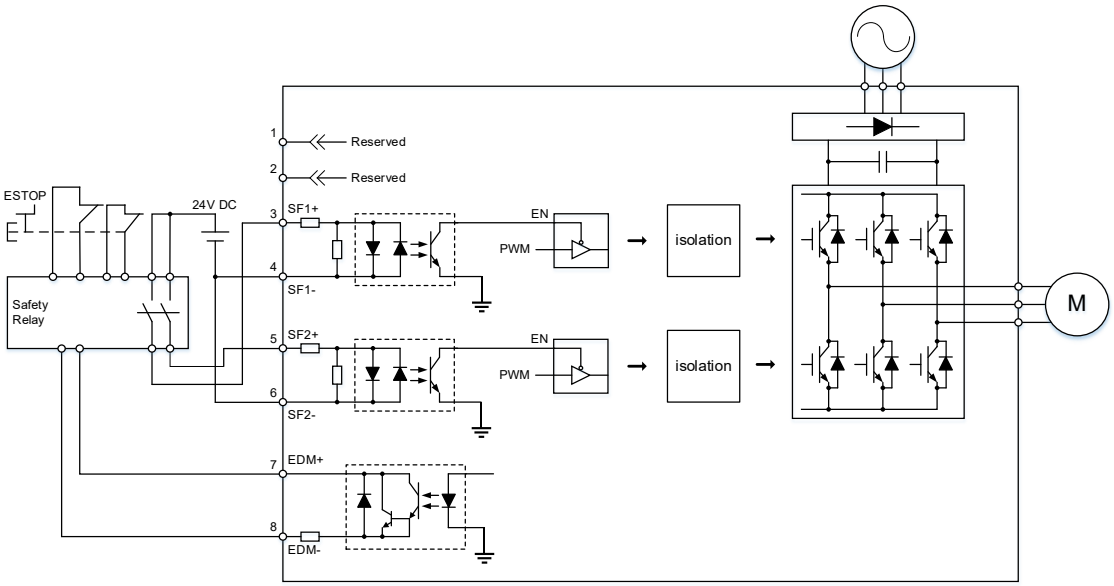
3.6.6.3 Not using the STO function

Follow the diagram for wiring or plug in the short-circuit connector that comes with the servo drive.



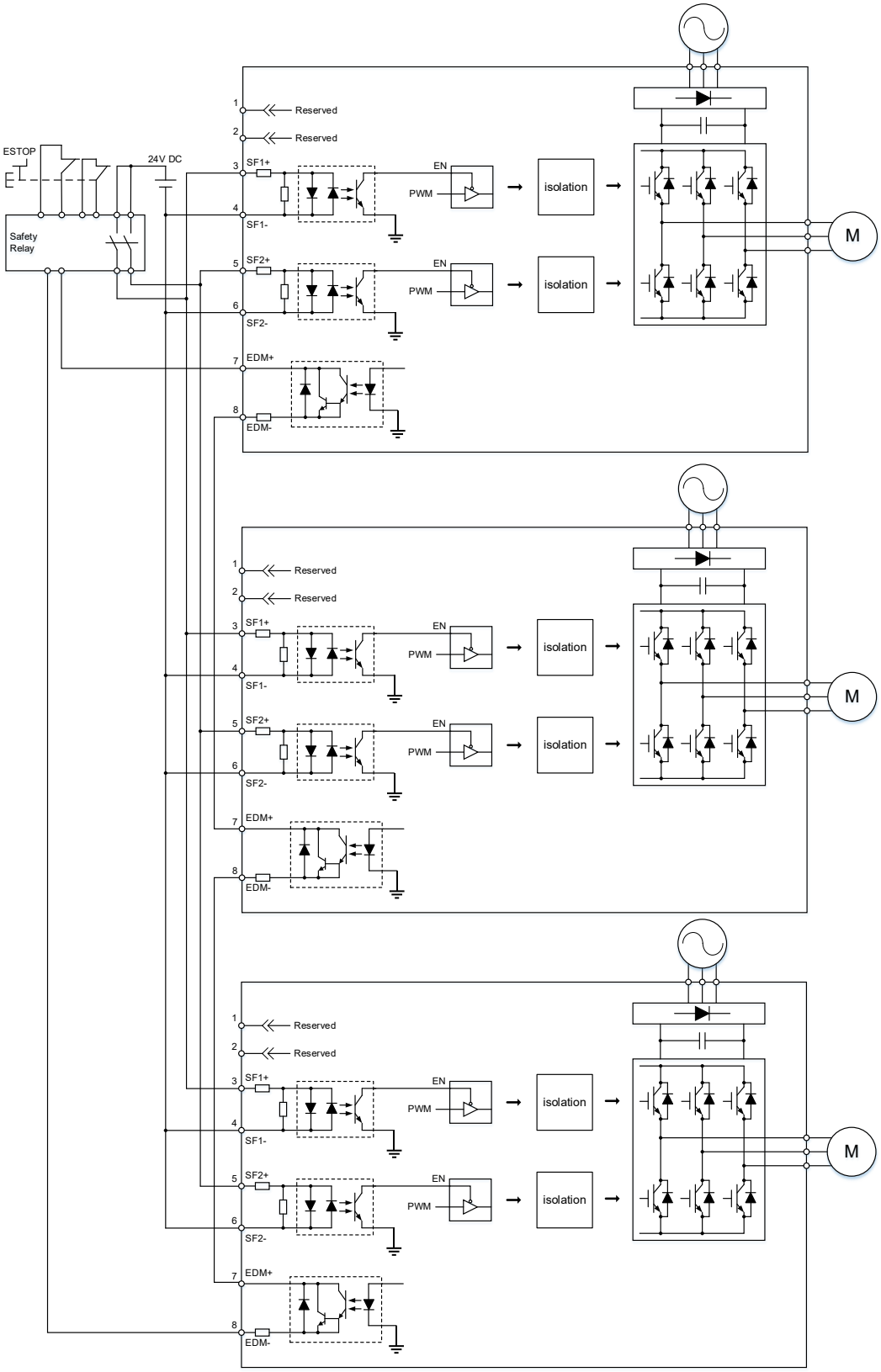
3.6.6.4 Using the STO function for a single drive

To use a safety relay to trigger the STO function, follow the diagram for wiring.



3.6.6.5 Using the STO function for multiple drives

Follow the diagram for wiring if using multiple servo drives. However, ensure the value of multiplying PFH and the number of servo drives is within the intended safety value for the multi-axis servo system.



3.6.7 Validation test

When installing, maintaining, or changing the servo drive, ensure to perform the following validation tests. (It is suggested that you keep a record of the test results.)

■ **With EDM diagnosis (SIL3 system)**

(1) When either SF1 or SF2 signal is OFF, the servo motor cannot be operated.

(2) When you switch the SF1 and SF2 signals to ON or OFF, the input / output logic has to be in accordance with the following table.

Signal		Status of opto-isolator			
STO	SF1+ SF1-	ON	ON	OFF	OFF
	SF2+ SF2-	ON	OFF	ON	OFF
Diagnostic output (EDM)		OFF	OFF	OFF	ON

■ **Without EDM diagnosis (SIL2 system)**

(1) When either SF1 or SF2 signal is OFF, the servo motor cannot be operated.

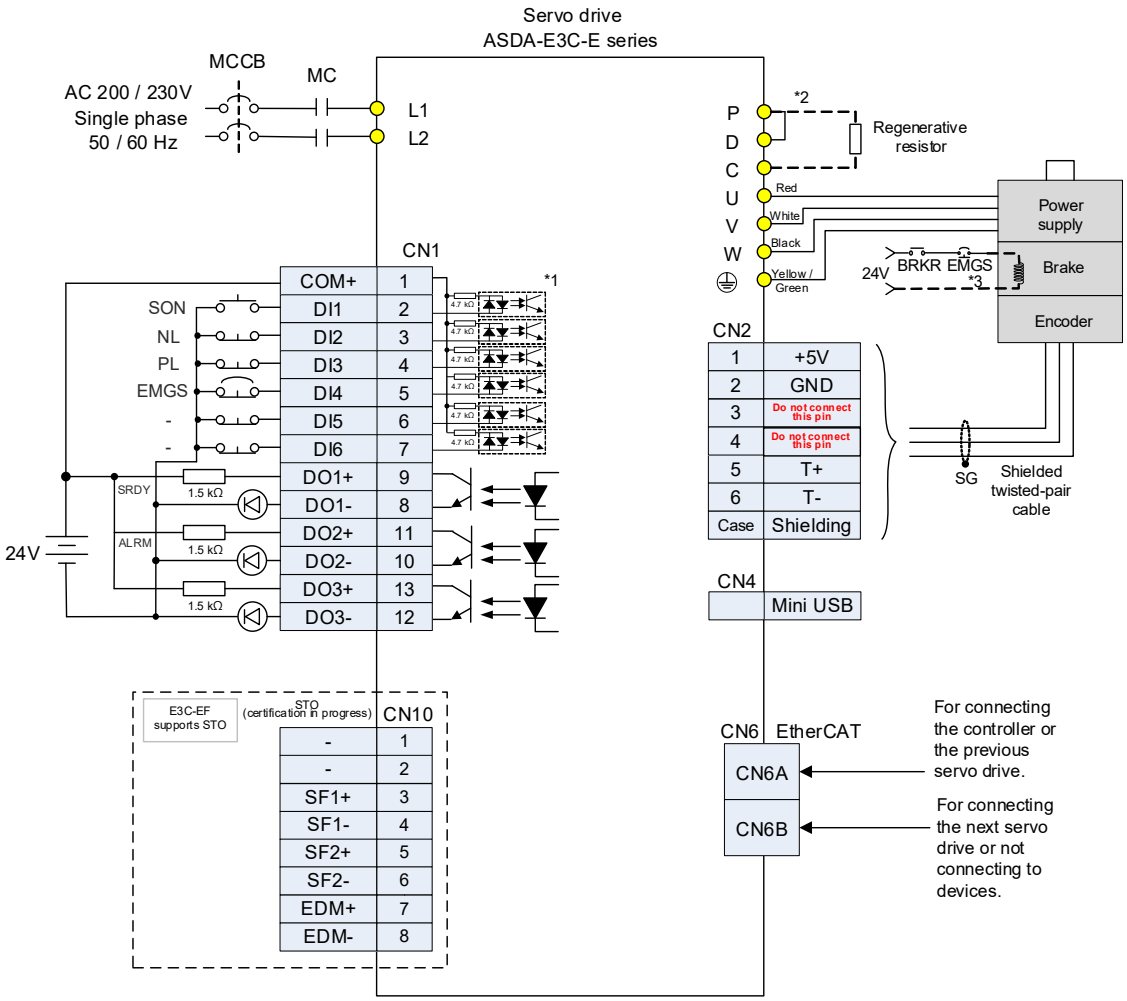
(2) When both SF1 and SF2 signals are ON or OFF, neither AL501 nor AL502 is triggered.

Note:
1. Ensure to perform the validation tests once every 3 months even if you do not install, maintain, or change the servo drive.
2. If a fault or danger is diagnosed, switch the safety input signals to OFF to set the servo drive to the safe state.

3

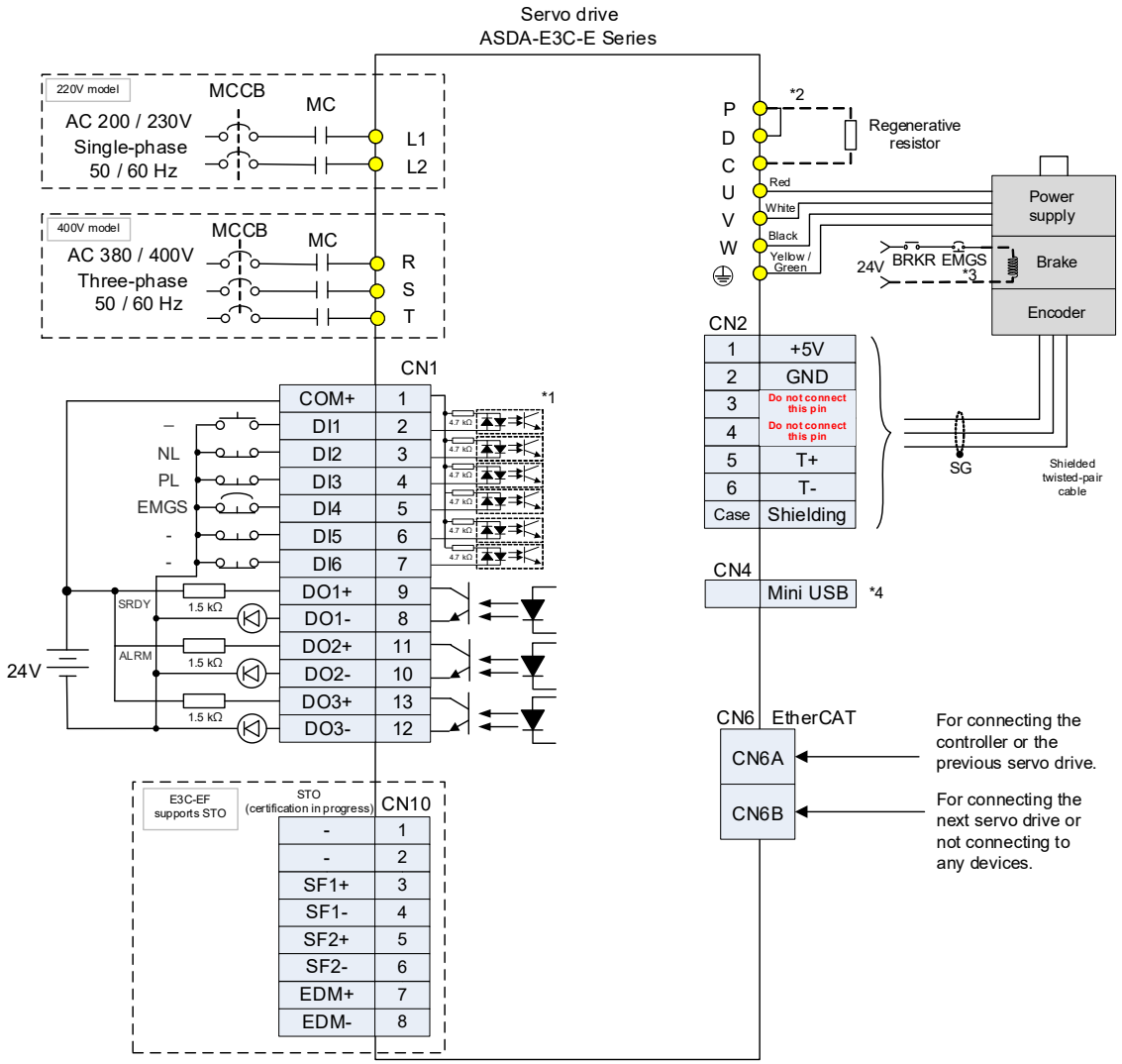
3.7 Standard wiring example

3.7.1 Position (PR) / Speed (S/Sz) / Torque (T/Tz) control mode



Note:
*1. Refer to Section 3.2.3 for wiring.
*2. The -E / -EF 400 W models have no built-in regenerative resistor.
*3. The brake coil has no polarity.
*4. To meet the DI/DO defaults in the preceding diagram, set P1.001.U = 1, P1.001.YX = 01 - 05, and then cycle power on the servo drive.

3.7.2 Communication mode (EtherCAT)



Note:
*1. Refer to Section 3.2.3 for wiring.
*2. The -E / -EF 400 W models have no built-in regenerative resistor.
*3. The brake coil has no polarity.
*4. To meet the DI/DO defaults in the preceding diagram, set P1.001.U = 1, P1.001.YX = 0C, and then cycle power on the servo drive.

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Test Operation and Panel Display

4

This chapter describes the display and operation for the ASDA-E3C-E servo drive panel as well as the testing for the servo drive and motor.

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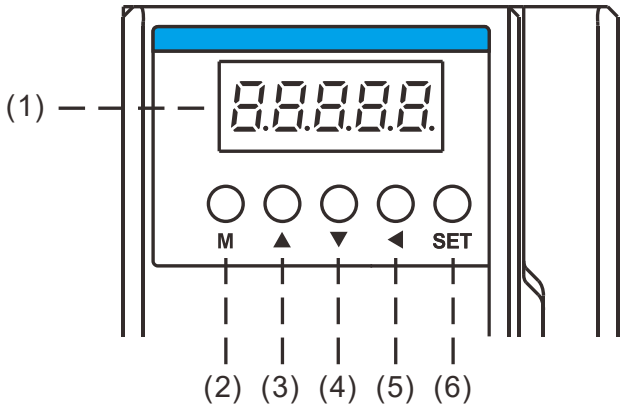
4.1 Panel description



(1) Display: the 5-digit, 7-segment LED display shows the monitoring codes, parameter numbers, and setting values.

(2) MODE key (M): switches the display among Monitoring mode, Parameter mode, and Alarm mode. In Editing mode, pressing this key switches back to Parameter mode.

(3) UP (▲) key: changes the monitoring codes, parameter numbers, and setting values.

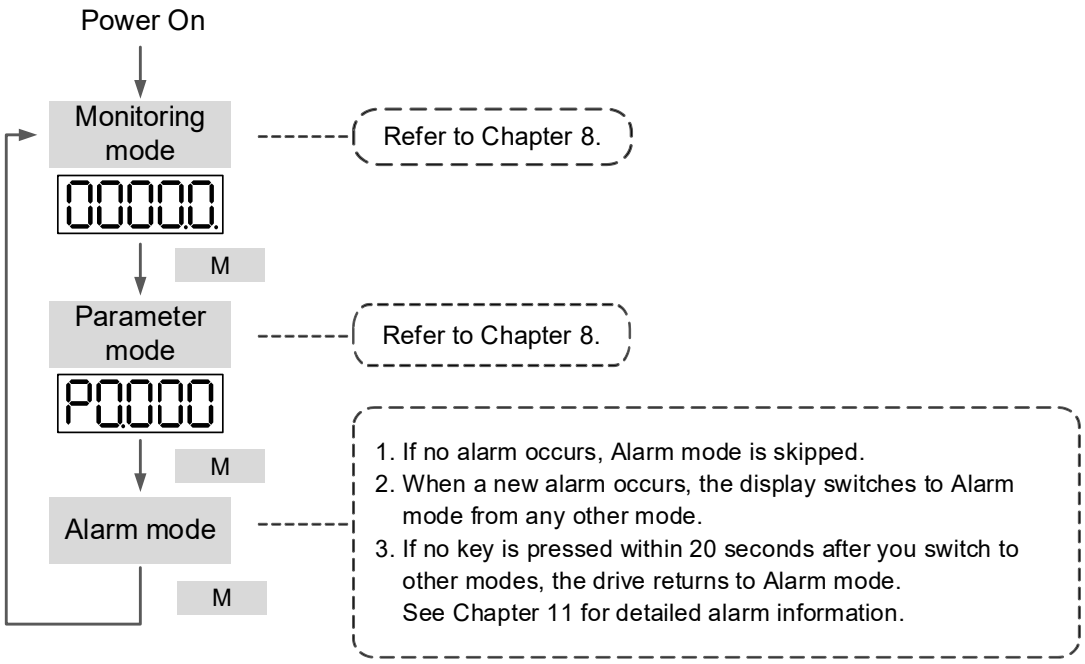
(4) DOWN (▼) key: changes the monitoring codes, parameter numbers, and setting values.

(5) SHIFT (◄) key: in Monitoring mode, pressing this key switches between high / low word display. In Parameter mode, pressing this key changes the group number. In Editing mode, pressing this key moves the blinking (selected) digit to the left for adjusting the value.

(6) SET key: in Monitoring mode, pressing this key switches between decimal and hexadecimal display. In Parameter mode, pressing this key switches to Editing mode and displays the setting values. In Editing mode, pressing this key saves the setting values.

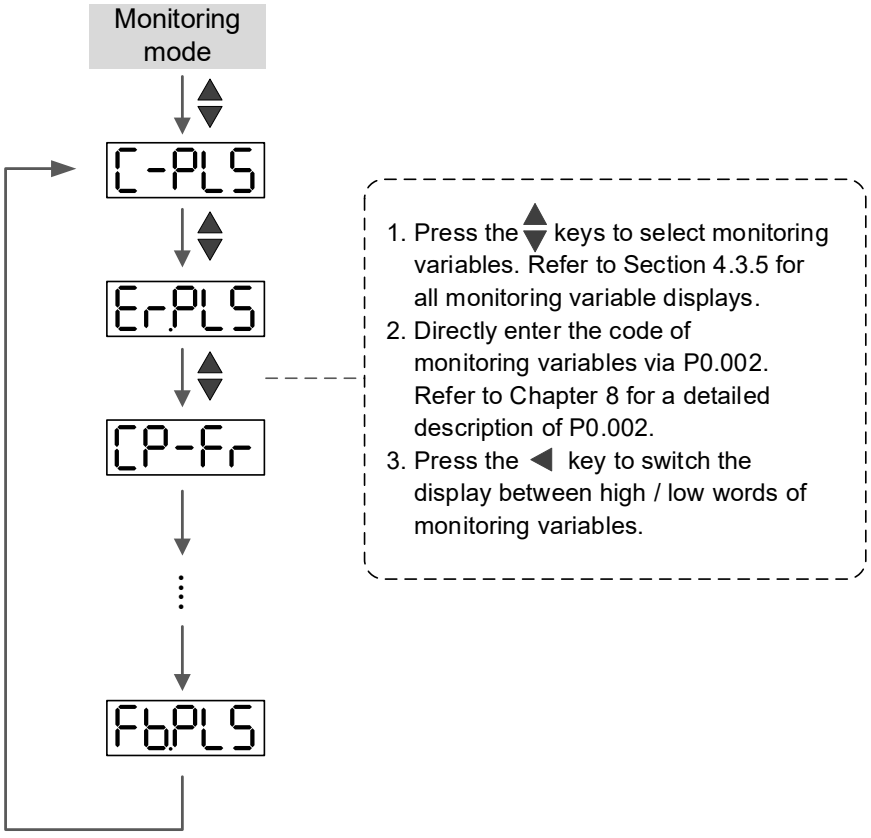
4.2 Parameter setting procedure

Switching modes:



Operating in each mode:

Monitoring mode



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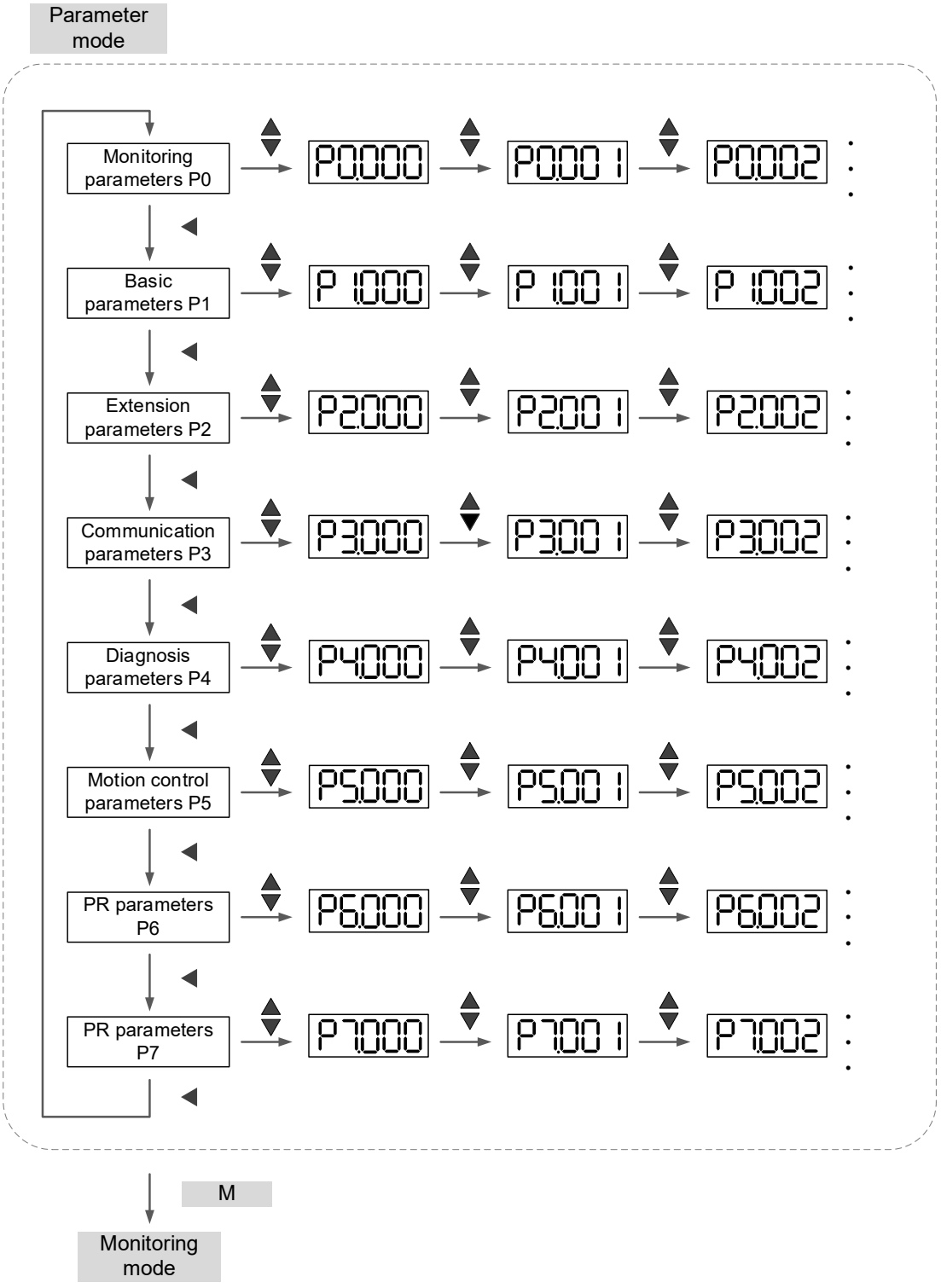
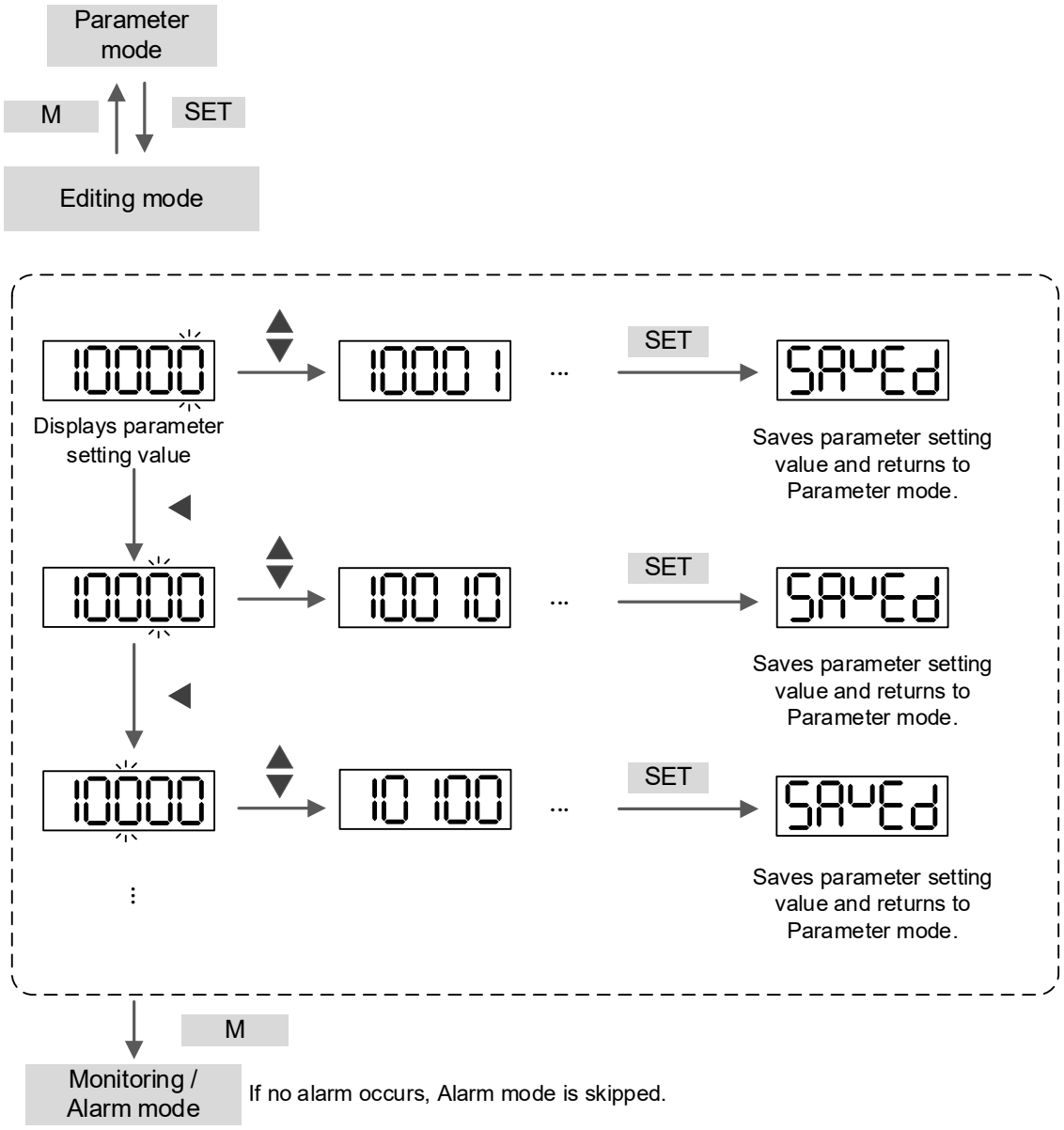
Parameter mode



Editing mode



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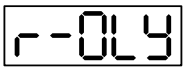
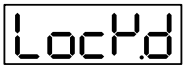
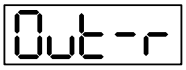
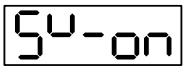
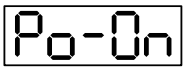
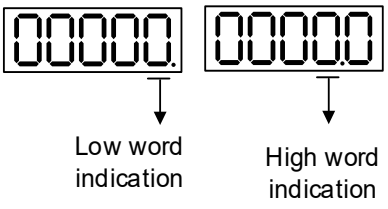
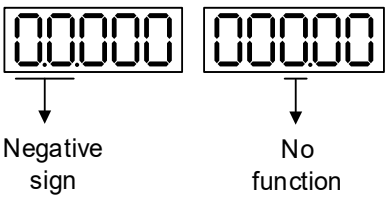
4.3 Status display

4.3.1 Data save status

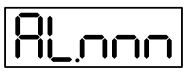
When you complete the parameter setting and press the SET key to save the parameters, the panel displays the symbol of the corresponding status for one second.

Display symbol	Description
	The setting value is correctly saved (Saved).
	The parameter is read-only and write-protected (Read-only).
	Wrong password or no password is entered (Locked).
	The setting value is incorrect or a reserved value is set (Out of Range).
	The parameter cannot be changed when the servo is in the Servo On state (Servo On).
	The setting takes effect only after you cycle power on the servo drive (Power On).

4.3.2 Decimal points

Display example	Description
	High word / low word indication: indicates the high word or low word when the 32-bit data is displayed in decimal format.
	Negative sign: the two decimal points on the left represent the negative sign when the 16- or 32-bit data is displayed in decimal format. When in hexadecimal format, it only shows positive values.

4.3.3 Alarm messages

Display symbol	Description
	When an error occurs, the servo drive panel displays ‘AL’ as the alarm symbol and ‘nnn’ as the alarm code. Refer to Chapter 11 Troubleshooting for alarm details.

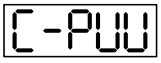
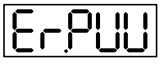
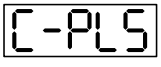
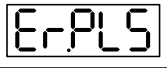
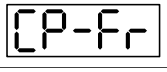
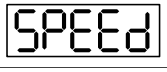
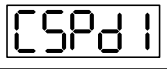
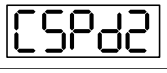
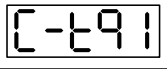
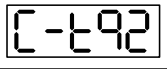
4.3.4 Positive and negative value setting

In Editing mode, pressing and holding the SHIFT (◄) key for 2 seconds switches between the positive and negative signs. If the value is out of the parameter setting range after switching, then the servo drive automatically resets it to the original value.

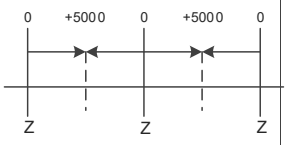
Display example	Description
	The positive value has no decimal points.
	The negative value has two decimal points on the left.

4.3.5 Monitoring display

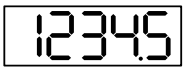
When you apply power to the drive, the display shows the monitoring display symbol for one second and then enters Monitoring mode. In Monitoring mode, press the UP (▲) and DOWN (▼) keys to change the monitoring variables. Or you can directly set P0.002 to specify the monitoring code. When the drive is powered, the default monitoring code is determined by the value of P0.002. For example, if the value of P0.002 is 4, when the drive is powered, the display shows “C-PLS” first and then shows the input number of pulse commands. Refer to the following table for more information. For all monitoring variables, refer to Table 8.3 Monitoring variables descriptions in Chapter 8.

P0.002 setting value	Display symbol	Description	Unit
0		Motor feedback pulse number (after the scaling of E-Gear ratio)	PUU
1		Input number of pulse commands (after the scaling of E-Gear ratio)	PUU
2		Error between control command pulse and feedback pulse number	PUU
3		Motor feedback pulse number (encoder unit)	pulse
4		Input number of pulse commands (before the scaling of E-Gear ratio) (encoder unit)	pulse
5		Error pulse number (after the scaling of E-Gear ratio) (encoder unit)	pulse
6		Position command frequency	Kpps
7		Motor speed	rpm
8		Speed command	Volt
9		Speed command	rpm
10		Torque command	Volt
11		Torque command	%

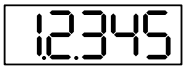
4

P0.002 setting value	Display symbol	Description	Unit
12	AUG-L	Average torque	%
13	PE-L	Peak torque	%
14	U buS	Main circuit voltage	Volt
15	J-L	Ratio of load inertia to motor inertia Note: if the display shows 13.0, it means the load inertia ratio is 13.	1 times
16	IGbt	IGBT temperature	°C
17	rSnFr	Resonance frequency (low word is the first resonance point and high word is the second resonance point)	Hz
18	dIFF2 	The absolute pulse number counting from the encoder Z phase (origin). It is -4999 to +5000 pulses when the motor rotates in the forward or reverse direction starting from the origin (0).	-
19	MAP1	Mapping parameter #1: shows the content of parameter P0.025 (P0.035 specifies the mapping target)	-
20	MAP2	Mapping parameter #2: shows the content of parameter P0.026 (P0.036 specifies the mapping target)	-
21	MAP3	Mapping parameter #3: shows the content of parameter P0.027 (P0.037 specifies the mapping target)	-
22	MAP4	Mapping parameter #4: shows the content of parameter P0.028 (P0.038 specifies the mapping target)	-
23	UAr-1	Monitoring variable #1: shows the content of parameter P0.009 (P0.017 specifies the monitoring variable)	-
24	UAr-2	Monitoring variable #2: shows the content of parameter P0.010 (P0.018 specifies the monitoring variable)	-
25	UAr-3	Monitoring variable #3: shows the content of parameter P0.011 (P0.019 specifies the monitoring variable)	-
26	UAr-4	Monitoring variable #4: shows the content of parameter P0.012 (P0.020 specifies the monitoring variable)	-

The following table shows the panel display of 16-bit and 32-bit values.

Display example	Description	
(Dec)	16 bits	If the value is 1234, the panel displays 01234 (in decimal format).
(Hex)		If the value is 0x1234, the panel displays 1234 (in hexadecimal format; the MSB is not shown).
 (Dec high) (Dec low)	32 bits	If the value is 1234567890, the display of the high word is 1234.5 and the display of the low word is 67890 (in decimal format).
(Hex high) (Hex low)		If the value is 0x12345678, the display of the high word is h1234 and the display of the low word is L5678 (in hexadecimal format).

The following table shows the panel display for negative values.

Display example	Description
	If the value is -12345, the panel displays 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 means the value is displayed in hexadecimal format.
2. The display shown in the preceding tables is applicable in both Monitoring mode and Editing mode.
3. All monitoring variables are 32-bit data, and the display can be switched between high / low word or Dec / Hex. The parameter (Px.xxx) data formats are defined in Chapter 8. Each parameter only supports one display method and cannot be switched.

4.3.6 Display when power is off

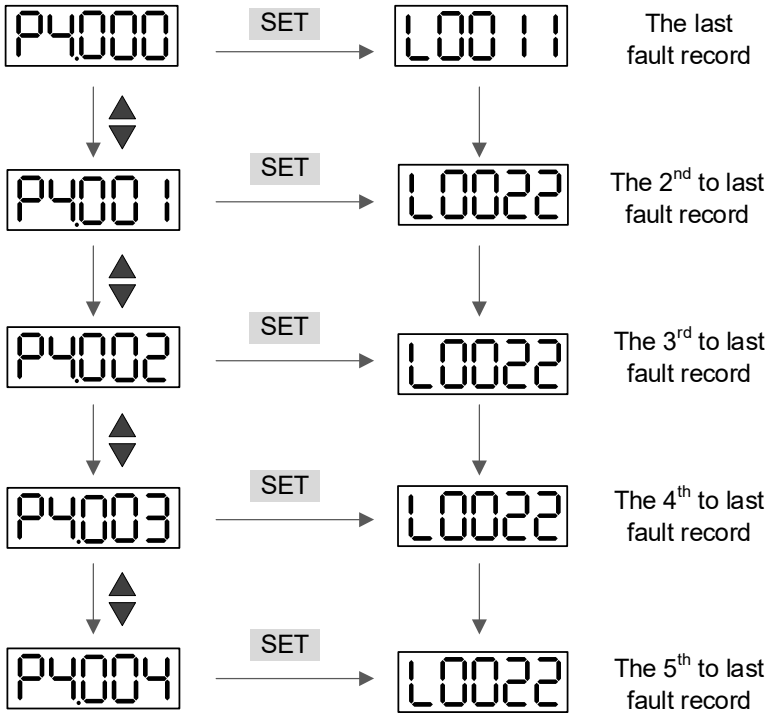
Display symbol	Description
	Updating the firmware is not allowed until the display of this symbol is off. For parameters requiring power cycling to have the changes take effect, you can cycle power on the servo drive when the panel displays this symbol.

4

4.4 General functions

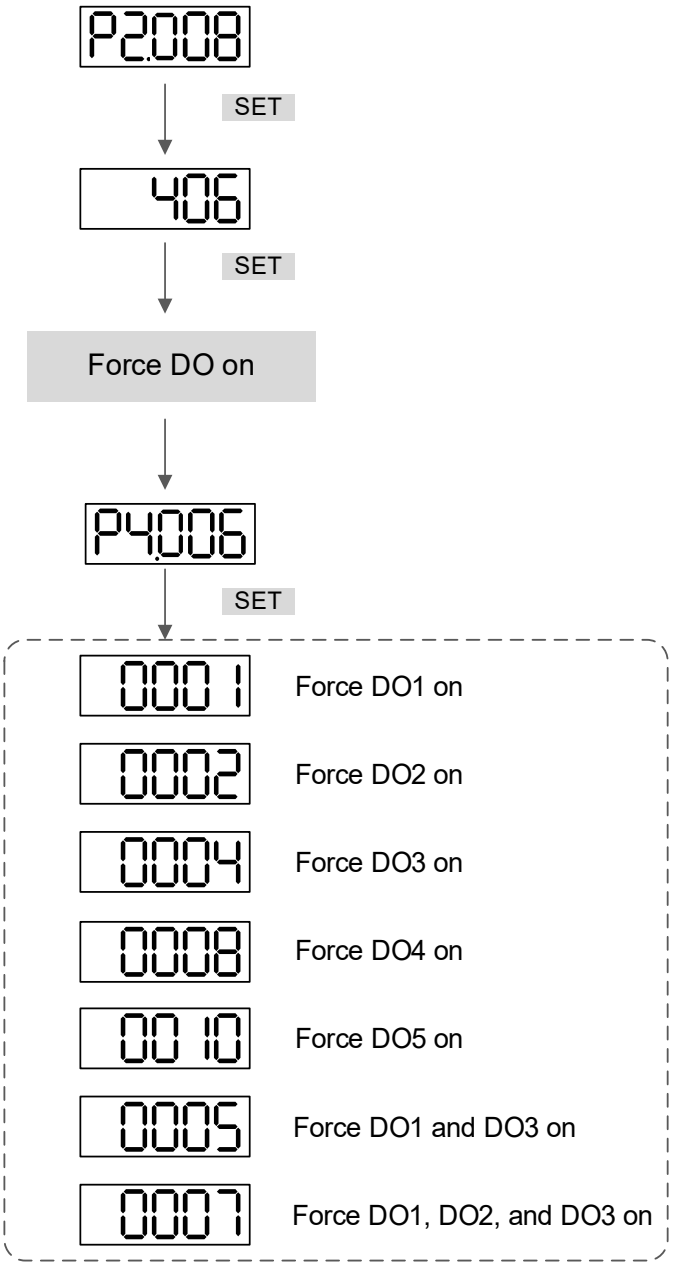
4.4.1 Operation of fault record display

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



4.4.2 Force DO on

You can switch to the Diagnosis mode by the following steps. Set P2.008 to 406 to force DO on. Then, set the DO by binary method with P4.006. When the value of P4.006 is 0x0002, it forces DO2 on. When the value is 0x0005, it forces DO1 and DO3 on. The mode is volatile; the drive returns to the normal DO mode after power cycling. You can also set P2.008 to 400 to switch to the normal DO mode.

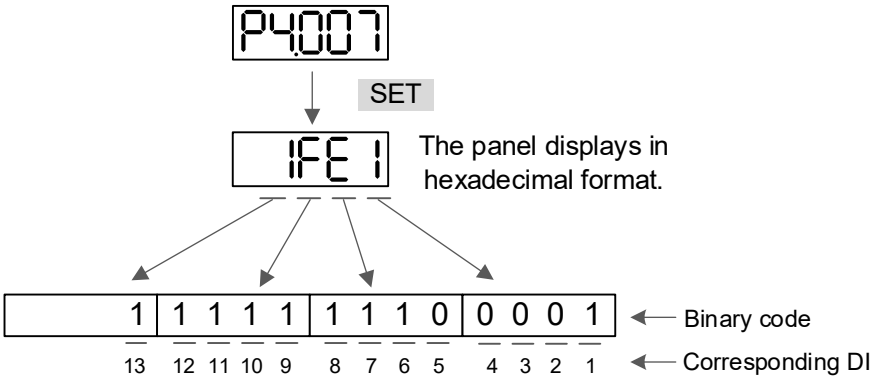


4

4.4.3 Digital input diagnosis

You can switch to Diagnosis mode by the following steps. When DI1 - DI9 are triggered by the external signal, the panel shows the corresponding signal. In binary format, when the bit shows 1, it means the DI is on.

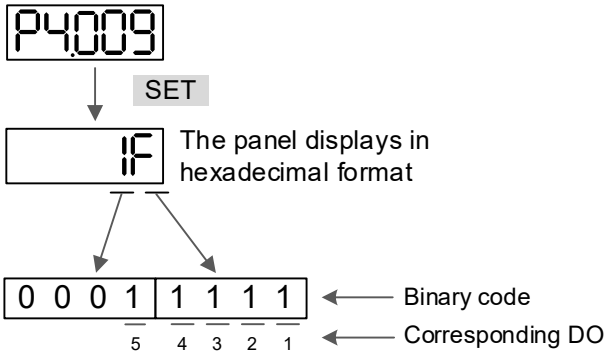
For example, if the panel shows “1FE1”, the hexadecimal E equals 1110 in binary format, indicating that DI6 - DI8 are on.



4.4.4 Digital output diagnosis

You can switch to the Diagnosis mode by the following steps. When DO1 - DO6 are triggered by the output signal, the panel shows the corresponding signal. In binary format, when the bit shows 1, it means the DO is on.

For example, if the panel shows “1F”, the hexadecimal F equals 1111 in binary format, indicating that DO1 - DO4 are on.



4.5 Testing

This section introduces the testing operations. To avoid danger, make sure to operate the servo motor without load first.

4.5.1 Initial testing

Remove the load from the servo motor, including coupling and accessories on the shaft, to avoid any damage to the servo drive or machine. This prevents the parts on the motor shaft from falling off and possibly causing personal injury or equipment damage during operation.

Caution: to prevent danger, check first if the motor runs normally without load during normal operation. Then, try operating the motor with load.

Check the following items carefully to avoid damage during motor operation.

Inspection before operation (without power)	■ Check for any obvious visible damage on the servo drive. ■ The wires at the wiring terminals should be isolated. ■ Make sure the wiring is correct to avoid damage or any abnormal operation. ■ Check for and remove any conductive objects, including sheet metals and screws, or inflammable objects inside or near the servo drive. ■ Check that the control switch is in the “Off” state. ■ Do not place the servo drive or external regenerative resistor on inflammable objects. ■ To ensure the electromagnetic brake works, check that the stop and circuit breaker functions are working normally. ■ When peripheral devices of the servo drive are subjected to electromagnetic interference, reduce the interference with EMI reduction devices. ■ Make sure the external voltage level of the servo drive is correct.
Inspection during operation (power is applied)	■ Protect the encoder cable from excessive stress. When the motor is running, make sure the cable is not worn or stretched. ■ Contact Delta if the servo motor vibrates or makes unusual noise during operation. ■ Make sure the settings for the parameters are correct. Different machines have different characteristics; adjust the parameters accordingly. ■ Reset the parameters when the servo drive is in the Servo Off state, or it may cause malfunction. ■ If the relay makes abnormal noise or does not make any contact noise when operating, please contact Delta. ■ Check that the power indicator and LED display work properly.

4.5.2 Applying power to the servo drive

Follow these instructions.

1. Make sure the wiring between the motor and servo drive is correct:
   (1) Connect the red, white, black, and yellow / green wires to the U, V, W, and FG terminals respectively. If the wiring is incorrect, the motor cannot work properly. The motor ground wire FG must connect to the drive's ground terminal. Refer to Chapter 3 for wiring.
   (2) Correctly connect the motor encoder cable to CN2: if you only want to use the JOG function, connecting to CN1 is not necessary. Refer to Chapter 3 for the wiring for CN2.

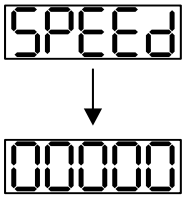
   Caution: do not connect power to the output terminals (U, V, W) of the servo drive, or it may damage the servo drive.

2. Connect the power circuit of the servo drive:
   Connect power to the servo drive. Refer to Wiring for power supply in Chapter 3.
3. Turn on the power:
   Apply power to the servo drive.

- When the power is on, the servo drive panel shows:

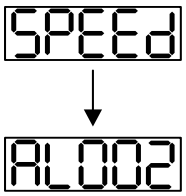
The default signal settings for the DIs are negative limit (NL), positive limit (PL), and emergency stop (EMGS). If not using the default settings, you must set the values of the corresponding parameters to 0 (disable the DI function) or other values for other functions.

- When P0.002 is set to 07 (motor speed), the servo drive panel shows:



When the panel shows no text, check if the power input is undervoltage.

- When the panel shows:



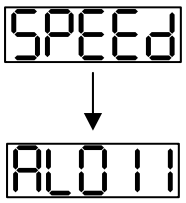
Overvoltage warning:

The input voltage of the main circuit is higher than the allowable rated value or an incorrect power input is applied (incorrect power system).

Corrective action:

1. Use a voltmeter to check if the input voltage of the main circuit is within the allowable rated value.
2. Use a voltmeter to check if the power system complies with the specifications.

- When the panel shows:



CN2 communication failure warning:

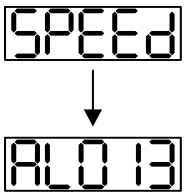
Check if the CN2 connector is securely connected and the wiring is correct.

Corrective action:

1. Make sure the wiring complies with the instructions in the user manual.
2. Check the CN2 connector.
3. Check for loose wiring.
4. Check if the encoder is damaged.

4

- When the panel shows:



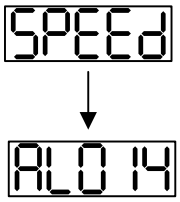
Emergency stop warning:

Check if any of the digital inputs are set to emergency stop (EMGS).

Corrective action:

1. If the emergency stop (EMGS) function is not needed, make sure none of the digital inputs are set to emergency stop (EMGS).
2. If the emergency stop (EMGS) function is needed, make sure the corresponding DI is on when it is preset as normally closed (function code: 0x0021), and then set this DI as normally open (function code: 0x0121).

- When the panel shows:



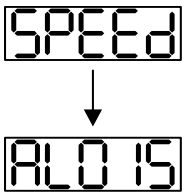
Negative limit error warning:

Check if any of the digital inputs are set to negative limit (NL) and that DI is off.

Corrective action:

1. If the negative limit (NL) function is not needed, make sure none of the digital inputs are set to negative limit (NL).
2. If the negative limit (NL) function is needed, make sure the corresponding DI is on when it is preset as normally closed (function code: 0x0022), and then set this DI as normally open (function code: 0x0122).

- When the panel shows:



Positive limit error warning:

Check if any of the digital inputs are set to positive limit (PL) and that DI is off.

Corrective action:

1. If the positive limit (PL) function is not needed, make sure none of the digital inputs are set to positive limit (PL).
2. If the positive limit (PL) function is needed, make sure the corresponding DI is on when it is preset as normally closed (function code: 0x0023), and then set this DI as normally open (function code: 0x0123).

- When the panel shows:

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 make sure the metal conductor is not exposed.

- When the panel shows:

Undervoltage warning:

Corrective action:

1. Check if the wiring of input voltage for the main circuit is correct.
2. Use a voltmeter to check the main circuit voltage.
3. Use a voltmeter to check if the power system complies with the specifications.

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

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 that you set JOG at low speed. Follow these steps:

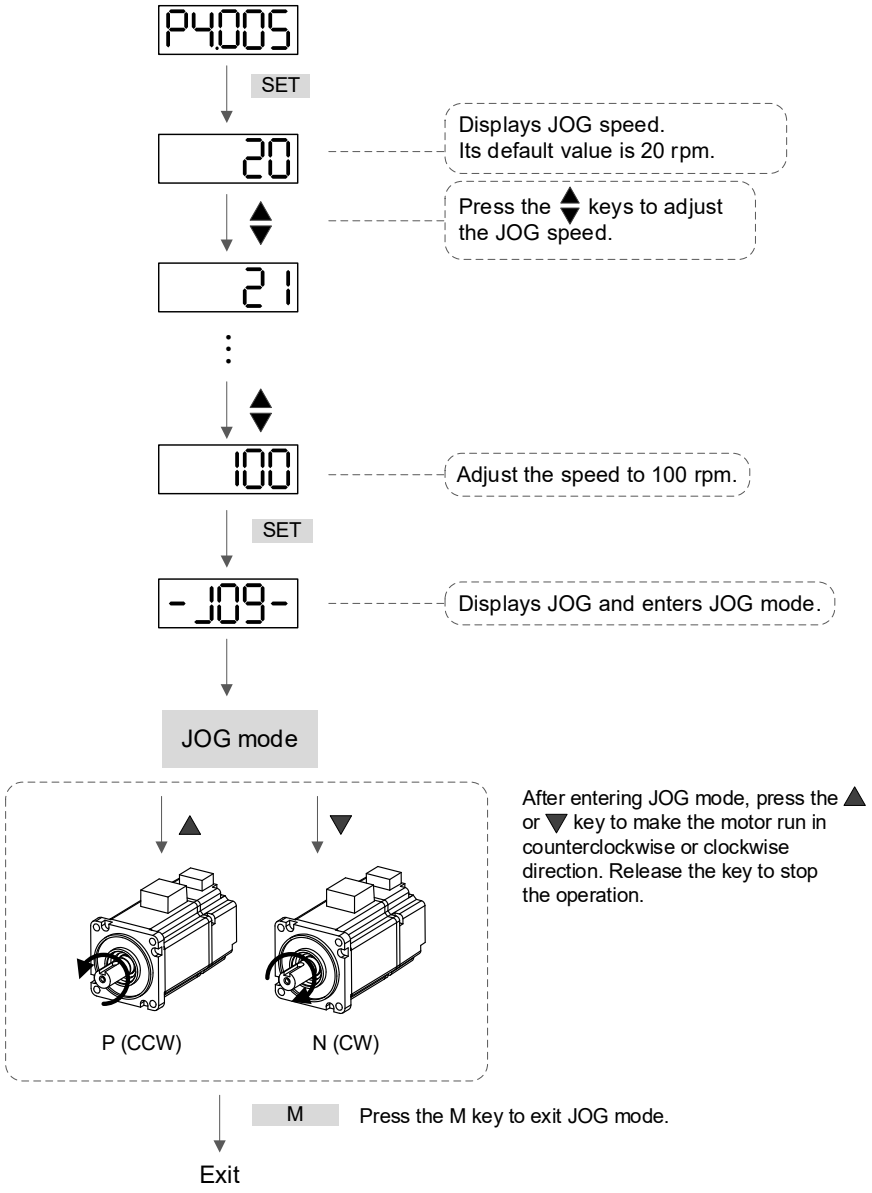
Step 1: JOG trial run is available only when the servo drive is in the Servo On state. The drive can be forced into the Servo On state by setting P2.030 to 1 or with the controller. JOG trial run by panel operation is not available in the communication mode (P1.001.X = C).

Step 2: set the JOG speed (unit: rpm) with P4.005. Press the SET key to display the JOG speed. The default value is 20 rpm.

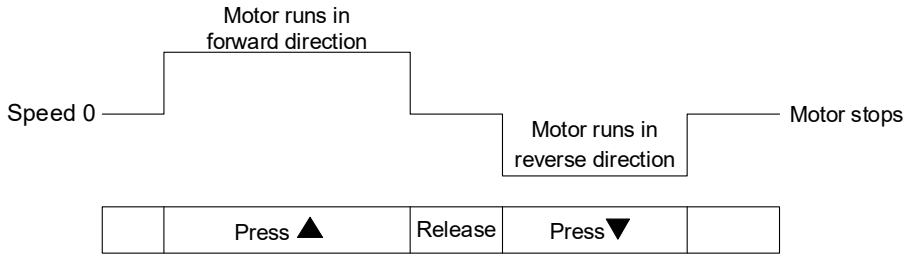
Step 3: press the ▲ or ▼ key to adjust the JOG speed. In the following example, the speed is set to 100 rpm.

Step 4: press the SET key to save the setting value, and then the panel displays “JOG” and enters JOG mode.

Step 5: press the M key to exit JOG mode after completing the trial run.



The following shows the JOG timing diagram:



If the motor does not run, check if the UVW and encoder cables are correctly wired.

If the motor runs abnormally, check if the UVW 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 counterforce generated during motor rotation.

Step 1: set P1.001.YX to 04 to set the control mode of the servo drive to Speed (Sz) mode. Then cycle power on the servo drive.

Step 2: in Sz mode, set the digital input settings as shown in the following table for the trial run.

Digital input	Parameter setting value	DI name	Function description	CN1 Pin No.
DI1	P2.010 = 0x0101	SON	Servo On	DI1- = 2
DI2	P2.011 = 0x0109	TRQLM	Torque limit	DI2- = 3
DI3	P2.012 = 0x0114	SPD0	Speed selection 0	DI3- = 4
DI4	P2.013 = 0x0115	SPD1	Speed selection 1	DI4- = 5
DI5	P2.014 = 0x0102	ARST	Alarm reset	DI5- = 6
DI6	P2.015 = 0x0000	-	DI disabled	-
DI7	P2.016 = 0x0000	-	DI disabled	-
DI8	P2.017 = 0x0000	-	DI disabled	-
DI9	P2.036 = 0x0000	-	DI disabled	-
DI10	P2.037 = 0x0000	-	DI disabled	-
DI11	P2.038 = 0x0000	-	DI disabled	-
DI12	P2.039 = 0x0000	-	DI disabled	-
DI13	P2.040 = 0x0000	-	DI disabled	-

You can program the digital inputs of Delta's servo drive by referring to Table 8.1 Digital input (DI) descriptions in Chapter 8.

The default setting includes the negative limit, positive limit, and emergency stop functions. Therefore, if any alarm occurs after you complete the preceding settings, cycle power on the servo drive or set DI5 to On to clear the alarm. Refer to Section 4.5.2.

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

Speed command number	DI signal of CN1		Command source			Content
	SPD1	SPD0				
S1	0	0	Mode	S Sz	N/A	Speed command is 0
S2	0	1	Internal register parameter			P1.009
S3	1	0				P1.010
S4	1	1				P1.011

0: means that DI is off (the circuit is open).

1: means that DI is on (the circuit is closed).

Rotation speed = parameter setting value x unit (0.1 rpm).

For example, P1.009 = +30000, and the rotation 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 rotation direction:

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

Step 3:

1. Switch on DI1 (Servo On).
2. When both DI3 (SPD0) and DI4 (SPD1) are off, that means the drive executes the S1 command. The speed command is 0.
3. When DI3 (SPD0) is on, that means the drive executes the S2 command. The rotation speed is +3000 rpm.
4. When DI4 (SPD1) is on, that means the drive executes the S3 command. The rotation speed is +100 rpm.
5. When both DI3 (SPD0) and DI4 (SPD1) are on, that means the drive executes the S4 command. The rotation speed is -3000 rpm.
6. You can repeatedly execute steps 3 to 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 counterforce generated during motor rotation.

Step 1: set P1.001.YX to 01 to set the control mode of the servo drive to Position (PR) mode. Then cycle power on the servo drive.

Step 2: in PR mode, set the digital input settings as shown in the following table for the trial run.

Digital input	Parameter setting value	DI name	Function description	CN1 Pin No.
DI1	P2.010 = 0x0101	SON	Servo On	DI1- = 2
DI2	P2.011 = 0x0108	CTRG	Command triggered	DI2- = 3
DI3	P2.012 = 0x0111	POS0	Position selection 0	DI3- = 4
DI4	P2.013 = 0x0112	POS1	Position selection 1	DI4- = 5
DI5	P2.014 = 0x0102	ARST	Alarm reset	DI5- = 6
DI6	P2.015 = 0x0000	-	DI disabled	-
DI7	P2.016 = 0x0000	-	DI disabled	-
DI8	P2.017 = 0x0000	-	DI disabled	-
DI9	P2.036 = 0x0000	-	DI disabled	-
DI10	P2.037 = 0x0000	-	DI disabled	-
DI11	P2.038 = 0x0000	-	DI disabled	-
DI12	P2.039 = 0x0000	-	DI disabled	-
DI13	P2.040 = 0x0000	-	DI disabled	-

You can program the digital inputs of Delta's servo drive by referring to Table 8.1 Digital input (DI) descriptions in Chapter 8.

The default setting includes the negative limit, positive limit, and emergency stop functions. Therefore, if any alarm occurs after you complete the preceding settings, cycle power on the servo drive or set DI5 to On to clear the alarm. Refer to Section 4.5.2.

See the following table for the 100 sets of PR and the corresponding Position commands (POS0 - POS6) and parameters.

Position command	POS6	POS5	POS4	POS3	POS2	POS1	POS0	CTRG	Corresponding parameter
Homing	0	0	0	0	0	0	0	↑	P6.000
									P6.001
PR#01	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

0: means that DI is off (the circuit is open).

1: means that DI is on (the circuit is closed).

You can set the 100 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 gain adjustment modes. Advanced users can also tune the servo system in Manual mode.

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5.1 Tuning procedure and modes

5.1.1 Flowchart of the tuning procedure

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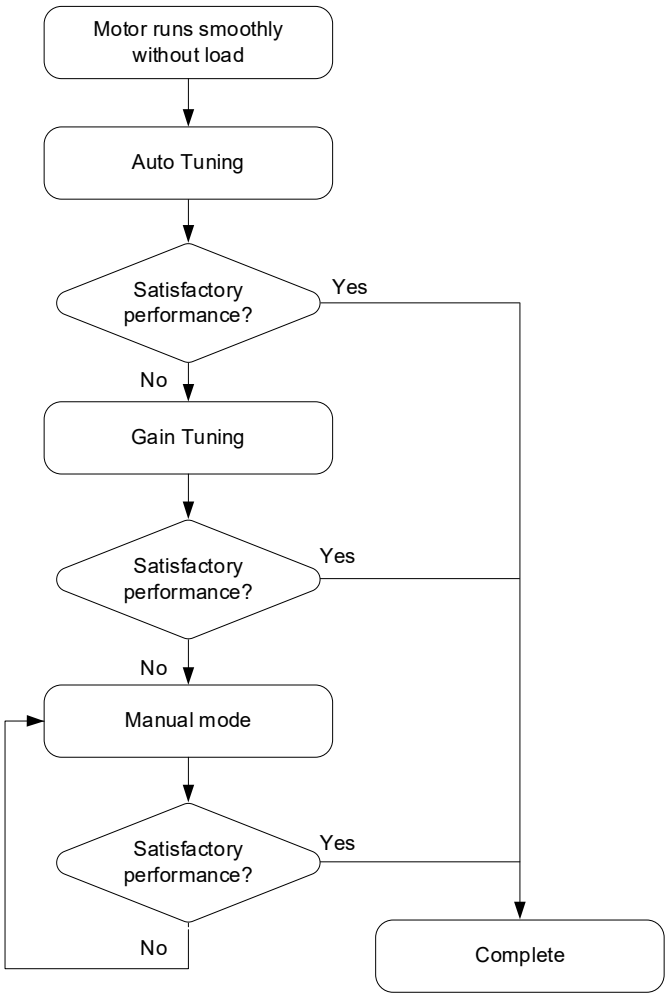
You can tune the servo drive by following this flowchart. First, start with **Auto Tuning**. If you are not satisfied with the tuning results, then use **Gain Tuning** and Manual mode in sequence to meet the requirements.



5.1.2 Differences between adjustment modes

P2.032 value	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	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 the default gain values		
5	Gain adjustment mode 5 (same as setting P2-32 to 1 for B2 series)	Real-time estimation; the value is updated to P1.037 every 30 minutes	P2.126	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, P2.094, P2.098, P2.099, P2.101, P2.102
6	Gain adjustment mode 6 (same as setting P2-32 to 2 for B2 series)	Fixed set value of P1.037	P1.037 P2.126	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.094, P2.098, P2.099, P2.101, P2.102

Note: for more information about the parameter functions, see the tables in Section 5.2.

5.2 Auto tuning

5

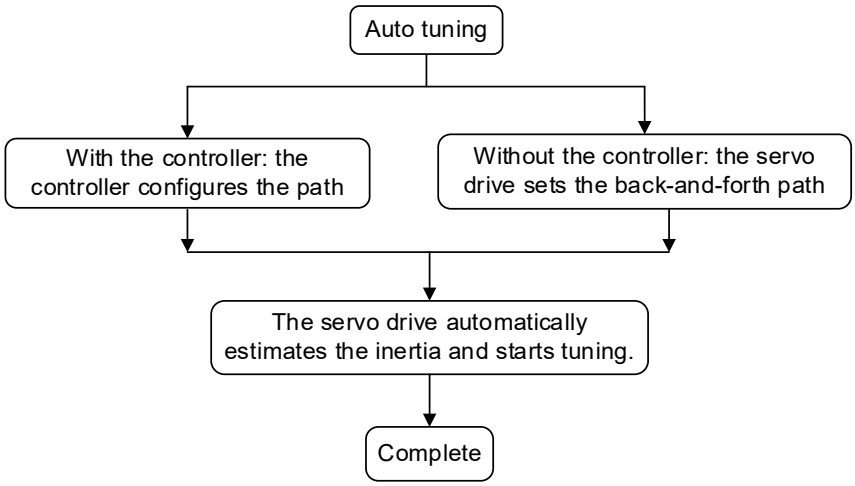
The Auto Tuning function enables the system to perform real-time machine inertia estimation and updates the optimized parameters to the servo drive. You can start auto tuning with ASDA-Soft or through the drive panel. The following tables list the parameters that change according to the results of auto tuning.

Gain parameters			
Parameter No.	Function	Parameter No.	Function
P1.037	Load inertia ratio or total weight	P2.031	Bandwidth response level
P2.000	Position proportional gain	P2.032	Gain adjustment mode
P2.002	Position feed forward gain	P2.089	Command response gain
P2.004	Speed proportional gain	P2.090	Two degree of freedom mode - anti-interference gain
P2.006	Speed integral compensation	P2.094	Special bit register 3 (enable the two degree of freedom control function)
P2.026	Anti-interference gain	-	-

Filter and resonance suppression parameters			
Parameter No.	Function	Parameter No.	Function
P1.025	Low-frequency vibration suppression frequency 1	P2.025	Resonance suppression low-pass filter
P1.026	Low-frequency vibration suppression gain 1	P2.043	Notch filter 2 - frequency
P1.027	Low-frequency vibration suppression frequency 2	P2.044	Notch filter 2 - attenuation level
P1.028	Low-frequency vibration suppression gain 2	P2.045	Notch filter 3 - frequency
P1.029	Auto low-frequency vibration suppression mode	P2.046	Notch filter 3 - attenuation level
P1.061	Viscous friction compensation	P2.049	Speed detection filter and jitter suppression
P1.062	Percentage of friction compensation	P2.095	Notch filter 1 - Q factor
P1.063	Constant of friction compensation	P2.096	Notch filter 2 - Q factor
P1.089	Vibration elimination 1 - anti-resonance frequency	P2.097	Notch filter 3 - Q factor
P1.090	Vibration elimination 1 - resonance frequency	P2.098	Notch filter 4 - frequency
P1.091	Vibration elimination 1 - resonance difference	P2.099	Notch filter 4 - attenuation level
P1.092	Vibration elimination 2 - anti-resonance frequency	P2.100	Notch filter 4 - Q factor
P1.093	Vibration elimination 2 - resonance frequency	P2.101	Notch filter 5 - frequency
P1.094	Vibration elimination 2 - resonance difference	P2.102	Notch filter 5 - attenuation level
P2.023	Notch filter 1 - frequency	P2.103	Notch filter 5 - Q factor
P2.024	Notch filter 1 - attenuation level	-	-

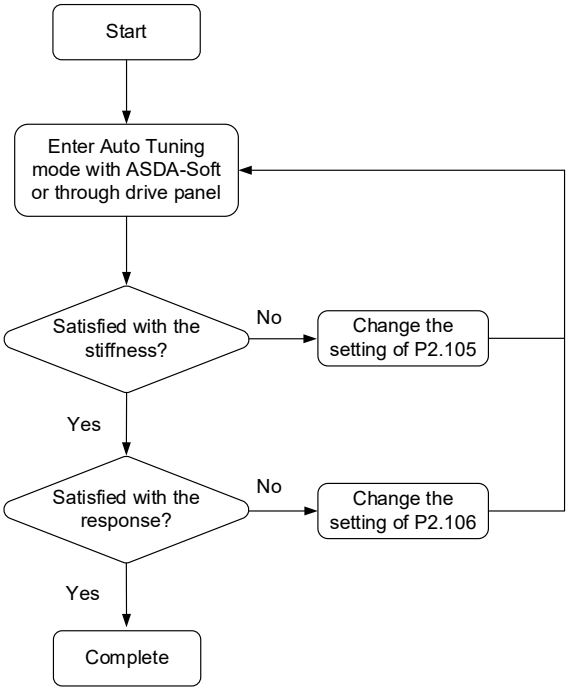
5.2.1 Flowchart of auto tuning

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



Note: when the path is configured by the controller, make sure the dwell time is added between the operation cycles. Otherwise, an alarm occurs and the servo drive cannot complete auto tuning.

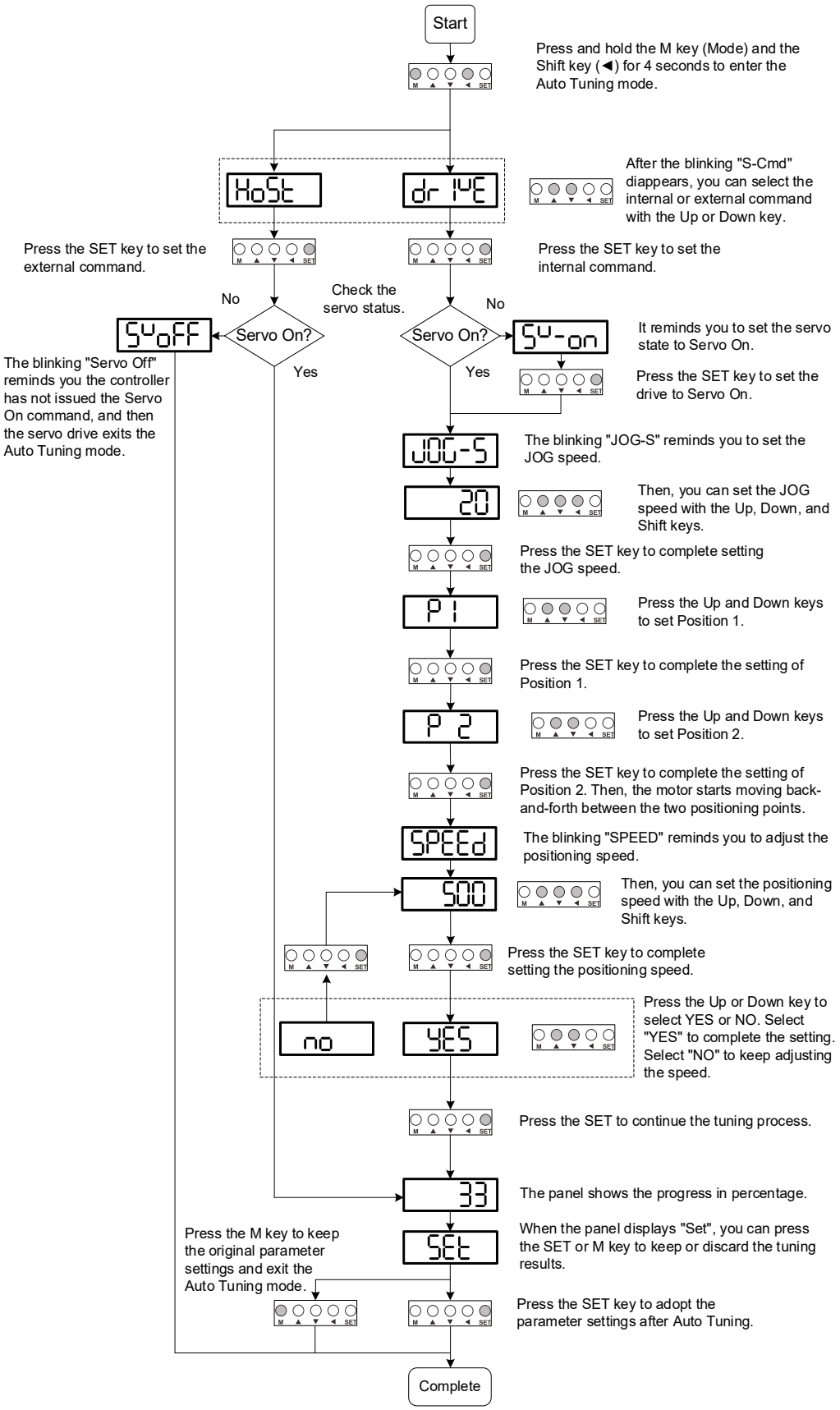
You can use P2.105 and P2.106 to adjust the stiffness and response in Auto Tuning mode. See the following flowchart.



5

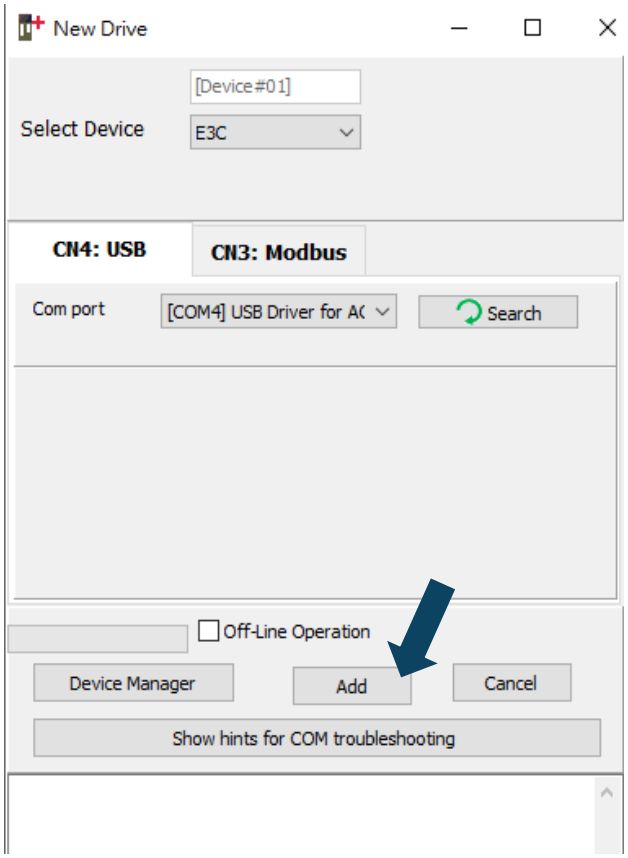
5.2.2 Auto tuning through the drive panel

You can use the drive panel to start auto tuning. Make sure the emergency stop and the positive and negative limit switches work properly before you start to tune the system.



5.2.3 Auto tuning with ASDA-Soft

In addition to executing auto tuning through the drive panel, you can go to Delta's website to download ADSA-Soft for free to tune the servo drive. After installing ASDA-Soft, start the executable file and the screen is as follows.



Make sure your servo drive, servo motor, and power are all properly connected. Then click **Add** for the ASDA-Soft to be in online mode.

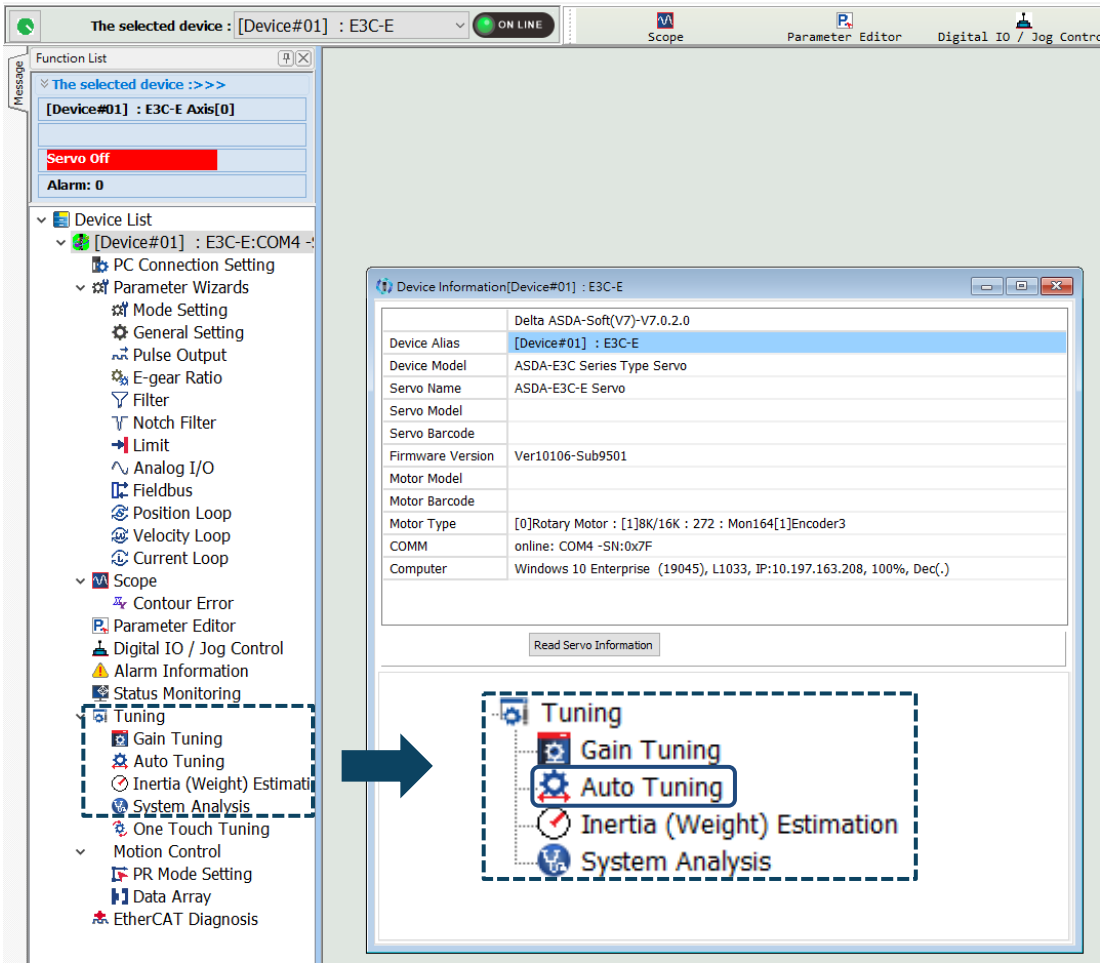
5

When ASDA-Soft is in online mode, start auto tuning according to the following steps. The following describes two auto tuning procedures, one using the controller and the other using the servo drive.

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

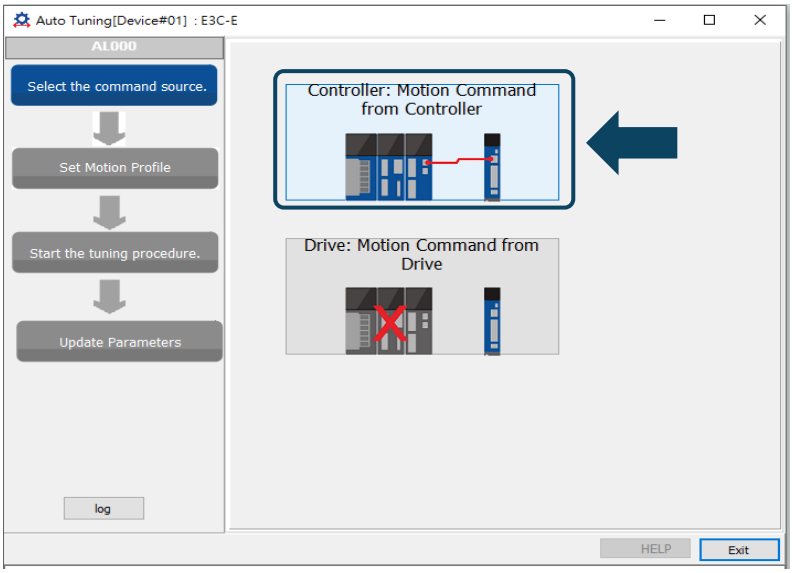
Step 1:

When ASDA-Soft is in online mode, the program window appears as follows. Click **Auto Tuning** in the Function List tree view.



Step 2:

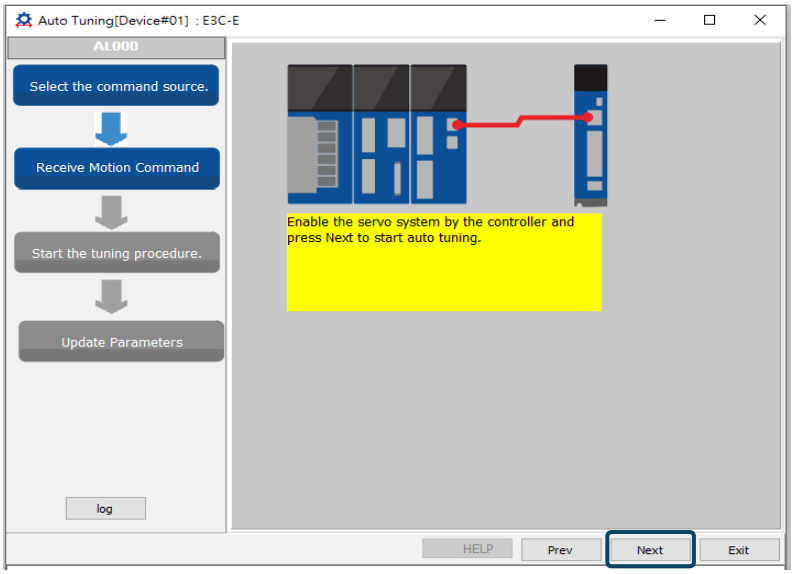
Click **Controller: Motion Command from Controller** and check for the motion / machining path.



Suggestions: set the motor to operate at least one cycle in both forward and reverse directions. The dwell time for reaching the positioning points in both forward and reverse directions should be no less than 1000 ms, and the running speed should be no less than 500 rpm.

Step 3:

Repeatedly run the motor with the path you just set. Make sure no personnel is standing close to the machine, and then you can click **Next** to start auto tuning.



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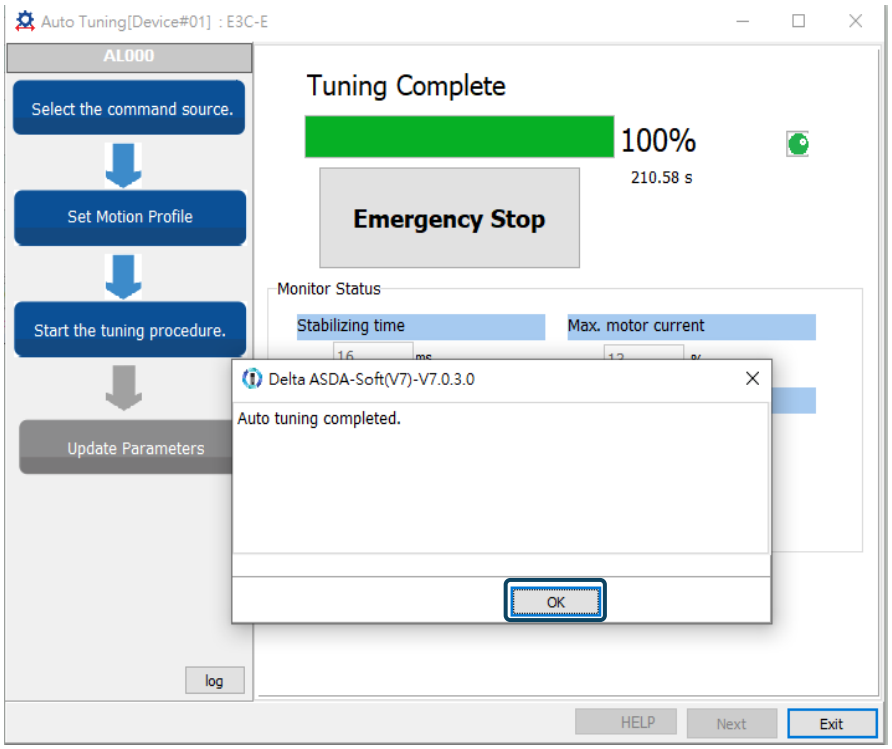
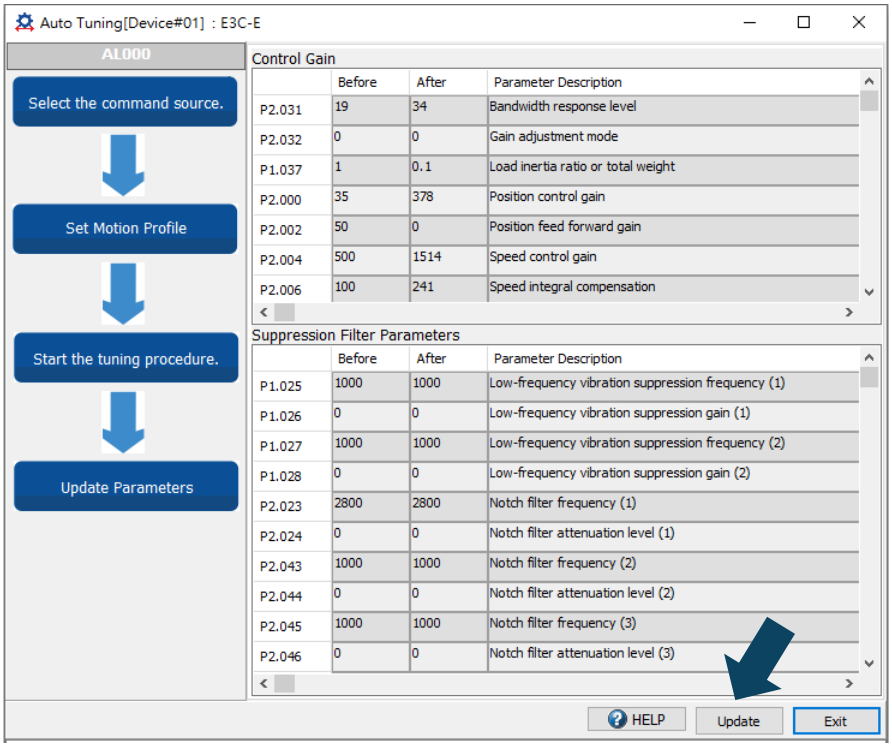
Wait until the tuning progress bar reaches 100%, and a window showing “Auto tuning completed.” appears as follows. Then click **OK**.



The screen shows a table comparing the parameter values before and after tuning.

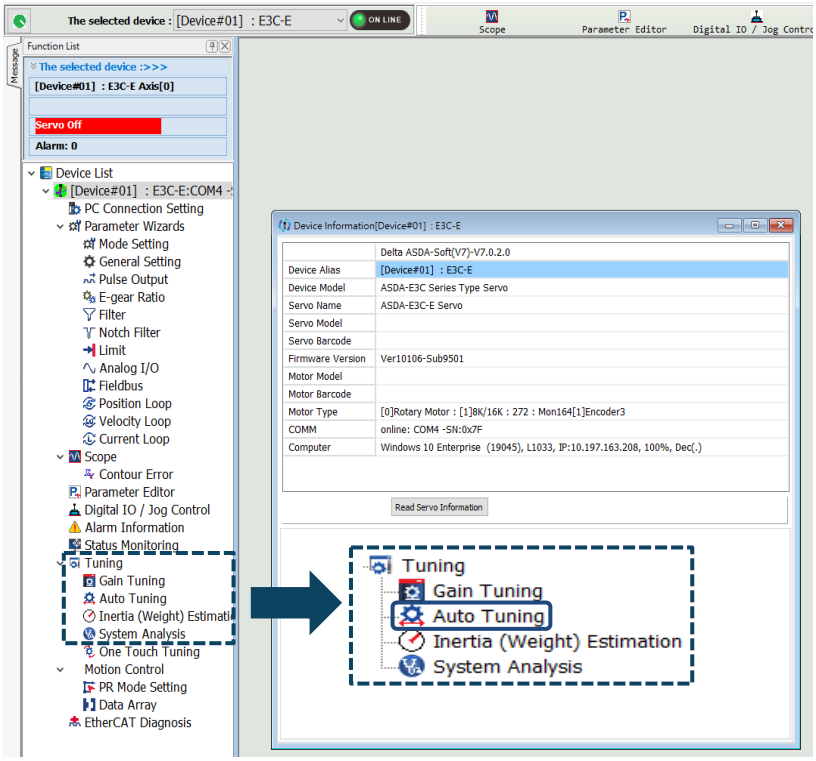


Click **Update** to complete auto tuning.

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

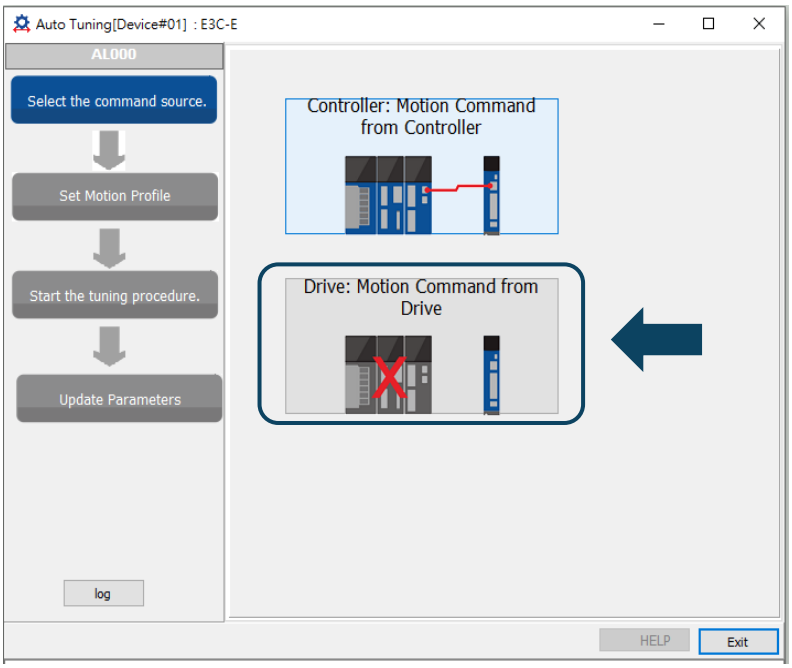
Step 1:

When ASDA-Soft is in online mode, the program window appears as follows. Click **Auto Tuning** in the Function List tree view.



Step 2:

Click **Drive: Motion Command from Drive** to enter the setting screen of motion profile.



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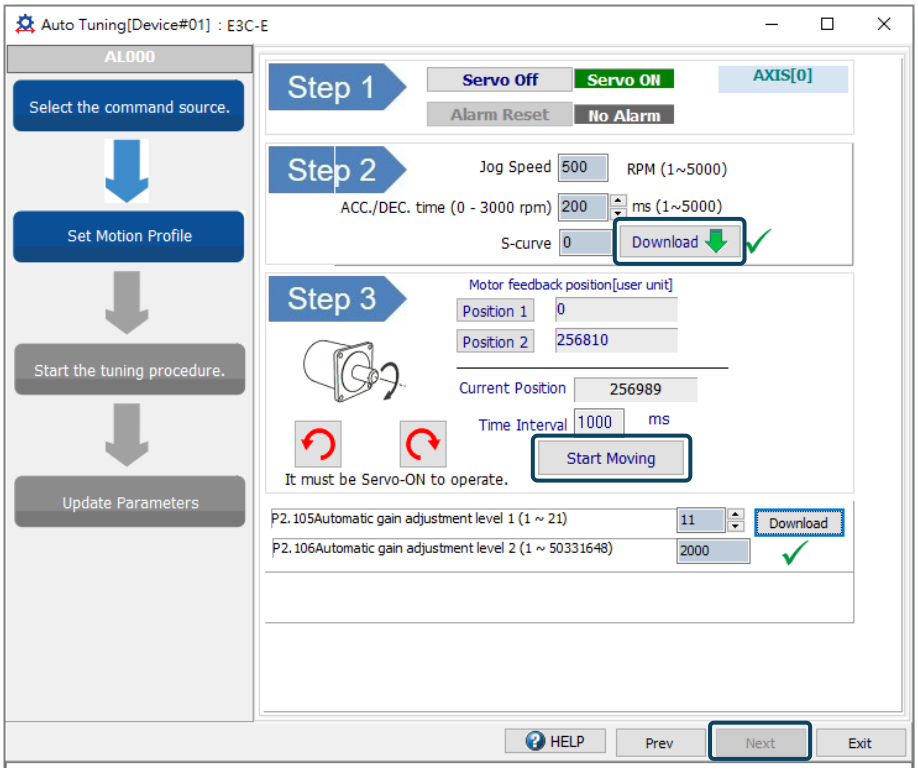
Follow these steps to set the motor running path:

Step 1: set the system to the Servo ON state.

Step 2: set the acceleration / deceleration time and jog speed. The default acceleration / deceleration time is 200 ms. Set the jog speed to no less than 500 rpm. After completing the settings, click the Download button.

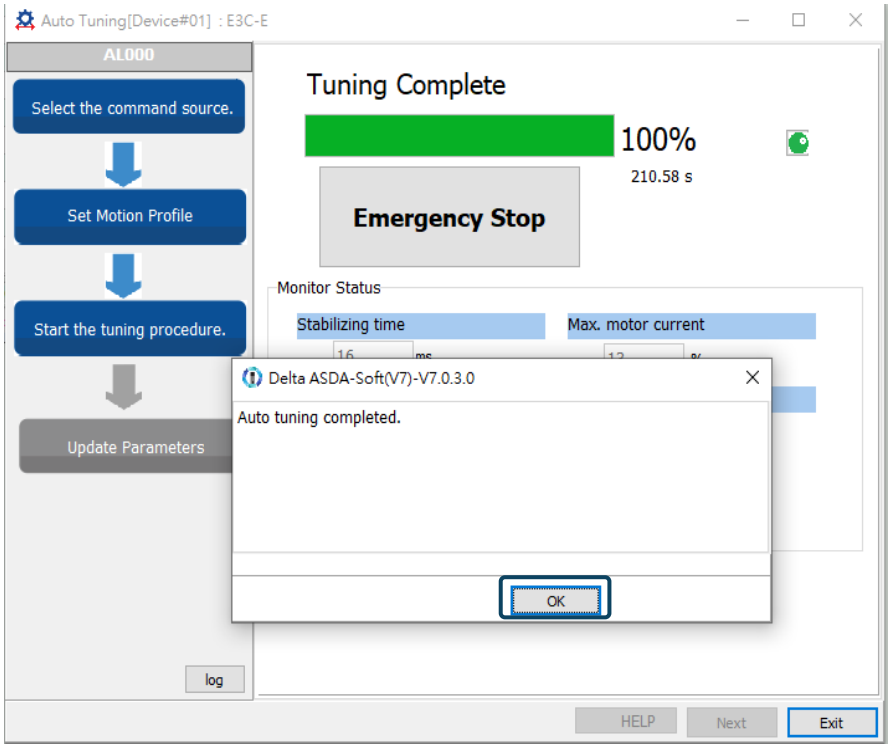
Step 3: use the Left ( ) or Right ( ) button to rotate the motor to Position 1 and Position 2. Then click **Start Moving**, and the motor regards Position 1 and Position 2 as the positive and negative limits and starts rotating in forward and reverse directions.

After completing the settings, make sure no personnel is standing close to the machine. Then, click **Next** to start auto tuning.

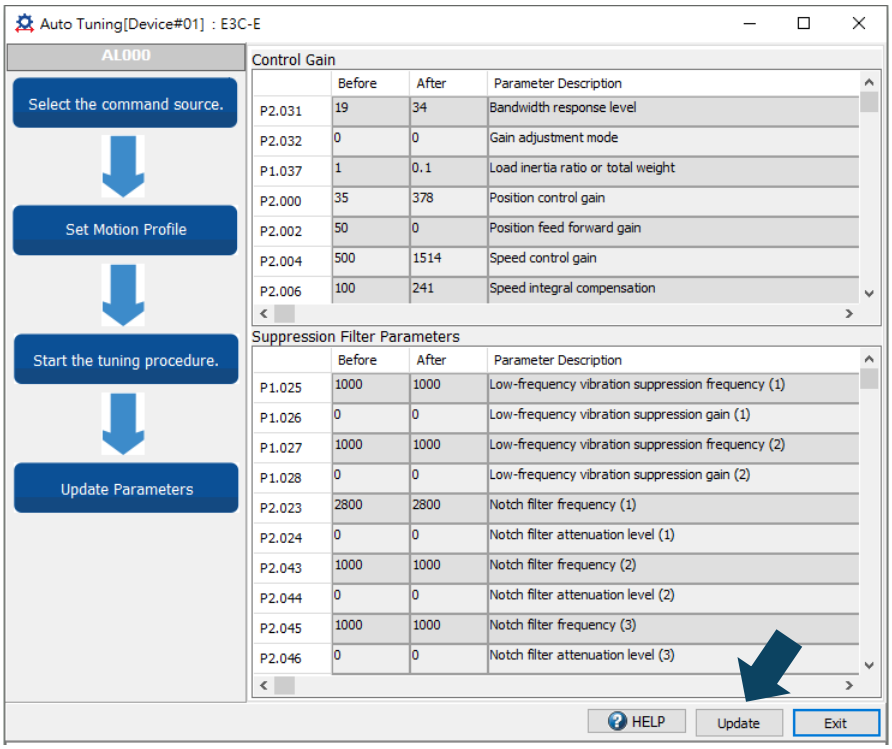


Step 3:

Wait until the tuning progress bar reaches 100%, and a window showing “Auto tuning completed.” appears as follows. Then click **OK**.



The screen shows a table comparing the parameter values before and after tuning.



Click **Update** to complete auto tuning.

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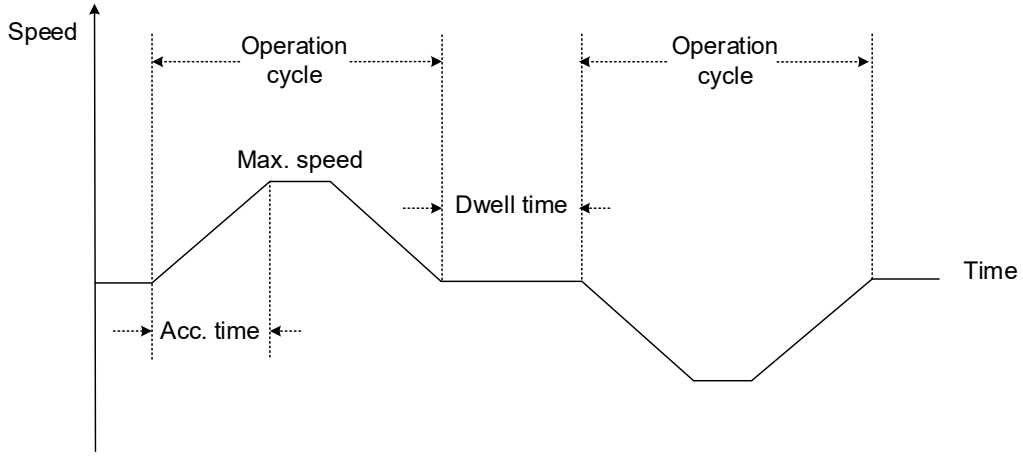
5.2.4 Alarms related to auto tuning

In Auto Tuning mode, it is vital that you program the command path. The path must contain the operation cycle (including the acceleration, constant speed, and deceleration zones) and dwell time as shown in the following figure. When any of the settings is incorrect, the servo drive stops tuning and displays an alarm, and then you need to check the alarm causes and take corrective actions.

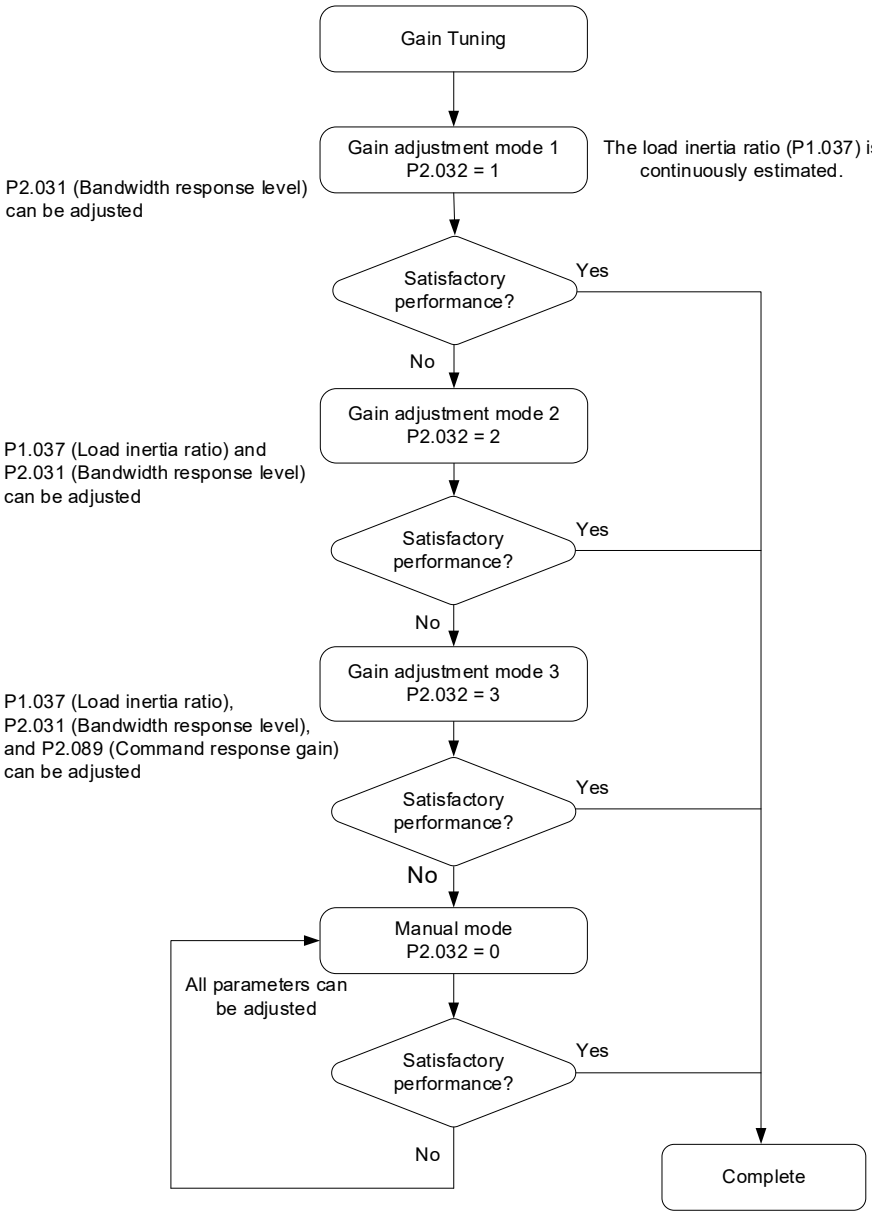


Display	Alarm name
AL08A	Auto tuning function - command error
AL08B	Auto tuning function - dwell time is too short
AL08C	Auto tuning function - inertia estimation error

5.3 Gain adjustment modes

In addition to the Auto Tuning function, the servo drive also provides the following gain adjustment modes. You can easily complete tuning by increasing or decreasing the bandwidth response level (P2.031). It is advisable to follow the tuning procedure in Section 5.1.1.

5.3.1 Flowchart of gain adjustment mode



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5.3.2 Gain adjustment mode 1

In this mode, the servo drive continuously estimates the machine inertia and instantly updates the value of P1.037.

P2.032 value	Mode	Inertia estimation	Parameter	
			Manual	Auto
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

Requirements for inertia estimation:

1. The time duration for the motor to accelerate from 0 rpm to 3,000 rpm or to decelerate from 3,000 rpm to 0 rpm should be within 1.5 seconds.
2. It is advisable to set the motor speed to 500 rpm or higher. The lowest speed should be no less than 200 rpm.
3. The load inertia ratio must be no more than 50 times the motor inertia.
4. The change in the inertia ratio cannot be too great.

5.3.3 Gain adjustment mode 2

When the inertia cannot be successfully estimated in Gain adjustment mode 1 , try Gain adjustment mode 2 to tune the servo system. In this mode, the system does not estimate the inertia automatically. You need to correctly set the machine inertia ratio in P1.037 first.

P2.032 value	Mode	Inertia estimation	Parameter	
			Manual	Auto
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

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

5.3.4 Gain adjustment mode 3

When Gain adjustment modes 1 and 2 cannot meet the requirements, try Gain adjustment mode 3 to tune the servo system. P2.089 (Command response gain) is available for manual adjustment 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 gain value too high, it may cause position overshoot which leads to mechanical vibration. P2.089 is effective only when the commands are changing, such as in the acceleration / deceleration application, and adjusting this parameter can improve the response.

When the two degree of freedom control function is disabled (P2.094 [Bit 12] = 0), the effect of Gain adjustment mode 3 is the same as that of Gain adjustment mode 2, so setting P2.089 is invalid in that scenario.

P2.032 value	Mode	Inertia estimation	Parameter	
			Manual	Auto
3	Gain adjustment mode 3	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

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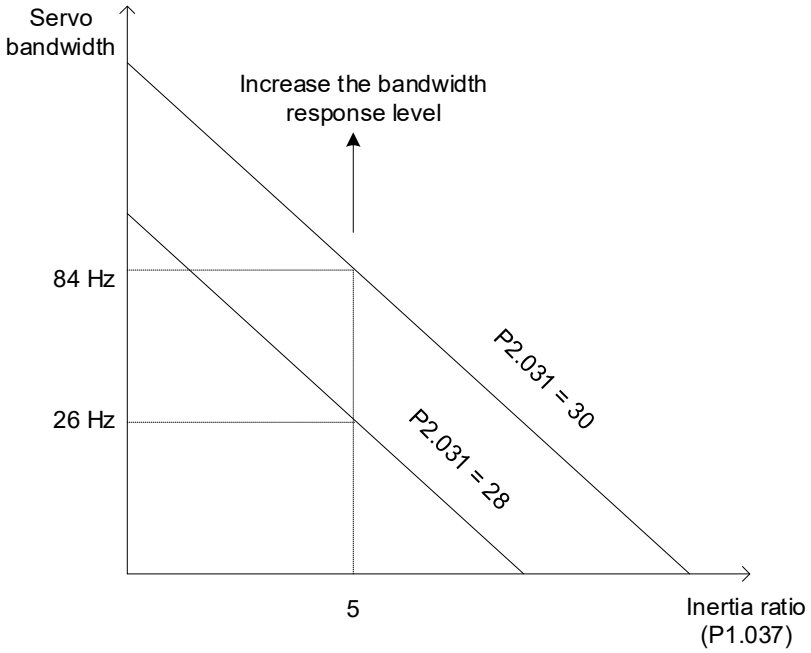
5.3.5 Bandwidth response level (P2.031) - stiffness adjustment

When the inertia is fixed and you increase the bandwidth response level (P2.031), the servo's bandwidth increases as well. If resonance occurs, decrease the setting value of P2.031 by one or two bandwidth response levels (you should adjust the bandwidth response level according to the actual situation). For instance, if the value of P2.031 is 30, you can lower the setting to 28. When you adjust the value of this parameter, the servo drive automatically adjusts the corresponding gain parameters, such as P2.000 and P2.004.



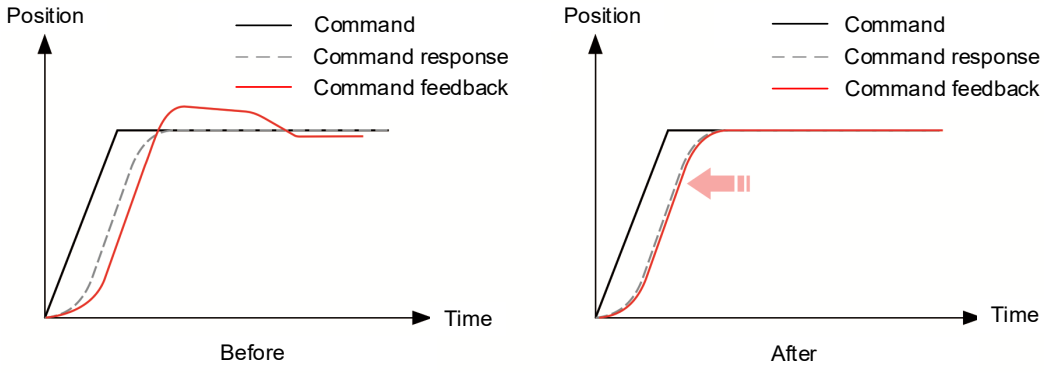


Figure 5.3.5.1 Adjusting the bandwidth response level

5.3.6 Command response gain (P2.089) - response adjustment

P2.089 adjusts the command response gain to improve the response to the servo command. Increasing the gain can reduce the transient error (in acceleration and deceleration zones) between the position command and command response. That is, the P2.089 setting is effective only when the commands are changing. This parameter is available only when the two degree of freedom control function is enabled (P2.094 [Bit 12] = 1). The two degree of freedom control function is enabled by default.

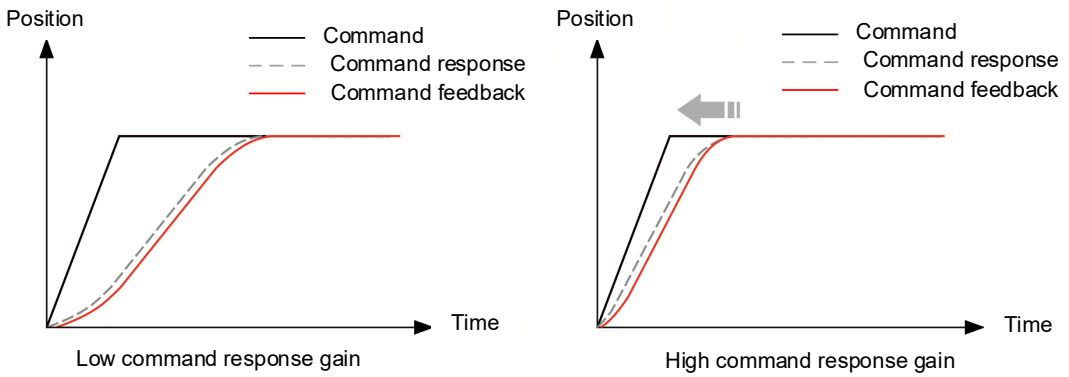


Figure 5.3.6.1 Adjusting the command response gain

5.4 Manual tuning of gain parameters

The position or speed loop response bandwidth is determined by the mechanical stiffness and the application. Generally, for applications or machines that require high-speed positioning and high precision, higher response bandwidth is required. However, increasing the response bandwidth is likely to cause mechanical resonance. Thus, machines with higher stiffness are applied to solve this problem. When the allowable response bandwidth of the machine is unknown, you can gradually increase the gain parameter values to increase the response bandwidth until hearing the sound of the resonance. Then, decrease the gain parameter values. The following are the descriptions of the gain adjustment parameters.

- P2.000 Position proportional gain (KPP)

  This parameter determines the response of the position loop. The bigger the KPP value, the higher the bandwidth of the position loop. This reduces the following error, position error, and settling time. However, if you set the value too high, it can cause machine jitter or cause overshoot when positioning. The calculation of position loop bandwidth is as follows:

$$\text{Position loop bandwidth (Hz)} = \frac{KPP}{2\pi}$$

- P2.004 Speed proportional gain (KVP)

  This parameter determines the response of the speed loop. The bigger the KVP value, the higher the bandwidth of the speed loop and the lower the following error. However, if you set the value too high, it is likely to cause mechanical resonance. The speed loop bandwidth must be 4 to 6 times the position loop bandwidth; when the position loop bandwidth is higher than the speed loop bandwidth, it can cause machine jitter or cause overshoot when positioning. The calculation of speed loop bandwidth is as follows:

$$\text{Speed loop bandwidth (Hz)} = \left(\frac{KVP}{2\pi}\right) \times \left[\frac{(1 + P1.037 / 10)}{(1 + JL / JM)}\right]$$

  JM: motor inertia; JL: load inertia

  When P1.037 (auto estimated or manually set value) is equal to the actual load inertia ratio (JL / JM), the actual speed loop bandwidth is:

$$\text{Speed loop bandwidth (Hz)} = \left(\frac{KVP}{2\pi}\right)$$

- P2.006 Speed integral compensation (KVI)

  The higher the KVI value, the better the elimination of the deviation. However, if you set the value too high, it can cause machine jitter. It is advisable to set the KVI value as follows:

  $$KVI \leq 1.5 \times \text{Speed loop bandwidth (Hz)}$$

- P2.025 Resonance suppression low-pass filter (NLP)

  A high load inertia ratio reduces the speed loop bandwidth. Therefore, you must increase the KVP value to maintain the speed loop bandwidth. Increasing the KVP value may cause mechanical resonance, and you can use this parameter to eliminate the noise. The higher the NLP value, the better the effect of reducing high-frequency noise. However, if you set the value too high, it can cause instability in the speed loop and overshoot. It is advisable to set the NLP value as follows:

  $$NLP \leq \frac{10000}{6 \times \text{Speed loop bandwidth (Hz)}}$$

- P2.026 Anti-interference gain (DST)

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

  Note: disable the two degree of freedom control function (P2.094 [Bit 12] = 0) before using this gain parameter.

- P2.002 Position feed forward gain (PFG)

  This parameter reduces the position error and settling time. However, if you set the value too high, it may cause overshoot when positioning. If the E-Gear ratio is higher than 10, it is likely to cause noise.

5.5 Mechanical resonance suppression

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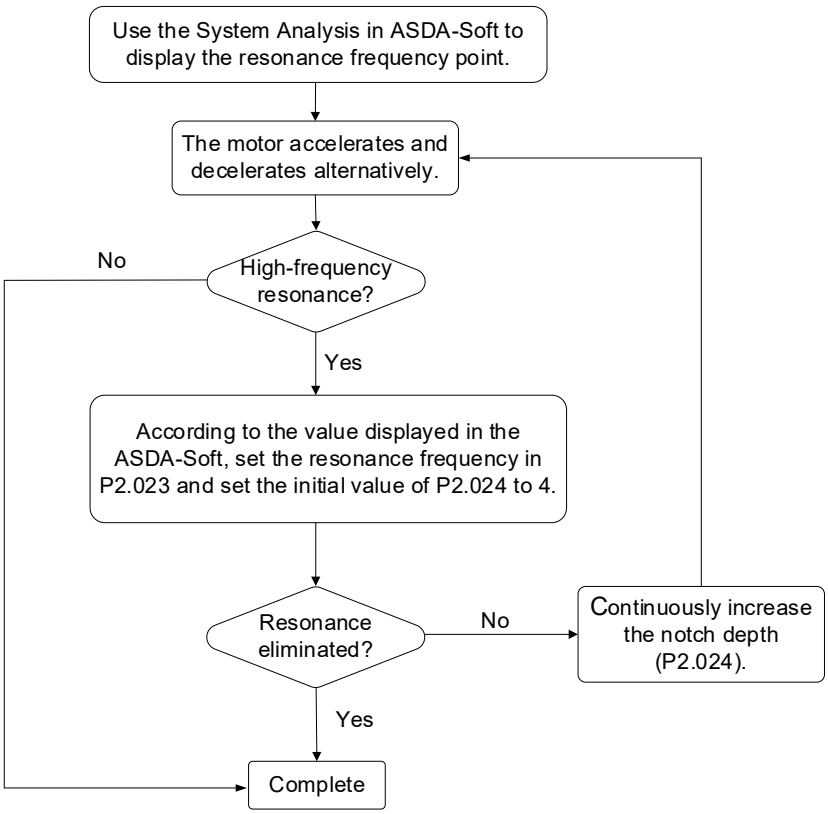
The servo drive provides 5 sets of notch filters for suppressing mechanical high-frequency resonances. Each set of notch filter supports the function of auto resonance suppression (set by P2.047). In addition, you can suppress the resonance manually.

Flowchart of manual resonance suppression:



6 Control Mode

This chapter describes the control structure of each mode, including the usage of gain adjustment and filters. For Position mode, Speed mode, and Torque mode, you can only use the commands from the internal registers. In addition to the single modes, dual mode are also available for meeting the application requirements.

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6.1 Selecting the control mode

This servo drive provides three basic control modes, Position, Speed, and Torque, and one communication mode. You can perform single-mode or dual-mode control with the basic control modes. The following table lists all the available modes and corresponding descriptions.

Mode		Short name	Code	Description
Single mode	Position mode (Internal register)	PR	01	The servo drive receives the Position command and controls the motor to move to the target position. The Position commands are issued from the internal registers (100 sets in total). Select the register number with DI signals or through communication.
	Speed mode	S	02	Refer to the description of Sz mode.
		Sz	04	The servo drive receives the Speed command and controls the motor to reach the target speed. The Speed command can only be issued from the internal registers (3 sets in total) instead of from the external terminal block. Select the command with DI signals.
	Torque mode	T	03	Refer to the description of Tz mode.
		Tz	05	The servo drive receives the Torque command and controls the motor to reach the target torque. The Torque command can only be issued from the internal registers (3 sets in total) instead of from the external terminal block. Select the command with DI signals.
Dual mode		S-PR	08	Switch between S and PR modes with DI signal.
		T-PR	09	Switch between T and PR modes with DI signal.
		S-T	0A	Switch between S and T modes with DI signal.
Communication mode		EtherCAT	0C	EtherCAT mode.

Here are the steps to switch the control modes:

1. Switch the servo drive to the Servo Off state. You can do this by setting DI.SON to off.
2. Set P1.001 by referring to the codes listed in the preceding table to set the control mode.
3. After setting P1.001, cycle power on the servo drive.

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

6.2 Position mode

The internal register (PR mode) allows you to accomplish position control without the external pulse command. The servo drive provides 100 sets of command registers. Set the required registers first before switching the drive to Servo On state. There are two ways to select the commands. One is setting DI.POS0 - DI.POS6 of CN1, and the other is directly setting the register values through communication.

6.2.1 Position command in PR mode

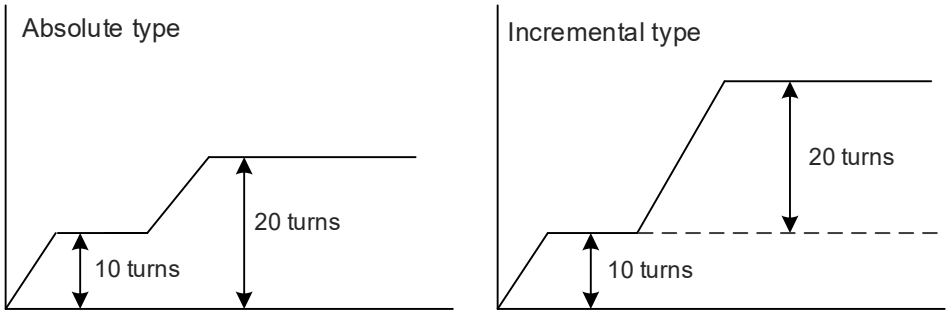
The PR position command source is the 100 sets of internal command registers (P6.000 - P7.099). Use DI.POS0 - DI.POS6 (0x11, 0x12, 0x13, 0x1A, 0x1B, 0x1C, 0x1E) of CN1 to select one of the 100 sets as the Position command and then trigger the command with DI.CTRG (0x08). See the following table for details.

Position command	POS6	POS5	POS4	POS3	POS2	POS1	POS0	CTRG	Corresponding parameter
Homing	0	0	0	0	0	0	0	↑	P6.000
									P6.001
PR#01	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

Status of POS0 - POS6: 0 means the DI is Off (the circuit is open); 1 means the DI is On (the circuit is closed).

CTRG ↑: this indicates the moment the DI is switched from Off to On.

The absolute type and incremental type position registers are used to control the operation process. You can easily complete a periodic motor operation according to the preceding table. For example, if the Position command PR#01 is 10 turns and PR#02 is 20 turns, when PR#01 is issued first and PR#02 comes second, the difference between absolute and incremental positioning is shown in the following diagrams.



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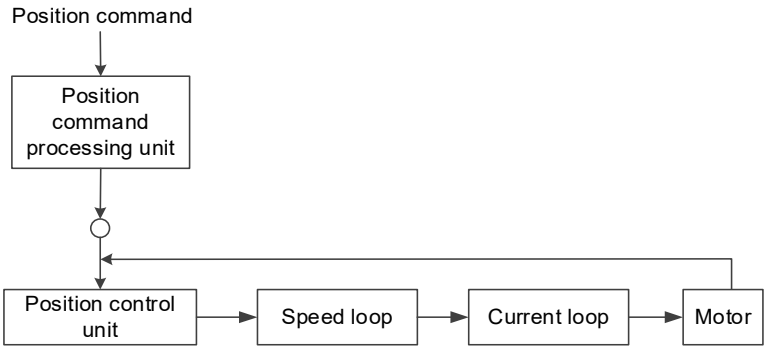
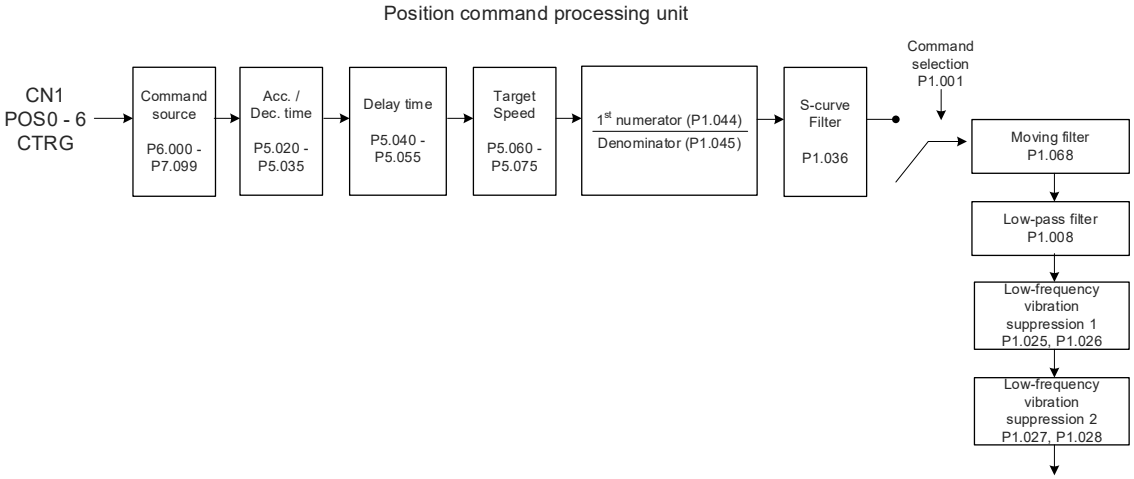
6.2.2 Control structure of Position mode

The following diagram shows the basic control structure of Position mode.

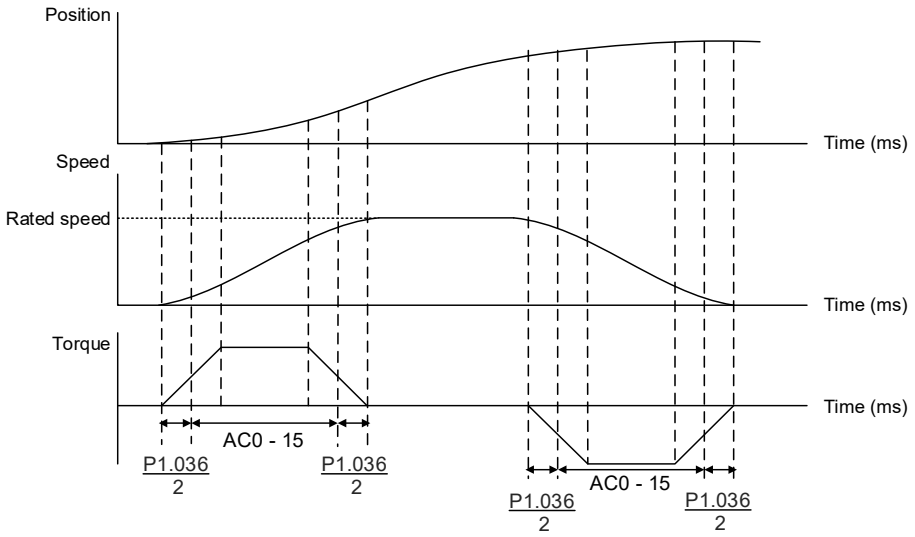


For better control, the pulse signals are processed by the Position command processing unit. The structure is shown in the following diagram.

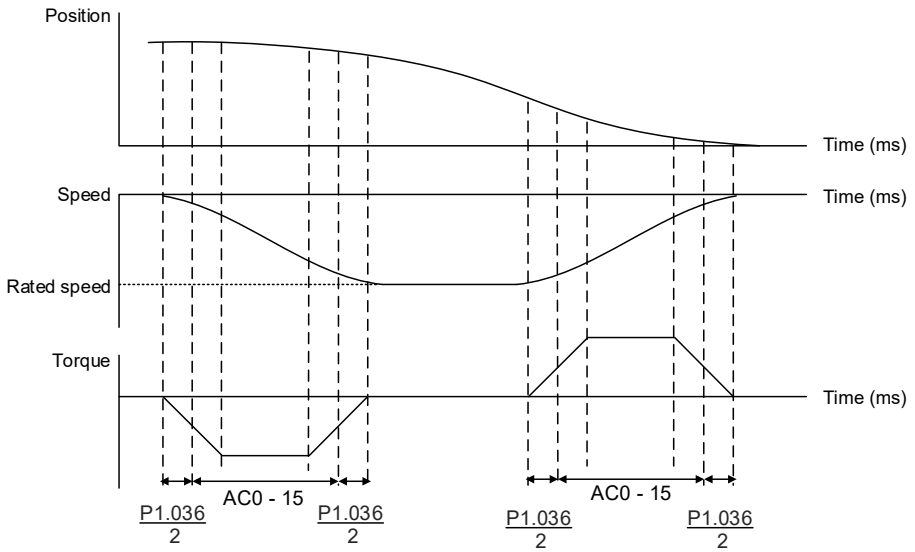


6.2.3 S-curve filter for Position commands

The S-curve filter for Position commands smooths the motion command in PR mode. The filter makes the speed and acceleration continuous and reduces jerks, resulting in a smoother mechanical operation. If the load inertia increases, the motor operation is affected by friction and inertia when the motor starts or stops rotating. Setting a higher value for P1.036 (S-curve acceleration / deceleration constant) and adjusting the settings for P5.020 - P5.035 (acceleration / deceleration time) can increase the smoothness of operation.



S-curve speed profile of Position command and time setting (incremental position command)



S-curve speed profile of Position command and time setting (decremental position command)

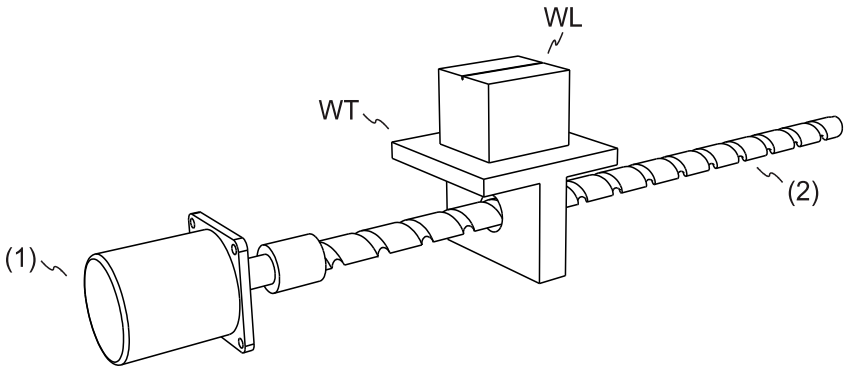
6

6.2.4 Electronic gear ratio (E-Gear ratio)

The E-Gear ratio (P1.044 and P1.045) provides easy settings for the resolution. The resolution of the servo drive is 24-bit, which means 16,777,216 pulses are generated per motor revolution. Regardless of the encoder resolution (17-bit, 20-bit, or 23-bit), the E-Gear ratio is set according to the servo drive resolution (24-bit).

When the E-Gear ratio is 1, it means 16,777,216 pulses are generated per motor revolution; when the E-Gear ratio is 0.5, then every two pulses from the command (controller) corresponds to one pulse for the motor. A high E-Gear ratio might create a sharp corner in the profile and lead to a high jerk. To solve this problem, apply an S-curve filter or a low-pass filter.

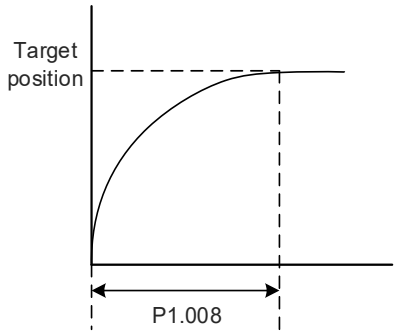
For example, if a workpiece is moved at the speed of 1 μm/pulse after you set a proper E-Gear ratio, then it means the workpiece moves 1 μm per pulse.



(1) Motor; (2) Ball screw pitch: 3 mm (equals 3,000 μm); WL: workpiece; WT: platform

	Gear ratio	Moving distance per 1 pulse command
E-Gear is not applied	$= \frac{1}{1}$	$= \frac{3000\frac{\mu m}{rev}}{16777216\frac{pulse}{rev}} \times \frac{1}{1} = \frac{3000}{16777216}$ (Unit: $\frac{\mu m}{pulse}$)
E-Gear is applied	$= \frac{16777216}{3000}$	$= \frac{3000\frac{\mu m}{rev}}{16777216\frac{pulse}{rev}} \times \frac{16777216}{3000} = 1$ (Unit: $\frac{\mu m}{pulse}$)

6.2.5 Low-pass filter

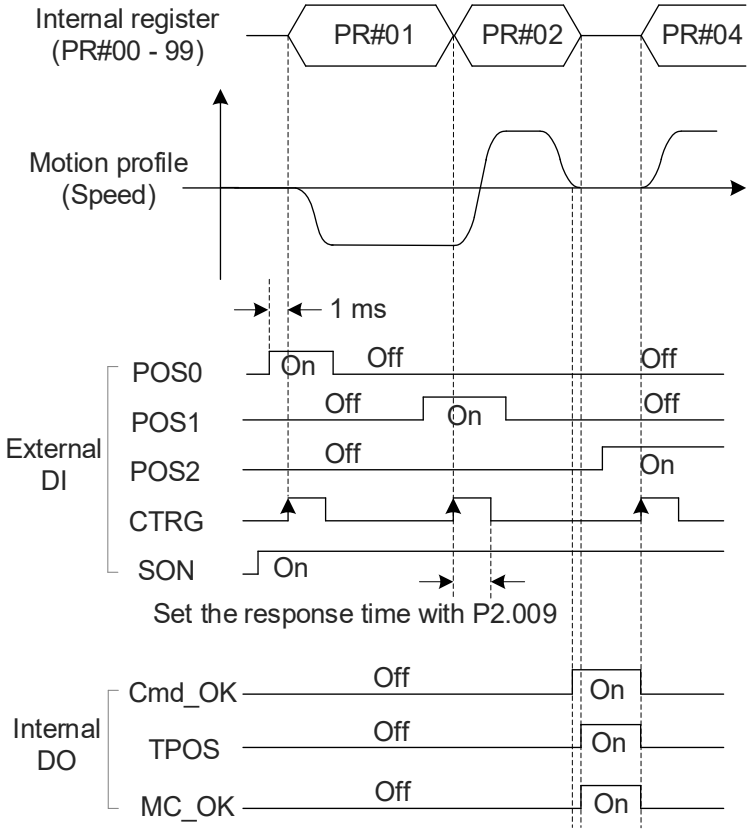


Refer to Chapter 8 for detailed descriptions of the relevant parameter.

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

6.2.6 Timing diagram of PR mode

In PR mode, the Position command is selected with DI.POS0 - POS6 (DI signals of CN1) and triggered with DI.CTRG. Refer to Section 6.2.1 for information about the DI signals and the selected register. The timing diagrams are shown as follows.



Note: Cmd_OK is On when the PR command is complete; TPOS is On when the position error is smaller than the set value of P1.054; MC_OK is On when both Cmd_OK and TPOS are On.

6.2.7 Gain adjustment of the position loop

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

6

Auto adjustment

The servo drive can complete the gain adjustment with the Auto Tuning function. Refer to Section 5.2 Auto tuning for details.

Manual adjustment

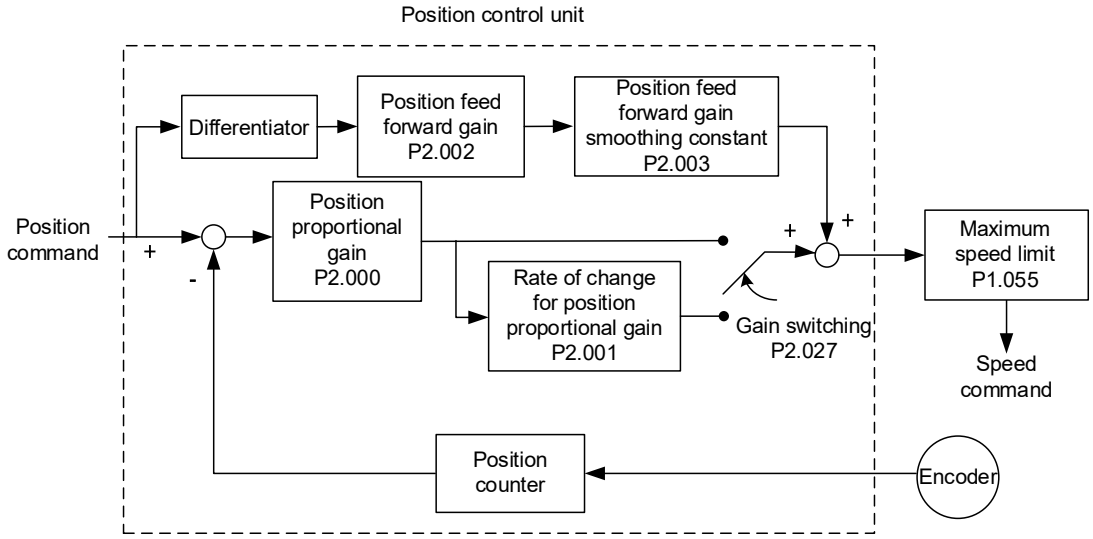
Before setting the position control unit, you have to manually set the speed control unit with P2.004 and P2.006 since a speed loop is included in the position loop. Then, set the position proportional gain (P2.000) and position feed forward gain (P2.002). The parameter description are as follows.

- P2.000 Position proportional gain (KPP): increasing this gain achieves a larger response bandwidth of position loop.
- P2.002 Position feed forward gain (PFG): increasing this gain reduces the deviation of phase delay.

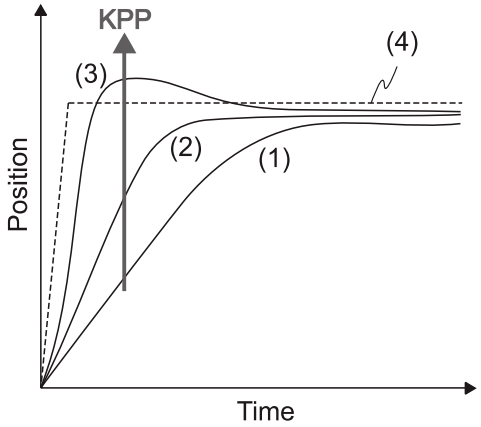
The position loop bandwidth (fp) should not be larger than the speed loop bandwidth (fv): $fp \leq \frac{fv}{4}$

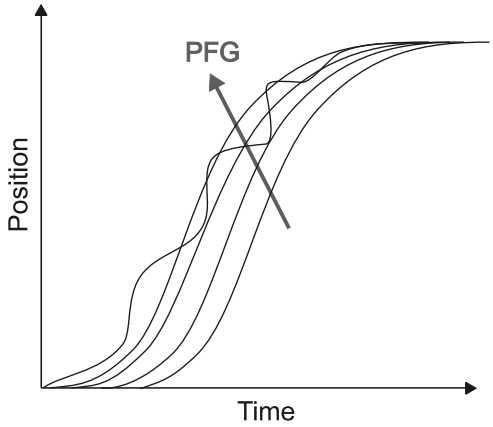
Calculation: $KPP = 2 \times \pi \times fp$

Example: if the desired position loop bandwidth is 20 Hz, set KPP to 125. ($2 \times \pi \times 20\ Hz = 125$)



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. This causes the rotor to rotate and vibrate in the forward and reverse directions; you have to decrease the KPP value until the rotor stops vibrating. However, when there is an external torque (e.g., a workpiece is added to the platform), a low value of KPP might not be able to reduce the position following error. In this case, increasing the value of PFG (P2.002) can effectively reduce the position following error.





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

6.2.8 Low-frequency vibration suppression in Position mode

If the machine is too flexible, vibration persists even when the motor stops after the positioning command is complete. The low-frequency vibration suppression function can reduce the machine vibration. The suppression range is between 1.0 Hz and 100.0 Hz. You can use this function with either auto or manual setting.

Auto setting

If you have difficulty finding the frequency, enable the auto low-frequency vibration suppression function (P1.029 = 1) to automatically search for the vibration frequency.

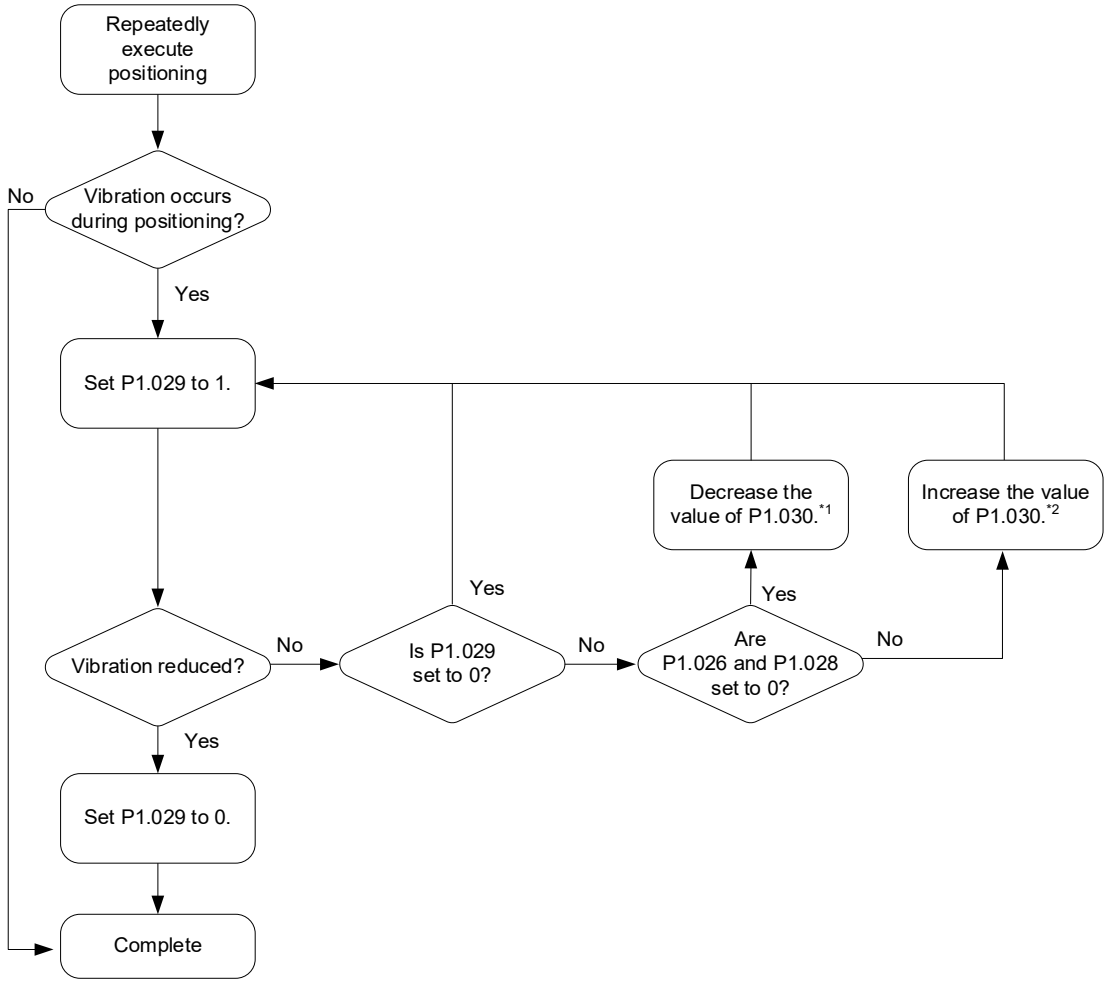
When you set P1.029 to 1, the system automatically disables the low-frequency vibration suppression function (P1.026 and P1.028 are set to 0) and starts to search for the frequency which causes low-frequency vibration. When the detected frequency remains at the same level, the system automatically changes the settings in the following order.

1. Automatically resets P1.029 to 0.
2. Sets P1.025 as the first frequency and P1.026 to 1.
3. Sets P1.027 as the second frequency and P1.028 to 1.

When P1.029 automatically resets to 0 and the low-frequency vibration still persists, check if either P1.026 or P1.028 is automatically set to 1. If so, increase the setting of P1.030 (Low-frequency vibration detection). If both P1.026 and P1.028 are 0, it means no frequency is detected. In this case, lower the value of P1.030 and set P1.029 to 1 to search for the vibration frequency again.

P1.030 sets the detection range for the peak-to-peak amplitude of low-frequency vibration. When the frequency is not detected, it is probably because the setting value of P1.030 is higher than the vibration of the machine. If so, it is suggested that you decrease the value of P1.030. Note that if the value is set too small, the system might mistakenly regard noises as the low-frequency vibrations. In this case, you can use the Scope function of ASDA-Soft and set the channel to **Position error (pulse)** to observe the peak-to-peak amplitude of the signal during positioning for setting P1.030.

Flowchart of auto low-frequency vibration suppression:



Note:
1. When both P1.026 and P1.028 are 0, it means no frequency is detected. It is probably because P1.030 is set too high so that the low-frequency vibration is not detected.
2. When the value of P1.026 or P1.028 is greater than 0, but the vibration persists, it is probably because P1.030 is set too low, causing the system to mistakenly regard minor frequency or noise as the low-frequency vibration.

Refer to Chapter 8 for detailed descriptions of the relevant parameters.

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

Manual setting

When the auto suppression procedure is complete, but the vibration persists, you can manually set P1.025 or P1.027 to suppress the vibration if you have identified the vibration frequency.

The low-frequency vibration suppression function provides two sets of low-frequency vibration suppression filters: parameters P1.025 - P1.026 and parameters P1.027 - P1.028. You can use two sets of parameters to reduce two different low-frequency vibrations.

Use P1.025 and P1.027 to set the frequencies for low-frequency vibration suppression. The filter function works only when the parameter setting is close to the actual vibration frequency.

Use 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 P1.026 and P1.028 are 0, which means the two filters are disabled by default.

Refer to Chapter 8 for detailed descriptions of the relevant parameters.

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

6.3 Speed mode

Before operation, respectively set the speed values in the three registers. Then, you can switch among the three sets of speed settings either by using DI.SPD0 and DI.SPD1 of CN1 or by communication. In order to deal with the problem of non-continuous speed when switching registers, you can use the S-curve acceleration and deceleration filter.

6.3.1 Selecting the Speed command source

The Speed command source is internal register (parameters). Select the command source with DI signals of CN1. See the following table for details.

<table>
<tr><th rowspan="2">Speed command number</th><th colspan="2">CN1 DI signal</th><th colspan="3" rowspan="2">Command source</th><th rowspan="2">Content</th></tr>
<tr><th>SPD1</th><th>SPD0</th></tr>
<tr><td>S1</td><td>0</td><td>0</td><td rowspan="2">Mode</td><td>S
Sz</td><td>N/A</td><td>Speed command is 0</td></tr>
<tr><td>S2</td><td>0</td><td>1</td><td colspan="3" rowspan="3">Internal register (parameter)</td><td>P1.009</td></tr>
<tr><td>S3</td><td>1</td><td>0</td><td>P1.010</td></tr>
<tr><td>S4</td><td>1</td><td>1</td><td>P1.011</td></tr>
</table>

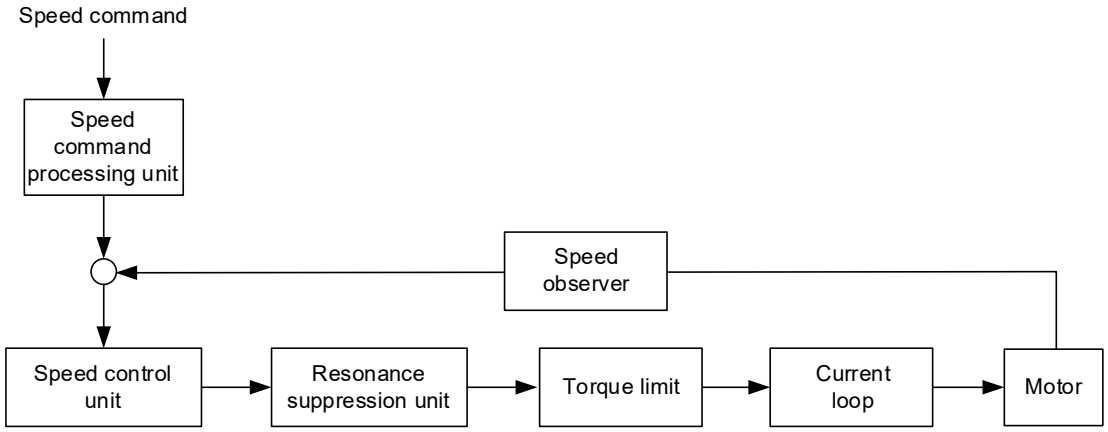
- Status of SPD0 and SPD1: 0 means that DI is Off (the circuit is open); 1 means that DI is On (the circuit is closed).
- When both SPD0 and SPD1 are 0, the command is 0.
- When either SPD0 or SPD1 is not 0, the internal parameters become the source for the Speed command. The command is activated once the status of SPD0 or SPD1 is switched. There is no need to use DI.CTRG for triggering.
- Rotation speed = setting value x unit (0.1 rpm).
  For example, if P1.009 = +30000, then rotation speed = +30000 x 0.1 rpm = +3000 rpm.

The Speed command can be used to control the speed in Speed mode (S or Sz) or limit the speed in Torque mode (T or Tz).

6

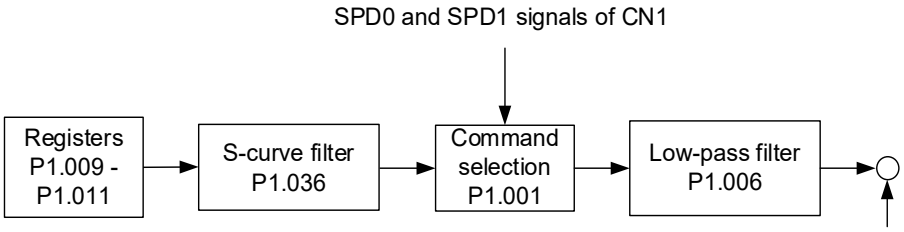
6.3.2 Control structure of Speed mode

The following diagram shows the basic control structure of Speed mode.



The Speed command processing unit selects the command source (see Section 6.3.1), including the S-curve filter (P1.036) 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 structure of Speed command processing unit is as follows.



The command from the internal register is selected with the status of SPD0 and SPD1, and P1.001 (S or Sz). In this condition, the S-curve and low-pass filters are applied to achieve a smoother response.

6.3.3 Smoothing the 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 profile. Using the S-curve filter avoids high jerks (rate of change of acceleration), mechanical resonance, and noise caused by abrupt changes in the speed input. You can use the following parameters for adjustment.

- P1.034 S-curve acceleration constant: adjusts the slope of the speed change during acceleration.
- P1.035 S-curve deceleration constant: adjusts the slope of the speed change during deceleration.
- P1.036 S-curve acceleration / deceleration constant: improves the stability of the motor when it starts and stops.

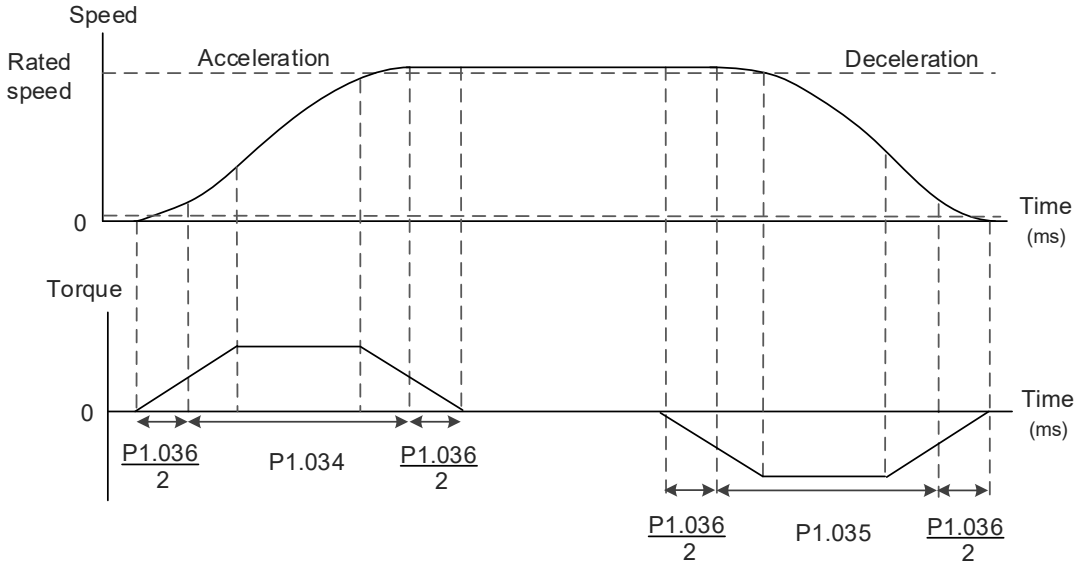
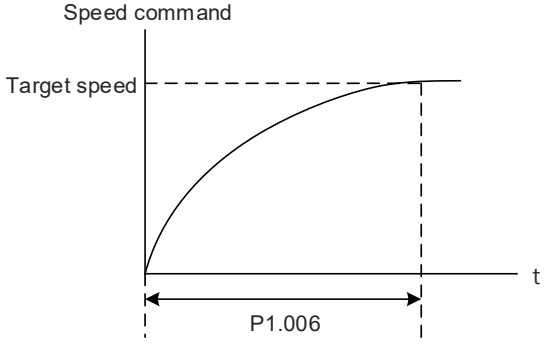


Figure 6.3.3.1 S-curve speed profile of Speed command and time setting

Low-pass filter for Speed commands

The low-pass filter for Speed commands is usually used to remove unwanted high-frequency response or noise so that the speed change is smoother.

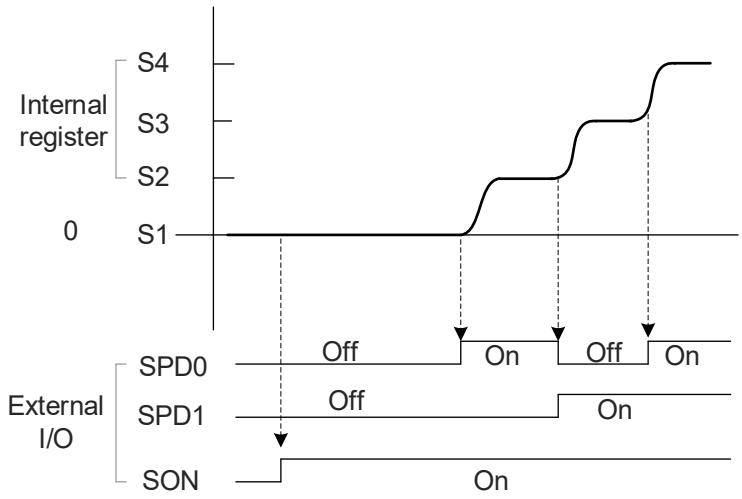


Refer to Chapter 8 for detailed descriptions of the relevant parameter.

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

6

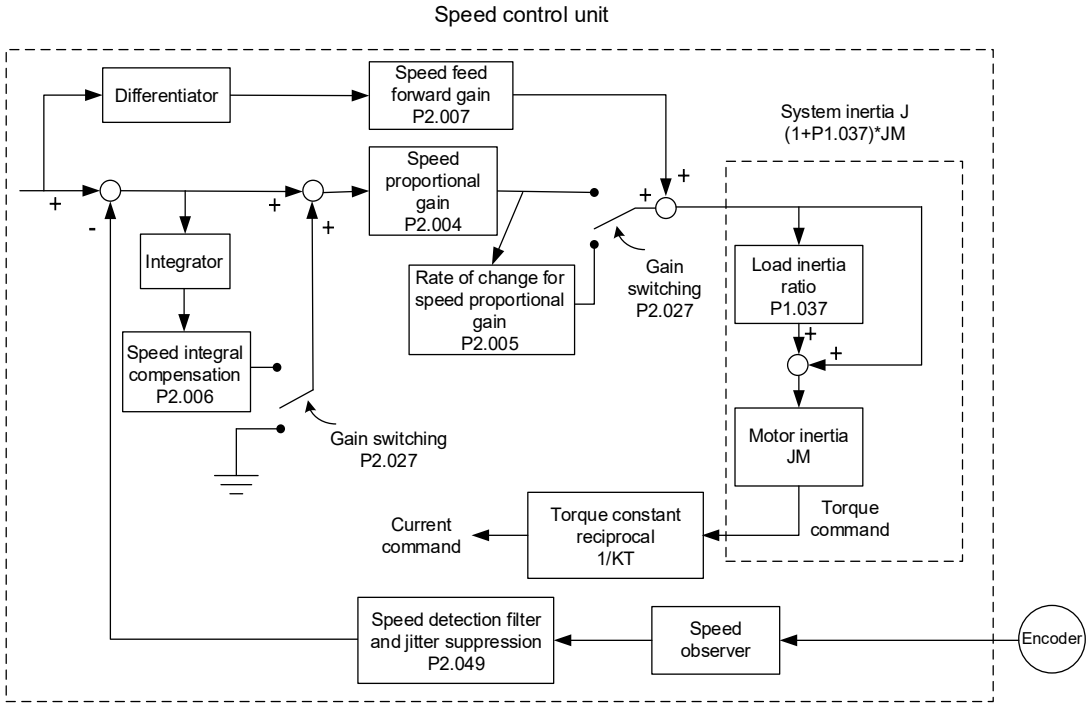
6.3.4 Timing diagram of Speed mode



Note:
1. “Off” means that DI is off (the circuit is open); “On” means that DI is on (the circuit is closed).
2. In the Servo On state, the command is selected according to the status of SPD0 and SPD1.

6.3.5 Gain adjustment of the speed loop

The structure of the speed control unit is shown in the following diagram.



In the speed control unit, you can adjust different types of gain manually or by using the multiple gain adjustment modes.

Gain adjustment mode

Refer to Section 5.2 Auto tuning for details.

Manual mode

Manually set the parameters with all auto or auxiliary functions disabled.

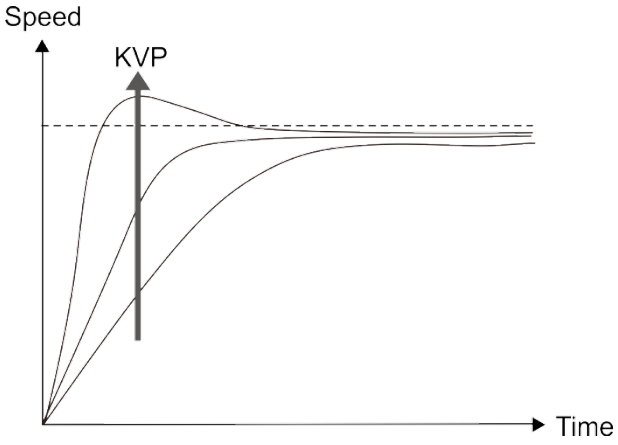
In Manual mode (P2.032 = 0), you can set the speed proportional gain (P2.004), speed integral compensation (P2.006), and speed feed forward gain (P2.007) for the speed loop. The parameter descriptions are as follows.

- P2.004 Speed proportional gain (KVP): increasing this gain achieves a larger response bandwidth of speed loop.
- P2.006 Speed integral compensation: (KVI): increasing this gain achieves a higher low frequency rigidity of speed loop and reduces the steady-state error. However, the phase margin becomes smaller. If you set this gain too high, it reduces the system stability.
- P2.007 Speed feed forward gain: (KVF): increasing this gain reduces the deviation of phase delay.

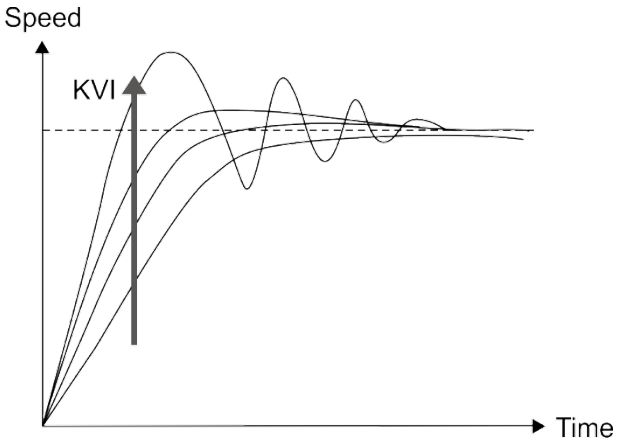
Here, the step response is used to illustrate the basic principles for speed proportional gain (KVP), speed integral compensation (KVI), and speed feed forward gain (KVF). Refer to the following examples.

6

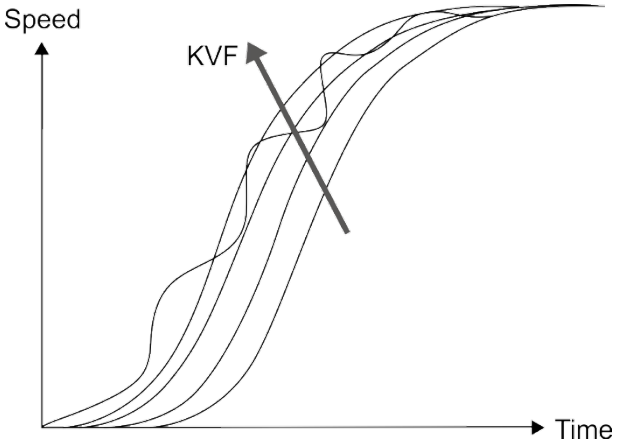
Time domain



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



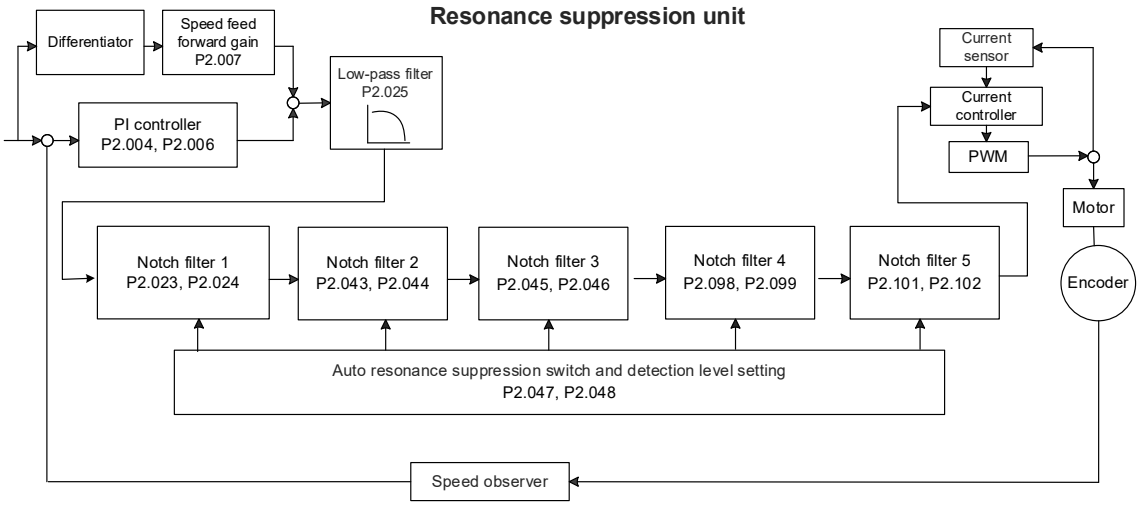
The higher the KVI value, the larger the low-frequency gain. It shortens the time for the steady-state error to reduce to zero but reduces the phase margin. However, it does not significantly reduce the following error.



The closer the KVF value is to 1, the more complete the forward compensation.
The following error becomes very small. However, setting the KVF value too high causes vibration.

6.3.6 Resonance suppression unit

When resonance occurs, it is probably because the stiffness of the control system is too high or the response bandwidth is too great. Eliminating these two factors can improve the situation. You can use the low-pass filter (P2.025) and Notch filters (P2.023, P2.024, P2.043 - P2.046, and P2.095 - P2.103) to suppress the resonance with the control parameters remain unchanged.



Refer to Chapter 8 for detailed descriptions of the relevant parameters.

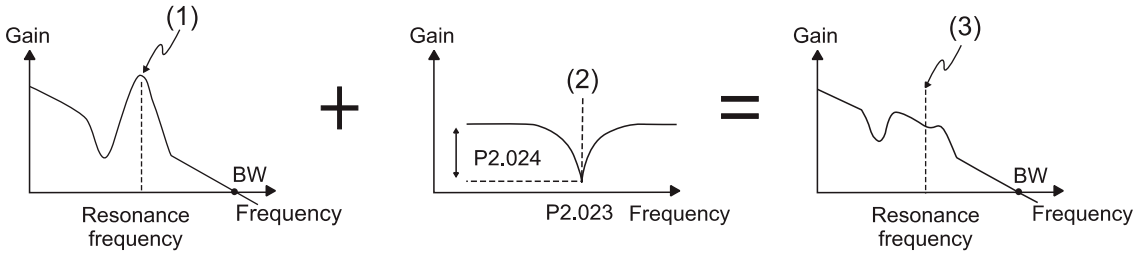
Parameter	Function
P2.023	Notch filter 1 - frequency
P2.024	Notch filter 1 - attenuation level
P2.025	Resonance suppression low-pass filter
P2.043	Notch filter 2 - frequency
P2.044	Notch filter 2 - attenuation level
P2.045	Notch filter 3 - frequency
P2.046	Notch filter 3 - attenuation level
P2.095	Notch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

The servo drive provides two filters, the Notch filter and the low-pass filter, for suppressing the resonance. See the following diagrams for the effects of these filters.

System open-loop gain with resonance:

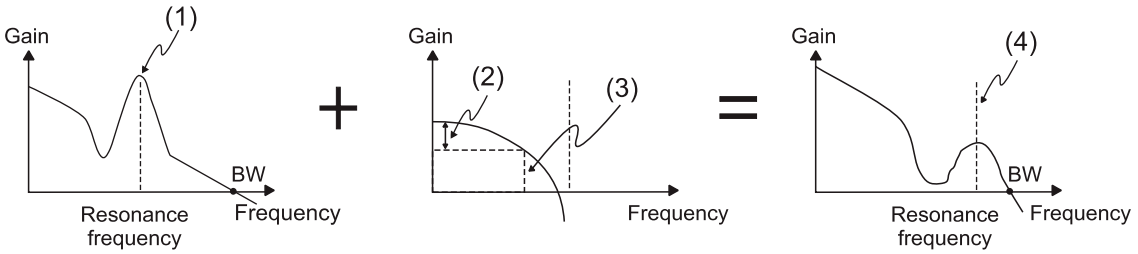
6

■ Notch filter



(1) Resonance point; (2) Notch filter; (3) Resonance point suppressed by the Notch filter

■ Low-pass filter



(1) Resonance point; (2) Attenuation level (-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 (Low-pass filter) from 0, the bandwidth (BW) becomes smaller. Although it solves the problem of resonance, it also reduces the response bandwidth and phase margin, making the system unstable.

If knowing 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. The frequency setting range for the Notch filter is 50 - 5000 Hz and the attenuation level is 0 - 40 dB. If the resonance frequency drifts significantly with time or due to other causes, using the low-pass filter to reduce the resonance is suggested.

6.4 Torque mode

Torque control mode is suitable for torque control applications, such as printing machines and winding machines. Respectively set the torque values in the three registers (P1.012 - P1.014). Then, you can switch among the three sets of torque settings by using DI.TCM0 (0x16) and DI.TCM1 (0x17).

6.4.1 Selecting the Torque command source

The Torque command source is internal register (parameters). Select the command source with DI signals of CN1. See the following table for details.

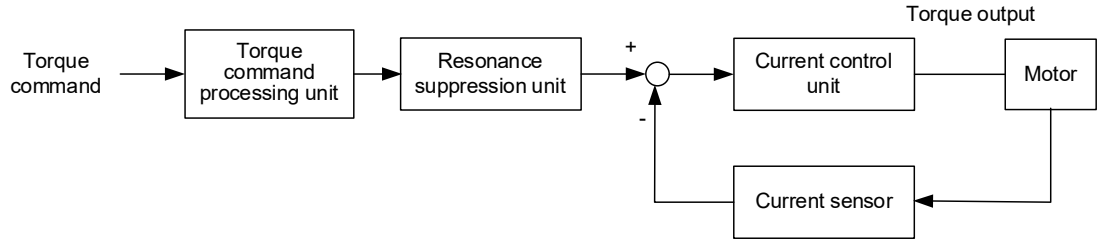
Torque command number	CN1 DI signal		Command source			Content
	TCM1	TCM0				
T1	0	0	Mode	T Tz	N/A	Torque command is 0
T2	0	1	Internal register (parameter)			P1.012
T3	1	0				P1.013
T4	1	1				P1.014

- Status of TCM0 and TCM1: 0 means that DI is off (the circuit is open); 1 means that DI is on (the circuit is closed).
- When both TCM0 and TCM1 are 0, the command is 0.
- When either TCM0 or TCM1 is not 0, the internal parameters become the source for the Torque command. The command is activated once the status of TCM0 or TCM1 is switched. There is no need to use DI.CTRG for triggering.

The Torque command can be used to control the torque in Torque mode (T or Tz) or limit the torque in Speed mode (S or Sz).

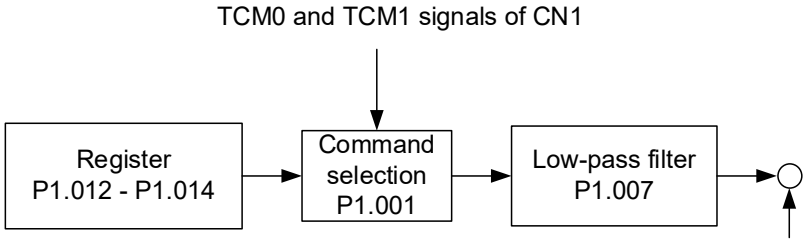
6.4.2 Control structure of Torque mode

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



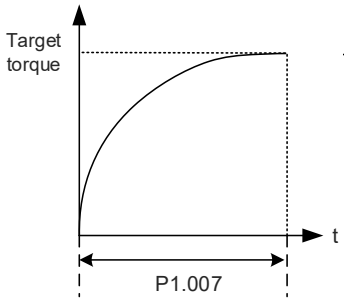
The Torque command processing unit selects the command source (see Section 6.4.1). The current control unit controls the gain parameters of the servo drive and calculates the current for servo motor in real time.

The structure of Torque command processing unit is as follows.



The command from the internal register is selected with the status of TCM0 and TCM1, and P1.001 (T or Tz). In this condition, the low-pass filter is applied to achieve a smoother response.

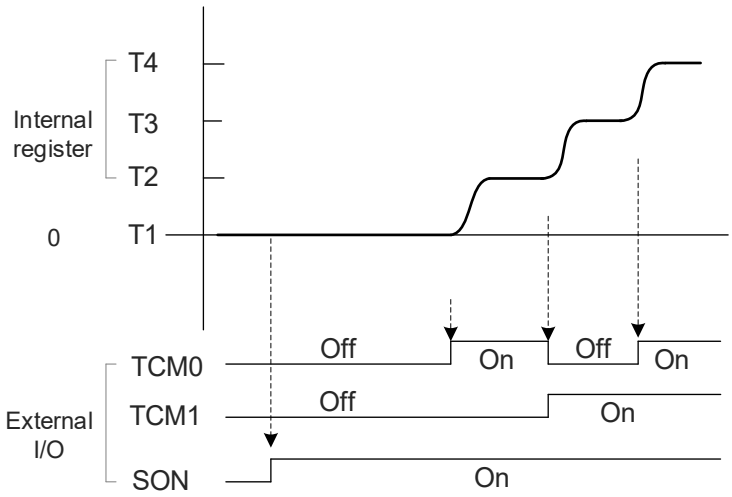
6.4.3 Smoothing the Torque command



Refer to Chapter 8 for detailed descriptions of the relevant parameter.

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

6.4.4 Timing diagram of Torque mode



Note:
1. “Off” means that DI is off (the circuit is open); “On” means that DI is on (the circuit is closed).
2. In the Servo On state, the command is selected according to the status of TCM0 and TCM1.

6.5 Dual-mode operations

Apart from the single modes for position, speed, and torque control, there are also dual-mode operations available (see Section 6.1).

6

Mode	Short name	Code	Description
Dual mode	S-PR	08	Switch S and PR modes with DI.S-P.
	T-PR	09	Switch T and PR modes with DI.T-P.
	S-T	0A	Switch S and T modes with DI.S-T.

Refer to Section 3.3.2 for the table of default DI/DO functions.

6.5.1 Speed / Position dual mode

For the Speed / Position dual mode (S-PR), the Position command source is the internal parameters P6.000 - P7.099, and the Speed command source is the internal parameters P1.009 - P1.011. The switch between Speed and Position modes is controlled by DI.S-P (0x18). Refer to the following timing diagram.

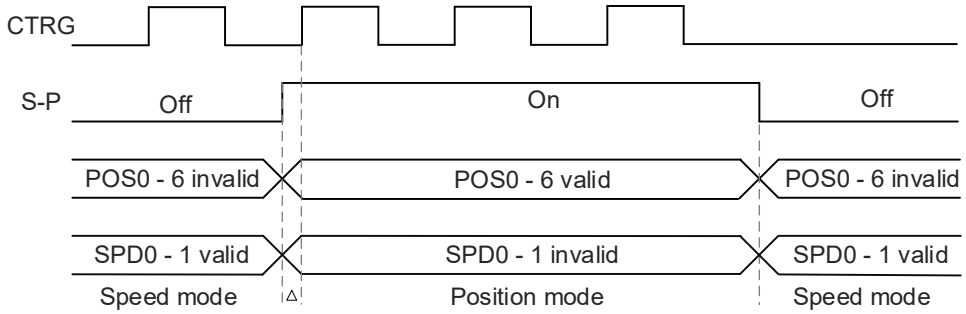


Figure 6.5.1.1 Speed / Position dual mode

In Speed mode (DI.S-P is Off), you select the Speed command with DI.SPD0 and DI.SPD1, and DI.CTRG is not applicable. When the mode is switched to Position mode (DI.S-P is On), since the Position command has not been issued (it waits for the rising edge of DI.CTRG), the motor stops (indicated by △ in the preceding figure). The Position command is selected with DI.POS0 - DI.POS6 when the rising edge of DI.CTRG is triggered, and then the motor operates to the specified position. When DI.S-P is Off, the drive returns to the Speed mode. Refer to the introduction section of each single mode for the DI signals and the selected commands.

6.5.2 Speed / Torque dual mode

For the Speed / Torque dual mode (S-T), the Speed command source is the internal parameters P1.009 - P1.011, which you select with DI.SPD0 and DI.SPD1. The Torque command source is the internal parameters P1.012 - P1.014, which you select with DI.TCM0 and DI.TCM1. The switch between Speed and Torque modes is controlled by DI.S-T (0x19). Refer to the following timing diagram.

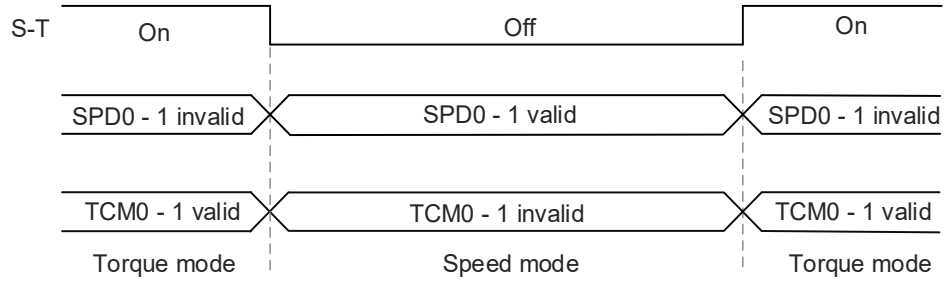


Figure 6.5.2.1 Speed / Torque dual mode

In Torque mode (DI.S-T is On), you select the Torque command with DI.TCM0 and DI.TCM1. When the mode is switched to Speed mode (DI.S-T is Off), you select the Speed command with DI.SPD0 and DI.SPD1, and then the motor operates according to the Speed command. When DI.S-T is On, the drive returns to the Torque mode. Refer to the introduction section of each single mode for the DI signals and the selected commands.

6.5.3 Torque / Position dual mode

For the Torque / Position dual mode (T-PR), the Position command source is the internal parameters P6.000 - P7.099, and the Torque command source is the internal parameters P1.012 - P1.014. The switch between Torque and Position modes is controlled by DI.T-P (0x20). Refer to the following timing diagram.

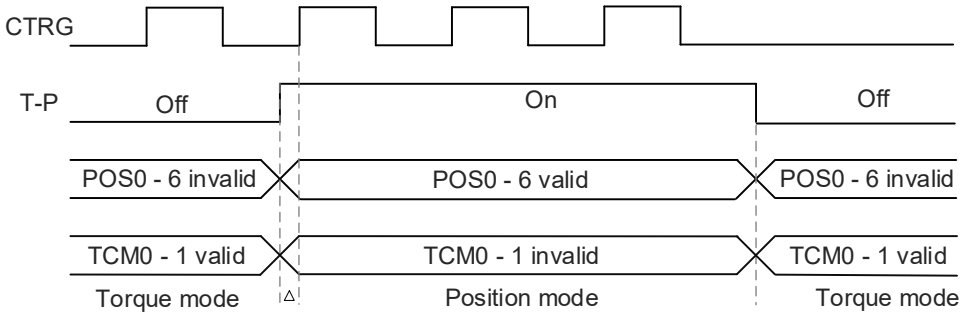


Figure 6.5.3.1 Torque / Position dual mode

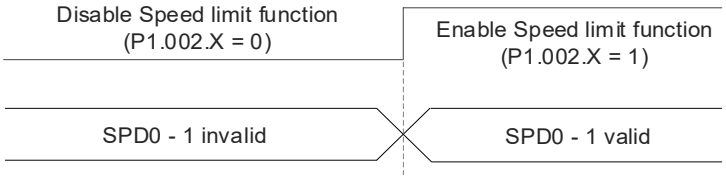
In Torque mode (DI.T-P is Off), you select the Torque command with DI.TCM0 and DI.TCM1, and DI.CTRG is not applicable. When the mode is switched to Position mode (DI.T-P is On), since the Position command has not been issued (it waits for the rising edge of DI.CTRG), the motor stops (indicated by △ in the preceding figure). The Position command is selected with DI.POS0 - DI.POS6 when the rising edge of DI.CTRG is triggered, and then the motor operates to the specified position. When DI.T-P is Off, the drive returns to the Torque mode. Refer to the introduction section of each single mode for the DI signals and the selected commands.

6.6 Others

6.6.1 Applying the speed limit

The maximum motor speed in each mode (Position, Speed, or Torque mode) is determined by the internal parameter P1.055. The sources for Speed limit command and Speed command are the same, which are the internal parameters P1.009 - P1.011. Refer to Section 6.3.1 for details.

The Speed limit command is applicable only in Torque mode for limiting the motor speed. When you set P1.002.X (disable / enable Speed limit function) to 1, the Speed limit function is enabled. The timing diagram is shown as follows.

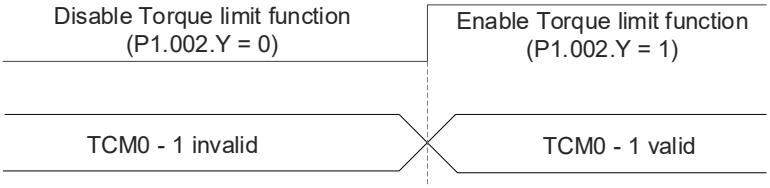


Source selection for Speed limit command

6.6.2 Applying the torque limit

The sources for Torque limit command and Torque command are the same, which are the internal parameters P1.012 - P1.014. Refer to Section 6.4.1 for details.

The Torque limit command is applicable in Position mode (PR) or Speed mode for limiting the motor torque output. When you set P1.002.Y (disable / enable Torque limit function) to 1, the Torque limit function is enabled. The timing diagram is shown as follows.



Source selection for Torque limit command

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7 Motion Control

This chapter introduces internal motion commands of the servo drive in PR mode. In this mode, motion commands are generated based on the internal command of the servo drive. Various motion commands are available, including Homing, Speed, Position, Jump, Write, and Rotary Axis Position commands. This chapter contains detailed description of each command type.

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7.1 PR mode description

In PR mode, the servo drive automatically generates the motion commands and saves all settings in the servo drive parameter file. Thus, changing parameter settings simultaneously changes the contents of PR paths. The servo drive provides 100 sets of PR path settings, which include homing methods, Speed command, Position command, Jump command, Write command, and Rotary Axis Position (Index Position) command.

The property and corresponding data content for each PR path are set by parameters. You can find information of all PR parameters in the descriptions for parameter groups 6 and 7 in Chapter 8. For example, PR#01 is defined by parameters P6.002 and P6.003. P6.002 specifies the property of PR#01, such as the PR command type, whether to interrupt, and whether to auto-execute the next PR path. The definition of P6.003 is subject to change based on the property set in P6.002. When 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 path. PR#02 is defined by parameters 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 the PR paths. See Figure 7.1.1.

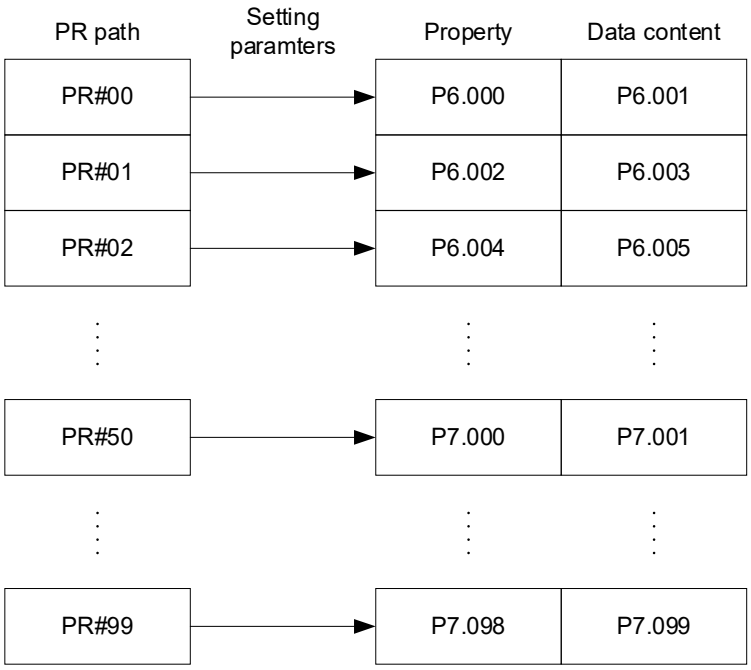


Figure 7.1.1 Setting parameters for each PR path

In ASDA-Soft, when you select a PR path to edit in PR mode, the setting parameters appear at the top of the window. See Figure 7.1.2. If you select PR#01, the settings of P6.002 and P6.003 appear at the top of the editing section. Table 7.1.1 shows that the path property and data content differ based on the motion command type with P6.002 and P6.003 as the example. For more information about Motion Control commands, refer to Section 7.1.3.

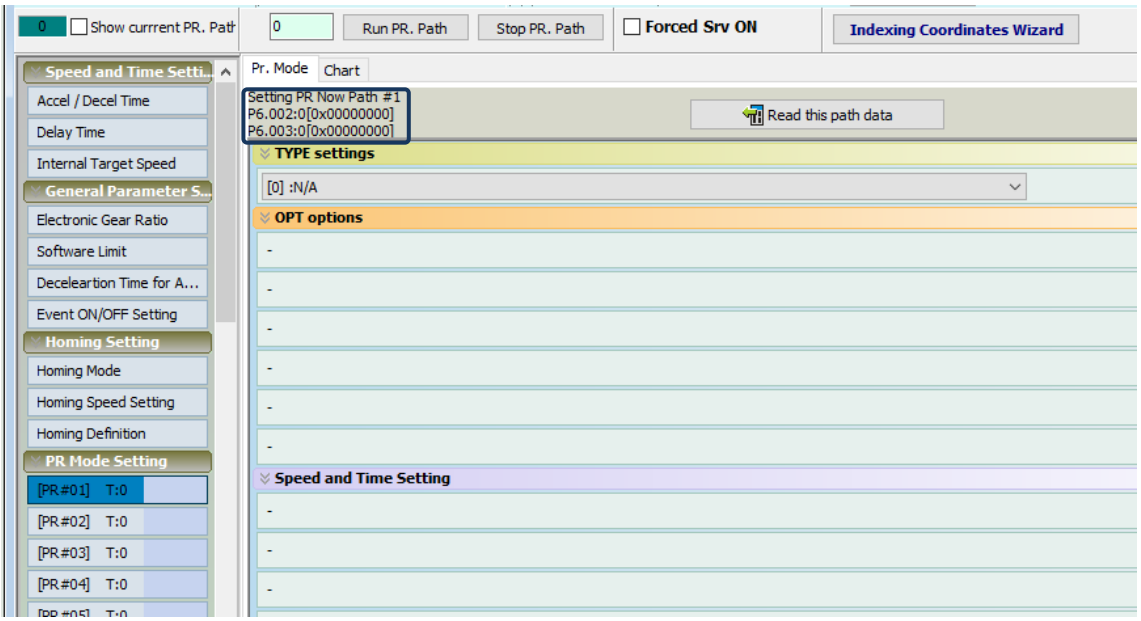


Figure 7.1.2 PR Mode Setting screen in ASDA-Soft

Table 7.1.1 Example of PR#01 property and data content

Bit / PR#01	31 - 28	27 - 24	23 - 20	19 - 16	15 - 12	11 - 8	7 - 4	3 - 0
P6.002	-	AUTO	DLY	SPD	DEC	ACC	OPT	TYPE
P6.003	Data content (32-bit)							

Note:
TYPE: path type

TYPE settings	Path type
1	SPEED, constant speed control
2	SINGLE, positioning control. The execution stops once the positioning is complete.
3	AUTO, positioning control. The next PR path is automatically loaded once the positioning is complete.
7	JUMP, jump to the specified path.
8	WRITE, write specified parameters to specified path.
A	INDEX, rotary axis position control (index position control)

ASDA-Soft provides a graphical interface for easier PR path editing, including the options of command triggering, command types, and other properties.

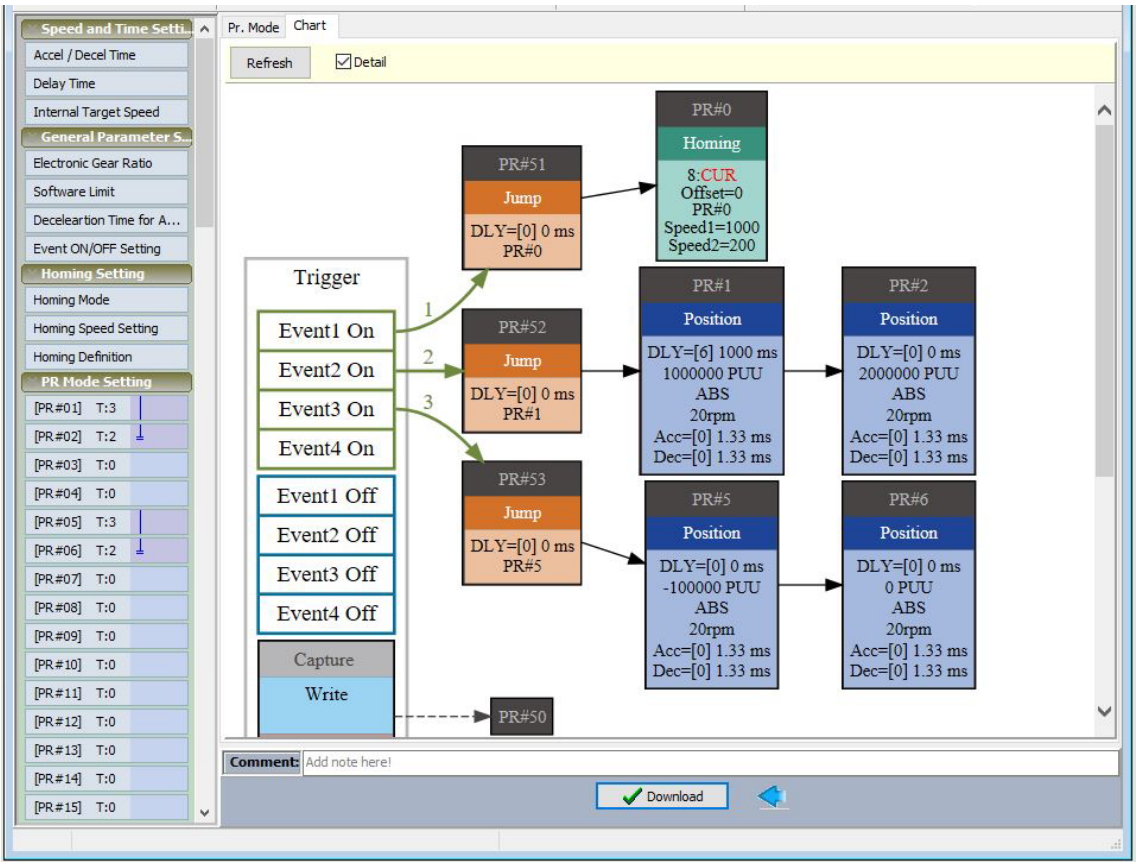
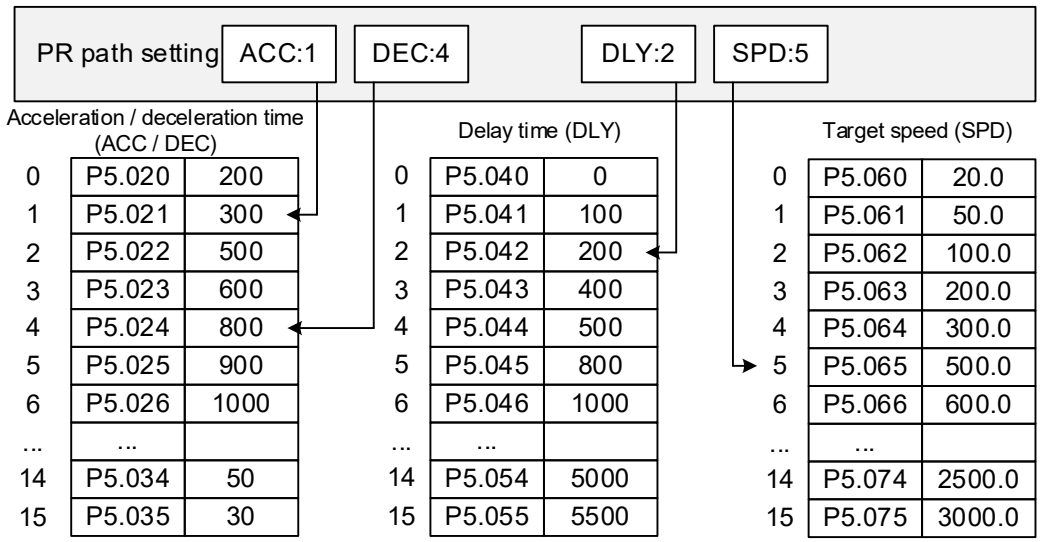


Figure 7.1.3 Graphical interface for PR paths in ASDA-Soft

7.1.1 Shared parameters for PR paths

The servo drive provides 16 sets of acceleration / deceleration time settings (P5.020 - P5.035), 16 sets of delay time settings (P5.040 - P5.055), and 16 sets of target speed settings (P5.060 - P5.075) for you to use when setting 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. For example, if multiple PR paths use the setting of P5.060 as the target speed, when you change the setting of P5.060, the target speed settings of those PR paths are changed as well. Be aware of this when setting the PR paths so as to avoid any danger or damage to the machine.

The **PR Mode Setting** function in ASDA-Soft provides a user-friendly screen for setting the shared parameters (see Figure 7.1.1.2). Among the data, the acceleration / deceleration time indicates the time duration required for the motor to accelerate from 0 to 3000 rpm or to decelerate from 3000 rpm to 0. For instance, when the acceleration time is set to 50 ms, the required acceleration time is 50 ms if the target speed for the motion command is 3000 rpm, and the required acceleration time is 25 ms if the target speed for the motion command is 1500 rpm. The acceleration / deceleration time setting is like a fixed slope, which does not change when you change the target speed settings.



0	P5.020	200	0	P5.040	0	0	P5.060	20.0
1	P5.021	300	1	P5.041	100	1	P5.061	50.0
2	P5.022	500	2	P5.042	200	2	P5.062	100.0
3	P5.023	600	3	P5.043	400	3	P5.063	200.0
4	P5.024	800	4	P5.044	500	4	P5.064	300.0
5	P5.025	900	5	P5.045	800	5	P5.065	500.0
6	P5.026	1000	6	P5.046	1000	6	P5.066	600.0
...	...		...	...		...	...	
14	P5.034	50	14	P5.054	5000	14	P5.074	2500.0
15	P5.035	30	15	P5.055	5500	15	P5.075	3000.0

Figure 7.1.1.1 Shared parameter data for PR paths

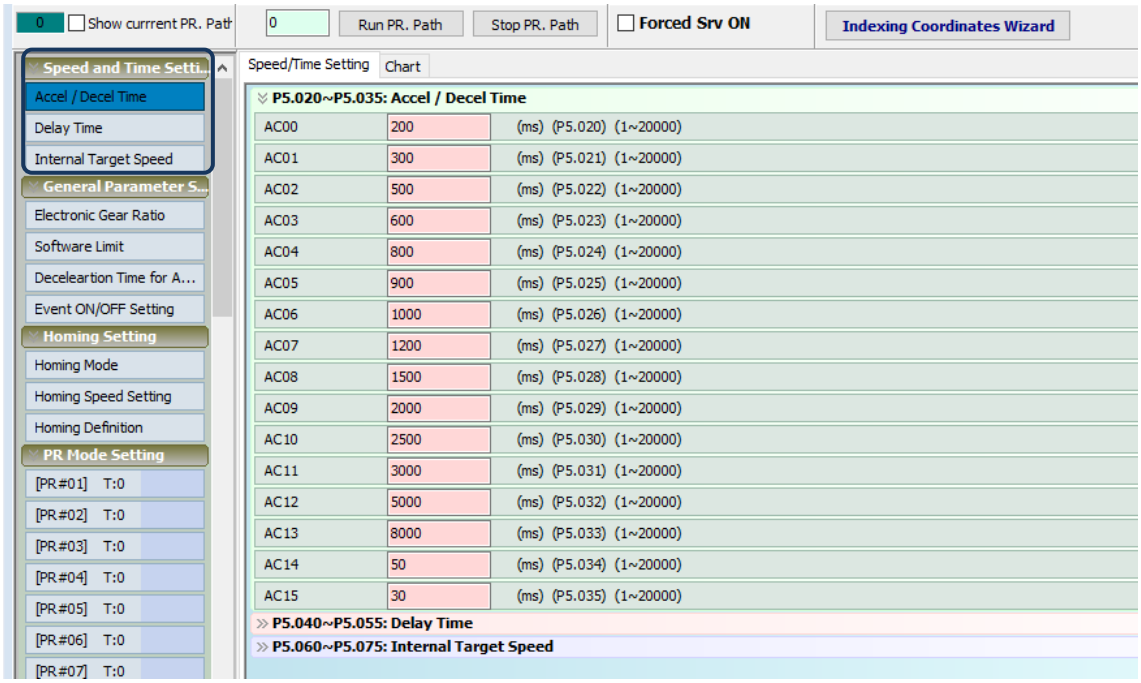


Figure 7.1.1.2 Setting screen of shared parameter data for PR paths in ASDA-Soft

7.1.2 Monitoring variables for PR mode

In PR mode, you can use the four monitoring variables to monitor the servo commands and feedback status: Position command (PUU), Register of PR command endpoint, Position feedback (PUU), and Following error (PUU). These are described as follows:

1. Position command (PUU): monitoring variable code 001, simplified as Cmd_O (Command Operation). This is the motion command generated during servo operation (updated every millisecond), which indicates the target position per scan cycle.
2. Register of PR command endpoint: monitoring variable code 064, simplified as Cmd_E (Command End). This is the target position of a PR position command. When a command is triggered, the servo drive calculates the target position and then updates this register.
3. Position feedback (PUU): monitoring variable code 000, simplified as Fb_PUU (Feedback PUU). This is the current position feedback of the motor encoder.
4. Following error (PUU): monitoring variable code 002, simplified as Err_PUU (Error PUU). This is the difference between Position command (PUU) and Position feedback (PUU).

How these four monitoring variables work is shown in Figure 7.1.2.1. After issuing 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 according to the PR path setting. Cmd_O is a dynamic command which calculates the amount of command difference in each fixed scan cycle and sends it to the servo drive. Fb_PUU is the motor encoder position feedback and Err_PUU is the position difference calculated by subtracting Fb_PUU from Cmd_O.

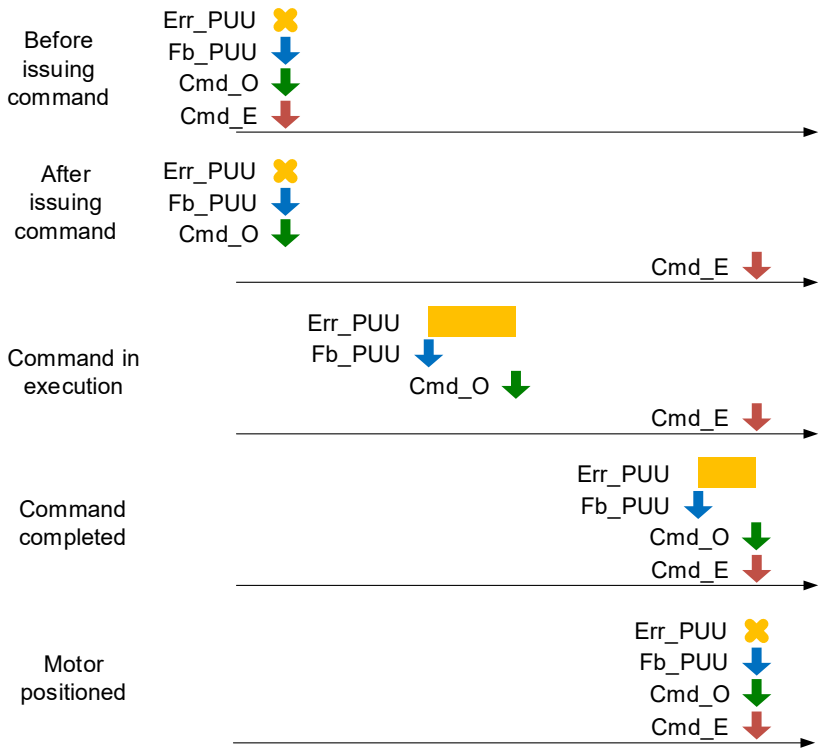


Figure 7.1.2.1 Timing diagram for monitoring variables in PR mode

The behavior of the servo drive during command execution is detailed in Figure 7.1.2.2. Cmd_E is the command endpoint that is set when the PR path is triggered. Fb_PUU is the position feedback, which is motor's actual position. Here we divide this motion command into scan cycles and take one of the cycles as the example. Cmd_O is the command target of this cycle and Err_PUU is the difference between the command target and the position feedback of this cycle.

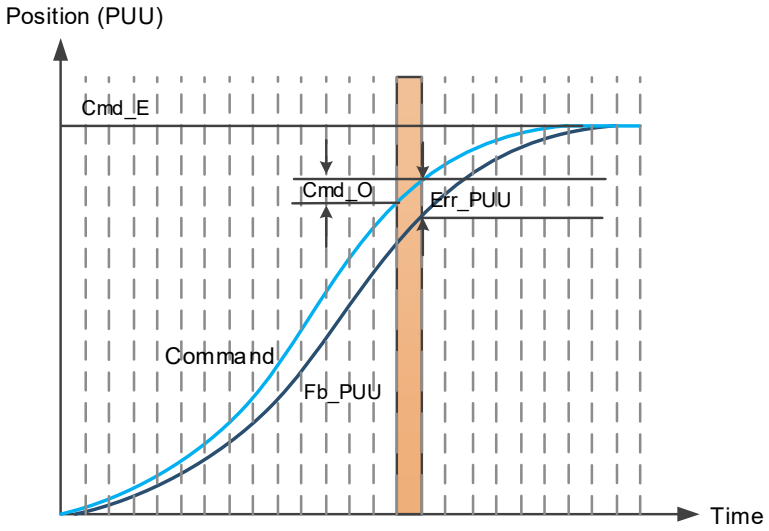


Figure 7.1.2.2 Monitoring variables during command execution in PR mode

You can use digital inputs (DIs) to call PR paths and digital outputs (DOs) to monitor PR paths (refer to Tables 8.1 and 8.2 in Chapter 8 for the DI/O function descriptions). When you trigger a PR path with DI.CTRG (0x08), the servo drive operates according to the command from the internal registers. Once the command is complete, DO.Cmd_OK (0x15) is set to On. When the motor reaches the target position, DO.TPOS (0x05) is set to On. When both DO.Cmd_OK (0x15) and DO.TPOS (0x05) are On, the servo sets DO.MC_OK (0x17) to On to signify that it has completed this PR path. The operation is as shown in Figure 7.1.2.3.

If you have set a delay time in this PR path, when the motor reaches the target position, DO.TPOS (0x05) is set to On. After the delay time is over, DO.Cmd_OK (0x15) is set to On. When both of the DO signals are On, the servo sets DO.MC_OK (0x17) to On to signify that it has completed this PR path. The operation is as shown in Figure 7.1.2.4.

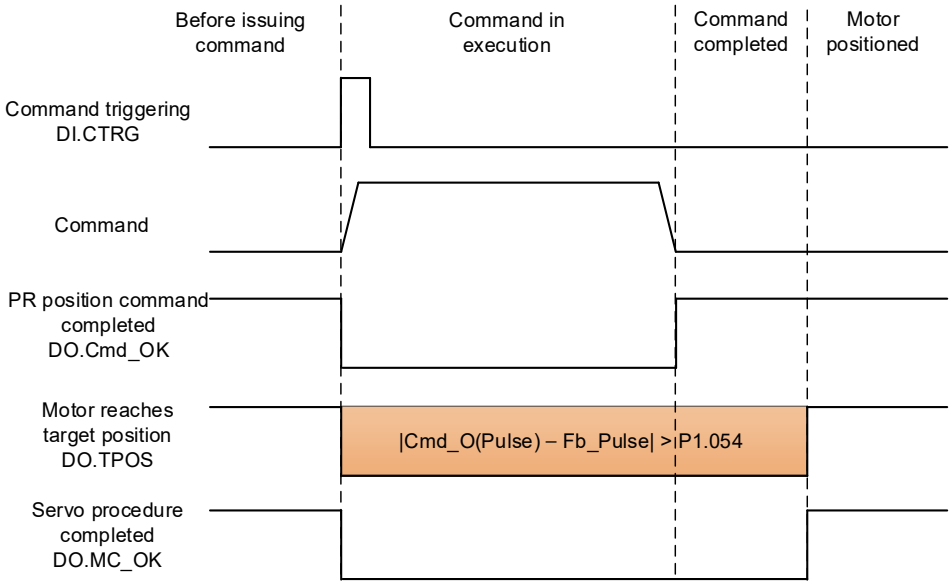


Figure 7.1.2.3 Operation of DI/DO signals in PR mode

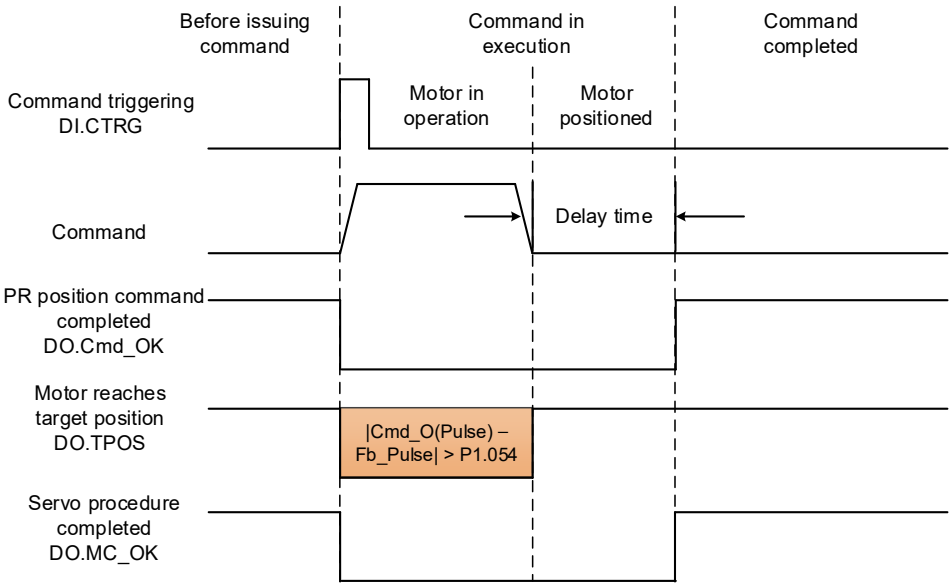


Figure 7.1.2.4 Operation of DI/DO signals in PR mode (including delay time)

7.1.3 Motion Control commands

The servo drive provides 100 sets of PR path settings, and each set can be a Homing command, Speed command, Position command, Jump command, Write command, or Rotary Axis Position (Index Position) command. The following sections detail each command type.

7.1.3.1 Homing command

The servo drive provides 11 homing methods in the PR mode, including referring to the home sensor, limit, and hard stop as the reference origin. They come with sub-options such as whether to refer to the Z pulse and the behavior when reaching the positive / negative limit signal, with more than 30 combinations available. The homing method is specified by P5.004 and the homing definition is determined by P6.000. The following lists the function of each bit.

P5.004	**Homing methods**		**Address: 0508H 0509H**
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 to 0x012A
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Definition of each setting value:

U	Z	Y	X
Reserved	Limit setting	Z pulse setting	Homing method
-	0 to 1	0 to 2	0 to A
	-	Y = 0: reverse to Z pulse Y = 1: go forward to Z pulse Y = 2: do not look for Z pulse	X = 0: homing in forward direction and define the positive limit as the homing origin
			X = 1: homing in reverse direction and define the negative limit as the homing origin
	When reaching the limit: Z = 0: show error Z = 1: reverse direction		X = 2: homing in forward direction, ORG: OFF→ON as the homing origin
			X = 3: homing in reverse direction, ORG: OFF→ON as the homing origin
		-	X = 4: look for Z pulse in forward direction and define it as the homing origin
			X = 5: look for Z pulse in reverse direction and define it as the homing origin
		Y = 0: reverse to Z pulse Y = 1: go forward to Z pulse Y = 2: do not look for Z pulse	X = 6: homing in forward direction, ORG: ON→OFF as the homing origin
			X = 7: homing in reverse direction, ORG: ON→OFF as the homing origin
	-	-	X = 8: define current position as the origin
	When reaching the limit: Z = 0: show error Z = 1: reverse direction	Y = 0: reverse to Z pulse Y = 2: do not look for Z pulse	X = 9: torque homing in forward direction
			X = A: torque homing in reverse direction

P6.000	Homing definition		Address: 0600H 0601H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 to 0xFFFFFF6F
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

7

Settings:

High word

D C B A

Low word

U Z YX

A	DEC2: deceleration time selection for second homing	YX	PATH: path type
B	DLY: select 0 - F for delay time	Z	ACC: select 0 - F for acceleration time
C	Reserved	U	DEC1: deceleration time selection for first homing
D	BOOT: whether to execute homing automatically when the drive is powered on	-	-

- YX: PATH: path type

  0x00: Stop: the servo stops after homing is complete

  0x01 - 0x63: Auto: the servo executes the specified path (PR#01 - PR#99) after homing is complete

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

  0 - F: correspond to P5.020 - P5.035

- U: DEC1: deceleration time selection for first homing

  0 - F: correspond to P5.020 - P5.035

- A: DEC2: deceleration time selection for second homing

  0 - F: correspond to P5.020 - P5.035

- B: DLY: select 0 - F for delay time

  0 - F: correspond to P5.040 - P5.055

- D: BOOT: whether to execute homing automatically when the drive is powered on

  0: do not execute homing

  1: execute homing automatically (servo switches to On for the first time after power is applied)

The PR Homing mode includes the function for setting the origin offset. You can define any point in the position system as the reference origin, which does not have to be 0. Once you define the reference origin, the position system of the motion axis can be established.

See Figure 7.1.3.1.1. The position of the reference origin is 2000 (P6.001 = 2000). The motor passes by the reference origin and then stops at the position of 1477. According to the position system that it established, the system automatically calculates the position of 0 (origin). Then the motor can move to any specified position as soon as a PR path is issued.

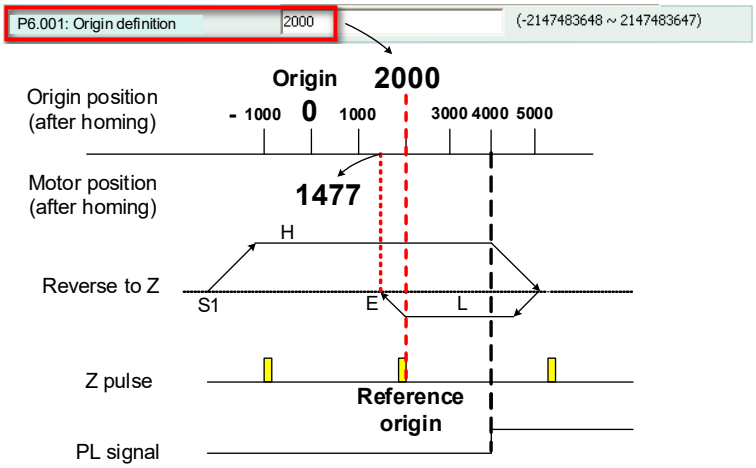


Figure 7.1.3.1.1 Origin definition

P6.001	Origin definition		Address: 0602H 0603H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Origin definition.

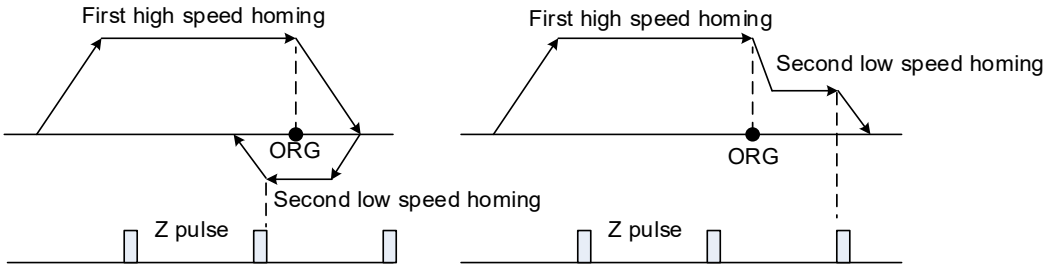
7

The homing procedure goes through two stages: high speed and low speed. The servo starts the homing procedure at high speed to seek the reference point (such as the limit switch or ORG signal), which takes shorter time. Once the servo detects the reference point, the motor runs at low speed to find the reference point (such as the Z pulse) accurately. 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	0.1 rpm	-	-
Setting range:	0.1 to 2000.0	1 to 20000	-	-
Format:	DEC	DEC	-	-
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

The first speed setting for high speed homing.



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	0.1 rpm	-	-
Setting range:	0.1 to 500.0	1 to 5000	-	-
Format:	DEC	DEC	-	-
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

The second speed setting for low speed homing.

You can set the homing parameters in the PR mode **Homing Setting** screen in ASDA-Soft, including the Homing Mode, Homing Speed Setting, and Homing Definition (see Figure 7.1.3.1.2).

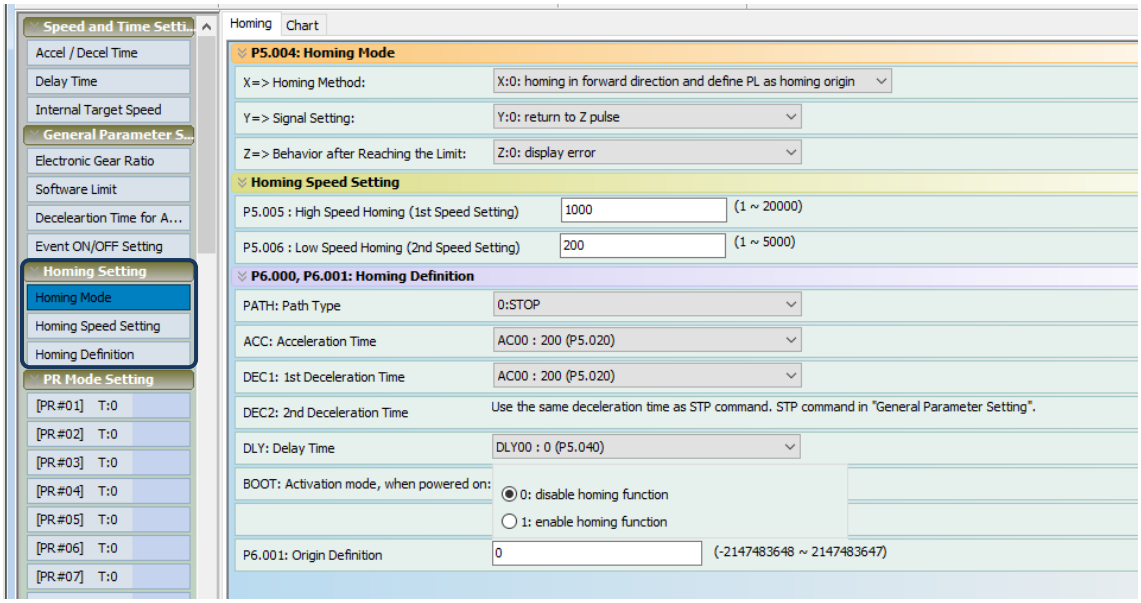
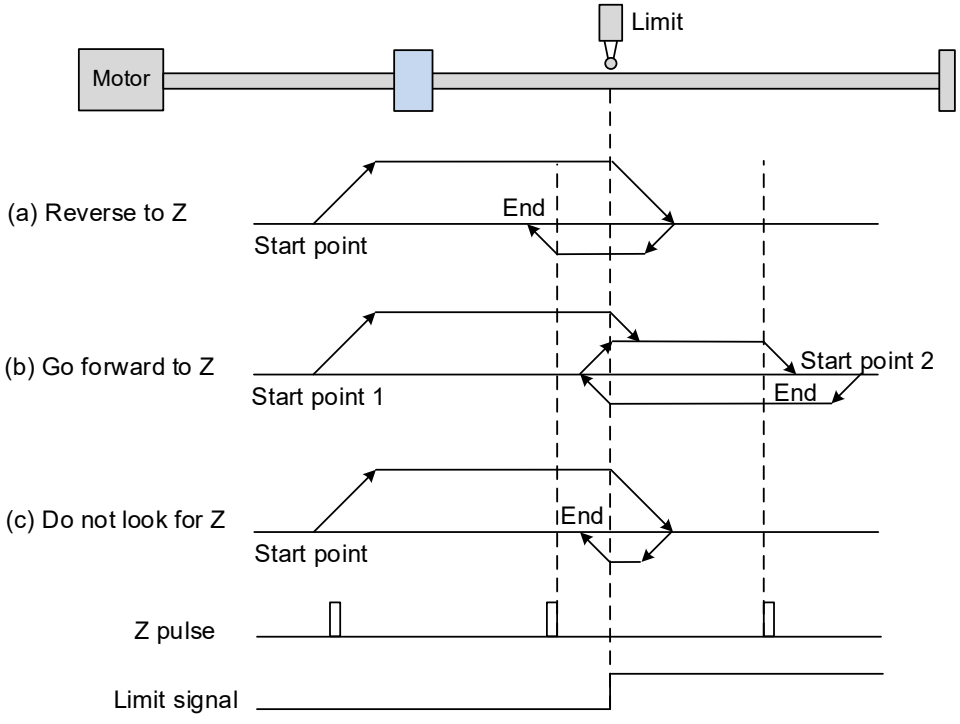


Figure 7.1.3.1.2 Homing Setting screen in ASDA-Soft

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

1. Referencing the limit.

   This method uses the positive or negative limit as the reference point. You can set whether or not to look for the Z pulse and use it as the reference origin after the limit is detected. The searching result is the same regardless of where the start point is. The servo drive always looks for the set reference point to reset the motor position.



(a) If you set the servo to look for the Z pulse in the reverse direction, the servo operates at high speed (first speed setting) then decelerates once reaching the limit (rising-edge triggered). Then the servo switches to low speed (second speed setting) to look for the Z pulse in the reverse direction. When the servo finds the Z pulse, it decelerates to a stop, completing the homing procedure.

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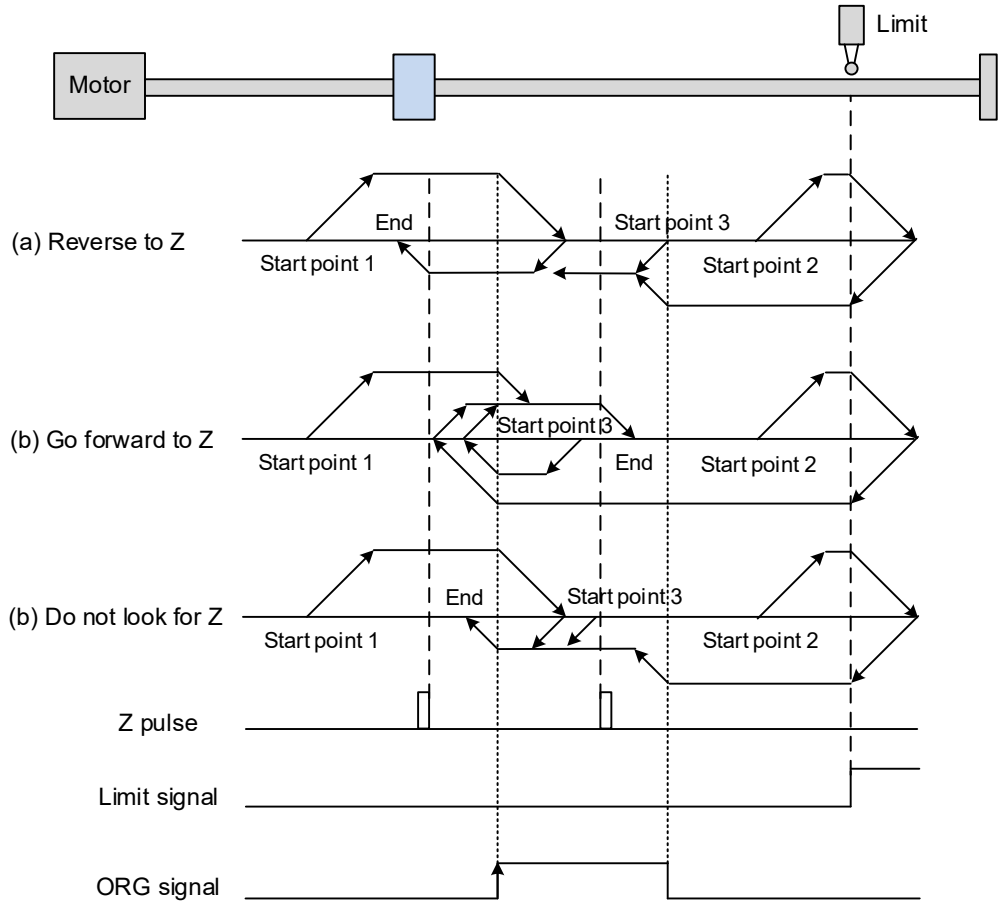
(b) If you set the servo to look for the Z pulse in the forward direction and the limit signal at the start position is un-triggered (low, Start point 1), the servo operates at high speed (first speed setting) then decelerates once reaching the limit (rising-edge triggered). Then the servo switches to low speed (second speed setting) to look for the Z pulse in the forward direction. When the servo finds the Z pulse, it decelerates to a stop, completing the homing procedure.

If you set the servo to look for the Z pulse in the forward direction and the limit signal at the start position is triggered (high, Start point 2), the servo operates at low speed (second speed setting) in the reverse direction to look for the rising-edge limit signal. Then the servo starts to look for the Z pulse in the forward direction once reaching the limit (rising-edge triggered). When the servo finds the Z pulse, it decelerates to a stop, completing the homing procedure.

From the examples, regardless of the start positions, the origin position after homing is the same under the same setting condition.

(c) If you set the servo to not look for the Z pulse, the servo operates at high speed (first speed setting) then decelerates once reaching the limit (rising-edge triggered). Then the servo switches to low speed (second speed setting) in the reverse direction to look for the rising-edge limit signal. When the servo finds the rising-edge signal, it decelerates to a stop, completing the homing procedure.

2. Referencing the rising edge of the home sensor (ORG) signal.
   This method uses the rising edge of the ORG signal as the reference origin. You can set whether or not to use the Z pulse as the reference origin after the ORG signal is detected.



(a) If you set the servo to look for the Z pulse in the reverse direction, when the ORG signal at the start point is un-triggered (low, Start point 1), the servo operates at high speed (first speed setting) then decelerates once reaching the ORG signal (rising-edge triggered). Then it reverses and switches to low speed (second speed setting) until the ORG signal switches to low. Next, the servo starts to look for the Z pulse in the reverse direction. When the servo finds the Z pulse, it decelerates to a stop, completing the homing procedure.

If the ORG signal at the start point is un-triggered (low, Start point 2) and the start point is relatively closer to the limit switch, the servo operates at high speed (first speed setting) until reaching the limit switch. You can set whether to show an error or reverse the direction when the servo reaches the limit switch. If you set the servo to reverse direction, it reverses to reach the ORG signal, and then decelerates and operates at low speed (second speed setting) until the ORG signal switches to low. Next, the servo starts to look for the Z pulse. When the servo finds the Z pulse, it decelerates to a stop, completing the homing procedure.

If the ORG signal at the start point is triggered (high, Start point 3), the servo reverses with low speed (second speed setting) until the ORG signal switches to low. Next, the servo continues to look for the Z pulse. When the servo finds the Z pulse, it decelerates to a stop, completing the homing procedure.

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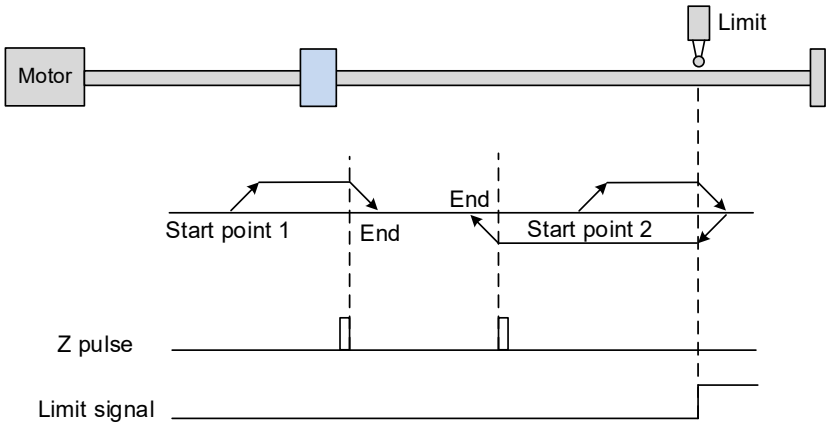
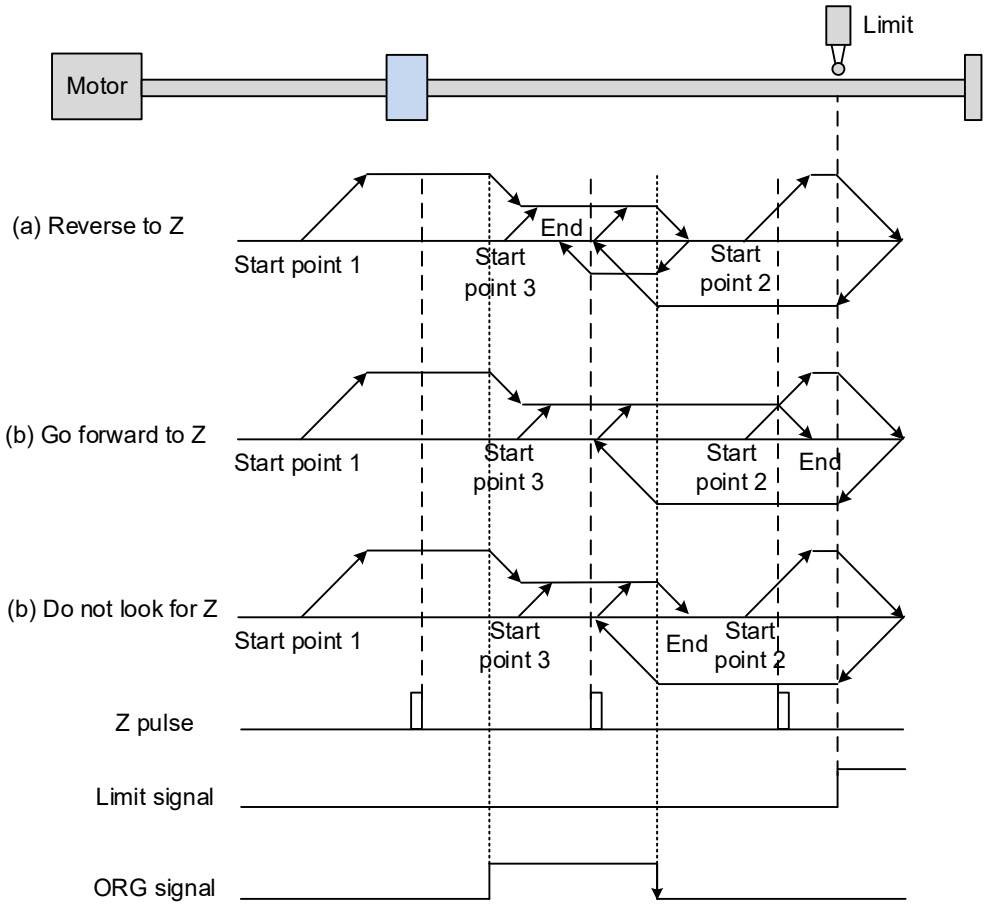
(b) If you set the servo to look for the Z pulse in the forward direction or not to look for the Z pulse (this is similar to method (a) Reverse to Z), refer to the preceding timing diagram.

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



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



(a) If you set the servo to look for the Z pulse in the reverse direction, when the ORG signal at the start point is un-triggered (low, Start point 1), the servo operates at high speed (first speed setting) until reaching the rising edge of the ORG signal. Then it decelerates and switches to low speed (second speed setting) until the ORG signal switches to low. Next, the servo reverses to look for the Z pulse. When the servo finds the Z pulse, it decelerates to a stop, completing the homing procedure.

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

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

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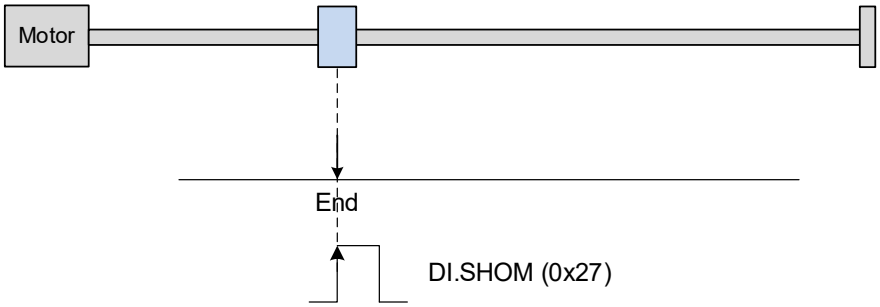
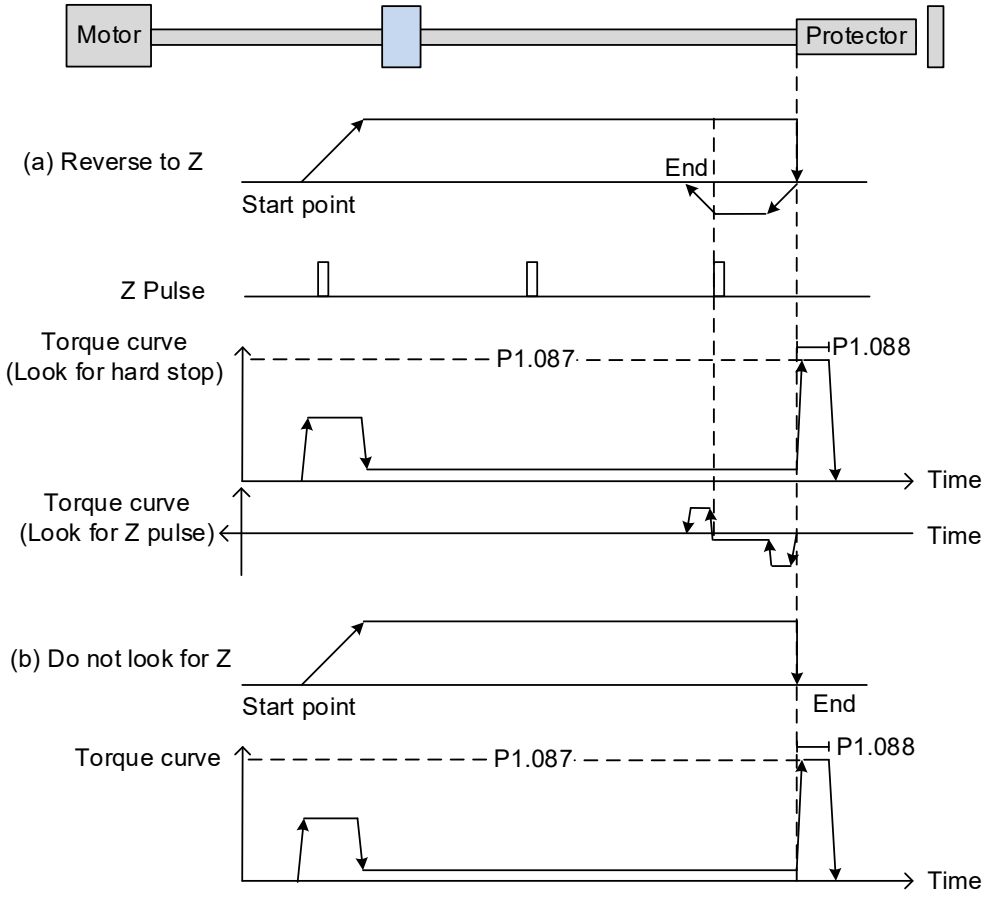
(b) If you set the servo to look for the Z pulse in the forward direction or not to look for the Z pulse (this is similar to method (a) Reverse to Z), refer to the preceding timing diagram.

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 motor positioning is complete.



6. Torque homing mode.

   This method uses the motor's stop position as the reference origin by referring to: the limit on the mechanical parts, the torque level detection (P1.087), and the level reached timer (P1.088). You can also set whether or not to use the Z pulse as the reference origin.



   (a) If you set the servo to look for the Z pulse in the reverse direction, the servo outputs a greater current to counter the external force once it touches the protector at high speed (first speed setting). When the motor torque reaches the torque level detection (P1.087) and the output duration is longer than the level reached timer setting (P1.088), the servo reverses to look for the Z pulse at low speed (second speed setting). When the servo finds the Z pulse, it decelerates to a stop, completing the homing procedure.

   (b) If you set the servo to not look for the Z pulse, the servo outputs a greater current to counter the external force once it touches the protector at high speed (first speed setting). When the motor torque reaches the torque level detection (P1.087) and the output duration is longer than the level reached timer setting (P1.088), the servo stops, completing the homing procedure.

Pay special attention when executing the Torque homing procedure. The motor's actual maximum torque output is 10% greater than the torque level detection setting (P1.087); excessive impact may cause damage to the machine.

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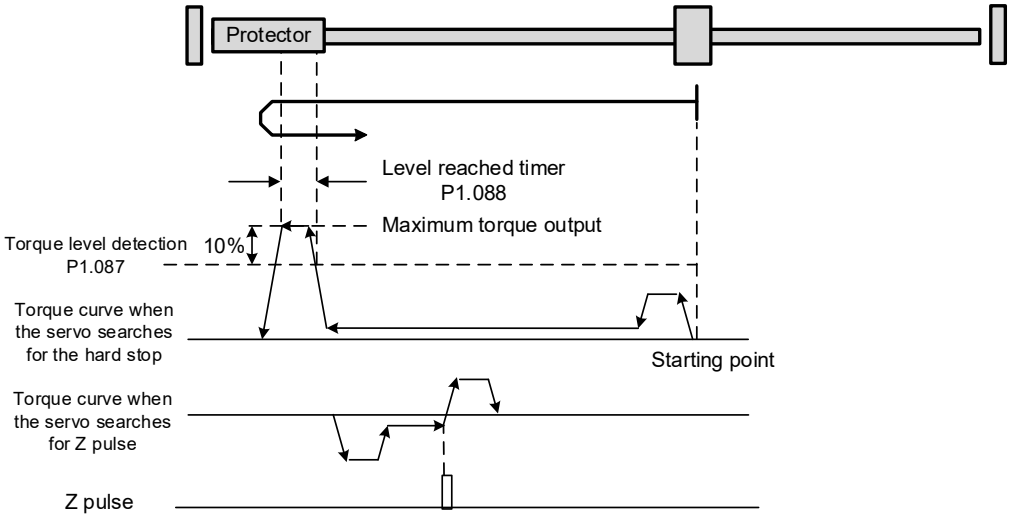
The following tables describe the settings for the torque level detection (P1.087) and the level reached timer (P1.088).

P1.087	Torque homing - torque level detection		Address: 01AEH 01AFH
Default:	1	Control mode:	PR
Unit:	%	Setting range:	1 to 300
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

This setting is only for the torque homing mode. As shown in the following figure, after homing is triggered, the motor runs in one direction and the mechanical part reaches the protector. The servo drive then outputs a larger motor current in order to counter the external force. The servo drive uses P1.087 and P1.088 as the conditions for homing. Since the hard stops are not always the same, it is recommended that you have the servo reverse to find the Z pulse as the origin.



Note: the actual maximum torque output of the motor is 10% greater than the detected torque level (P1.087). For example, when you set P1.087 to 50%, the maximum torque output of the motor is 60%.

P1.088	Torque homing - level reached timer		Address: 01B0H 01B1H
Default:	2000	Control mode:	PR
Unit:	ms	Setting range:	2 to 2000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The setting of the torque level reached timer for the torque homing mode. If the motor torque output continues to exceed the level set by P1.087 and the duration exceeds this setting, the homing is complete. Refer to P1.087 for the timing diagram of torque homing mode.

As mentioned in Section 7.1.2, in PR mode, you can use the four monitoring variables to monitor the servo commands and feedback status: Position command (PUU) (Cmd_O), Register of PR command endpoint (Cmd_E), Position feedback (PUU) (Fb_PUU), and Following error (PUU) (Err_PUU). Since the position system is not established before homing is complete, the target position remains unknown and thus Cmd_E cannot be calculated. This is why the changes of the monitoring variables in Homing mode (Figure 7.1.3.1.3) are different from that when the servo issues the PR position command (Figure 7.1.2.1). In Homing mode, the content of Cmd_E is identical to that of Cmd_O at default setting. After the servo finds the reference origin and establishes the position system, it sets the content of Cmd_E to the position of the reference origin. However, once the servo finds the reference origin, the motor still requires some distance to decelerate to a stop. Meanwhile, Cmd_O continues to issue the commands. If no other PR paths are issued after the PR homing command, unlike the condition where the servo issues the PR position command, the final contents of Cmd_O and Cmd_E in Homing mode will be different. See Figure 7.1.3.1.3.

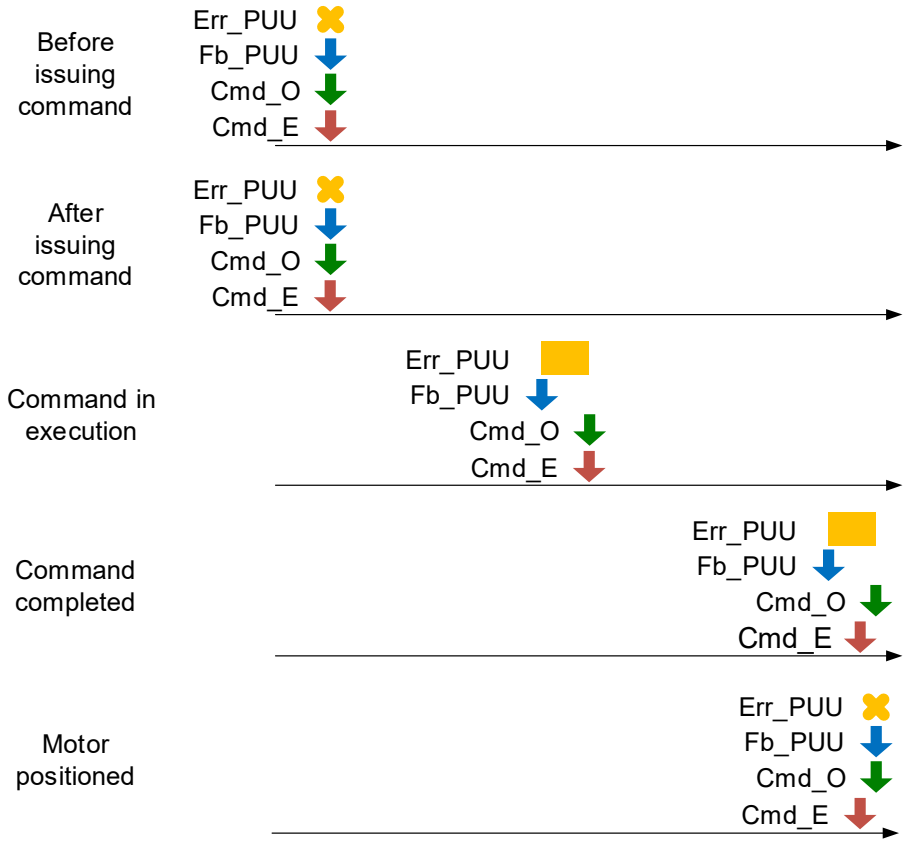


Figure 7.1.3.1.3 Timing diagram for monitoring variables in Homing mode

7.1.3.2 Speed command

The PR mode includes a speed control command. The following parameters are available for setting the PR speed command: acceleration / deceleration time, delay time, and target speed. You can easily set the Speed command by selecting **[1]: Constant speed control** for the TYPE settings in the **PR Mode Setting** screen of ASDA-Soft. See Figure 7.1.3.2.1.

- INS is the interrupt function that allows the next PR path to interrupt the previous PR path. Refer to Section 7.1.6 for more details.
- AUTO is the function that automatically loads and executes the next PR path when the current PR path completes.
- UNIT is the unit setting for the target speed, with options of 0.1 rpm and 1 PPS, and the setting range is -6000 rpm to +6000 rpm.
- ACC / DEC is the acceleration / deceleration time determined by the shared parameters. The software calculates and displays the required duration for the motor to accelerate from 0 to the target speed or to decelerate from the target speed to 0.
- DLY is the delay time determined by the shared parameters. It is defined by the command from the controller; in other words, once the target speed is reached, the servo drive starts counting the delay time.

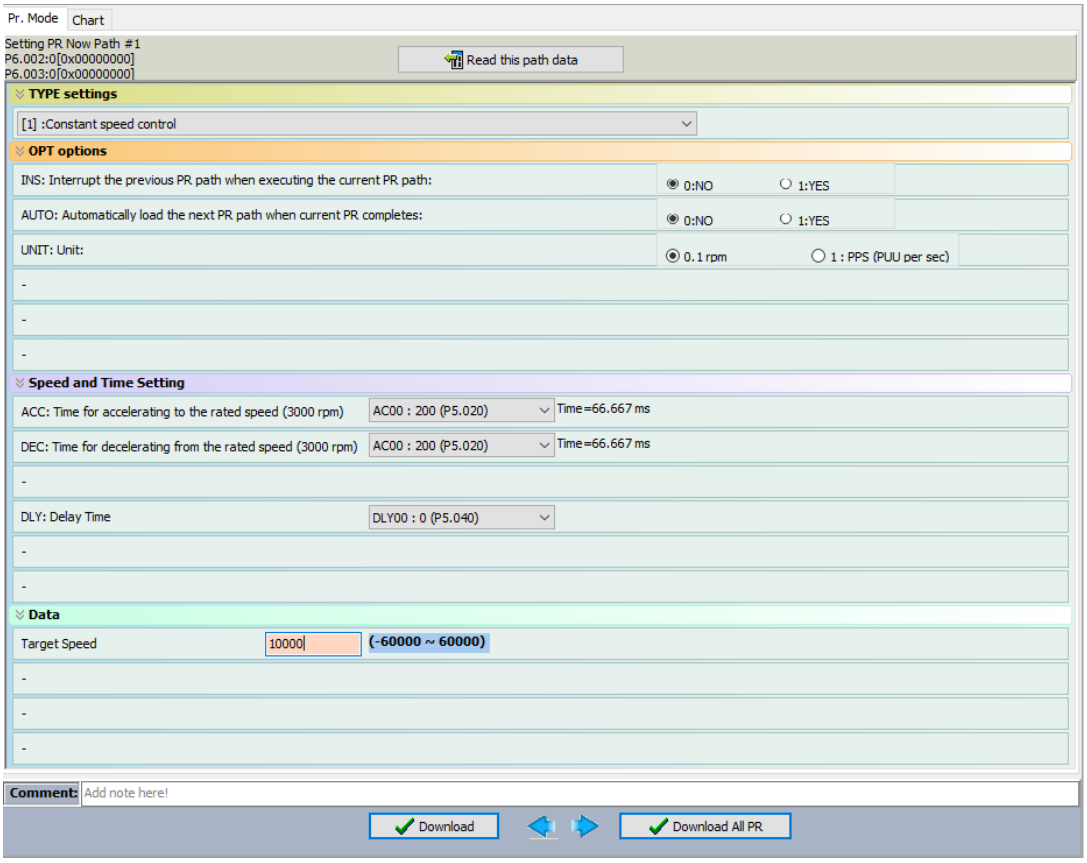


Figure 7.1.3.2.1 PR mode Speed control screen in ASDA-Soft

See Figure 7.1.3.2.2 for the effects of the parameters for the PR mode speed control.

Table 7.1.3.2.1 shows the bit functions when Speed command is in operation.

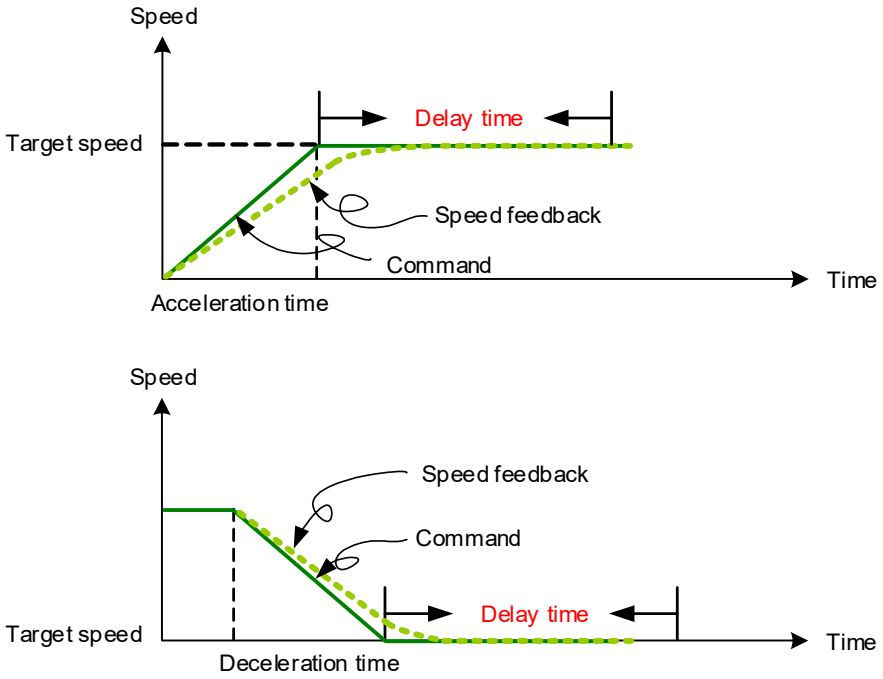


Figure 7.1.3.2.2 Parameters for PR mode speed control

Table 7.1.3.2.1 Bit functions of PR speed control

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

Note:

1. X: 1: SPEED, constant speed control
2. Y: OPT, option

Bit	7	6	5	4
Property	-	UNIT	AUTO	INS

INS: interrupts the previous path when the current path is executed.
AUTO: once current PR path is finished, automatically loads the next path.
UNIT: speed unit selection; 0 = 0.1 rpm and 1 = PPS.

3. Z, U: ACC / DEC, acceleration / deceleration time, set by P5.020 - P5.035.
4. B: DLY, delay time, set by P5.040 - P5.055.

7.1.3.3 Position command

The PR mode includes a position control command of two types: **[2]: Point-to-Point Command** and **[3]: Point-to-Point Command (Proceed to the next path when completed)**. The way to set these two types of commands is the same. You can easily set the Position command in the **PR Mode Setting** screen of ASDA-Soft. Refer to Figure 7.1.3.3.1.

- INS is the interrupt function that allows the next PR path to interrupt the previous PR path. Refer to Section 7.1.6 for more details.
- OVLP is the function that allows the next PR path to overlap the PR path currently being executed during deceleration. If you use this function, setting the delay time to 0 is suggested. Refer to Section 7.1.6 for more details.
- ACC / DEC is the acceleration / deceleration time determined by the shared parameters. The software calculates and displays the required duration for the motor to accelerate from 0 to the target speed or to decelerate from the target speed to 0.
- SPD is the target speed determined by the shared parameters. You can choose whether it is multiplied by 0.1.
- DLY is the delay time determined by the shared parameters. It is defined by the command from the controller; in other words, once the target position is reached, the servo drive starts counting the delay time.
- The Position command (Position CMD DATA) is user-defined and in units of PUU.

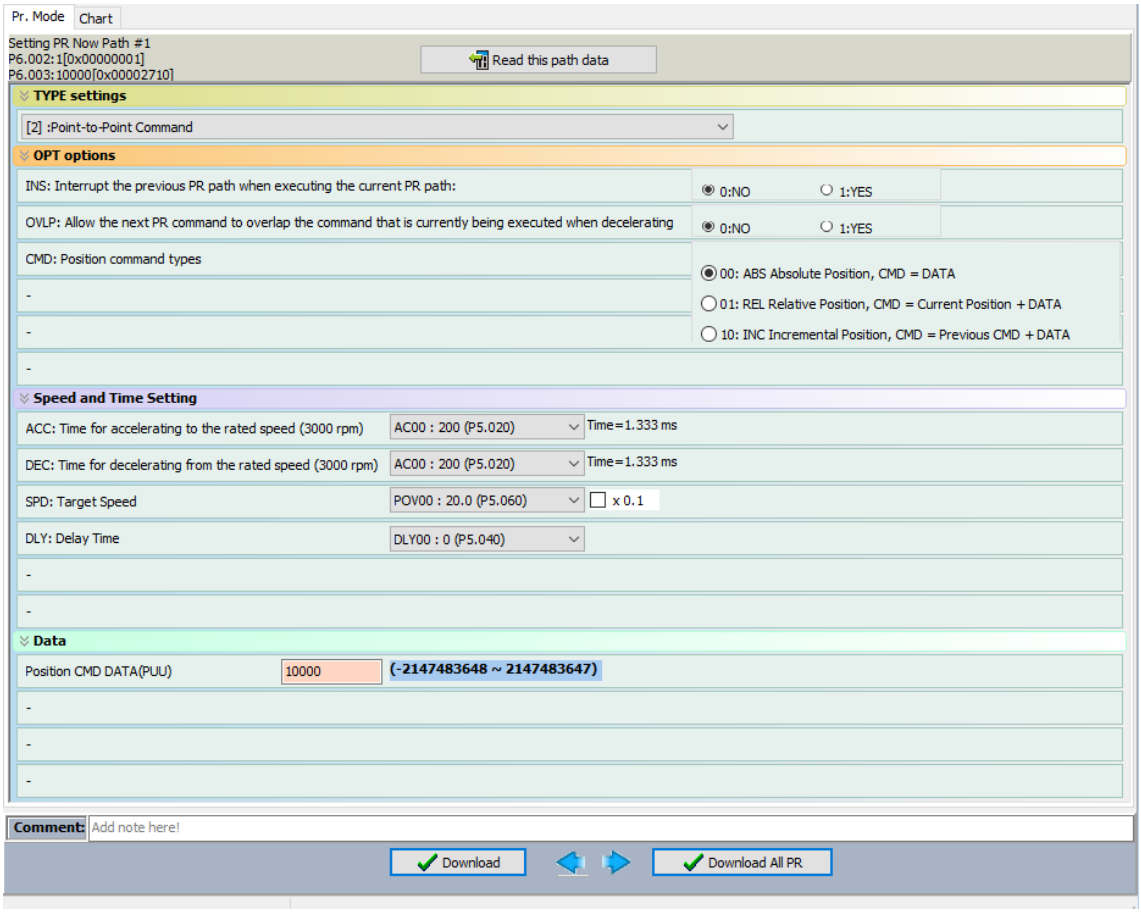


Figure 7.1.3.3.1 PR mode Position control screen in ASDA-Soft

See Figure 7.1.3.3.2 for the effects of the parameters for the PR mode position control.

Table 7.1.3.3.1 shows the bit functions when Position command is in operation.

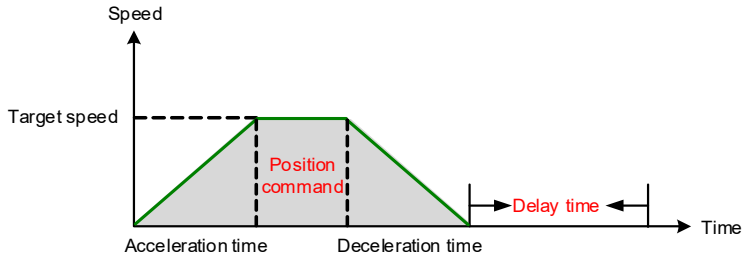


Figure 7.1.3.3.2 Parameters for PR mode position control

The PR mode provides the following types of position commands. You can choose the suitable type of command according to the application requirements. The functions of each type are described in the following examples. Note that the condition in these examples is that a position command is still being executed and a command of another type interrupts. To see the definition of each command type and how the position commands are integrated, refer to Figure 7.1.3.3.3.

1. Absolute position command (ABS): when an absolute command interrupts, the target position value equals the absolute command value. In the following example, an ABS command with the value of 60000 PUU interrupts the previous PR path, so the target position is 60000 PUU in the position system.
2. Relative position command (REL): when a relative command interrupts, the target position value is the motor's current position value plus the position command value. In the following example, a REL command with the value of 60000 PUU interrupts 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 position system. The target position specified by the previous command is omitted.
3. Incremental position command (INC): when an incremental command interrupts, the target position is the previous target position value plus the current position command value. In the following example, an INC command with the value of 60000 PUU interrupts 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 in the position system. The target position specified by the previous command is integrated into the new one.

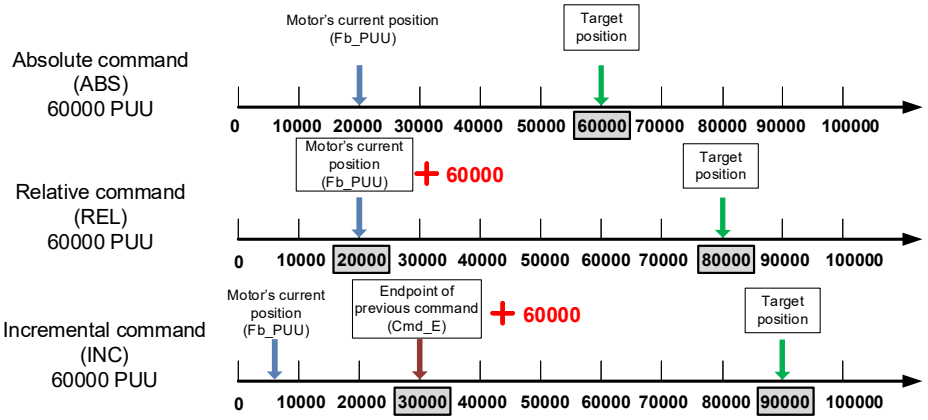


Figure 7.1.3.3.3 Three types of Position command

Table 7.1.3.3.1 Bit functions of PR position control

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

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Note:

1. X:
   2: SINGLE, positioning control. It stops once positioning is complete.
   3: AUTO, positioning control. It automatically loads the next path once positioning is complete.
2. Y: OPT, option

Bit	7	6	5	4	Description
Property	CMD		OVLP	INS	-
Data content	0	0	-	-	ABS (absolute positioning)
	0	1			REL (relative positioning)
	1	0			INC (incremental positioning)

   INS: interrupts the previous path when the current path is executed.
   OVLP: allow overlapping of the next command.
   CMD: Position command selection.
3. Z, U: ACC / DEC, acceleration / deceleration time, set by P5.020 - P5.035.
4. A: SPD, target speed, set by P5.060 - P5.075.
5. B: DLY, delay time, set by P5.040 - P5.055.

7.1.3.4 Jump command

The PR mode includes a Jump command. It can call any PR paths or form PR paths into a loop, as shown in Figure 7.1.3.4.1. You can specify the target PR number by selecting **[7]: Jump to the specified path** for the TYPE settings in the **PR Mode Setting** screen of ASDA-Soft (see Figure 7.1.3.4.2).

- INS is the interrupt function that allows the next PR path to interrupt the previous PR path. Refer to Section 7.1.6 for more details.
- DLY is the delay time determined by the shared parameters. Once a Jump command is issued, the servo drive starts counting the delay time.
- Available target PR numbers are PR#00 - PR#99.

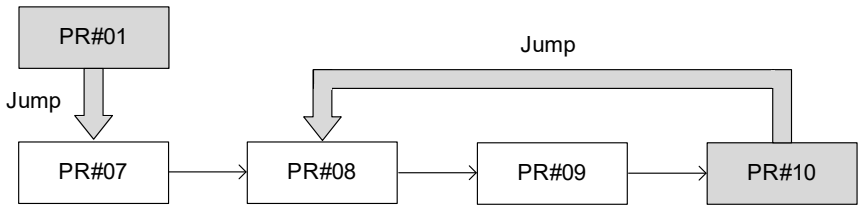

Figure 7.1.3.4.1 Jump command in PR mode

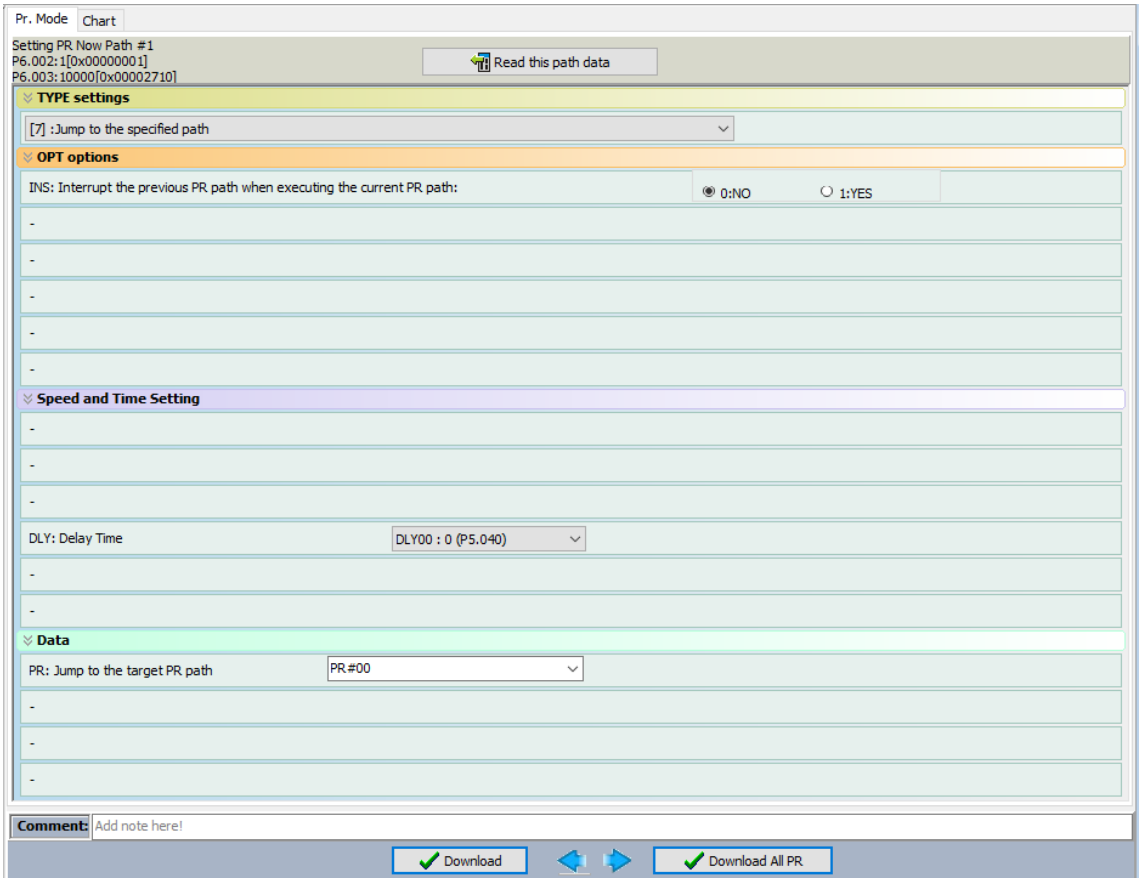

Figure 7.1.3.4.2 PR mode Jump command screen in ASDA-Soft

Table 7.1.3.4.1 shows the bit functions when Jump command is in operation.

Table 7.1.3.4.1 Bit functions of PR Jump command

PR parameters	D	C	B	A	U	Z	Y	X
Property	-	-	DLY	-	-	-	OPT	7
Data content	Jump to target PR path (PR#00 - PR#99)							

Note:
1. X: 7: JUMP, jump to the specified path.
2. Y: OPT, option

Bit	7	6	5	4
Property	-	-	-	INS

INS: interrupts the previous path when the current path is executed.
3. B: DLY, delay time, set by P5.040 - P5.055.

7.1.3.5 Write command

The PR mode includes a Write command. It can write constants, parameters, data arrays, and monitoring variables to the specified parameters or data arrays. You can set the Write command by selecting **[8]: Write to Parameters or Data Array** for the TYPE settings in the **PR Mode Setting** screen of ASDA-Soft (see Figure 7.1.3.5.1).

- INS is the interrupt function that allows the next PR path to interrupt the previous PR path. Refer to Section 7.1.6 for more details.
- AUTO is the function that automatically loads and executes the next PR path when the current PR path completes.
- ROM is the function that writes parameters to both RAM and EEPROM at the same time for the parameter settings to be non-volatile; however, frequent writing shortens the lifetime of the EEPROM.
- DLY is the delay time determined by the shared parameters. Once a Write command is issued, the servo drive starts counting the delay time.
- Writing target (Target) and data source (Written Data):

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

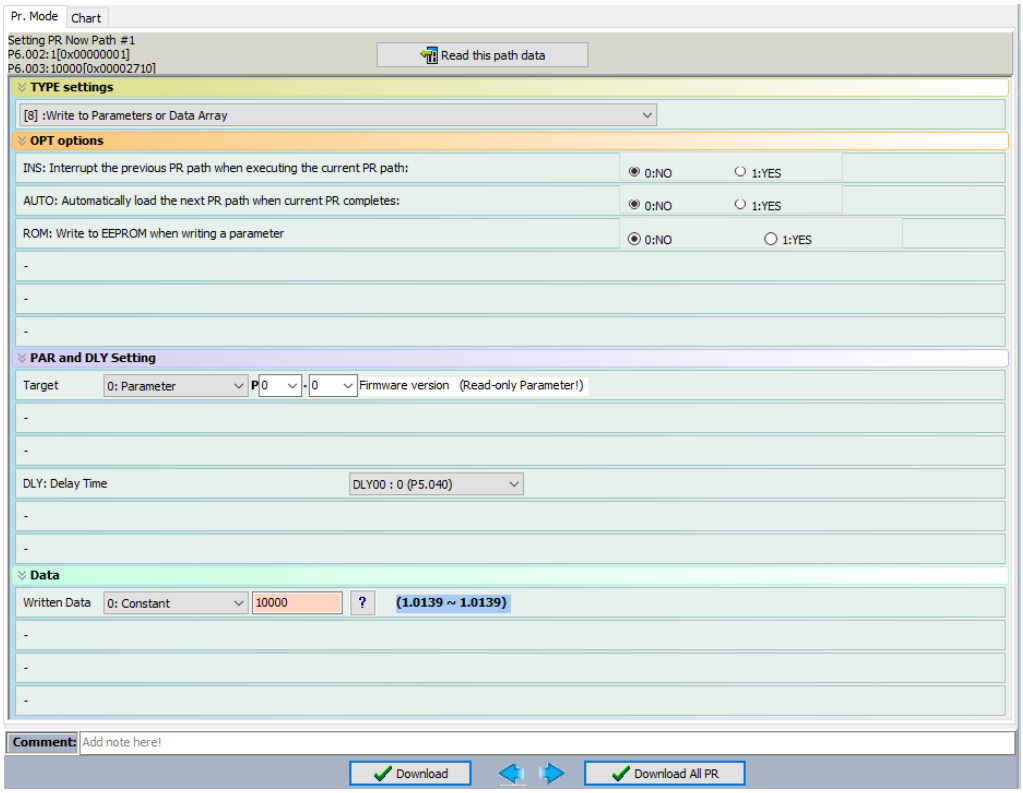

Figure 7.1.3.5.1 PR mode Write command screen in ASDA-Soft

Table 7.1.3.5.1 shows the bit functions when Write command is in operation.

Table 7.1.3.5.1 Bit functions of PR Write command

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

Note:
1. X: 8: WRITE, write specified parameters to the specified path.
2. Y: OPT, option

Bit	7	6	5	4
Property	-	ROM	AUTO	INS

INS: interrupts the previous path when the current path is executed.
AUTO: once current PR path is finished, automatically loads the next path.
ROM: write data to RAM and EEPROM at the same time. This function can only write parameters.

3. B: DLY, delay time, set by P5.040 - P5.055.
4. C: SOUR_DEST, data source and writing target.

Bit	27	26	25	24	Description	
Property	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

5. Z, U, A: DESTINATION, writing target setting

	A	U	Z
Writing target: parameter	Parameter group	Parameter number	
Writing target: data array	Data array number		

6. 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	

7.1.3.6 Rotary Axis Position (Index Position) command

The PR mode includes a Rotary Axis Position command, which creates a rotary axis position system and sets the motor within the position system, unlike the position feedback in a global position system. The Rotary Axis Position command is able to divide the rotary axis position scale into the number of paths required by the application (see Figure 7.1.3.6.1). When the Rotary Axis Position command is used for motor operation in single direction (or mostly in the same direction), if the motor position exceeds the range, absolute position or position counter overflow occurs. Refer to the setting in Chapter 9.

You can click **Indexing Coordinates Wizard** in the **PR Mode Setting** screen of ASDA-Soft to start the Rotary Axis Position Setting Wizard (Index Coordinates Setting Wizard) (see Figure 7.1.3.6.2). As shown in the example, the starting PR path is set to 1, the number of paths (path size) is set to 8, and the total moving distance (P2.052) is 80000 PUU. When you click **OK**, the software automatically writes the position command of 0 PUU to PR#01, 10000 PUU to PR#02, 20000 PUU to PR#03, and so on up to PR#08. When the rotary axis position reaches 80000 PUU, it automatically returns to 0 PUU.

In addition, you can modify the Rotary Axis Position command in the setting screen of each PR path as needed, as shown in Figure 7.1.3.6.3.

- INS is the interrupt function that allows the next PR path to interrupt the previous PR path. Refer to Section 7.1.6 for more details.
- OVLP is the function that allows the next PR path to overlap the PR path currently being executed during deceleration. If you use this function, setting the delay time to 0 is suggested. Refer to Section 7.1.6 for more details.
- DIR sets the rotation direction with options of forward rotation (always move forward), reverse rotation (always move in reverse direction), and the shortest distance. The movement is illustrated in Figure 7.1.3.6.4.
- S_LOW is the speed unit with options of 0.1 r/min or 0.01 r/min.
- AUTO is the function that automatically loads and executes the next PR path when the current PR path completes.
- ACC / DEC is the acceleration / deceleration time determined by the shared parameters.
- SPD is the target speed determined by the shared parameters.
- DLY is the delay time determined by the shared parameters. It is defined by a command from the controller; in other words, once the target position is reached, the servo drive starts counting the delay time.
- Rotary Axis Position command (Written Data) is the target position of each rotary axis traveling segment. Note that the setting range must be smaller than P2.052 (rotary axis position scale).

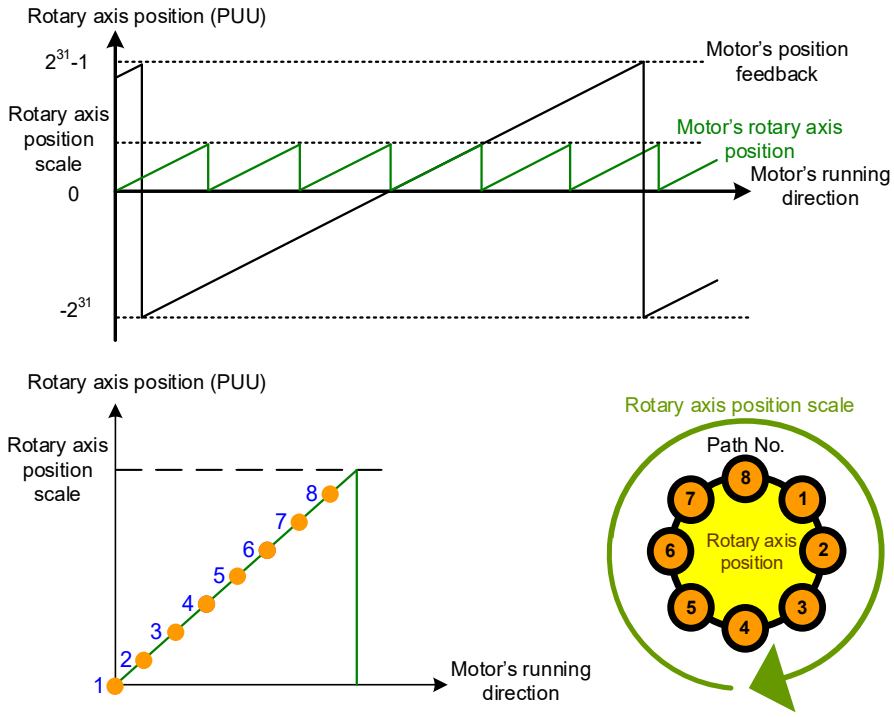

Figure 7.1.3.6.1 Rotary axis position in PR mode

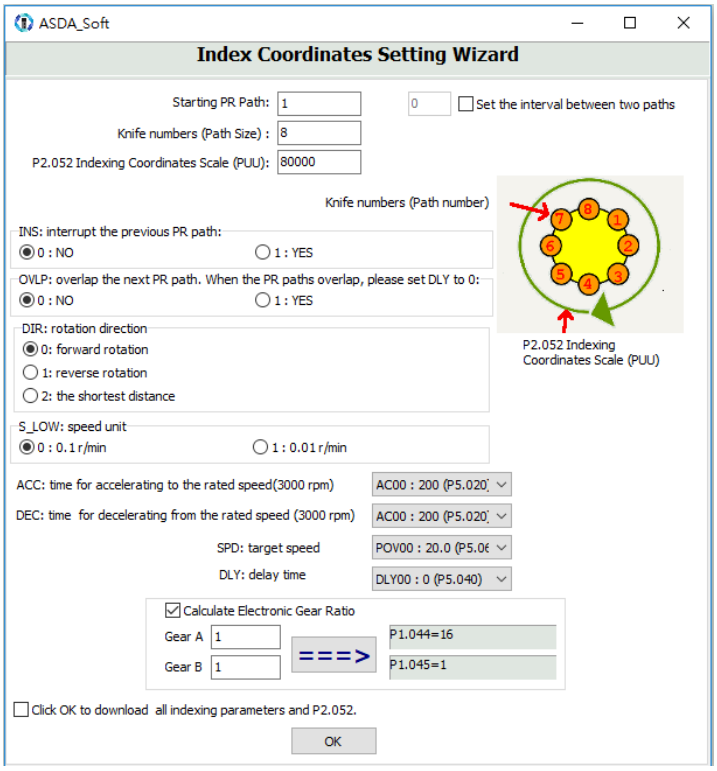

Figure 7.1.3.6.2 Rotary Axis Position Setting Wizard (Index Coordinates Setting Wizard) in PR mode

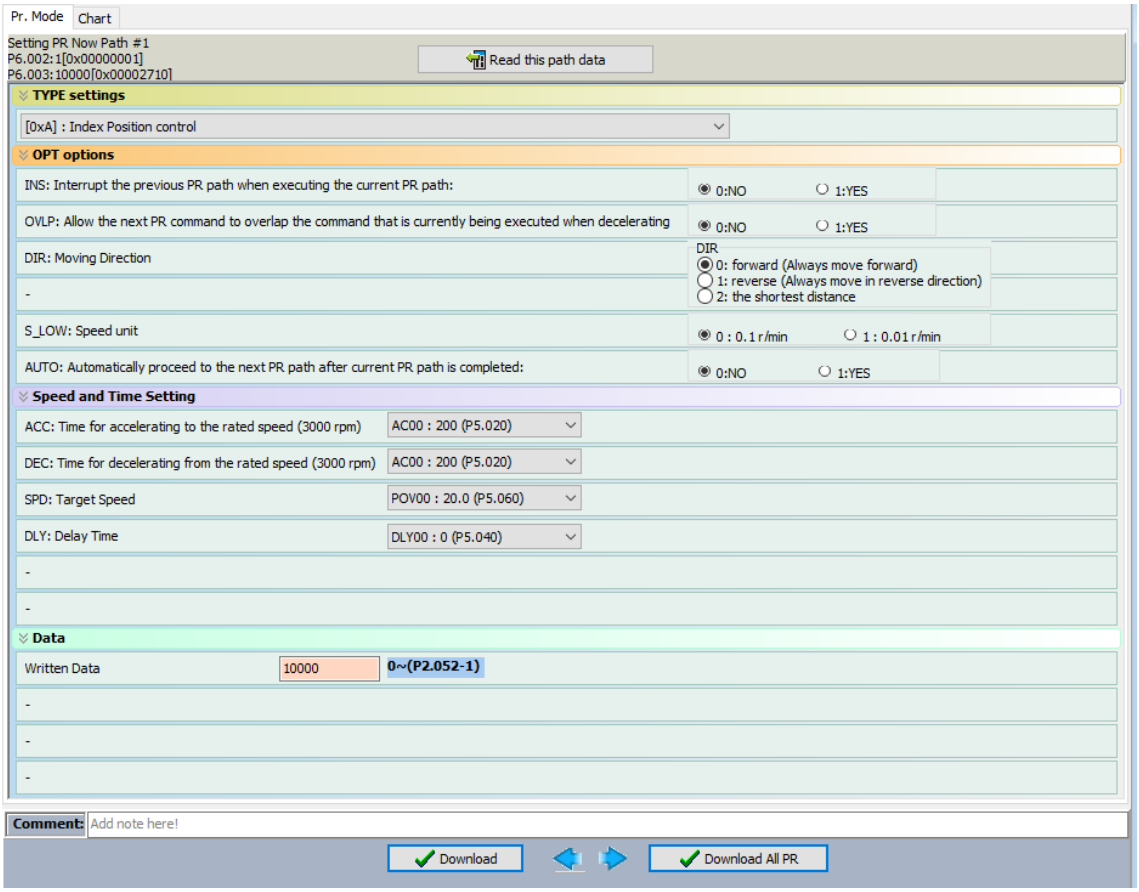

Figure 7.1.3.6.3 PR mode Rotary Axis Position control (Index Position control) screen in ASDA-Soft

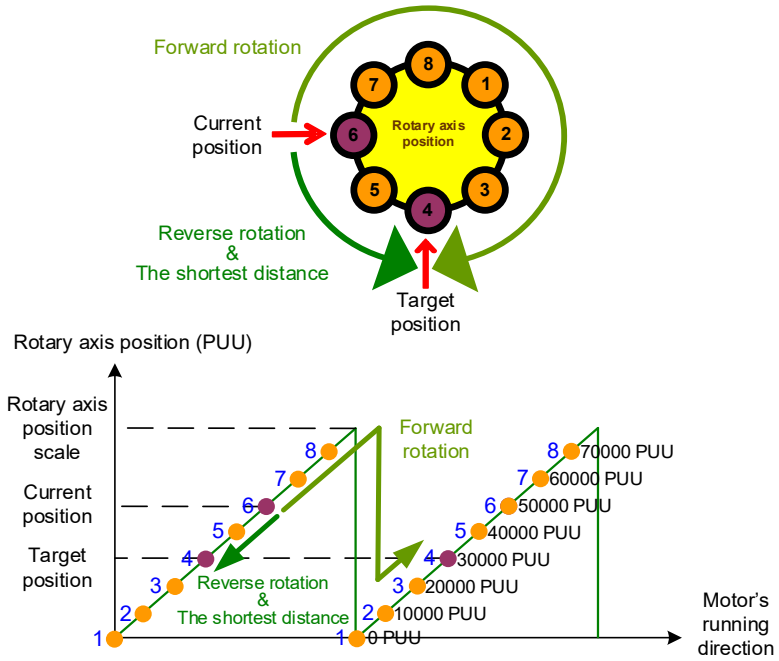

Figure 7.1.3.6.4 Motor's operation direction and rotary axis position

Table 7.1.3.6.1 shows the bit functions when a Rotary Axis Position command is in operation. When you use the rotary axis position function, execute homing first to create a position system so that the origin of the motor's position feedback and that of the motor's rotary axis position can be identical. If you use the rotary axis position function without executing homing, AL237 occurs.

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Table 7.1.3.6.1 Bit functions of the PR Rotary Axis Position command

Bit / PR parameters	D	C	B	A	U	Z	Y	X
Property	-	OPT2	DLY	SPD	DEC	ACC	OPT	A
Data content	Rotary Axis Position command [PUU] (0 to P2.052 minus 1)							

Note:
1. X: A: INDEX, rotary axis position control (index position control)
2. Y: OPT, option

Bit	7	6	5	4	Description
Property	DIR		OVLP	INS	-
Data content	0	0	-	-	Forward rotation (always move forward)
	0	1			Reverse rotation (always move in reverse direction)
	1	0			The shortest distance
	1	1			-

INS: interrupts the previous path when the current path is executed.
OVLP: allow overlapping of the next command.
DIR: rotation direction.

3. C: OPT2, option 2

Bit	27	26	25	24
Property	-	AUTO	-	S_LOW

S_LOW: speed unit options, 0 = 0.1 r/min and 1 = 0.01 r/min.
AUTO: once current PR path is finished, automatically loads the next path.

4. Z, U: ACC / DEC, acceleration / deceleration time, set by P5.020 - P5.035.
5. A: SPD, target speed, set by P5.060 - P5.075.
6. B: DLY, delay time, set by P5.040 - P5.055.

7.1.4 Overview of the PR path

To make the PR paths easier to understand, ASDA-Soft presents the execution order and calling sequence of all PR paths. The symbols and contents in the PR path diagram are shown as follows, including five parts: number, command execution type (property), command type, next PR path, and command information. See Figure 7.1.4.1.

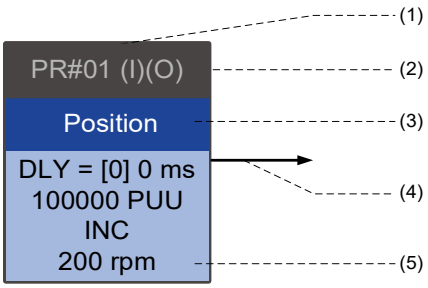

Figure 7.1.4.1 Overview of the PR path

(1) Number: the PR path number, ranging from PR#00 to PR#99 (100 sets of PR paths).

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

(3) Command type: there are six types of PR paths: Homing, Speed, Position, Jump, Write, and Rotary Axis Position (Index Position). The color displayed in this section depends on the command type.

(4) Next PR path: if the current path is followed by a PR path, there would be an arrow pointing to the specified PR path.

(5) Command information: displays the details of this PR path. The displayed contents and color depend on the command type.

The following sections illustrate each command type and its display.

Homing methods

In the display of homing methods, PR#00 always signifies the homing procedure, which is marked as “Homing”. See Figure 7.1.4.2.

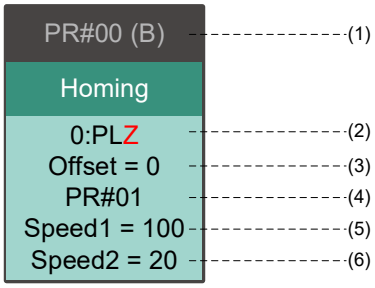

Figure 7.1.4.2 Homing methods display

(1) Activation mode (Boot): if the drive is set to execute homing when it is switched to On for the first time after powered on, (B) is displayed; if homing is not required, no information is displayed.

(2) Method selection: including the homing methods and Z pulse setting shown as follows.
PL signifies positive limit; NL signifies negative limit. When the mode name ends with a “Z”, it means the servo looks for the Z pulse in the forward or reverse direction; when the mode name ends with a non-Z character, it means the servo does not look for the Z pulse.
F signifies running forward; R signifies running in reverse; ORG signifies the home sensor signal; CUR signifies the current position; and BUMP signifies the hard stop.

Homing method	Y = 0: reverse to Z pulse Y = 1: go forward to Z pulse	Y = 2: do not look for Z pulse
X = 0: homing in forward direction and define the positive limit as the homing origin	0: PLZ	0: PL
X = 1: homing in reverse direction and define the negative limit as the homing origin	1: NLZ	1: NL
X = 2: homing in forward direction, ORG: OFF→ON as the homing origin	2: F_ORGZ	2: F_ORG
X = 3: homing in reverse direction, ORG: OFF→ON as the homing origin	3: R_ORGZ	3: R_ORG
X = 4: look for Z pulse in forward direction and define it as the homing origin	4: F_Z	
X = 5: look for Z pulse in reverse direction and define it as the homing origin	5: R_Z	
X = 6: homing in forward direction, ORG: ON→OFF as the homing origin	6: F_ORGZ	6: F_ORG
X = 7: homing in reverse direction, ORG: ON→OFF as the homing origin	7: R_ORGZ	7: R_ORG
X = 8: define current position as the origin	8: CUR	
X = 9: torque homing in forward direction	9: F_BUMPZ	9: F_BUMP
X = A: torque homing in reverse direction	A: R_BUMPZ	A: R_BUMP

(3) Offset: origin offset (P6.001).

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

(5) Homing at high speed (Speed1): first homing speed (P5.005).

(6) Homing at low speed (Speed2): second homing speed (P5.006).

Speed command

You can use the Speed command in any PR paths from PR#01 to PR#99, which is marked as “Speed”. See Figure 7.1.4.3.

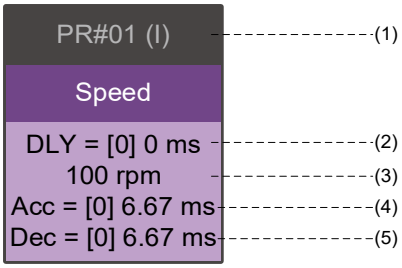

Figure 7.1.4.3 Speed command display

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

(2) Delay time (DLY): determined by the shared parameters. It is defined by the command from the controller; in other words, once the target speed is reached, the servo drive starts counting the delay time.

(3) Target speed: the set target speed.

(4) Acceleration time (Acc): determined by the shared parameters. The software calculates and displays the required duration for the motor to accelerate from 0 to the target speed.

(5) Deceleration time (Dec): determined by the shared parameters. The software calculates and displays the required duration for the motor to decelerate from the target speed to 0.

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Position command

You can use the Position command in any PR paths from PR#01 to PR#99, which is marked as “Position” with the options of “stop once the positioning is complete” and “automatically loads the next PR path once the positioning is complete”. The only difference is that the latter shows an arrow pointing to the next PR path. See Figure 7.1.4.4.

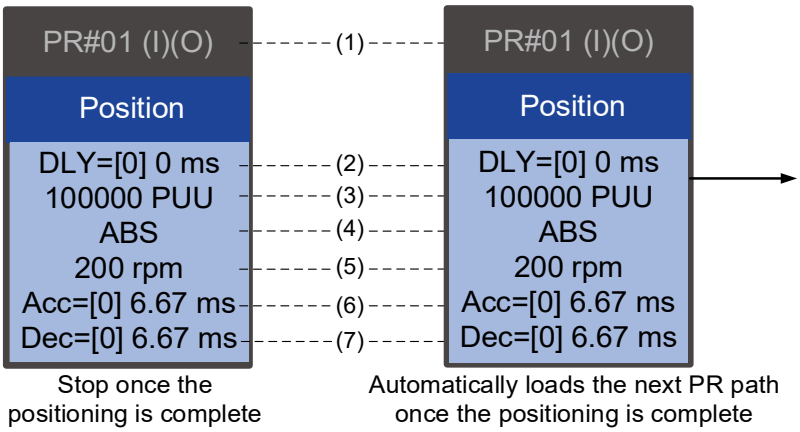

Figure 7.1.4.4 Position command display

(1) Command execution type (property): a Position command can interrupt (INS) the previous PR path. If the Interrupt function is enabled, (I) is displayed; if not, no information is displayed. You can also set an Overlap (OVLP) function in the Position command and set the delay time (DLY) to 0, so that the next PR path can overlap the current one. If the Overlap function is enabled, (O) is displayed; if not, no information is displayed.

(2) Delay time (DLY): determined by the shared parameters. It is defined by the command from the controller; in other words, once the target position is reached, the servo drive starts counting the delay time.

(3) Target position: the set target position.

(4) Position command type: “ABS” means absolute positioning; “REL” means relative positioning; and “INC” means incremental positioning.

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

(6) Acceleration time (Acc): determined by the shared parameters. The software calculates and displays the required duration for the motor to accelerate from 0 to the target speed.

(7) Deceleration time (Dec): determined by the shared parameters. The software calculates and displays the required duration for the motor to decelerate from the target speed to 0.

Jump command

You can use the Jump command in any PR paths from PR#01 to PR#99, which is marked as "Jump" and followed by an arrow pointing to the next PR path. See Figure 7.1.4.5.

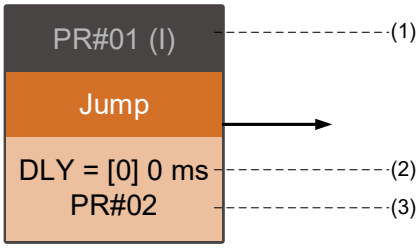

Figure 7.1.4.5 Jump command display

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

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

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

Write command

You can use the Write command in any PR paths from PR#01 to PR#99, which is marked as "Write". See Figure 7.1.4.6.

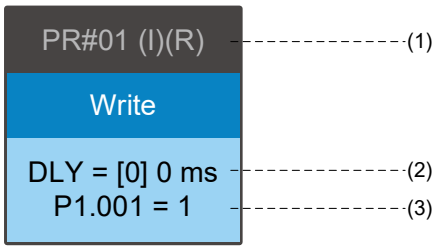

Figure 7.1.4.6 Write command display

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

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

(3) Writing target and data source: the representations are shown in the following table. 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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Rotary Axis Position (Index Position) command

You can use the Rotary Axis Position command in any PR paths from PR#01 to PR#99. The setting of the number of PR paths for the Rotary Axis Position command determines the number of path segments. The path is marked as “Index Position”. See Figure 7.1.4.7.

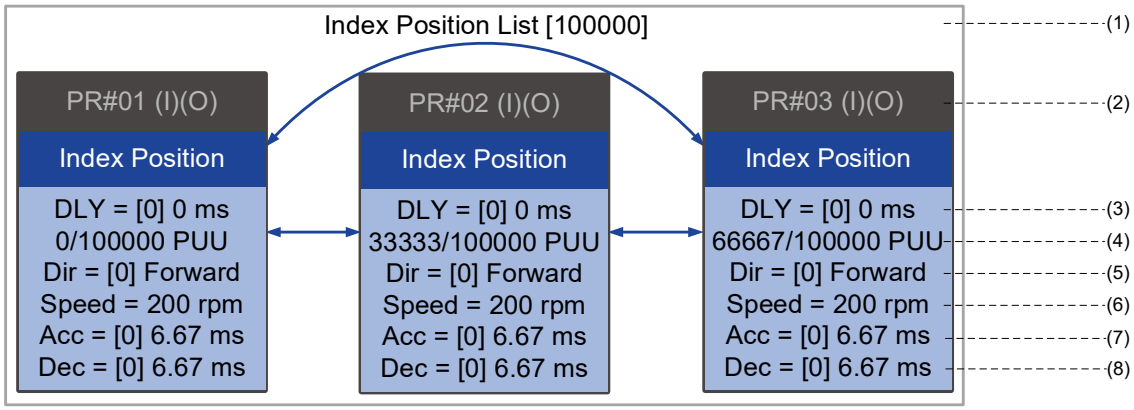

Figure 7.1.4.7 Rotary Axis Position (Index Position) command display

(1) Rotary Axis Position command section: indicates a set of Rotary Axis Position commands. It shows the total moving distance at the top, and uses double arrows to show that the motor can run reciprocally between each target position in each PR path.

(2) Command execution type (property): a Rotary Axis Position command can interrupt (INS) the previous PR path. If the Interrupt function is enabled, (I) is displayed; if not, no information is displayed. You can also set an Overlap (OVLP) function in the Rotary Axis Position command and set the delay time (DLY) to 0, so that the next PR path can overlap the current one. If the Overlap function is enabled, (O) is displayed; if not, no information is displayed.

(3) Delay time (DLY): determined by the shared parameters. It is defined by the command from the controller; in other words, once the target position is reached, the servo starts counting the delay time.

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

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

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

(7) Acceleration time (Acc): determined by the shared parameters. The software calculates and displays the required duration for the motor to accelerate from 0 to the target speed.

(8) Deceleration time (Dec): determined by the shared parameters. The software calculates and displays the required duration for the motor to decelerate from the target speed to 0.

7.1.5 Trigger methods for the PR path

There are three methods for triggering the PR path: Digital input (DI) triggering, Event triggering, and PR path trigger register (P5.007). Choose the most suitable trigger method based on the applications and requirements.

Digital input (DI) triggering

You can choose the PR path to execute by using the internal command registers (POS0 - POS6) and use DI.CTRG to trigger the selected PR path. Before triggering the PR path with the digital input (DI), you must define the functions of 8 sets of DIs, which are DI.POS0 (0x11), DI.POS1 (0x12), DI.POS2 (0x13), DI.POS3 (0x1A), DI.POS4 (0x1B), DI.POS5 (0x1C), DI.POS6 (0x1E), and DI.CTRG (0x08) (see Table 8.1 in Chapter 8). You can set these DIs in the Digital IO setting screen in ASDA-Soft, as shown in Figure 7.1.5.1.

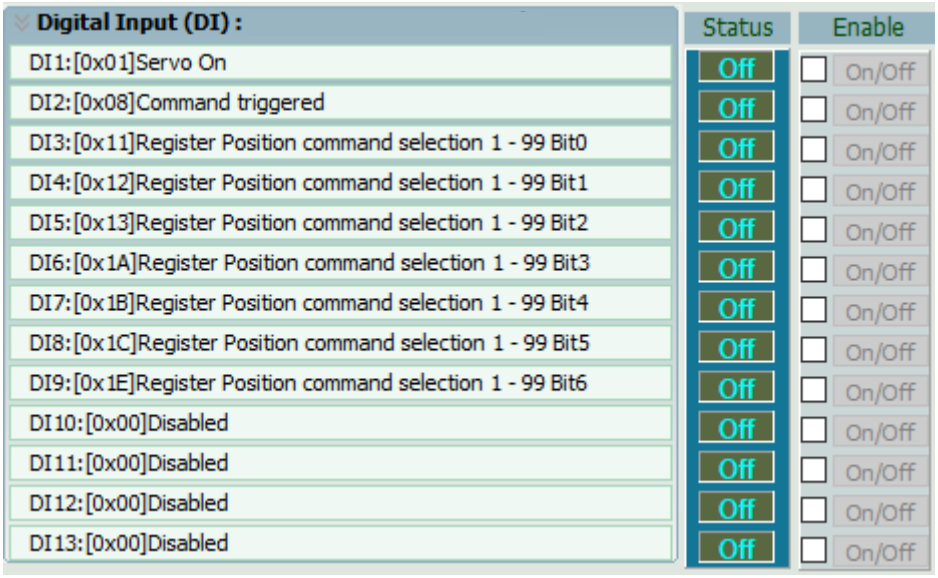

Figure 7.1.5.1 Digital IO setting screen in ASDA-Soft

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Select the PR path to execute based on the On / Off status of DI.POS0 - POS6 and use DI.CTRG to trigger the specified PR path. See the following table as an example.

Position command	POS6	POS5	POS4	POS3	POS2	POS1	POS0	CTRG	Correspon-ding parameter
Homing	0	0	0	0	0	0	0	↑	P6.000
									P6.001
PR#01	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 DIs for special functions: DI.SHOM (0x27) and DI.STP (0x46). If the former is triggered, the servo drive executes homing according to the homing setting. If the latter is triggered, the servo drive stops the motor. You can use the Digital IO setting screen in ASDA-Soft to set these functions, as shown in Figure 7.1.5.2.

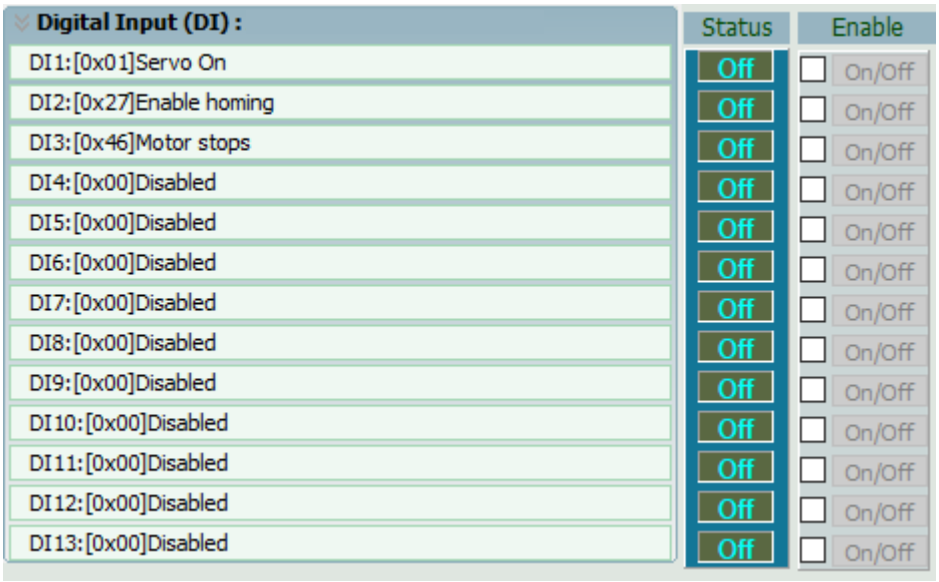

Figure 7.1.5.2 Digital IO setting screen in ASDA-Soft

Event triggering

You can use Event trigger commands 1 - 4 to execute the specified PR path. There are two types of Event triggering: rising-edge trigger and falling-edge trigger. The PR path numbers that you can specify are PR#51 - 63 (see the example in Figure 7.1.5.3). Before using the event triggering for PR paths, you must define the functions of these DIs, which are DI.EV1 (0x39), DI.EV2 (0x3A), DI.EV3 (0x3B), and DI.EV4 (0x3C) (see Table 8.1 in Chapter 8). You can use the Digital IO setting screen in ASDA-Soft to set these functions, as shown in Figure 7.1.5.4.

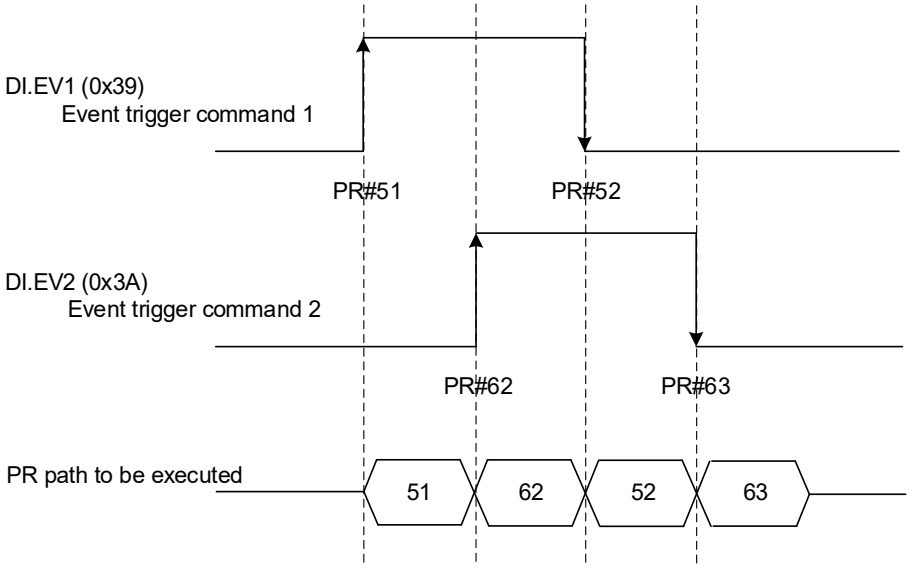

Figure 7.1.5.3 Example of event triggering timing diagram

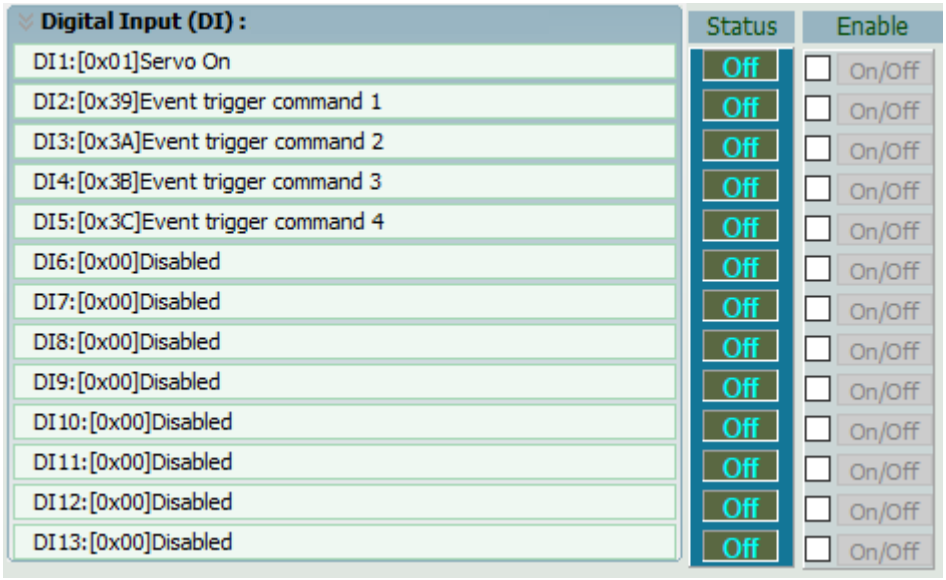

Figure 7.1.5.4 Digital IO setting screen in ASDA-Soft

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You can set the rising-edge trigger of the PR path with P5.098 and set the falling-edge trigger with P5.099. Refer to Chapter 8 for more details. You can also use ASDA-Soft to set the event triggering of PR paths. See Figure 7.1.5.5.

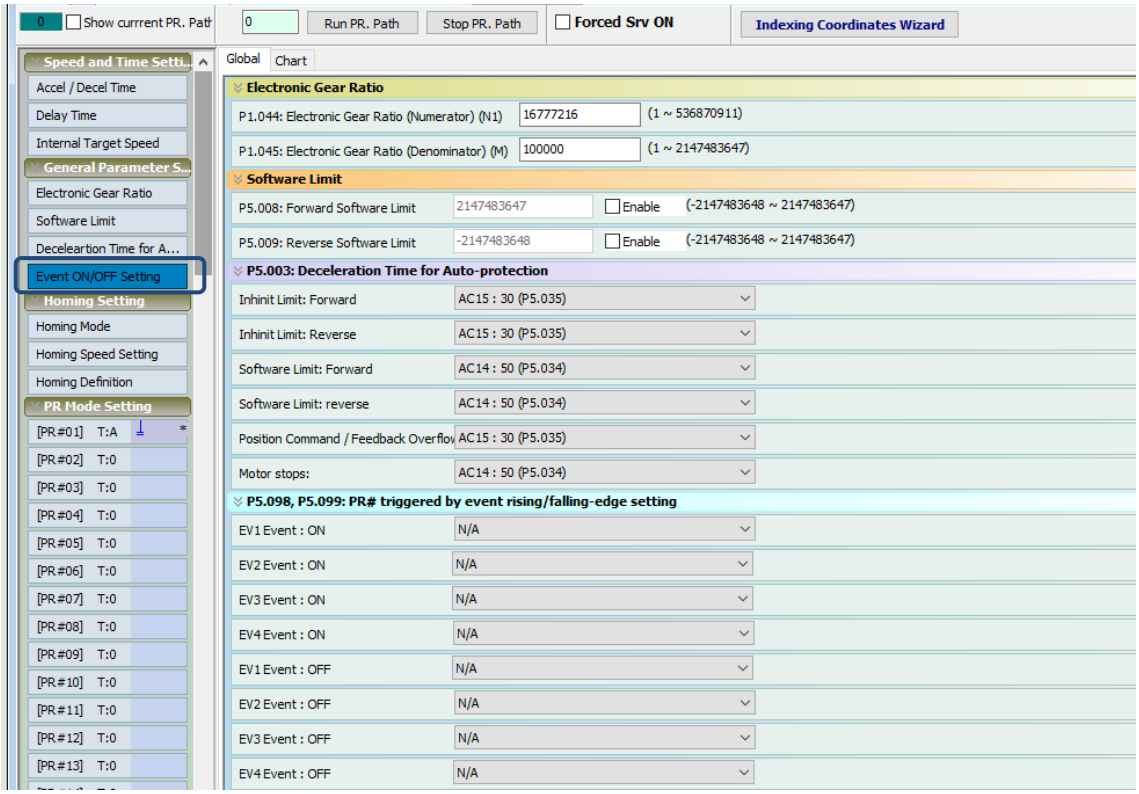


Figure 7.1.5.5 Event ON / OFF Setting screen in ASDA-Soft

PR path trigger register (P5.007)

You can write the No. of the PR path to be executed in P5.007 to have the servo drive execute the specified PR path.

If you set P5.007 to 0, the servo drive executes homing. If you set P5.007 to 1 - 99, the servo drive executes the specified PR path. If you set P5.007 to 1000, the servo drive stops executing PR paths. Refer to the setting descriptions of P5.007 in Chapter 8.

7.1.6 PR path execution flow

The servo drive updates the command status every millisecond. Figure 7.1.6.1 illustrates how the servo drive deals with the PR paths. Once a PR path is triggered, it goes through three processing units, which are PR queue, PR executor, and motion command generator.

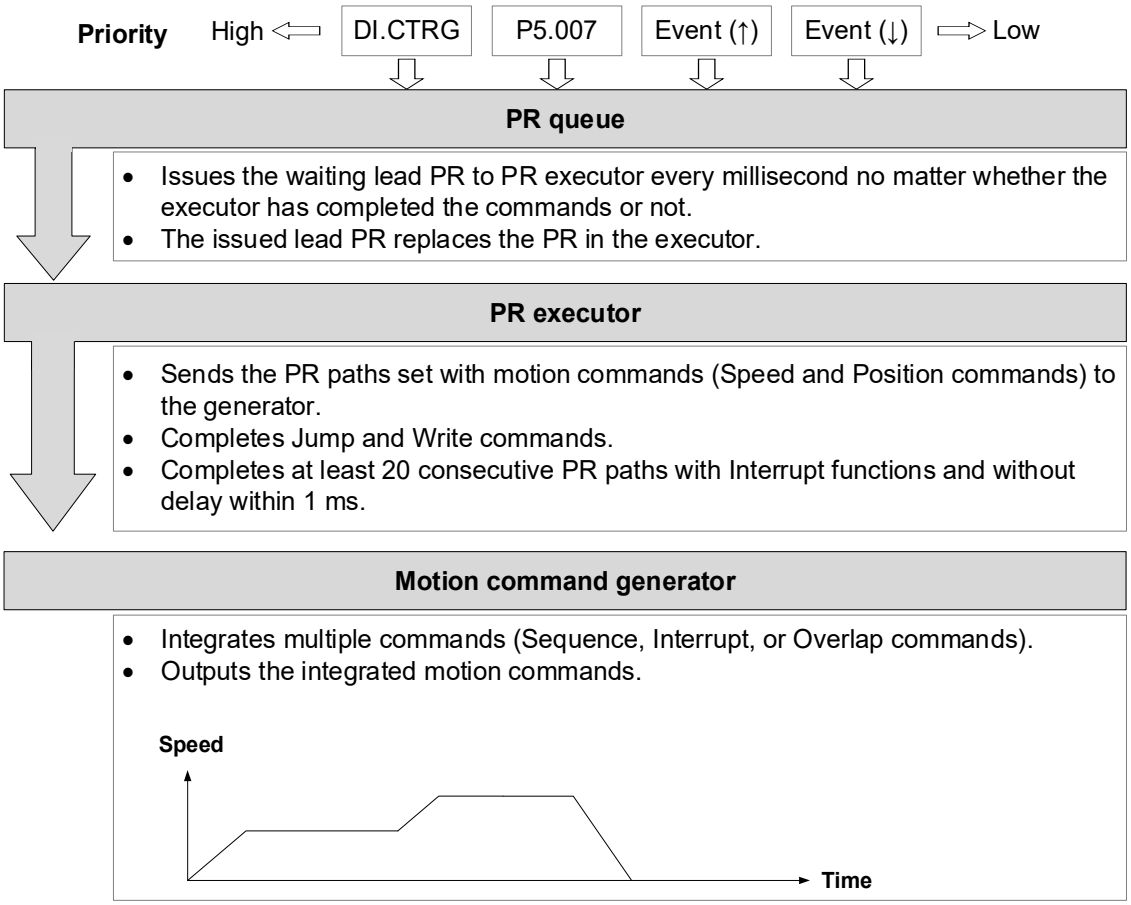


Figure 7.1.6.1 PR execution flow in the servo drive

■ Trigger process

As mentioned in Section 7.1.5, the servo drive provides multiple trigger methods. A PR path is executed as long as a trigger signal is output. When two different triggers are generated within the same millisecond, the priority is: DI triggering (DI.CTRG) > PR path trigger register (P5.007) > Rising-edge event triggering (Event ↑) > Falling-edge event triggering (Event ↓). Within this millisecond, the path with higher priority is executed first and then the path with lower priority is sent in the next millisecond. If three PR paths are triggered in the same millisecond, the third one is not added to the PR queue.

■ **PR queue**

The triggered PR path is the lead PR. The waiting lead PR goes into the PR queue with its PR group. In each millisecond, the servo drive sends the lead PR and its PR group to the PR executor on a first-in first-out basis no matter whether a PR path is being executed in the PR executor. Therefore, as long as a PR path is triggered, the PR queue collects it and sends it to the PR executor.

■ **PR executor**

Once the PR executor receives the lead PR and its PR group, the PR group in execution is replaced immediately. If the received PR group includes motion commands (Speed and Position commands), then the PR executor sends them to the motion command generator. PR paths with Write or Jump commands are executed at the moment when the PR executor reads the command, and thus they do not enter the generator. The PR executor can consecutively complete at least 20 PR paths with the Interrupt function (INS) without delay (DLY) within 1 millisecond. If there are PR paths that have not been completed within 1 millisecond, and the PR queue has already sent a new PR group to the PR executor, then the new PR group replaces the previous one. In other words, instead of executing the PR group that has not been completed, the PR executor starts executing the new PR group. If there are PR paths that have not been completed within 1 millisecond but no new PR group is sent to the PR executor, the PR executor continues to execute the unfinished PR paths.

■ **Motion command generator**

The PR executor sends the motion commands (Speed and Position commands) 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 long as they enter the generator. If another motion command set with the Interrupt function also enters the generator, it is integrated with the current command in the generator. The settings of the integrated command, including whether multiple motion commands are Sequence commands and whether they are set with the Interrupt (INS) or Overlap (OVLP) function, are determined by the setting of each PR path.

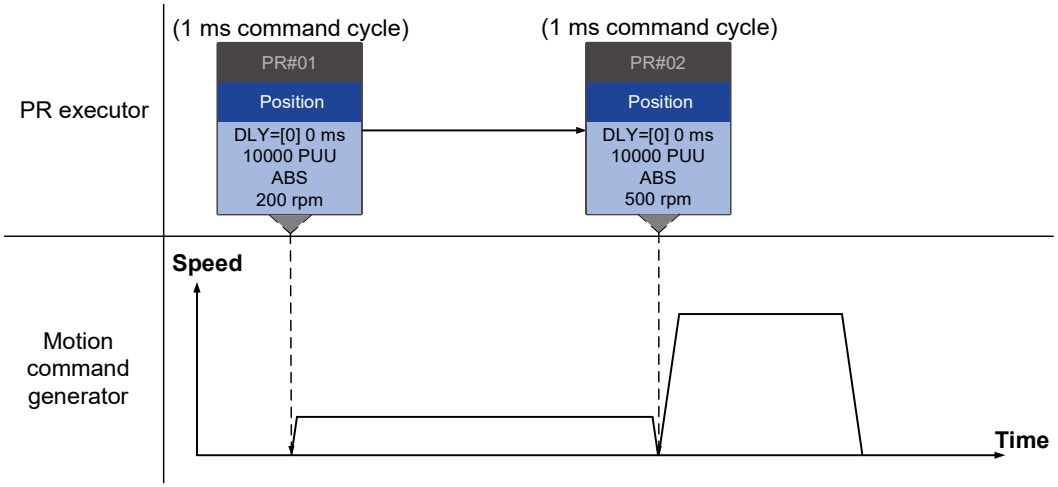
Sequence command

The configurable motion commands for PR paths are the Position and Speed commands. Sequence command refers to a series of motion commands without the Overlap (OVLP) or Interrupt (INS) function, and the next command is executed only after the delay time (DLY) set in the previous command is over. For Position commands, the delay time starts to count after the target position is reached. For Speed commands, the delay time starts to count after the target speed is reached.

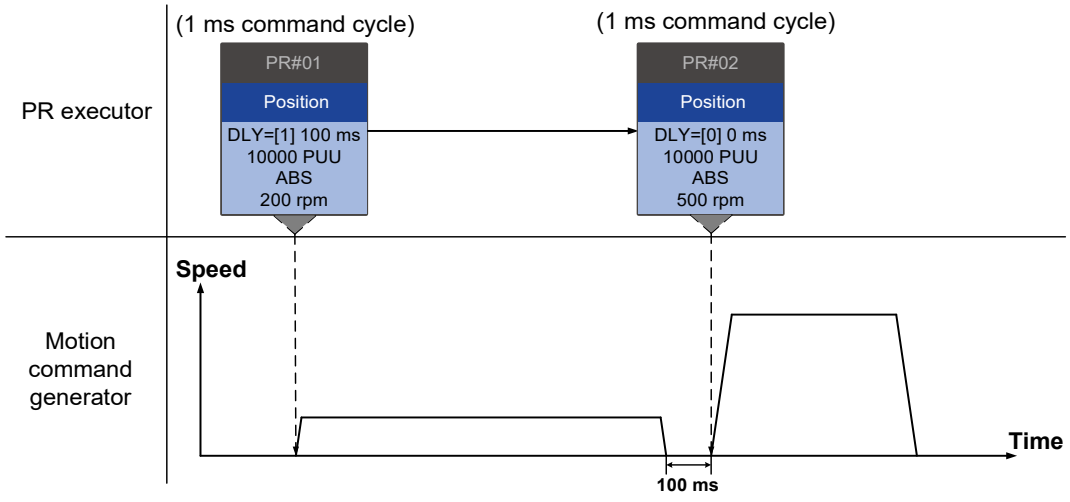
■ Position command ▶ Position command

When the PR executor receives two consecutive Position commands without the Interrupt or Overlap function, the PR executor sends 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 sends the second Position command for the generator to start the second part of position control, as shown in 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, and then sends the second Position command for the generator to start the second part of position control, as shown in Figure 7.1.6.2 (b).



(a) Position command without delay



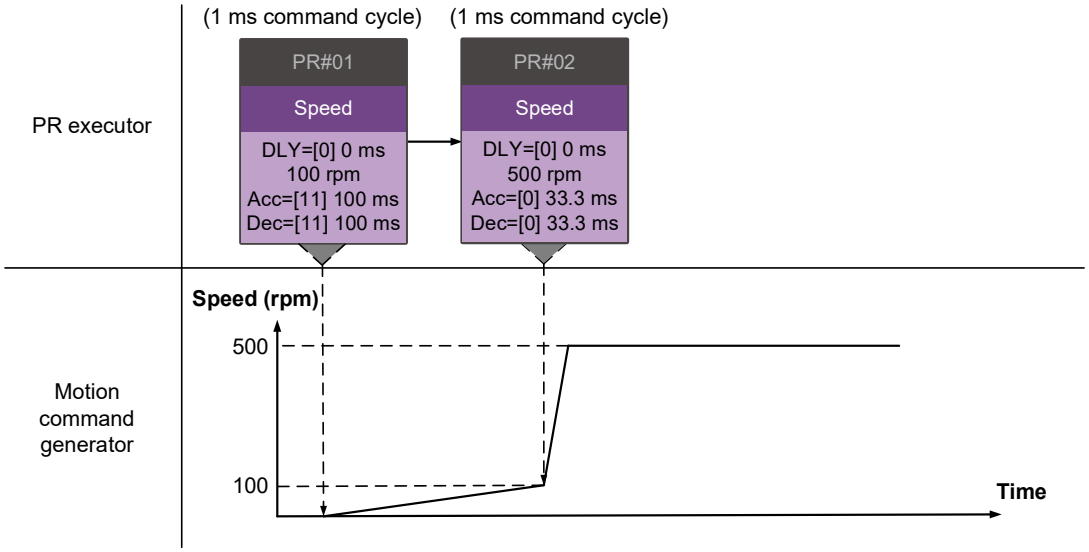
(b) Position command with delay

Figure 7.1.6.2 Position Sequence commands

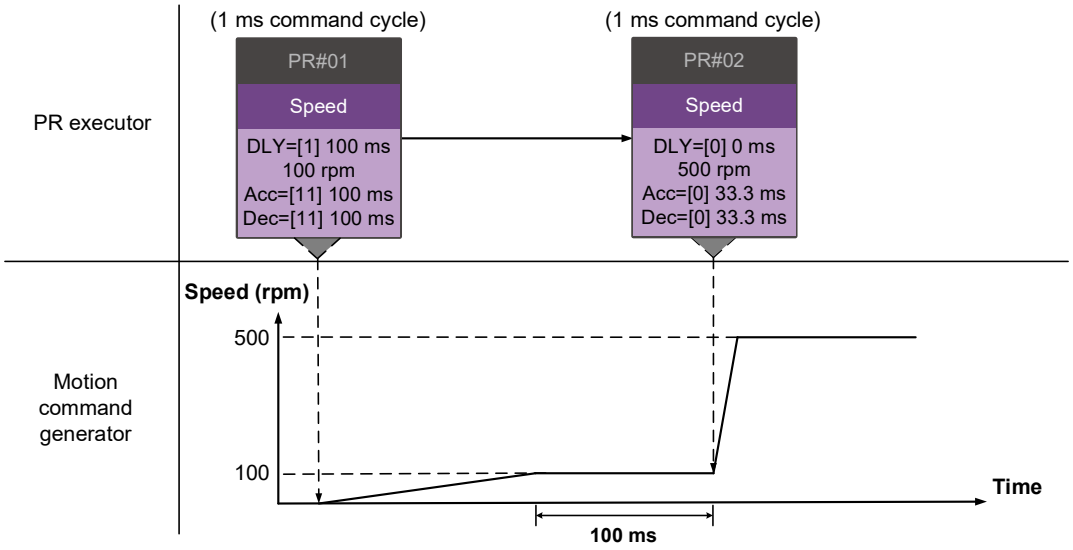
■ Speed command ▶ Speed command

When the PR executor receives two consecutive Speed commands without the Interrupt or Overlap function, the PR executor sends 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 sends the second Speed command for the generator to start the second part of speed control, as shown in 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, and then sends the second Speed command for the generator to start 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 commands

■ Multiple commands

The PR queue updates the commands every millisecond. For a motion command, the PR queue sends the next command to the motion command generator only after the previous command is complete. Jump or Write commands are executed by the PR executor immediately. As shown in Figure 7.1.6.4, in the first millisecond, the PR queue receives a Position command and the PR executor sends this command to the motion command generator for execution. In the second millisecond when the Position command is complete, the PR queue receives a Write command and the PR executor executes it immediately. In the next millisecond, the PR queue receives a Jump command and the PR executor executes it immediately as well. The Write and Jump commands are not sent to the motion command generator since the PR executor and the generator execute commands independently. In the next millisecond, the PR queue receives a Position command and the PR executor sends this command to the motion command generator for execution.

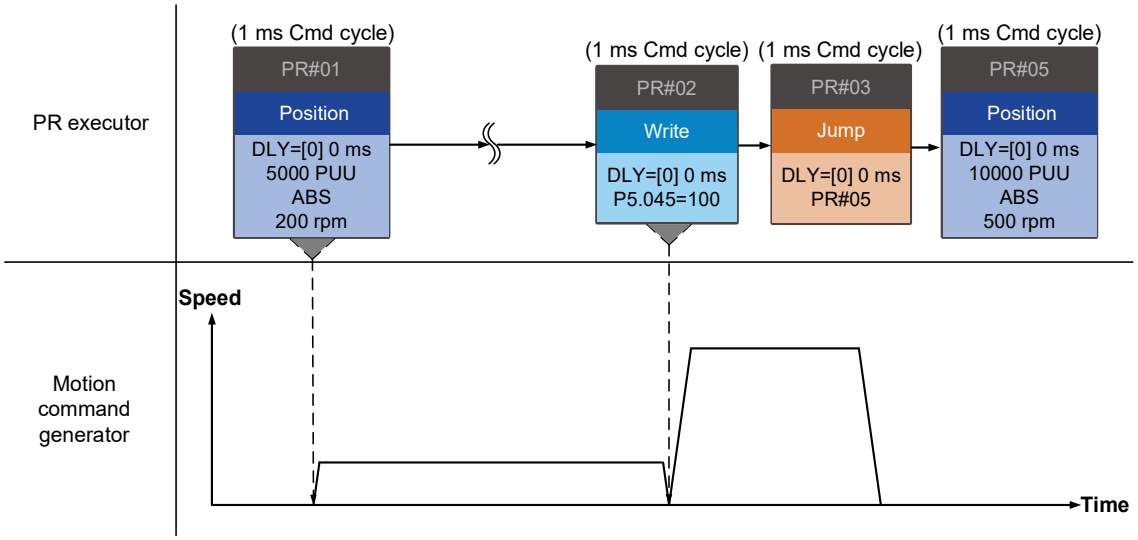


Figure 7.1.6.4 Multiple Sequence commands

7

Command interruption

The Interrupt function (INS) causes a command in execution to be replaced or integrated by the next command. The results of interruption differ based on the command types. There are two types of interruption: internal and external, as shown in Figure 7.1.6.5.

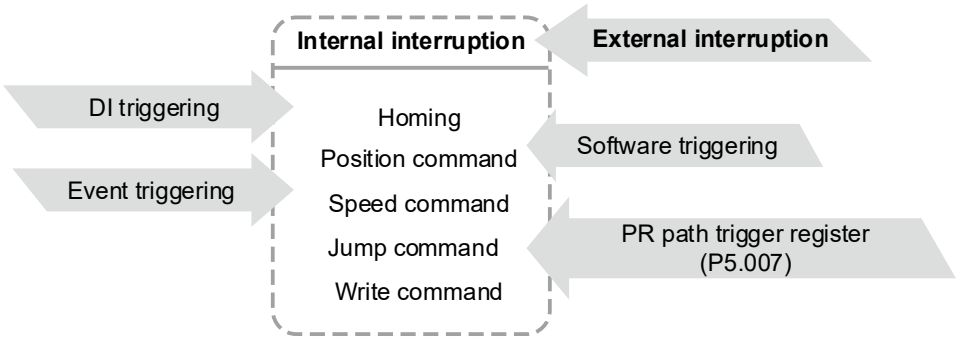


Figure 7.1.6.5 Internal and external interruption

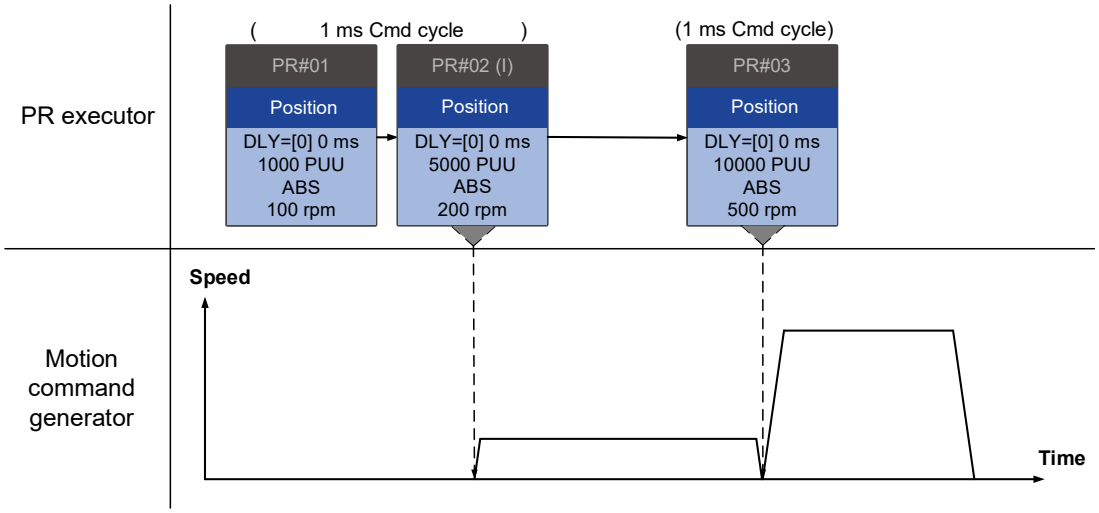
1. Internal interruption

For a series of PR paths, if one PR path includes the AUTO function (auto-execute the next path), the system continues to read the next path right after reading the current path instead of reading the next path after the current path is complete. If the current path includes a delay, the next path is read after the delay time is over. Meanwhile, if the next path includes the Interrupt function (which has a higher execution priority), the servo drive immediately executes the path set with the Interrupt function by replacing the un-executed commands in the previous path with the next path or integrating the commands of the previous path which are in execution with the next path.

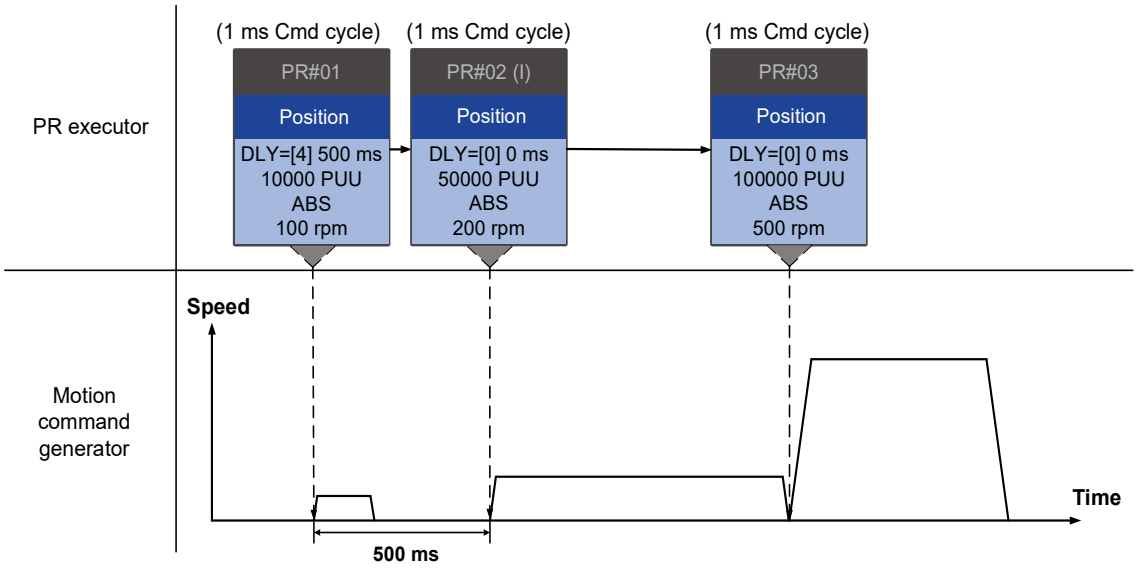
■ Position command ▶ Position command (I) ▶ Position command

When the PR executor receives three consecutive Position commands and the second one is set with the Interrupt function, it treats the first and second Position commands as one PR group. Since the first Position command is not yet executed by the PR executor, the PR executor replaces the first command with the second one and only sends the second one to the motion command generator for execution. After the second command is complete, the PR executor sends the third command to the generator (see Figure 7.1.6.6 (a)).

If the first command includes a delay, the PR executor sends the first command to the generator and then starts counting the delay time. After the delay time 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. Since this integration differs from that described in Section 7.1.3.3, refer to the following note for descriptions. Once the integrated command is complete, the PR 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 commands

Note: the way to integrate the position commands of internal interruption is slightly different from what is described in Section 7.1.3.3.
Generally, the relative position command (REL)'s target position = motor's current position + command value. However, for internal interruption, the relative position command (REL) works the same as the incremental position command (INC), with the target position = previous target position + command value. See the following example.
The rest of the integration method is the same as that mentioned in Section 7.1.3.3.

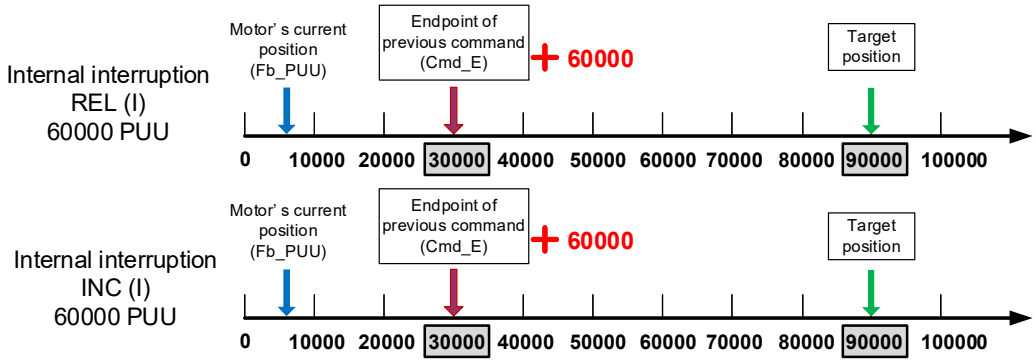
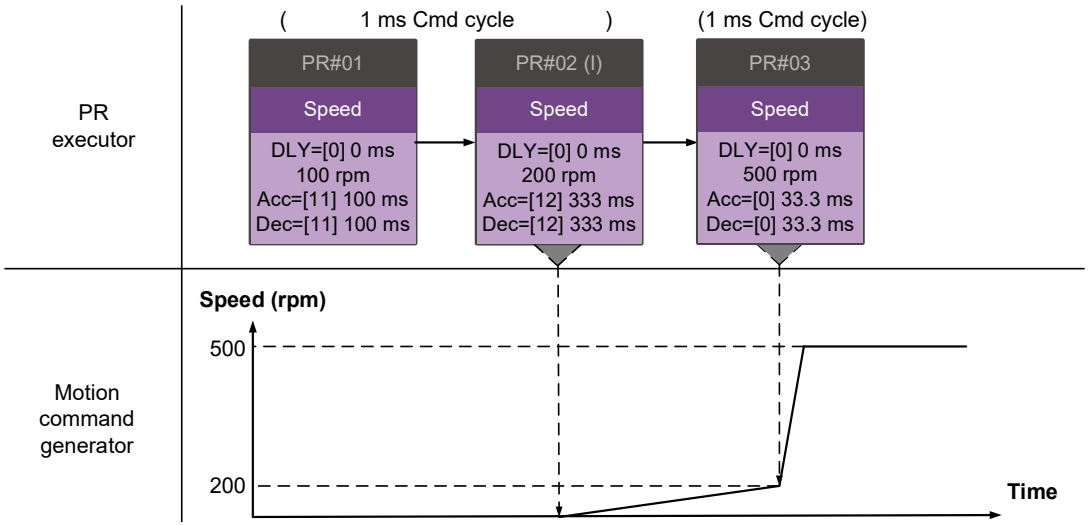


Figure 7.1.6.7 Example of relative and incremental position commands for internal interruption

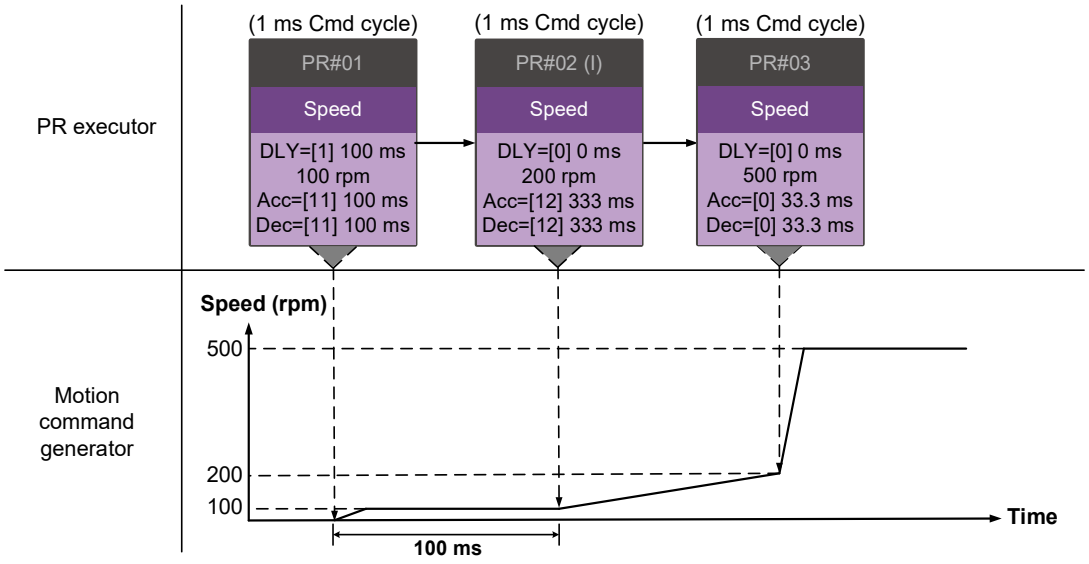
■ Speed command ▶ Speed command (I) ▶ Speed command

When the PR executor receives three consecutive Speed commands and the second command is set with the Interrupt function, it treats the first and second Speed commands as one PR group. Since the first Speed command is not yet executed by the PR executor, the PR executor replaces the first command with the second one and only sends the second one to the motion command generator for execution. After the second command is complete, the PR executor sends the third command to the generator (see Figure 7.1.6.8 (a)).

If the first command includes a delay, the PR executor sends the first command to the generator and then starts counting the delay time. After the delay time is over, the PR executor 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 complete, the PR executor sends the third command to the generator for execution (see Figure 7.1.6.8 (b)).



(a) Speed command without delay



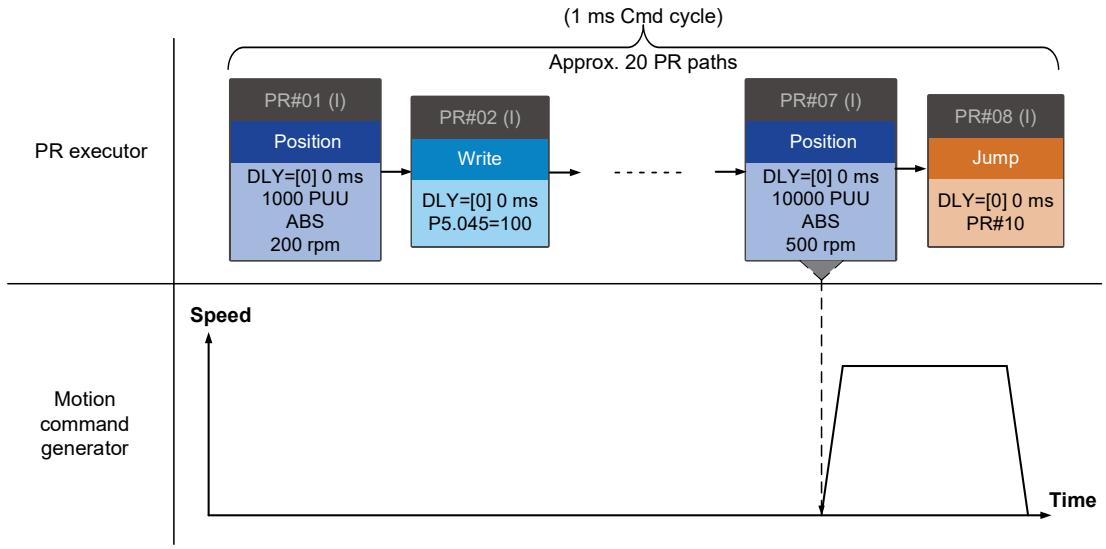
(b) Speed command with delay

Figure 7.1.6.8 Internal interruption - Speed commands

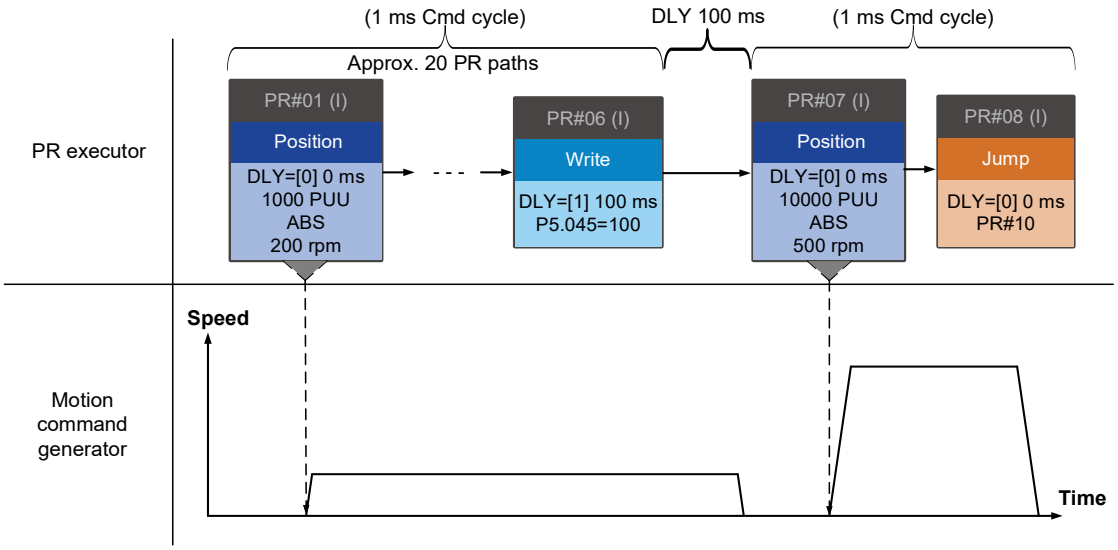
■ Multiple interruptions

The PR queue updates the commands every millisecond. If all PR paths are consecutive with the Interrupt functions and without delay, the PR queue can read at least 20 PR paths in 1 millisecond, and these paths are regarded as one PR group. If this PR group includes multiple motion commands, the PR queue only sends the last command it receives to the motion command generator for execution. That is, in a PR group, only one PR path with motion command is executed. The latter motion command directly replaces the former ones, whereas Jump and Write commands are executed by the PR executor as soon as they are received by the PR queue, as shown in Figure 7.1.6.9 (a).

If one of the PR paths includes a delay, the PR queue regards this PR path and the prior path(s) as the first PR group, and what follows is the second PR group. In this case, up to two PR paths with motion commands can be executed, as shown in Figure 7.1.6.9 (b).



(a) Multiple commands without delay



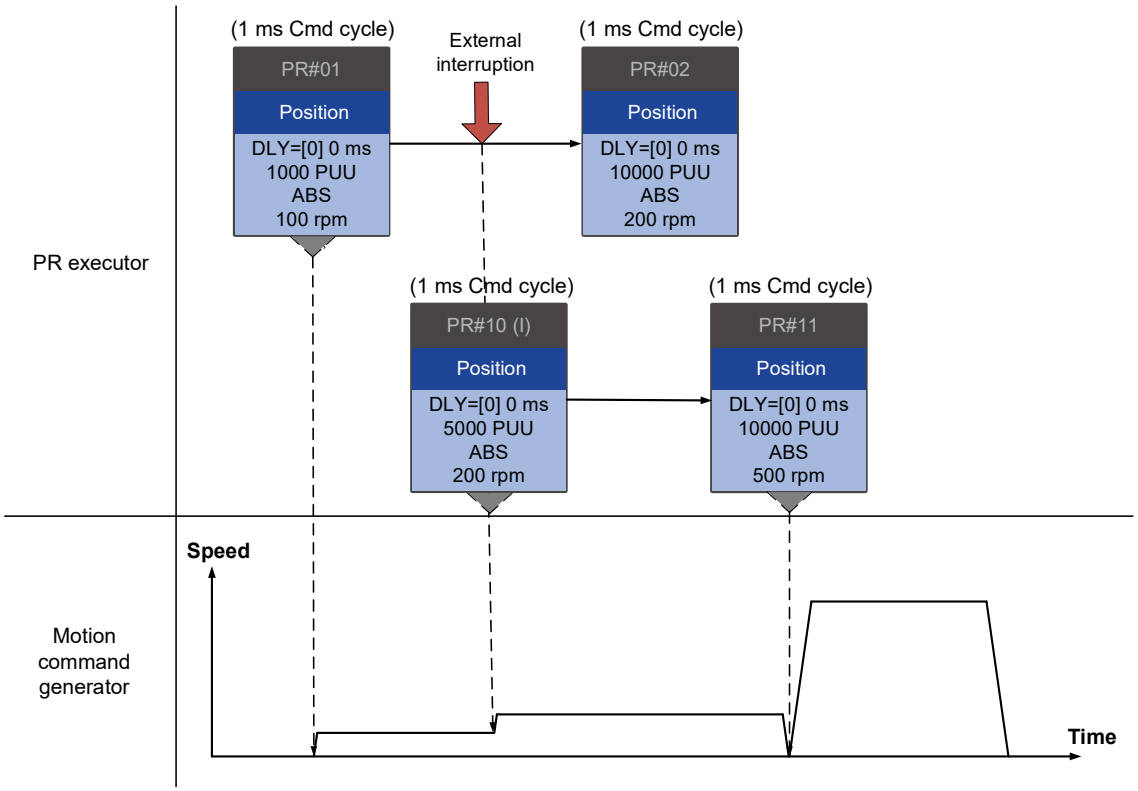
(b) Multiple commands with delay

Figure 7.1.6.9 Internal interruption - Multiple commands

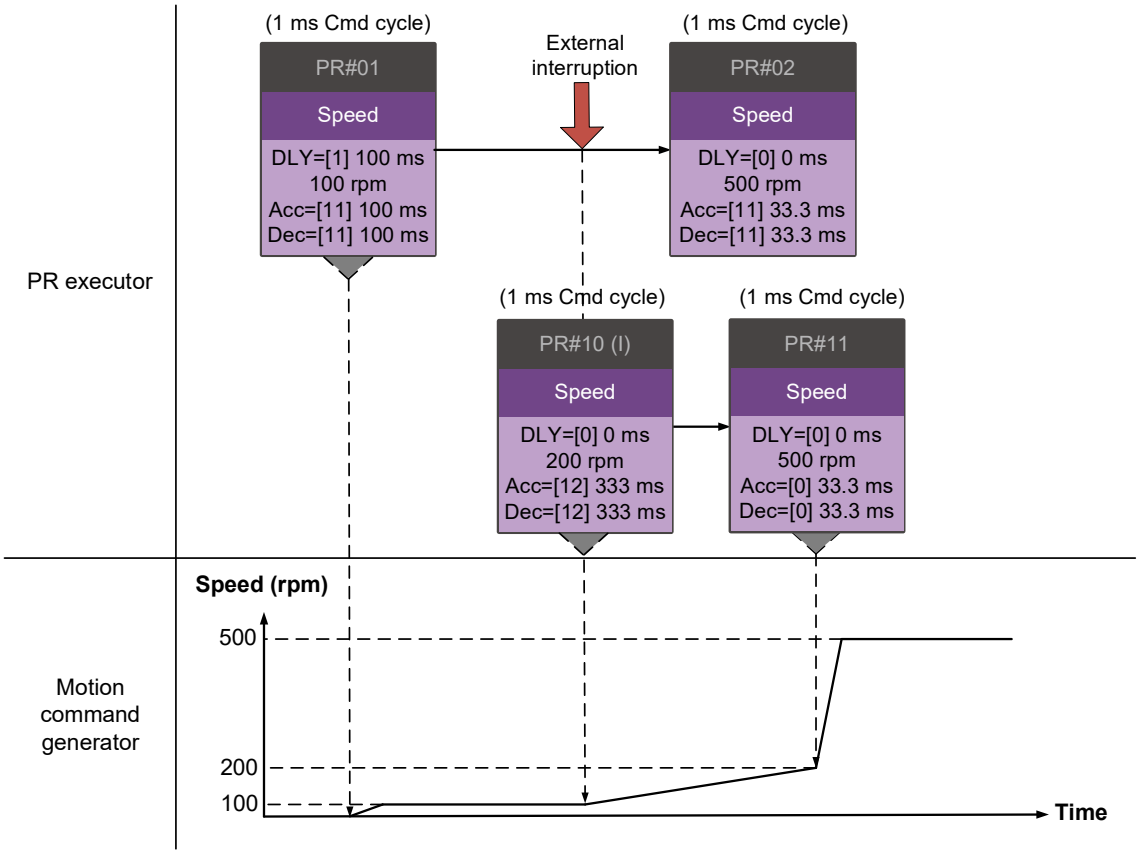
2. External interruption

When a PR path is being executed, if another PR path is forced to execute with any of the trigger methods for the PR path (refer to Section 7.1.5 for PR trigger methods), the PR queue receives the PR path with the Interrupt function and sends this path to the motion command generator immediately to change the path in execution. Note that a delay does not change the result of an external interruption. That is, once the PR queue receives a command set with the Interrupt function through external interruption, the next motion command is executed by the generator and integrated with the previous command.

The external interruption of the Position command is as shown in Figure 7.1.6.10 (a). If a PR path with the Interrupt function enters the PR executor by external interruption, the executor sends this Position command immediately to the motion command generator for execution. The motor then runs with the settings integrated with the previous motion command. The methods of integration are described in Section 7.1.3.3. The external interruption of the Speed commands is the same as that of the Position commands (see Figure 7.1.6.10 (b)), and the same is true for multiple commands.



(a) External interruption - Position command



(b) External interruption - Speed command

Figure 7.1.6.10 External interruption

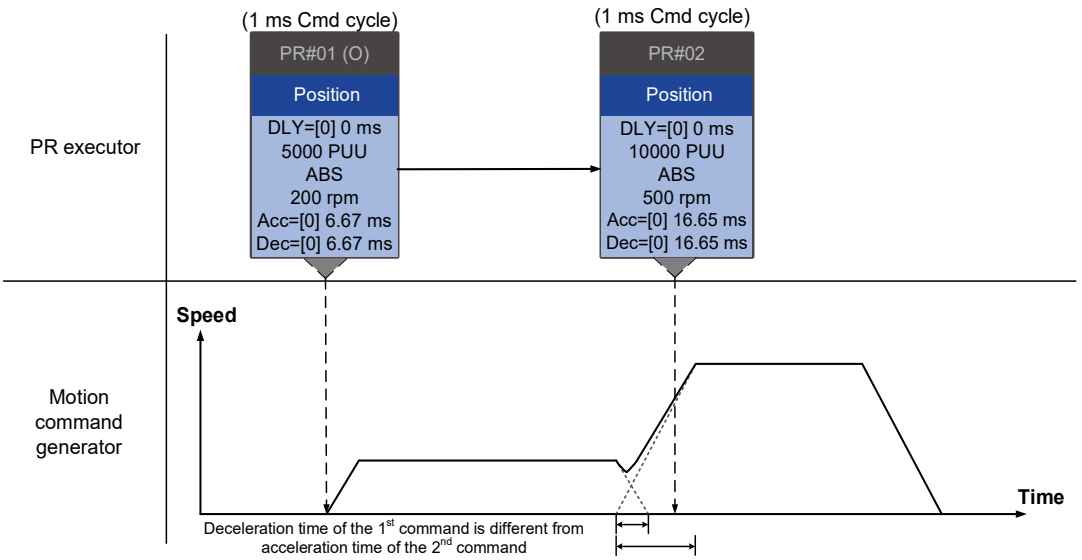
Command overlapping

If the previous position command includes the Overlap (OVLP) function, it allows the next command to be executed while the previous motion is decelerating, thus achieving a continuous motion. When you use the Overlap function, the delay time setting is still effective. The delay time starts to count from the start point of the command; however, in order to have a smooth command transition, setting the delay time to 0 is suggested. In addition, if the deceleration time of the previous command is identical to the acceleration time of the next command, the discontinuous speed during transition can be avoided, smoothing the transition between commands (see Figure 7.1.6.11).

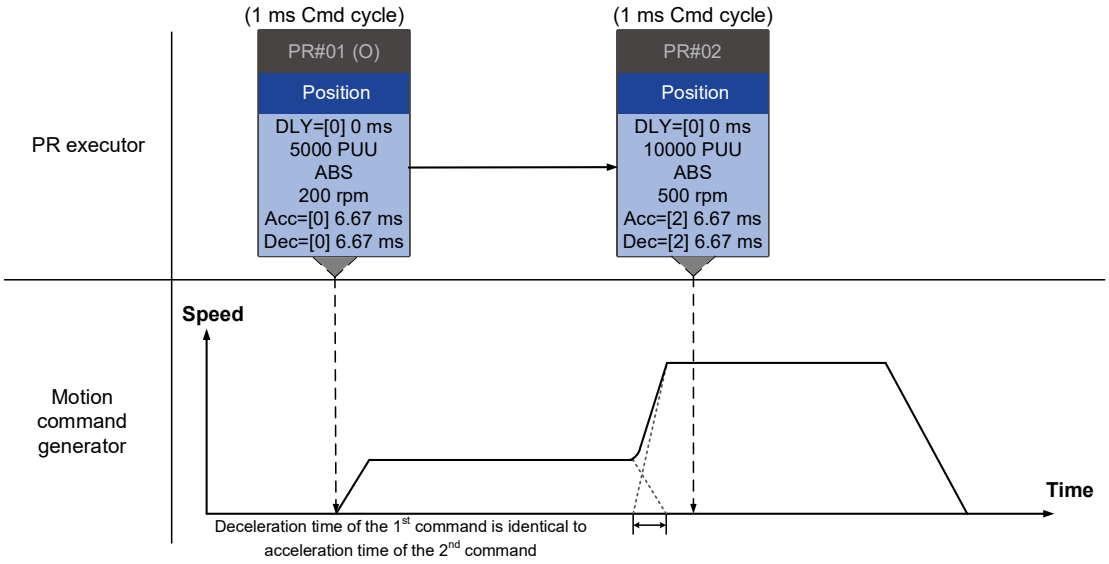
The relationship between the 1st target speed and its deceleration time and the relationship between the 2nd target speed and its acceleration time are as follows.

$$\frac{\text{1st target speed (Spd1)}}{3000} \times \text{Dec. time (Dec)} = \frac{\text{2nd target speed (Spd2)}}{3000} \times \text{Acc. time (Acc)}$$

Command interruption has a higher priority than command overlapping. Thus, when you set the Overlap function in the current Position command, and the next motion command includes the Interrupt function, only the command with the Interrupt function is executed.



(a) Command overlapping - Acceleration and deceleration times are different



(b) Command overlapping - Acceleration and deceleration times are identical

Figure 7.1.6.11 Command overlapping

Interpreting the PR path flow

As mentioned earlier, the PR paths include the Sequence command, the Interrupt function, the Overlap function, and so on. The replacement, integration, and overlapping of commands lead to different motion behaviors depending on the settings. The suggested steps to interpret a series of PR paths are as follows.

1. Check the command sequence. Check whether there are delay time (DLY) and Interrupt (INS) function because these two settings change the command execution sequence.
2. Find the lead PR and identify the PR groups of each millisecond.
3. In each PR group of 1 millisecond, only the last motion command is executed. Meanwhile, the Jump and Write commands are immediately executed in the PR executor.
4. Position commands are integrated based on the principle described in Section 7.1.3.3.

7.1.7 Data array

The data array stores up to 128 sets (0 - 127) of 32-bit data. Set P2.008 to 30 and then 35 to write the data to EEPROM; otherwise, the data in RAM is volatile.

You can read data from or write data to the data array with parameter settings through the drive panel or communication. The first group of parameters for reading and writing the data array are P5.011 to P5.013. P5.011 specifies the address of data array to be read and written. P5.012 and P5.013 read data from or write data to the data array address set by P5.011. The behaviors after reading and writing are different between P5.012 and P5.013. Refer to Table 7.1.7.1 for more information.

The second group of parameters for reading and writing the data array are P5.011 and P5.100 to P5.103. P5.011 specifies the address of data array to be read and written. P5.100 reads data from or writes data to the data array address set by P5.011. P5.101 reads data from or writes data to the data array address following the address set by P5.011. P5.102 and P5.103 work the same way. If the address increments and eventually exceeds the maximum value, the return content of the address is 0. Refer to Table 7.1.7.2 for descriptions and examples.

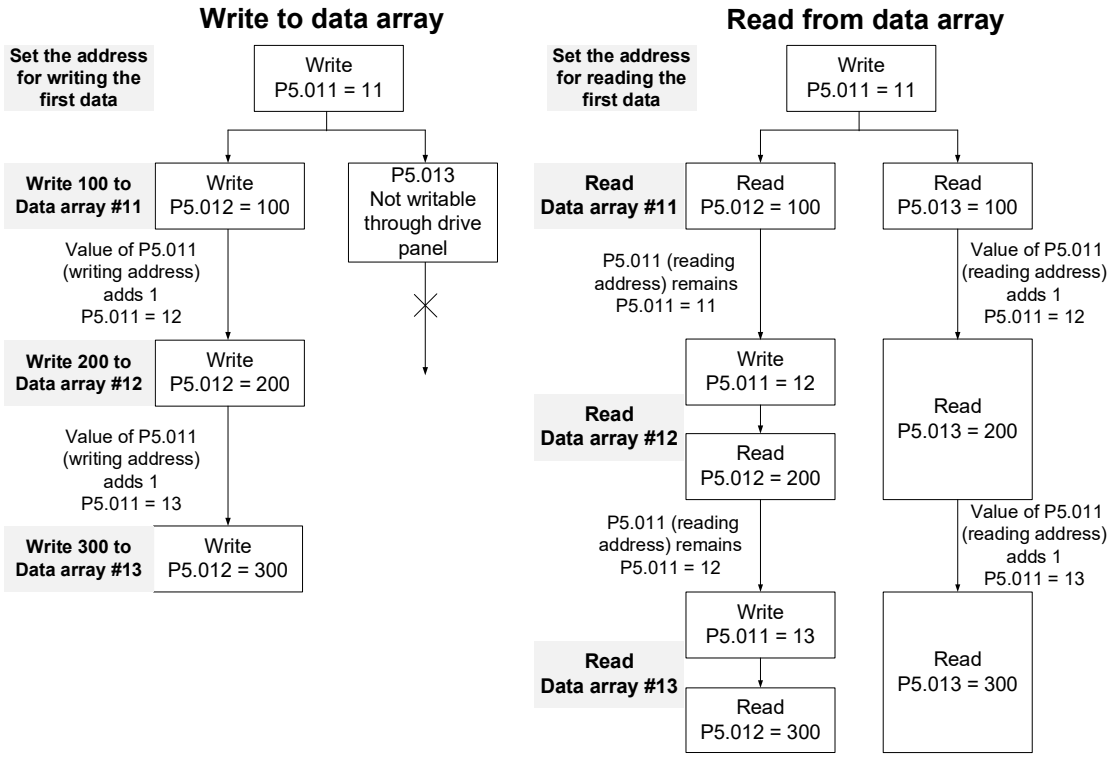
Table 7.1.7.1 Group 1 parameters for reading and writing the data array

Parameter	Description		
P5.011 Address for reading and writing	Specifies the data array address for reading and writing		
Window for reading and writing	Read / write through	Behavior after reading	Behavior after writing
P5.012 Window #1 for reading and writing	Drive panel	**Value of P5.011 does not add 1**	Value of P5.011 adds 1
	Communication	Value of P5.011 adds 1	Value of P5.011 adds 1
P5.013 Window #2 for reading and writing	Drive panel	Value of P5.011 adds 1	**Not writable through drive panel**
	Communication	Value of P5.011 adds 1	Value of P5.011 adds 1

Example: reading and writing the data array through the drive panel or communication.

Write values to the data array addresses in the following sequence: Data array #11 = 100, Data array #12 = 200, Data array #13 = 300. Then, read the data in the same sequence.

1. Read / write through the drive panel:



2. Read / write through communication:

To read from or write to the data array through Modbus, use the communication command 0x10 to write consecutively, 0x06 to write single data, and 0x03 to read consecutively. First, use the consecutive writing command to write 100 to Data array #11, 200 to Data array #12, and 300 to Data array #13.

When reading, use the single data writing command to set the start address as Data array #11, and then use the consecutive reading command to read P5.011 - P5.013 (Data array #11 and #12). Since P5.011 has been read twice, its value is incremented by 2, and you can continue to read from Data array #13.

Writing to the data array									
Packet	Communication command	Start address	Data length	P5.011		P5.012		P5.013	
				Low byte	High byte	Low word	High word	Low word	High word
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 from the data array									
Packet	Communication command	Start address	Data length	P5.011		P5.012		P5.013	
				Low byte	High byte	Low word	High word	Low word	High word
3	0x06	P5.011	-	11	0	-	-	-	-
4	0x03	P5.011	6 words	11	0	100	0	200	0
5	0x03	P5.011	6 words	13	0	300	0	0	0

Table 7.1.7.2 Group 2 parameters for reading and writing the data array

Parameter	Description	Example 1		Example 2	
P5.011 Address for reading and writing	Specifies the data array address for reading and writing	5		125	
Window for reading and writing	Description	Example 1		Example 2	
		Address	Content	Address	Content
P5.100 Window #3 for reading and writing	Reads from or writes to the address specified by P5.011.	5	1234	125	5678
P5.101 Window #4 for reading and writing	Reads from or writes to the first address following the address specified by P5.011.	6	2345	126	6789
P5.102 Window #5 for reading and writing	Reads from or writes to the second address following the address specified by P5.011.	7	3456	127	7890
P5.103 Window #6 for reading and writing	Reads from or writes to the third address following the address specified by P5.011.	8	4567	x	0

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Parameters

8

This chapter introduces the parameter settings of the servo drive, as well as the descriptions for digital input (DI), digital output (DO), and monitoring variables. You can control the drive functions with these parameters and DI/O.

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8.2 Parameter descriptions ····· 8-3
P0.xxx Monitoring parameters ····· 8-3
P1.xxx Basic parameters ····· 8-18
P2.xxx Extension parameters ····· 8-48
P3.xxx Communication parameters ····· 8-81
P4.xxx Diagnosis parameters ····· 8-87
P5.xxx Motion control parameters ····· 8-95
P6.xxx PR parameters ····· 8-119
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Table 8.3 Monitoring variables descriptions ····· 8-173

8.1 Parameter definitions

The servo drive parameters are divided into eight groups. The first character after the start code P is the group number 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:

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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:

PR: Position control (command sent from internal register)
S: Speed control
T: Torque control
EtherCAT: Communication control

Special symbol description:

Icon of parameter property	Description
★	Read-only parameter. Can only read the value of the parameter.
▲	Parameter cannot be changed when servo is in Servo On state.
●	Parameter changes become valid after power cycling.
■	Parameter resets to its default value after power cycling.

8.2 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
Model:	E3C-E, E3C-E1, E3C-EF		

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

For the list of alarms, refer to Section 11.1 Alarm list.

P0.002	Drive status		Address: 0004H 0005H
Default:	1	Control mode:	All
Unit:	-	Setting range:	-4095 to +127
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Input the monitoring code into P0.002 to view changes to the variable on the panel. For the list of monitoring variables, refer to Table 8.3 Monitoring variables descriptions.

P0.003 - P0.007	Reserved

8

P0.008★	Total servo drive operation time		Address: 0010H 0011H
Default:	0x00000000	Control mode:	All
Unit:	hour	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

High word

D C B A

Low word

U Z Y X

DCBA	Total Servo On time	UZYX	Total power-on time

Displays the total power-on time and Servo On time of the servo drive from the date of shipment. The time is in hours and durations of less than 1 hour are not recorded. The recorded hours are non-volatile.

P0.009★■	Status monitoring register 1		Address: 0012H 0013H
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Set the status to be read from P0.009 in P0.017 through the drive panel or communication (refer to P0.002). To access the status data, read the communication addresses through the communication port or monitor the value through the panel (set P0.002 to 23, and the panel displays “VAR-1” and then the value of P0.009).

For example, when you set P0.017 to 7, reading P0.009 can access the motor speed (rpm). To access the data through Modbus communication, have the servo drive read two 16-bit values (0012H and 0013H) as a single 32-bit value. (0013H : 0012H) = (High word : Low word). To monitor the data through the drive panel, set P0.002 to 23 and the panel displays “VAR-1” and then 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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Set the status to be read from P0.010 in P0.018 through the drive panel or communication (refer to P0.002). To access the status data, read the communication addresses through the communication port or monitor the value through the panel (set P0.002 to 24, and the panel displays “VAR-2” and then the value of P0.010).

P0.011★■	Status monitoring register 3		Address: 0016H 0017H
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Set the status to be read from P0.011 in P0.019 through the drive panel or communication (refer to P0.002). To access the status data, read the communication addresses through the communication port or monitor the value through the panel (set P0.002 to 25, and the panel displays “VAR-3” and then 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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Set the status to be read from P0.012 in P0.020 through the drive panel or communication (refer to P0.002). To access the status data, read the communication addresses through the communication port or monitor the value through the panel (set P0.002 to 26, and the panel displays “VAR-4” and then 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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Set the status to be read from P0.013 in P0.021 through the drive panel or communication (refer to P0.002). To access the status data, read the communication addresses through the communication port.

P0.014 - P0.016	Reserved

P0.017	Specifying content of status monitoring register 1		Address: 0022H 0023H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-4095 to +127
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to Table 8.3 for the available values.

For example, if you set P0.017 to 7, then reading P0.009 can access the motor speed (rpm).

P0.018	Specifying content of status monitoring register 2		Address: 0024H 0025H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-4095 to +127
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to Table 8.3 for the available values.

P0.019	Specifying content of status monitoring register 3		Address: 0026H 0027H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-4095 to +127
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to Table 8.3 for the available values.

P0.020	Specifying content of status monitoring register 4		Address: 0028H 0029H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-4095 to +127
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to Table 8.3 for the available values.

P0.021	Specifying content of status monitoring register 5		Address: 002AH 002BH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-4095 to +127
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to Table 8.3 for the available values.

P0.022 - P0.024	Reserved

P0.025■	Mapping parameter 1		Address: 0032H 0033H
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

You can continuously read and write two different parameters faster with mapping parameters. Use P0.035 to specify the parameter numbers to be read or written with the mapping parameter through the panel or communication. The value of the parameter that is specified by P0.035 is shown in P0.025. Refer to P0.035 for its settings.

P0.026■	Mapping parameter 2		Address: 0034H 0035H
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.042.

P0.033 - P0.034	Reserved

P0.035	Target setting for mapping parameter P0.025		Address: 0046H 0047H
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The formats of the parameter high word (PH) and parameter low word (PL) are:

High word

D C BA

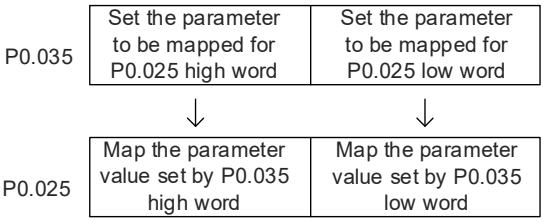
Low word

U Z YX

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	Reserved	U	Reserved

Select the corresponding parameter(s) for the data block access register 1 (P0.035). The mapping value is 32 bits and can map to two 16-bit parameters or one 32-bit parameter.

P0.035: (Parameter to be mapped: P0.035; Content of mapping parameter: P0.025)

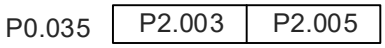


1. When PH ≠ PL, it indicates that the content of P0.025 includes two 16-bit parameters.

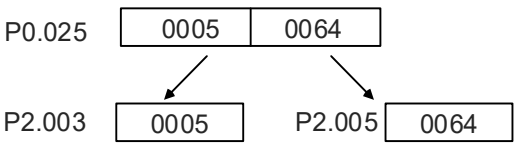
   Example: Target: set P2.003 to 5 and P2.005 to 100 through the mapping parameter.

   Setting: set the P0.035 high word to 0203 (P2.003) and low word to 0205 (P2.005).

   Thus, P0.035 = 0x02030205.



   Write: set 0x00050064 to the mapping parameter P0.025, and the values of P2.003 and P2.005 are:

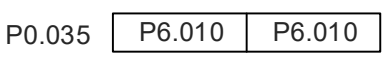


2. When PH = PL = P, it indicates that the content of P0.025 includes one 32-bit parameter.

   Example: Target: set P6.010 to 0x00050064 through the mapping parameter.

   Setting: set both the high word and low word of P0.035 to 060A (P6.010).

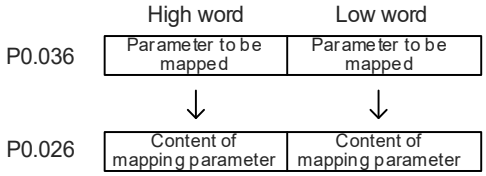
   Thus, P0.035 = 0x060A060A.



   Write: set 0x00050064 to the mapping parameter P0.025, and P6.010 changes immediately.

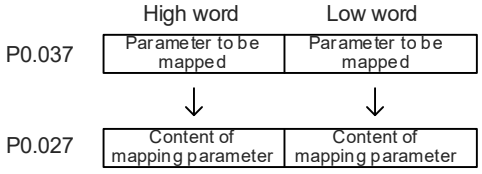
P0.036	Target setting for mapping parameter P0.026		Address: 0048H 0049H
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:



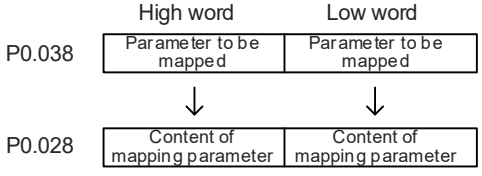
P0.037	Target setting for mapping parameter P0.027		Address: 004AH 004BH
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:



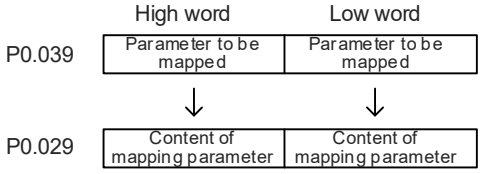
P0.038	Target setting for mapping parameter P0.028		Address: 004CH 004DH
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:



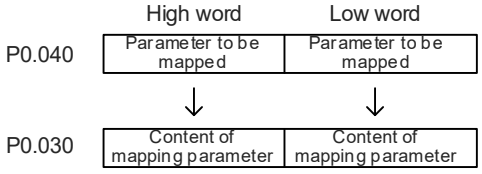
P0.039	Target setting for mapping parameter P0.029		Address: 004EH 004FH
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:



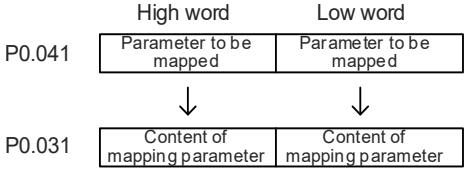
P0.040	Target setting for mapping parameter P0.030		Address: 0050H 0051H
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:



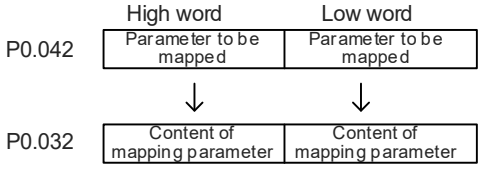
P0.041	Target setting for mapping parameter P0.031		Address: 0052H 0053H
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:



P0.042	Target setting for mapping parameter P0.032		Address: 0054H 0055H
Default:	-	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:



P0.043	Reserved

P0.044★■	Status monitoring register (for PC software)		Address: 0058H 0059H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

This setting is the same as P0.009.

P0.045■	Specifying content of status monitoring register (for PC software)		Address: 005AH 005BH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-4095 to +127
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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:	0x0000 to 0x00FF
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Bit	Function	Bit	Function
0	SRDY (servo ready)	8	HOME (homing complete)
1	SON (Servo On)	9	OLW (early warning for motor overload)
2	ZSPD (zero speed detection)	10	WARN (Servo warning, CW, CCW, EMGS, undervoltage, or communication error)
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 (electromagnetic brake control output)	15	Reserved

P0.047 - P0.048	Reserved

P0.049■	Updating encoder absolute position		Address: 0062H 0063H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0002
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

X	Command processing	Z	Reserved
Y	Reserved	U	Reserved

■ X: command processing

0: N/A

1: update the encoder data to P0.051 - P0.052.

2: update P0.051 - P0.052 and clear the position error. When this 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 position system status		Address: 0064H 0065H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0xFFFF
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0	Absolute position status	0: normal. 1: lost.
Bit 1	Battery voltage status	0: normal. 1: undervoltage.
Bit 2	Status of absolute number of revolutions	0: normal. 1: overflows.
Bit 3	PUU status	0: normal. 1: overflows.
Bit 4	Absolute position status	0: established. 1: not yet established.
Bit 5 - Bit 15	Reserved	-

P0.051★■	Encoder absolute position - number of revolutions		Address: 0066H 0067H
Default:	0	Control mode:	All
Unit:	rev	Setting range:	-32768 to +32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When P2.070 [Bit 1] = 1, P0.051 displays the encoder's absolute position in the form of number of revolutions.

When P2.070 [Bit 1] = 0, P0.051 becomes invalid and the panel displays 0.

P0.052★■	Encoder absolute position - pulse number within single turn or PUU		Address: 0068H 0069H
Default:	0	Control mode:	All
Unit:	pulse or PUU	Setting range:	0 to 16777216-1 (pulse) -2147483648 to +2147483647 (PUU)
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When P2.070 [Bit 1] = 1, P0.052 displays the encoder's absolute position in the form of pulse number within a single turn.

When P2.070 [Bit 1] = 0, P0.052 displays the motor's absolute position in PUU.

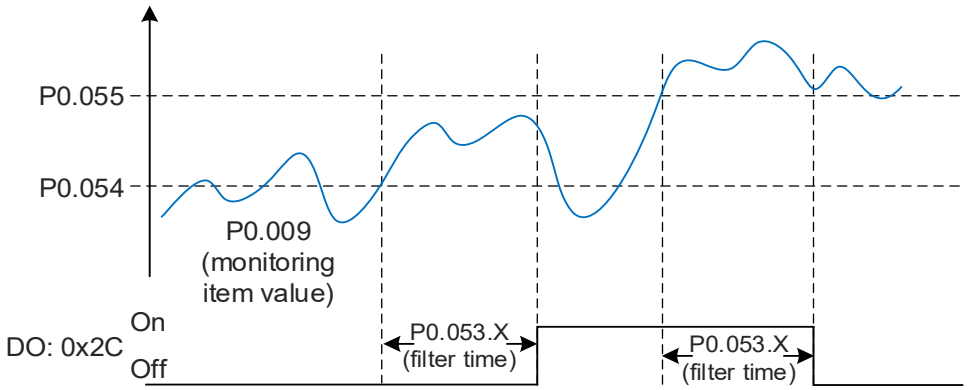
P0.053	General range compare digital output - filter time		Address: 006AH 006BH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0xFFFF
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

X	First filter time	Z	Third filter time
Y	Second filter time	U	Fourth filter time

Note: the minimum filter time is 1 ms (set value 0 = 1 ms; 1 = 2 ms; 2 = 3 ms; ...; F = 16 ms).

Example of the first filter:



P0.054	General range compare digital output 1 - lower limit		Address: 006CH 006DH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Before using this function, set the digital output function to 0x2C (first set of general range comparison) and the monitoring item of P0.017. When P0.009 (monitoring item value) is within the range defined by P0.054 and P0.055, and after the filter time set in P0.053.X has elapsed, this digital output is On.

P0.055	General range compare digital output 1 - upper limit		Address: 006EH 006FH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P0.054.

P0.056	General range compare digital output 2 - lower limit		Address: 0070H 0071H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Before using this function, set the digital output function to 0x2D (second set of general range comparison) and the monitoring item of P0.018. When P0.010 (monitoring item value) is within the range defined by P0.056 and P0.057, and after the filter time set in P0.053.Y has elapsed, this digital output is On.

P0.057	General range compare digital output 2 - upper limit		Address: 0072H 0073H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P0.056.

P0.058	General range compare digital output 3 - lower limit		Address: 0074H 0075H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Before using this function, set the digital output function to 0x2E (third set of general range comparison) and the monitoring item of P0.019. When P0.011 (monitoring item value) is within the range defined by P0.058 and P0.059, and after the filter time set in P0.053.Z has elapsed, this digital output is On.

P0.059	General range compare digital output 3 - upper limit		Address: 0076H 0077H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P0.058.

P0.060	General range compare digital output 4 - lower limit		Address: 0078H 0079H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Before using this function, set the digital output function to 0x2F (fourth set of general range comparison) and the monitoring item of P0.020. When P0.012 (monitoring item value) is within the range defined by P0.060 and P0.061, and after the filter time set in P0.053.U has elapsed, this digital output is On.

P0.061	General range compare digital output 4 - upper limit		Address: 007AH 007BH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P0.060.

P0.062	Reserved

P0.063★	Total duration of DC Bus overvoltage		Address: 007EH 007FH
Default:	0	Control mode:	All
Unit:	ms	Setting range:	0 to 2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

220V models: records the total time during which the voltage of the DC Bus exceeded 400V.

400V models: records the total time during which the voltage of the DC Bus exceeded 740V.

P0.064 - P0.078	Reserved

P0.079★	IGBT highest temperature		Address: 009EH 009FH
Default:	0	Control mode:	All
Unit:	°C	Setting range:	0 to 2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Records the highest IGBT temperature.

P0.080 - P0.100	Reserved

P1.xxx Basic parameters

P1.000	Reserved

P1.001●	Input for control mode and control command		Address: 0102H 0103H
Default:	0x000C	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x112F
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

YX	Control mode setting	Z	Direction control
-	-	U	DIO value control

■ YX: control mode setting

Mode	PR	S	T	Sz	Tz
01	▲				
02		▲			
03			▲		
04				▲	
05					▲
Dual mode					
08	▲	▲			
09	▲		▲		
0A		▲	▲		
0C	EtherCAT mode				

PR: Position control mode; the command source is from the 100 sets of internal registers which you can select with DI.POS0 - DI.POS6. Multiple homing methods are also available.

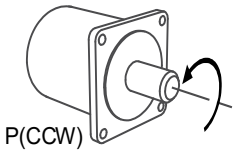
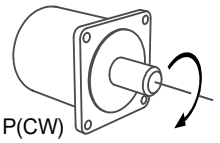
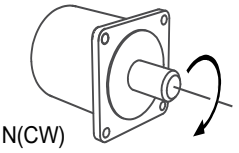
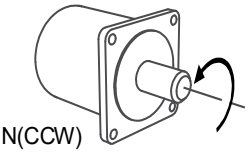
S / Sz: Speed control mode; the speed command is zero or the command source is from the internal speed registers which you can select with DI.SPD0 and DI.SPD1.

T / Tz: Torque control mode; the torque command is zero or the command source is from the internal torque registers which you can select with DI.TCM0 and DI.TCM1.

Dual mode: you can switch between two modes with the external DI. Refer to Table 8.1 for further information.

Communication mode: the command source is from the external fieldbus controller, which sends the command to the servo drive through direct communication.

■ Z: direction control

	Z = 0	Z = 1
Positive direction		
Negative direction		

■ U: DIO value control (volatile)

0: when modes are switched, DIO settings remain the same.

1: when modes are switched, DIO settings are reset to the default for each mode.

Note: different servo drive models have different default settings for each mode; refer to Chapter 3.

P1.002▲	**Speed and torque limits**		**Address: 0104H 0105H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0011
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

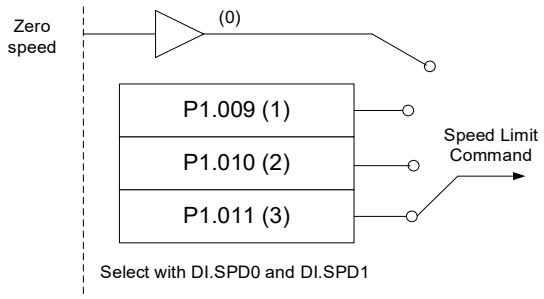
X	Disable / enable Speed Limit function	Z	Reserved
Y	Disable / enable Torque Limit function	U	Reserved

■ X: disable / enable Speed Limit function

0: disable Speed Limit function

1: enable Speed Limit function (only available in T and Tz modes)

See the following diagram for Speed Limit setting:



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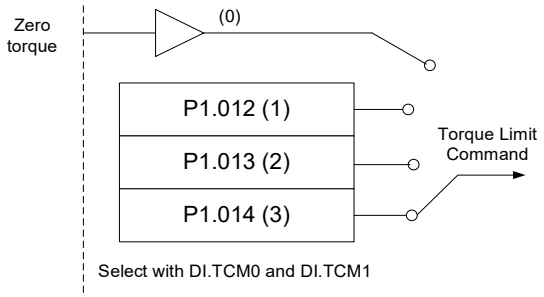
- Y: disable / enable Torque Limit function

  0: disable Torque Limit function

  1: enable Torque Limit function

  See the following diagram for Torque Limit setting:



When using the Torque Limit function, set P1.002.Y = 1 to enable the Torque Limit function permanently without occupying a DI setting. Alternatively, you can enable or disable the Torque Limit function with 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.

P1.003 - P1.005	Reserved

P1.006	Speed command - smoothing constant (low-pass filter)		Address: 010CH 010DH
Default:	0	Control mode:	S / Sz
Unit:	ms	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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 to 1000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

0: disable this function.

P1.008	Position command - smoothing constant (low-pass filter)		Address: 0110H 0111H
Default:	0	Control mode:	PR
Unit:	10 ms	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Example:	11 = 110 ms		
Model:	E3C-E, E3C-E1, E3C-EF		

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	Setting range:	-75000 to +75000
Format:	DEC	Data size:	32-bit
Example:	Internal Speed command: 120 = 12 rpm Internal speed limit: positive and negative values are identical. Refer to the following descriptions.		
Model:	E3C-E, E3C-E1, E3C-EF		

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			

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	Setting range:	-75000 to +75000
Format:	DEC	Data size:	32-bit
Example:	Internal Speed command: 120 = 12 rpm Internal speed limit: positive and negative values are identical. Refer to the following descriptions.		
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Internal Speed command 2: second internal Speed command.

Internal speed limit 2: second internal speed limit.

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			

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	Setting range:	-75000 to +75000
Format:	DEC	Data size:	32-bit
Example:	Internal Speed command: 120 = 12 rpm Internal speed limit: positive and negative values are identical. Refer to the following descriptions.		
Model:	E3C-E, E3C-E1, E3C-EF		

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			

P1.012	Internal Torque command 1 / internal torque limit 1		Address: 0118H 0119H
Default:	100	Control mode:	T / Tz: internal Torque command 1 PR / S / Sz: internal torque limit 1
Unit:	%	Setting range:	-5000 to +5000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Internal Torque command 1: first internal Torque command.

Internal torque limit 1: first internal torque limit.

1. When P2.112 [Bit 14] = 0

Internal Torque command: 35 = 35%

Internal torque limit: positive and negative values are identical. Refer to the following descriptions.

Torque limit value of P1.012	Valid torque range	Torque limit in forward direction	Torque limit in reverse direction
35	-35% to +35%	35%	-35%
-35			

2. When P2.112 [Bit 14] = 1

Internal Torque command: 35 = 3.5%

Internal torque limit: positive and negative values are identical. Refer to the following descriptions.

Torque limit value of P1.012	Valid torque range	Torque limit in forward direction	Torque limit in reverse direction
35	-3.5% to +3.5%	3.5%	-3.5%
-35			

P1.013	Internal Torque command 2 / internal torque limit 2		Address: 011AH 011BH
Default:	100	Control mode:	T / Tz: internal Torque command 2 PR / S / Sz: internal torque limit 2
Unit:	%	Setting range:	-5000 to +5000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Internal Torque command 2: second internal Torque command.

Internal torque limit 2: second internal torque limit.

1. When P2.112 [Bit 14] = 0

Internal Torque command: 35 = 35%

Internal torque limit: positive and negative values are identical. Refer to the following descriptions.

Torque limit value of P1.013	Valid torque range	Torque limit in forward direction	Torque limit in reverse direction
35	-35% to +35%	35%	-35%
-35			

2. When P2.112 [Bit 14] = 1

Internal Torque command: 35 = 3.5%

Internal torque limit: positive and negative values are identical. Refer to the following descriptions.

Torque limit value of P1.013	Valid torque range	Torque limit in forward direction	Torque limit in reverse direction
35	-3.5% to +3.5%	3.5%	-3.5%
-35			

P1.014	Internal Torque command 3 / internal torque limit 3		Address: 011CH 011DH
Default:	100	Control mode:	T / Tz: internal Torque command 3 PR / S / Sz: internal torque limit 3
Unit:	%	Setting range:	-5000 to +5000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Internal Torque command 3: third internal Torque command.

Internal torque limit 3: third internal torque limit.

1. When P2.112 [Bit 14] = 0

Internal Torque command: 35 = 35%

Internal torque limit: positive and negative values are identical. Refer to the following descriptions.

Torque limit value of P1.014	Valid torque range	Torque limit in forward direction	Torque limit in reverse direction
35	-35% to +35%	35%	-35%
-35			

2. When P2.112 [Bit 14] = 1

Internal Torque command: 35 = 3.5%

Internal torque limit: positive and negative values are identical. Refer to the following descriptions.

Torque limit value of P1.014	Valid torque range	Torque limit in forward direction	Torque limit in reverse direction
35	-3.5% to +3.5%	3.5%	-3.5%
-35			

P1.015 - P1.021	Reserved

P1.022	PR command special filter		Address: 012CH 012DH
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 to 0x107F
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

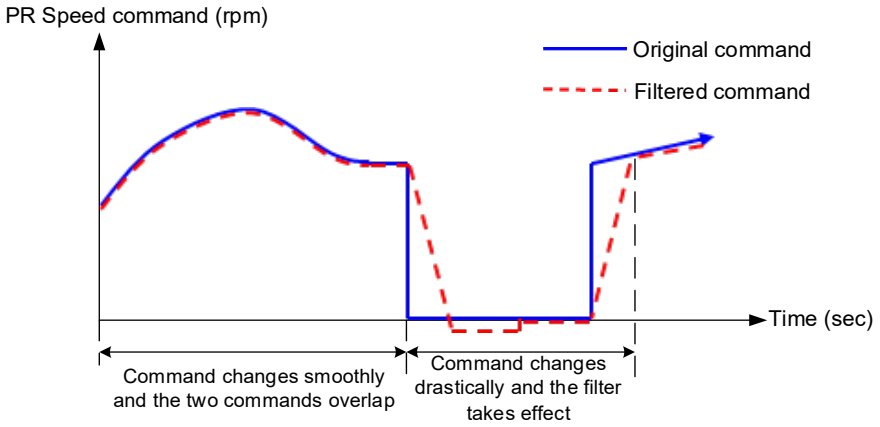
YX	Acceleration / deceleration time limit (0 - 1270 ms)	Z	Reserved
-	-	U	Reverse inhibit

■ YX: acceleration / deceleration time limit (0 - 1270 ms)

If the PR Speed command changes too drastically, it causes mechanical vibration. Set the acceleration / deceleration time limit (the time required for the motor to accelerate from 0 to 3,000 rpm or to decelerate from 3,000 rpm to 0) with this function. If the acceleration / deceleration time of the command is shorter than this limit, the filter takes effect to smooth the acceleration / deceleration which prevents the command from changing too drastically and causing mechanical vibration. When the filter is functioning, the following error caused by the smooth command is automatically compensated after the command is smoothed, so the final position is not deviated.

Example:

Set YX to 12 (data format is HEX and unit is 10 ms) and thus the acceleration / deceleration time limit is 180 ms. If the acceleration / deceleration time of the PR Speed command is shorter than 180 ms, the filter takes effect. If the acceleration / deceleration time of the PR Speed command is longer than 180 ms, the filter does not take effect.



Note: if the command keeps changing drastically, the following error of the internal position exceeds the allowable range and then triggers AL404.

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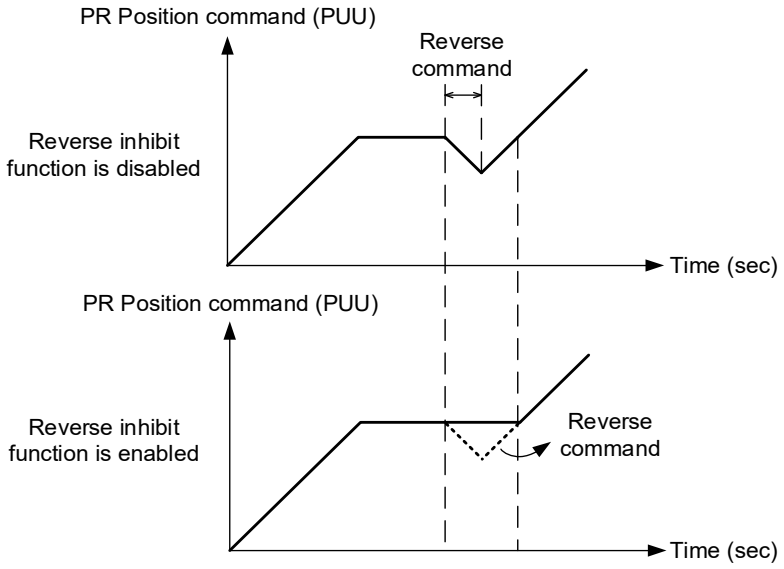
- U: reverse inhibit

  0: disable this function

  1: enable this function. When the value of the current PR Position command is lower than that of the previous position command, the motor does not move.



P1.023 - P1.024	Reserved

P1.025	Low-frequency vibration suppression frequency 1		Address: 0132H 0133H
Default:	1000	Control mode:	PR
Unit:	0.1 Hz	Setting range:	10 to 1000
Format:	DEC	Data size:	16-bit
Example:	150 = 15 Hz		
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The frequency of the first low-frequency vibration suppression filter. 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:	PR
Unit:	-	Setting range:	0 to 9
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The gain of the first low-frequency vibration suppression filter. Increasing the value improves the position response. If you set the value too high, the motor may not operate smoothly. The suggested value is 1. Setting P1.026 to 0 disables the first low-frequency vibration suppression filter.

P1.027	Low-frequency vibration suppression frequency 2		Address: 0136H 0137H
Default:	1000	Control mode:	PR
Unit:	0.1 Hz	Setting range:	10 to 1000
Format:	DEC	Data size:	16-bit
Example:	150 = 15 Hz		
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The frequency of the second low-frequency vibration suppression filter. When you set P1.028 to 0, the second low-frequency vibration suppression filter is disabled.

P1.028	Low-frequency vibration suppression gain 2		Address: 0138H 0139H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	0 to 9
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The gain of the second low-frequency vibration suppression filter. Increasing the value improves the position response. If you set the value too high, the motor may not operate smoothly. The suggested value is 1. Setting P1.028 to 0 disables the second low-frequency vibration suppression filter.

P1.029	Auto low-frequency vibration suppression mode		Address: 013AH 013BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	0 to 1
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Setting value	Description
0	Disable the automatic low-frequency vibration detection function.
1	Vibration suppression is in automatic mode. When the vibration frequency 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.

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P1.030	Low-frequency vibration detection		Address: 013CH 013DH
Default:	8000	Control mode:	PR
Unit:	pulse	Setting range:	1 to 128000
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Sets the detection level when automatic vibration suppression is enabled (P1.029 = 1). Setting P1.030 lower improves the detection sensitivity, but the system may treat noise or minor low-frequency vibrations as frequencies to be suppressed. Setting P1.030 higher reduces the possibility of misjudgment, but if the vibration of the machine is small, the system may not properly detect low-frequency vibrations.

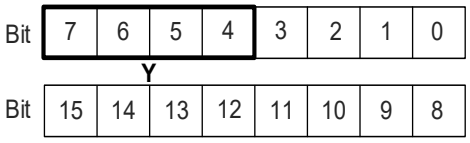
P1.031	Reserved

P1.032	Motor stop mode		Address: 0140H 0141H
Default:	0x0010	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0060
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

X	Reserved	Z	Reserved
Y	Motor stop mode	U	Reserved

■ Y: motor stop mode



Bit	Function	Description
Bit 5, Bit 4	Dynamic brake operation options	Options for stopping the motor when the servo is in the Servo Off state or an alarm (including EMGS) occurs Bit 5 = 0 and Bit 4 = 0: use dynamic brake Bit 5 = 0 and Bit 4 = 1: motor runs freely Bit 5 = 1 and Bit 4 = 0: use dynamic brake first, and then let the motor run freely once the speed is slower than the value of P1.038
Bit 6	Trigger stop command when RST power error (AL022) occurs Note	0: disable this function 1: when P1.043 is a negative value and RST power error (AL022) occurs, the servo drive commands the motor to decelerate to 0 in the Servo On state
Bit 7	Reserved	-

When the motor reaches PL (CCWL) or NL (CWL), refer to P5.003 for setting the deceleration time. If you set the deceleration time to 1 ms, the motor stops instantly.

Note: this function is only available in Position and Speed (PR, S, and Sz) modes and is effective only when P1.043 (Delay time for disabling the electromagnetic brake) is a negative value.

P1.033	Reserved

P1.034	S-curve acceleration constant		Address: 0144H 0145H
Default:	200	Control mode:	S / Sz
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Sets the time for the Speed command to accelerate the motor from 0 to 3000 rpm. You can set P1.034, P1.035, and P1.036 individually. When an internal command is used, even if you set P1.036 to 0, the acceleration and deceleration still follow a trapezoidal curve.

P1.035	S-curve deceleration constant		Address: 0146H 0147H
Default:	200	Control mode:	S / Sz
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

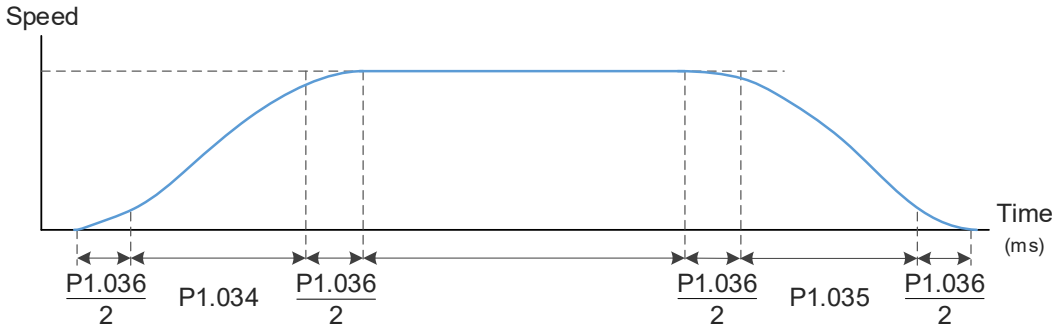
Settings:

Sets the time for the Speed command to decelerate the motor from 3000 rpm to 0. You can set P1.034, P1.035, and P1.036 individually. When an internal command is used, even if you set P1.036 to 0, the acceleration and deceleration still follow a trapezoidal curve.

P1.036	S-curve acceleration / deceleration smoothing constant		Address: 0148H 0149H
Default:	0	Control mode:	PR / S / Sz
Unit:	ms	Setting range:	0 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

0: disable this function



P1.034: sets the acceleration time for the trapezoidal curve.

P1.035: sets the deceleration time for the trapezoidal curve.

P1.036: sets the smoothing time for the S-curve acceleration and deceleration.

You can set P1.034, P1.035, and P1.036 individually. Even if you set P1.036 to 0, the acceleration and deceleration still follow a trapezoidal curve.

	P1.036 = 0	P1.036 = 1	P1.036 > 1
Smoothing function for S-curve	Disabled	Disabled	Enabled
Following error compensation function	Disabled	Enabled	Determined by P2.068.X

P1.037	Load inertia ratio or total weight			Address: 014AH 014BH
Operation interface:	Panel / software	Communication	Control mode:	All
Default:	2.0	20	Data size:	32-bit
Unit:	1 times	0.1 times	-	-
Setting range:	0.0 to 200.0	0 to 2000	-	-
Format:	One decimal	DEC	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Load inertia ratio of rotary motor: (J_load / J_motor)

J_motor: rotational inertia of the servo motor

J_load: total equivalent inertia of external mechanical load

P1.038	Zero speed detection level			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 to 200.0	0 to 2000	-	-
Format:	One decimal	DEC	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

When the absolute value of the motor speed is lower than this value, the condition for triggering the zero-speed signal is met and DO.ZSPD is On.

P1.039	Target speed detection level		Address: 014EH 014FH
Default:	3000	Control mode:	All
Unit:	rpm	Setting range:	0 to 30000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Sets the motor target speed. When the absolute value of the motor speed is higher than this value, the condition for triggering the target speed reached signal is met and DO.TSPD is On.

P1.040 - P1.041	Reserved

P1.042	Delay time for enabling the electromagnetic brake		Address: 0154H 0155H
Default:	0	Control mode:	All
Unit:	ms	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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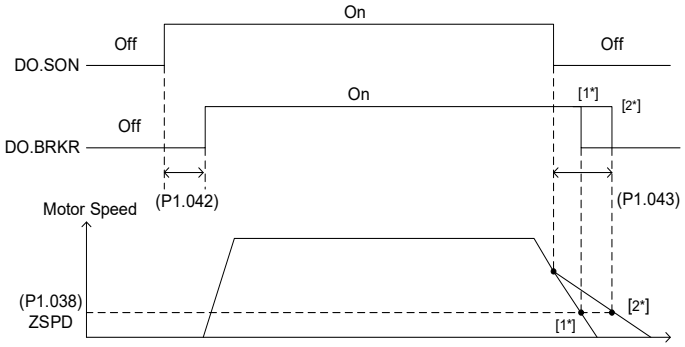
Settings:

Sets the delay time from Servo On state to the activation of the electromagnetic brake signal (DO: 0x08, BRKR).



Note:
1. If the delay time specified in P1.042 has not passed yet and the motor speed is slower than the value of P1.038, the electromagnetic brake signal (DO.BRKR) is disabled.
2. If the delay time specified in P1.042 has passed and the motor speed is faster than the value of P1.038, the electromagnetic brake signal (DO.BRKR) is disabled.

P1.043	Delay time for disabling the electromagnetic brake		Address: 0156H 0157H
Default:	0	Control mode:	All
Unit:	ms	Setting range:	-1000 to +1000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Sets the delay time from Servo Off state to the deactivation of the electromagnetic brake signal (DO: 0x08, BRKR). Refer to P1.042 for the detailed diagram.

Note: if P1.043 is a negative value and the servo is Off due to an alarm (except for AL022) or emergency stop, the setting of P1.043 is invalid. This is equivalent to setting the delay time to 0.

P1.044▲	E-Gear ratio - numerator N1		Address: 0158H 0159H
Default:	16777216	Control mode:	All
Unit:	pulse	Setting range:	1 to (2^{29}-1)
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

For the E-Gear ratio setting, refer to Section 6.2.4.

Note:
1. Do not change the setting in the Servo On state.
2. In communication mode (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 re-establishment of the absolute position system, so you must re-do the homing procedure. If you do not want P1.044 and P1.045 to be reset to the default values, set P3.012.Z to 1. Refer to P3.012 for details.

P1.045▲	E-Gear ratio - denominator M		Address: 015AH 015BH
Default:	100000	Control mode:	All
Unit:	pulse	Setting range:	1 to (2^{31}-1)
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

If the setting is incorrect, the servo motor is prone to sudden unintended acceleration. Follow these instructions.

E-Gear ratio setting: $f2 = f1 \times \frac{N}{M}$

Pulse of User Unit (PUU) (f1) → $\frac{N}{M}$ → Resolution determined by servo drive (pulse) (f2)

Range of E-gear ratio: $1 \le Nx / M \le 262144$.

For the E-Gear ratio setting, refer to Section 6.2.4.

Note:
1. Do not change the setting in the Servo On state.
2. In communication mode (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 re-establishment of the absolute position system, so you must re-do the homing procedure. If you do not want P1.044 and P1.045 to be reset to the default values, set P3.012.Z to 1. Refer to P3.012 for details.

P1.046	Reserved

P1.047	Speed reached (DO.SP_OK) range		Address: 015EH 015FH
Default:	10	Control mode:	S / Sz
Unit:	rpm	Setting range:	0 to 300
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

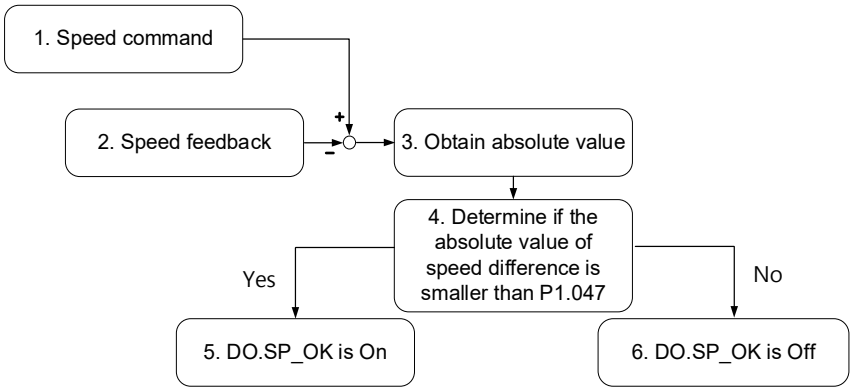
8

Settings:

In Speed modes, when the absolute value of the difference between the Speed command and the motor speed feedback is less than this parameter and this status is kept for the time duration set in P1.049, the digital output DO.SP_OK (0x19) is On.

Note: when the difference between the Speed command and the motor speed feedback exceeds the range set in P1.047, the system recalculates the duration.

Diagram:



1. Speed command: the command that you input without acceleration or deceleration, rather than the command from the front end speed circuit. Its source is from the register.
2. Speed feedback: the actual speed of the motor which has been filtered.
3. Obtain the absolute value.
4. Determine whether the absolute value of the speed difference is smaller than the parameter value. If you set the parameter to 0, DO.SP_OK is always Off. If the absolute value is smaller than the parameter, the digital output is On, otherwise it is Off.

P1.048	Motion reached (DO.MC_OK) operation option		Address: 0160H 0161H
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 to 0x0011
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Options for controlling the behavior of the digital output DO.MC_OK (0x17).

X	DO output retaining option	Z	Reserved
Y	Position offset alarm (AL380) option	U	Reserved

- X: DO output retaining option

  0: output status is not retained

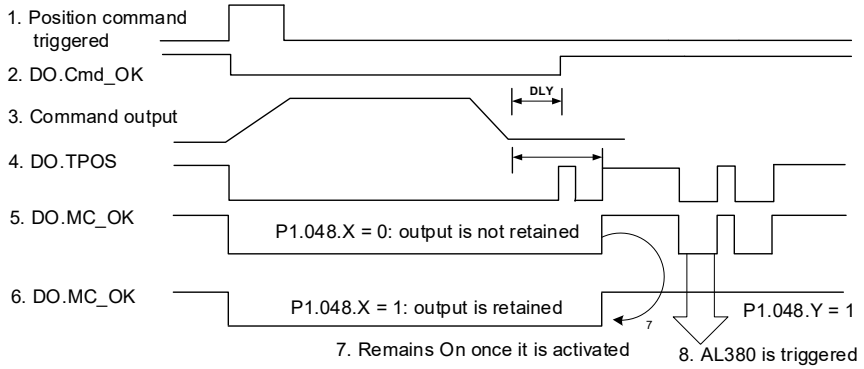
  1: output status is retained

- Y: position offset alarm (AL380) option

  0: AL380 not functioning

  1: AL380 functioning

Diagram:



Description:

1. Position command triggered: new PR Position command is effective. Command 3 starts and signals 2, 4, 5, and 6 are cleared simultaneously. Command triggering source: DI.CTRG, DI.EV1/EV2, and P5.007 (triggered through software).
2. DO.Cmd_OK: indicates whether command 3 is complete, and can be set with a delay time (DLY) with parameters.
3. Command output: output the profile of the Position command based on the setting for acceleration or deceleration.
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 indicates that both DO.Cmd_OK and DO.TPOS are On.
6. DO.MC_OK (retains digital output status): same as 5, except that once this DO is On, its status is retained regardless of the signal 4 status.
7. Either event 5 or signal 6 can occur, and this is determined by P1.048.X.
8. Position offset: when event 7 occurs, if signal 4 or 5 is Off, it means there is a position offset and AL380 can be triggered. Set whether whether AL380 is functioning 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 to 65535
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

8

Settings:

In Speed modes, when the absolute value of the difference between the Speed command and the motor speed feedback is less than the range set in P1.047 and this status is kept for the time duration set in P1.049, the digital output DO.SP_OK (0x19) is On. If the difference exceeds the range set in P1.047, no matter how long it lasts, the system recalculates the duration.

P1.050 - P1.051	Reserved

P1.052	Regenerative resistor value		Address: 0168H 0169H
Default:	Determined by the model. Refer to the following tables.	Control mode:	All
Unit:	ohm	Setting range:	Determined by the model. Refer to the following tables.
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

E3C-E1 models		Default (Ω)	Setting range (Ω)
220V	400 W	100	60 to 750

E3C-E, E3C-EF models		Default (Ω)	Setting range (Ω)
220V	750 W or below	100	60 to 750
	1 kW to 1.5 kW	100	30 to 750
400V	1 kW	100	80 to 750
	1.5 kW	100	60 to 750
	2 kW	50	45 to 750
	3 kW	50	40 to 750

Refer to the description of P1.053 for the parameter values when connecting the regenerative resistor with different methods.

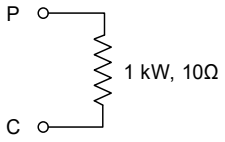
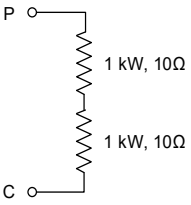
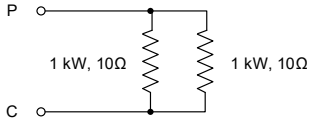
P1.053	Regenerative resistor capacity		Address: 016AH 016BH
Default:	Determined by the model. Refer to the following tables.	Control mode:	All
Unit:	Watt	Setting range:	0 to 15000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

E3C-E1 models		Default (Watt)
220V	400 W	36

E3C-E, E3C-EF models		Default (Watt)
220V	400 W	0
	750 W	36
	1 kW to 1.5 kW	40
400V	1 kW to 3 kW	80

Setting the parameter values when connecting the regenerative resistor with different methods:

External regenerative resistor (single)	External regenerative resistor (in series)	External regenerative resistor (in parallel)
		
P1.052 = 10 (Ω) P1.053 = 1000 (W)	P1.052 = 20 (Ω) P1.053 = 2000 (W)	P1.052 = 5 (Ω) P1.053 = 2000 (W)

P1.054	Pulse range for position reached		Address: 016CH 016DH
Default:	167772	Control mode:	PR
Unit:	pulse	Setting range:	0 to 16777216
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

In Position Register (PR) mode, when the difference between the target position and the actual motor position is less than this parameter, the condition for triggering the target position reached signal is met and DO.TPOS is On.

Example:

If P1.054 = 167772 and the error 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:	Rated speed	Control mode:	All
Unit:	rpm	Setting range:	0 to maximum speed
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Sets the maximum operating speed of the servo motor.

P1.056	Motor output overload warning level		Address: 0170H 0171H
Default:	120	Control mode:	All
Unit:	%	Setting range:	0 to 120
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When the value is 0 - 100 and the servo motor continuously outputs load that is higher than the setting of P1.056, the pre-warning signal for overload (DO: 0x10, OLW) is On. If the value is over 100, the pre-warning function is disabled.

P1.057	Motor hard stop 1 - torque percentage		Address: 0172H 0173H
Default:	0	Control mode:	All
Unit:	%	Setting range:	0 to 300
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Sets the protection level which is the percentage of rated torque. Set the value to 0 to disable the function and set the value to 1 or above to enable the function.

When there is no external force, the setting value = (motor current in percentage when the motor runs at constant speed in the forward direction + motor current in percentage when the motor runs at constant speed in the reverse direction) / 2 + protection torque value. When there is external force, set P1.060 additionally.

P1.058	Motor hard stop - protection time		Address: 0174H 0175H
Default:	1	Control mode:	All
Unit:	ms	Setting range:	1 to 1000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Sets the protection time: when the motor torque reaches the protection level and the protection time is exceeded, AL030 occurs.

Note: this function is only suitable for non-contactable uses, such as electrical discharge machines (make sure P1.037 is correctly set).

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 to 4.0	0 to 40	-	-
Example:	1.5 = 1.5 ms	15 = 1.5 ms	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

0: disable this function.

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 beginning and end of the step command, 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. As for simple speed control, use the moving filter for better smoothing.

P1.060	Motor hard stop 1 - level offset		Address: 0178H 0179H
Default:	0	Control mode:	All
Unit:	%	Setting range:	-300 to +300
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When using P1.057 (Motor hard stop 1 - torque percentage) and the average torque level deviates because of an external force, such as Z-axis gravity, you can use this parameter to set the corresponding compensation.

Suggested setting value = (Average torque at constant speed in forward direction + Average torque at constant speed in reverse direction) / 2

Note: refer to P0.002 = 54 (Torque feedback) for the average torque at constant speed.

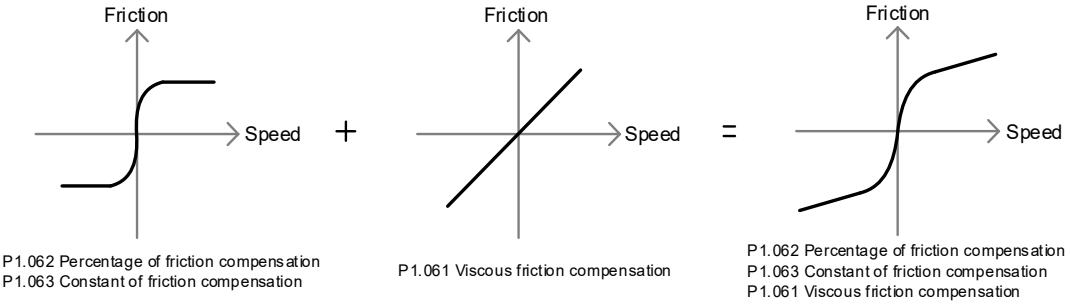
P1.061	Viscous friction compensation		Address: 017AH 017BH
Default:	0	Control mode:	PR / S / Sz
Unit:	0.1%/1000 rpm	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

8

Settings:

Because kinetic friction corresponds with the speed, you can use this parameter to compensate the motor torque according to the speed to reduce the position error during acceleration and deceleration.

When P1.062 = 0, this parameter is invalid.



P1.062 Percentage of friction compensation
P1.063 Constant of friction compensation

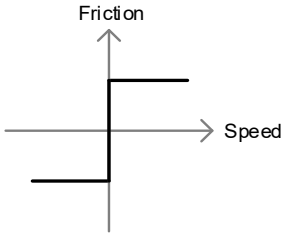
P1.061 Viscous friction compensation

P1.062 Percentage of friction compensation
P1.063 Constant of friction compensation
P1.061 Viscous friction compensation

P1.062	Percentage of friction compensation		Address: 017CH 017DH
Default:	0	Control mode:	PR / S / Sz
Unit:	%	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Sets the level of friction compensation, which is the percentage of the rated torque. Set the value to 0 to disable the friction compensation function. Set the value to 1 or above to enable the function for reducing the position error at the moment the motion starts.



P1.062 Percentage of friction compensation

P1.063	Constant of friction compensation		Address: 017EH 017FH
Default:	100	Control mode:	PR / S / Sz
Unit:	%	Setting range:	1 to 1000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Sets the speed for the friction compensation value to reach the setting value of P1.062.

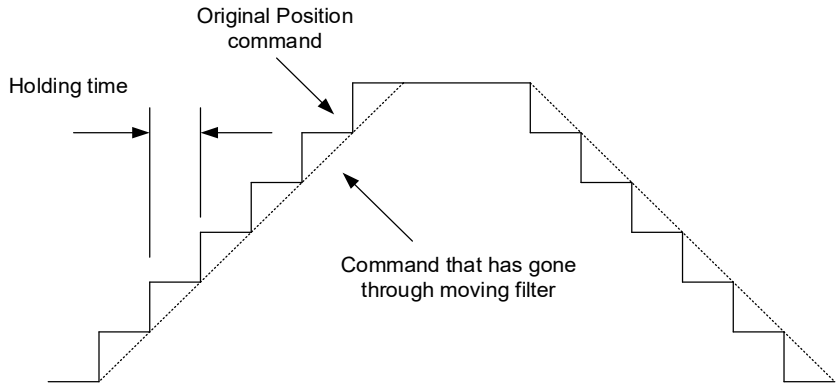
P1.064 - P1.067	Reserved

P1.068	Position command - moving filter		Address: 0188H 0189H
Default:	4	Control mode:	PR
Unit:	ms	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

0: disable this function.

The moving filter smooths the beginning and end of the step command, but it also delays the command.



P1.069 - P1.077	Reserved

P1.078	Gain switching delay time		Address: 019CH 019DH
Default:	0	Control mode:	P / S
Unit:	ms	Setting range:	0 to 3276.7
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When using the gain switching function (P2.027.X = 3 or 7), you can use this parameter to set the delay time after the switching condition is met. Refer to the description of P2.027 for more details.

P1.079	Rate of change for gain values during gain switching delay		Address: 019EH 019FH
Default:	100	Control mode:	P / S
Unit:	%	Setting range:	0 to 500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Sets the rate of change for the gain values during gain switching delay. If P1.078 is 0, this function is disabled.

Within the delay time set by P1.078, the settings of P2.000 (Position proportional gain) and P2.004 (Speed proportional gain) will be affected by the setting of P1.079. Refer to the description of P2.027 for more details.

P1.080	Rate of change for speed detection filter and jitter suppression		Address: 01A0H 01A1H
Default:	100	Control mode:	P / S
Unit:	%	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

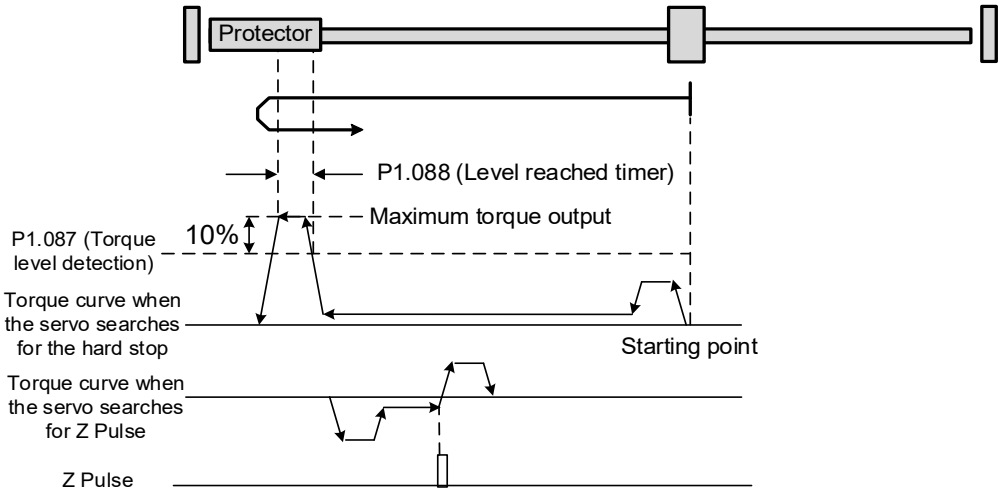
Adjusts the rate of change for speed detection filter and jitter suppression (P2.049) according to the gain switching condition. (This parameter is inversely proportional to the value of P2.049. The smaller the setting value of P1.080, the stronger the filtering effect.)

P1.081 - P1.086	Reserved

P1.087	Torque homing - torque level detection		Address: 01AEH 01AFH
Default:	1	Control mode:	PR
Unit:	%	Setting range:	1 to 300
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

This setting is only for the torque homing mode. As shown in the following figure, after homing is triggered, the motor runs in one direction and the mechanical part reaches the protector. The servo drive then outputs a larger motor current in order to counter the external force. The servo drive uses P1.087 and P1.088 as the conditions for homing. Since the hard stops are not always the same, it is recommended that you have the servo reverse to find the Z pulse as the origin.



Note: the actual maximum torque output of the motor is 10% greater than the detected torque level (P1.087). For example, when you set P1.087 to 50%, the maximum torque output of the motor is 60%.

P1.088	Torque homing - level reached timer		Address: 01B0H 01B1H
Default:	2000	Control mode:	PR
Unit:	ms	Setting range:	2 to 2000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The setting of **the torque level reached timer** for the torque homing mode. If the motor torque output continues to exceed the level set by P1.087 and the duration exceeds this setting, the homing is complete. Refer to P1.087 for the timing diagram of torque homing mode.

P1.089	Vibration elimination 1 - anti-resonance frequency		Address: 01B2H 01B3H
Default:	4000	Control mode:	PR
Unit:	0.1 Hz	Setting range:	10 to 4000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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.

The servo drive 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** function in **System Analysis** of ASDA-Soft with the check box for **Low Frequency Analysis** selected.

Vibration elimination takes effect only when the two degree of freedom control function is enabled (P2.094 [Bit 12] = 1). After enabling the two degree of freedom control function, enable 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 sets simultaneously.

P1.090	Vibration elimination 1 - resonance frequency		Address: 01B4H 01B5H
Default:	4000	Control mode:	PR
Unit:	0.1 Hz	Setting range:	10 to 4000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Resonance frequency for the first set of low frequency vibration elimination.

P1.091	Vibration elimination 1 - resonance difference		Address: 01B6H 01B7H
Default:	10	Control mode:	PR
Unit:	0.1 dB	Setting range:	10 to 4000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Attenuation level for the first set of low frequency vibration elimination.

P1.092	Vibration elimination 2 - anti-resonance frequency		Address: 01B8H 01B9H
Default:	4000	Control mode:	PR
Unit:	0.1 Hz	Setting range:	10 to 4000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Anti-resonance frequency for the second set of low frequency vibration elimination. The setting method is the same as the first set of vibration elimination (P1.089).

P1.093	Vibration elimination 2 - resonance frequency		Address: 01BAH 01BBH
Default:	4000	Control mode:	PR
Unit:	0.1 Hz	Setting range:	10 to 4000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Resonance frequency for the second set of low frequency vibration elimination.

P1.094	Vibration elimination 2 - resonance difference		Address: 01BCH 01BDH
Default:	10	Control mode:	PR
Unit:	0.1 dB	Setting range:	10 to 4000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Attenuation level for the second set of low frequency vibration elimination.

P1.095 - P1.097	Reserved

P1.098	Disconnection detection protection (UVW) response time		Address: 01C4H 01C5H
Default:	0	Control mode:	All
Unit:	ms	Setting range:	0, 100 to 800
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When the switch for motor power cable disconnection detection (ALC31) is enabled (P2.065 [Bit 9] = 1), set the detection response time with this parameter.

Set P1.098 = 0 to use the servo's default response time.

When P1.098 is not set to 0, the value should be between 100 and 800 for the detection response time.

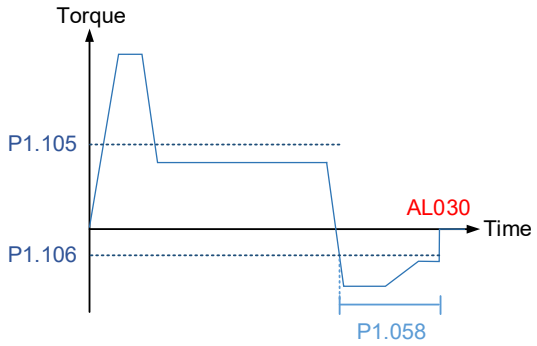
Note:
1. If it is necessary to shorten the response time, it is recommended that you use this parameter.
2. When the servo is On and has not started running, it is recommended that you properly set this parameter if you need to detect disconnection.

P1.099 - P1.104	Reserved

P1.105	Motor hard stop 2 - torque upper limit		Address: 01D2H 01D3H
Default:	0	Control mode:	All
Unit:	%	Setting range:	-300 to +300
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When Motor hard stop 2 is enabled (P2.112 [Bit 8] = 1), the settings of torque percentage (P1.057) and level offset (P1.060) for Motor hard stop 1 are invalid. During motor operation, if the motor torque is higher than this protection setting value and the duration of this condition exceeds the protection time (P1.058), AL030 will be triggered.



P1.106	Motor hard stop 2 - torque lower limit		Address: 01D4H 01D5H
Default:	0	Control mode:	All
Unit:	%	Setting range:	-300 to +300
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When Motor hard stop 2 is enabled (P2.112 [Bit 8]= 1), the settings of torque percentage (P1.057) and level offset (P1.060) for Motor hard stop 1 are invalid. During motor operation, if the motor torque is lower than this protection setting value and the duration of this condition exceeds the protection time (P1.058), AL030 will be triggered.

P1.107 - P1.110	Reserved

P1.111	Overspeed protection level		Address: 01DEH 01DFH
Default:	Maximum motor speed x 1.1	Control mode:	All
Unit:	rpm	Setting range:	0 to 27500
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

This function is to protect the motor from overspeeding. When the filtered motor speed exceeds this set speed, AL056 occurs.

P1.112■	Single-direction torque limit		Address: 01E0H 01E1H
Default:	500	Control mode:	All
Unit:	%	Setting range:	-500 to +500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P4.044 for more details.

P1.113 - P1.119	Reserved

P1.120	STO deactivation settings		Address: 01F0H 01F1H
Default:	3	Control mode:	All
Unit:	-	Setting range:	0 to 3
Format:	DEC	Data size:	16-bit
Model:	E3C-EF		

Settings:

The servo state when STO is activated and the way to deactivate STO for restarting the servo vary with the setting of P1.120. Descriptions for each setting value are as follows. For more details, refer to the signal timing diagrams in Section 3.6.5.3.

0: to deactivate STO and restart the servo, send the Servo Off command first and then the Servo On command.

1: to deactivate STO and restart the servo, clear the alarm first, and send the Servo Off command and then the Servo On command.

2: the servo restarts after STO is deactivated.

3: to deactivate STO and restart the servo, clear the alarm first.

P2.xxx Extension parameters

P2.000	Position proportional gain		Address: 0200H 0201H
Default:	35	Control mode:	PR
Unit:	rad/s	Setting range:	0 to 2047
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Increasing the position proportional 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	Rate of change for position proportional gain		Address: 0202H 0203H
Default:	100	Control mode:	PR
Unit:	%	Setting range:	10 to 500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Adjust the rate of change for the position proportional gain (P2.000) according to the gain switching condition.

P2.002	Position feed forward gain		Address: 0204H 0205H
Default:	50	Control mode:	PR
Unit:	%	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

If the position control command changes smoothly, increasing the gain value can reduce the position following errors. If the position control command does not change smoothly, decreasing the gain value can reduce the mechanical vibration.

P2.003	Position feed forward gain smoothing constant		Address: 0206H 0207H
Default:	5	Control mode:	PR
Unit:	ms	Setting range:	2 to 100
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

If the position control command changes smoothly, decreasing the smoothing constant value can reduce the position following errors. If the position control command does not change smoothly, increasing the smoothing constant value can reduce the mechanical vibration.

P2.004	Speed proportional gain		Address: 0208H 0209H
Default:	500	Control mode:	All
Unit:	rad/s	Setting range:	0 to 8191
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Increasing the speed proportional gain can enhance the speed response. If you set the value too high, it may cause vibration and noise.

P2.005	Rate of change for speed proportional gain		Address: 020AH 020BH
Default:	100	Control mode:	All
Unit:	%	Setting range:	10 to 500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Adjust the rate of change for the speed proportional gain (P2.004) according to the gain switching condition.

P2.006	Speed integral compensation		Address: 020CH 020DH
Default:	100	Control mode:	All
Unit:	rad/s	Setting range:	0 to 1023
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Increasing the value of the integral speed control can enhance the speed response and reduce the error 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 to 100
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

If the speed control command changes smoothly, increasing the gain value can reduce the speed following errors. If the speed control command does not change smoothly, decreasing the gain value can reduce the mechanical vibration.

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P2.008■	Special parameter write-in function		Address: 0210H 0211H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 to 501
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Setting value	Function
10	Reset parameter groups P0 - P7 (cycle the power after reset).
20	P4.010 is writable.
22	P4.015 - P4.021 are writable.
400	When forced DO mode is enabled, switch back to the normal DO mode.
406	Enable forced DO mode.

P2.009	DI response filter time		Address: 0212H 0213H
Default:	2	Control mode:	All
Unit:	ms	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When environmental interference is high, increasing this value can enhance the control stability. If you set the value too high, it affects the response time.

P2.010	DI1 functional planning		Address: 0214H 0215H
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

U Z YX

YX	Input function selection	Z	Input contact: A or B contact
-	-	U	Reserved

- YX: input function selection

  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)

After the parameter is modified, cycle power on the servo drive to ensure the DI functions normally. Use P3.006 to change the source for the digital input signal, which can be either an external terminal block or the parameter P4.007.

P2.011	DI2 functional planning		Address: 0216H 0217H
Default:	0x0022	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.010.

P2.012	DI3 functional planning		Address: 0218H 0219H
Default:	0x0023	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.010.

P2.013	DI4 functional planning		Address: 021AH 021BH
Default:	0x0021	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.010.

P2.014	DI5 functional planning		Address: 021CH 021DH
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.010.

P2.015	DI6 functional planning		Address: 021EH 021FH
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.010.

P2.016	DI7 functional planning		Address: 0220H 0221H
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.010. If there is no physical pin for DI7 on the model, this parameter can be a virtual digital input to be triggered through communication or to be used when the number of physical DI points is insufficient. You can set the DI to be used as soon as the servo power is On (e.g., DI.SON) to be a virtual DI and normally closed.

P2.017	DI8 functional planning		Address: 0222H 0223H
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.010. If there is no physical pin for DI8 on the model, this parameter can be a virtual digital input to be triggered through communication or to be used when the number of physical DI points is insufficient. You can set the DI to be used as soon as the servo power is On (e.g., DI.SON) to be a virtual DI and normally closed.

P2.018	DO1 functional planning		Address: 0224H 0225H
Default:	0x0101	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x014F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

YX	Output function selection	Z	Output contact: A or B contact
-	-	U	Reserved

- YX: output function selection

  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).

After the parameter is modified, cycle power on the servo drive to ensure the DO functions normally.

P2.019	DO2 functional planning		Address: 0226H 0227H
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x014F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.018.

P2.020	DO3 functional planning		Address: 0228H 0229H
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x014F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.018.

P2.021 - P2.022	Reserved

P2.023	Notch filter 1 - frequency		Address: 022EH 022FH
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 to 5000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The resonance frequency of the first Notch filter. This function is disabled if P2.024 is 0.

P2.023, P2.024, and P2.095 are the first set of Notch filter parameters.

P2.024	Notch filter 1 - attenuation level		Address: 0230H 0231H
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 to 40
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The attenuation level of the first Notch filter. For example, a value of 5 indicates -5 dB. Set this parameter to 0 to disable the first Notch filter.

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 to 100.0	0 to 1000	-	-
Format:	One decimal	DEC	-	-
Example:	1.5 = 1.5 ms	15 = 1.5 ms	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Sets 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 to 1023
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Increasing this parameter can increase the damping of the speed loop and reduce the speed loop response. Setting the value of P2.026 to the same value of P2.006 is recommended. See the following for setting P2.026:

1. In Speed modes, increase the value of this parameter to reduce speed overshoot.
2. In Position mode, decrease the value of this parameter to reduce position overshoot.

Note: the setting of this gain parameter is invalid when the two degree of freedom control function is On (P2.094 [Bit 12] = 1).

P2.027	Gain switching condition and method selection		Address: 0236H 0237H
Default:	0x0000	Control mode:	Shown as follows
Unit:	-	Setting range:	0x0000 to 0x0018
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

X	Gain switching condition	Z	Reserved
Y	Gain switching method	U	Reserved

■ X: gain switching condition

X	Condition	Control mode	P1.078 (Gain switching delay time)
0	Disable gain switching function.	-	-
1	Signal of gain switching (DI.GAINUP: 0x03) is On.	All	-
2	In Position modes, position error (P0.002 = 33) is larger than P2.029.	P	-
3	Position command frequency (P0.002 = 6) is larger than P2.029.	P	Supported
4	Motor speed (P0.002 = 51) is faster than P2.029.	All	-
5	Signal of gain switching (DI.GAINUP: 0x03) is Off.	All	-
6	In Position modes, position error (P0.002 = 33) is smaller than P2.029.	P	-
7	Position command frequency (P0.002 = 6) is smaller than P2.029.	P	Supported
8	Motor speed (P0.002 = 51) is slower than P2.029.	All	-

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■ Y: gain switching method

0: gain rate switching

1: integrator switching (switch from P controller to PI controller)

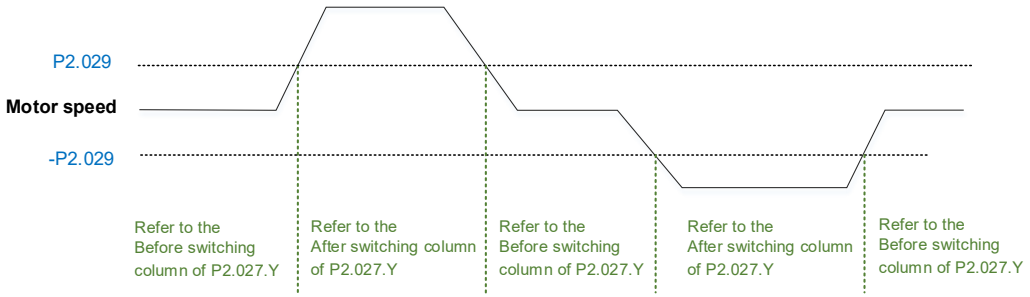
Setting value	Control mode P	Control mode S	Gain switching
0	P2.000 x 100%	-	Before switching
	P2.004 x 100%	P2.004 x 100%	
	P2.006 x 100%	P2.006 x 100%	
	P2.025 x 100%	P2.025 x 100%	
	P2.026 x 100%	P2.026 x 100%	
	P2.049 x 100%	P2.049 x 100%	
	P2.000 x P2.001	-	After switching
	P2.004 x P2.005	P2.004 x P2.005	
	P2.006 x 100%	P2.006 x 100%	
	P2.025 x P2.107	P2.025 x P2.107	
	P2.026 x 100%	P2.026 x 100%	
	P2.049 x P1.080	P2.049 x P1.080	
1	P2.000 x 100%	-	Before switching
	P2.004 x 100%	P2.004 x 100%	
	P2.006 x 0%	P2.006 x 0%	
	P2.025 x 100%	P2.025 x 100%	
	P2.026 x 0%	P2.026 x 0%	
	P2.049 x 100%	P2.049 x 100%	
	P2.000 x P2.001	-	After switching
	P2.004 x 100%	P2.004 x 100%	
	P2.006 x 100%	P2.006 x 100%	
	P2.025 x P2.107	P2.025 x P2.107	
	P2.026 x 100%	P2.026 x 100%	
	P2.049 x P1.080	P2.049 x P1.080	

Note: the parameters marked with different colors in the preceding table are the differences between Y = 0 and Y = 1.

When P2.027.X is set to 0, 1, 2, 4, 5, 6, or 8, P1.078 (Gain switching delay time) is not supported.

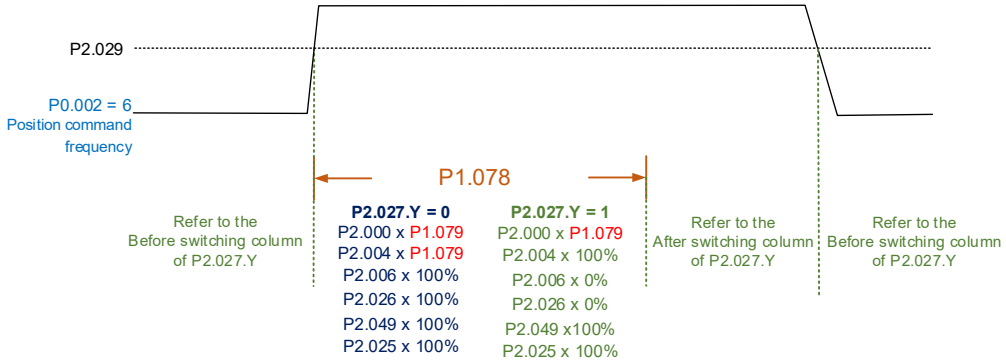
P2.027.X = 4 is taken as the example in the following figure.

P2.027.X = 4

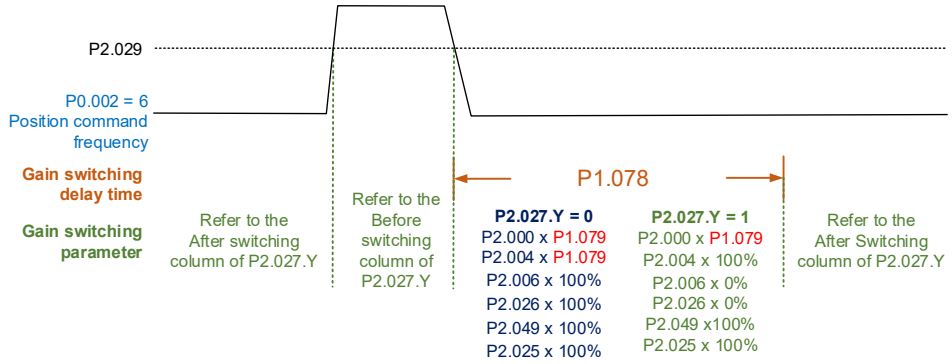


When P2.027.X is set to 3 or 7 and P1.078 (Gain switching delay time) is set, the gain parameter during the delay time is adjusted as follows.

P2.027.X = 3



P2.027.X = 7



P2.028	Gain switching time constant		Address: 0238H 0239H
Default:	10	Control mode:	Refer to P2.027.X (Gain switching condition)
Unit:	ms	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Smoothes the speed of gain switching (P2.027). Set this parameter to 0 to disable this function.

P2.029	Gain switching condition		Address: 023AH 023BH
Default:	16777216	Control mode:	Refer to P2.027.X (Gain switching condition)
Unit:	pulse; Kpps; rpm	Setting range:	0 to 50331648
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The unit of this parameter is determined by the selection of gain switching condition (P2.027.X).

P2.030■	Auxiliary function		Address: 023CH 023DH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-8 to +8
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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Settings:

Value	Function
0	Disable all functions described as follows.
1	Switch servo to Servo On state.
2 to 4	Reserved.
5	This setting makes all parameter settings volatile. When there is no need to permanently save the data continually written through the panel or communication, this setting can avoid shortening the lifetime of the EEPROM from continuous writing. You must use this function when using communication control.
6	This setting enables command simulation mode. In this mode, use the **Digital IO** function in ASDA-Soft to switch the servo to the Servo On state as both the external Servo On signal and the force Servo On of the PR mode in ASDA-Soft cannot work, the error code of the servo drive (monitoring variable 0x6F) is read as 0, and P0.001 only shows part of the error codes (such as positive / negative limit, emergency stop). When DO.SRDY is On, commands are accepted in each mode. You can use the **Scope** function in ASDA-Soft to observe these commands to examine their accuracy, but the motor does not operate.
7	Reserved.
8	Back up all current parameter values to EEPROM, so that the values are retained after power cycling. The panel displays “to.rom” during execution. This feature can also be executed when servo is in the Servo On state.
-1, -5, -6	Respectively disable the functions of setting values 1, 5, and 6.
-2 to -4, -7, -8	Reserved.

Note: set this parameter to 0 during normal operation. The value returns to 0 automatically after power cycling of the servo drive.

P2.031	Bandwidth response level		Address: 023EH 023FH
Default:	19	Control mode:	All
Unit:	-	Setting range:	1 to 50
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

In gain adjustment mode (P2.032), adjust the servo bandwidth with the bandwidth response level parameter (P2.031). When you increase the bandwidth response level (P2.031), the servo bandwidth increases as well. Refer to Chapter 5 for adjustment details.

P2.032	Gain adjustment mode		Address: 0240H 0241H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0006
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The servo drive provides the following gain adjustment modes for fine tuning. You can then easily complete tuning by increasing or decreasing the bandwidth response level (P2.031).

Recommendations for tuning the machine are in Section 5.1.

Value	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	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		
5	Gain adjustment mode 5 (same as setting P2-32 to 1 for B2 series)	Real-time estimation, the value is updated to P1.037 every 30 minutes	P2.126	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, P2.094, P2.098, P2.099, P2.101, P2.102
6	Gain adjustment mode 6 (same as setting P2-32 to 2 for B2 series)	Fixed set value of P1.037	P1.037 P2.126	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.094, P2.098, P2.099, P2.101, P2.102

P2.033	Reserved

P2.034	Excessive error warning condition of Speed command		Address: 0244H 0245H
Default:	5000	Control mode:	S / Sz
Unit:	rpm	Setting range:	1 to 25000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

In Speed modes, this parameter sets the allowable difference between the command speed and the speed feedback. If the difference is greater than this value, AL007 occurs.

Note: when P2.094 [Bit 6] = 1, this parameter is available in both Position mode (PR) and Speed modes (S, Sz).

P2.035	Excessive error warning condition of Position command		Address: 0246H 0247H
Default:	50331648	Control mode:	PR
Unit:	pulse	Setting range:	1 to 1677721600
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

In Position mode, this parameter sets the allowable difference between the command position and the position feedback. If the difference is greater than this value, AL009 occurs.

P2.036	DI9 functional planning		Address: 0248H 0249H
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.010. If there is no physical pin for DI9 on the model, this parameter can be a virtual digital input to be triggered through communication or to be used when the number of physical DI points is insufficient. You can set the DI to be used as soon as the servo power is On (e.g., Servo On) to be a virtual DI and normally closed.

P2.037	DI10 functional planning		Address: 024AH 024BH
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.010. If there is no physical pin for DI10 on the model, this parameter can be a virtual digital input to be triggered through communication or to be used when the number of physical DI points is insufficient. You can set the DI to be used as soon as the servo power is On (e.g., Servo On) to be a virtual DI and normally closed.

P2.038	DI11 functional planning		Address: 024CH 024DH
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.010. If there is no physical pin for DI11 on the model, this parameter can be a virtual digital input to be triggered through communication or to be used when the number of physical DI points is insufficient. You can set the DI to be used as soon as the servo power is On (e.g., Servo On) to be a virtual DI and normally closed.

P2.039	DI12 functional planning		Address: 024EH 024FH
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.010. If there is no physical pin for DI12 on the model, this parameter can be a virtual digital input to be triggered through communication or to be used when the number of physical DI points is insufficient. You can set the DI to be used as soon as the servo power is On (e.g., Servo On) to be a virtual DI and normally closed.

P2.040	DI13 functional planning		Address: 0250H 0251H
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P2.010. If there is no physical pin for DI13 on the model, this parameter can be a virtual digital input to be triggered through communication or to be used when the number of physical DI points is insufficient. You can set the DI to be used as soon as the servo power is On (e.g., Servo On) to be a virtual DI and normally closed.

P2.041 - P2.042	Reserved

P2.043	Notch filter 2 - frequency		Address: 0256H 0257H
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 to 5000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The resonance frequency of the second Notch filter. This function is disabled if P2.044 is 0.

P2.043, P2.044, and P2.096 are the second set of Notch filter parameters.

P2.044	Notch filter 2 - attenuation level		Address: 0258H 0259H
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 to 40
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The attenuation level of the second Notch filter. A value of 5 indicates -5 dB. Set this parameter to 0 to disable the second Notch filter.

P2.045	Notch filter 3 - frequency		Address: 025AH 025BH
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 to 5000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The resonance frequency of the third Notch filter. This function is disabled if P2.046 is 0.

P2.045, P2.046, and P2.097 are the third set of Notch filter parameters.

P2.046	Notch filter 3 - attenuation level		Address: 025CH 025DH
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 to 40
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The attenuation level of the third Notch filter. A value of 5 indicates -5 dB. Set this parameter to 0 to disable the third Notch filter.

P2.047	Auto resonance suppression mode		Address: 025EH 025FH
Default:	0x0001	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x01F2
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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 mode 1; when the servo determines it is stable*2, the servo stores the resonance suppression points to EEPROM (non-volatile memory for parameters) and disables the auto resonance suppression function (X = 0). Before the servo is stable,

  (1) If you cycle power on the servo drive, the found resonance suppression points are lost and will not be saved. The servo searches for the resonance suppression points again.

  (2) If you switch the setting of X from 1 to 0, the known resonance suppression points will be stored to EEPROM.

  (3) If you keep the setting of X as 1, the known resonance suppression points will not be cleared, but they are not written to EEPROM yet. They are written to EEPROM when the servo determines it is stable.

  2: auto resonance suppression mode 2; when the servo determines it is stable*2, the servo stores the known resonance suppression points to EEPROM (non-volatile memory for parameters). In this mode, the searching cycle continues until the 5 sets of resonance suppression parameters are set, and then the auto resonance suppression function is disabled (X = 0). Before the servo is stable,

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(1) If you cycle power on the servo drive, the resonance suppression points that are not yet stored in EEPROM are lost and will not be saved. The resonance suppression points that have been stored to EEPROM will not be affected.

(2) If you switch the setting of X from 2 to 0, the known resonance suppression points will be stored to EEPROM.

(3) If you keep the setting of X as 2, the known resonance suppression points will not be cleared, but they are not written to EEPROM yet. They are written to EEPROM when the servo determines it is stable.

Note:
1. If you switch the setting of X from 0 to 1 or 2, the unfixed Notch filter is automatically cleared, the frequency is set to 1,000 Hz, and the notch depth is set to 0 dB.
2. The servo determines it is stable when the following conditions are met: resonances have been suppressed, no other interference that affects the operation is found, and the motor speed is maintained at above 10 rpm for 3 minutes.

■ Y: fixed resonance suppression parameter

In auto resonance suppression mode, you can set the resonance suppression parameters manually by setting P2.047.Y.

Bit	7	6	5	4

Bit	Function	Description
4	Notch 1 auto / manual setting	0: auto resonance suppression 1: manually set the first set of resonance suppression parameters
5	Notch 2 auto / manual setting	0: auto resonance suppression 1: manually set the second set of resonance suppression parameters
6	Notch 3 auto / manual setting	0: auto resonance suppression 1: manually set the third set of resonance suppression parameters
7	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 mode, you can set the resonance suppression parameters manually by setting P2.047.Z.

Bit	11	10	9	8

Bit	Function	Description
8	Notch 5 auto / manual setting	0: auto resonance suppression 1: manually set the fifth set of resonance suppression parameters
9 to 11	Reserved	-

Example: if P2.047 = 0x0021, the auto resonance suppression function is enabled, and the servo searches for the point of resonance and suppresses it. When you set P2.047.Y to 2, you manually set the second set of resonance suppression parameters. Then, if the servo finds 2 resonance points, it writes the data of the 1st point to the 1st set of resonance suppression parameters and the data of 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:	0 to 1000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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 to 100.0	0 to 1000	-	-
Format:	One decimal	DEC	-	-
Example:	1.5 = 1.5 ms	15 = 1.5 ms	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Sets the filter for speed detection. Adjusting this parameter can improve the extent of the speed jitter, but when the value is too high, the phase margin affecting the speed loop decreases, and thus makes the system unstable.

P2.050	Position error clear setting		Address: 0264H 0265H
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 to 0x0001
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to Table 8.1 for digital input descriptions. Set the digital input as CCLR (DI: 0x04) to enable this function. When DI.CCLR is On, the position error in the servo drive is reset to 0.

When P2.050 = 0, DI.CCLR is rising-edge triggered.

When P2.050 = 1, DI.CCLR is level triggered.

P2.051	Reserved

P2.052▲	Rotary axis position scale		Address: 0268H 0269H
Default:	1073741824	Control mode:	All
Unit:	PUU	Setting range:	32 to 1073741824
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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Settings:

Sets the scale of the rotary axis position, rotary axis command position, and rotary axis position feedback. If the value is too small, it may cause errors in the rotary axis position system.

The input range of P2.052 is:

$$P2.052 > \text{Maximum motor speed (rpm)} \times (16777216 \times \frac{P1.045}{P1.044}) \div 57142$$

P2.053	Position integral compensation		Address: 026AH 026BH
Default:	0	Control mode:	All
Unit:	rad/s	Setting range:	0 to 1023
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

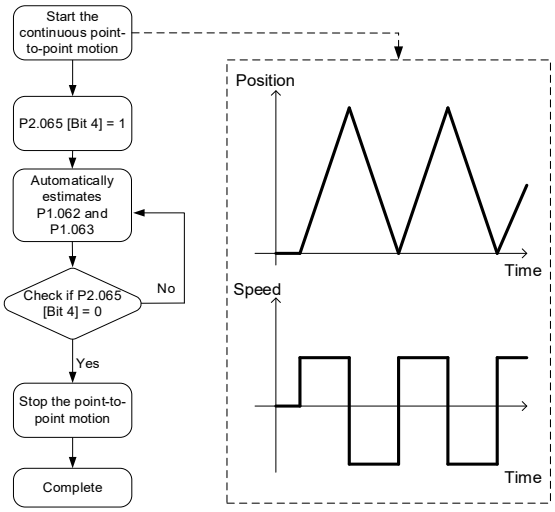
Increase the position control integral compensation to reduce the position steady-state errors. If the value is too high, it may cause position overshoot and noise.

P2.054 - P2.064	Reserved

P2.065	Special bit register 1		Address: 0282H 0283H
Default:	0x0300	Control mode:	PR / S / Sz
Unit:	-	Setting range:	0x0000 to 0xFFFF
Format:	HEX	Data size:	-
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0 - Bit 3	Reserved	-
Bit 4	Automatic friction estimation	After enabling this function, you must conduct the continuous point-to-point motion to automatically write the estimated values to P1.062 and P1.063. 0: disable the function. 1: enable the function. 
Bit 5	Switch for AL003 (Undervoltage) and AL022 (RST power error) in Servo Off state	0: when the servo is Off, disable the detection for AL003 (Undervoltage) and AL022 (RST power error). 1: when the servo is Off, enable the detection for AL003 (Undervoltage) and AL022 (RST power error).
Bit 6 - Bit 7	Reserved	-
Bit 8	Switch for motor power cable wiring error detection (AL031)	0: disable the detection. 1: enable the detection.
Bit 9	Switch for motor power cable disconnection detection (ALC31)	0: disable the detection. 1: enable the detection.
Bit 10	ZCLAMP function selection	The ZCLAMP function is enabled when all 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

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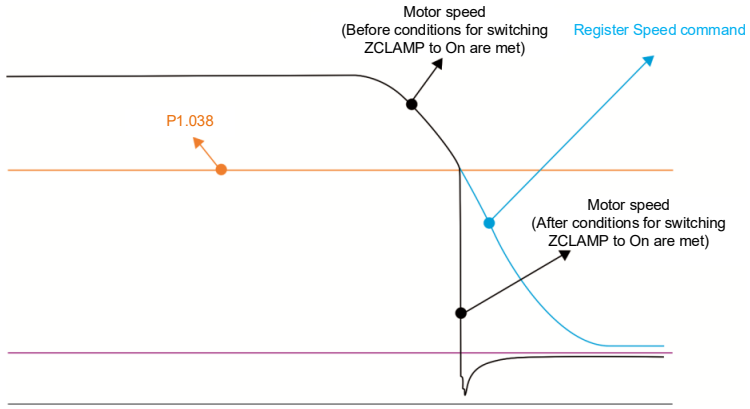
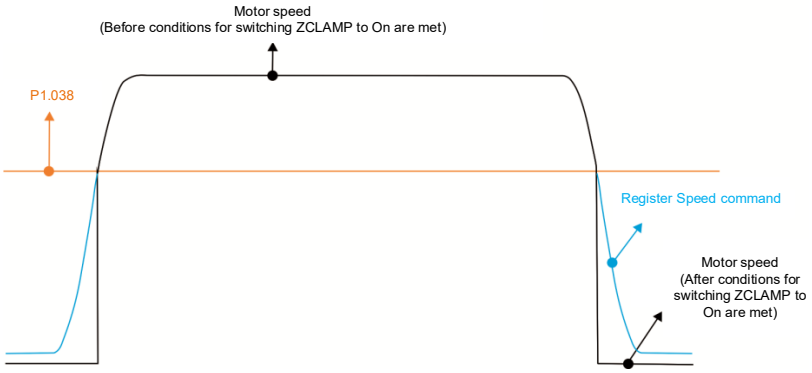
Bit 10 description
Bit 10 = 0 and command source is the internal register. The ZCLAMP function uses the register Speed command with acceleration or deceleration to determine if this function should be enabled. The motor is clamped at the position where ZCLAMP conditions are met.



Bit 10 = 1 and command source is the internal register. The ZCLAMP function uses the register Speed command with acceleration or deceleration to determine if this function should be enabled. When ZCLAMP conditions are met, the motor speed is set to 0 rpm.



Bit	Function	Description
Bit 11	Reserved	-
Bit 12	RST power error (AL022) detection function	0: enable the RST power error (AL022) detection function. 1: disable the RST power error (AL022) detection function.
Bit 13 - Bit 15	Reserved	-

P2.066	Special bit register 2		Address: 0284H 0285H
Default:	0x0020	Control mode:	PR / S / Sz
Unit:	-	Setting range:	0x0000 to 0x587F
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0 - Bit 1	Reserved	-
Bit 2	Disable the AL003 (Undervoltage error) latch	0: latch enabled; the undervoltage error is not cleared automatically. 1: latch disabled; the undervoltage error is cleared automatically.
Bit 3	Reserved	-
Bit 4	Disable the detection for AL044 (Servo function operational warning)	0: enable the detection. 1: disable the detection.
Bit 5	Reserved	-
Bit 6	RST power error (AL022) latch	0: disable the latch; RST power error (AL022) is cleared automatically. 1: enable the latch; RST power error (AL022) is not cleared automatically.
Bit 7 - Bit 8	Reserved	-
Bit 9	Set AL003 (Undervoltage) as ALM or WARN	0: WARN 1: ALM
Bit 10 - Bit 11	Reserved	-
Bit 12	Set AL022 (RST power error) as ALM or WARN	0: WARN 1: ALM
Bit 13 - Bit 15	Reserved	-

P2.067	Reserved

P2.068	Following error compensation switch		Address: 0288H 0289H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	0x00000000 - 0x10002101
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

High word

D C B A

Low word

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	Reserved

- X: following error compensation switch (functions under the condition of P1.036 > 1)

  0: disable following error compensation

  1: enable following error compensation

- Z: DI.STP triggering method

  0: rising-edge triggered

  1: level triggered

P2.069●	Absolute encoder		Address: 028AH 028BH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0211
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

X	Operation mode setting	Z	Function of preventing rotary axis position offset when overflow occurs
Y	Pulse command setting when absolute position is lost	U	Reserved

- X: operation mode setting

  0: incremental mode. An absolute type motor can be operated as an incremental type motor.

  1: absolute mode. This setting is only applicable to an absolute type motor. If it is used for an incremental type motor, AL069 occurs.

- Y: pulse command setting when absolute position is lost

  0: when AL060 or AL06A occurs, the system cannot receive a pulse command.

  1: when AL060 or AL06A occurs, the system can receive a pulse command.

- Z: function of preventing rotary axis position offset when overflow occurs

  0: when the number of revolutions of the encoder overflows, the absolute position and the rotary axis position are offset after power is off.

  1: during power-on initialization and the establishment of origin position, the position feedback remains unchanged as the servo drive position feedback. The rotary axis position is not affected by overflow, but the absolute position is offset (AL062, AL066, and AL289 do not function).

  2: during power-on initialization and the establishment of origin position, the position feedback is set as the current rotary axis position. The rotary axis position is not affected by overflow, but the absolute position is offset (AL062, AL066, and AL289 do not function). This setting is applicable when the Delta AX series or DVP50MC series controller is used; optional when other controllers are used.

Note: 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:	0x0000 to 0x0007
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0	DI/DO data unit setting	0: PUU 1: pulse
Bit 1	Unit setting for P0.051 and P0.052	0: P0.051 is invalid; P0.052 is in units of PUU. 1: P0.051 is in units of number of turns; P0.052 is in units of pulse.
Bit 2	Overflow warning setting	0: the servo drive issues the overflow warnings AL289 (PUU) and AL062 (pulse). 1: no overflow warning.
Bit 3 - Bit 15	Reserved	-

P2.071■	Absolute position homing		Address: 028EH 028FH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0001
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Setting P2.071 to 0x0001 resets the current absolute position of the encoder. The clear function is enabled by setting P2.008 to 271 and P2.069.X to 1.

P2.072 - P2.088	Reserved

P2.089	Command response gain		Address: 02B2H 02B3H
Default:	25	Control mode:	PR
Unit:	rad/s	Setting range:	1 to 2000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Increasing this gain speeds up the responsiveness of the Position command and shortens the settling time, but when the gain is too large, it causes position overshoot which leads to machine jitter.

Note: enable the two degree of freedom control function (P2.094 [Bit 12] = 1) before adjusting this parameter.

P2.090	Two degree of freedom mode - anti-interference gain		Address: 02B4H 02B5H
Default:	850	Control mode:	PR
Unit:	0.001	Setting range:	500 to 1999
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

This parameter improves the command response and fine tunes the overshoot when the command is settling. Set this parameter to a smaller value to reduce the occurrence of command overshoot. This parameter is only valid when the two degree of freedom control function is enabled (P2.094 [Bit 12] = 1) and its function is similar to that of P2.026.

P2.091	Two degree of freedom mode - position feed forward gain		Address: 02B6H 02B7H
Default:	1000	Control mode:	PR
Unit:	0.1%	Setting range:	0 to 3000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

This parameter reduces the following error of the motor. If the value is set too high, it may cause overshoot during positioning. It is suggested that you set this parameter to the default value or only make small adjustments. This parameter is only valid when the two degree of freedom control function is enabled (P2.094 [Bit 12] = 1) and its function is similar to that of P2.002.

P2.092	Two degree of freedom mode - speed feed forward gain		Address: 02B8H 02B9H
Default:	1000	Control mode:	PR
Unit:	0.1%	Setting range:	0 to 3000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

This parameter reduces the following error when the motor starts and stops. Use this parameter to roughly adjust the overshoot during positioning. Set this parameter to a larger value to reduce overshoot. This parameter is only valid when the two degree of freedom control function is enabled (P2.094 [Bit 12] = 1) and its function is similar to that of P2.007.

P2.093	Reserved

P2.094▲	Special bit register 3		Address: 02BCH 02BDH
Default:	0x0090	Control mode:	PR / S / Sz
Unit:	-	Setting range:	0x0000 to 0xF3F6
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0 - Bit 3	Reserved	-
Bit 4	Dynamic brake options	0: disable new dynamic brake. 1: enable new dynamic brake.
Bit 5	Switch for AL016 (Abnormal IGBT temperature)	0: enable AL016 (Abnormal IGBT temperature). 1: disable AL016 (Abnormal IGBT temperature).
Bit 6	Switch for AL007 detection in Position mode	Switch for AL007 detection in Position mode (PR) 0: disable AL007 detection (default). 1: enable AL007 detection.
Bit 7	Switch for AL086	Switch for the regenerative resistor temperature protection when the input voltage is too high 0: disable 1: enable
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 degree of freedom control function is enabled (P2.094 [Bit 12] = 1).
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 degree of freedom control function is enabled (P2.094 [Bit 12] = 1).
Bit 10 - Bit 11	Reserved	-
Bit 12	Two degree of freedom control function	0: disable two degree of freedom control function (A2 and B2 models do not have this function.) 1: enable two degree of freedom control function
Bit 13 - Bit 15	Reserved	-

P2.095	Notch filter 1 - Q factor		Address: 02BEH 02BFH
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 to 10
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The resonance Q factor of the first Notch filter. This function is disabled if P2.024 is 0.

P2.023, P2.024, and P2.095 are the first set of Notch filter parameters.

P2.096	Notch filter 2 - Q factor		Address: 02C0H 02C1H
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 to 10
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The resonance Q factor of the second Notch filter. 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 3 - Q factor		Address: 02C2H 02C3H
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 to 10
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The resonance Q factor of the third Notch filter. 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 4 - frequency		Address: 02C4H 02C5H
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 to 5000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The resonance frequency of the fourth Notch filter. This function is disabled if P2.099 is 0.

P2.098, P2.099, and P2.100 are the fourth set of Notch filter parameters.

P2.099	Notch filter 4 - attenuation level		Address: 02C6H 02C7H
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 to 40
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The attenuation level of the fourth Notch filter. A value of 5 indicates -5 dB. Set this parameter to 0 to disable the fourth Notch filter.

P2.100	Notch filter 4 - Q factor		Address: 02C8H 02C9H
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 to 10
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The resonance Q factor of the fourth Notch filter. This function is disabled if P2.099 is 0.

P2.098, P2.099, and P2.100 are the fourth set of Notch filter parameters.

P2.101	Notch filter 5 - frequency		Address: 02CAH 02CBH
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 to 5000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The resonance frequency of the fifth Notch filter. This function is disabled if P2.102 is 0.

P2.101, P2.102, and P2.103 are the fifth set of Notch filter parameters.

P2.102	Notch filter 5 - attenuation level		Address: 02CCH 02CDH
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 to 40
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The attenuation level of the fifth Notch filter. A value of 5 indicates -5 dB. Set this parameter to 0 to disable the fifth Notch filter.

P2.103	Notch filter 5 - Q factor		Address: 02CEH 02CFH
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 to 10
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The resonance Q factor of the fifth Notch filter. This function is disabled if P2.102 is 0.

P2.101, P2.102, and P2.103 are the fifth set of Notch filter parameters.

P2.104	Torque command condition for P/PI switching		Address: 02D0H 02D1H
Default:	800	Control mode:	PR / S / Sz
Unit:	%	Setting range:	1 to 800
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

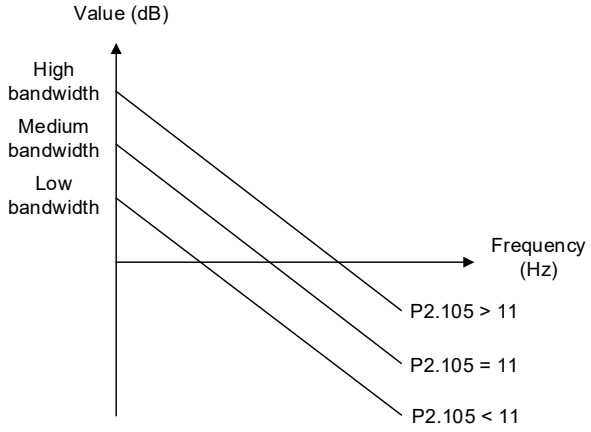
When the Torque command exceeds P2.104, the speed controller gain is switched from PI to P in order to reduce response overshoot.

P2.105	Automatic gain adjustment level 1		Address: 02D2H 02D3H
Default:	11	Control mode:	PR
Unit:	-	Setting range:	1 to 21
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Use this parameter to adjust the bandwidth when auto tuning. Setting P2.105 higher increases the bandwidth after auto tuning but reduces the system margin, causing machine jitter. Setting P2.105 lower decreases the bandwidth after auto tuning but slows down the response.

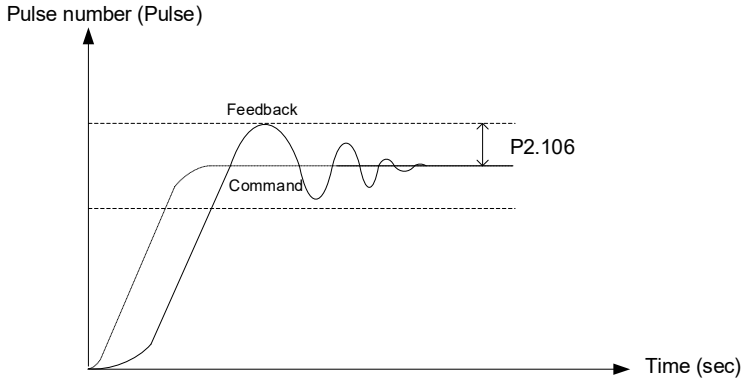
P2.105 setting value	Stiffness and response	Applicable mechanical parts
1 - 7	Low stiffness and low response	Belt, gear rack, reducer, cam
8 - 14	Medium stiffness and medium response	Screw
15 - 21	High stiffness and high response	Direct-coupled mechanical parts



P2.106	Automatic gain adjustment level 2		Address: 02D4H 02D5H
Default:	2000	Control mode:	PR
Unit:	pulse	Setting range:	1 to 50331648
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Use this parameter to adjust the maximum allowable overshoot when auto tuning. The overshoot range is set according to either the user's requirement or the machine characteristics. Setting P2.106 higher increases the maximum overshoot allowed by auto tuning and speeds up the response. Setting P2.106 lower reduces the maximum overshoot allowed by auto tuning but slows down the response.



P2.107	Rate of change for resonance suppression low-pass filter		Address: 02D6H 02D7H
Default:	100	Control mode:	P / S
Unit:	%	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Adjusts the rate of change for the **resonance suppression low-pass filter** (P2.025) according to the gain switching condition.

(This parameter is inversely proportional to the value of P2.025. The smaller the setting value of P2.107, the stronger the filtering effect.)

P2.108 - P2.111	Reserved

P2.112▲	Special bit register 4		Address: 02E0H 02E1H
Default:	0x2018	Control mode:	PR / S / Sz
Unit:	-	Setting range:	0x0000 to 0x753F
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0	Reserved	-
Bit 1	Enable or disable AL089	0: disable AL089 1: enable AL089
Bit 2	Reserved	-
Bit 3	Auto gain adjustment mode	0: reserved 1: cycle adjustment
Bit 4 - Bit 7	Reserved	-
Bit 8	Motor hard stop function selection	Motor hard stop 2 only supports absolute motors. 0: Motor hard stop 1 (refer to the settings of P1.057, P1.058, and P1.060.) 1: Motor hard stop 2 (refer to the settings of P1.105, P1.106, and P1.058.)
Bit 9 - Bit 12	Reserved	-
Bit 13	Regenerative braking method	0: method 1 1: method 2, which releases the capacitor voltage faster and reduces the load voltage of the capacitor.
Bit 14	Unit selection for internal Torque command / internal torque limit (P1.012 - P1.014).	0: 1% 1: 0.1%
Bit 15	Reserved	-

P2.113 - P2.120	Reserved

P2.121	Special bit register 6		Address: 02F2H 02F3H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	0x00000000 - 0x000001FF
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0	Reserved	-
Bit 1	Behavior after homing in communication mode	0: after homing, execute absolute positioning to the position with the offset distance set in OD 607Ch. 1: decelerate to a stop after homing.
Bit 2	Definition of the settings for Origin definition (P6.001) and Home offset (OD 607Ch) in communication mode	0: origin definition (P6.001) = - (setting of OD 607Ch) 1: origin definition (P6.001) = OD 607Ch
Bit 3 - Bit 4	Reserved	-
Bit 5	Unit selection for Homing speeds (OD 6099h), Homing acceleration (OD 609Ah), Profile acceleration (OD 6083h), and Profile deceleration (OD 6084h) in communication mode	0: the unit of OD 6099h is determined by the setting of P2.121 [Bit 3]. The unit of OD 609Ah, OD 6083h, and OD 6084h is ms (0 - 3000 rpm). When P2.121 [Bit 3] = 0, the unit of OD 6099h is 0.1 rpm. When P2.121 [Bit 3] = 1, the unit of OD 6099h is 1 rpm. 1: the unit of OD 6099h is PUU/sec. The unit of OD 609Ah, OD 6083h, and OD 6084h is PUU/sec^2.
Bit 6 - Bit 7	Reserved	-
Bit 8	Auto clearing of AL180 and AL185 after the State Machine re-enters the Operational state in EtherCAT mode	0: no; you need to manually clear the alarms 1: yes
Bit 9 - Bit 15	Reserved	-

P2.122	Reserved

P2.123	Delay time before alarm reset		Address: 02F6H 02F7H
Default:	3000	Control mode:	All
Unit:	ms	Setting range:	0 - 20000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When an alarm occurs, performing “Alarm reset” is not allowed until this delay time has elapsed. You can monitor the remaining time with the monitoring variable -248 (Alarm reset delay time).

This parameter setting affects the alarms: AL005, AL006, AL016, AL02C, AL02F, AL085, and AL086.

Important: setting P2.123 lower than 3000 may cause component overheating.

P2.124	Reserved

P2.125	Special bit register 7		Address: 02FAH 02FBH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0xFFFF
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0	Frequency setting of the filter processing the speed feedback (monitoring variable of P0.002 = 7)	0: 15 Hz 1: 1 Hz
Bit 1 - Bit 2	Reserved	-
Bit 3	Bandwidth response level reversion	Before using this function, set the gain adjustment mode to mode 1, mode 2, or mode 3. When the system limit is reached and the resonance cannot be suppressed, the servo automatically reverts to the response level where the resonance does not occur. 0: disable 1: enable
Bit 4 - Bit 6	Reserved	-
Bit 7	Smoothing function for Velocity offset (OD 60B1h) and Torque offset (OD 60B2h) in EtherCAT communication mode	0: disable 1: enable
Bit 8 - Bit 15	Reserved	-

P2.126	Bandwidth for speed loop response		Address: 02FCH 02FDH
Default:	40	Control mode:	PR / S / Sz
Unit:	Hz	Setting range:	1 to 1000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The setting of P2.126 is effective only when you set P2.032 to 5 or 6.

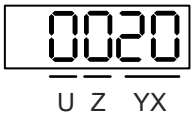
Bandwidth	Stiffness and response	Applicable mechanical parts
1 - 100 Hz	Low stiffness and low response	Belt, gear rack, reducer, cam
101 - 250 Hz	Medium stiffness and medium response	Screw
251 Hz and above	High stiffness and high response	Direct-coupled mechanical parts

Note: the servo drive automatically sets the response of the position loop according to the setting of P2.126.
The function of P2.126 is the same as that of P2-31 for the B2 series.

P3.xxx Communication parameters

P3.000●	Address		Address: 0300H 0301H
Default:	0x007F	Control mode:	All
Unit:	-	Setting range:	0x0001 - 0x007F
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:



UZ	Reserved	YX	Communication address setting

■ EtherCAT

When P3.018.A = 1, the address refers to the setting of P3.000; when P3.018.A = 0, the address must be set by the controller.

P3.001 - P3.003	Reserved

P3.004	USB communication timeout		Address: 0308H 0309H
Default:	0	Control mode:	All
Unit:	sec	Setting range:	0 to 20
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

If the value is not 0, communication timeout is enabled 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:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x1FFF
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Control switch for the source of DI. Each bit of this parameter determines the input source of one DI signal: Bit 0 - Bit 12 correspond to DI1 - DI13.

The setting for each bit is as follows:

0: DI status is controlled by the external terminal block.

1: DI status is controlled by P4.007.

For more information on DI functional planning, refer to the following:

DI1 - DI8: P2.010 - P2.017

DI9 - DI13: P2.036 - P2.040

P3.007 - P3.008	Reserved

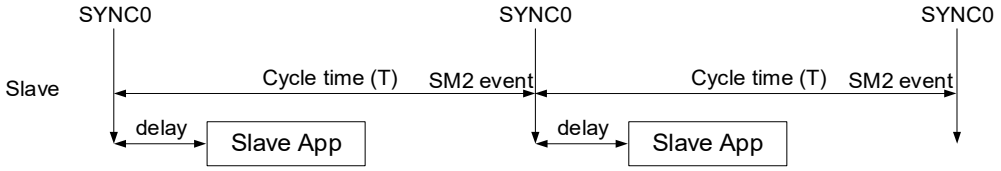
P3.009	Communication synchronization		Address: 0312H 0313H
Default:	0x5055	Control mode:	EtherCAT
Unit:	-	Setting range:	0x0000 - 0x9AFF
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The slave synchronizes with the master via SYNC. The definition is as follows:

- Z: when the servo is operating in the DC-Synchronous mode, you can adjust the timing of the servo accessing the EtherCAT packets to ensure this timing is not in conflict with the timing of the controller sending the packets.

  The delay time shown in the following figure is (T/10) x Z (μs).



P3.010 - P3.011	Reserved

P3.012	Communication support setting		Address: 0318H 0319H
Default:	0x0000	Control mode:	EtherCAT
Unit:	-	Setting range:	0x0000 to 0x1111
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

X	Reserved	Z	Load in the EtherCAT parameter values
Y	Reserved	U	Alarm clearing when the limit alarm (AL014, AL015, AL283, or AL285) occurs

■ Z: load in the EtherCAT parameter values

0: when the servo drive is power cycled or the communication is reset, parameters in the following table load the values of the EtherCAT parameters.

1: when the servo drive is power cycled or the communication is reset, parameters in the following table retain the same settings and do not load the values of the EtherCAT parameters.

Relevant parameters for Z setting:

Parameter	P3.012 = 0x0100 (Z = 1)		P3.012 = 0x0000 (Z = 0)	
	Servo parameter	Default	OD address	Default
Motor stop mode	P1.032	0x0010	605Bh	0
S-curve acceleration constant	P1.034	200	6087h	200
Zero speed detection level	P1.038	100 (0.1 rpm)	606Fh	100 (0.1 rpm)
E-Gear ratio - numerator N1	P1.044	16777216	6093h sub1	1
E-Gear ratio - denominator M	P1.045	100000	6093h sub2	1
Speed reached (DO.SP_OK) range	P1.047	10 (1 rpm)	606Dh	100 (0.1 rpm)
Accumulated time to reach desired speed	P1.049	0	606Eh	0
Maximum speed limit	P1.055	Depending on the motor (rpm)	607Fh	Depending on the motor (0.1 rpm)
			6080h	Depending on the motor (rpm)
Excessive deviation warning condition of Position command	P2.035	50331648	6065h	50331648
Positive software limit (PP / CSP / CSV / CST mode)	P5.008	2147483647	607Dh sub2	2147483647
Negative software limit (PP / CSP / CSV / CST mode)	P5.009	-2147483648	607Dh sub1	-2147483648
Origin definition (HM mode)	P6.001	0	607Ch	0

Methods to write parameters to EEPROM (non-volatile):

SDO: parameters are stored in EEPROM when written.

PDO: refer to the setting of P3.011.X.

P3.011.X = 1 indicates when written through PDOs, parameters are stored in EEPROM.

P3.011.X = 0 indicates when written through PDOs, parameters are not stored in EEPROM.

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■ U: alarm clearing when the limit alarm (AL014, AL015, AL283, or AL285) occurs

0: alarm clearing is required before the servo reverses away from the limit.

1: alarm clearing is not required before the servo reverses away from the limit.

Note: determine whether the servo has reached the limit with the bit status of OD 6041h (Statusword) and OD 60FDh (Digital inputs).
Positive limit: OD 6041h [Bit 14] = On & OD 60FDh [Bit 1] = On
Negative limit: OD 6041h [Bit 15] = On & OD 60FDh [Bit 0] = On
When the servo reaches the limit, the status of P0.046 and other bits of OD 6041h (Fault / Quick stop / Warning) changes with the setting of P3.019.A. See the following table for details.

P3.012.U	P3.019.A	P0.046		OD 6041h			Servo state	Alarm clearing before reversing the servo
		[Bit 6] ALRM	[Bit 10] WARN	[Bit 3] Fault	[Bit 5] Quick stop	[Bit 7] Warning		
0	0	Off	On	Off	Off	On	Servo On	Required
0	1	On	Off	On	Off	On	Servo Off	Required
1	0	Off	On	Off	On	On	Servo On	Not required
1	1	On	Off	Off	On	On	Servo On	Not required

P3.013 - P3.017	Reserved

P3.018	EtherCAT special function switch		Address: 0324H 0325H
Default:	0x00002000	Control mode:	EtherCAT
Unit:	-	Setting range:	0x00000000 - 0x01112211
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

High word

D C B A

Low word

U Z Y X

A	Source setting for the content loaded to the EtherCAT Station Alias Register 0x0012 after the servo drive is powered on	X	Unit selection for Target velocity (OD 60FFh) and Velocity actual value (OD 606Ch) when in the PV (Profile Velocity) mode or CSV (Cyclic Synchronous Velocity) mode
B	Reserved	Y	Reserved
C	Unit selection for the maximum speed of OD 607Fh and OD 6080h	Z	AL185 communication disconnection detection setting
D	Reserved	U	Reserved

■ X: unit selection for Target velocity (OD 60FFh) and Velocity actual value (OD 606Ch) when in the PV (Profile Velocity) mode or CSV (Cyclic Synchronous Velocity) mode.

0: 0.1 rpm

1: pulse/sec

- Z: AL185 communication disconnection detection setting

  0: disconnection detection starts after EtherCAT communication enters OP state.

  1: disconnection detection starts after EtherCAT communication enters Init state.

  2: disable disconnection detection.

  Note: when using the ring topology connection, set P3.018.Z = 2 to disable the disconnection detection.

- A: source setting for the content loaded to the EtherCAT Station Alias Register 0x0012 after the servo drive is powered on.

  0: determined by the EtherCAT EEPROM station number field (ADR 0x0004) setting, which needs to be set by the controller.

  1: determined by the address set with servo parameter P3.000.

- C: unit selection for the maximum speed of OD 607Fh and OD 6080h

  0: 0.1 rpm for OD 607Fh and rpm for OD 6080h.

  1: pulse/sec for OD 607Fh and OD 6080h.

P3.019	Statusword display content		Address: 0326H 0327H
Default:	0x00000021	Control mode:	EtherCAT
Unit:	-	Setting range:	0x00000000 - 0x0001FFFF
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

High word

D C B A

Low word

U Z Y X

A	P0.046 status display when servo alarm AL014, AL015, AL283, or AL285 is triggered	X	Reserved
B	Reserved	Y	Reserved
C	Reserved	Z	Display content of OD 6041h [Bit 14]
D	Reserved	U	Display content of OD 6041h [Bit 15]

- Z: display content of OD 6041h [Bit 14]

  0: Positive limit.

  1: displays the current synchronization status between the servo drive and controller. When the bit is On, it indicates that the synchronization is complete (SYNC_OK).

- U: display content of OD 6041h [Bit 15]

  0: Negative limit.

  1: the bit remains Off.

- A: P0.046 status display when servo alarm AL014, AL015, AL283, or AL285 is triggered

  0: P0.046 [Bit 10] = On, indicating the WARN status (servo warning).

  1: P0.046 [Bit 6] = On, indicating the ALRM status (servo alarm).

  Note: P3.019.A only indicates the P0.046 status. The status of EtherCAT OD 6041h is related to P3.012.U; see P3.012 for details.

P3.020 - P3.021	Reserved

P3.022	EtherCAT PDO timeout setting		Address: 032CH 032DH
Default:	0xFF04	Control mode:	EtherCAT
Unit:	-	Setting range:	0x0002 to 0xFF14
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When using the PDO to transmit data periodically, use this parameter to set the allowable timeout. The following two sets of digits specify the trigger conditions for AL180 and AL3E3 respectively to ensure that the servo drive receives the PDO. When one of the alarms occurs, it means the packet loss period has exceeded the allowable range.

Digit	UZ	YX
Function	AL180 trigger condition	AL3E3 trigger condition
Range	0x00 (disabled) - 0xFF (default)	0x02 - 0x14

- YX: AL3E3 trigger condition (allowable cycle for elapsed time); applicable to CSP / CSV / CST mode.
  AL3E3 occurs when the servo drive does not receive the PDO within the set cycle.
  When the communication cycle is 4 ms and you set P3.022.YX to 0x02 (allow two cycles), it means if the servo drive does not receive any PDO within 8 ms, AL3E3 occurs.
- UZ: AL180 trigger condition (allowable duration for elapsed time); applicable to all operation modes.
  AL180 occurs when the servo drive does not receive the PDO within the set duration (unit: ms).
  For example, when you set P3.022.UZ to 0x01, the duration is 1 ms; when you set P3.022.UZ to 0x02, the duration is 2 ms; and when you set P3.022.UZ to 0xFF, the duration is 255 ms.

P3.023 - P3.038	Reserved

P4.xxx Diagnosis parameters

P4.000	Fault record (last)		Address: 0400H 0401H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The last fault record.

Low word (LXXXX): the alarm number.

High word (hYYYY): the error code corresponding to EtherCAT.

For example, when the low word displays AL001, the high word displays the error code of AL001.

P4.001★	Fault record (second to last)		Address: 0402H 0403H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The second to last fault record.

Refer to the description of high / low word in P4.000.

P4.002★	Fault record (third to last)		Address: 0404H 0405H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The third to last fault record.

Refer to the description of high / low word in P4.000.

P4.003★	Fault record (fourth to last)		Address: 0406H 0407H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The fourth to last fault record.

Refer to the description of high / low word in P4.000.

P4.004★	Fault record (fifth to last)		Address: 0408H 0409H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The fifth to last fault record.

Refer to the description of high / low word in P4.000.

P4.005	Servo motor JOG control		Address: 040AH 040BH
Default:	20	Control mode:	All
Unit:	rpm	Setting range:	0 - 5000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The control methods are as follows:

1. Panel control:

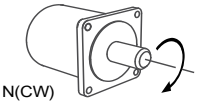
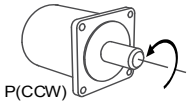
   Set the P4.005 JOG speed with the panel and it displays the JOG symbol. Pressing the UP key controls the JOG operation in the positive direction; pressing the DOWN key controls the JOG operation in the negative direction. Release the key to stop the JOG operation. If there is any error in this setting, then the motor cannot operate.

2. DI control:

   If you set the DIs to 0x37 (JOGU) and 0x38 (JOGD) (refer to Table 8.1), then the JOG operation in the positive or negative direction is controlled with the DIs.

3. Communication control:

   Set the JOG speed (1 - 4997, 5000) for operation to P4.005, and then set P4.005 to 4999 or 4998 for positive or negative direction. To stop the motor operation, set P4.005 to 0.

0: stop operation	1 - 4997, 5000: JOG speed
4998*2: JOG operation in negative direction 	4999*2: JOG operation in positive direction 

Note:
1. When using communication to write values frequently, set P2.030 to 5.
2. When you control the JOG operation with the panel, the operation direction (positive / negative) varies depending on the value of P1.001.Z.
3. This function supports the S-curve acceleration / deceleration settings in P1.034 - P1.036.
4. When P1.001.X = C, JOG operation test is not supported.

P4.006■	Software digital output register (readable and writable)		Address: 040CH 040DH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0FFF
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

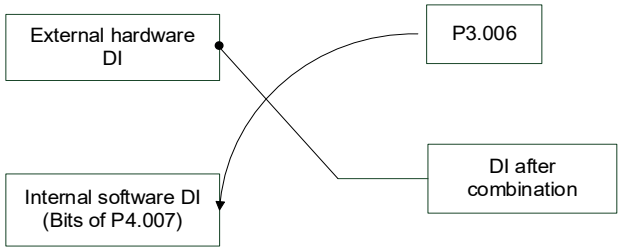
bit 00: corresponds to DO code = 0x30	bit 08: corresponds to DO code = 0x38
bit 01: corresponds to DO code = 0x31	bit 09: corresponds to DO code = 0x39
bit 02: corresponds to DO code = 0x32	bit 10: corresponds to DO code = 0x3A
bit 03: corresponds to DO code = 0x33	bit 11: corresponds to DO code = 0x3B
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 DO1 is the bit 00 status of P4.006, and so forth. Set the DO codes (0x30 - 0x3F) through communication DO, and then write to P4.006.

P4.007■	Multifunction for digital input		Address: 040EH 040FH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x1FFF
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The source of the DI signal can be the external hardware terminal or the internal software DI (P4.007), which is determined by P3.006. If the corresponding bit of P3.006 is 1, it means the source is the software DI (P4.007); if the corresponding bit is 0, then the source is the hardware DI. See the following figure:



Reading P4.007: shows the DI status after combining external DI and software DI.

Writing to P4.007: writes the software DI status. This function is the same whether you use the panel or communication to set the parameter.

For example: if the read value of P4.007 is 0x0011, it means DI1 and DI5 are On after combination; if the value written to P4.007 is 0x0011, it means the software DI1 and DI5 are On. Refer to P2.010 - P2.017 and P2.036 - P2.040 for more information on DI functional planning.

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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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Read this parameter through communication and check if 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:	0x0000 to 0x0007
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

There is no difference either reading by panel or through communication.

P4.010▲■	Hardware calibration options		Address: 0414H 0415H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 to 15
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

0 - 2: reserved	5: calibrate the hardware offset of options 2 - 3
3: calibrate the hardware offset of the current detector (V phase)	6 - 15: reserved
4: calibrate the hardware offset of the current detector (W phase)	-

Note: the calibration function must be enabled by setting P2.008.

P4.011 - P4.014	Reserved

P4.015	Current detector (V1 phase) - hardware offset calibration		Address: 041EH 041FH
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	13926 to 18842
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Manually calibrate the hardware offset. The function must be enabled by setting P2.008. Do not change the auxiliary calibration as this parameter cannot be reset.

P4.016	Current detector (V2 phase) - hardware offset calibration		Address: 0420H 0421H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	13926 to 18842
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P4.015.

P4.017	Current detector (W1 phase) - hardware offset calibration		Address: 0422H 0423H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	13926 to 18842
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P4.015.

P4.018	Current detector (W2 phase) - hardware offset calibration		Address: 0424H 0425H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	13926 to 18842
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P4.015.

P4.019	IGBT NTC calibration level (cannot reset)		Address: 0426H 0427H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	1 to 4
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Cool down the drive to 25°C (77°F) before calibration. The function must be enabled by setting P2.008.

P4.020 - P4.023	Reserved

P4.024	Level of undervoltage error		Address: 0430H 0431H
Default:	160 (220V models) 282 (400V models)	Control mode:	All
Unit:	V (rms)	Setting range:	140 to 380
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When the voltage of the DC Bus is lower than P4.024 x $\sqrt{2}$, the undervoltage alarm (AL003) occurs.

P4.025 - P4.043	Reserved

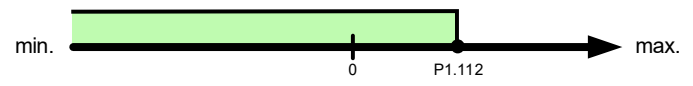
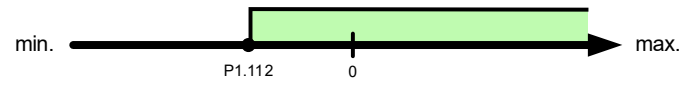
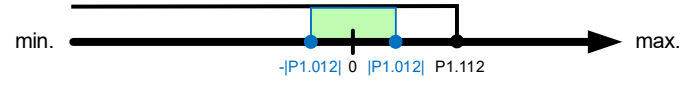
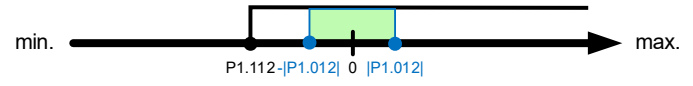
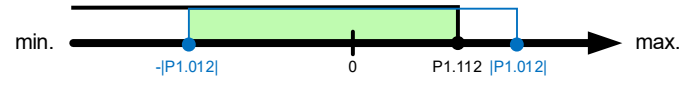
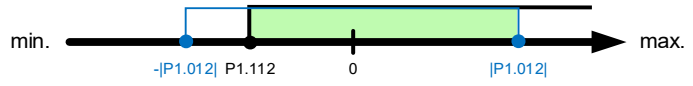
P4.044	Special bit register 5		Address: 0458H 0459H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0063
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

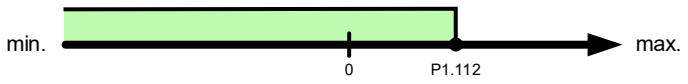
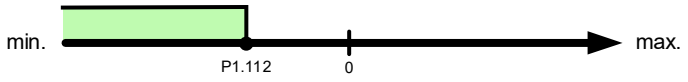
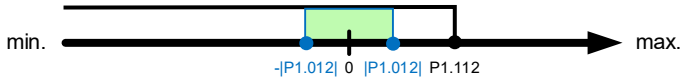
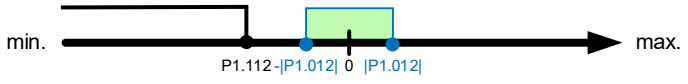
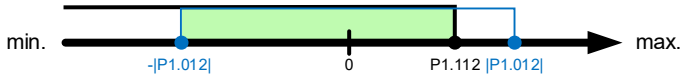
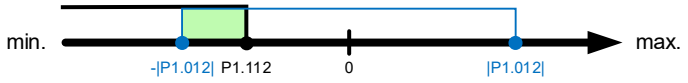
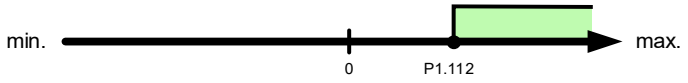
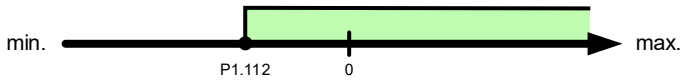
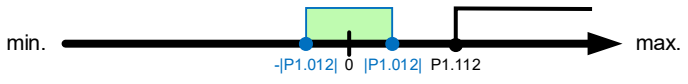
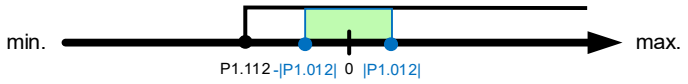
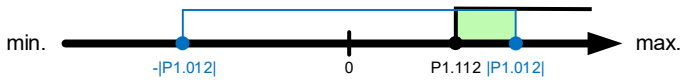
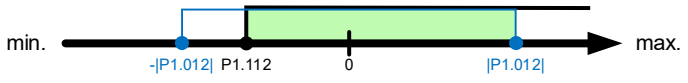
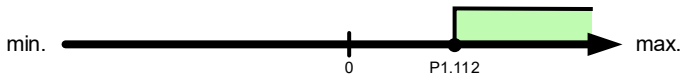
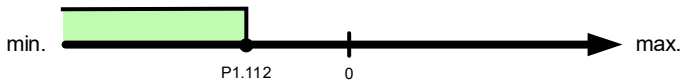
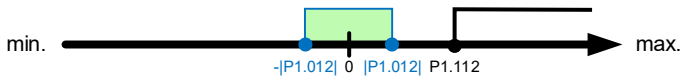
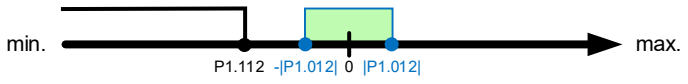
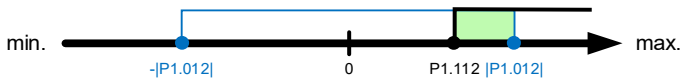
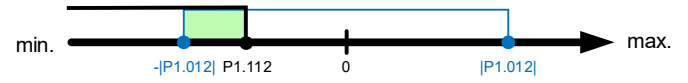
Settings:

X	Single-direction torque limit setting	Z	Reserved
Y	Special function switch	U	Reserved

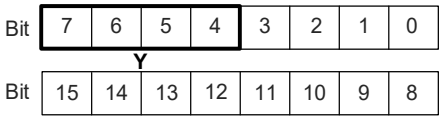
■ X: single-direction torque limit setting

This setting limits the torque of the motor, and is applicable to internal torque limits (P1.012 - P1.014). The following diagrams are illustrated based on P1.012; you can set parameters P1.012 - P1.014 according to the requirements. The light green highlighted area is the torque limit area.

P4.044.X	P1.012	P1.112	Operating range
0	Disable P1.012 (P1.002.Y = 0)	≥ 0	
		< 0	
	≤ |P1.112|	≥ 0	
		< 0	
	≥ |P1.112|	≥ 0	
		< 0	

P4.044.X	P1.012	P1.112	Operating range
1	Disable P1.012 (P1.002.Y = 0)	≥ 0	
		< 0	
	< |P1.112|	≥ 0	
		< 0	
	> |P1.112|	≥ 0	
		< 0	
2	Disable P1.012 (P1.002.Y = 0)	≥ 0	
		< 0	
	< |P1.112|	≥ 0	
		< 0	
	> |P1.112|	≥ 0	
		< 0	
3	Disable P1.012 (P1.002.Y = 0)	≥ 0	
		< 0	
	< |P1.112|	≥ 0	
		< 0	
	> |P1.112|	≥ 0	
		< 0	

■ Y: special function switch



Bit	Function	Description
Bit 4	Reserved	-
Bit 5	Function of Velocity offset (OD 60B1h) in EtherCAT mode	0: enable 1: disable
Bit 6	Function of Torque offset (OD 60B2h) in EtherCAT mode	0: enable 1: disable
Bit 7	Reserved	-

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The low word 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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Digit	D	C	B	A	U	Z	Y	X
Function	STP	PFQS	CTO	OVF	SNL	SPL	NL	PL
Range	0 - F	0 - F	0 - F	0 - F	0 - F	0 - F	0 - F	0 - F

- OVF (DO: 0x12, Position command / feedback overflows), CTO (AL020 Serial communication timeout), SPL, SNL, PL, and NL are auto-protection functions.
- STP is the stop function.
- Use 0 - F to index the deceleration time of P5.020 - P5.035. For example: if you set P5.003.X to A, then the deceleration time of PL is determined by P5.030.

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P5.004	Homing methods		Address: 0508H 0509H
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 to 0x012A
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

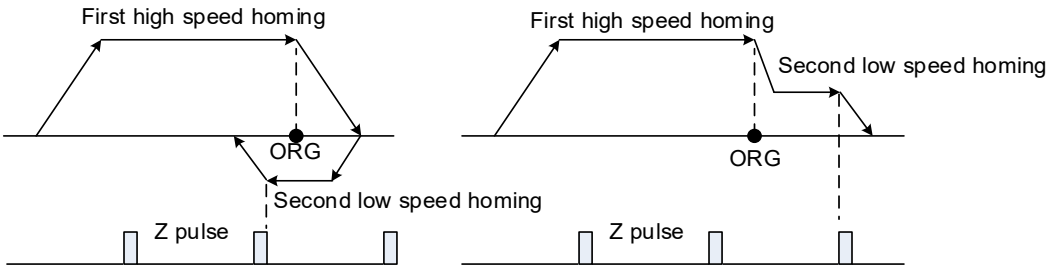
Definition of each setting value:

<table>
<tr><th>U</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="11">-</td><td>0 to 1</td><td>0 to 2</td><td>0 to A</td></tr>
<tr><td rowspan="2">-</td><td rowspan="5">Y = 0: reverse 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 the positive limit as the homing origin</td></tr>
<tr><td>X = 1: homing in reverse direction and define the negative limit as the homing origin</td></tr>
<tr><td rowspan="7">When reaching the limit:
Z = 0: show error
Z = 1: reverse direction</td><td>X = 2: homing in forward direction,
ORG: OFF→ON as the homing origin</td></tr>
<tr><td>X = 3: homing in reverse direction,
ORG: OFF→ON as the homing origin</td></tr>
<tr><td rowspan="2">-</td><td>X = 4: look for Z pulse in forward direction and define it as the homing origin</td></tr>
<tr><td>X = 5: look for Z pulse in reverse direction and define it as the homing origin</td></tr>
<tr><td rowspan="2">Y = 0: reverse to Z pulse
Y = 1: go forward to Z pulse
Y = 2: do not look for Z pulse</td><td>X = 6: homing in forward direction,
ORG: ON→OFF as the homing origin</td></tr>
<tr><td>X = 7: homing in reverse direction,
ORG: ON→OFF as the homing origin</td></tr>
<tr><td>-</td><td>-</td><td>X = 8: define current position as the origin</td></tr>
<tr><td rowspan="2">When reaching the limit:
Z = 0: show error
Z = 1: reverse direction</td><td rowspan="2">Y = 0: reverse to Z pulse
Y = 2: do not look for Z pulse</td><td>X = 9: torque homing in forward direction</td></tr>
<tr><td>X = A: torque homing in reverse direction</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	0.1 rpm	-	-
Setting range:	0.1 to 2000.0	1 to 20000	-	-
Format:	DEC	DEC	-	-
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

The first speed setting for high speed homing.



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	0.1 rpm	-	-
Setting range:	0.1 to 500.0	1 to 5000	-	-
Format:	DEC	DEC	-	-
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

The second speed setting for low speed homing.

P5.007■	PR path trigger register		Address: 050EH 050FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

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Settings:

- Set P5.007 = 0 to start homing.
- Set P5.007 = 1 - 99 to execute the specified PR path, 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: if you want to trigger PR#02

Method 1	Trigger by DI: Register Position command selection 1 - 99 Bit 1 (DI: 0x12) + Command triggered (DI: 0x08)
Method 2	Trigger by P5.007: Set P5.007 = 2 to start executing PR#02

- Set P5.007 = 1000 to execute the stop command which is the same as DI.STP.
- When reading P5.007, if the command is incomplete and DO.TPOS is Off (the motor does not reach the target position), the drive reads the current command (1 - 99).

  If the command is complete, the drive reads the current command +10000.

  If the command is complete and DO.TPOS is On (the motor reaches the target position), the drive reads the current command +20000. Commands triggered by DI are also applicable.

  Example:

  If the value read is 3, it means PR#03 is being executed and not yet complete.

  If the value read is 10003, it means PR#03 is complete, but the motor has not reached the target position yet.

  If the value read is 20003, it means PR#03 is complete and the motor reached the target position.

P5.008	Positive software limit		Address: 0510H 0511H
Default:	2147483647	Control mode:	PR
Unit:	PUU	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

In PR mode, if the motor moves in the positive direction and its position feedback exceeds the value of P5.008, AL283 occurs.

P5.009	Negative software limit		Address: 0512H 0513H
Default:	-2147483648	Control mode:	PR
Unit:	PUU	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

In PR mode, if the motor moves in the negative direction and its position feedback exceeds the value of P5.009, AL285 occurs.

P5.010★■	Data array: data size		Address: 0514H 0515H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Read-only
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The total data size is N x 32 bits, where N indicates the number of data sets returned to the 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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Specify the address to read or write the data array. 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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Window #1: when read with the panel, the value set by P5.011 does not add 1, but when read or written by other methods, it adds 1. Refer to Section 7.1.7 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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Window #2: when read with the panel or read and written through communication, the value set by P5.011 adds 1, but this parameter is not writable with the panel. Refer to Section 7.1.7 Data array for detailed instructions.

P5.014	Reserved

P5.015■	PATH 1 - PATH 2 volatile setting		Address: 051EH 051FH
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 to 0x0011
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

This parameter allows you to write data to the target continuously through communication.

X	PATH 1 volatile setting	Z	Reserved
Y	PATH 2 volatile setting	U	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 - main encoder		Address: 0520H 0521H
Default:	0	Control mode:	All
Unit:	PUU	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Read: main encoder position feedback, which is the monitoring variable 000 (00h) + offset value (value written in P5.016).

Write: writing any value to the parameter neither changes the monitoring variable 000 (00h) nor affects the positioning system. It adjusts the offset value only for easier observation.

P5.017	Reserved

P5.018	Axis position - pulse command		Address: 0524H 0525H
Default:	0	Control mode:	All
Unit:	pulse	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Pulse count from the pulse command.

P5.019	Reserved

P5.020	Acceleration / deceleration time #0		Address: 0528H 0529H
Default:	200	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode, which is the time duration required for the motor to accelerate from 0 to 3,000 rpm or decelerate from 3,000 rpm to 0.

P5.021	Acceleration / deceleration time #1		Address: 052AH 052BH
Default:	300	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.022	Acceleration / deceleration time #2		Address: 052CH 052DH
Default:	500	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.023	Acceleration / deceleration time #3		Address: 052EH 052FH
Default:	600	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.024	Acceleration / deceleration time #4		Address: 0530H 0531H
Default:	800	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.025	Acceleration / deceleration time #5		Address: 0532H 0533H
Default:	900	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.026	Acceleration / deceleration time #6		Address: 0534H 0535H
Default:	1000	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.027	Acceleration / deceleration time #7		Address: 0536H 0537H
Default:	1200	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.028	Acceleration / deceleration time #8		Address: 0538H 0539H
Default:	1500	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.029	Acceleration / deceleration time #9		Address: 053AH 053BH
Default:	2000	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.030	Acceleration / deceleration time #10		Address: 053CH 053DH
Default:	2500	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.031	Acceleration / deceleration time #11		Address: 053EH 053FH
Default:	3000	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.032	Acceleration / deceleration time #12		Address: 0540H 0541H
Default:	5000	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.033	Acceleration / deceleration time #13		Address: 0542H 0543H
Default:	8000	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The time setting for acceleration or deceleration in PR mode. Refer to P5.020 for details.

P5.034	Acceleration / deceleration time #14		Address: 0544H 0545H
Default:	50	Control mode:	PR
Unit:	ms	Setting range:	1 to 1500
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The deceleration time setting for auto-protection. The default value is small for faster deceleration.

P5.035	Acceleration / deceleration time #15		Address: 0546H 0547H
Default:	30	Control mode:	PR
Unit:	ms	Setting range:	1 to 1200
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The deceleration time setting for auto-protection. The default value is small for faster deceleration.

P5.036 - P5.039	Reserved

P5.040	Delay time #0 after position reached		Address: 0550H 0551H
Default:	0	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

There are 16 sets of delay time (#0 - 15) in PR mode. This parameter is the delay time #0 in PR mode.

P5.041	Delay time #1 after position reached		Address: 0552H 0553H
Default:	100	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #1 in PR mode.

P5.042	Delay time #2 after position reached		Address: 0554H 0555H
Default:	200	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #2 in PR mode.

P5.043	Delay time #3 after position reached		Address: 0556H 0557H
Default:	400	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #3 in PR mode.

P5.044	Delay time #4 after position reached		Address: 0558H 0559H
Default:	500	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #4 in PR mode.

P5.045	Delay time #5 after position reached		Address: 055AH 055BH
Default:	800	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #5 in PR mode.

P5.046	Delay time #6 after position reached		Address: 055CH 055DH
Default:	1000	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #6 in PR mode.

P5.047	Delay time #7 after position reached		Address: 055EH 055FH
Default:	1500	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #7 in PR mode.

P5.048	Delay time #8 after position reached		Address: 0560H 0561H
Default:	2000	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #8 in PR mode.

P5.049	Delay time #9 after position reached		Address: 0562H 0563H
Default:	2500	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #9 in PR mode.

P5.050	Delay time #10 after position reached		Address: 0564H 0565H
Default:	3000	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #10 in PR mode.

P5.051	Delay time #11 after position reached		Address: 0566H 0567H
Default:	3500	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #11 in PR mode.

P5.052	Delay time #12 after position reached		Address: 0568H 0569H
Default:	4000	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #12 in PR mode.

P5.053	Delay time #13 after position reached		Address: 056AH 056BH
Default:	4500	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #13 in PR mode.

P5.054	Delay time #14 after position reached		Address: 056CH 056DH
Default:	5000	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #14 in PR mode.

P5.055	Delay time #15 after position reached		Address: 056EH 056FH
Default:	5500	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Delay time #15 in PR mode.

P5.056 - P5.059	Reserved

P5.060	Target speed setting #0			Address: 0578H 0579H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	20.0	200	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #0 in PR mode.

P5.061	Target speed setting #1			Address: 057AH 057BH
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	50.0	500	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #1 in PR mode.

P5.062	Target speed setting #2			Address: 057CH 057DH
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	100.0	1000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #2 in PR mode.

P5.063	Target speed setting #3			Address: 057EH 057FH
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	200.0	2000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #3 in PR mode.

P5.064	Target speed setting #4			Address: 0580H 0581H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	300.0	3000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #4 in PR mode.

P5.065	Target speed setting #5			Address: 0582H 0583H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	500.0	5000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #5 in PR mode.

P5.066	Target speed setting #6			Address: 0584H 0585H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	600.0	6000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #6 in PR mode.

P5.067	Target speed setting #7			Address: 0586H 0587H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	800.0	8000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #7 in PR mode.

P5.068	Target speed setting #8			Address: 0588H 0589H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	1000.0	10000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #8 in PR mode.

P5.069	Target speed setting #9			Address: 058AH 058BH
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	1300.0	13000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #9 in PR mode.

P5.070	Target speed setting #10			Address: 058CH 058DH
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	1500.0	15000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #10 in PR mode.

P5.071	Target speed setting #11			Address: 058EH 058FH
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	1800.0	18000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #11 in PR mode.

P5.072	Target speed setting #12			Address: 0590H 0591H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	2000.0	20000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #12 in PR mode.

P5.073	Target speed setting #13			Address: 0592H 0593H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	2300.0	23000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #13 in PR mode.

P5.074	Target speed setting #14			Address: 0594H 0595H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	2500.0	25000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #14 in PR mode.

P5.075	Target speed setting #15			Address: 0596H 0597H
Operation interface:	Panel / software	Communication	Control mode:	PR
Default:	3000.0	30000	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 7500.0	0 to 75000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-
Model:	E3C-E, E3C-E1, E3C-EF			

Settings:

Target speed #15 in PR mode.

P5.076 - P5.092	Reserved

P5.093	Motion control macro command: command parameter #4		Address: 05BAH 05BBH
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	0x00000000 to 0xFFFFFFFF
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Before issuing the macro command, set the relevant parameters in advance. The function of the parameter is determined by the macro command code. Not every macro command requires this parameter.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to P5.093 for details.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to P5.093 for details.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to P5.093 for details.

P5.097■	Motion control macro command: issuing command / reading execution result		Address: 05C2H 05C3H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x099F
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Write to this parameter to issue a macro command; read this parameter to examine the execution result of a macro command.

When you write the command code 0x0003 to this parameter, 0x1003 is returned if successful; and 0xF03X if unsuccessful (depending on the command description). If you issue a command that is not supported, the failure code 0xF001 is returned.

The command codes are listed in the following tables:

Command code 0x0003	**Parameter and data array protection: password setting, protection activation**
	This function can only be executed prior to activating the parameter protection function. When the protection function is activated, the failure code is returned if this function is executed repeatedly.
Macro parameters	P5.093 = parameter write protection 0: disabled 1: enabled P5.094 = read protection range of parameter and data array (-1 to +8) -1: parameter groups 5, 6, 7 and data array are readable 0: parameter groups 5, 6, 7 and data array are unreadable 1: parameter groups 5, 6, 7 and data array #100 - 799 are unreadable 2: parameter groups 5, 6, 7 and data array #200 - 799 are unreadable 3: parameter groups 5, 6, 7 and data array #300 - 799 are unreadable 4: parameter groups 5, 6, 7 and data array #400 - 799 are unreadable 5: parameter groups 5, 6, 7 and data array #500 - 799 are unreadable 6: parameter groups 5, 6, 7 and data array #600 - 799 are unreadable 7: parameter groups 5, 6, 7 are unreadable, but data array is readable 8: all parameter groups (P0 - P7) are unreadable P5.095 = set new password (1 - 16777215) P5.096 = confirm new password (1 - 16777215)
Read the return value of P5.097 after executing the macro	Success code
	0x1003
	Failure code
	0xF031: protection function is activated and cannot be set repeatedly
	0xF032: wrong password setting; P5.095 does not equal P5.096
	0xF033: password value exceeds the allowable range (1 - 16777215)
	0xF034: protection range P5.094 exceeds the allowable range (-1 to +8)
	0xF035: protection level P5.093 exceeds the allowable range (0 - 1)

Command code 0x0004	**Parameter and data array protection: unlock protection**
	This function can only be executed when the protection function is activated. When the protection function is unlocked, the failure code is returned if this function is executed repeatedly. If the wrong password is entered, failure code 0xEnnn is returned. nnn indicates the remaining attempts to enter the password. The number decrements by 1 after each failed attempt. When the number displays 0, it indicates the maximum number of failed password attempts has been reached and this function is disabled. You can only reset all parameters (P2.008 = 10) to unlock.
Macro parameter	P5.096 = enter password (1 - 16777215)
Read the return value of P5.097 after executing the macro	Success code
	0x1004
	Failure code
	0xF041: protection function is unlocked and cannot be unlocked repeatedly
	0xF043: password value exceeds the allowable range (1 - 16777215)
	0xF044: the maximum number of failed password attempts has been reached and it is locked. You can only unlock by resetting the parameters (P2.008 = 10), but this also resets all parameters to the default values.
	0xEnnn: incorrect password setting; failed to unlock nnn: remaining attempts to enter the password. The number decrements by 1 after each failed attempt. When the number displays 0, the function is disabled and does not allow further attempts.

P5.098	PR path triggered by event rising-edge		Address: 05C4H 05C5H
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 to 0xDDDD
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

X	The action when PR is EV1 rising-edge triggered	Z	The action when PR is EV3 rising-edge triggered
Y	The action when PR is EV2 rising-edge triggered	U	The action when PR is EV4 rising-edge triggered

- X: the action when EV1 is On

  0: no action

  1 - D: execute PR#51 - 63

- Y: the action when EV2 is On

  0: no action

  1 - D: execute PR#51 - 63

- Z: the action when EV3 is On

  0: no action

  1 - D: execute PR#51 - 63

- U: the action when EV4 is On

  0: no action

  1 - D: execute PR#51 - 63

P5.099	PR path triggered by event falling-edge		Address: 05C6H 05C7H
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 to 0xDDDD
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

X	The action when PR is EV1 falling-edge triggered	Z	The action when PR is EV3 falling-edge triggered
Y	The action when PR is EV2 falling-edge triggered	U	The action when PR is EV4 falling-edge triggered

- X: the action when EV1 is Off

  0: no action

  1 - D: execute PR#51 - 63

- Y: the action when EV2 is Off

  0: no action

  1 - D: execute PR#51 - 63

- Z: the action when EV3 is Off

  0: no action

  1 - D: execute PR#51 - 63

- U: the action when EV4 is Off

  0: no action

  1 - D: execute PR#51 - 63

P5.100■	Data array: window #3 for reading and writing		Address: 05C8H 05C9H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Window #3: when read or written by any method, the value of P5.011 does not add 1.

Refer to Section 7.1.7 Data array for detailed instructions.

P5.101■	Data array: window #4 for reading and writing		Address: 05CAH 05CBH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Window #4: when read or written by any method, the value of P5.011 does not add 1.

Refer to Section 7.1.7 Data array for detailed instructions.

P5.102■	Data array: window #5 for reading and writing		Address: 05CCH 05CDH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Window #5: when read or written by any method, the value of P5.011 does not add 1.

Refer to Section 7.1.7 Data array for detailed instructions.

P5.103■	Data array: window #6 for reading and writing		Address: 05CEH 05CFH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Window #6: when read or written by any method, the value of P5.011 does not add 1.

Refer to Section 7.1.7 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 - 0xFFFFFF6F
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

High word

D C B A

Low word

U Z YX

A	DEC2: deceleration time selection for second homing	YX	PATH: path type
B	DLY: select 0 - F for delay time	Z	ACC: select 0 - F for acceleration time
C	Reserved	U	DEC1: deceleration time selection for first homing
D	BOOT: whether to execute homing automatically when the drive is powered on	-	-

- YX: PATH: path type

  0x00: Stop: the servo stops after homing is complete

  0x01 - 0x63: Auto: the servo executes the specified path (PR#01 - PR#99) after homing is complete

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

  0 - F: correspond to P5.020 - P5.035

- U: DEC1: deceleration time selection for first homing

  0 - F: correspond to P5.020 - P5.035

- A: DEC2: deceleration time selection for second homing

  0 - F: correspond to P5.020 - P5.035

- B: DLY: select 0 - F for delay time

  0 - F: correspond to P5.040 - P5.055

- D: BOOT: whether to execute homing automatically when the drive is powered on

  0: do not execute homing

  1: execute homing automatically (servo switches to On for the first time after power is applied)

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

1. P5.004: homing methods.
2. P5.005 - P5.006: speed settings for homing.
3. P6.001: the origin definition (ORG_DEF) is the position of the origin and is not necessarily 0. This function is used as a traversal of the position system.

Note:

1. After finding the origin (sensor or Z), the servo 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 0x00.
   If returning to the origin is needed, set PATH to 0x01 - 0x63 and set the route as PABS = 0.
   Example: when P6.000 = 0x0001, the servo automatically executes PR#01 after homing is complete.
   Set the route of PR#01 (setting P6.002 & P6.003) as moving to the absolute position of 0.
2. If the origin (sensor or Z) is found and you want the servo to move an offset S and define the position after moving as P, then set 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
Model:	E3C-E, E3C-E1, E3C-EF		

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

High word

D C B A

Low word

U Z Y X

A	SPD, Target speed[Note]	X	TYPE, Path type
B	DLY, Delay time	Y	OPT, Option
C	AUTO[Note]	Z	ACC, Acceleration time[Note]
D	Reserved	U	DEC, Deceleration time[Note]

Definitions are as follows:

■ YX

Y: OPT, Option				X: TYPE, Path type
Bit 7	Bit 6	Bit 5	Bit 4	
-	UNIT	AUTO	INS	1: SPEED, constant speed control.
CMD		OVLP	INS	2: SINGLE, positioning control. It stops when finished.
				3: AUTO, positioning control. It automatically loads the next path when finished.
-	-	-	INS	7: JUMP, jump to the specified path.
-	ROM	AUTO	INS	8: WRITE, write specified parameter to specified path.
DIR		OVLP	INS	A: INDEX, rotary axis position control.

TYPE: when path type 1, 2, or 3 is executed, the motor operation can be interrupted and stopped by DI.STP and software limits.

INS: interrupts the previous path when the current path is executed.

OVLP: allow overlapping of the next path. Overlapping is not allowed in Speed mode. When you set an Overlap function in Position mode, DLY has no function.

AUTO: once the current PR path is finished, automatically load the next path.

CMD, DIR, ROM, and UNIT: refer to Section 7.1.3 Motion Control commands.

■ UZ

U: DEC, Deceleration time	Z: ACC, Acceleration time	Corresponding parameter	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
A	A	P5.030	2500
B	B	P5.031	3000
C	C	P5.032	5000
D	D	P5.033	8000
E	E	P5.034	50
F	F	P5.035	30

■ A: SPD, target speed

A	Corresponding parameter	Default value (rpm)
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
A	P5.070	1500
B	P5.071	1800
C	P5.072	2000
D	P5.073	2300
E	P5.074	2500
F	P5.075	3000

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- B: DLY, delay time

B	Corresponding parameter	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
A	P5.050	3000
B	P5.051	3500
C	P5.052	4000
D	P5.053	4500
E	P5.054	5000
F	P5.055	5500

- C: AUTO: once current PR path is finished, automatically load the next path.

  This function is enabled only when P6.002.X = A (rotary axis position control).

  Description of each bit:

Bit	Function	Description
Bit 24 - Bit 25	Reserved	-
Bit 26	AUTO	0: disable auto function 1: once current PR path is finished, automatically load the next path
Bit 27	Reserved	-

Note: the definitions of digits C, A, U, Z are different from those in the preceding tables when the path type is 8 (write specified parameter to specified path). 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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

P6.002 defines the property of the target point and 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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.002.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.002.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.002.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.002.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.003.

P6.046	PATH 23 definition		Address: 065CH 065DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.002.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.002.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.002.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.002.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.002.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.003.

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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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.003.

P7.010	PATH 55 definition		Address: 0714H 0715H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.003.

P7.020	PATH 60 definition		Address: 0728H 0729H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.002.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.003.

P7.050	PATH 75 definition		Address: 0764H 0765H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.003.

P7.060	PATH 80 definition		Address: 0778H 0779H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.003.

P7.070	PATH 85 definition		Address: 078CH 078DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.002.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.003.

P7.080	PATH 90 definition		Address: 07A0H 07A1H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.002.

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.003.

P7.090	PATH 95 definition		Address: 07B4H 07B5H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

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
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Refer to the description of P6.003.

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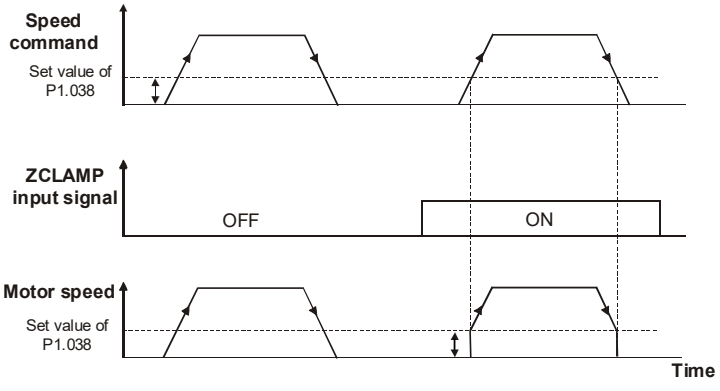
Table 8.1 Digital input (DI) descriptions

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 you troubleshoot the alarm, this DI is On and the alarm signal displayed by the servo drive is cleared.	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 0x0001), the gain value switches to the value which is the original gain multiplied by the rate of change.	Level triggered	PR, S

Value: 0x04			
DI name	Description	Triggering method	Control mode
CCLR	Clear the pulse counter. Refer to P2.050 for the method to clear the pulses. When this DI is On, the accumulative position pulse error of the drive (P0.002 = 33) is cleared to 0. Note: change the triggering method with P2.050.	Rising-edge triggered, level triggered	PR

Value: 0x05			
DI name	Description	Triggering method	Control mode
ZCLAMP	When the speed is slower than the setting of P1.038 (zero speed detection level), the motor stops operating when this DI is On. 	Level triggered	S, Sz

Value: 0x06			
DI name	Description	Triggering method	Control mode
CMDINV	In Speed and Torque modes, the input command is reversed when this DI is On.	Level triggered	S, Sz, T, Tz

Value: 0x08			
DI name	Description	Triggering method	Control mode
CTRG	In PR mode, after the PR Position command (POS0 - 6) is selected, 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.	Level triggered	PR, S

Value: 0x10			
DI name	Description	Triggering method	Control mode
SPDLM	In Torque mode, motor speed is limited when this DI is On, and source of the Speed limit command is the internal register.	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 path selection (0 - 99)	Level triggered	PR

Position command	POS6	POS5	POS4	POS3	POS2	POS1	POS0	CTRG	Corres-ponding parameter
Homing	0	0	0	0	0	0	0	↑	P6.000
									P6.001
PR#01	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: 0x14, 0x15

DI name	Description	Triggering method	Control mode
SPD0 SPD1	Register Speed command selection (1 - 4)	Level triggered	S, Sz

Speed command number	DI signal of CN1		Command source	Content
	SPD1	SPD0		
S1	0	0	S Sz	Speed command is 0
S2	0	1	Internal register (parameter)	P1.009
S3	1	0		P1.010
S4	1	1		P1.011

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<table>
<tr><th colspan="6">Value: 0x16, 0x17</th></tr>
<tr><th>DI name</th><th colspan="4">Description</th><th>Triggering method</th><th>Control mode</th></tr>
<tr><td rowspan="7">TCM0
TCM1</td><td colspan="4">Register Torque command selection (1 - 4)
<table>
<tr><th rowspan="2">Torque command number</th><th colspan="2">DI signal of CN1</th><th rowspan="2">Command source</th><th rowspan="2">Content</th></tr>
<tr><th>TCM1</th><th>TCM0</th></tr>
<tr><td>T1</td><td>0</td><td>0</td><td>T
Tz</td><td>Torque command is 0</td></tr>
<tr><td>T2</td><td>0</td><td>1</td><td rowspan="3">Internal register (parameter)</td><td>P1.012</td></tr>
<tr><td>T3</td><td>1</td><td>0</td><td>P1.013</td></tr>
<tr><td>T4</td><td>1</td><td>1</td><td>P1.014</td></tr>
</table></td><td rowspan="7">Level triggered</td><td rowspan="7">T, Tz</td></tr>
</table>

<table>
<tr><th colspan="4">Value: 0x18</th></tr>
<tr><th>DI name</th><th>Description</th><th>Triggering method</th><th>Control mode</th></tr>
<tr><td>S-P</td><td>In S-P dual mode, when this DI is Off, the drive is in Speed mode; when this DI is On, the drive is in Position mode.</td><td>Level triggered</td><td>Dual mode</td></tr>
</table>

<table>
<tr><th colspan="4">Value: 0x19</th></tr>
<tr><th>DI name</th><th>Description</th><th>Triggering method</th><th>Control mode</th></tr>
<tr><td>S-T</td><td>In S-T dual mode, when this DI is Off, the drive is in Speed mode; when this DI is On, the drive is in Torque mode.</td><td>Level triggered</td><td>Dual mode</td></tr>
</table>

<table>
<tr><th colspan="4">Value: 0x1D</th></tr>
<tr><th>DI name</th><th>Description</th><th>Triggering method</th><th>Control mode</th></tr>
<tr><td>ABSE</td><td>When DI.ABSE is On, the servo is in absolute mode and the functions of DI.ABSQ, DI.ABSC, DO.ABSR, and DO.ABSD are enabled at the same time.
When DI.ABSE is On, the functions of DI4, DO2, and DO3 are no longer the ones planned by the corresponding parameters. The DI4 function will be DI.ABSQ, DO2 will be DO.ABSR, and DO3 will be DO.ABSD. In addition, the DI point of DI.ABSC can be assigned by parameter settings.</td><td>Level triggered</td><td>All</td></tr>
</table>

<table>
<tr><th colspan="4">Value: 0x1F</th></tr>
<tr><th>DI name</th><th>Description</th><th>Triggering method</th><th>Control mode</th></tr>
<tr><td>ABSC</td><td>When DI.ABSC is On, the current absolute position of the encoder is set as the origin definition (P6.001), but this DI is only valid when DI.ABSE is On.
Note: in communication mode, the origin definition is the setting value of OD 607Ch multiplied by a negative sign.</td><td>Rising-edge triggered</td><td>All</td></tr>
</table>

<table>
<tr><th colspan="4">Value: when DI.ABSE is On, the function of DI4 is changed to DI.ABSQ</th></tr>
<tr><th>DI name</th><th>Description</th><th>Triggering method</th><th>Control mode</th></tr>
<tr><td>ABSQ (always input by DI4)</td><td>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 signal is only valid when DI.ABSE is On; when DI.ABSE is Off, the function of DI4 is planned by P2.013. Refer to Figure 9.3.5.1.1 in Chapter 9 for a detailed description.</td><td>Rising- and falling-edge triggered</td><td>All</td></tr>
</table>

Value: 0x20			
DI name	Description	Triggering method	Control mode
T-P	In T-P dual mode, when this DI is Off, the drive is in Torque mode; when this DI is On, the drive is in Position mode.	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)	Negative inhibit limit (normally closed contact).	Level triggered	All

Value: 0x23			
DI name	Description	Triggering method	Control mode
PL (CCWL)	Positive inhibit limit (normally closed contact).	Level triggered	All

Value: 0x24			
DI name	Description	Triggering method	Control mode
ORGP	During homing, when this DI is On, the servo regards this position as the origin. 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, the servo starts to search for the origin. Refer to the setting of P5.004.	Rising-edge triggered	PR

Value: 0x37			
DI name	Description	Triggering method	Control mode
JOGU	When this DI is On, the motor jogs in the positive direction.	Level triggered	All

Value: 0x38			
DI name	Description	Triggering method	Control mode
JOGD	When this DI is On, the motor jogs in the negative direction.	Level triggered	All

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Value: 0x39			
DI name	Description	Triggering method	Control mode
EV1	Event trigger command 1. Refer to the settings 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. Refer to the settings 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. Refer to the settings 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. Refer to the settings of P5.098 and P5.099.	Rising- and falling-edge triggered	PR

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 P5.003 (deceleration time for auto-protection). When this DI is On, AL35F occurs and the motor starts decelerating. When the speed reaches 0, AL3CF occurs and servo is switched to Servo Off.	Rising-edge triggered	All

Note: the digital input function is disabled when P2.010 - P2.017 and P2.036 - P2.040 are set to 0x0100.

Table 8.2 Digital output (DO) descriptions

Value: 0x01			
DO name	Description	Triggering method	Control mode
SRDY	When the 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 zero speed setting (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 pulse number error is smaller than the position range setting (P1.054), this DO is On.	Level triggered	PR

Value: 0x06			
DO name	Description	Triggering method	Control mode
TQL	When the torque limit is activated, this DO is On.	Level triggered	All (except for T and Tz)

Value: 0x07			
DO name	Description	Triggering method	Control mode
ALRM	When a servo alarm occurs, this DO is On. (Except for positive / negative limit, communication error, and undervoltage.)	Level triggered	All

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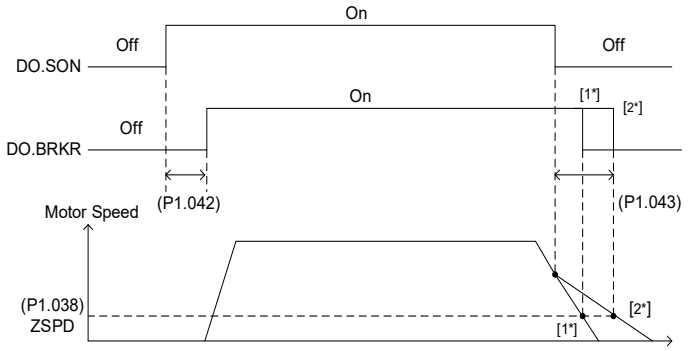
Value: 0x08			
DO name	Description	Triggering method	Control mode
BRKR	Output signal of the electromagnetic brake control. Set P1.042 and P1.043 to adjust the delay time before and after the electromagnetic brake control function is activated and deactivated.  Note: refer to the note in P1.042.	Level triggered	All

Value: 0x09			
DO name	Description	Triggering method	Control mode
HOME	When homing is complete, it means the position system and position counter are defined and this DO is On. When power is applied for the first time, this DO is Off; when homing is complete, 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 complete, this DO is On.	Level triggered	PR

Value: 0x0D			
DO name	Description	Triggering method	Control mode
ABSW	When an absolute encoder alarm occurs, this DO is On.	-	All

Value: 0x0E			
DO name	Description	Triggering method	Control mode
IDXD	When this DO is On, it means the rotary axis position is defined. When homing is complete, the rotary axis position is defined as well.	-	PR

Value: 0x10			
DO name	Description	Triggering method	Control mode
OLW	This DO is On when the accumulative overload time exceeds t_{OL}. However, if the accumulative overload time exceeds the allowable overload time of the servo, the servo sends the overload alarms AL006 and AL023. t_{OL}= Allowable overload time of the servo x setting value of P1.056 (Motor output overload warning level) For example: P1.056 = 60 (unit: %). When the output average load of the servo drive is 200% and the output time exceeds 8 seconds, the overload alarms (AL006 and AL023) occur. t_{OL} = 8 sec x 60% = 4.8 sec That is, when the output average load of the servo drive is 200% for over t_{OL} = 4.8 seconds, DO.OLW (0x10) is On. If the duration exceeds 8 seconds, the servo drive sends AL006 (overload) and AL023 (overload prewarning).	Level triggered	All

Value: 0x11			
DO name	Description	Triggering method	Control mode
WARN	Warning outputs (positive / negative limit, communication error, and undervoltage).	Level triggered	All

Value: 0x12			
DO name	Description	Triggering method	Control mode
OVF	Position command / feedback overflows.	Level triggered	PR

Value: 0x13			
DO name	Description	Triggering method	Control mode
SNL (SCWL)	Software limit (negative limit).	Level triggered	PR

Value: 0x14			
DO name	Description	Triggering method	Control mode
SPL (SCCWL)	Software limit (positive limit).	Level triggered	PR

Value: 0x15			
DO name	Description	Triggering method	Control mode
Cmd_OK	When the Position command is complete and the drive enters Position mode, this DO is On. When the Position command is executing, this DO is Off; after the command is complete, this DO is On. This DO only indicates that the command is complete, but the motor positioning may not be complete yet. Refer to DO.TPOS.	Level triggered	PR

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Value: 0x17			
DO name	Description	Triggering method	Control mode
MC_OK	When both DO.Cmd_OK and DO.TPOS are On, then this DO is On; otherwise, it is Off. Refer to P1.048.	Level triggered	PR

Value: 0x19			
DO name	Description	Triggering method	Control mode
SP_OK	Motor speed reaches the target speed: in Speed modes, when the error 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	First set of general range comparison: when the value of the item monitored by P0.009 ranges between the values of P0.054 and P0.055, then this DO is On.	-	All

Value: 0x2D			
DO name	Description	Triggering method	Control mode
Zon2	Second set of general range comparison: when the value of the item monitored by P0.010 ranges between the values of P0.056 and P0.057, then this DO is On.	-	All

Value: 0x2E			
DO name	Description	Triggering method	Control mode
Zon3	Third set of general range comparison: when the value of the item monitored by P0.011 ranges between the values of P0.058 and P0.059, then this DO is On.	-	All

Value: 0x2F			
DO name	Description	Triggering method	Control mode
Zon4	Fourth set of general range comparison: when the value of the item monitored by P0.012 ranges between the values of P0.060 and P0.061, then this DO is On.	-	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

Value: when DI.ABSE is On, the function of DO2 is changed to DO.ABSR			
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 after the request is received, the data has been prepared and the ABSD data is valid for the controller to access. This signal is only valid when DI.ABSE is On; when DI.ABSE is Off, the function of DO2 is planned by P2.019. Refer to Figure 9.3.5.1.1 in Chapter 9 for a detailed description.	Level triggered	All

Value: when DI.ABSE is On, the function of DO3 is changed to DO.ABSD			
DO name	Description	Triggering method	Control mode
ABSD (always output by DO3)	The DO for ABS data. This signal is only valid when both DI.ABSE and DO.ABSR are On; when DI.ABSE is Off, the function of DO3 is planned by P2.020. Refer to Figure 9.3.5.1.1 in Chapter 9 for a detailed description.	Level triggered	All

Note: the digital output function is disabled when P2.018 - P2.020 are set to 0x0100.

Table 8.3 Monitoring variables descriptions

Description of monitoring variables:

Item	Description
Monitoring code	Each monitoring variable has a code, and you can set the code in P0.002 for monitoring the variable.
Format	Each monitoring variable is stored as a 32-bit long integer in the servo drive.
Category	Basic variables / extension variables: 1. Basic variables: the variables displayed on the panel, which can be scrolled through with the UP / DOWN key in Monitoring mode. 2. Extension variables: the variables other than basic variables.
Monitoring method	Panel display / mapping: 1. Panel display: monitor with the panel. 2. Mapping: monitor the variables or parameters by mapping parameters.
Panel display	1. Use the MODE key to switch to the Monitoring mode and press the UP / DOWN keys to select the variable to monitor. 2. Input the code of the variable to be monitored into P0.002 and start monitoring. Press the SHIFT key on the panel to switch between high and low word display; press the SET key on the panel to switch between decimal and hexadecimal display.
Mapping	1. Parameters that support monitoring variable mapping: P0.009 - P0.013. Refer to Section 8.2 Parameter descriptions. 2. Read the monitoring variables through communication using mapping parameters. 3. The values of the mapping parameters (P0.009 - P0.013) are the content of the basic variables 17h, 18h, 19h, and 1Ah. To monitor P0.009, set P0.017 to the value to read (refer to P0.002). When reading the data through communication, you can directly read the data specified by P0.017; when monitoring the data through the panel (set P0.002 to 23), the panel displays “VAR-1” and then the content value of P0.009.

The property code of each monitoring variable is described in the following table:

Property	Description
B	Basic variables, which can be selected with the UP / DOWN keys on the panel.
D1 D2	Decimal place displayed on the panel. D1 indicates 1 decimal place and 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.

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The monitoring variables are described in the following table by the code sequence:

Code	Variable name / property	Description
000 (00h)	Position feedback (PUU) B	Current position feedback of the motor encoder. Unit: Pulse of User Unit (PUU).
001 (01h)	Position command (PUU) B	Current position of the Position command. Unit: Pulse of User Unit (PUU). PR mode: absolute position of the Position command.
002 (02h)	Following error (PUU) B	Difference between the Position command before filtered and the position feedback. Unit: Pulse of User Unit (PUU).
003 (03h)	Position feedback (pulse) B	Current position feedback of the motor encoder. Unit: encoder unit (pulse).
004 (04h)	Position command (pulse) B	Current position of the Position command. Unit: encoder unit (pulse).
005 (05h)	Following error (pulse) B	Difference between the Position command before filtered and the position feedback. Unit: encoder unit (pulse).
006 (06h)	Position command frequency B	Frequency of the position command received by the drive. Unit: Kpps. Applicable to PR mode.
007 (07h)	Speed feedback B D1 Dec	Current motor speed. Unit: 0.1 rpm. This is the speed processed by the low-pass filter, which makes it more stable.
009 (09h)	Speed command (integrated) B	Integrated Speed command. Unit: 0.1 rpm. Source includes register or position loop.
011 (0Bh)	Torque command (integrated) B	Integrated Torque command. Unit: percentage (%). Source includes register or speed loop.
012 (0Ch)	Average load rate B	Average load rate (moving average every 20 ms) from the servo 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, consisting of two sets of frequencies: F1 and F2. When monitoring from the panel, press the SHIFT key to switch between F1 and F2: F2 displays zero decimal places; F1 displays 1 decimal place. When reading through communication (mapping parameter): Low word returns frequency F2. High word returns frequency F1.

Code	Variable name / property	Description
018 (12h)	Z phase offset B Dec	Offset value between motor position and Z phase; range: -4999 to +5000. When the motor position overlaps with Z phase, the value is 0; the greater the absolute value of this variable, 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 P0.010 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.
027 (1Bh)	Z phase offset B	Offset value between motor position and Z phase. (Only available for Delta CNC controllers.)
028 (1Ch)	Alarm code Dec B	The alarm code (in decimal format). The value converted to hexadecimal equals to the alarm code in P0.001 and the error code of communication models.
032 (20h)	Position error (PUU)	Difference between the Position command after filtered and the position feedback. Unit: Pulse of User Unit (PUU).
033 (21h)	Position error (pulse)	Difference between the Position command after filtered and the position feedback. Unit: encoder unit (pulse).
035 (23h)	Rotary axis position command	Rotary axis position command at present. Unit: Pulse of User Unit (PUU).
038 (26h)	Voltage level of the battery	Voltage level of the battery in an absolute encoder. To display the voltage level, 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 or 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 DO channel.
041 (29h)	Status of the drive	Returns the value of P0.046. Refer to the description of P0.046.
042 (2Ah)	No. of PR in execution	Displays the number of the PR path being executed.

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Code	Variable name / property	Description
051 (33h)	Speed feedback (immediate) D1 Dec	Actual motor speed at present. Unit: 0.1 rpm.
053 (35h)	Torque command (integrated) D1 Dec	Integrated Torque command. Unit: 0.1%. Source includes register or speed loop.
054 (36h)	Torque feedback D1 Dec	Actual motor torque at present. Unit: 0.1%.
055 (37h)	Current feedback D2 Dec	Actual motor current at present. Unit: 0.01 ampere (Amp).
056 (38h)	DC Bus voltage D1 Dec	Rectified capacitor voltage. Unit: 0.1 Volt.
064 (40h)	Register of PR command endpoint	In PR mode, the endpoint of the Position command (Cmd_E).
065 (41h)	Register of PR command output	In PR mode, the accumulative output of the Position command after filtered.
067 (43h)	PR target speed	Target speed specified in the PR path. Unit: PPS (pulse per second).
082 (52h)	No. of PR in execution	Provides the number of the PR path currently executed by the servo drive to the HMC.
091 (5Bh)	Rotary axis position feedback	Immediate feedback of the rotary axis position. 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 SHIFT 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.
119 (77h)	EtherCAT State Machine	1: Init 2: Pre-Operational (Pre-OP) 4: Safe-Operational (Safe-OP) 8: Operational (OP)
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.

Code	Variable name / property	Description
124 (7Ch)	EtherCAT network and connection status	Panel display: U Z Y X X: network status for OUT port; Z: EtherCAT error status Y: network status for IN port; U: EtherCAT connection status ■ X: network status for OUT port 0: connection is not established 1: connection is established ■ Y: network status for IN port 0: connection is not established 1: connection is established ■ Z: EtherCAT error status 0: no error has occurred 1: error occurs in the controller or servo drive ■ U: EtherCAT connection status 0: Init 1: Pre-Operational (Pre-OP) 2: Safe-Operational (Safe-OP) 3: Operational (OP)
-80	Encoder 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 change.
-91	Overload (AL006) protection counter	Displays the condition of motor overload during operation. When the value reaches 100, AL006 occurs.
-111	Regeneration error (AL005) protection counter	When the value of the regeneration counter reaches 100%, AL005 occurs.
-124	Encoder temperature	Monitor the encoder temperature.
-169	Regenerative resistor overload (AL086) protection counter	The average power consumption (unit: %) of the regenerative resistor at the time when the energy of the servo drive capacitor is released to the regenerative resistor. When the value reaches 100%, AL086 occurs.
-202	Motor electrical angle	The current electrical angle multiplied by 4.
-207	Regenerative resistor power consumption	The power consumption (unit: %) of the regenerative resistor at the time when the energy of the servo drive capacitor is released to the regenerative resistor.
-223	Servo drive overload (AL02C) protection counter	Displays the condition of drive overload during motor operation. When the value reaches 100, AL02C occurs.
-246	Blocked rotor protection (AL02F) counter	Displays the condition of drive overload when the motor speed is maintained at 10 rpm and below or the rotor is blocked. When the value reaches 100, AL02F occurs.
-248	Alarm reset delay time	When an alarm occurs, this value counts down from the time (unit: ms) set in P2.123 to 0. The alarm can be reset only when this value reaches 0. Affected alarms: AL005, AL006, AL016, AL02C, AL02F, AL085, and AL086.

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Absolute System

9

This chapter introduces the absolute servo system, including the installation of the battery box and the operating procedures for initializing the system for the first time.

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Important

An absolute servo system includes a servo drive, an absolute motor, and a battery box. The battery supplies power to the system so that the encoder continues operating when the main power to the servo drive 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 with an absolute motor; if it is used with an incremental motor and the absolute function is enabled (P2.069.X = 1), AL069 occurs.

When using an absolute motor, make sure the motor speed is lower than 250 rpm at the moment when power is on. When the encoder is operating under battery power, make sure the maximum speed of the motor does not exceed 200 rpm.

To determine whether you use an absolute motor, check the model number as follows:

ECM-E3 series servo motor

ECM - E3 □ - □ □ □ □ □ □ □ □ □

A / P: absolute motor

Correctly connect the battery box to the encoder. One servo drive uses one single battery box; two servo drives can share one dual battery box. Use the specified Delta encoder cable to connect to the battery box.

9.1 Battery specifications

Precautions

Carefully read and follow these safety precautions. Use batteries in accordance with the specifications as follows to avoid damage or danger.

- Install the battery in an environment free of water vapor, corrosive gas, and flammable gas.
- Properly store the batteries to avoid short circuits.
- Do not short-circuit the positive and negative terminals of the batteries, or install the batteries in reverse direction.
- Do not use new and used batteries together to avoid losing power or shortening the life of the new batteries. Replacing all batteries with new ones is recommended.
- The battery box J1 port connects to the battery and J2 port connects to the battery box connection wire on the encoder cable.
- The current consumption is nearly 0 when the absolute origin position is not established. Once the absolute origin position is established, the battery starts losing power. To avoid battery power consumption, it is recommended that you disconnect the battery or do not establish the absolute origin position when transporting the machine.
- Follow the instructions in the manual when installing and wiring the battery box to avoid danger.
- Use the battery provided by Delta, or the absolute function may not work normally.

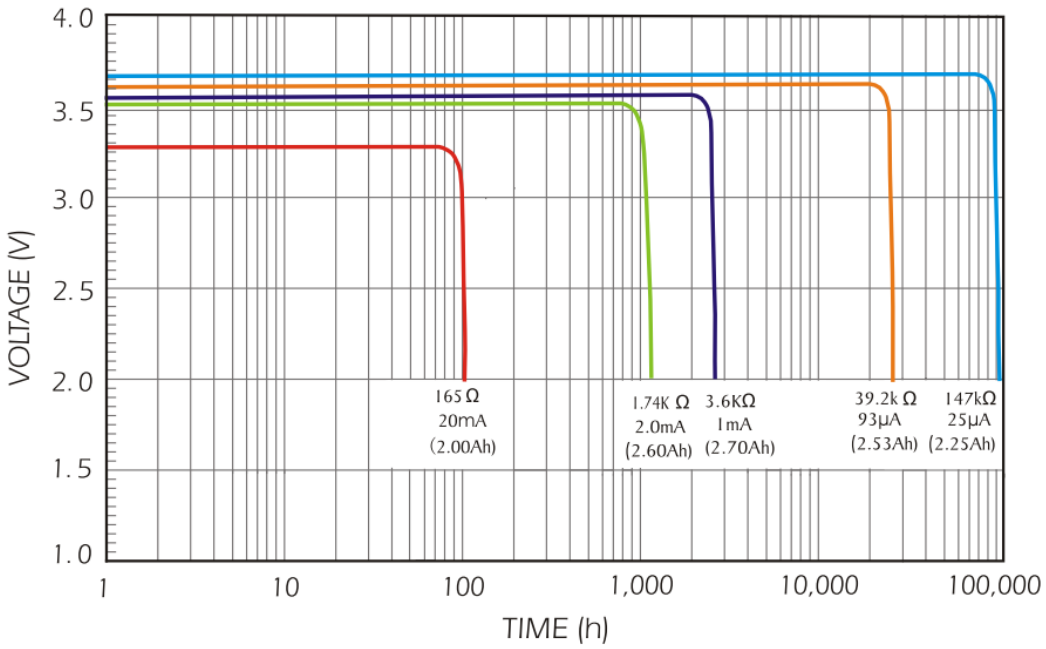
- Do not place the battery in fire or in an environment with the ambient temperature over 100°C (212°F), or this may cause a fire or an explosion.
- The batteries are non-rechargeable. Do not charge the batteries as this may cause an explosion.
- Do not directly weld on the surface of the battery.

Battery specifications

Item	Li/SOCl2 Cylindrical Battery
Delta model number	ASD-CLBT0100
International standard size	AA
Nominal voltage	3.6V
Nominal 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°C to +85°C (-40°F to +185°F)

9

Battery life



Source: *EVE Energy Co. ER14505 Discharge Characteristics*

(1) The preceding figure illustrates the discharge current curves measured in the constant current test. According to the five curves, if the battery voltage is kept at 3V or higher, the battery life expectancy is as shown in the following table. Therefore, a battery voltage below 3.1V is considered undervoltage for an absolute encoder.

Motor	Current consumption (μA) when the encoder operates under battery power	Battery life expectancy (month)
ECM-E3□-□A□□□□□□□ ECM-E3□-□P□□□□□□□	30	87.5

(2) The battery voltage remains ≥ 3.6V for up to 5 years when the battery is stored in a dry place at room temperature.

Note: the battery life expectancy is measured with a test using a servo drive, a motor, and a single battery.

9.2 Installation

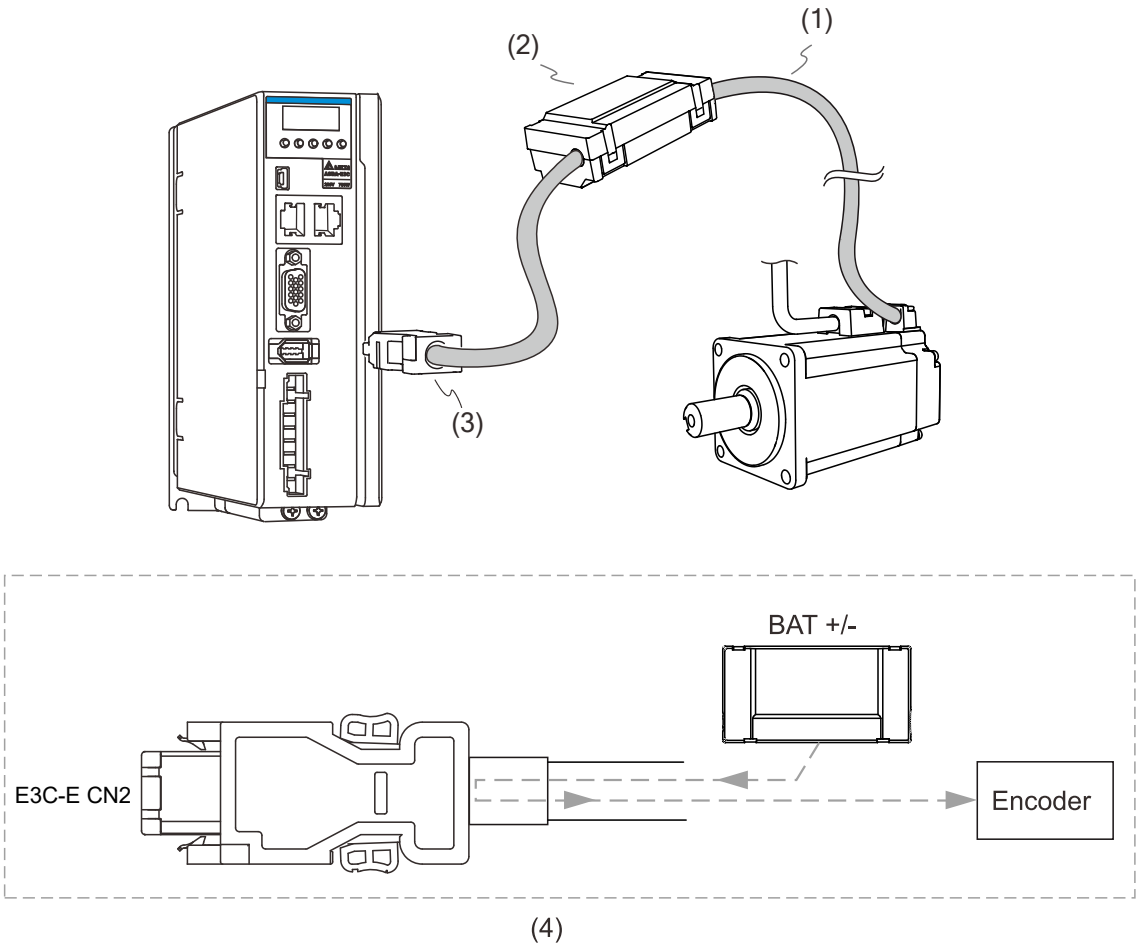
- For the pin assignments of the absolute encoder cables, refer to Section 3.3.
- When selecting the battery box and the absolute encoder cables, refer to Appendix B.

9.2.1 Installing the battery box in the servo system

WARNING

- DO NOT connect to Pin 3 and Pin 4 of the servo drive CN2 connector. These pins are for internal use only. Wiring them will cause damage to the internal circuit.
- When an absolute encoder is used, the battery supplies power directly to the encoder, so wiring the battery wires to the servo drive CN2 connector is not required.

Wiring example: single battery box (standard wiring)



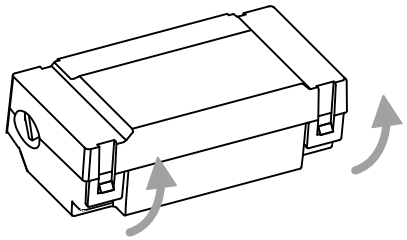
(1) Absolute encoder cable; (2) Single battery box; (3) CN2 connector; (4) Battery box wiring

9.2.2 Installing and replacing a battery

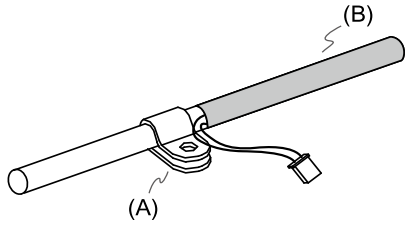
When the servo drive displays the alarm AL061, it means the voltage of the absolute encoder is too low. In this case, you can set P0.002 to 38 to read the voltage level of the battery. If the displayed value is lower than 31 (indicating that the voltage is below 3.1V), replace the battery immediately to avoid data loss.

When the battery voltage is below 2.9V, the motor's position record is lost. If the servo drive displays the alarm AL060, it will then display AL06A after the battery is replaced. In this case, you need to re-establish the absolute origin position.

Single battery box

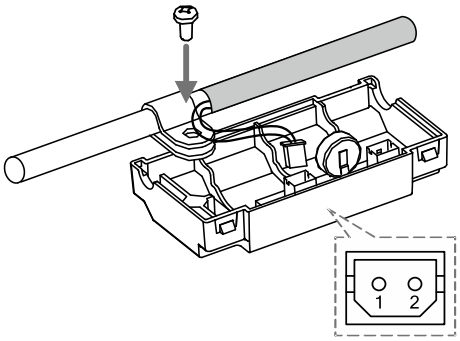


Step 1:
Release the snap-fit tabs on both sides and remove the battery box cover.

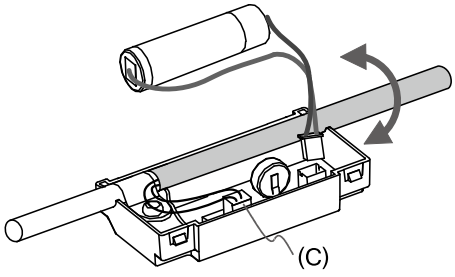


Step 2:
Attach the cable clamp to the encoder cable. Note that the cable clamp should be placed as close as possible to the heat shrink.

(A) Cable clamp; (B) Heat shrink

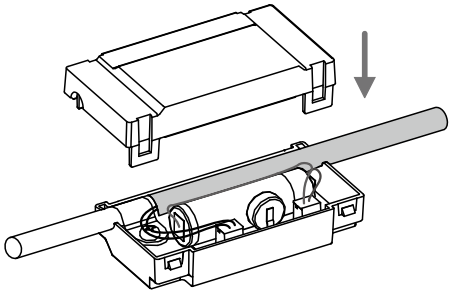


Step 3:
Tighten a cable clamp screw to secure the clamp to the battery box, and then connect the battery box connection wire to the J2 port on the battery box.



Step 4:
Install a new battery, and then connect the battery wire to the J1 port on the battery box.
Replace the battery only when the main power to the servo drive is on. Do not remove the battery box connection wire, or the system data may be lost.

(C) Battery box connection wire



Step 5:
Place the wires into the box and fit the cover, and then the battery replacement and battery box installation are complete.

9.3 System initialization and operating procedures

9.3.1 System initialization

When the servo system resumes operation after power cycling, the controller can acquire the motor's current absolute position either through communication or with DI/DO. Delta's absolute system provides two types of position value for the controller: pulse and PUU.

- When the absolute system is initialized for the first time, the position system is not established and thus AL06A occurs. Clear the alarm by setting up the position system.
- AL060 occurs when the position data is lost because of low battery voltage or an interruption in the battery power.
- In the absolute system, the position data has to be within a specific range. AL062 occurs when the number of motor revolutions exceeds the range of -32,768 to +32,767. AL289 occurs when the position value in PUU exceeds the range of -2,147,483,648 to +2,147,483,647.
- In addition to the preceding alarms (which are enabled by default), you can use P2.070 [Bit 2] to set whether to show AL062 or AL289 when the absolute position system overflows (the number of revolutions or the PUU number exceeds the range specified in the preceding ranges). This function is for systems which use incremental commands to operate in a single direction.

Steps for system initialization:

1. Establish the absolute origin position with DI/DO, parameters, or the PR homing function. When the position setting is complete, AL06A or AL060 is automatically cleared. The controller can establish the absolute origin position in pulse or in PUU.
2. When the system is power cycled, the controller can access the motor's absolute position either with DI/DO or through communication. Based on the setting of P2.070 [Bit 1], the controller can read the number of revolutions plus the pulse number within a single turn (refer to Section 9.3.2) or the position value in PUU (refer to Section 9.3.3).

9.3.2 Pulse number

When the motor rotates clockwise, the number of revolutions is defined as a negative value. When the motor rotates counterclockwise, the number of revolutions is defined as a positive value. The countable number of revolutions is between -32,768 and +32,767. AL062 occurs once the number of revolutions overflows (which means the number exceeds the range). To clear the alarm, re-establish the absolute origin position. If P2.070 [Bit 2] has been set to 1 (no overflow warning), then the system ignores the overflow of number of revolutions.

If the motor rotates counterclockwise and the number of revolutions reaches +32,767, the value jumps to -32,768 in the next turn, and keeps increasing from -32,768 to +32,767.
If the motor rotates clockwise and the number of revolutions reaches -32,768, the value jumps to +32,767 in the next turn, and keeps decreasing from +32,767 to -32,768.

In addition, there are 16,777,216 pulses (0 to 16,777,215) in one motor revolution. Pay attention to the motor's rotation direction and read the number of revolutions plus the pulse number within a single turn either through communication or with DI/DO.

Total pulse number = m (number of revolutions) x 16,777,216 + pulse number within a single turn (0 to 16,777,215).

The conversions between pulse number and PUU are as follows:
When P1.001.Z = 0: the PUU number when power on = pulse number x $\frac{P1.045}{P1.044}$ + P6.001.
When P1.001.Z = 1: the PUU number when power on = (-1) x pulse number x $\frac{P1.045}{P1.044}$ + P6.001.

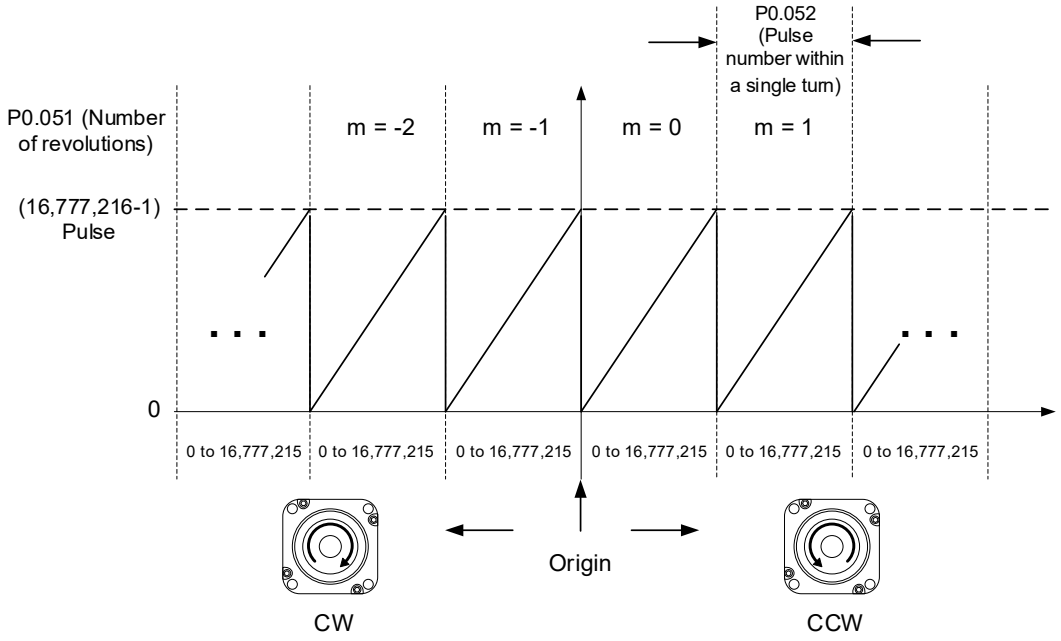


Figure 9.3.2.1 Absolute position in pulses

9.3.3 PUU number

The PUU number is a 32-bit absolute position data with a positive or negative sign. When the motor rotates in the positive direction, the PUU number increases; when the motor rotates in the negative direction, the PUU number decreases. The motor rotation direction (positive / negative) is defined by P1.001.Z; rotating clockwise does not necessarily mean the motor rotates in the positive direction.

If the motor keeps rotating in the same direction and the number of revolutions exceeds the range of -32,768 to +32,767, the servo drive generates AL062. If the motor's PUU number exceeds the range of -2,147,483,648 to +2,147,483,647, the servo drive generates AL289. When an overflow issue occurs to the absolute encoder, re-establish the absolute origin position to clear the alarm. You can set P2.070 to determine whether the servo drive generates AL062 and AL289 when an overflow occurs. If the motor rotates in the positive direction and the absolute position data reaches +2,147,483,647 PUU, the value jumps to -2,147,483,648 in the next turn, and keeps increasing from -2,147,483,648 to +2,147,483,647.

If the motor rotates in the negative direction and the absolute position data reaches -2,147,483,648 PUU, the value jumps to +2,147,483,647 in the next turn, and keeps increasing from +2,147,483,647 to -2,147,483,648.

See the following examples:

Example 1:

When P1.044 = 16,777,216 and P1.045 = 100,000, the motor needs 100,000 PUU to run one revolution. 2,147,483,647 ÷ 100,000 ≒ 21,474.8, so once the motor runs over 21,474.8 (< 32,767) revolutions in the positive direction, AL289 occurs.

Example 2:

When P1.044 = 16,777,216 and P1.045 = 10,000, the motor needs 10,000 PUU to run one revolution. 2,147,483,647 ÷ 10,000 ≒ 214,748.3, so once the motor runs over 32,767 (< 214,748.3) revolutions in the positive direction, AL062 occurs.

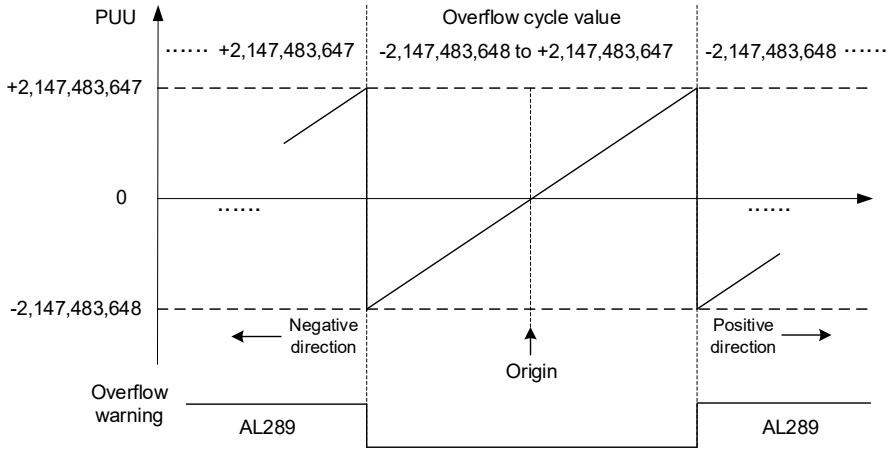


Figure 9.3.3.1 Absolute position in PUU

Note: after the absolute origin position is established, any modification to P1.001.Z or the E-Gear ratio (P1.044 and P1.045) changes the original setting of the absolute origin position. If one of these parameters are modified, re-establish the absolute origin position.

9.3.4 Establishing the absolute origin position

When the absolute position is lost, the servo drive provides several methods to establish the absolute origin position. The following details each method.

9

9.3.4.1 Establishing the absolute origin position with DI/DO

When the servo system is controlled by the controller, you can establish the absolute origin position with DI/DO. Once the absolute position is established, the pulse number is reset to 0 and the PUU number is reset to the setting value of P6.001. Refer to the following diagram for detailed descriptions.

Description:

1. When the controller triggers DI.ABSE, it has to wait for the T_S delay time before proceeding to the next step.
2. After reaching T_S, the controller starts to establish the absolute origin position. When DI.ABSC is triggered and remains On for the T_Q delay time, the pulse number is reset to 0 and the PUU number is reset to the setting value of P6.001.

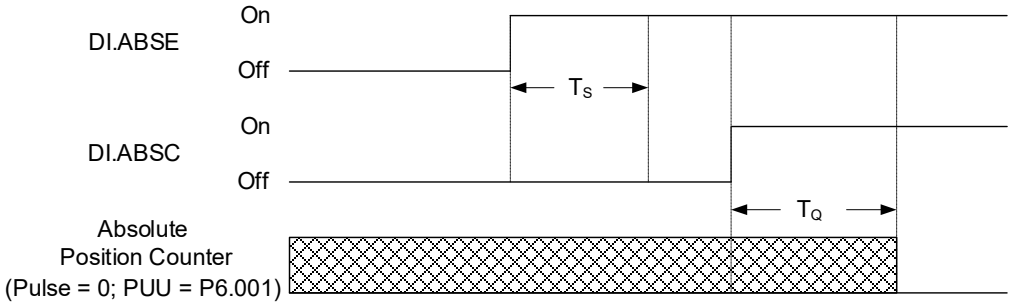


Figure 9.3.4.1.1 Timing diagram for establishing the absolute origin position with DI/DO

The following table describes the T_S and T_Q delay times after DI.ABSE and DI.ABSC are switched to On.

	T_S (ms)	T_Q (ms)
Min.	P2.009 + 2	
Max.	P2.009 + 10	

9.3.4.2 Establishing the absolute origin position with parameters

Set P2.071 to 0x0001 through the panel or communication to establish the absolute origin position. Since P2.071 is write-protected by P2.008, you must set P2.008 to 271 first, and then set P2.071 to 0x0001. Then, the absolute position system resets immediately.

9.3.4.3 Establishing the absolute origin position with the PR homing function

You can use the homing methods in PR mode to establish the absolute origin position.
For more details, refer to Section 7.1.3.1 Homing methods.

9.3.5 Reading the absolute position

9.3.5.1 Reading the absolute position with DI/DO

Set P2.070 [Bit 0] to 0 so that you can read the PUU number with DI/DO. See the following descriptions.

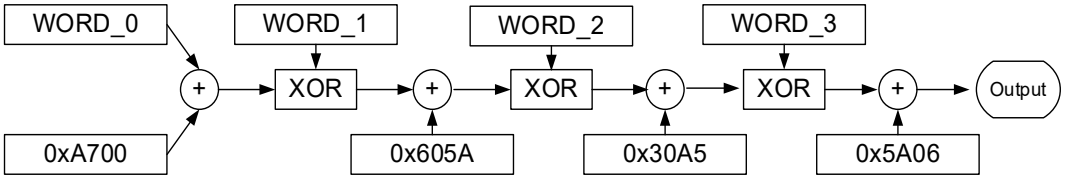
Bit 79 - Bit 64	Bit 63 - Bit 32		Bit 31 - Bit 16	Bit 15 - Bit 0
-	WORD_3	WORD_2	WORD_1	WORD_0
Check Sum	Encoder PUU -2,147,483,648 to +2,147,483,647		0	Encoder status (P0.050)

Set P2.070 [Bit 0] to 1 so that you can read the pulse number with DI/DO. See the following descriptions.

Bit 79 - Bit 64	Bit 63 - Bit 32		Bit 31 - Bit 16	Bit 15 - Bit 0
-	WORD_3	WORD_2	WORD_1	WORD_0
Check Sum	Encoder pulse number within a single turn 0 to 16,777,215 (= 16,777,216 - 1)		Number of encoder revolution -32,768 to +32,767	Encoder status (P0.050)

Example: reading the pulse number with DI/DO

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 constants in hexadecimal format.

9

You can set P2.070 [Bit 0] to read the position value in units of pulse or PUU with DI/DO.

See the following timing diagram.

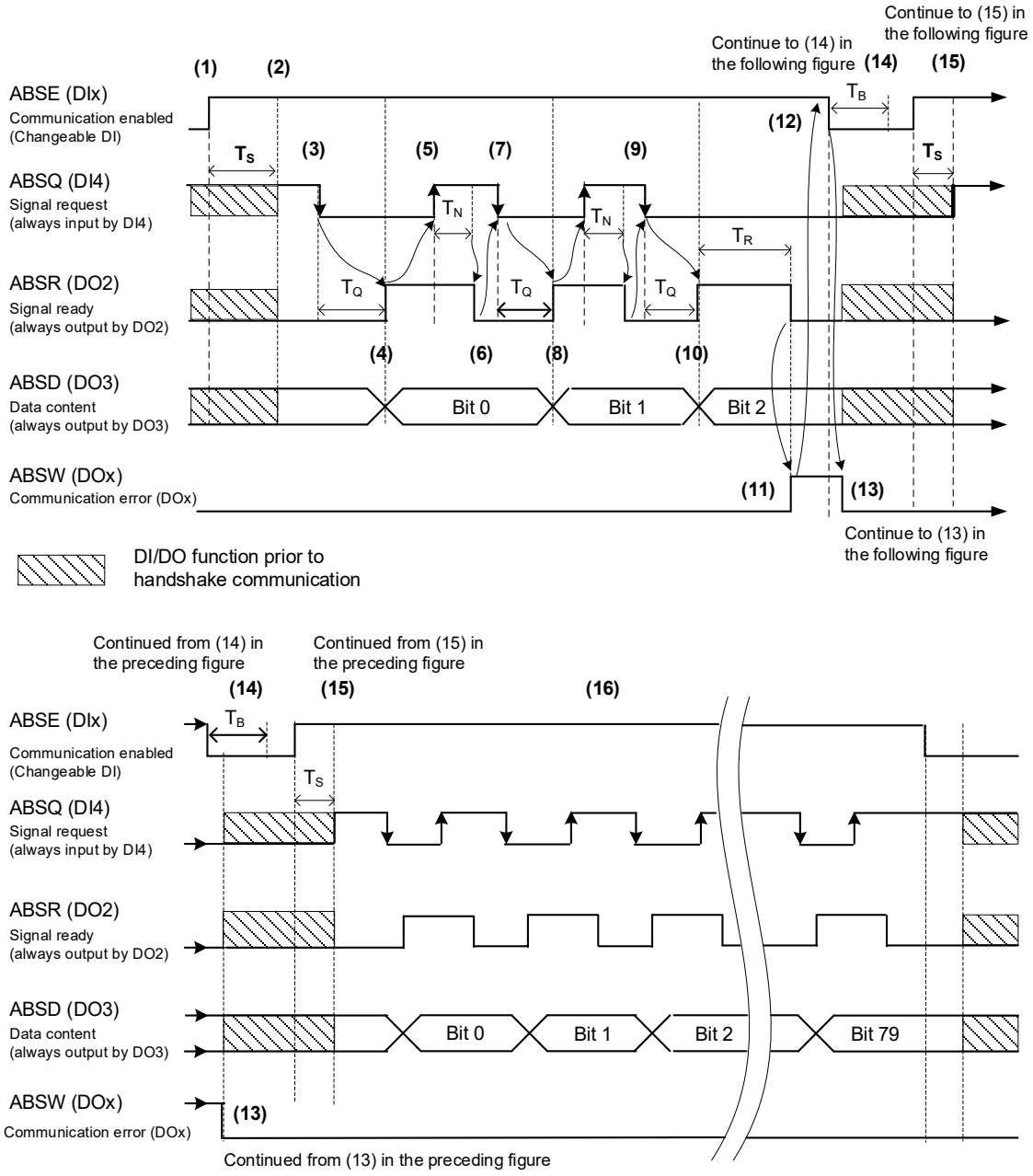


Figure 9.3.5.1.1 Timing diagram for reading the absolute position with DI/DO

The following table describes the delay times when you read the absolute position with DI/DO.

	T_R (ms)	T_S (ms)	T_Q (ms)	T_N (ms)	T_B (ms)
Min.	-	P2.009 + 2			
Max.	200	P2.009 + 10			

Descriptions:

(1) When the handshake communication starts, the ABSE signal is triggered.

(2) After the T_s delay time (to make sure the ABSE 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 switching, it remains in the high-level state when switched to ABSQ (logic high-level signal). DI4, DO2, and DO3 are dual-function DI/DOs, which means the original functions for DI4, DO2, and DO3 share the same DI/DOs with ABSQ, ABSR, and ABSD. Pay special attention when switching their functions before, during, and after the signal handshake. To set these three DI/DOs as single function, set them to 0 before switching the functions.

(3) If DI4 was in the high-level state and its function was switched to ABSQ after the T_S delay time, when the controller resets this signal to low level, the new signal is interpreted as the request for data access.

(4) After the T_Q delay time, the handshake data is ready and sent to ABSD. Now the servo drive triggers the ABSR signal and the controller can access the data. If the controller cannot detect that the ABSR state has changed to high level after the maximum T_Q time, there may be a communication error such as communication cable disconnection.

(5) Once detecting the ABSR signal state as high level, the controller accesses the data, and sets the ABSQ signal to high level to notify the servo drive that the data was read.

(6) When ABSQ is at high level for the T_N time, ABSR is set to low level in order to send the data for the next bit communication.

(7) When detecting the ABSR signal state as low level, the controller sets ABSQ to low level and sends a request to the servo drive for the next bit communication.

(8) Repeat steps 3 and 4. Send the absolute position to ABSD for the next bit communication.

(9) Repeat steps 5 to 7. The controller reads the data and notifies the servo drive that it has received the data.

(10) The third bit data is ready.

(11) After the T_R waiting time, if the controller has neither read the data nor triggered the ABSQ signal, the servo drive sends the ABSW signal (communication error) and stops the handshake communication.

(12) When the controller receives the ABSW signal, it sets ABSE to low level and prepares to restart the handshake communication.

(13) ABSW resumes to low level after the controller sets the ABSE signal to low level.

(14) The controller restarts the communication after the T_B time.

(15) Repeat step 1.

(16) If no error occurs, the controller completes 80 bits (Bit 0 - 79) of the handshake communication with the servo drive. DI4, DO2, and DO3 then restore to their original functions.

Note: if ABSE is set to low level first and then changed to high level, but ABSW does not return to low level and the communication remains in the error state, it means some other errors have also occurred, such as AL060 (absolute position is lost), AL061 (encoder undervoltage), or AL062 (number of revolutions of the absolute encoder overflows (issued by encoder)). The communication can only be restarted after the errors have been cleared.

9.3.5.2 Reading the absolute position through communication

You can access the data of the absolute encoder through the following communication methods.

9

Instant access

The servo drive reads the motor's position feedback once the power is supplied. Setting P0.017 to 0 means to access the motor's position feedback through P0.009 (Status monitoring register 1).

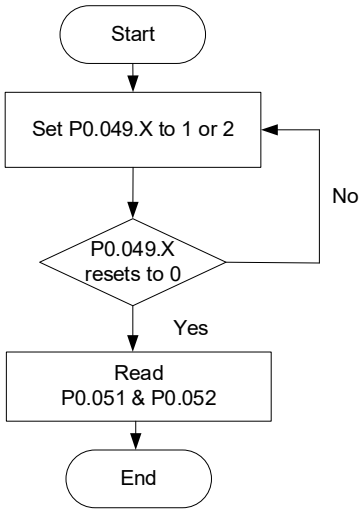
Register access

The motor's position is stored in the drive's register and the read value does not change with the motor's movement. Once you set P0.049.X through communication, the encoder absolute position is stored in P0.051 and P0.052, whose data unit can be set with P2.070 [Bit 1].

- When P0.049.X is set to 1, the drive does not clear the position error when reading the position value.
- When P0.049.X is set to 2, the drive clears the position error while reading the position value.

  After the motor is enabled, it moves slightly forward and backward to correct its position even when it is to remain stopped. To avoid the difference between the actual and read positions, set P0.049.X to 2 to update the motor's actual position to the servo drive, which clears the position error at the same time.

  For example, the motor's current position is 20000, but the actual position is between 19999 and 20001. If you issue a command to read the position when the motor is at 20001, the read value is 20001 and updated to the servo drive as the motor position, which clears the position error. If the read position is not updated, it may be different from the motor's current position, which causes a command error.
- After the position is updated to P0.051 and P0.052, P0.049.X automatically resets to 0, meaning the controller can access the values of P0.051 and P0.052.
- P0.050 shows the status of the absolute encoder. When "absolute position lost" or "absolute number of revolutions overflows" is shown, the read absolute position is invalid, and you must re-establish the absolute origin position.



EtherCAT Mode 10

This chapter provides details for the required parameter settings when the servo communicates with the controller through the EtherCAT communication function.

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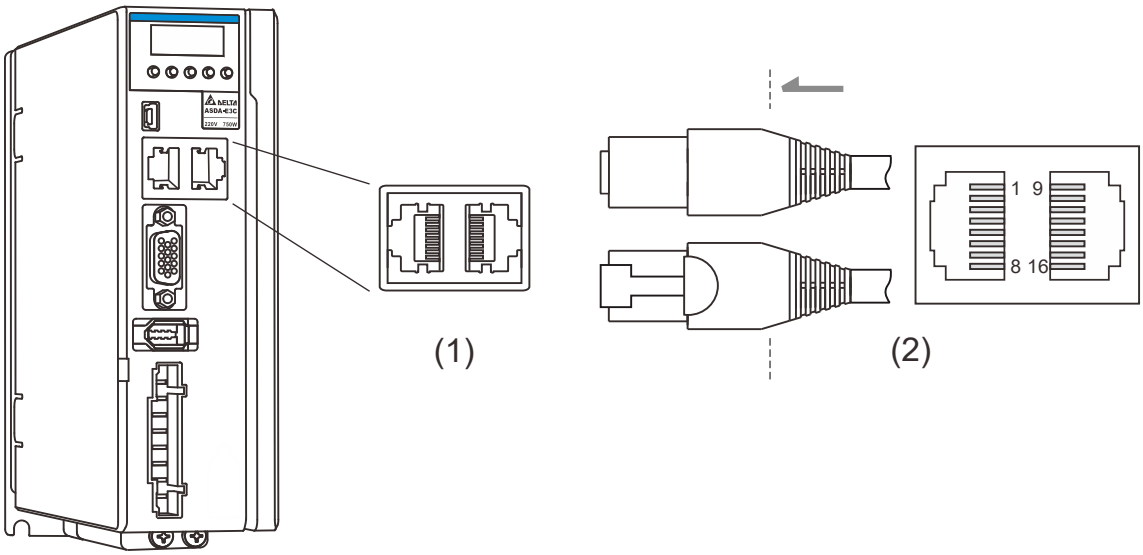
10

10.1 Basic configuration

10.1.1 Hardware configuration

The pin assignments of the two ports of the EtherCAT connector (CN6) are the same. Note that the IN port is for connecting the controller or the previous servo drive, and the OUT port is for connecting the next servo drive or not connecting to any devices. Incorrect wiring will lead to communication error.



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

Pin assignment:

Transmission port	Pin No.	Signal	Description
IN	1	TX+	Transmit +
	2	TX-	Transmit -
	3	RX+	Receive +
	4	-	Reserved
	5	-	Reserved
	6	RX-	Receive -
	7	-	Reserved
	8	-	Reserved
OUT	9	TX+	Transmit +
	10	TX-	Transmit -
	11	RX+	Receive +
	12	-	Reserved
	13	-	Reserved
	14	RX-	Receive -
	15	-	Reserved
	16	-	Reserved

10

Set P0.002 = 124 to monitor the EtherCAT network and connection status through the panel:

■ X & Y: network status for OUT and IN ports

X & Y	Status	Description
0	No connection	Network connection is not established.
1	Network is connected	Network connection is established.

■ Z: EtherCAT error status

Z	Status	Description
0	No error	No error has occurred.
1	Error	Error occurs in the controller or servo drive.

■ U: EtherCAT connection status

U	Status	Description
0	Init	After the servo drive is powered on and the initialization is complete, the communication has not yet started, but the controller can access the servo drive's register.
1	Pre-Operational	The controller can exchange data through the mailbox.
2	Safe-Operational	The servo drive can use the SDO and TxPDO data packets to exchange data with the controller.
3	Operational	SDO, TxPDO, and RxPDO data packets can be transmitted.

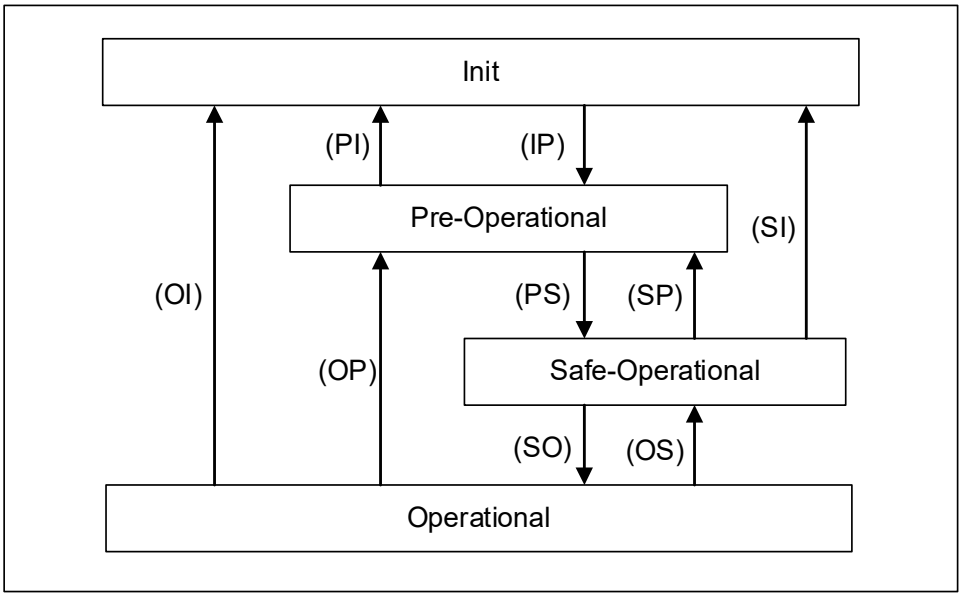
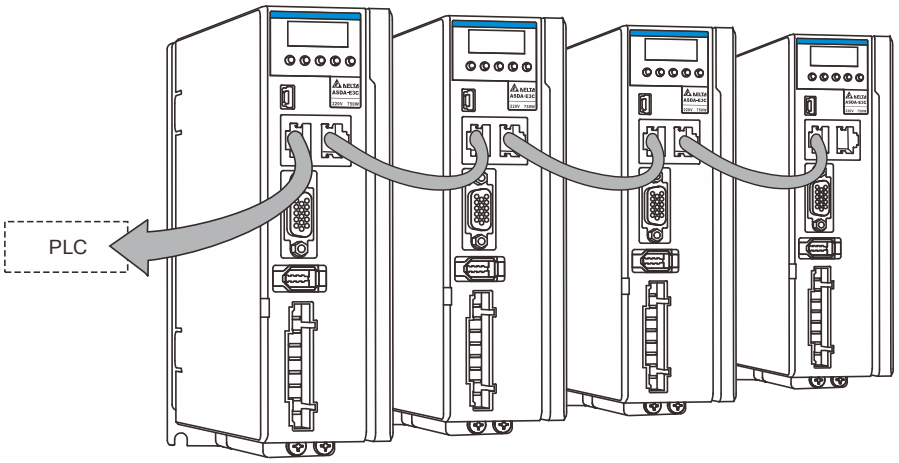


Figure 10.1.1.1 EtherCAT State Machine

Connecting multiple servo drives:



Note:

1. When multiple servo drives are connected, the maximum distance between each drive is 50 m (164.04 inches).
2. Use CAT5e STP cables with metal connectors.
3. It is suggested that you use a Beckhoff network cable (model number: ZB9020).
4. Ensure the wiring is correct. The IN port is for connecting the controller or the previous servo drive, and the OUT port is for connecting the next servo drive or not connecting to any devices.

10.1.2 ESI file import

The EtherCAT motion control fieldbus is an open standard that requires using the ESI (EtherCAT Slave Information) file to configure the functions and related object properties for each slave device. Generally, the ESI file is an XML file.

Delta controller

No need to import ESI files.

Non-Delta controller

Import the ESI file of the slave device to the controller software, so the controller can recognize and control each slave device according to the configuration in the ESI file. An ESI file may contain data of multiple devices. Delta's A3-E, B3-E, E3-E, and E3C-E servo drives share the same ESI file (available in the Download Center of Delta's website). To import ESI files to non-Delta controllers, refer to the manufacturer's instruction manual.

After being imported to the non-Delta controller software, the ESI files are usually stored in the following paths:

Beckhoff TwinCAT

TwinCAT 2: C:\TwinCAT\IO\EtherCAT

TwinCAT 3: C:\TwinCAT\3.1\Config\Io\EtherCAT

Omron Sysmac Studio

C:\Program Files (x86)\OMRON\Sysmac Studio\IODeviceProfiles\EsiFiles\UserEsiFiles

Note: refer to the manufacturer's instruction manual of each controller for the actual storage path.

10.1.3 Parameter settings of EtherCAT mode

Follow these instructions to connect the EtherCAT controller and the servo drive:

1. Set to EtherCAT mode: set P1.001.YX to 0C.
2. Set the slave address: set P3.000 to 0x0001 - 0x007F.
3. It is suggested that you change the setting value of P3.012.Z from 0 (default) to 1 to enable the non-volatile setting for the following parameters. Note that the default E-Gear ratio varies with the set value of P3.012.Z.

Settings	P3.012 = 0x0100 (Z = 1)		P3.012 = 0x0000 (Z = 0)	
	Servo parameter	Default	OD address	Default
Motor stop mode	P1.032	0x0000	605Bh	0
S-curve acceleration constant	P1.034	200	6087h	200
Zero speed range	P1.038	100 (0.1 rpm)	606Fh	100 (0.1 rpm)
E-Gear ratio - numerator N1	P1.044	16777216	6093h sub1	1
E-Gear ratio - denominator M	P1.045	100000	6093h sub2	1
Speed reached (DO.SP_OK) range	P1.047	10 (rpm)	606Dh	100 (0.1 rpm)
Accumulated time to reach desired speed	P1.049	0	606Eh	0
Maximum speed limit	P1.055	Depending on the motor (rpm)	607Fh	Depending on the motor (0.1 rpm)
			6080h	Depending on the motor (rpm)
Excessive deviation warning condition of Position command	P2.035	50331648	6065h	50331648
Positive software limit (PP / CSP / CSV / CST mode)	P5.008	2147483647	607Dh sub2	2147483647
Negative software limit (PP / CSP / CSV / CST mode)	P5.009	-2147483648	607Dh sub1	-2147483648
Origin definition (HM mode)	P6.001	0	607Ch	0

10

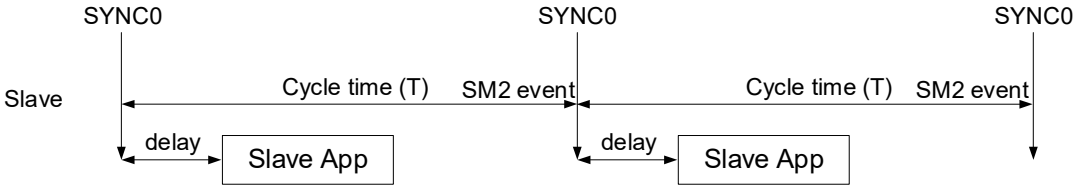
P3.009	Communication synchronization		Address: 0312H 0313H
Default:	0x5055	Control mode:	EtherCAT
Unit:	-	Setting range:	0x0000 - 0x9AFF
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

The slave synchronizes with the master via SYNC. The definition is as follows:

- Z: when the servo is operating in the DC-Synchronous mode, you can adjust the timing of the servo accessing the EtherCAT packets to ensure this timing is not in conflict with the timing of the controller sending the packets.

  The delay time shown in the following figure is (T/10) x Z (μs).



P3.018	EtherCAT special function switch		Address: 0324H 0325H
Default:	0x00002000	Control mode:	EtherCAT
Unit:	-	Setting range:	0x00000000 - 0x00112211
Format:	HEX	Data size:	32-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

A	Source setting for the content loaded to the EtherCAT Station Alias Register 0x0012 after the servo drive is powered on	X	Unit selection for Target velocity (OD 60FFh) and Velocity actual value (OD 606Ch) when in the PV (Profile Velocity) mode or CSV (Cyclic Synchronous Velocity) mode
B	Reserved	Y	Reserved
C	Unit selection for the maximum speed of OD 607Fh and OD 6080h	Z	AL185 communication disconnection detection setting
D	Reserved	U	Reserved

- X: unit selection for Target velocity (OD 60FFh) and Velocity actual value (OD 606Ch) when in the PV (Profile Velocity) mode or CSV (Cyclic Synchronous Velocity) mode

  0: 0.1 rpm

  1: pulse/sec

- Z: AL185 communication disconnection detection setting

  0: disconnection detection starts after EtherCAT communication enters OP state.

  1: disconnection detection starts after EtherCAT communication enters Init state.

  2: disable disconnection detection.

  Note: when using the ring topology connection, set P3.018.Z to 2 to disable the disconnection detection.

- A: source setting for the content loaded to the EtherCAT Station Alias Register 0x0012 after the servo drive is powered on.

  0: determined by the EtherCAT EEPROM station number field (ADR 0x0004) setting, which needs to be set by the controller.

  1: determined by the address set with servo parameter P3.000.

- C: unit selection for the maximum speed of OD 607Fh and OD 6080h

  0: 0.1 rpm for OD 607Fh and rpm for OD 6080h.

  1: pulse/sec for OD 607Fh and OD 6080h.

P3.022	EtherCAT PDO timeout setting		Address: 032CH 032DH
Default:	0xFF04	Control mode:	EtherCAT
Unit:	-	Setting range:	0x0002 - 0xFF14
Format:	HEX	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

When using the PDO to transmit data periodically, use this parameter to set the allowable timeout. The following two sets of digits specify the trigger conditions for AL180 and AL3E3 respectively to ensure that the servo drive receives the PDO. When one of the alarms occurs, it means the packet loss period has exceeded the allowable range.

Digit	UZ	YX
Function	AL180 trigger condition	AL3E3 trigger condition
Range	0x00 (disabled) - 0xFF (default)	0x02 - 0x14

- YX: AL3E3 trigger condition (allowable cycle for elapsed time); applicable to CSP / CSV / CST mode. AL3E3 occurs when the servo drive does not receive the PDO within the set cycle.

  When the communication cycle is 4 ms and you set P3.022.YX to 0x02 (allow two cycles), it means if the servo drive does not receive any PDO within 8 ms, AL3E3 occurs.

- UZ: AL180 trigger condition (allowable duration for elapsed time); applicable to all operation modes.

  AL180 occurs when the servo drive does not receive the PDO within the set duration (unit: ms). For example, when you set P3.022.UZ to 0x01, the duration is 1 ms; when you set P3.022.UZ to 0x02, the duration is 2 ms; and when you set P3.022.UZ to 0xFF, the duration is 255 ms.

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P0.002	Drive status		Address: 0004H 0005H
Default:	1	Control mode:	All
Unit:	-	Setting range:	-4095 to +127
Format:	DEC	Data size:	16-bit
Model:	E3C-E, E3C-E1, E3C-EF		

Settings:

Input the monitoring code to P0.002 to view changes to the variable on the panel. For the list of monitoring variables, refer to Chapter 8 for Table 8.3 Monitoring variables descriptions.

The monitoring variables related to EtherCAT communication are as follows.

Code	Variable name	Description
119 (77h)	EtherCAT State Machine	1: Init 2: Pre-Operational (Pre-OP) 4: Safe-Operational (Safe-OP) 8: Operational (OP)
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.
124 (7Ch)	EtherCAT network and connection status	Panel display: X: network status for OUT port / Z: EtherCAT error status Y: network status for IN port / U: EtherCAT connection status ■ X: network status for OUT port 0: connection is not established 1: connection is established ■ Y: network status for IN port 0: connection is not established 1: connection is established ■ Z: EtherCAT error status 0: no error has occurred 1: error occurs in the controller or servo drive ■ U: EtherCAT connection status 0: Init 1: Pre-Operational (Pre-OP) 2: Safe-Operational (Safe-OP) 3: Operational (OP)

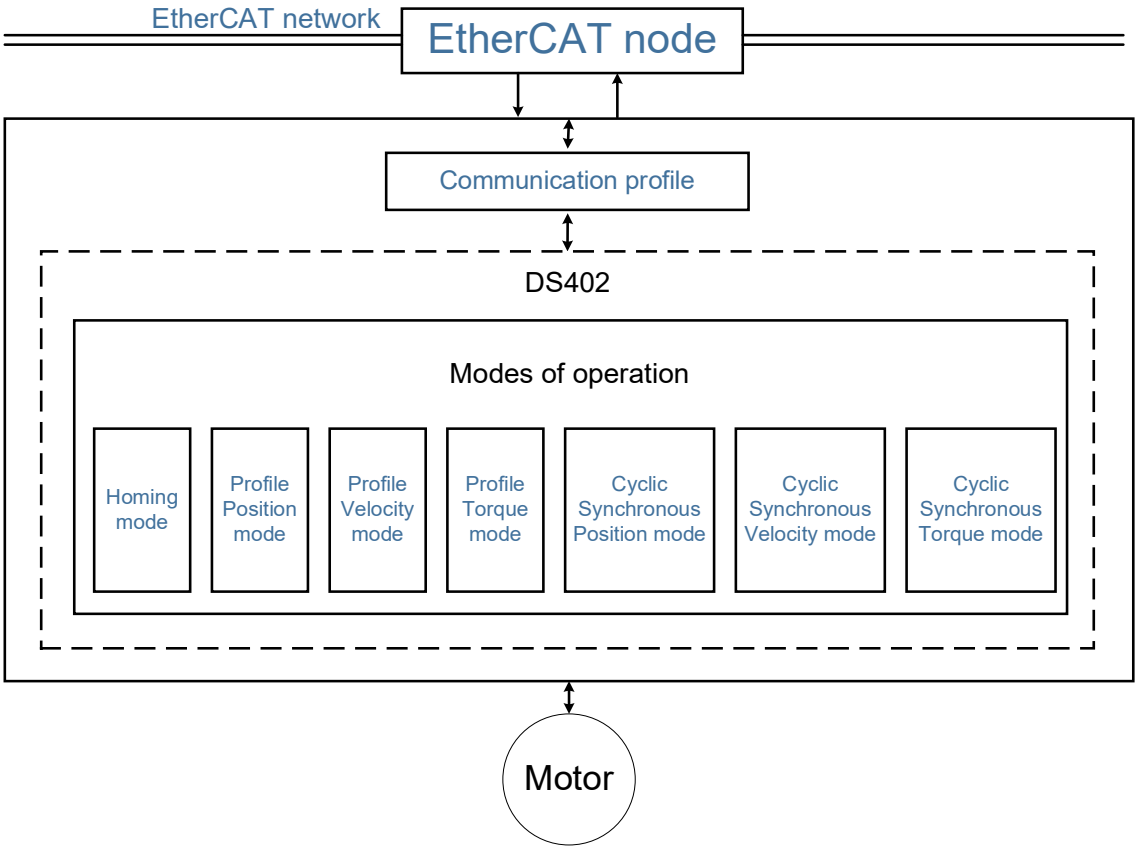
10.2 Communication function

10.2.1 Specifications

EtherCAT communication functions	Physical layer	100BASE-TX
	Communication connector	RJ45 × 2
	Network connection	Serial connection
	Baud rate	2 x 100 Mbps (full duplex)
	Data frame length	Maximum 1,484 bytes
	SyncManager	SM0: mailbox output SM1: mailbox input SM2: process data output SM3: process data input
	Fieldbus Memory Management Units (FMMU)	FMMU0: process data output area FMMU1: process data input area FMMU2: mailbox status area
	Application layer protocol	CoE: CANopen over EtherCAT
	Synchronization mode	DC-Synchronous mode (SYNC0) Asynchronous mode (Free Run)
	Communication object	SDO: Service data object PDO: Process data object SYNC: Synchronization object EMCY: Emergency object
	LED indicator	No LED indicators. Refer to Section 10.1.1 for the panel display of EtherCAT network and connection status.
	Application layer specifications	IEC 61800-7 CiA DS402 Drive Profile
Supported CiA DS402 operation modes		■ Profile Position (PP) mode ■ Profile Velocity (PV) mode ■ Profile Torque (PT) mode ■ Homing (HM) mode ■ Cyclic Synchronous Position (CSP) mode ■ Cyclic Synchronous Velocity (CSV) mode ■ Cyclic Synchronous Torque (CST) mode

The EtherCAT architecture of the servo drive is as follows:

- Communication profile: this protocol includes the communication objects (PDO, SDO, SYNC, and EMCY) and related communication object dictionary.
- DS402 is the device profile for drives and motion control. It defines the behavior of each operation mode and the required object settings for execution.



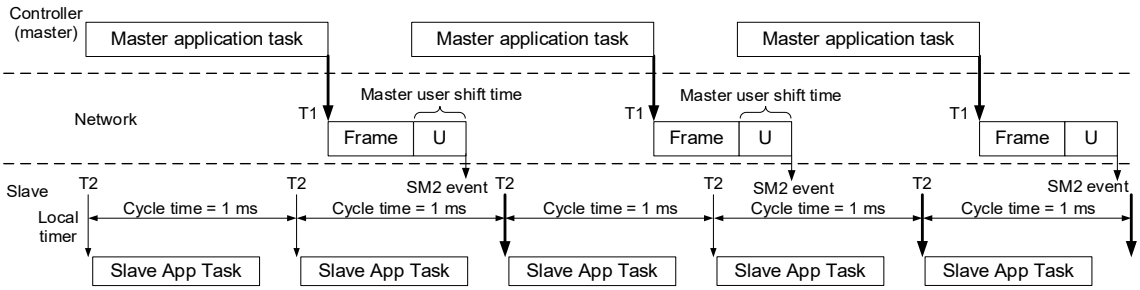
10.2.2 Synchronization mode

10.2.2.1 Synchronization modes of the servo drive

The servo drive supports two synchronization modes: Free Run mode and DC-Synchronous mode. Note that the Free Run mode is defined as a synchronous mode in the EtherCAT specification established by the EtherCAT Technology Group (ETG).

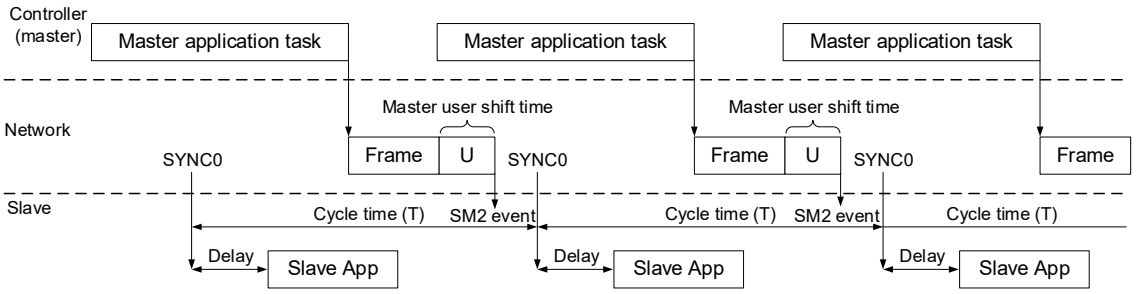
Free Run mode (Asynchronous)

Actually, the master and slave(s) run asynchronously in the Free Run mode. The clock of the slave runs independently of the master clock. That is, the clocks are not synchronized. The command and feedback transmissions between the master and slave(s) are based on a sequential order instead of a precise time synchronization. For example, the master sends a PDO at the time T1, and the slave(s) receives the PDO at the time T2 after the SM2 event.



DC-Synchronous mode (DC mode - synchronous with SYNC0 event)

There is precise time synchronization between the master and slave(s) in the DC-Synchronous mode. The master executes the control program and sends PDO packets at a fixed time cyclically according to the distributed clocks (DC), transmitting the command to and receiving the feedback from the slave(s). The slave(s) receives and updates the PDO data at a fixed time according to the distributed clocks.



Note: Delay = P3.009.Z * (T/10) (μs)

10.2.2.2 Select Synchronization mode

Follow these steps to select DC-Synchronous or Free Run mode.

1. Select **Drive 4 (ASDA-E3-E CoE Drive)** in the left column of the TwinCAT System Manager window.
2. Select **DC-Synchronous** or **Free Run** as the Operation Mode under the **DC** tab in the right column.

10.2.2.3 Distributed clocks setting

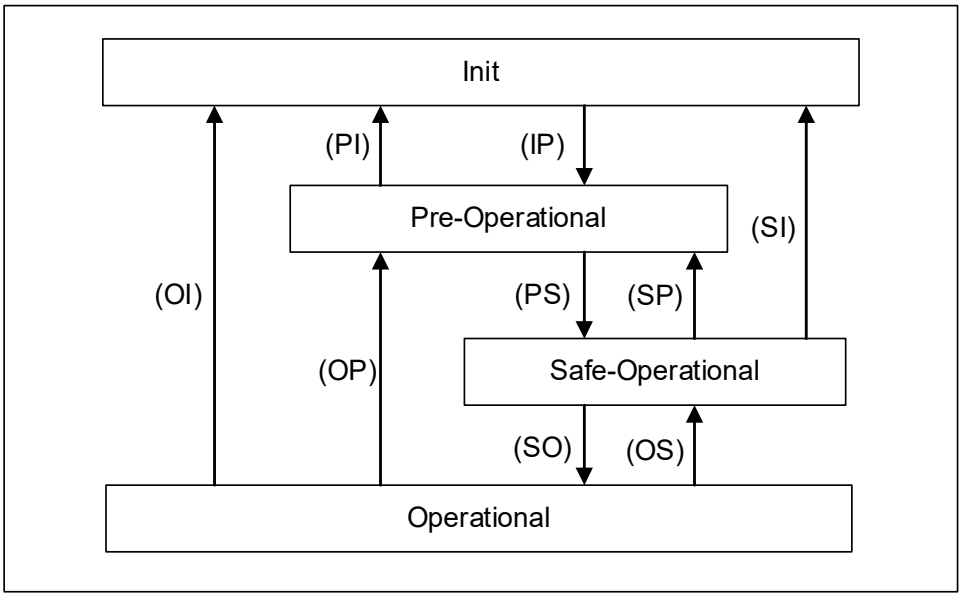
Follow these steps to set the data exchange cycle.

1. Select **NC-Task 1 SAF** in the left column of the TwinCAT System Manager window.
2. Set the data exchange cycle in the **Cycle ticks** field under the **Task** tab in the right column.

The SYNC0 cycle is used to define the PDO cycle time. The minimum unit of the SYNC0 cycle for A3-E, B3-E, E3-E, and E3C-E is 125 μs. The SYNC0 cycles within 1 ms are 125 μs, 250 μs, and 500 μs in sequence. The SYNC0 cycles above 1 ms are accumulated at intervals of 1 ms, such as 1 ms, 2 ms, 3 ms… 10 ms. If the configuration includes an A2-E servo drive, the unit of the SYNC0 cycle refers to the minimum unit of A2-E (1 ms).

10.2.3 EtherCAT State Machine

In EtherCAT communication, the servo drive's state machine can be in the following states. The controller (master) controls the servo (slave) based on the actual state. The controller needs to configure the servo drive according to the designated flow in the following figure. After the controller completes the initialization of the communication, the servo is in the Operational state and waits for the user's command to perform motion control. Use the monitoring variable P0.002 = 119 to monitor the current state of the EtherCAT State Machine.



Value displayed on the panel when P0.002 = 119	State	Description
1	Init	The servo drive successfully completes the initialization without any errors occurring after being powered on. The packets cannot yet be transmitted in this state.
2	Pre-Operational (Pre-OP)	Data can be exchanged with SDOs. If an alarm occurs in the servo drive, an emergency message is sent to notify the controller.
4	Safe-Operational (Safe-OP)	The servo drive can use SDO and TxPDO data packets to exchange data with the controller.
8	Operational (OP)	All data exchanges including SDOs and PDOs (TxPDO and RxPDO) are allowed.

The controller (master) issues corresponding commands to the servo (slave) according to the state transition.

10

State transition	Description
IP	■ The master confirms the VendorID, ProductCode and RevisionNumber of the slave. ■ The master calibrates the distributed clocks of the slave (DC-Synchronous mode). ■ The master defines the slave address as well as the SyncManager 0 and 1 (SM0 and SM1) registers and establishes the mailbox communication. ■ The master issues the command and confirms that the slave switches to the Pre-Operational state.
PS	■ The master uses the SDOs to set the PDO mapping and DC related parameters. ■ The master defines the FMMU as well as the SyncManager 2 and 3 (SM2 and SM3) registers, and the slave continues to transmit PDO (TxPDO) packets to the master. ■ The master issues the command and confirms that the slave switches to the Safe-Operational state.
SO	■ The master starts transmitting PDOs (RxPDOs). ■ The DC synchronization process between the master and slave is started.
PI, SI, OI	■ The slave disables all communication functions, including the SDOs and PDOs. ■ The slave switches to the Init state.
SP, OP	■ The slave disables the PDO function. ■ The slave switches to the Pre-Operational state.
OS	■ The master stops transmitting PDOs (RxPDOs). ■ The slave switches to the Safe-Operational state.

10.2.4 PDO mapping configuration

The PDO mapping objects are allocated in the object dictionary: OD 1600h to OD 1603h for RxPDOs and OD 1A00h to OD 1A03h for TxPDOs. The RxPDOs and TxPDOs in each group support updating up to 8 sets of 32-bit PDO data.

10.2.4.1 Default PDO mapping configuration

The following tables show the default PDO mapping configuration of the EtherCAT servo drive for data exchange. This is also defined in the ESI file of the EtherCAT slave. You can modify the PDO mapping configuration according to the requirements. The fourth group is the suggested configuration for Omron controllers.

The first to fourth groups of PDO configuration in the ESI file are shown as follows:

First group of PDO mapping

RxPDO (OD 1600h)	Controlword (OD 6040h)	Target position (OD 607Ah)	Target velocity (OD 60FFh)	Touch probe function (OD 60B8h)

TxPDO (OD 1A00h)	Statusword (OD 6041h)	Position actual value (OD 6064h)	Velocity actual value (OD 606Ch)	Touch probe status (OD 60B9h)
	Touch probe pos1 pos value (OD 60BAh)	Digital inputs (OD 60FDh)		

Second group of PDO mapping (default)

RxPDO (OD 1601h)	Controlword (OD 6040h)	Target position (OD 607Ah)	Target velocity (OD 60FFh)	Target torque (OD 6071h)
	Touch probe function (OD 60B8h)			

TxPDO (OD 1A01h)	Statusword (OD 6041h)	Position actual value (OD 6064h)	Velocity actual value (OD 606Ch)	Torque actual value (OD 6077h)
	Touch probe status (OD 60B9h)	Touch probe pos1 pos value (OD 60BAh)	Digital inputs (OD 60FDh)	

Third group of PDO mapping

RxPDO (OD 1602h)	Controlword (OD 6040h)	Target position (OD 607Ah)	Target velocity (OD 60FFh)	Target torque (OD 6071h)
	Modes of operation (OD 6060h)	Touch probe function (OD 60B8h)		

TxPDO (OD 1A02h)	Statusword (OD 6041h)	Position actual value (OD 6064h)	Velocity actual value (OD 606Ch)	Torque actual value (OD 6077h)
	Modes of operation display (OD 6061h)	Touch probe status (OD 60B9h)	Touch probe pos1 pos value (OD 60BAh)	Digital inputs (OD 60FDh)

Fourth group of PDO mapping (for Omron controllers)

RxPDO (OD 1603h)	Controlword (OD 6040h)	Target position (OD 607Ah)	Target velocity (OD 60FFh)	Target torque (OD 6071h)
	Modes of operation (OD 6060h)	Positive torque limit (OD 60E0h)	Negative torque limit (OD 60E1h)	Touch probe function (OD 60B8h)

TxPDO (OD 1A03h)	Statusword (OD 6041h)	Position actual value (OD 6064h)	Torque actual value (OD 6077h)	Modes of operation display (OD 6061h)
	Touch probe status (OD 60B9h)	Touch probe pos1 pos value (OD 60BAh)	Error code (OD 603Fh)	Digital inputs (OD 60FDh)

10.2.4.2 Set PDO mapping

Take the default (the second group) PDO configuration OD 1601h and OD 1A01h as an example, and the settings are as follows:

1. Disable the PDO configuration: set OD 1C12h sub0 to 0 (RxPDO) and OD 1C13h sub0 to 0 (TxPDO).
2. Disable the PDO mapping setting: set OD 1600h sub0 to 0 (RxPDO) and OD 1A01h sub0 to 0 (TxPDO).
3. Set OD 1601h sub1 - sub5 for the RxPDO mapping content, and set OD 1601h sub0 to 5 for the RxPDO mapping number.

Mapping parameter setting for RxPDO	Data			Description
OD 1601h sub1	6040h	00h	10h	Controlword (6040h); data length is 16-bit.
OD 1601h sub2	607Ah	00h	20h	Target position (607Ah); data length is 32-bit.
OD 1601h sub3	60FFh	00h	20h	Target velocity (60FFh); data length is 32-bit.
OD 1601h sub4	6071h	00h	10h	Target torque (6071h); data length is 16-bit.
OD 1601h sub5	60B8h	00h	10h	Touch probe function (60B8h); data length is 16-bit.
OD 1601h sub0	5			Set 5 for the RxPDO mapping number.

4. Set OD 1A01h sub1 - sub7 for the TxPDO mapping content, and set OD 1A01h sub0 to 7 for the TxPDO mapping number.

Mapping parameter setting for TxPDO	Data			Description
OD 1A01h sub1	6041h	00h	10h	Statusword (6041h); data length is 16-bit.
OD 1A01h sub2	6064h	00h	20h	Position actual value (6064h); data length is 32-bit.
OD 1A01h sub3	606Ch	00h	20h	Velocity actual value (606Ch); data length is 32-bit.
OD 1A01h sub4	6077h	00h	10h	Torque actual value (6077h); data length is 16-bit.
OD 1A01h sub5	60B9h	00h	10h	Touch probe status (60B9h); data length is 16-bit.
OD 1A01h sub6	60BAh	00h	20h	Touch probe pos1 pos value (60BAh); data length is 32-bit.
OD 1A01h sub7	60FDh	00h	20h	Digital inputs (60FDh); data length is 32-bit.
OD 1A01h sub0	7			Set 7 for the TxPDO mapping number.

5. Set the PDO mapping configuration: set OD 1C12h sub1 to 0x1601 (RxPDO) and OD 1C13h sub1 to 0x1A01 (TxPDO).
6. Enable the PDO configuration: set OD 1C12h sub0 to 1 (RxPDO) and OD 1C13h sub0 to 1 (TxPDO).

10.2.4.3 PDO mapping object

10

Real-time data transmission can be achieved with Process data objects (PDOs). There are two types of PDOs: transmit PDOs (TxPDOs) and receive PDOs (RxPDOs). This definition is from the perspective of the servo drive; for example, TxPDO refers to the object that the servo drive sends to the controller. Set the mapping parameters as shown in the following table to use the PDOs.

Communication object	Mapping object index
RxPDO1	1600h
RxPDO2	1601h
RxPDO3	1602h
RxPDO4	1603h

Communication object	Mapping object index
TxPDO1	1A00h
TxPDO2	1A01h
TxPDO3	1A02h
TxPDO4	1A03h

The format of PDO mapping parameter is:

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function
Bit 0 - Bit 7	Object data length
Bit 8 - Bit 15	Object sub-index
Bit 16 - Bit 31	Object index

10.2.4.4 SDO abort codes

The abort codes are as follows:

Abort code	Description
05040001h	Client / server command is invalid or does not exist.
06010002h	Attempt to write a read-only object.
06020000h	Object does not exist in the object dictionary.
06040041h	Unable to map the object to the PDO.
06040042h	The number and length of mapped objects exceed the PDO length.
06060000h	Access failed due to hardware error (storage or restore error).
06070010h	Data type does not match; parameter length does not match.
06090011h	Sub-index does not exist.
06090030h	The written parameter value is out of range.
08000000h	General error.
080000a1h	An error occurred when an object is read from EEPROM.
080000a2h	An error occurred when an object is written to EEPROM.
080000a3h	Invalid range when accessing EEPROM.
080000a4h	EEPROM data content error occurred when EEPROM is accessed.
080000a5h	The entered password is incorrect when data is written to the encryption area.
08000020h	Unable to transfer data or save data to the application.
08000021h	Unable to transfer data or save data to the application due to restrictions (storing or restoring in the wrong state).
08000022h	Object is in use.

10.3 EtherCAT operation modes

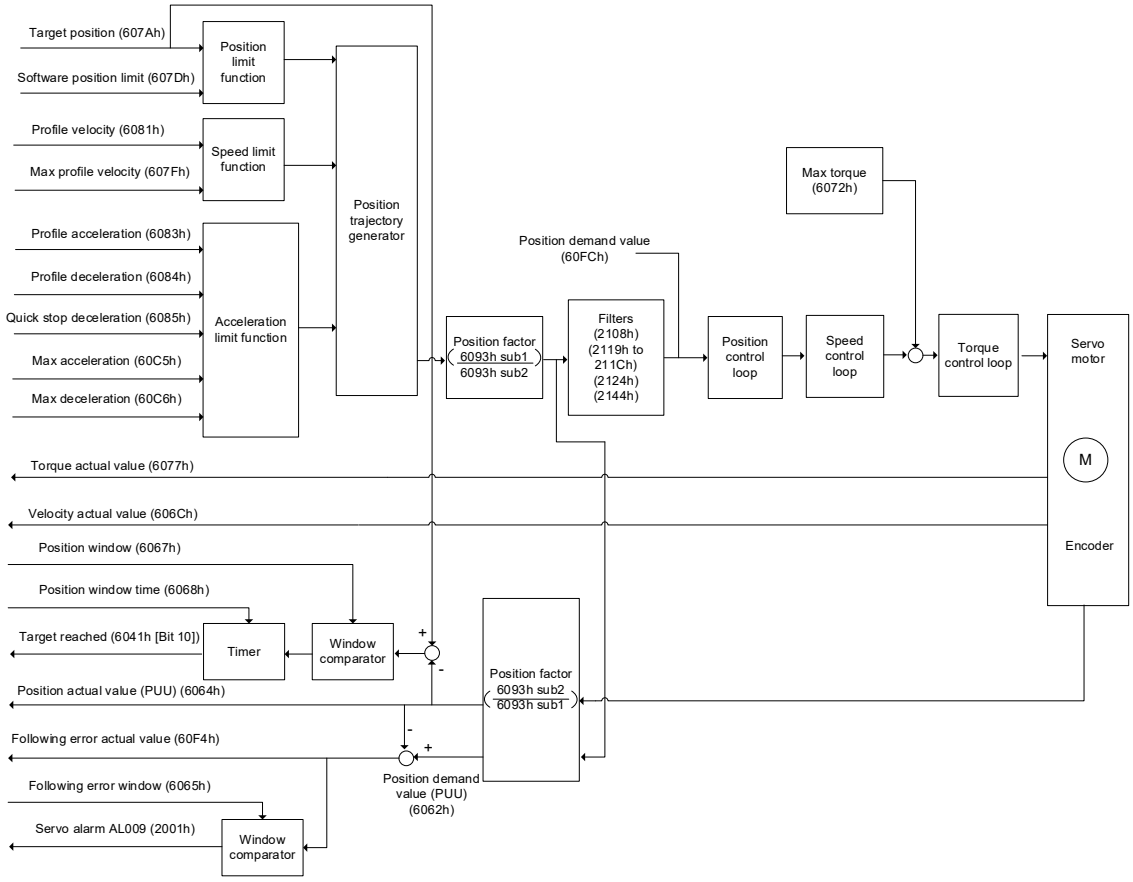
This section describes the modes of operation specified by CiA DS402 when the servo is in the EtherCAT mode. The content includes basic operation settings and related object descriptions.

10.3.1 Profile Position mode

After receiving the position command transmitted from the controller, the servo drive controls the servo motor to reach the target position.

In Profile Position (PP) mode, the controller only informs the servo drive of the target position, speed command, and acceleration / deceleration settings at the beginning. The motion planning from command triggering to the arrival of the target position is performed by the trajectory generator in the servo drive.

The following figure shows the Profile Position mode architecture of the servo drive:



Operation steps:

1. Set OD 6060h to 01h to set the mode as Profile Position mode.
2. Set OD 607Ah for the target position (unit: PUU).
3. Set OD 6081h for the profile velocity (unit: PUU/sec).
4. Set OD 6083h for the profile acceleration (unit: ms).
5. Set OD 6084h for the profile deceleration (unit: ms).
6. Set the Controlword (OD 6040h). Follow these steps for operation. Steps 6.1 and 6.2 are to bring the servo drive's state machine into the ready state. For the description of the state machine, refer to the OD 6040h description in Section 10.4.3.3.

Step	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
6.1	0	0	1	1	0	Shutdown.
6.2	0	0	1	1	1	Switch on (ready for Servo On).
6.3	0	1	1	1	1	Enable operation (Servo On).
6.4	1	1	1	1	1	Command triggering (rising-edge triggered)

7. After the servo completes the first motion command, the servo sets the target position, speed, and other conditions to execute the next motion command.
8. Set the Controlword (OD 6040h). Since the command is rising-edge triggered, switch Bit 4 to Off first and then to On.

Step	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
8.1	0	1	1	1	1	Enable operation (Servo On).
8.2	1	1	1	1	1	Command triggering (rising-edge triggered)

Read the servo drive information:

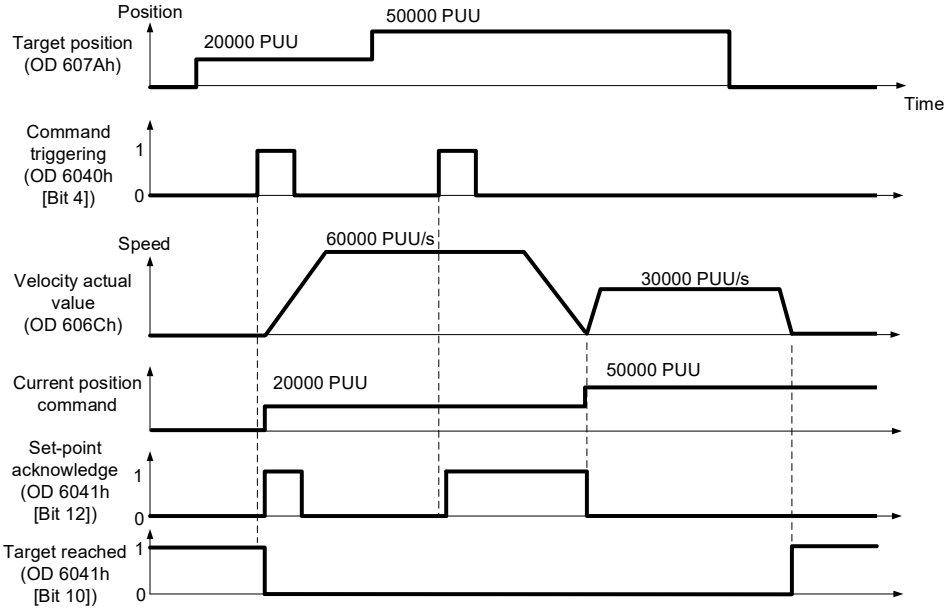
1. Read OD 6064h to obtain the actual value of the motor position at present.
2. Read OD 6041h to obtain the servo drive status, including the following error and notifications for set-point acknowledge and target reached.

Function for the command to take immediate effect

In Profile Position mode, set the command to take effect immediately or not with OD 6040h [Bit 5].

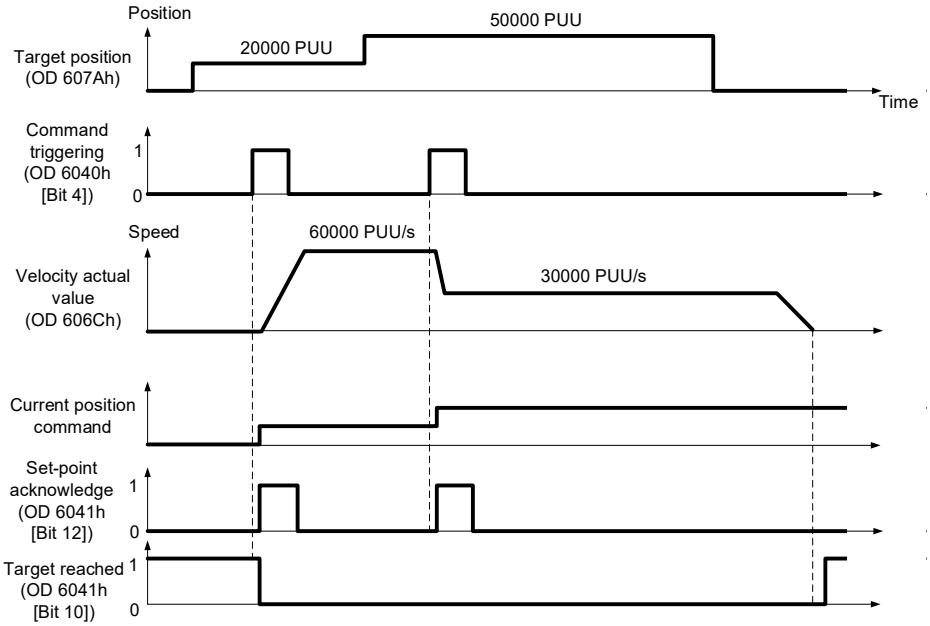
- Set OD 6040h [Bit 5] to 0 to disable the command from taking immediate effect.

If the command is not enabled to take immediate effect, when the current motion command is in execution (not yet complete), the servo continues to execute the current motion command even if a new command is triggered. The new command is acknowledged and executed only after the current command is complete.



- Set OD 6040h [Bit 5] to 1 to enable the command to take immediate effect.

If the command is enabled to take immediate effect, when the current motion command is in execution (not yet complete), the servo immediately interrupts the current command and executes the new command once receiving the new triggered command.



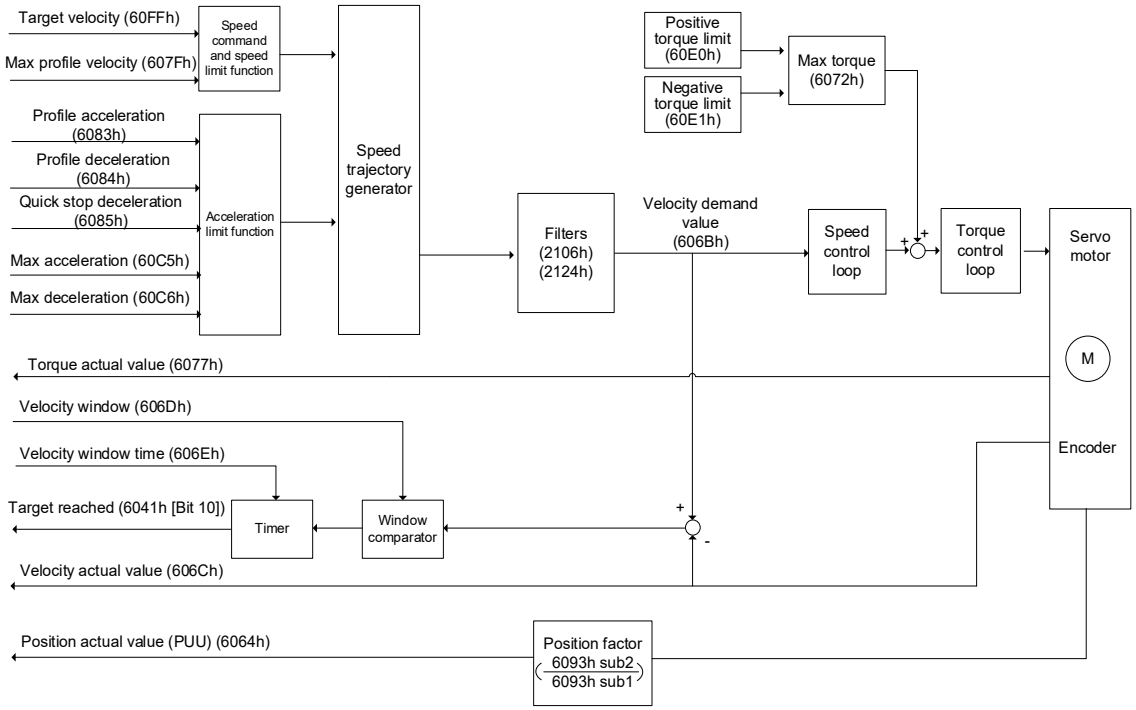
Relevant object list

Index	Name	Data type	Access
6040h	Controlword	UNSIGNED16	RW
6041h	Statusword	UNSIGNED16	RO
6060h	Modes of operation	INTEGER8	RW
6061h	Modes of operation display	INTEGER8	RO
6062h	Position demand value (PUU)	INTEGER32	RO
6063h	Position actual internal value (pulse)	INTEGER32	RO
6064h	Position actual value (PUU)	INTEGER32	RO
6065h	Following error window	UNSIGNED32	RW
6067h	Position window	UNSIGNED32	RW
6068h	Position window time	UNSIGNED16	RW
606Ch	Velocity actual value	INTEGER32	RO
6072h	Max torque	UNSIGNED16	RW
6077h	Torque actual value	INTEGER16	RO
607Ah	Target position	INTEGER32	RW
607Dh	Software position limit	INTEGER32	RW
607Fh	Max profile velocity	UNSIGNED32	RW
6081h	Profile velocity	UNSIGNED32	RW
6083h	Profile acceleration	UNSIGNED32	RW
6084h	Profile deceleration	UNSIGNED32	RW
6085h	Quick stop deceleration	UNSIGNED32	RW
6093h	Position factor	UNSIGNED32	RW
60C5h	Max acceleration	UNSIGNED32	RW
60C6h	Max deceleration	UNSIGNED32	RW
60F4h	Following error actual value	INTEGER32	RO
60FCh	Position demand value	INTEGER32	RO

Note: for more details, refer to Section 10.4.3 Details of objects.

10.3.2 Profile Velocity mode

In Profile Velocity (PV) mode, the controller specifies the speed command and acceleration / deceleration conditions, and then the trajectory generator of the servo drive plans the motion path according to these conditions.



Operation steps:

1. Set OD 6060h to 03h to set the mode as Profile Velocity mode.
2. Set OD 6083h for the profile acceleration.
3. Set OD 6084h for the profile deceleration.
4. Set the target velocity (OD 60FFh) to 0. In Profile Velocity mode, the servo motor starts operating once the servo drive is switched to Servo On (Step 5). Therefore, setting the target velocity (OD 60FFh) to 0 ensures that the motor remains at 0 rpm at the moment of Servo On.
5. Set the Controlword (OD 6040h). Follow these steps for operation. Steps 5.1 and 5.2 are to bring the servo drive's state machine into the ready state. For more details of the state machine, refer to the OD 6040h description in Section 10.4.3.3.

Step	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
5.1	0	0	1	1	0	Shutdown.
5.2	0	0	1	1	1	Switch on (ready for Servo On).
5.3	0	1	1	1	1	Enable operation (Servo On).

6. Set OD 60FFh for the target velocity.

Read the servo drive information:

1. Read OD 6041h to obtain the servo drive status.
2. Read OD 606Ch to obtain the current velocity actual value.

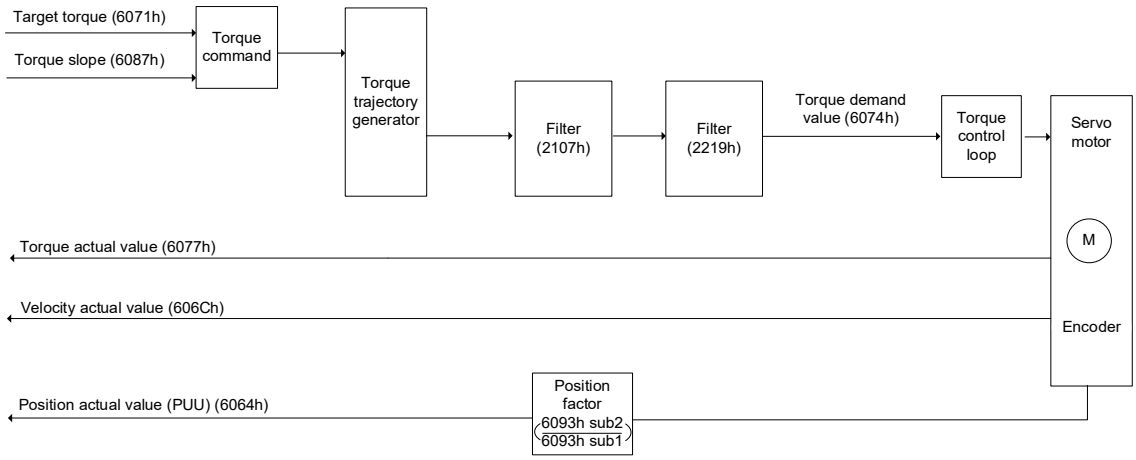
Relevant object list

Index	Name	Data type	Access
6040h	Controlword	UNSIGNED16	RW
6041h	Statusword	UNSIGNED16	RO
6060h	Modes of operation	INTEGER8	RW
6061h	Modes of operation display	INTEGER8	RO
6064h	Position actual value (PUU)	INTEGER32	RO
606Bh	Velocity demand value	INTEGER32	RO
606Ch	Velocity actual value	INTEGER32	RO
606Dh	Velocity window	UNSIGNED16	RW
606Eh	Velocity window time	UNSIGNED16	RW
606Fh	Velocity threshold	UNSIGNED16	RW
6072h	Max torque	UNSIGNED16	RW
6077h	Torque actual value	INTEGER16	RO
607Fh	Max profile velocity	UNSIGNED32	RW
6083h	Profile acceleration	UNSIGNED32	RW
6084h	Profile deceleration	UNSIGNED32	RW
6085h	Quick stop deceleration	UNSIGNED32	RW
6093h	Position factor	UNSIGNED32	RW
60C5h	Max acceleration	UNSIGNED32	RW
60C6h	Max deceleration	UNSIGNED32	RW
60E0h	Positive torque limit	UNSIGNED16	RW
60E1h	Negative torque limit	UNSIGNED16	RW
60FFh	Target velocity	INTEGER32	RW

Note: for more details, refer to Section 10.4.3 Details of objects.

10.3.3 Profile Torque mode

In Profile Torque (PT) mode, the controller specifies the torque command and filtering conditions, and then the trajectory generator of the servo drive plans the torque slope according to these conditions.



Operation steps:

1. Set OD 6060h to 04h to set the mode as Profile Torque mode.
2. Set OD 6087h for the torque slope.
3. Set the target torque (OD 6071h) to 0. In Profile Torque mode, the servo target torque takes effect once the servo drive is switched to Servo On (Step 4). Therefore, set the target torque (OD 6071h) to 0 for safety reasons.
4. Set the Controlword (OD 6040h). Follow these steps for operation. Steps 4.1 and 4.2 are to bring the servo drive's state machine into the ready state. For more details of the state machine, refer to the OD 6040h description in Section 10.4.3.3.

Step	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
4.1	0	0	1	1	0	Shutdown.
4.2	0	0	1	1	1	Switch on (ready for Servo On).
4.3	0	1	1	1	1	Enable operation (Servo On).

5. Set OD 6071h for the target torque.

Read the servo drive information:

1. Read OD 6041h to obtain the servo drive status.
2. Read OD 6077h to obtain the current torque actual value.

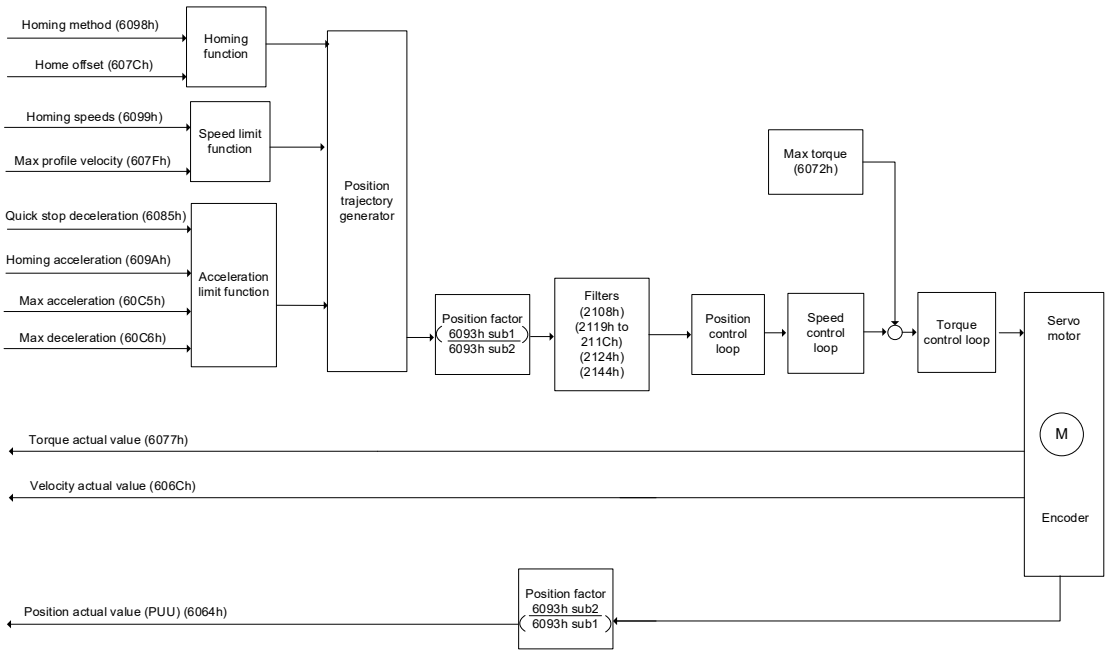
Relevant object list

Index	Name	Data type	Access
6040h	Controlword	UNSIGNED16	RW
6041h	Statusword	UNSIGNED16	RO
6060h	Modes of operation	INTEGER8	RW
6061h	Modes of operation display	INTEGER8	RO
6064h	Position actual value (PUU)	INTEGER32	RO
606Ch	Velocity actual value	INTEGER32	RO
6071h	Target torque	INTEGER16	RW
6074h	Torque demand value	INTEGER16	RO
6075h	Motor rated current	UNSIGNED32	RO
6077h	Torque actual value	INTEGER16	RO
6078h	Current actual value	INTEGER16	RO
6087h	Torque slope	UNSIGNED32	RW
6093h	Position factor	UNSIGNED32	RW

Note: for more details, refer to Section 10.4.3 Details of objects.

10.3.4 Homing mode

After homing is complete, the position system of the servo drive is established and the drive can start executing the position command issued by the controller. The Delta servo drive offers various homing methods, including homing on the home switch, positive or negative limit, motor Z pulse, and hard stop.



Operation steps:

1. Set OD 6060h to 06h to set the mode as Homing mode.
2. Set OD 607Ch for the home offset.
3. Set OD 6098h for the homing method.
4. Set OD 6099h sub1 for the speed during the search for the home switch.
5. Set OD 6099h sub2 for the speed during the search for the Z pulse.
6. Set OD 609Ah for the homing acceleration.
7. Set the Controlword (OD 6040h). Follow these steps for operation. Steps 7.1 and 7.2 are to bring the servo drive's state machine into the ready state. For more details of the state machine, refer to the OD 6040h description in Section 10.4.3.3.

Step	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
7.1	0	0	1	1	0	Shutdown.
7.2	0	0	1	1	1	Switch on (ready for Servo On).
7.3	0	1	1	1	1	Enable operation (Servo On).
7.4	1	1	1	1	1	Homing (rising-edge triggered).

Read the servo drive information:

1. Read OD 6041h to obtain the servo drive status.
2. Read OD 6064h to obtain the actual value of the motor position at present.

10

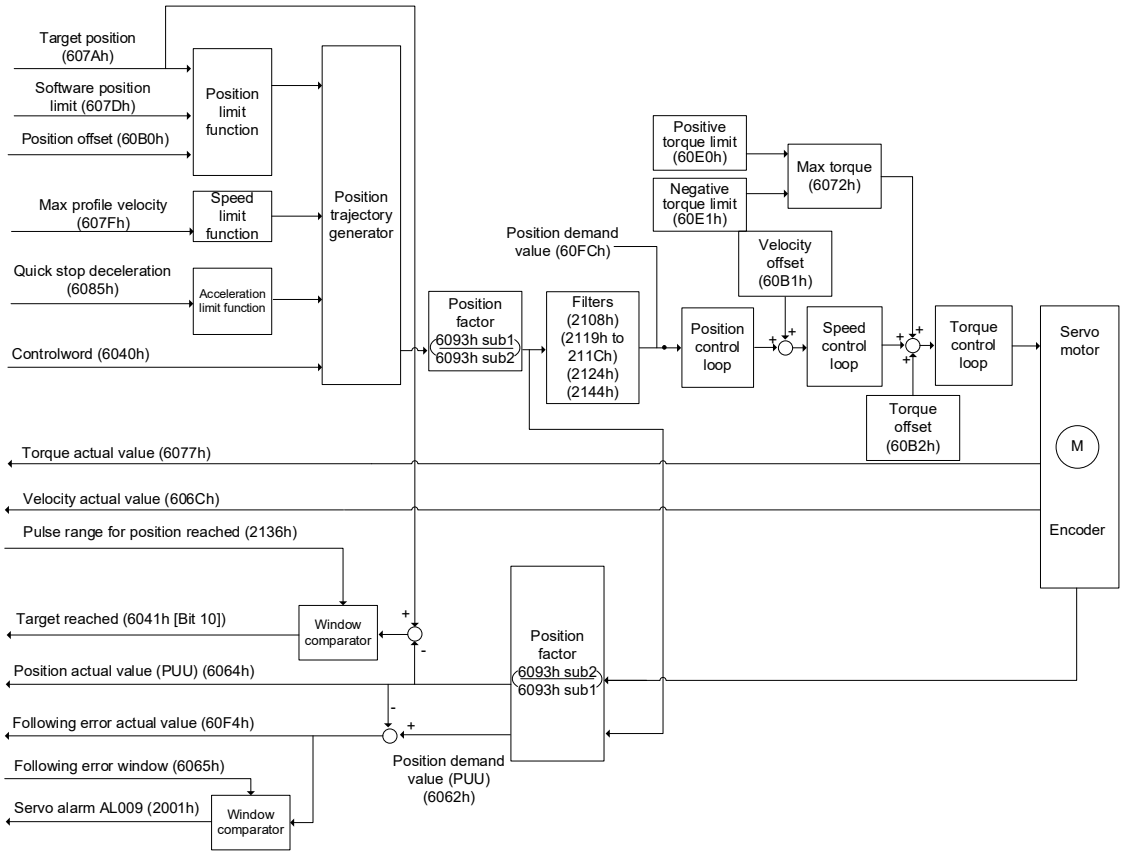
Relevant object list

Index	Name	Data type	Access
6040h	Controlword	UNSIGNED16	RW
6041h	Statusword	UNSIGNED16	RO
6060h	Modes of operation	INTEGER8	RW
6061h	Modes of operation display	INTEGER8	RO
6064h	Position actual value (PUU)	INTEGER32	RO
606Ch	Velocity actual value	INTEGER32	RO
6072h	Max torque	UNSIGNED16	RW
6077h	Torque actual value	INTEGER16	RO
607Ch	Home offset	INTEGER32	RW
607Fh	Max profile velocity	UNSIGNED32	RW
6085h	Quick stop deceleration	UNSIGNED32	RW
6093h	Position factor	UNSIGNED32	RW
6098h	Homing method	INTEGER8	RW
6099h	Homing speeds	UNSIGNED32	RW
609Ah	Homing acceleration	UNSIGNED32	RW
60C5h	Max acceleration	UNSIGNED32	RW
60C6h	Max deceleration	UNSIGNED32	RW

Note: for more details, refer to Section 10.4.3 Details of objects.

10.3.5 Cyclic Synchronous Position mode

The controller plans the path in Cyclic Synchronous Position (CSP) mode and transmits PDOs to the servo drive periodically. In this mode, when the controller transmits each PDO, it simultaneously transmits the target position and Controlword data to the servo drive. Besides, the velocity offset and torque offset can be used as the velocity and torque feed forward control setting.



Operation steps:

1. Set OD 6060h to 08h to set the mode as Cyclic Synchronous Position mode.
2. Set OD 607Ah for the target position (unit: PUU).
3. Set the Controlword (OD 6040h). Follow these steps for operation. Steps 3.1 and 3.2 are to bring the servo drive's state machine into the ready state. For the description of the state machine, refer to the OD 6040h description in Section 10.4.3.3.

Step	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
3.1	0	0	1	1	0	Shutdown.
3.2	0	0	1	1	1	Switch on (ready for Servo On).
3.3	0	1	1	1	1	Enable operation (Servo On).

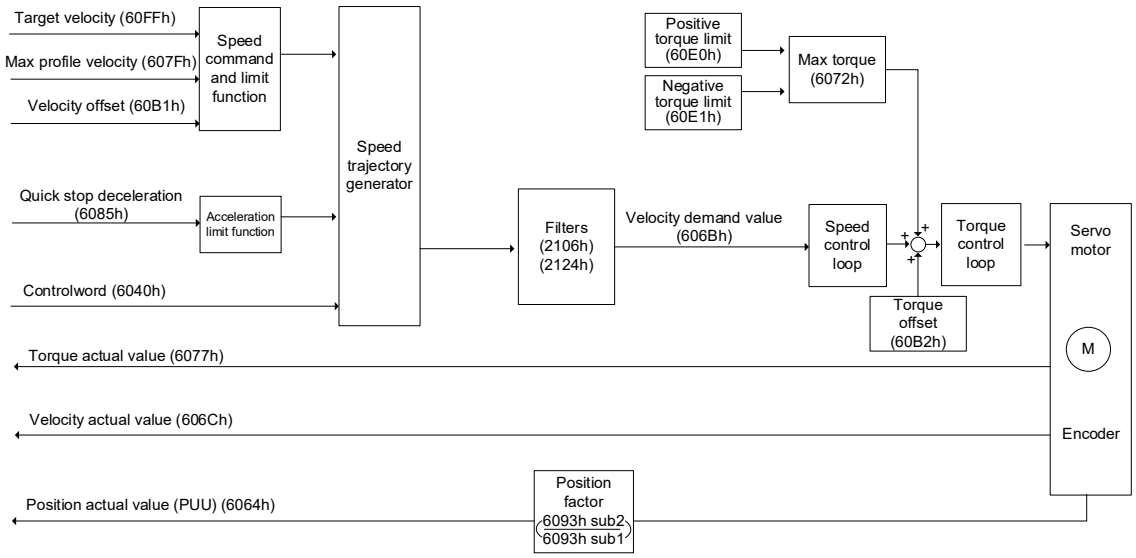
Relevant object list

Index	Name	Data type	Access
6040h	Controlword	UNSIGNED16	RW
6041h	Statusword	UNSIGNED16	RO
6060h	Modes of operation	INTEGER8	RW
6061h	Modes of operation display	INTEGER8	RO
6062h	Position demand value (PUU)	INTEGER32	RO
6064h	Position actual value (PUU)	INTEGER32	RO
6065h	Following error window	UNSIGNED32	RW
606Ch	Velocity actual value	INTEGER32	RO
6072h	Max torque	UNSIGNED16	RW
6077h	Torque actual value	INTEGER16	RO
607Ah	Target position	INTEGER32	RW
607Dh	Software position limit	INTEGER32	RW
607Fh	Max profile velocity	UNSIGNED32	RW
6085h	Quick stop deceleration	UNSIGNED32	RW
6093h	Position factor	UNSIGNED32	RW
60B0h	Position offset	INTEGER32	RW
60B1h	Velocity offset	INTEGER32	RW
60B2h	Torque offset	INTEGER16	RW
60E0h	Positive torque limit	UNSIGNED16	RW
60E1h	Negative torque limit	UNSIGNED16	RW
60F4h	Following error actual value	INTEGER32	RO
60FCh	Position demand value	INTEGER32	RO

Note: for more details, refer to Section 10.4.3 Details of objects.

10.3.6 Cyclic Synchronous Velocity mode

The controller plans the speed in Cyclic Synchronous Velocity (CSV) mode and transmits PDOs to the servo drive periodically. In this mode, when the controller transmits each PDO, it simultaneously transmits the target velocity and Controlword data to the servo drive. Besides, the velocity offset and torque offset can be used as the velocity and torque feed forward control setting.



Operation steps:

1. Set OD 6060h to 09h to set the mode as Cyclic Synchronous Velocity mode.
2. Set the target velocity (OD 60FFh) to 0. In Cyclic Synchronous Velocity mode, the servo motor starts operating once the servo drive is switched to Servo On (Step 3). Therefore, setting the target velocity (OD 60FFh) to 0 ensures that the motor remains at 0 rpm at the moment of Servo On.
3. Set the Controlword (OD 6040h). Follow these steps for operation. Steps 3.1 and 3.2 are to bring the servo drive's state machine into the ready state. For the description of the state machine, refer to the OD 6040h description in Section 10.4.3.3.

Step	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
3.1	0	0	1	1	0	Shutdown.
3.2	0	0	1	1	1	Switch on (ready for Servo On).
3.3	0	1	1	1	1	Enable operation (Servo On).

4. Set OD 60FFh for the target velocity.

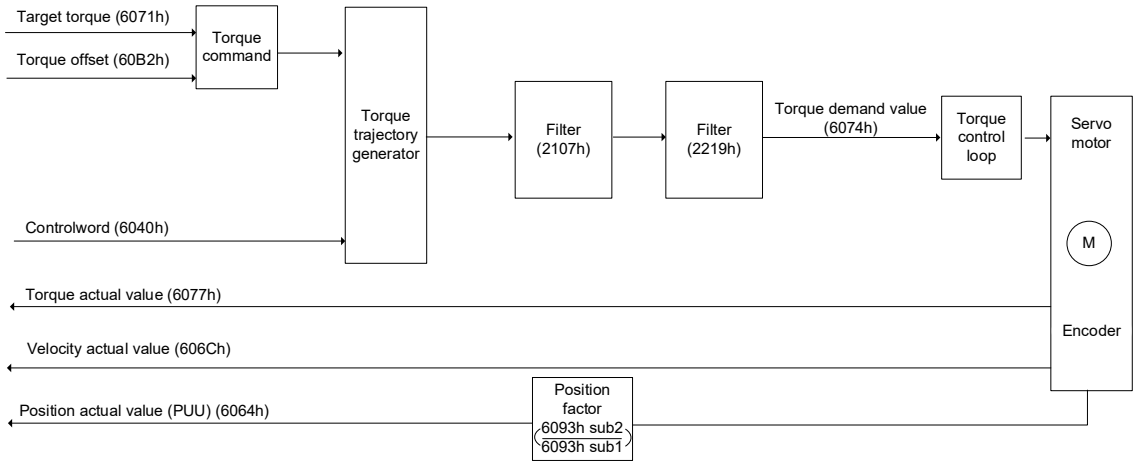
Relevant object list

Index	Name	Data type	Access
6040h	Controlword	UNSIGNED16	RW
6041h	Statusword	UNSIGNED16	RO
6060h	Modes of operation	INTEGER8	RW
6061h	Modes of operation display	INTEGER8	RO
6064h	Position actual value (PUU)	INTEGER32	RO
606Bh	Velocity demand value	INTEGER32	RO
606Ch	Velocity actual value	INTEGER32	RO
6072h	Max torque	UNSIGNED16	RW
6077h	Torque actual value	INTEGER16	RO
607Fh	Max profile velocity	UNSIGNED32	RW
6085h	Quick stop deceleration	UNSIGNED32	RW
6093h	Position factor	UNSIGNED32	RW
60B1h	Velocity offset	INTEGER32	RW
60B2h	Torque offset	INTEGER16	RW
60E0h	Positive torque limit	UNSIGNED16	RW
60E1h	Negative torque limit	UNSIGNED16	RW
60FFh	Target velocity	INTEGER32	RW

Note: for more details, refer to Section 10.4.3 Details of objects.

10.3.7 Cyclic Synchronous Torque mode

The controller plans the torque in Cyclic Synchronous Torque (CST) mode and transmits PDOs to the servo drive periodically. In this mode, when the controller transmits each PDO, it simultaneously transmits the target torque and Controlword data to the servo drive. Besides, the torque offset can be used as the torque feed forward control setting.



Operation steps:

1. Set OD 6060h to 0Ah to set the mode as Cyclic Synchronous Torque mode.
2. Set the target torque (OD 6071h) to 0. In Cyclic Synchronous Torque mode, the servo target torque takes effect once the servo drive is switched to Servo On (Step 3). Therefore, set the target torque (OD 6071h) to 0 for safety reasons.
3. Set the Controlword (OD 6040h). Follow these steps for operation. Steps 3.1 and 3.2 are to bring the servo drive's state machine into the ready state. For more details of the state machine, refer to the OD 6040h description in Section 10.4.3.3.

Step	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
3.1	0	0	1	1	0	Shutdown.
3.2	0	0	1	1	1	Switch on (ready for Servo On).
3.3	0	1	1	1	1	Enable operation (Servo On).

4. Set OD 6071h for the target torque.

Relevant object list

Index	Name	Data type	Access
6040h	Controlword	UNSIGNED16	RW
6041h	Statusword	UNSIGNED16	RO
6060h	Modes of operation	INTEGER8	RW
6061h	Modes of operation display	INTEGER8	RO
6064h	Position actual value (PUU)	INTEGER32	RO
606Ch	Velocity actual value	INTEGER32	RO
6071h	Target torque	INTEGER16	RW
6074h	Torque demand value	INTEGER16	RO
6077h	Torque actual value	INTEGER16	RO
6093h	Position factor	UNSIGNED32	RW
60B2h	Torque offset	INTEGER16	RW

Note: for more details, refer to Section 10.4.3 Details of objects.

10.3.8 Touch Probe function and Touch Probe status

The Touch Probe function can be triggered by high-speed digital inputs (only DI1 and DI2) or by the motor Z pulse. This function is used for high-speed measurement or packaging applications.

If the capture source is the motor Z pulse or DI of CN1, note the following:

1. When the capture source is set to the motor Z pulse, you can only use Touch Probe 1. Regardless of the settings of OD 60B8h [Bit 4] and [Bit 5], the command is rising-edge triggered and the data is stored in OD 60BAh.
2. When the capture source is set to the DI of CN1, the previously set function code for the DI is changed to 0x0100 so one DI does not have two functions.

Set the Touch Probe function with OD 60B8h. The definition of each bit is as follows.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function	Description
Bit 0	Touch Probe 1 switch	0: disable Touch Probe 1. 1: enable Touch Probe 1.
Bit 1	Touch Probe 1 number of capturing times	0: capture one time. If the Touch Probe 1 signal is set to be triggered at both rising and falling edges, the data is captured once for each triggering. 1: capture multiple times.
Bit 2	Touch Probe 1 capture source	0: DI1 of CN1 1: motor Z pulse
Bit 3	Reserved	-
Bit 4	Rising-edge trigger action of Touch Probe 1	0: N/A 1: start capturing when the Touch Probe 1 signal is rising-edge triggered and store the data in OD 60BAh.
Bit 5	Falling-edge trigger action of Touch Probe 1	0: N/A 1: start capturing when the Touch Probe 1 signal is falling-edge triggered and store the data in OD 60BBh.
Bit 6 - Bit 7	Reserved	-
Bit 8	Touch Probe 2 switch	0: disable Touch Probe 2. 1: enable Touch Probe 2.
Bit 9	Touch Probe 2 number of capturing times	0: capture one time. If the Touch Probe 2 signal is set to be triggered at both rising and falling edges, the data is captured once for each triggering. 1: capture multiple times.
Bit 10	Touch Probe 2 capture source	0: DI2 of CN1
Bit 11	Reserved	-
Bit 12	Rising-edge trigger action of Touch Probe 2	0: N/A 1: start capturing when the Touch Probe 2 signal is rising-edge triggered and store the data in OD 60BCh.
Bit 13	Falling-edge trigger action of Touch Probe 2	0: N/A 1: start capturing when the Touch Probe 2 signal is falling-edge triggered and store the data in OD 60BDh.
Bit 14 - Bit 15	Reserved	-

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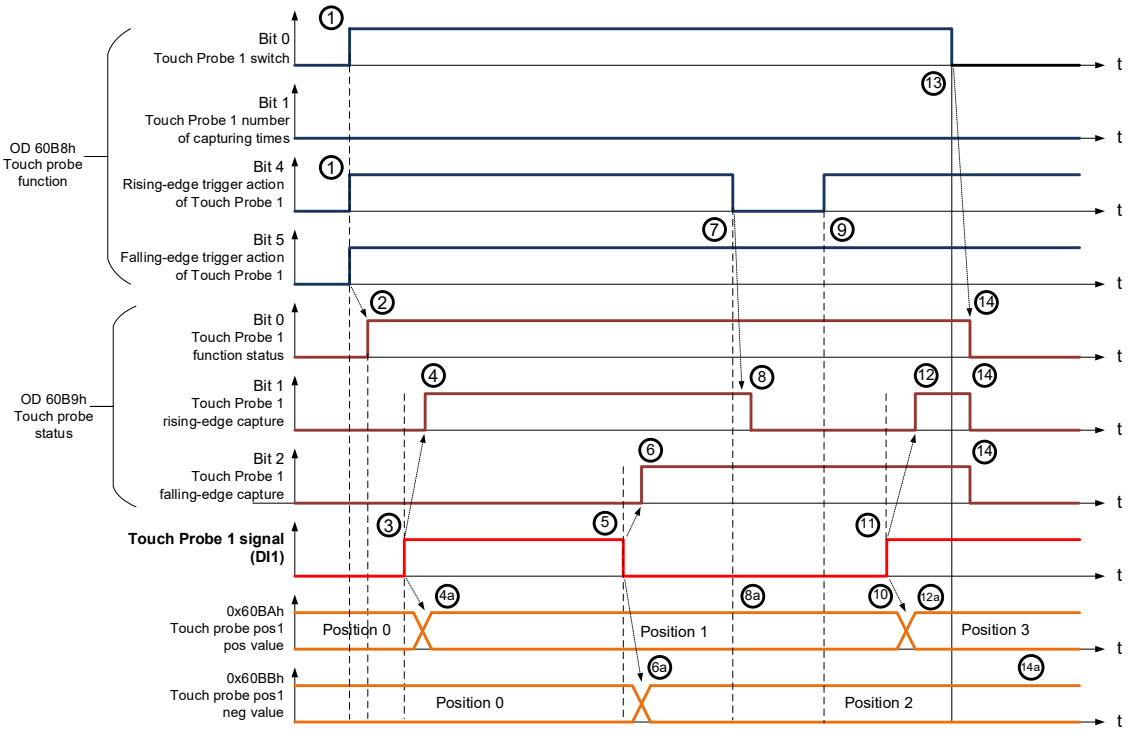
You can access the Touch Probe status with OD 60B9h. The definition of each bit is as follows.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function	Description
Bit 0	Touch Probe 1 function status	0: Touch Probe 1 disabled. 1: Touch Probe 1 enabled.
Bit 1	Touch Probe 1 rising-edge capture	0: capturing is not triggered. 1: the Touch Probe 1 signal is rising-edge triggered and the data is successfully captured.
Bit 2	Touch Probe 1 falling-edge capture	0: capturing is not triggered. 1: the Touch Probe 1 signal is falling-edge triggered and the data is successfully captured.
Bit 3 - Bit 5	Reserved	-
Bit 6	Touch Probe 1 capture source	0: DI1 of CN1 1: motor Z pulse
Bit 7	Touch Probe 1 signal for capturing multiple times (Available when the function of OD 60B8h [Bit 1] Number of capturing times is enabled)	The status is reversed once the capturing succeeds. Refer to the timing diagram in Example 3.
Bit 8	Touch Probe 2 function status	0: Touch Probe 2 disabled. 1: Touch Probe 2 enabled.
Bit 9	Touch Probe 2 rising-edge capture	0: capturing is not triggered 1: the Touch Probe 2 signal is rising-edge triggered and the data is successfully captured.
Bit 10	Touch Probe 2 falling-edge capture	0: capturing is not triggered 1: the Touch Probe 2 signal is falling-edge triggered and the data is successfully captured.
Bit 11 - Bit 13	Reserved	-
Bit 14	Touch Probe 2 capture source	0: DI2 of CN1
Bit 15	Touch Probe 2 signal for capturing multiple times (Available when the function of OD 60B8h [Bit 9] Number of capturing times is enabled)	The status is reversed once the capturing succeeds.

Example 1: the following is the timing diagram for the Touch Probe 1 function. In this example, the Touch Probe 1 function is triggered by the external DI. When OD 60B8h [Bit 1] is set to 0 and OD 60B8h [Bit 4] & [Bit 5] are set to 1, the Touch Probe 1 signal is triggered at both rising and falling edges , and the data is captured once for each triggering.



Status	Function	Description
(1)	OD 60B8h [Bit 0] = 1	Enable Touch Probe 1.
	OD 60B8h [Bit 1] = 0	Capture one time.
	OD 60B8h [Bit 4] = 1	Start capturing when the Touch Probe 1 signal is rising-edge triggered.
	OD 60B8h [Bit 5] = 1	Start capturing when the Touch Probe 1 signal is falling-edge triggered.
(2)	OD 60B9h [Bit 0] = 1	Touch Probe status: Touch Probe 1 function enabled.
(3)	-	Touch Probe 1 is rising-edge triggered by external signal.
(4)	OD 60B9h [Bit 1] = 1	Touch Probe status: Touch Probe 1 is rising-edge triggered and the data is successfully captured.
(4a)	OD 60BAh	The data captured when the Touch Probe 1 signal is rising-edge triggered is stored in OD 60BAh.
(5)	-	Touch Probe 1 is falling-edge triggered by external signal.
(6)	OD 60B9h [Bit 2] = 1	Touch Probe status: Touch Probe 1 signal is falling-edge triggered and the data is successfully captured.
(6a)	OD 60BBh	The data captured when the Touch Probe 1 signal is falling-edge triggered is stored in OD 60BBh.
(7)	OD 60B8h [Bit 4] = 0	Disable the rising-edge trigger action of Touch Probe 1.
(8)	OD 60B9h [Bit 1] = 0	Touch Probe status: reset the rising-edge capture status to non-triggered.
(8a)	OD 60BAh	Data at the rising-edge remains the same.
(9)	OD 60B8h [Bit 4] = 1	Start capturing when the Touch Probe 1 signal is rising-edge triggered.
(10)	OD 60BAh	Data at the rising-edge remains the same.

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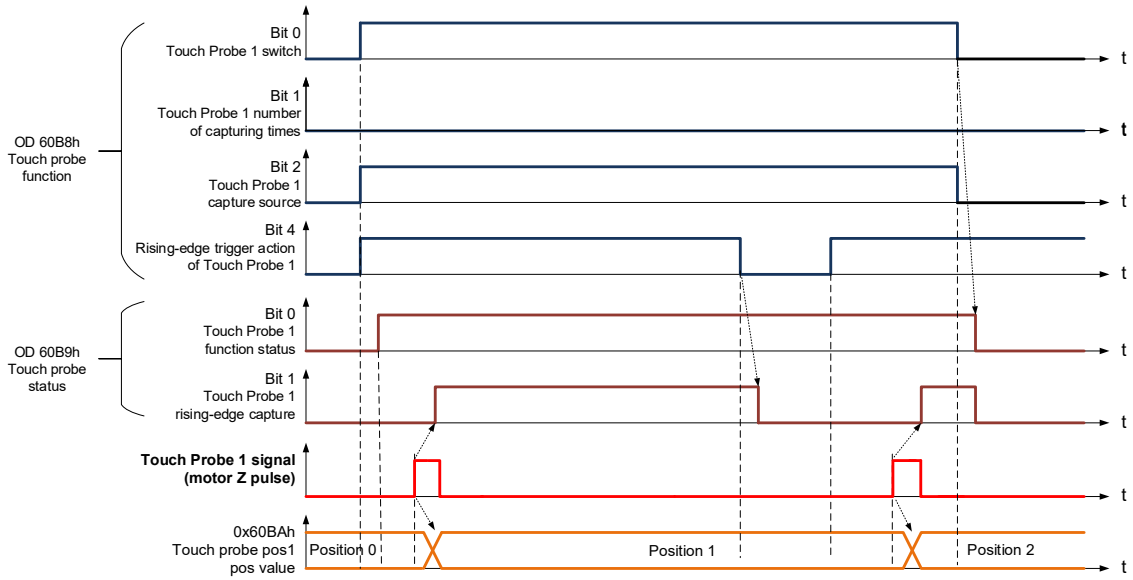
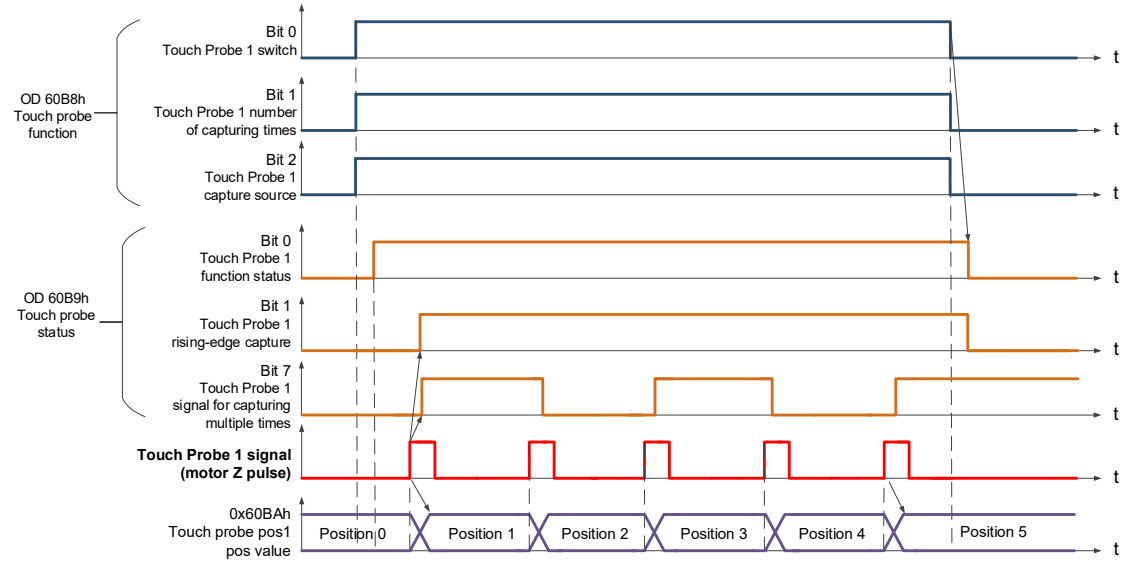
Status	Function	Description
(11)	-	Touch Probe 1 is rising-edge triggered by external signal.
(12)	OD 60B9h [Bit 1] = 1	Touch Probe status: Touch Probe 1 signal is rising-edge triggered and the data is successfully captured.
(12a)	OD 60BAh	The data captured when the Touch Probe 1 signal is rising-edge triggered is stored in OD 60BAh.
(13)	OD 60B8h [Bit 0] = 0	Disable Touch Probe 1.
(14)	OD 60B9h [Bit 0] = 0 OD 60B9h [Bit 1] = 0 OD 60B9h [Bit 2] = 0	Reset Touch Probe 1 status.
(14a)	OD 60BAh	The previously captured data remains the same.

Example 2: the following is the timing diagram for the Touch Probe 1 function. In this example, the Touch Probe 1 function is triggered by the motor Z pulse. The data is captured only once when the Touch Probe 1 signal is rising-edge triggered.



Example 3: the following is the timing diagram for the Touch Probe 1 function. In this example, the Touch Probe 1 function is triggered by the motor Z pulse. The data is captured **multiple times** when the Touch Probe 1 signal is rising-edge triggered.



Relevant object list

Index	Name	Data type	Access
60B8h	Touch probe function	UNSIGNED16	RW
60B9h	Touch probe status	UNSIGNED16	RO
60BAh	Touch probe pos1 pos value	INTEGER32	RO
60BBh	Touch probe pos1 neg value	INTEGER32	RO
60BCh	Touch probe pos2 pos value	INTEGER32	RO
60BDh	Touch probe pos2 neg value	INTEGER32	RO

Note: for more details, refer to Section 10.4.3 Details of objects.

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10.4 Object dictionary

This section details the EtherCAT objects supported by the servo. The contents include object index, name, data type, data length, and read / write permissions (access).

10.4.1 Specifications for objects

Object code

Object code	Description
VAR	A single value, such as an UNSIGNED8, Boolean, float, and INTEGER16.
ARRAY	An object of multiple data fields consisting of multiple variables of the same data type, such as an UNSIGNED16 array. The sub-index 0h data type is UNSIGNED8, so it is not an ARRAY data.
RECORD	An object of multiple data fields consisting of multiple variables of different data types. The sub-index 0h data type is UNSIGNED8, so it is not a RECORD data.

Data type

Refer to CANopen DS301.

10.4.2 List of objects

OD 1XXXh communication object group

Index	Object code	Name	Data type	Access
1000h	VAR	Device type	UNSIGNED32	RO
1001h	VAR	Error register	UNSIGNED8	RO
1003h	ARRAY	Pre-defined error field	UNSIGNED32	RW
1006h	VAR	Communication cycle period	UNSIGNED32	RW
1600h - 1603h	RECORD	Receive PDO mapping parameter	UNSIGNED32	RW
1A00h - 1A03h	RECORD	Transmit PDO mapping parameter	UNSIGNED32	RW
1C12h	ARRAY	RxPDO assign	UNSIGNED16	RW
1C13h	ARRAY	TxPDO assign	UNSIGNED16	RW

Note: only 1001h can be mapped to PDO.

OD 2XXXh servo parameter group

Index	Object code	Name	Data type	Access	Mappable
2XXXh	VAR	Parameter mapping	INTEGER16/32	RW	Y

OD 6XXXh communication object group

Index	Object code	Name	Data type	Access	Mappable
603Fh	VAR	Error code	UNSIGNED16	RO	Y
6040h	VAR	Controlword	UNSIGNED16	RW	Y
6041h	VAR	Statusword	UNSIGNED16	RO	Y
605Bh	VAR	Shutdown option code	INTEGER16	RW	Y
6060h	VAR	Modes of operation	INTEGER8	RW	Y
6061h	VAR	Modes of operation display	INTEGER8	RO	Y
6062h	VAR	Position demand value (PUU)	INTEGER32	RO	Y
6063h	VAR	Position actual internal value (pulse)	INTEGER32	RO	Y
6064h	VAR	Position actual value (PUU)	INTEGER32	RO	Y
6065h	VAR	Following error window	UNSIGNED32	RW	Y
6067h	VAR	Position window	UNSIGNED32	RW	Y
6068h	VAR	Position window time	UNSIGNED16	RW	Y
606Bh	VAR	Velocity demand value	INTEGER32	RO	Y
606Ch	VAR	Velocity actual value	INTEGER32	RO	Y
606Dh	VAR	Velocity window	UNSIGNED16	RW	Y
606Eh	VAR	Velocity window time	UNSIGNED16	RW	Y
606Fh	VAR	Velocity threshold	UNSIGNED16	RW	Y
6071h	VAR	Target torque	INTEGER16	RW	Y
6072h	VAR	Max torque	UNSIGNED16	RW	Y
6074h	VAR	Torque demand value	INTEGER16	RO	Y
6075h	VAR	Motor rated current	UNSIGNED32	RO	Y
6076h	VAR	Motor rated torque	UNSIGNED32	RO	Y
6077h	VAR	Torque actual value	INTEGER16	RO	Y
6078h	VAR	Current actual value	INTEGER16	RO	Y
607Ah	VAR	Target position	INTEGER32	RW	Y
607Ch	VAR	Home offset	INTEGER32	RW	Y

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Index	Object code	Name	Data type	Access	Mappable
607Dh	ARRAY	Software position limit	INTEGER32	RW	Y
607Fh	VAR	Max profile velocity	UNSIGNED32	RW	Y
6080h	VAR	Max motor speed	UNSIGNED32	RW	Y
6081h	VAR	Profile velocity	UNSIGNED32	RW	Y
6083h	VAR	Profile acceleration	UNSIGNED32	RW	Y
6084h	VAR	Profile deceleration	UNSIGNED32	RW	Y
6085h	VAR	Quick stop deceleration	UNSIGNED32	RW	Y
6086h	VAR	Motion profile type	INTEGER16	RO	Y
6087h	VAR	Torque slope	UNSIGNED32	RW	Y
6093h	ARRAY	Position factor	UNSIGNED32	RW	Y
6098h	VAR	Homing method	INTEGER8	RW	Y
6099h	ARRAY	Homing speeds	UNSIGNED32	RW	Y
609Ah	VAR	Homing acceleration	UNSIGNED32	RW	Y
60B0h	VAR	Position offset	INTEGER32	RW	Y
60B1h	VAR	Velocity offset	INTEGER32	RW	Y
60B2h	VAR	Torque offset	INTEGER16	RW	Y
60B8h	VAR	Touch probe function	UNSIGNED16	RW	Y
60B9h	VAR	Touch probe status	UNSIGNED16	RO	Y
60BAh	VAR	Touch probe pos1 pos value	INTEGER32	RO	Y
60BBh	VAR	Touch probe pos1 neg value	INTEGER32	RO	Y
60BCh	VAR	Touch probe pos2 pos value	INTEGER32	RO	Y
60BDh	VAR	Touch probe pos2 neg value	INTEGER32	RO	Y
60C5h	VAR	Max acceleration	UNSIGNED32	RW	Y
60C6h	VAR	Max deceleration	UNSIGNED32	RW	Y
60E0h	VAR	Positive torque limit	UNSIGNED16	RW	Y
60E1h	VAR	Negative torque limit	UNSIGNED16	RW	Y
60F4h	VAR	Following error actual value	INTEGER32	RO	Y
60FCh	VAR	Position demand value	INTEGER32	RO	Y
60FDh	VAR	Digital inputs	UNSIGNED32	RO	Y
60FEh	ARRAY	Digital outputs	UNSIGNED32	RW	Y
60FFh	VAR	Target velocity	INTEGER32	RW	Y
6502h	VAR	Supported drive modes	UNSIGNED32	RO	Y

10.4.3 Details of objects

10.4.3.1 OD 1XXXh communication object group

Object 1000h: Device type

Index	1000h
Name	Device type
Object code	VAR
Data type	UNSIGNED32
Access	RO
PDO mapping	No
Setting range	UNSIGNED32

Format of this object: (High word h) DCBA; (Low word L) UZYX

A	Bit 16 - Bit 31 Model type	X	Bit 0 - Bit 15 Device profile number
B		Y	
C		Z	
D		U	

Definitions are as follows:

- UZYX: device profile number (servo drive: 0192)
- DCBA: model type

DCBA	Model type
1802	E3C

Object 1001h: Error register

Index	1001h
Name	Error register
Object code	VAR
Data type	UNSIGNED8
Access	RO
PDO mapping	Yes
Setting range	UNSIGNED8
Default	0

Object function:

The bits and corresponding functions are as follows:

Bit	7	6	5	4	3	2	1	0

Bit	Function
Bit 0	Generic error
Bit 1	Current
Bit 2	Voltage
Bit 3	Temperature
Bit 4	Communication error
Bit 5 - Bit 7	Reserved

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Object 1003h: Pre-defined error field

Index	1003h
Name	Pre-defined error field
Object code	ARRAY
Data type	UNSIGNED32
Access	RW
PDO mapping	No

Sub-index	0h
Description	Number of errors
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	0 - 5
Default	0

Sub-index	1h - 5h
Description	Standard error field
Data type	UNSIGNED32
Access	RO
PDO mapping	No
Setting range	UNSIGNED32
Default	0

Format of this object: (High word h) DCBA; (Low word L) UZYX

A	Bit 16 - Bit 31 Delta servo alarm	X	Bit 0 - Bit 15 Error code
B		Y	
C		Z	
D		U	

Definitions are as follows:

- UZYX: error code. Refer to the error code definition in DS402.
- DCBA: Delta servo alarm. Refer to Chapter 11 Troubleshooting.

Example:

When you operate the servo, if the encoder cable is not correctly connected, the servo drive panel displays AL011 and its error code is stored in the OD 1003h array. The display is as follows:

Byte:	High word	Low word
	Delta servo alarm (UINT16)	Error code (UINT16)
	0x0011	0x7305

AL011 is defined as “CN2 communication failed” based on the Delta servo alarm.

Error code: 0x7305 is defined as “Incremental sensor 1 fault” according to DS402.

Object 1006h: Communication cycle period

Index	1006h
Name	Communication cycle period
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	No
Setting range	UNSIGNED32
Default	0
Unit	μs

Object function:

This object is to set the communication cycle, which is the interval between two SYNCs. If you are not using SYNC, set this object to 0.

Objects 1600h - 1603h: Receive PDO mapping parameter

Index	1600h, 1601h, 1602h, 1603h
Name	Receive PDO mapping parameter
Object code	RECORD
Data type	PDO mapping
Access	RW
Note	The total length of objects in a group of PDO cannot exceed 64 bits.

Sub-index	0h
Description	Number of PDO mappings
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	0: disable 1 - 8: set the number of PDO mapping and enable the function
Default	0

Sub-index	1h - 8h
Description	Specify the 1st (to 8th) object and its content to be mapped
Data type	UNSIGNED32
Access	RW
PDO mapping	No
Setting range	UNSIGNED32
Default	0

The format of this object is as follows:

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

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Bit	Function
Bit 0 - Bit 7	Object data length
Bit 8 - Bit 15	Object sub-index
Bit 16 - Bit 31	Object index

Example:

To set the three PDOs, OD 6040h, OD 607Ah, and OD 6060h, in the first group of PDO, the setting is as follows.

Mapping parameter setting for RxPDO	Data			Description
OD 1600h sub1	6040h	00h	10h	Mapping the Controlword (OD 6040h); data length is 16-bit
OD 1600h sub2	607Ah	00h	20h	Mapping the target position (OD 607Ah); data length is 32-bit
OD 1600h sub3	6060h	00h	08h	Mapping the operation mode (OD 6060h); data length is 8-bit
OD 1600h sub0	3			Set 3 PDO mappings.
Note	The total length is 38h (56-bit), which meets the specification of less than 64-bit.			

Objects 1A00h - 1A03h: Transmit PDO mapping parameter

Index	1A00h, 1A01h, 1A02h, 1A03h
Name	Transmit PDO mapping parameter
Object code	RECORD
Data type	PDO mapping
Access	RW
Note	The total length of objects in a group of PDO cannot exceed 64 bits.

Sub-index	0h
Description	Number of PDO mappings
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	0: disable 1 - 8: set the number of PDO mapping and enable the function
Default	0

Sub-index	1h - 8h
Description	Specify the 1st (to 8th) object and its content to be mapped
Data type	UNSIGNED32
Access	RW
PDO mapping	No
Setting range	UNSIGNED32
Default	0

Format of this object: (High word h) DCBA; (Low word L) UZYX

DCBA	Bit 16 - Bit 31 Object index	YX	Bit 0 - Bit 7 Object data length
		UZ	Bit 8 - Bit 15 Object sub-index

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Object 1C12h: RxPDO assign

Index	1C12h
Name	RxPDO assign
Object code	ARRAY
Data type	UNSIGNED16
Access	RW
PDO mapping	No

Sub-index	0h
Description	Number of sub-index
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	0 - 1
Default	1

Sub-index	1h
Description	Specify the RxPDO index to be used
Data type	UNSIGNED16
Access	RW
PDO mapping	No
Setting range	0x1600, 0x1601, 0x1602, 0x1603
Default	0x1601

Object 1C13h: TxPDO assign

Index	1C13h
Name	TxPDO assign
Object code	ARRAY
Data type	UNSIGNED16
Access	RW
PDO mapping	No

Sub-index	0h
Description	Number of sub-index
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	0 - 1
Default	1

Sub-index	1h
Description	Specify the TxPDO index to be used
Data type	UNSIGNED16
Access	RW
PDO mapping	No
Setting range	0x1A00, 0x1A01, 0x1A02, 0x1A03
Default	0x1A01

10.4.3.2 OD 2XXXh servo parameter group

Object 2XXXh: Parameter mapping

Index	2XXXh
Name	Parameter mapping
Object code	VAR
Data type	INTEGER16 / INTEGER32
Access	RW
PDO mapping	Yes
Setting range	INTEGER16 / INTEGER32
Default	N/A

Object function:

Access the corresponding servo parameters with the OD 2XXXh group. The conversion between the parameter number and object index is as follows:

Object index	Servo parameter	Description
2**aBC**h	P**a**.**bcd**	"**BC**" is the hexadecimal format of "**bcd**".

You can read the object index first to get the information of the parameter length, and then use SDO or PDO to change the data.

Example 1:

Object 2300h: Node-ID [P3.000]

Index	2300h
Name	Node-ID
Object code	VAR
Data type	INTEGER16
Access	RW
PDO mapping	Yes
Setting range	INTEGER16
Default	7Fh

Example 2:

Object 212Ch: Electronic gear [P1.044]

Index	212Ch
Name	Electronic gear
Object code	VAR
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	INTEGER32
Default	1

10.4.3.3 OD 6XXXh communication object group

Object 603Fh: Error code (CANopen defined)

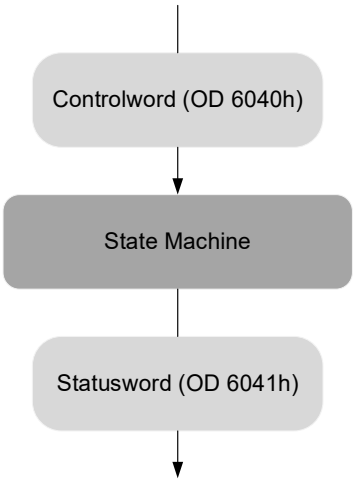
Index	603Fh
Name	Error code
Object code	VAR
Data type	UNSIGNED16
Access	RO
PDO mapping	Yes
Setting range	UNSIGNED16
Default	0

Object 6040h: Controlword

Index	6040h
Name	Controlword
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED16
Default	0x0004

Object function:

The Controlword contains many functions, such as Servo On, command triggering, fault reset, and quick stop. The state machine architecture is as follows:



Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function	Description
Bit 0	Switch on	Ready for Servo On.
Bit 1	Enable voltage	-
Bit 2	Quick stop (B contact (NC))	-
Bit 3	Enable operation	Servo On.
Bit 4 - Bit 6	Defined in each operation mode	These bits are individually defined according to the operation mode, as shown in the following table.

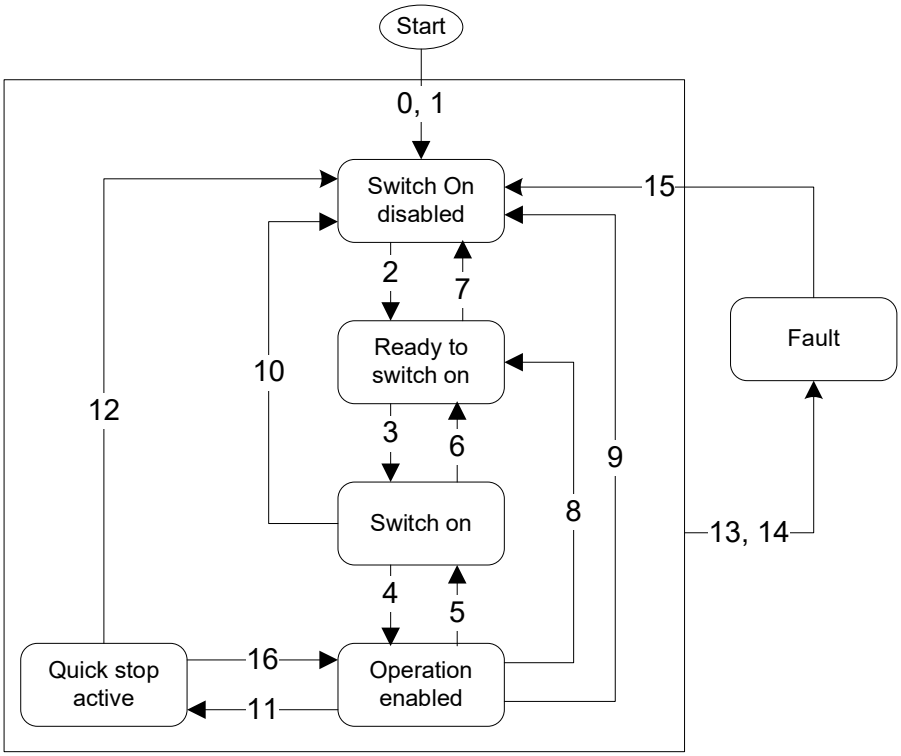
Bit	Function	Description
Bit 7	Fault reset	-
Bit 8	Halt	-
Bit 9 - Bit 15	Reserved	-

Bits 4 - 6 are individually defined according to the operation mode, as shown in the following table:

Bit	Definition in each operation mode					
	PP	PV / PT	HM	CSP	CSV	CST
Bit 4	Command triggering (rising-edge triggered)	-	Homing (rising-edge triggered)	-	-	-
Bit 5	Function for the command to take immediate effect	-	-	-	-	-
Bit 6	0: absolute position command 1: relative position command	-	-	-	-	-

Note: - indicates the bit is invalid.

Finite state machine (as shown in the following diagram) defines the behavior of a servo drive system. Each state represents an internal or external behavior. For example, the servo drive can execute point-to-point motion only in the “Operation enabled” state.



The state transition is defined as follows:

Transition	Event	Action
0, 1	Automatic transition after power-on	Device boot and initialization
2	Shutdown command	N/A
3	Switch on command	Servo is ready for Servo On
4	Enable operation command	Servo switches to Servo On and enters the mode in which the controller is allowed to issue a motion command
5	Disable operation command	Servo switches to Servo Off
6	Shutdown command	N/A
7	Disable voltage or quick stop command	N/A
8	Shutdown command	Servo switches to Servo Off
9	Disable voltage command	Servo switches to Servo Off
10	Disable voltage or quick stop command	N/A
11	Quick stop command The following two errors belong to this quick stop type: 1. Positive / negative limit switch triggered 2. Quick stop triggered by the Controlword (OD 6040h [Bit 2] = 0)	Quick stop function is enabled. The time setting for deceleration to a stop is different for the two errors. 1. OD 2503h (P5.003) 2. OD 6085h
12	Disable voltage command (OD 6040h = 0000 0110 or OD 6040h [Bit 1] = 0)	Servo switches to Servo Off
13, 14	Alarm occurs	Servo switches to Servo Off
15	Fault reset	N/A
16	Enable operation command; no alarm	Motion operation restart. The restart action is mode-dependent.

State transition can be achieved by issuing commands with the Controlword (OD 6040h).

The settings of OD 6040h for different commands are as follows:

OD 6040h					Command	Transition
Bit 7	Bit 3	Bit 2	Bit 1	Bit 0		
0	X	1	1	0	Shutdown	2, 6, 8
0	0	1	1	1	Switch on	3
0	1	1	1	1	Switch on + Enable operation	3 + 4
0	X	X	0	X	Disable voltage	7, 9, 10, 12
0	X	0	1	X	Quick stop	7, 10, 11
0	0	1	1	1	Disable operation	5
0	1	1	1	1	Enable operation	4, 16
↑	X	X	X	X	Fault reset	15

Object 6041h: Statusword

Index	6041h
Name	Statusword
Object code	VAR
Data type	UNSIGNED16
Access	RO
PDO mapping	Yes
Setting range	UNSIGNED16
Default	0

Object function:

The Statusword contains many statuses, such as Servo On, command statuses, fault signal, and quick stop. The state machine architecture is as follows:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Status		Description
Bit 0	Ready to switch on	Ready to be activated	Current status of the servo drive (see the following table for details).
Bit 1	Switched on	Servo ready	
Bit 2	Operation enabled	Servo On	
Bit 3	Fault	Fault signal	
Bit 4	Voltage enabled	Servo is powered on	
Bit 5	Quick stop	Quick stop	
Bit 6	Switch on disabled	Servo disabled	
Bit 7	Warning	Warning signal	When outputting the warning signal, the servo keeps outputting the Servo On signal.
Bit 8	Reserved	-	-
Bit 9	Remote	Remote control	-
Bit 10	Target reached	Target reached	-
Bit 11	Reserved	-	-
Bit 12 - Bit 13	Operation mode specific	-	These bits are individually defined according to the operation mode, as shown in the following table.
Bit 14	Positive limit	Positive limit	-
Bit 15	Negative limit	Negative limit	-

Bit 0 - Bit 6: current status of the servo drive.

Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
0	-	-	0	0	0	0	Not ready to switch on.
1	-	-	0	0	0	0	Switch on disabled.
0	1	-	0	0	0	1	Ready to switch on.
0	1	-	0	0	1	1	Switched on.
0	1	-	0	1	1	1	Operation enabled (Servo On).
0	0	-	0	1	1	1	Quick stop active.
0	-	-	1	1	1	1	Fault reaction active.
0	-	-	1	0	0	0	Servo fault (servo switches to Servo Off).

Note: 0 indicates the bit is Off, 1 indicates the bit is On, and - indicates the bit is invalid.

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Bit 12 - Bit 13 are individually defined according to the operation mode.

Bit	Definition in each operation mode						
	PP	PV	PT	HM	CSP	CSV	CST
Bit 12	Set-point acknowledge (servo received the command signal)	Zero speed	-	Homing is complete	Mode is in effect	Mode is in effect	Mode is in effect
Bit 13	Following error	-	-	Homing error	Following error	-	-

Note: - indicates the bit is invalid.

Object 605Bh: Shutdown option code

Index	605Bh
Name	Shutdown option code
Object code	VAR
Data type	INTEGER16
Access	RW
PDO mapping	Yes
Setting range	INTEGER16
Default	0

Object function:

OD 605Bh = 0: when Servo Off, the dynamic brake has no effect, so the motor runs freely and the machine stops only by friction.

OD 605Bh = -1: when Servo Off, the servo stops with the operation of the dynamic brake.

Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.

Object 6060h: Modes of operation

Index	6060h
Name	Modes of operation
Object code	VAR
Data type	INTEGER8
Access	RW
PDO mapping	Yes
Setting range	INTEGER8
Default	0

Object function:

This object sets the mode for operation.

Setting value	Mode
0	Reserved
1	Profile Position mode
2	Reserved
3	Profile Velocity mode
4	Profile Torque mode
5	Reserved
6	Homing mode
7	Reserved
8	Cyclic Synchronous Position mode
9	Cyclic Synchronous Velocity mode
10	Cyclic Synchronous Torque mode

Object 6061h: Modes of operation display

Index	6061h
Name	Modes of operation display
Object code	VAR
Data type	INTEGER8
Access	RO
PDO mapping	Yes
Setting range	INTEGER8
Default	0

Object function:

This object displays the current operation mode. Refer to the table in OD 6060h.

Object 6062h: Position demand value (PUU)

Index	6062h
Name	Position demand value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	PUU

Object function:

This position demand value is the interpolation command calculated by the servo internal interpolator. This command is processed by the servo internal filter. For its detailed location, refer to the servo architecture diagram of each mode.

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Object 6063h: Position actual internal value (pulse)

Index	6063h
Name	Position actual internal value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	pulse (unit for encoder pulse resolution) ASDA-E3C servo drive generates 16,777,216 pulses per motor revolution.

Object 6064h: Position actual value (PUU)

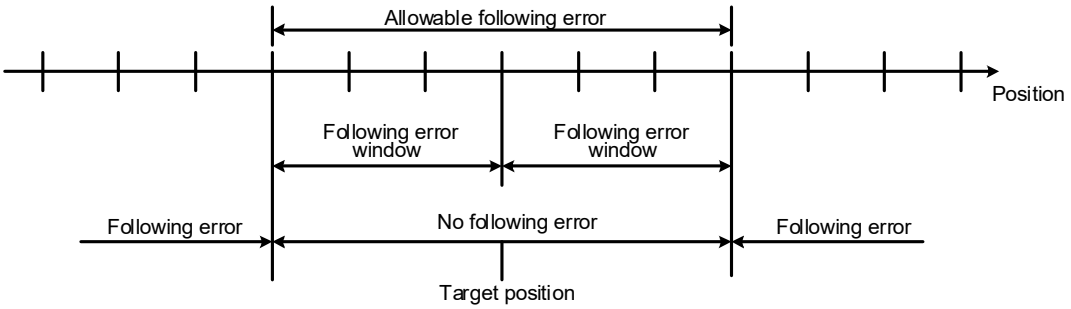
Index	6064h
Name	Position actual value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	PUU

Object 6065h: Following error window

Index	6065h
Name	Following error window
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED32
Default	50331648
Unit	PUU

Object function:

When the following error actual value (OD 60F4h) exceeds the Following error window, AL009 (Excessive deviation of Position command) is triggered.



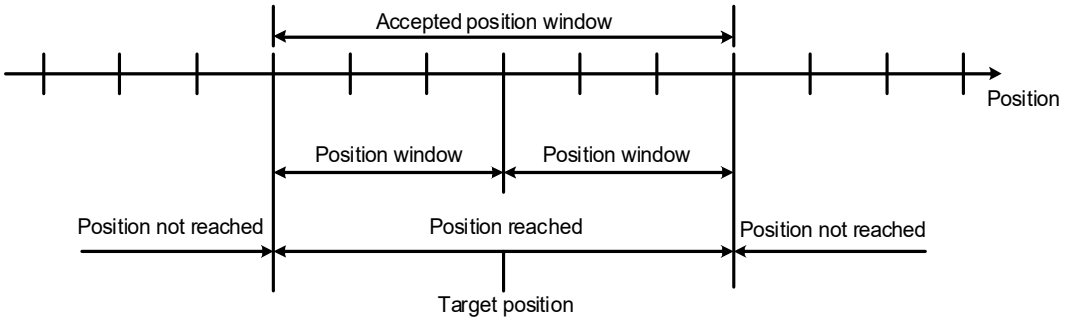
Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.

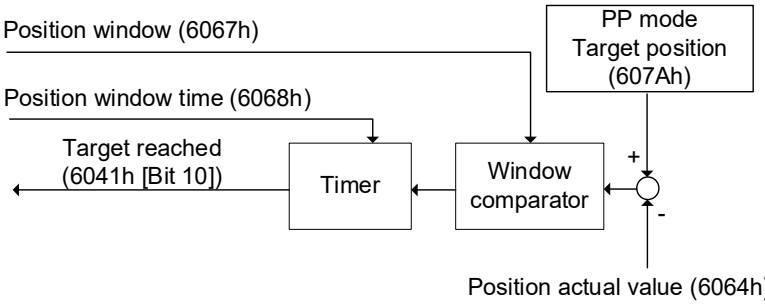
Object 6067h: Position window

Index	6067h
Name	Position window
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED32
Default	100
Unit	PUU

Object function:

When the difference (absolute value) between the target position (PP mode: OD 607Ah) and the position actual value (OD 6064h) is within the range set in OD 6067h (Position window), and the duration of this condition is longer than the time set in OD 6068h (Position window time), OD 6041h [Bit 10] (Target reached) is output.





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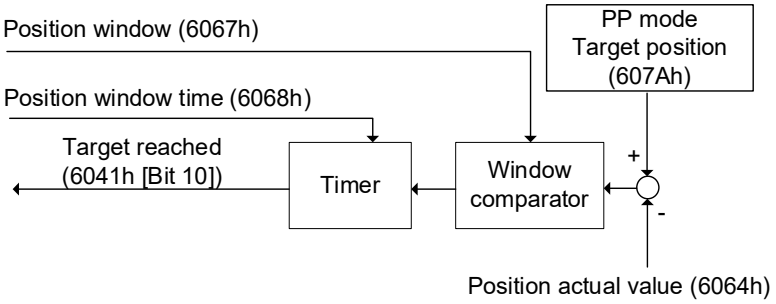
Object 6068h: Position window time

Index	6068h
Name	Position window time
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED16
Default	0
Unit	ms

Object function:

When the difference (absolute value) between the target position (PP mode: OD 607Ah) and the position actual value (OD 6064h) is within the range set in OD 6067h (Position window), and the duration of this condition is longer than the time set in OD 6068h (Position window time), OD 6041h [Bit 10] (Target reached) is output.



Object 606Bh: Velocity demand value

Index	606Bh
Name	Velocity demand value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Unit	0.1 rpm

Object function:

The velocity demand value is a command generated by the speed trajectory generator and filtered by the command filter of the drive. This object works in Profile Velocity mode and Cyclic Synchronous Velocity mode. For more details, refer to Sections 10.3.2 and 10.3.6.

Object 606Ch: Velocity actual value

Index	606Ch
Name	Velocity actual value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Unit	0.1 rpm

Object function:

Returns the motor speed at present for monitoring.

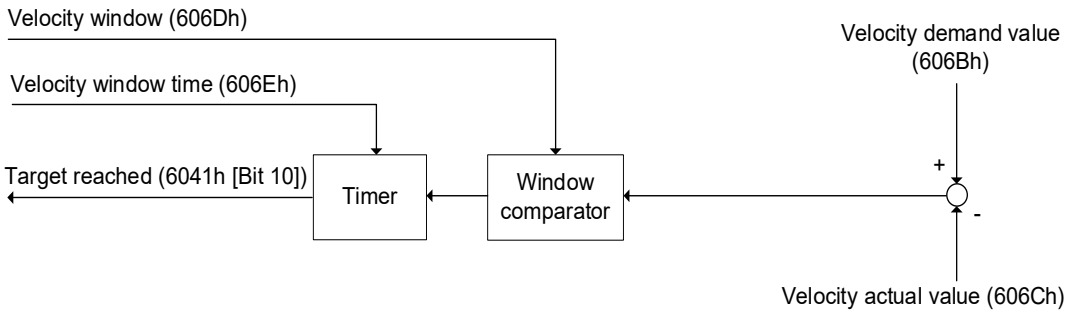
Object 606Dh: Velocity window

Index	606Dh
Name	Velocity window
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	Yes
Setting range	0 - 3000
Default	100
Unit	0.1 rpm

Object function:

The window comparator compares the speed difference with the velocity window (OD 606Dh). When the difference (absolute value) is within the range set in the velocity window and the duration of this condition is longer than the time set in the velocity window time (OD 606Eh), OD 6041h [Bit 10] (Target reached) is output. This object works in Profile Velocity mode. For more details, refer to Section 10.3.2.

Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.



Object 606Eh: Velocity window time

Index	606Eh
Name	Velocity window time
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED16
Default	0
Unit	ms

Object function:

Refer to OD 606Dh for the description of this object.

Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.

Object 606Fh: Velocity threshold

Index	606Fh
Name	Velocity threshold
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	Yes
Setting range	0 - 2000
Default	100
Unit	0.1 rpm

Object function:

This object sets the range for the zero-speed signal output. When the forward or reverse speed (absolute value) of the motor is lower than the setting value of OD 606Fh, OD 6041h [Bit 12] (zero-speed signal) outputs 1.

Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.

Object 6071h: Target torque

Index	6071h
Name	Target torque
Object code	VAR
Data type	INTEGER16
Access	RW
PDO mapping	Yes
Setting range	-3500 to +3500
Default	0
Unit	0.1%

Object function:

This object sets the target torque in Profile Torque mode and Cyclic Synchronous Torque mode. If OD 6071h = 1000 (100.0%), it corresponds to the motor rated torque.

Object 6072h: Max torque

Index	6072h
Name	Max torque
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	Yes
Setting range	0 - 3500
Default	3500
Unit	0.1%

Object function:

This object sets the maximum torque in Profile Torque mode and Cyclic Synchronous Torque mode.

Object 6074h: Torque demand value

Index	6074h
Name	Torque demand value
Object code	VAR
Data type	INTEGER16
Access	RO
PDO mapping	Yes
Setting range	INTEGER16
Default	0
Unit	0.1%

Object function:

The torque demand value is the command generated by the speed trajectory generator and filtered by the command filter of the drive. This object works in Profile Torque mode and Cyclic Synchronous Torque mode. For more details, refer to Sections 10.3.3 and 10.3.7.

Object 6075h: Motor rated current

Index	6075h
Name	Motor rated current
Object code	VAR
Data type	UNSIGNED32
Access	RO
PDO mapping	Yes
Setting range	UNSIGNED32
Default	0
Unit	mA

Object function:

This object displays the rated current specified on the motor nameplate.

Object 6076h: Motor rated torque

Index	6076h
Name	Motor rated torque
Object code	VAR
Data type	UNSIGNED32
Access	RO
PDO mapping	Yes
Setting range	UNSIGNED32
Default	0
Unit	0.001 N·m

Object function:

This object displays the rated torque specified on the motor nameplate.

Object 6077h: Torque actual value

Index	6077h
Name	Torque actual value
Object code	VAR
Data type	INTEGER16
Access	RO
PDO mapping	Yes
Setting range	INTEGER16
Default	0
Unit	0.1%

Object function:

This object is the motor torque feedback in percentage at present.

Object 6078h: Current actual value

Index	6078h
Name	Current actual value
Object code	VAR
Data type	INTEGER16
Access	RO
PDO mapping	Yes
Setting range	INTEGER16
Default	0
Unit	0.1%

Object function:

This object is the motor current feedback in percentage at present.

Object 607Ah: Target position

Index	607Ah
Name	Target position
Object code	VAR
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	PUU

Object function:

This object works in Profile Position mode and Cyclic Synchronous Position mode. For more details, refer to Sections 10.3.1 and 10.3.5.

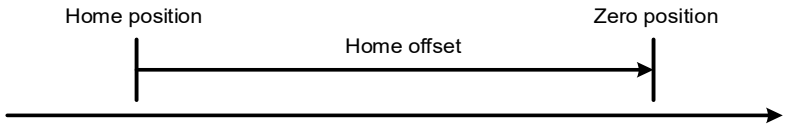
Object 607Ch: Home offset

Index	607Ch
Name	Home offset
Object code	VAR
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	PUU

Object function:

The origin reference point which the system looks for during the homing procedure is Home position, such as the origin sensor and Z pulse. When the origin reference point is found, the position offset from this point is the user-defined origin (Zero position), and the offset value is Home offset.

Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.



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Object 607Dh: Software position limit

Index	607Dh
Name	Software position limit
Object code	ARRAY
Data type	INTEGER32
Access	RW

Sub-index	0h
Description	Number of entries
Data type	UNSIGNED8
Access	RO
PDO mapping	Yes
Setting range	2
Default	2

Sub-index	1h
Description	Min position limit
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	-2147483648 to +2147483647
Default	-2147483648
Unit	PUU

Sub-index	2h
Description	Max position limit
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	-2147483648 to +2147483647
Default	+2147483647
Unit	PUU

Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.

Object 607Fh: Max profile velocity

Index	607Fh
Name	Max profile velocity
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED32
Default	Varies depending on the motor model
Unit	0.1 rpm

Object function:

The unit of this object is 0.1 rpm, so dividing this object by 10 is equivalent to P1.055 (Maximum speed limit in units of 1 rpm).

Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.

Object 6080h: Max motor speed

Index	6080h
Name	Max motor speed
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED32
Default	Varies depending on the motor model
Unit	rpm

Object function:

OD 6080h is equivalent to P1.055 (Maximum speed limit).

Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.

Object 6081h: Profile velocity

Index	6081h
Name	Profile velocity
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED32
Default	10000
Unit	PUU/s

Object function:

This object works in Profile Position mode. For more details, refer to Section 10.3.1.

Object 6083h: Profile acceleration

Index	6083h
Name	Profile acceleration
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	1 - 65500
Default	200
Unit	ms

Object function:

The time slope set by this object is the time required for the motor to accelerate from 0 rpm to 3,000 rpm. This object works in Profile Position mode and Profile Velocity mode. For more details, refer to Sections 10.3.1 and 10.3.2.

Object 6084h: Profile deceleration

Index	6084h
Name	Profile deceleration
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	1 - 65500
Default	200
Unit	ms

Object function:

The time slope set by this object is the time required for the motor to decelerate from 3,000 rpm to 0 rpm. This object works in Profile Position mode and Profile Velocity mode. For more details, refer to Sections 10.3.1 and 10.3.2.

Object 6085h: Quick stop deceleration

Index	6085h
Name	Quick stop deceleration
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	1 - 65500
Default	200
Unit	ms

Object function:

The time slope set by this object is the time required for the motor to decelerate from 3,000 rpm to 0 rpm using the quick stop function.

Object 6086h: Motion profile type

Index	6086h
Name	Motion profile type
Object code	VAR
Data type	INTEGER16
Access	RO
PDO mapping	Yes
Setting range	0
Default	0

Object function:

This object sets the type of motion profile for operation. Currently, only linear ramp (trapezoidal profile) is available.

Setting value	Type
0	Linear ramp (trapezoidal profile)

Object 6087h: Torque slope

Index	6087h
Name	Torque slope
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	0 - 65500
Default	200
Unit	ms

Object function:

The time slope set by this object is the time required for the motor torque to change from 0% to 100% of the rated torque.

Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.

Object 6093h: Position factor

Index	6093h
Name	Position factor
Object code	ARRAY
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Corresponding servo parameter	P1.044 and P1.045
Note	Position factor = Numerator / Feed_constant

Sub-index	0h
Description	Number of sub-index
Data type	UNSIGNED8
Access	RO
PDO mapping	No
Setting range	2
Default	2

Sub-index	1h
Description	E-Gear ratio numerator
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Default	1
Corresponding servo parameter	P1.044
Note	For the E-Gear ratio setting, refer to Section 6.2.4.

Sub-index	2h
Description	E-Gear ratio denominator
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Default	1
Corresponding servo parameter	P1.045
Note	For the E-Gear ratio setting, refer to Section 6.2.4.

Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.

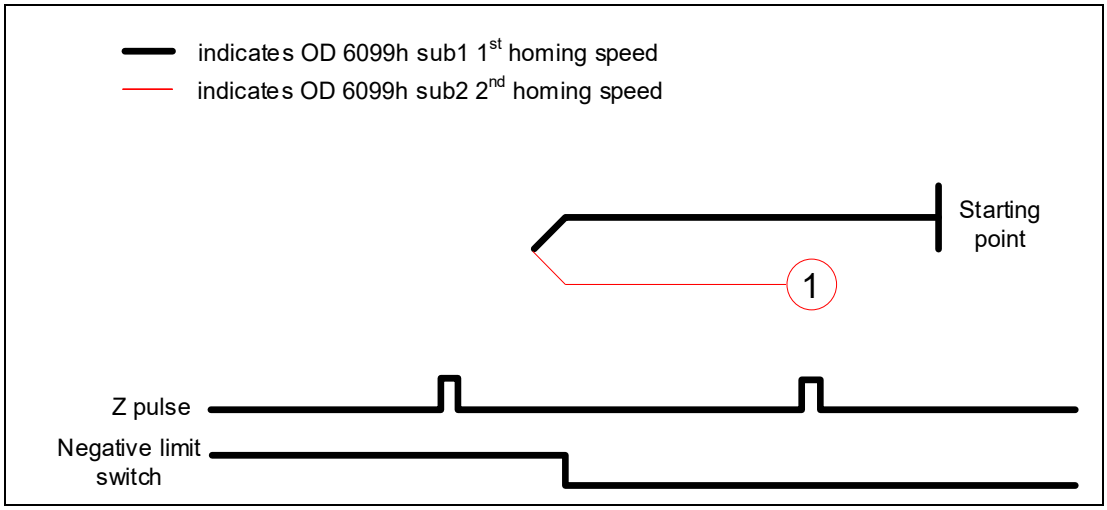
Object 6098h: Homing method

Index	6098h
Name	Homing method
Object code	VAR
Data type	INTEGER8
Access	RW
PDO mapping	Yes
Setting range	-4 to +35
Default	0

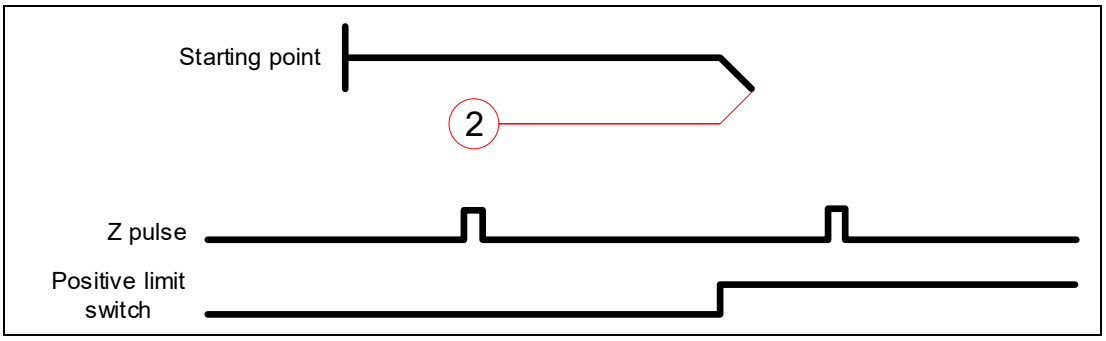
Object function:

The homing methods include looking for the Z pulse (Methods 1 - 14, 33, 34, 36, and 37), not looking for the Z pulse (Methods 17 - 30), defining the current position as the origin (Method 35), and looking for the hard stop (Methods 36 - 39). Methods 15, 16, 31, and 32 are reserved. To use Methods 1 to 35, set OD 6098h to 1 to 35. To use Methods 36 to 39, set OD 6098h to -1 to -4.

Method 1: homing on the negative limit switch and Z pulse



Method 2: homing on the positive limit switch and Z pulse



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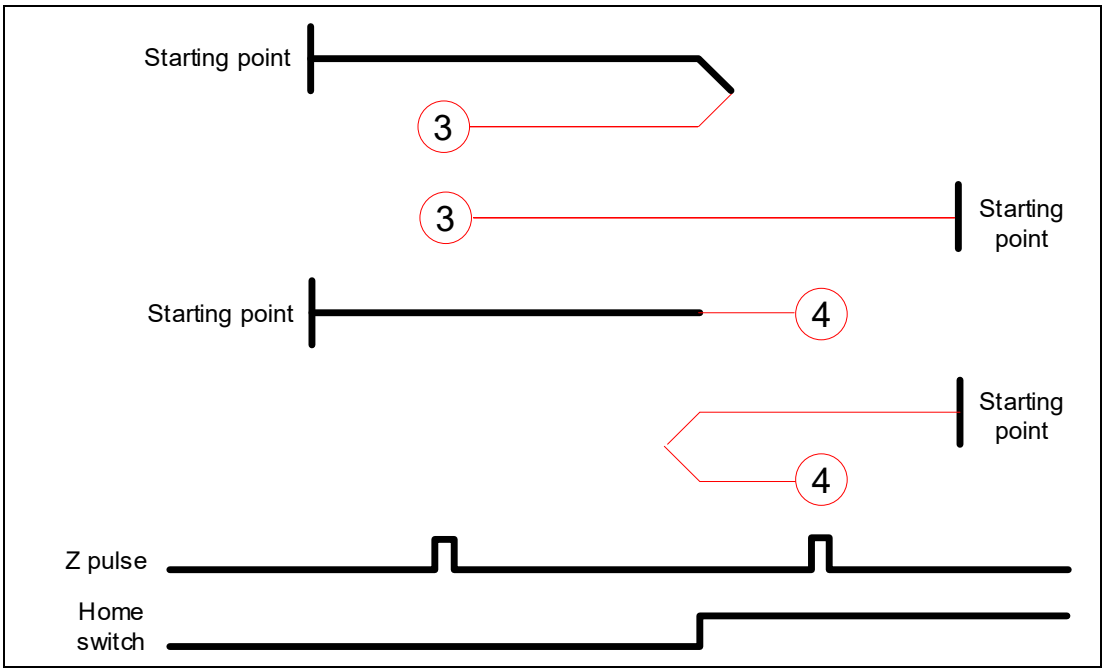
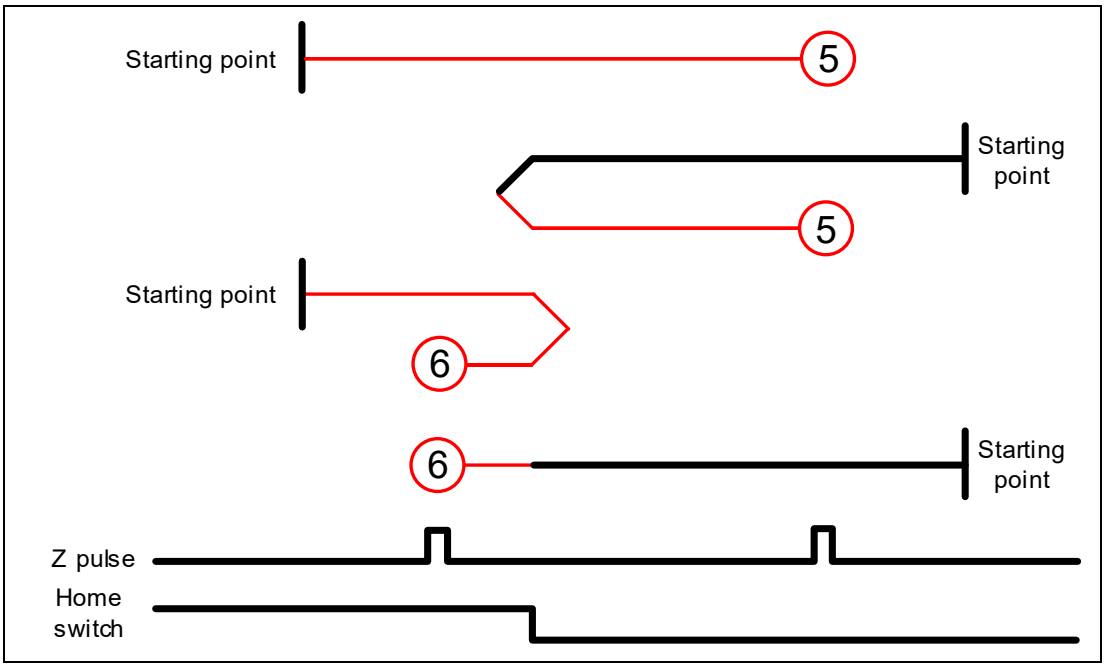
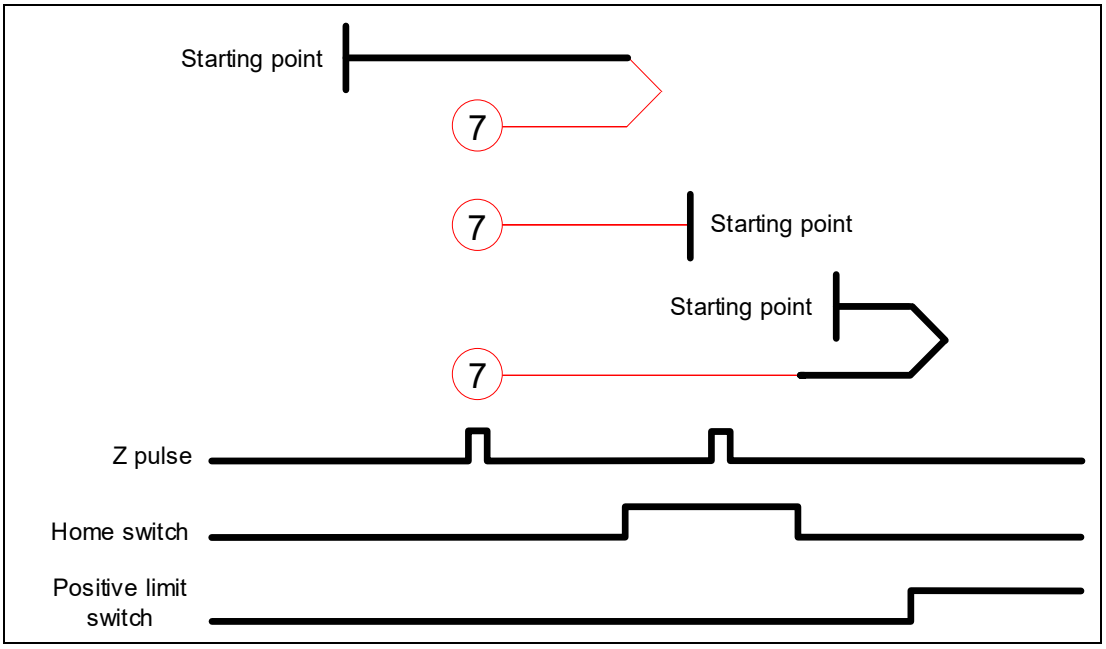
Methods 3 and 4: homing on the home switch and Z pulse



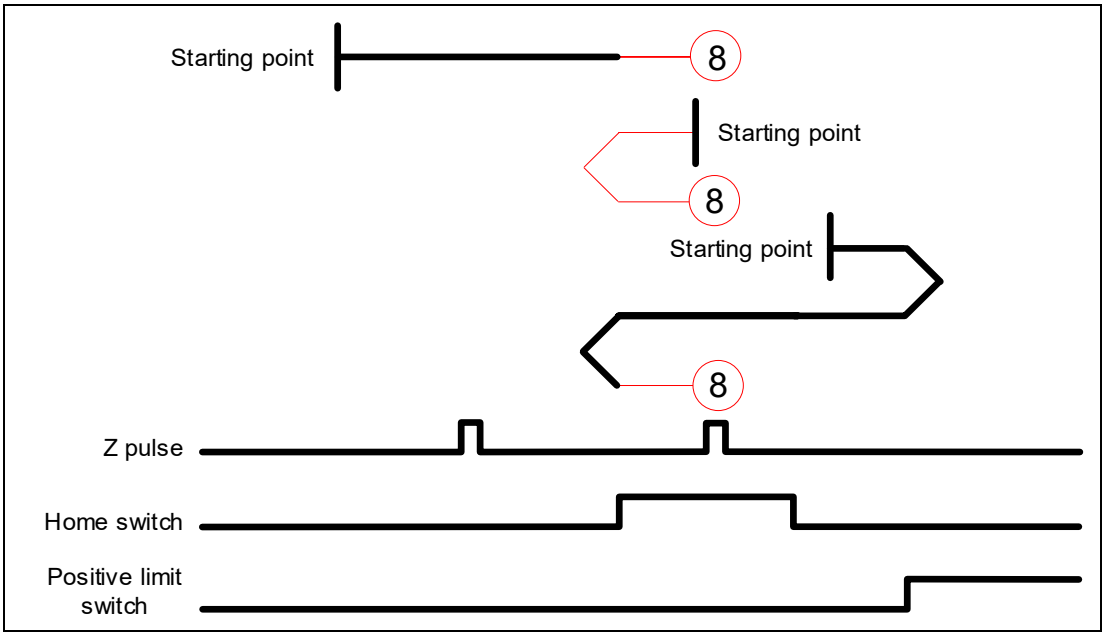
Methods 5 and 6: homing on the home switch and Z pulse



Method 7: homing on the positive limit switch, home switch, and Z pulse



Method 8: homing on the positive limit switch, home switch, and Z pulse



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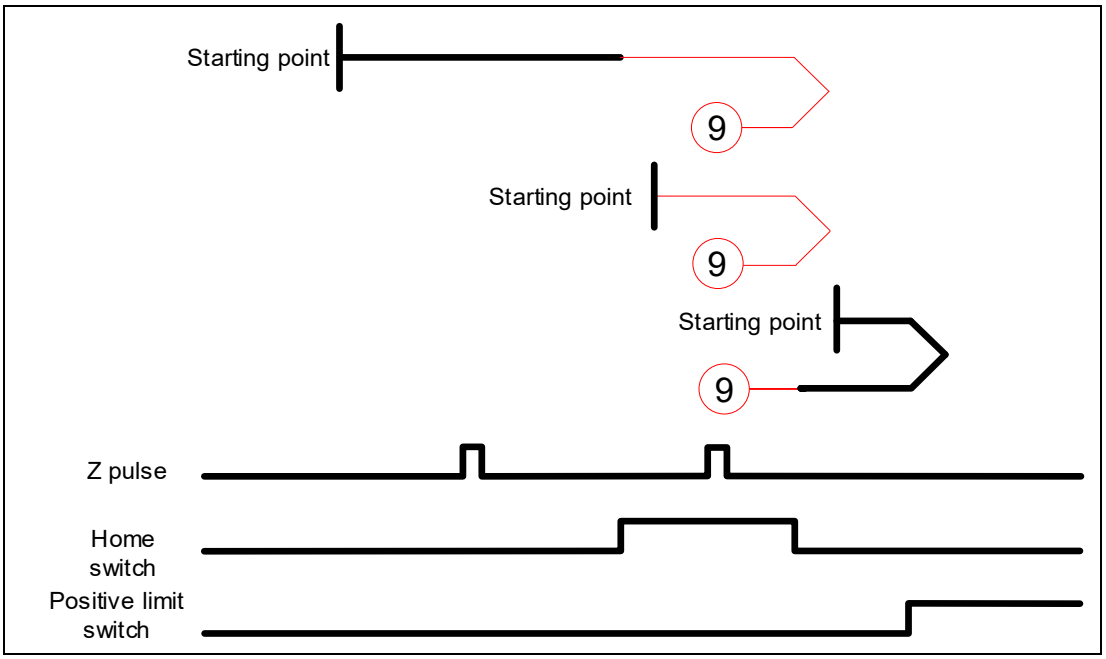
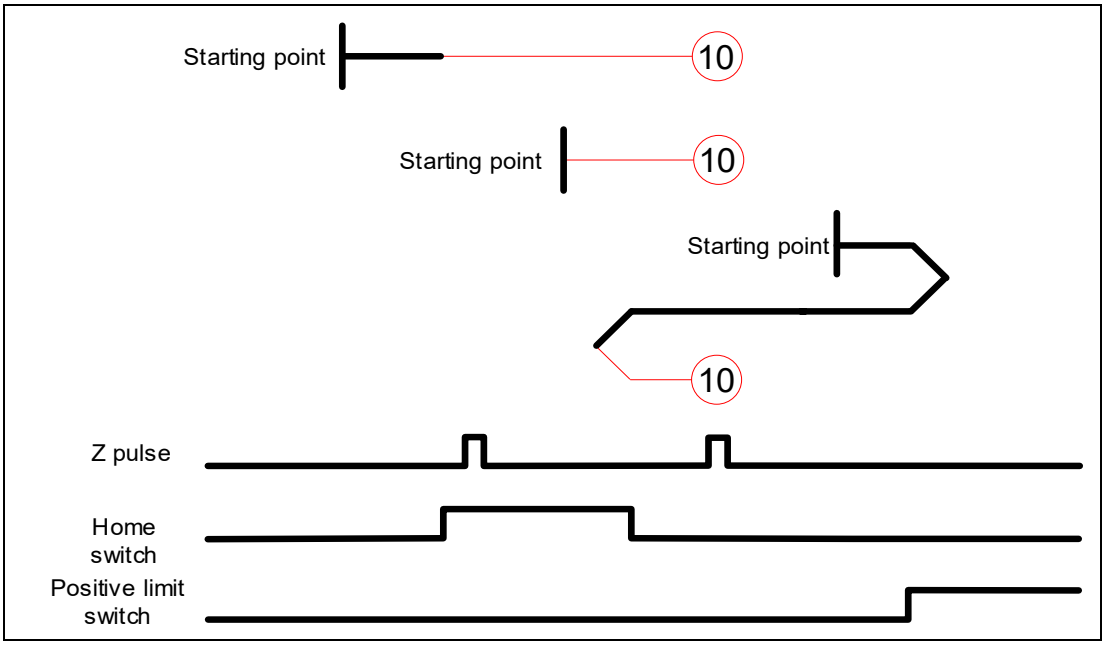
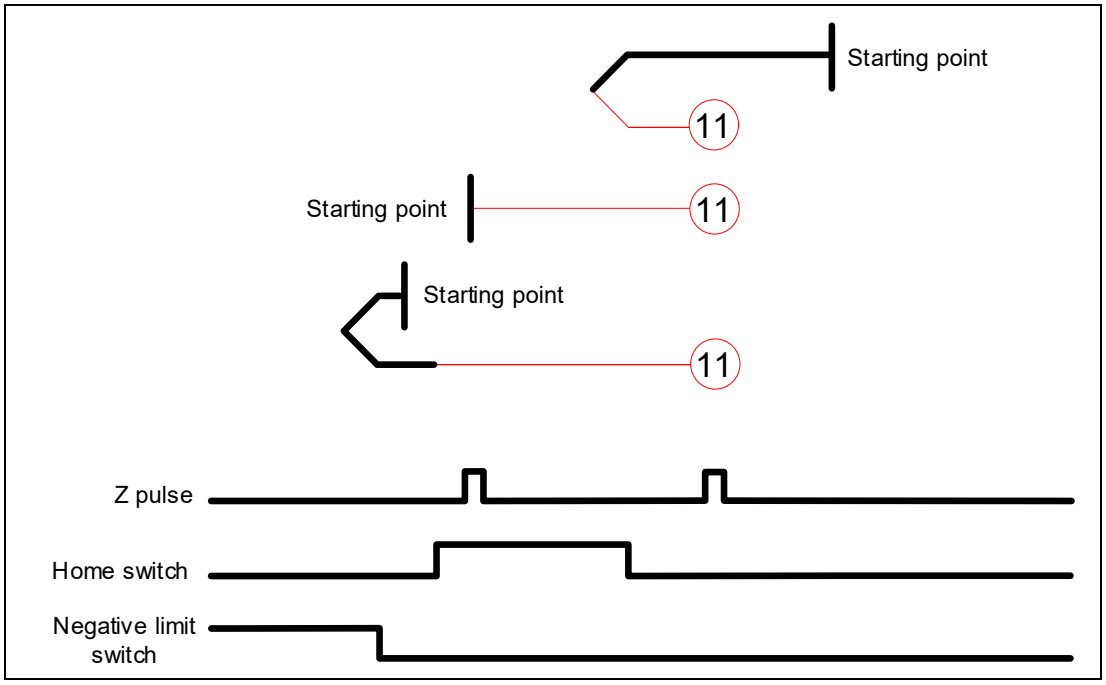
Method 9: homing on the positive limit switch, home switch, and Z pulse



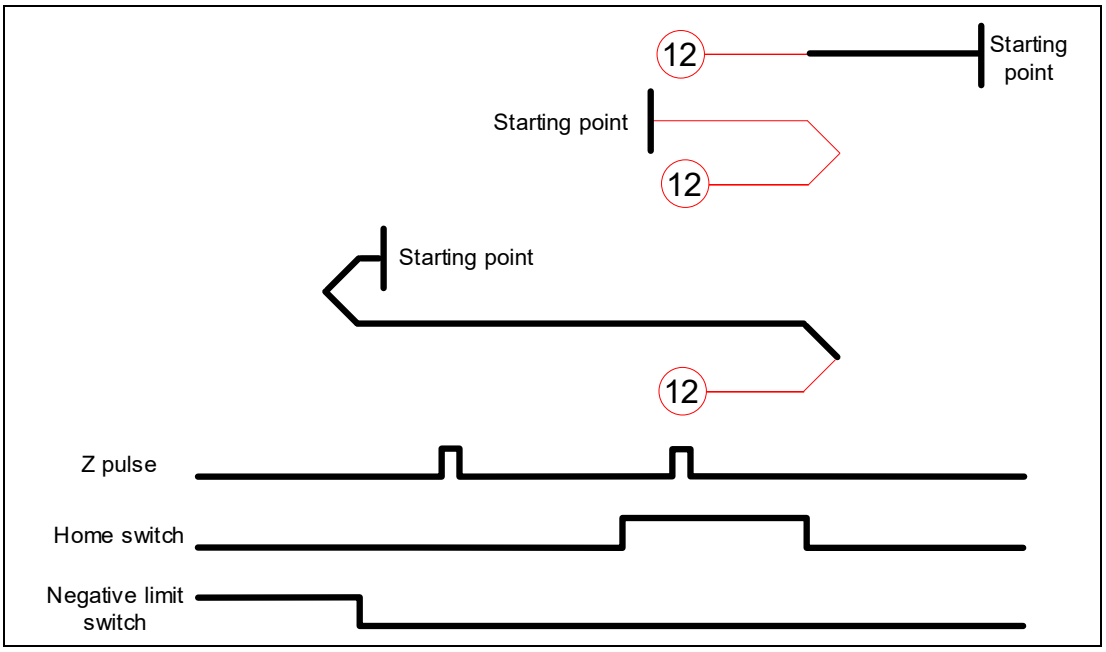
Method 10: homing on the positive limit switch, home switch, and Z pulse



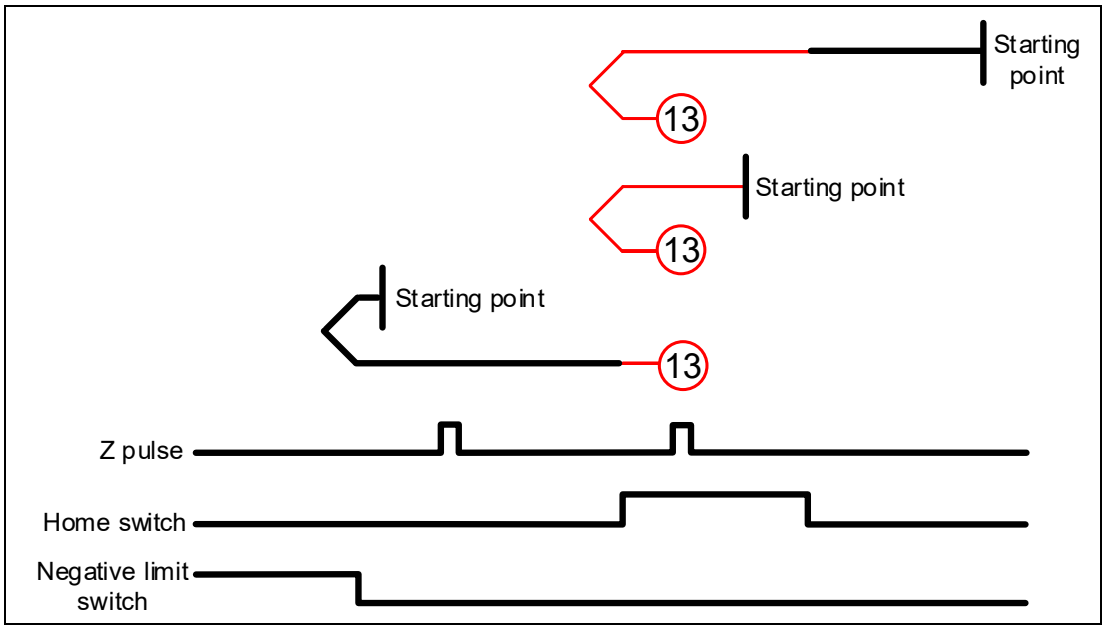
Method 11: homing on the negative limit switch, home switch, and Z pulse



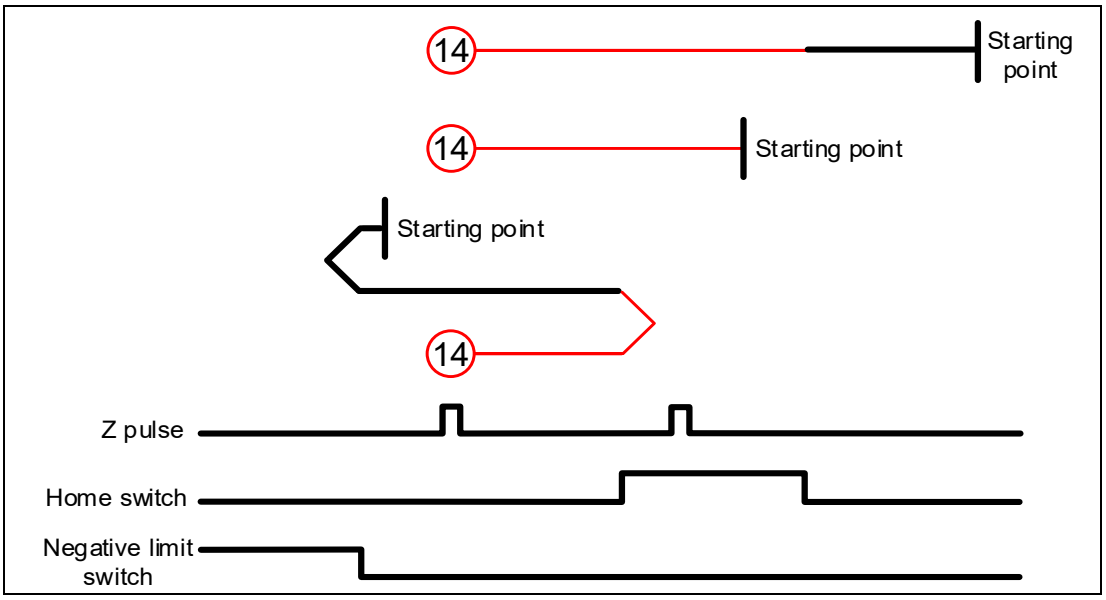
Method 12: homing on the negative limit switch, home switch, and Z pulse



Method 13: homing on the negative limit switch, home switch, and Z pulse

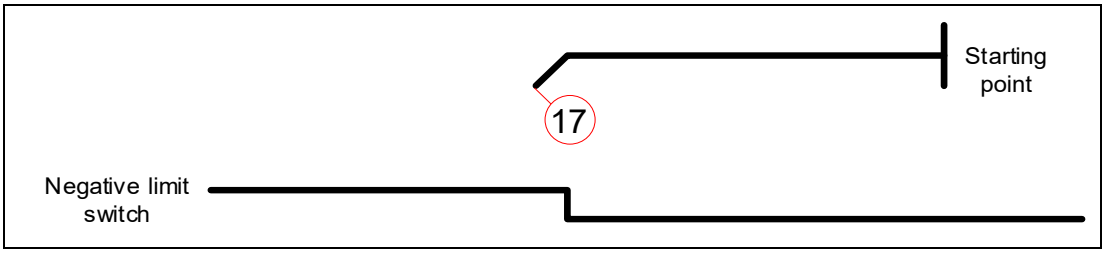


Method 14: homing on the negative limit switch, home switch, and Z pulse

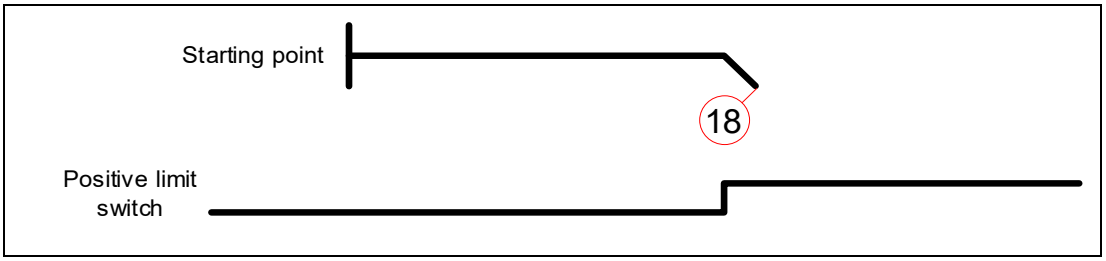


Methods 15 and 16: reserved

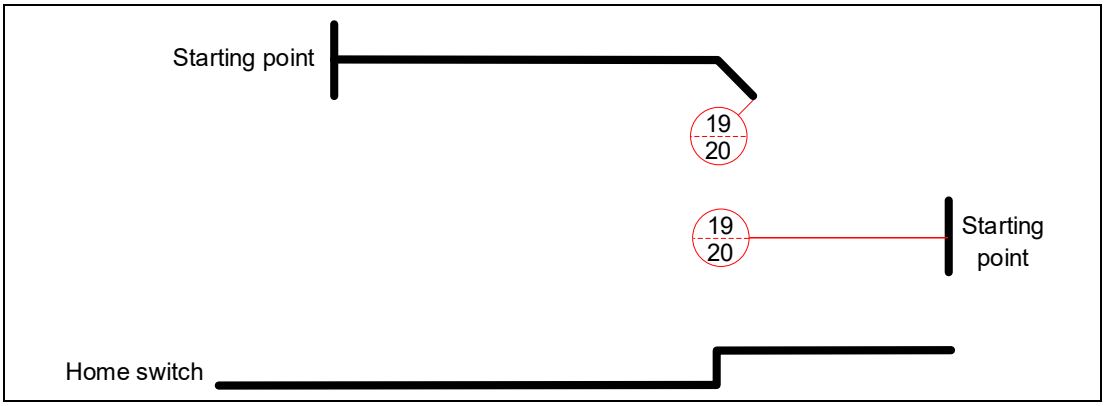
Method 17: homing on the negative limit switch



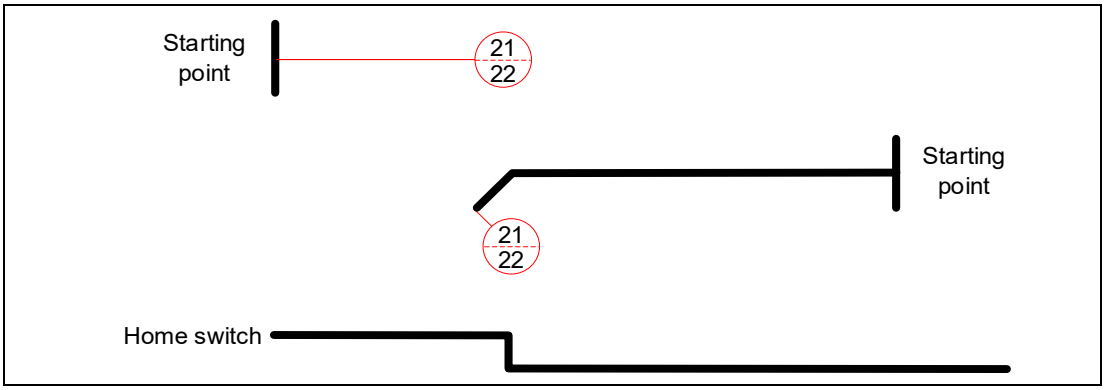
Method 18: homing on the positive limit switch



Methods 19 and 20: homing on the home switch



Methods 21 and 22: homing on the home switch



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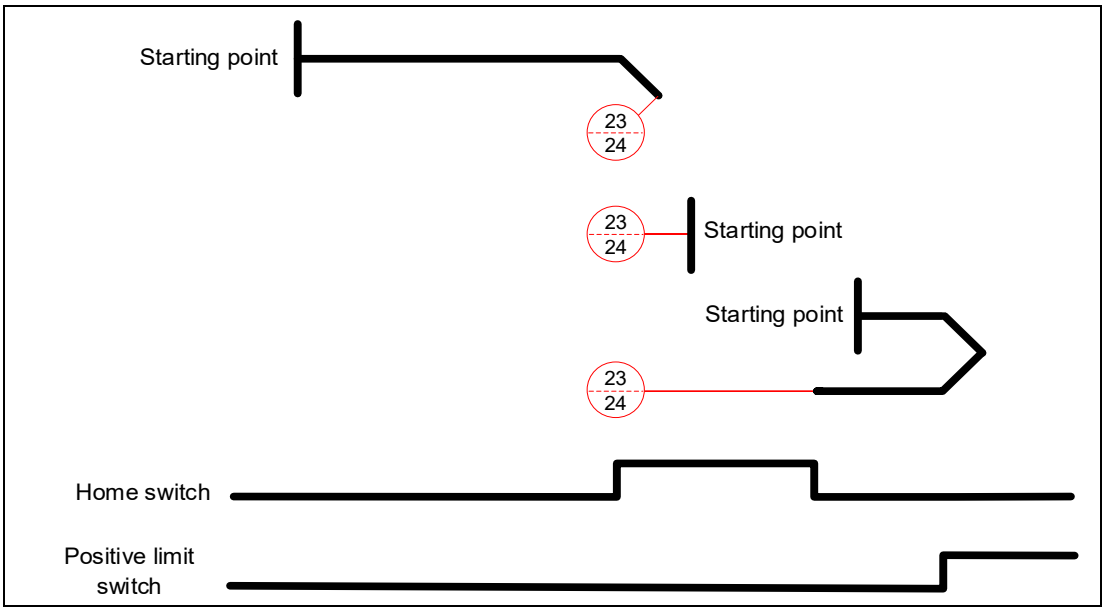
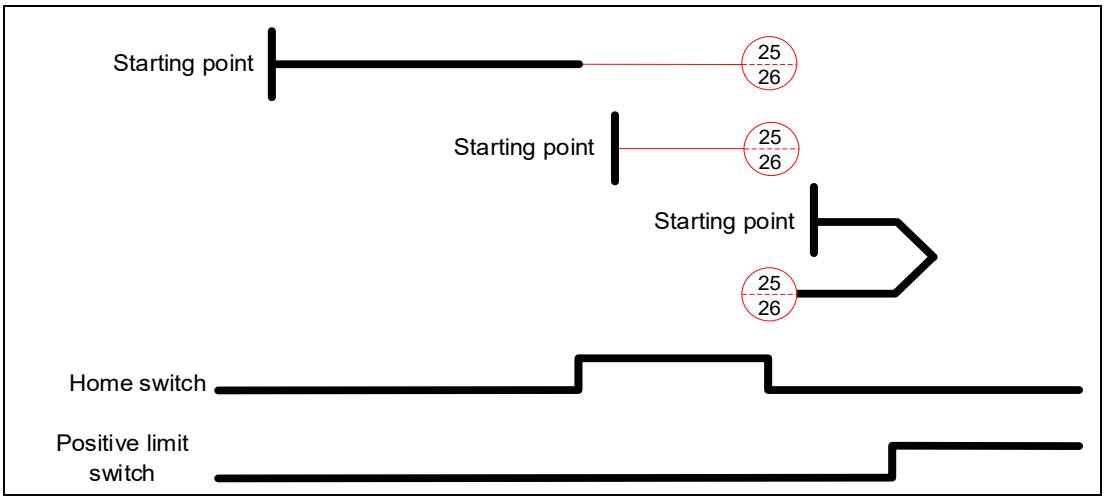
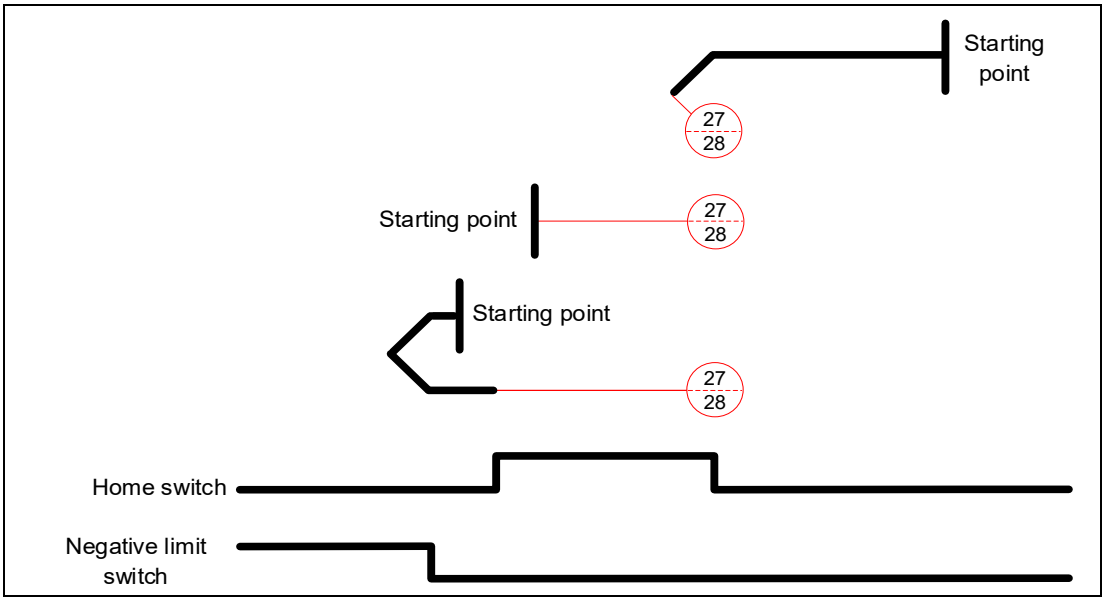
Methods 23 and 24: homing on the positive limit switch and home switch



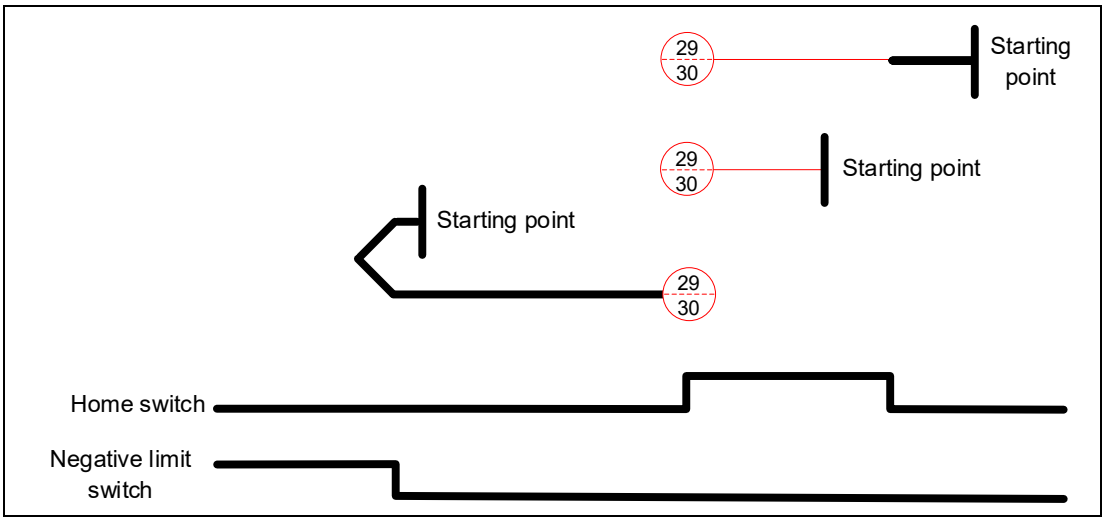
Methods 25 and 26: homing on the positive limit switch and home switch



Methods 27 and 28: homing on the negative limit switch and home switch

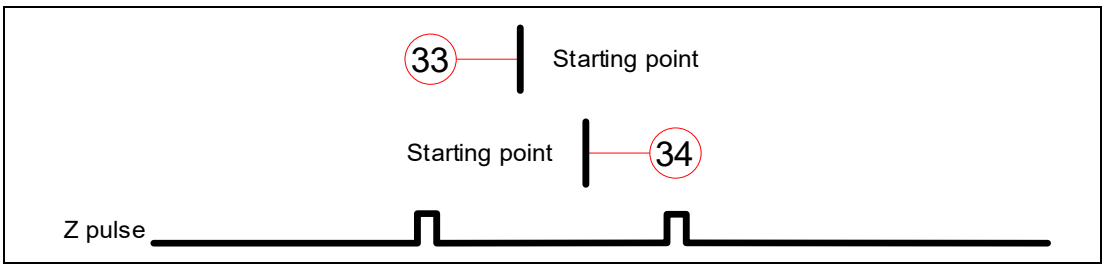


Methods 29 and 30: homing on the negative limit switch and home switch



Methods 31 and 32: reserved

Methods 33 and 34: homing on the Z pulse

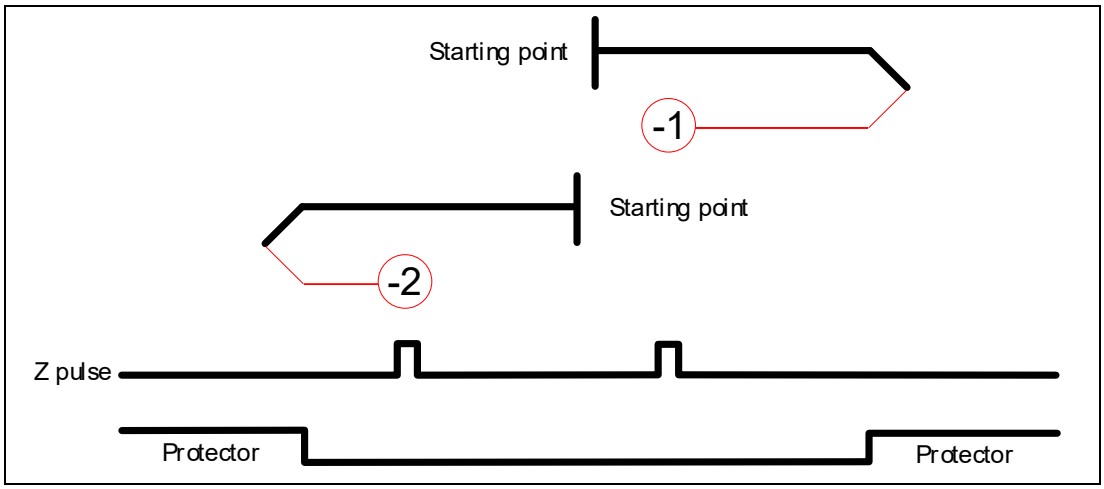


Method 35: defines the current position feedback as the origin

10

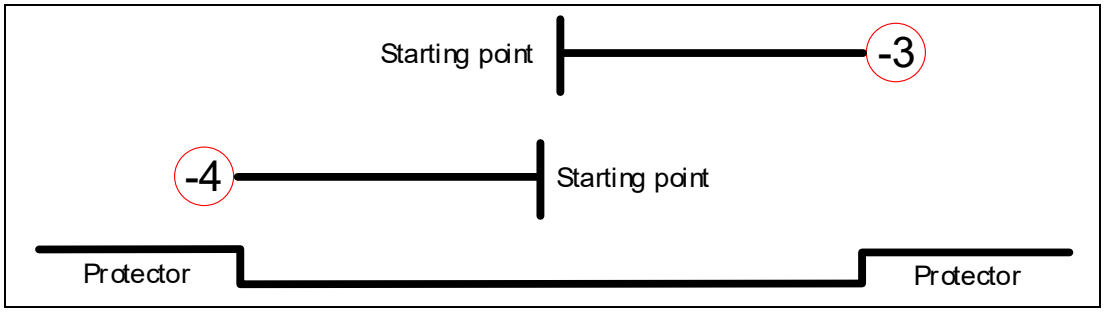
Methods 36 and 37:

When OD 6098h is set to -1 or -2: homing on the hard stop and Z pulse. Set the servo parameters P1.087 (torque level detection) and P1.088 (level reached timer) when using these homing methods.



Methods 38 and 39:

When OD 6098h is set to -3 or -4: homing on the hard stop. Set the servo parameters P1.087 (torque level detection) and P1.088 (level reached timer) when using these homing methods.



Object 6099h: Homing speeds

Index	6099h
Name	Homing speeds
Object code	ARRAY
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes

Sub-index	0h
Description	Number of sub-index
Data type	UNSIGNED8
Access	RO
PDO mapping	Yes
Setting range	2
Default	2

Sub-index	1h
Description	Speed during search for switch
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	1 - 20000
Default	100
Unit	0.1 rpm

Sub-index	2h
Description	Speed during search for zero
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	1 - 5000
Default	20
Unit	0.1 rpm

Object 609Ah: Homing acceleration

Index	609Ah
Name	Homing acceleration
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED32
Default	100
Unit	ms

Object function:

The time slope set by this object is the time required for the motor to accelerate from 0 rpm to 3,000 rpm and decelerate from 3,000 rpm to 0 rpm. This object works in Homing mode. For more details, refer to Section 10.3.4.

Object 60B0h: Position offset

Index	60B0h
Name	Position offset
Object code	VAR
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	PUU

Object function:

This object sets the position offset, and works in Cyclic Synchronous Position mode. For more details, refer to Section 10.3.5.

Object 60B1h: Velocity offset

Index	60B1h
Name	Velocity offset
Object code	VAR
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	0.1 rpm

Object function:

This object sets the velocity offset, and works in Cyclic Synchronous Velocity mode. For more details, refer to Section 10.3.6.

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Object 60B2h: Torque offset

Index	60B2h
Name	Torque offset
Object code	VAR
Data type	INTEGER16
Access	RW
PDO mapping	Yes
Setting range	-3500 to +3500
Default	0
Unit	0.1%

Object function:

This object sets the torque offset, and works in Cyclic Synchronous Torque mode. For more details, refer to Section 10.3.7.

Object 60B8h: Touch probe function

Index	60B8h
Name	Touch probe function
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED16
Default	0

Object function:

This object sets the functions related to Touch Probe. For the operation details, refer to Section 10.3.8.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function	Description
Bit 0	Touch Probe 1 switch	0: disable Touch Probe 1. 1: enable Touch Probe 1.
Bit 1	Touch Probe 1 number of capturing times	0: capture one time. If the Touch Probe 1 signal is set to be triggered at both rising and falling edges, the data is captured once for each triggering. 1: capture multiple times.
Bit 2	Touch Probe 1 capture source	0: DI1 of CN1 1: motor Z pulse
Bit 3	Reserved	-
Bit 4	Rising-edge trigger action of Touch Probe 1	0: N/A 1: start capturing when the Touch Probe 1 signal is rising-edge triggered and store the data in OD 60BAh.
Bit 5	Falling-edge trigger action of Touch Probe 1	0: N/A 1: start capturing when the Touch Probe 1 signal is falling-edge triggered and store the data in OD 60BBh.

Bit	Function	Description
Bit 6 - Bit 7	Reserved	-
Bit 8	Touch Probe 2 switch	0: disable Touch Probe 2. 1: enable Touch Probe 2.
Bit 9	Touch Probe 2 number of capturing times	0: capture one time. If the Touch Probe 2 signal is set to be triggered at both rising and falling edges, the data is captured once for each triggering. 1: capture multiple times.
Bit 10	Touch Probe 2 capture source	0: DI2 of CN1
Bit 11	Reserved	-
Bit 12	Rising-edge trigger action of Touch Probe 2	0: N/A 1: start capturing when the Touch Probe 2 signal is rising-edge triggered and store the data in OD 60BCh.
Bit 13	Falling-edge trigger action of Touch Probe 2	0: N/A 1: start capturing when the Touch Probe 2 signal is falling-edge triggered and store the data in OD 60BDh.
Bit 14 - Bit 15	Reserved	-

Object 60B9h: Touch probe status

Index	60B9h
Name	Touch probe status
Object code	VAR
Data type	UNSIGNED16
Access	RO
PDO mapping	Yes
Setting range	UNSIGNED16
Default	0

Object function:

You can access the Touch Probe status with this object. For the operation details, refer to Section 10.3.8.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function	Description
Bit 0	Touch Probe 1 function status	0: Touch Probe 1 disabled. 1: Touch Probe 1 enabled.
Bit 1	Touch Probe 1 rising-edge capture	0: capturing is not triggered. 1: the Touch Probe 1 signal is rising-edge triggered and the data is successfully captured.
Bit 2	Touch Probe 1 falling-edge capture	0: capturing is not triggered. 1: the Touch Probe 1 signal is falling-edge triggered and the data is successfully captured.
Bit 3 - Bit 5	Reserved	-
Bit 6	Touch Probe 1 capture source	0: DI1 of CN1 1: motor Z pulse

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Bit	Function	Description
Bit 7	Touch Probe 1 signal for capturing multiple times (Available when the function of OD 60B8h [Bit 1] Number of capturing times is enabled)	The status is reversed once the capturing succeeds. Refer to Section 10.3.8 for the timing diagram in Example 3.
Bit 8	Touch Probe 2 function status	0: Touch Probe 2 disabled. 1: Touch Probe 2 enabled.
Bit 9	Touch Probe 2 rising-edge capture	0: capturing is not triggered. 1: the Touch Probe 2 signal is rising-edge triggered and the data is successfully captured.
Bit 10	Touch Probe 2 falling-edge capture	0: capturing is not triggered. 1: the Touch Probe 2 signal is falling-edge triggered and the data is successfully captured.
Bit 11 - Bit 13	Reserved	-
Bit 14	Touch Probe 2 capture source	0: DI2 of CN1
Bit 15	Touch Probe 2 signal for capturing multiple times (Available when the function of OD 60B8h [Bit 9] Number of capturing times is enabled)	The status is reversed once the capturing succeeds.

Object 60BAh: Touch probe pos1 pos value

Index	60BAh
Name	Touch probe pos1 pos value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Default	0

Object function:

For the function of this object, refer to Section 10.3.8.

Object 60BBh: Touch probe pos1 neg value

Index	60BBh
Name	Touch probe pos1 neg value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Default	0

Object function:

For the function of this object, refer to Section 10.3.8.

Object 60BCh: Touch probe pos2 pos value

Index	60BCh
Name	Touch probe pos2 pos value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Default	0

Object function:

For the function of this object, refer to Section 10.3.8.

Object 60BDh: Touch probe pos2 neg value

Index	60BDh
Name	Touch probe pos2 neg value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Default	0

Object function:

For the function of this object, refer to Section 10.3.8.

Object 60C5h: Max acceleration

Index	60C5h
Name	Max acceleration
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	1 - 65500
Default	1
Unit	ms

Object function:

The time slope set by this object is the time required for the motor to accelerate from 0 rpm to 3,000 rpm.

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Object 60C6h: Max deceleration

Index	60C6h
Name	Max deceleration
Object code	VAR
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	1 - 65500
Default	1
Unit	ms

Object function:

The time slope set by this object is the time required for the motor to decelerate from 3,000 rpm to 0 rpm.

Object 60E0h: Positive torque limit

Index	60E0h
Name	Positive torque limit
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	Yes
Setting range	0 - 3000
Default	3000
Unit	0.1%

Object function:

This object sets the positive torque limit.

Object 60E1h: Negative torque limit

Index	60E1h
Name	Negative torque limit
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	Yes
Setting range	0 - 3000
Default	3000
Unit	0.1%

Object function:

This object sets the negative torque limit.

Object 60F4h: Following error actual value

Index	60F4h
Name	Following error actual value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	PUU

Object function:

The following error actual value is the difference between the position demand value (OD 6062h) and the position actual value (OD 6064h). For more details, refer to the architecture diagrams in Section 10.3.

Object 60FCh: Position demand value

Index	60FCh
Name	Position demand value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	pulse (unit for encoder pulse resolution)

Object function:

This command is generated after being processed by the servo drive filter. For more details, refer to the architecture diagrams in Section 10.3.

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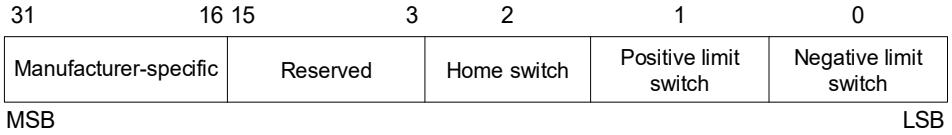
Object 60FDh: Digital inputs

Index	60FDh
Name	Digital inputs
Object code	VAR
Data type	UNSIGNED32
Access	RO
PDO mapping	Yes
Setting range	UNSIGNED32
Default	0
Unit	-

Object function:



Bit	Function
Bit 0	Negative limit signal
Bit 1	Positive limit signal
Bit 2	Homing signal
Bit 3 - Bit 15	Reserved
Bit 16	DI1
Bit 17	DI2
Bit 18	DI3
Bit 19	DI4
Bit 20	DI5
Bit 21	DI6
Bit 22 - Bit 31	Reserved

Object 60FEh: Digital outputs

Index	60FEh
Name	Digital outputs
Object code	ARRAY
Data type	UNSIGNED32
Access	RW

Sub-Index	0h
Description	Number of sub-index
Data type	UNSIGNED8
Access	RO
PDO mapping	Yes
Setting range	2
Default	2

Sub-Index	1h
Description	Physical outputs
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	0x00000000 to 0xFFFFFFFF
Default	0

Sub-Index	2h
Description	Bit mask
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	0x00000000 to 0xFFFFFFFF
Default	0

Object function:

OD 60FEh sub1 (Physical outputs)

Bit	DO	Description
Bit 0 - Bit 15	-	Reserved
Bit 16	DO1	0: Off; 1: On
Bit 17	DO2	0: Off; 1: On
Bit 18	DO3	0: Off; 1: On
Bit 19 - Bit 31	-	Reserved

OD 60FEh sub2 (Bit mask)

Bit	DO	Description
Bit 0 - Bit 15	-	Reserved
Bit 16	DO1	0: disable physical outputs; 1: enable
Bit 17	DO2	0: disable physical outputs; 1: enable
Bit 18	DO3	0: disable physical outputs; 1: enable
Bit 19 - 31	-	Reserved

- To use the software to control the DO output, you must first set the corresponding DO function code.
  When P2.018 = 0x0130, the output of DO1 is controlled by the software.
  When P2.019 = 0x0131, the output of DO2 is controlled by the software.
  When P2.020 = 0x0132, the output of DO3 is controlled by the software.

- DO output settings
  When the corresponding OD 60FEh sub2 bit of the DO is set to 1, the output status of this DO is determined by the corresponding bit of OD 60FEh sub1.
  When the corresponding OD 60FEh sub2 bit of the DO is set to 0, the output status of this DO is determined by P4.006.

- Example
  1. Set P2.018 to 0x0130, which means the output of DO1 is controlled by the software.
  2. When OD 60FEh sub2 [Bit 16] is 1, the output of DO1 is determined by OD 60FEh sub1 [Bit 16].
     When OD 60FEh sub2 [Bit 16] is 0, the output of DO1 is determined by P4.006 [Bit 0].

Object 60FFh: Target velocity

Index	60FFh
Name	Target velocity
Object code	VAR
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	0.1 rpm

Object function:

This object sets the target velocity. This object works in Profile Velocity mode and Cyclic Synchronous Velocity mode. For more details, refer to Sections 10.3.2 and 10.3.6.

Object 6502h: Supported drive modes

Index	6502h
Name	Supported drive modes
Object code	VAR
Data type	UNSIGNED32
Access	RO
PDO mapping	Yes
Setting range	UNSIGNED32
Default	03ADh

Object function:

This object is read-only and provides the operation modes supported by Delta servo drives in EtherCAT mode.

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function
Bit 0	Profile Position mode
Bit 1	Reserved
Bit 2	Profile Velocity mode
Bit 3	Profile Torque mode
Bit 4	Reserved
Bit 5	Homing mode
Bit 6	Reserved
Bit 7	Cyclic Synchronous Position mode
Bit 8	Cyclic Synchronous Velocity mode
Bit 9	Cyclic Synchronous Torque mode
Bit 10 - Bit 31	Reserved

10.5 Diagnostics and troubleshooting

This section provides diagnostics and troubleshooting information related to interference elimination. For information about the servo drive alarms, refer to Chapter 11 Troubleshooting.

- Eliminate interference

  Packets are particularly sensitive to interference in high-speed network communication applications. To achieve fast and high-precision control, the selection of the wire is extremely important. Use shielded cables for the communication wiring, and make sure that the shielded connector is firmly connected to the servo drive communication port. Also, ensure the ground wire is properly connected and grounded.

10.5.1 EtherCAT Diagnosis

To use the EtherCAT automatic error diagnostic function, go to **EtherCAT Diagnosis** in ASDA-Soft and click **Diagnosis** to get the following EtherCAT connection information for error detection.

1. Check if the servo parameter P1.001.YX is set to 0C for communication mode.
2. Port hardware detection (check if Port0 or Port1 is connected).
3. Time synchronization status (Cycle time and DC time).
4. Physical address (Config ID) and logical address (P3.000) information.
5. Check the content of PDO mapping to determine if the configuration is correct.
6. SM0 - SM3: the channels used by the SDO & PDO and the channel length information.
7. FMMU0 - FMMU3 configuration information.
8. EtherCAT State Machine display (Init ➔ Pre-OP ➔ Safe-OP ➔ OP).
9. Status display for EtherCAT communication initialization application layer (Application Layer Error Code).
10. EtherCAT communication error rate display.
11. Controlword (OD 6040h) and Statusword (OD 6041h) display.
12. EtherCAT operation mode status display (OD 6060h, 6061h, 6071h, 6072h, 6080h, 60FFh, 60E0h, 60E1h, and 607Ah)

Note: refer to the latest version of ASDA-Soft for the updated functions of **EtherCAT Diagnosis**.

10.5.2 Alarm list

Display	Alarm name	16-bit error code
AL001	Overcurrent	2310h
AL002	Overvoltage	3110h
AL003	Undervoltage	3120h
AL004	Motor combination error	7122h
AL005	Regeneration error	3210h
AL006	Overload	3230h
AL007	Excessive deviation of Speed command	8400h
AL009	Excessive deviation of Position command	8611h
AL010	Voltage error during regeneration	3210h
AL011	CN2 communication failed	7305h
AL013	Emergency stop	5441h
AL014	Negative limit error	5443h
AL015	Positive limit error	5442h
AL016	Abnormal IGBT temperature	4210h
AL017	EEPROM error	5330h
AL020	USB communication timeout	7520h
AL022	Main power error	3130h
AL023	Early overload warning	3231h
AL024	Encoder initial magnetic field error	7305h
AL025	Encoder internal error	7305h
AL026	Encoder unreliable internal data	7305h
AL027	Encoder internal reset error	7305h
AL028	Battery voltage error or encoder internal error	7305h
AL029	Gray code error	7305h
AL02A	Number of revolutions of the encoder is in error	7305h
AL02B	Motor data error	7305h
AL02C	Servo drive overload	3230h
AL02F	Blocked rotor protection	002Fh
AL030	Motor collision error	7121h
AL031	Motor power cable wiring error	3300h
AL032	Abnormal encoder vibration	7305h
AL033	Motor is in error	7305h
AL034	Encoder internal communication error	7305h
AL035	Encoder temperature exceeds the protective range	7305h
AL036	Encoder alarm status error	7305h
AL044	Servo function operational warning	6100h
AL045	E-Gear ratio value error	6320h
AL053	Motor parameter error	0000h

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Display	Alarm name	16-bit error code
AL056	Excessive motor speed	0000h
AL05C	Motor position feedback error	0000h
AL060	Absolute position is lost	7305h
AL061	Encoder undervoltage	7305h
AL062	Number of revolutions of the absolute encoder overflows (issued by encoder)	7305h
AL064	Encoder vibration warning	7305h
AL066	Number of revolutions of the absolute encoder overflows (issued by servo drive)	7305h
AL067	Encoder temperature warning	7305h
AL068	Absolute data transmitted by I/O is in error	7305h
AL069	Wrong motor type	0000h
AL06A	Absolute position is lost	7305h
AL06B	The error between the servo drive internal position and the encoder position is too large	7305h
AL06E	Encoder type is unidentifiable	7305h
AL06F	The absolute position is not established	7305h
AL070	Encoder did not complete the read / write procedure	7305h
AL071	Number of revolutions of the encoder is in error	7305h
AL072	Encoder overspeed	7305h
AL073	Encoder memory error	7305h
AL074	Encoder single-turn absolute position is in error	7305h
AL075	Encoder absolute number of revolutions is in error	7305h
AL077	Encoder internal error	7305h
AL079	Encoder parameter setting incomplete	7305h
AL07A	Encoder Z phase position is lost	7305h
AL07B	Encoder memory is busy	7305h
AL07C	Command to clear the absolute position is issued when the motor speed is over 200 rpm	7305h
AL07D	Motor stops operating when servo drive power is cycled before AL07C is cleared	7305h
AL07E	Error occurs when the encoder clears the procedure	7305h
AL07F	Encoder version error	7305h
AL083	Servo drive outputs excessive current	2310h
AL085	Regeneration setting error	3210h
AL086	Regenerative resistor overload	3110h
AL088	Servo function operational alarm	0000h
AL089	Current detection interference	6100h
AL08A	Auto tuning function - command error	7305h
AL08B	Auto tuning function - dwell time is too short	7305h
AL08C	Auto tuning function - inertia estimation error	7305h
AL095	Regenerative resistor is disconnected or regenerative circuit is in error	0000h

Display	Alarm name	16-bit error code
AL099	DSP firmware error	5500h
AL09C	Parameter reset failed	5500h
AL0A6	Absolute positions of the servo drive and motor do not match	7305h
AL111	Buffer overflow occurs when SDO is received	8110h
AL112	Buffer overflow occurs when PDO is received	8110h
AL113	TxPDO transmission failed	8110h
AL121	Object's index does not exist when PDO is accessed	8200h
AL122	Object's sub-index does not exist when PDO is accessed	8200h
AL123	Data length error occurs when PDO is accessed	8200h
AL124	Data range error occurs when PDO is accessed	8200h
AL125	PDO object is read-only and write-protected	8200h
AL126	Specified object does not support PDO mapping	8200h
AL127	PDO object is write-protected when servo drive is on	8200h
AL128	Error occurs when PDO object is read from EEPROM	8200h
AL129	Error occurs when PDO object is written to EEPROM	8200h
AL130	Accessing address of EEPROM is out of range	8200h
AL131	EEPROM CRC calculation error	8200h
AL132	Parameter is write-protected	8200h
AL170	Bus communication timeout	8130h
AL180	Bus communication timeout	8130h
AL185	Bus hardware error	8120h
AL186	Bus data transmission error	8100h
AL201	Initialization error of object dictionary data	6310h
AL207	Parameter group of the data source for Type [8] PR is out of range	0207h
AL209	Parameter number of the data source for Type [8] PR is out of range	0209h
AL211	Parameter format setting of Type [8] PR is in error	0211h
AL213	Parameter setting of Type [8] PR is in error	0213h
AL215	Parameter written by Type [8] PR is read-only	0215h
AL217	Parameter written by Type [8] PR is write-protected when Servo On	0217h
AL219	Parameter written by Type [8] PR is write-protected	0219h
AL231	Monitoring variable code specified by Type [8] PR is out of range	0231h
AL235	Position counter overflow warning	0235h
AL237	Rotary axis position is undefined	0237h
AL245	PR positioning timeout	0245h
AL249	PR path number is out of range	0249h
AL283	Software positive limit	5444h
AL285	Software negative limit	5445h
AL289	Position counter overflows	7305h
AL305	SYNC period error	6200h

Display	Alarm name	16-bit error code
AL35F	Emergency stop during deceleration	6200h
AL380	Position offset alarm for DO.MC_OK	6200h
AL3CF	Emergency stop	6200h
AL3E2	Communication synchronization signal is sent too soon	6200h
AL3E3	Communication synchronization signal timeout	6200h
AL3F1	Absolute position command of the communication type servo drive is in error	6200h
AL400	Rotary axis position setting error	FF05h
AL401	NMT reset command is received when servo is on	0000h
AL404	PR special filter setting value is too great	FF07h
AL422	Write-in failed caused by power supply cut-off	0000h
AL500	STO function is activated	9000h
AL501	SF1 lost (signal loss or signal error)	9000h
AL502	SF2 lost (signal loss or signal error)	9000h
AL503	STO self-diagnostic error	9000h
AL510	Internal parameter update program of the servo drive is abnormal	0000h
AL520	Calculation program timeout	6100h
AL521	Vibration elimination parameter error	6100h
AL555	System failure	-
AL809	PR motion setting error or command decoding error	0000h
ALC31	Motor power cable disconnection	3300h
ALCDB	Servo drive model type error	0000h

11 Troubleshooting

This chapter provides alarm descriptions and the corrective actions you can take for troubleshooting.

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The alarms are categorized into the following types:

General type: alarms caused by hardware or encoder signal errors.

STO type: alarms caused by improper use of STO functions.

Motion control type: alarms caused by motion control command (in PR mode) errors.

Communication type: alarms caused by EtherCAT communication errors.

AL.nnn is the alarm format on the 7-segment display, as shown in the following figure.

If the recommended alarm clearing method is DI.ARST, set DI.ARST (alarm reset) to On or P0.001 to 0x0000 for clearing the alarm.

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 control error of Speed command	○			○
AL009	Excessive control error of Position command	○			○
AL010	Voltage error during regeneration	○			○
AL011	CN2 communication failed	○			○
AL013	Emergency stop		○		○
AL014	Negative limit error		○	○	
AL015	Positive limit error		○	○	
AL016	Abnormal IGBT temperature	○			○
AL017	EEPROM error	○			○
AL020	USB communication timeout		○	○	
AL022	Main power error		○		○
AL023	Overload prewarning		○	○	
AL024	Encoder initial magnetic field error	○			○
AL025	Encoder internal error	○			○
AL026	Encoder unreliable internal data	○			○
AL027	Encoder internal reset error	○			○
AL028	Battery voltage error or encoder internal error	○			○
AL029	Gray code error	○			○
AL02A	Number of revolutions of the encoder is in error	○			○
AL02B	Motor data error	○			○
AL02C	Servo drive overload	○			○
AL02F	Blocked rotor protection	○			○
AL030	Motor collision error	○			○
AL031	Motor power cable wiring error	○			○
AL032	Abnormal encoder vibration	○			○
AL033	Motor is in error	○			○
AL034	Encoder internal communication error	○			○
AL035	Encoder temperature exceeds the protection limit	○			○
AL036	Encoder alarm status error	○			○
AL044	Servo function operational warning		○	○	
AL045	E-Gear ratio value error	○			○
AL053	Motor parameter error	○			○
AL056	Excessive motor speed	○			○
AL05C	Motor position feedback error	○			○

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Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL060	Absolute position is lost		○	○	
AL061	Encoder undervoltage		○	○	
AL062	Number of revolutions of the absolute encoder overflows (issued by encoder)		○	○	
AL064	Encoder vibration warning		○	○	
AL066	Number of revolutions of the absolute encoder overflows (issued by servo drive)		○	○	
AL067	Encoder temperature warning		○	○	
AL068	Absolute data transmitted by I/O is in error		○	○	
AL069	Wrong motor type	○			○
AL06A	Absolute position is lost		○	○	
AL06B	The error between the servo drive internal position and the encoder position is too large		○	○	
AL06E	Encoder type is unidentifiable	○			○
AL06F	The absolute position is not established		○	○	
AL070	Encoder did not complete the read / write procedure		○	○	
AL071	Number of revolutions of the encoder is in error	○			○
AL072	Encoder overspeed	○			○
AL073	Encoder memory error	○			○
AL074	Encoder single-turn absolute position is in error	○			○
AL075	Encoder absolute number of revolutions is in error	○			○
AL077	Encoder internal error	○			○
AL079	Encoder parameter setting incomplete	○			○
AL07A	Encoder Z phase position is lost	○			○
AL07B	Encoder memory is busy	○			○
AL07C	Command to clear the absolute position is issued when the motor speed is over 200 rpm		○	○	
AL07D	Motor stops operating when servo drive power is cycled before AL07C is cleared	○			○
AL07E	Error occurs when the encoder clears the procedure	○			○
AL07F	Encoder version error	○			○
AL083	Servo drive outputs excessive current	○			○
AL085	Regeneration setting error	○			○
AL086	Regenerative resistor overload	○			○
AL088	Servo function operational alarm	○			○
AL089	Current detection interference		○	○	
AL08A	Auto tuning function - command error		○	○	
AL08B	Auto tuning function - dwell time is too short		○	○	
AL08C	Auto tuning function - inertia estimation error		○	○	
AL095	Regenerative resistor is disconnected or regenerative circuit is in error		○	○	
AL099	DSP firmware error	○			○
AL09C	Parameter reset failed	○			○
AL0A6	Absolute positions of the servo drive and motor do not match		○	○	
AL35F	Quick stop during deceleration		○	○	

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL3CF	Quick stop		○		○
AL422	Write-in failed caused by power supply cut-off	○			○
AL521	Vibration elimination parameter error	○			○
ALC31	Motor power cable disconnection	○			○
ALCDB	Servo drive model type error	○			○

Note: if the servo drive shows an alarm that is not in this table, contact the local distributor or technician.

STO type

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL500	STO function is activated	○			○
AL501	SF1 lost (signal loss or signal error)	○			○
AL502	SF2 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, contact the local distributor or technician.

Motion control type

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL207	Parameter group of the data source for Type [8] PR is out of range		○	○	
AL209	Parameter number of the data source for Type [8] PR is out of range		○	○	
AL211	Parameter format setting of Type [8] PR is in error		○	○	
AL213	Parameter setting of Type [8] PR is in error		○	○	
AL215	Parameter written with Type [8] PR is read-only		○	○	
AL217	Parameter written with Type [8] PR is write-protected when Servo On		○	○	
AL219	Parameter written with Type [8] PR is write-protected		○	○	
AL231	Monitoring variable code specified with Type [8] PR is out of range		○	○	
AL235	Position counter overflow warning		○	○	
AL237	Rotary axis position is undefined		○	○	
AL245	PR positioning timeout	○			○
AL249	PR path number is out of range	○			○
AL283	Software positive limit		○	○	
AL285	Software negative limit		○	○	
AL289	Position counter overflows		○	○	
AL380	Position offset alarm for DO.MC_OK		○	○	
AL3F1	Absolute position command of the communication type servo drive is in error	○			○
AL400	Rotary axis position setting error	○			○
AL404	PR special filter setting value is too great	○			○
AL510	Internal parameter update program of the servo drive is abnormal		○	○	
AL520	Calculation program timeout	○			○

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL555	System failure	○			○
AL809	PR motion setting error or command decoding error	○			○

Note: if the servo drive shows an alarm that is not in this table, contact the local distributor or technician.

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Communication type

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL111	Buffer overflow occurs when SDO is received	○		○	
AL112	Buffer overflow occurs when PDO is received	○		○	
AL113	TxPDO transmission failed	○		○	
AL121	Object's index does not exist when PDO is accessed	○		○	
AL122	Object's sub-index does not exist when PDO is accessed	○		○	
AL123	Data length error occurs when PDO is accessed	○		○	
AL124	Data range error occurs when PDO is accessed	○		○	
AL125	PDO object is read-only and write-protected	○		○	
AL126	Specified object does not support PDO mapping	○		○	
AL127	PDO object is write-protected when servo drive is on	○		○	
AL128	Error occurs when PDO object is read from EEPROM	○		○	
AL129	Error occurs when PDO object is written to EEPROM	○		○	
AL130	Accessing address of EEPROM is out of range	○		○	
AL131	EEPROM CRC calculation error	○		○	
AL132	Parameter is write-protected	○		○	
AL170	Bus communication timeout	○		○	
AL180	Bus communication timeout	○			○
AL185	Bus hardware error	○			○
AL186	Bus data transmission error	○		○	
AL201	Initialization error of object dictionary data	○			○
AL305	SYNC period error		○	○	
AL3E2	Communication synchronization signal is sent too soon	○			○
AL3E3	Communication synchronization signal timeout	○			○
AL401	NMT reset command is received when servo is on	○			○

Note: if the servo drive shows an alarm that is not in this table, contact the local distributor or technician.

11.2 Causes and corrective actions

AL001 Overcurrent	
Trigger condition and cause	Condition: main circuit current is greater than 1.5 times the maximum instantaneous current of the servo drive. Cause: 1. The servo drive output is short-circuited. 2. Motor wiring is in error. 3. IGBT error.
Checking method and corrective action	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 conductor. Check that you have followed the wiring sequence described in this manual for connecting the motor to the servo drive. 2. If the temperature of the heat sink is abnormal, send your servo drive back to the distributor or contact Delta. Check if the set value of the parameter is much greater than the default. It is recommended that you reset the parameter to the factory default setting and then modify the setting gradually.
How to clear the alarm?	Cycle power on the servo drive.

AL002 Overvoltage	
Trigger condition and cause	Condition: main circuit voltage exceeds the rated value. Cause: 1. The input voltage to the main circuit is higher than the allowable rated value. 2. Incorrect power input (incorrect power system). 3. Malfunction of the servo drive hardware. 4. Incorrect selection of or no connection to an external regenerative resistor.
Checking method and corrective action	1. Use a voltmeter to check if the input voltage to the main circuit is within the allowable rated value (refer to Appendix A Specifications) and if the power system complies with the specifications. Use the correct power supply or install a transformer or regulator to keep the voltage within the range. 2. If the alarm occurs when the input voltage to the main circuit measured by the voltmeter is within the allowable rated value, send your servo drive back to the distributor or contact Delta. 3. Check the connection for the regenerative resistor and re-calculate the resistance value. Correctly set the values of P1.052 and P1.053.
How to clear the alarm?	DI.ARST

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AL003 Undervoltage	
Trigger condition and cause	Condition: 1. Main circuit voltage is below the rated value. The error type of AL003 is a warning (WARN) by default. To set AL003 as an alarm (ALM), you can set P2.066 [Bit 9] to 1. 2. DC Bus voltage is below P4.024 × $\sqrt{2}$. Cause: 1. The input voltage to the main circuit is lower than the allowable rated value. 2. No voltage input to the main circuit. 3. Incorrect power input (incorrect power system).
Checking method and corrective action	1. Check if the wiring of the power supply is correct and the input voltage to the main circuit is normal. 2. Check the switch of the power supply and use a voltmeter to check the main circuit voltage. 3. Use a voltmeter to check if the power system complies with the specifications. If not, use the correct power supply or install a transformer.
How to clear the alarm?	Clear AL003 according to the setting of P2.066 [Bit 2]: 1. If P2.066 [Bit 2] = 0, set DI.ARST = On to clear the alarm after the voltage is back in the normal range. 2. If P2.066 [Bit 2] = 1, the alarm is automatically cleared after the voltage is back in the normal range.

AL004 Motor combination error	
Trigger condition and cause	Condition: an incorrect motor is used with the servo drive. Cause: 1. Motor combination error (the wrong motor is connected to the servo drive). 2. The encoder connector is loose. 3. The encoder is damaged.
Checking method and corrective action	1. Use the right motor. 2. Check and re-install the encoder connector. 3. If the encoder is not operating properly, replace the motor.
How to clear the alarm?	Cycle power on the servo drive.

AL005 Regeneration error	
Trigger condition and cause	Condition: an error occurs during regeneration. Cause: 1. Incorrect selection of or no connection to an external regenerative resistor. 2. P1.053 (Regenerative resistor capacity) is not set to 0 when a regenerative resistor is not connected. 3. Incorrect parameter settings for P1.052 and P1.053.
Checking method and corrective action	1. Check the connection for the regenerative resistor and re-calculate the resistance value. Correctly set the values of P1.052 and P1.053. If the issue persists, send your servo drive back to Delta. 2. Set P1.053 to 0 if not using a regenerative resistor. 3. Correctly set the regenerative resistor value (P1.052) and the regenerative resistor capacity (P1.053).
How to clear the alarm?	After the alarm occurs, wait until the time set in P2.123 has elapsed and then reset the alarm.

AL006 Overload	
Trigger condition and cause	Condition: overload of motor and servo drive. Cause: 1. The load is over the rated range and the servo drive is in a continuous overload condition. 2. Improper settings for the parameters of the control system. 3. Motor wiring is in error. 4. Encoder is in error.
Checking method and corrective action	1. Set P0.002 = 12 to monitor if the average load rate [%] is continuously over 100%. If so, increase the motor capacity or reduce the load. Refer to Appendix A for Graph of load ratio and operating time. 2. Check if there is any mechanical vibration or the setting for acceleration or deceleration is too drastic. 3. Check if the wiring of the motor power cable and the encoder cable is correct. 4. Send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	After the alarm occurs, wait until the time set in P2.123 has elapsed and then reset the alarm.

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AL007 Excessive control error of Speed command	
Trigger condition and cause	Condition: difference between the Speed command and the speed feedback exceeds the allowable range set by P2.034. Cause: 1. A drastic change in the Speed command input. 2. Improper setting of P2.034 (Excessive deviation warning condition of Speed command). 3. Incorrect wiring of the motor power cable and the encoder cable.
Checking method and corrective action	1. Check if there is a drastic change in the Speed command input. 2. Check if the value of P2.034 is set properly. 3. Check if the wiring of the motor power cable and the encoder cable is correct.
How to clear the alarm?	DI.ARST

AL009 Excessive control error of Position command	
Trigger condition and cause	Condition: difference between the Position command and the position feedback exceeds the allowable range set by P2.035. Cause: 1. P2.035 (Excessive deviation of Position command warning) is set too low. 2. Gain value is set too low. 3. Torque limit or speed limit is set too low. 4. Excessive external load. 5. Improper setting for the E-Gear ratio. 6. The power cable is loose. 7. The maximum speed limit is set too low.
Checking method and corrective action	1. If the set value of P2.035 is too low, set a higher value. 2. Check if the gain value is appropriate for the application. 3. When the speed and torque limit functions are not needed, disable P1.002; otherwise, check if the internal speed limit (P1.009 - P1.011) and internal torque limit (P1.012 - P1.014) are set correctly. 4. Check the external load. Reduce the external load or re-evaluate the motor capacity if necessary. 5. Check if the settings of P1.044 and P1.045 are appropriate for the application. If not, set them to proper values. 6. Check if the power cable is loose. 7. Check if the set value of P1.055 (Maximum speed limit) is too low.
How to clear the alarm?	DI.ARST

AL010 Voltage error during regeneration	
Trigger condition and cause	Condition: an error occurs during regeneration. Cause: 1. The regenerative voltage remains at 400V for a period of time during regeneration. This may be caused by incorrect selection of or no connection to an external regenerative resistor. 2. P1.053 (Regenerative resistor capacity) is not set to 0 when a regenerative resistor is not connected.
Checking method and corrective action	1. Check the connection for the regenerative resistor and re-calculate the resistance value. Correctly set the values of P1.052 and P1.053. If the issue persists, send your servo drive back to Delta. 2. Set P1.053 to 0 if not using a regenerative resistor.
How to clear the alarm?	DI.ARST

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AL011 CN2 communication failed	
Trigger condition and cause	Condition: encoder communication is in error. Cause: 1. CN2 wiring is incorrect. 2. CN2 connector is loose. 3. CN2 wiring is poor. 4. Encoder communication is disconnected due to interference. 5. The encoder is damaged. 6. A motor not supported by this servo drive is used.
Checking method and corrective action	1. Check if the wiring follows the instructions in the user manual. If not, connect the wire correctly. 2. Check the connection between the CN2 port of the servo drive and the CN2 connector. Reconnect them if the connection is loose. 3. Check for the encoder cable and connector which connect the motor and CN2 port of the servo drive to see if there is any poor wiring or damaged wires. If so, replace the connector and cable. 4. Set P0.002 = -80 to monitor the encoder communication error rate. If this value increases continuously, it means there is interference. Check the following items: (a) Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is connected to the servo drive heat sink. (b) Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference. (c) Use a shielded encoder cable and correctly ground the shield. 5. If you took all corrective actions but the issue persists, replace the motor. 6. Contact the distributor for the supported motor models or the communication specifications of the encoder.
How to clear the alarm?	Cycle power on the servo drive.

AL013 Emergency stop	
Trigger condition and cause	The emergency stop button is pressed.
Checking method and corrective action	Make sure the emergency stop button is off.
How to clear the alarm?	Set DI.EMGS to Off.

AL014 Negative limit error	
Trigger condition and cause	Condition: negative limit switch is triggered. Cause: 1. Negative limit switch is triggered. 2. Servo system is unstable.
Checking method and corrective action	1. Make sure the negative limit switch is off. 2. Check the parameter setting or re-estimate the motor capacity.
How to clear the alarm?	The alarm is automatically cleared after the motor moves away from the limit.

AL015 Positive limit error	
Trigger condition and cause	Condition: positive limit switch is triggered. Cause: 1. Positive limit switch is triggered. 2. Servo system is unstable.
Checking method and corrective action	1. Make sure the positive limit switch is off. 2. Check the parameter setting or re-estimate the motor capacity.
How to clear the alarm?	The alarm is automatically cleared after the motor moves away from the limit.

AL016 Abnormal IGBT temperature	
Trigger condition and cause	Condition: temperature of IGBT is abnormal. Cause: 1. The load is over the rated range and the servo drive is in a continuous overload condition. 2. The servo drive output is short-circuited.
Checking method and corrective action	1. Check for servo drive overload or motor overcurrent. If so, try increasing the motor capacity or reducing the load. 2. Check if the wiring of servo drive output is correct.
How to clear the alarm?	After the alarm occurs, wait until the time set in P2.123 has elapsed and then reset the alarm.

AL017 EEPROM error	
Trigger condition and cause	Condition: an error occurs when DSP accesses EEPROM. Cause: 1. Parameter writing error or the value exceeds the allowable range. 2. When power is supplied to the servo drive, the data in ROM is damaged or there is no data in ROM.
Checking method and corrective action	Press the SHIFT key and the panel displays the parameter code “EXGAB”. X = 1, 2, 3 G = Group number of the parameter AB = Parameter number in hexadecimal format If the panel displays “E320A”, it indicates parameter P2.010. If the panel displays “E3610”, it indicates parameter P6.016. Check the value for the corresponding parameter. 1. The panel displays the parameter code. If this alarm occurs when power is supplied to the drive, it means the parameter value has exceeded the range. Modify the value and then cycle power on the servo drive. If the alarm occurs during normal operation, it means an error occurred when the parameter is written. Set DI.ARST = On to clear this alarm. 2. The panel displays “E100X” or “E0001”. If this alarm occurs when power is supplied to the drive, it is usually because the data in ROM is damaged or there is no data in ROM. Send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	If this alarm occurs once the power is supplied, reset the parameter and then cycle power on the servo drive. If the alarm occurs during operation, set DI.ARST to On.

AL020 USB communication timeout	
Trigger condition and cause	Condition: USB communication error. Cause: 1. Improper setting for P3.004 (USB communication timeout). 2. The servo drive has not received the communication command for a long time and has timed out (refer to P3.004).
Checking method and corrective action	1. Check and correctly set the value for the communication timeout parameter. 2. Check if the communication cable is loose or disconnected and make sure it is correctly wired.
How to clear the alarm?	DI.ARST

AL022 Main power error	
Trigger condition and cause	Condition: main power cable is loose or there is no input power. The error type of AL022 is a warning (WARN) by default. To set AL022 as an alarm (ALM), you can set P2.066 [Bit 12] to 1. Cause: main power error.
Checking method and corrective action	Check if the main power cable is loose or there is no power. AL022 occurs when one single phase is not connected to the power supply. Correctly connect the power to the servo drive. If the issue persists, send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	DI.ARST

AL023 Overload prewarning	
Trigger condition and cause	Overload prewarning.
Checking method and corrective action	1. Check if the motor is overloaded and refer to the checking method and corrective action of AL006. 2. Check if the value of P1.056 (Motor output overload warning level) is set too low. If so, set the value higher, or disable the warning function by setting the value greater than 100.
How to clear the alarm?	DI.ARST

AL024 Encoder initial magnetic field error	
Trigger condition and cause	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 (magnetic field of the encoder U, V, W signal is in error).
Checking method and corrective action	1. Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is connected to the servo drive heat sink. 2. Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference. 3. Use a shielded encoder cable and correctly ground the shield. If the issue persists, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

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AL025 Encoder internal error	
Trigger condition and cause	Condition: internal memory and counter of the encoder are in error. Cause: 1. Encoder internal error (internal memory and counter are in error). 2. When power is applied, the motor rotates because of mechanical inertia or other causes.
Checking method and corrective action	1. If there is interference, check the following items: (a) Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is connected to the servo drive heat sink. (b) Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference. (c) Use a shielded encoder cable and correctly ground the shield. 2. Make sure the motor shaft does not move when power is turned on.
How to clear the alarm?	Cycle power on the servo drive.

AL026 Encoder unreliable internal data	
Trigger condition and cause	Condition: internal data error occurs three consecutive times. Cause: 1. External interference. 2. Malfunction of the encoder hardware.
Checking method and corrective action	If there is interference, check the following items: 1. Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is connected to the servo drive heat sink. 2. Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference. 3. Use a shielded cable encoder cable and correctly ground the shield. 4. Set P0.002 = -80 to monitor the communication error rate. If the value is greater than 0 and increases continuously, check the previous three items again. If the value is 0, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL027 Encoder internal reset error	
Trigger condition and cause	Condition: encoder reset error. Cause: encoder reset.
Checking method and corrective action	1. Check if there is poor contact in the encoder cable. 2. Check if the power to the encoder is stable and make sure to use a shielded encoder cable. 3. Check if the operating temperature is over 95°C (203°F). Fix the cause of the high temperature and do not restart the operation before the temperature falls within the allowable range. If the issue persists, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL028 Battery voltage error or encoder internal error	
Trigger condition and cause	Condition: battery voltage is higher than the specification (> 3.8V) or the encoder signal is in error. Cause: 1. Voltage level of the battery is too high. 2. Encoder internal error.
Checking method and corrective action	1. Check if there is a charging circuit. Avoid incorrect wiring. If Pin 1 (5V) of CN2 is connected to BAT+ of the encoder connector, it means the 5V power of the servo drive is being charged to the battery. 2. Check if the battery is incorrectly installed (voltage > 3.8V). 3. Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is connected to the servo drive heat sink. 4. Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference. 5. Use a shielded encoder cable and correctly ground the shield. If the issue persists, send your servo drive and motor back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

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AL029 Gray code error	
Trigger condition and cause	Absolute position within a single revolution is in error.
Checking method and corrective action	Cycle power on the servo drive and operate the motor. Then, check if the alarm occurs again. If the issue persists, replace the encoder.
How to clear the alarm?	Cycle power on the servo drive.

AL02A Number of revolutions of the encoder is in error	
Trigger condition and cause	Condition: the number of revolutions of the encoder is in error. Cause: the internal signal of the encoder is abnormal, causing error in the number of revolutions.
Checking method and corrective action	Send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	N/A

AL02B Motor data error	
Trigger condition and cause	Internal data access to the motor is in error.
Checking method and corrective action	Send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	N/A

AL02C Servo drive overload	
Trigger condition and cause	Condition: servo drive is overloaded. Cause: 1. The load is over the rated range and the servo drive is in a continuous overload condition. 2. Improper settings for the gain parameters or the motion profile of the control system. 3. Motor wiring error. 4. The encoder is damaged or malfunctioning.
Checking method and corrective action	1. Monitor the current feedback by setting P0.002 to 55. Check if the motor current exceeds the rated output current of the servo drive for a long period of time. 2. (a) Check if there is any mechanical vibration. If so, properly adjust the gain parameters. (b) Set a higher acceleration / deceleration time constant or a lower target speed. 3. Check if the wiring of the motor power cable and encoder cable is correct. 4. Replace the encoder.
How to clear the alarm?	After the alarm occurs, wait until the time set in P2.123 has elapsed and then reset the alarm.

AL02F Blocked rotor protection	
Trigger condition and cause	Condition: the servo drive is overloaded, and the motor speed is maintained at 10 rpm and below or the rotor is blocked. Cause: 1. The motor or the connected mechanical part is jammed, preventing the motor from rotating. 2. The motor is running at an extremely low speed or the rotor is blocked for a long time.
Checking method and corrective action	1. Set the motor speed higher to shorten the blocked rotor time. 2. Check if the mechanical part connected to the motor is working normally. 3. Check if the wiring of the motor power cable and the encoder cable is correct. 4. Send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	After the alarm occurs, wait until the time set in P2.123 has elapsed and then reset the alarm.

AL030 Motor collision error	
Trigger condition and cause	Condition: the motor hits the device, reaching the torque value set by P1.057 for the duration of the time set by P1.058. Cause: 1. Check if the protection function of motor hard stop (P1.057) is enabled by mistake. If so, set P1.057 to 0. 2. Check if the value set by P1.057 is too low and the time set by P1.058 is too short. Set P1.057 according to the actual torque. Setting P1.057 too low may lead to malfunction; setting P1.057 too high may render the protection function ineffective.
Checking method and corrective action	Cycle power on the servo drive to operate the motor. Then, check if the alarm occurs again. If the issue persists, replace the encoder.
How to clear the alarm?	DI.ARST

AL031 Motor power cable wiring error	
Trigger condition and cause	Condition: incorrect wiring of the motor power cable (U, V, W) and ground (GND). Cause: incorrect wiring of the motor power cable (U, V, W) and ground (GND). The detection for motor power cable wiring error is set by P2.065 [Bit 8], which is enabled by default.
Checking method and corrective action	Check if the wiring of the motor power cable (U, V, W) and ground (GND) is correct. Follow the instructions in this user manual for correct wiring and proper grounding.
How to clear the alarm?	Cycle power on the servo drive.

AL032 Abnormal encoder vibration	
Trigger condition and cause	Condition: abnormal vibration occurred in the encoder. Cause: the internal signal or mechanical part of the encoder is abnormal, so the encoder returns an error signal.
Checking method and corrective action	Check if the motor vibration range exceeds the specification of 2.5 G. If the vibration is within the specification but the alarm still occurs, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	DI.ARST or cycle power on the servo drive.

AL033 Motor is in error	
Trigger condition and cause	The motor is in error.
Checking method and corrective action	1. Check if the encoder 5V power is lower than 4.3V. 2. Check if the cable complies with the specifications. Do not use a cable that is too long or unshielded. 3. Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference.
How to clear the alarm?	If the issue persists, send your servo motor back to the distributor or contact Delta.

AL034 Encoder internal communication error	
Trigger condition and cause	Condition: 1. Internal communication error for the absolute encoder. 2. Internal error for other types of encoders. Cause: encoder internal communication error.
Checking method and corrective action	1. Check if the battery wiring is correct or loose. If it is loose, wire it again and cycle power on the system. 2. Check if the battery voltage is within the normal range. 3. Internal communication error for the absolute encoder occurs. Replace the motor.
How to clear the alarm?	Cycle power on the servo drive.

AL035 Encoder temperature exceeds the protection limit	
Trigger condition and cause	Condition: encoder temperature is over the upper limit of 100°C (212°F). Cause: encoder temperature is over 100°C.
Checking method and corrective action	Set P0.002 = -124 to read the temperature and check if it is below 100°C. If the encoder temperature is higher than 100°C, improve the heat dissipation to lower the temperature. If the temperature difference between the encoder and motor is over 30°C (54°F), send your servo motor back to Delta.
How to clear the alarm?	After the temperature becomes lower than 100°C, cycle power on the servo drive.

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AL036 Encoder alarm status error	
Trigger condition and cause	Condition: abnormal state occurred in the encoder. Cause: the encoder sends out an alarm signal, but the alarm status of the encoder read by the servo drive shows no error.
Checking method and corrective action	1. Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is connected to the servo drive heat sink. 2. Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference. 3. Use a shielded encoder cable and correctly ground the shield. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	DI.ARST or cycle power on the servo drive.

AL044 Servo function operational warning	
Trigger condition and cause	Condition: too many motor control functions on the servo drive are enabled. Cause: servo function operational alarm.
Checking method and corrective action	1. If using a filter, see if using the filter is necessary. 2. Set P2.066 [Bit 4] = 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 (P1.089 - P1.094), Notch filter (1^{st} to 5^{th} sets), percentage of friction compensation (P1.062), and motor hard stop - torque percentage (P1.057). 2. Set P2.066 [Bit 4] to 1 and cycle power on the servo drive.

AL045 E-Gear ratio value error	
Trigger condition and cause	Condition: when the value of the E-Gear ratio exceeds the range (1 - 262144), this alarm occurs once the power is cycled on the servo drive. Cause: E-Gear ratio value is found to be in error after the servo drive is powered on.
Checking method and corrective action	Check if the value of the E-Gear ratio is within the allowable range (1 - 262144). If not, correct the value and then cycle power to the servo drive.
How to clear the alarm?	Cycle power on the servo drive after correcting the value.

AL053 Motor parameter error	
Trigger condition and cause	Motor parameter is in error.
Checking method and corrective action	Check the motor barcode in the Device Information screen of ASDA-Soft or replace the motor.
How to clear the alarm?	Cycle power on the servo drive.

AL056 Excessive motor speed	
Trigger condition and cause	Condition: when the filtered motor speed exceeds the setting of P1.111, the servo drive immediately switches to the Servo Off state and displays this alarm. Cause: this alarm is to remind you that the motor speed has reached the maximum limit (setting value of P1.111).
Checking method and corrective action	1. Check the reason for the high motor speed, such as the set value of P1.111 is too small or the bandwidth is not set properly. 2. Evaluate the motor speed and the condition of the mechanical parts. If allowable, increase the speed and the set value of P1.111.
How to clear the alarm?	DI.ARST

AL05C Motor position feedback error	
Trigger condition and cause	Condition: sudden jumps occur to the motor position feedback. Cause: 1. Encoder feedback is abnormal or the encoder is damaged. 2. Encoder feedback is interfered.
Checking method and corrective action	1. Check if the feedback signal is abnormal. Use the Scope function of ASDA-Soft and select **Feedback position [PUU]** as the input signal for the channel and sample at 16 kHz or 20 kHz, and then operate the motor manually to monitor whether the feedback value has discontinuous sudden jumps. 2. Check if the feedback signal is interfered, causing sudden jumps to the motor position feedback. 3. Check if the communication error rate increases due to interference. For example, check the communication error rate by setting P0.017 to -80 and monitor whether the value of P0.009 is not 0 and continuously increases.
How to clear the alarm?	Cycle power on the servo drive.

AL060 Absolute position is lost	
Trigger condition and cause	Condition: the absolute encoder loses the recorded number of revolutions because of low battery voltage or power loss. Cause: 1. Voltage level of the battery is too low. 2. The battery is replaced when the power to the servo drive is off. 3. The battery is not installed when the absolute function is enabled. 4. Poor contact or disconnection in the battery power circuit.
Checking method and corrective action	1. Check if the battery voltage is below 2.9V. Re-establish the absolute origin position after replacing the battery. 2. Do not replace or remove the battery when the power to the servo drive is off. 3. Follow these instructions: (a) Install the battery. (b) Check the wiring between the battery box and the servo drive. (c) Check the encoder wiring. 4. Ensure the wiring is correct so that the battery power is supplied to the encoder and then re-establish the absolute origin position.
How to clear the alarm?	Reconnect or correct the wiring so that the battery power is supplied to the encoder and then re-establish the absolute origin position. For establishing the absolute origin position, refer to Section 9.3.4 for more details.

AL061 Encoder undervoltage	
Trigger condition and cause	Condition: battery voltage of the absolute encoder is lower than 3.1V. Cause: voltage level of the battery is too low.
Checking method and corrective action	1. Set P0.002 = 38 to monitor if the battery voltage is below 3.1V. 2. Measure the battery voltage to see if it is below 3.1V. If the voltage is too low, replace the battery when the servo drive's power is On.
How to clear the alarm?	The alarm is cleared automatically when the battery voltage is higher than 3.1V.

AL062 Number of revolutions of the absolute encoder overflows (issued by encoder)	
Trigger condition and cause	Condition: the number of revolutions of the absolute motor exceeds the range of -32768 to +32767. Cause: the number of revolutions of the motor exceeds the allowable range.
Checking method and corrective action	1. Check if the number of revolutions of the motor during operation is within the range of -32768 to +32767. If not, re-establish the absolute origin position. 2. Make sure you have enabled the function for preventing rotary axis position offset when an overflow occurs. If the function is disabled, set P2.069.Z = 1 to enable it.
How to clear the alarm?	Cycle power on the servo drive.

AL064 Encoder vibration warning	
Trigger condition and cause	Condition: abnormal vibration occurred in the encoder. Cause: the internal signal or mechanical part of the encoder is abnormal, so the encoder returns a warning signal.
Checking method and corrective action	Check if the motor vibration range is within the warning range (2.0 to 2.5 G). If the vibration is below the warning range but the alarm still occurs, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	DI.ARST or cycle power on the servo drive.

AL066 Number of revolutions of the absolute encoder overflows (issued by servo drive)	
Trigger condition and cause	Condition: 1. The number of revolutions of the absolute motor (P0.051) exceeds half the number of revolutions of the encoder. 2. The number of revolutions of a Delta motor is -32768 to +32767. Cause: the number of revolutions of the motor exceeds the allowable range.
Checking method and corrective action	1. Check if the number of motor revolutions during operation is within the specified range. If not, re-establish the absolute origin position. 2. Make sure you have enabled the function of preventing rotary axis position offset when an overflow occurs. If the function is disabled, set P2.069.Z = 1 to enable it.
How to clear the alarm?	Re-establish the absolute origin position.

AL067 Encoder temperature warning	
Trigger condition and cause	Condition: the encoder temperature is over the warning level of 85°C (185°F), but still under 100°C (212°F), which is within the protective range. Cause: encoder temperature warning (85°C to 100°C).
Checking method and corrective action	Set P0.002 = -124 to monitor the encoder temperature and check if it matches the motor temperature. If the temperature is too high, improve the heat dissipation or decrease the operating temperature. If the temperature difference between the encoder and motor is over 30°C (54°F), send your servo motor back to Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL068 Absolute data transmitted by I/O is in error	
Trigger condition and cause	Condition: the time sequence is wrong when the absolute position is read by DI/O. Cause: 1. Time sequence is wrong. 2. Reading timeout.
Checking method and corrective action	1. Correct the time sequence for reading the data with DI/O: (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 when 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, switch DI.ABSQ On, and 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 cause	Incremental motor does not support the absolute function.
Checking method and corrective action	1. Check whether your servo motor has an incremental or absolute encoder. 2. Check the setting of P2.069 and correctly set the value. Set P2.069.X to 0 if desiring to operate the absolute motor as an incremental motor.
How to clear the alarm?	Set P2.069.X to 0 and then cycle power on the servo drive.

AL06A Absolute position is lost	
Trigger condition and cause	There are two conditions that may cause the loss of absolute position. ■ Absolute position is not established. Condition: 1. The servo drive is used for the first time. 2. The battery is drained and the power to the servo drive is cut off. 3. When the bus communication type (EtherCAT) servo drive is used with an absolute motor, the user issues an absolute position command after the first use or modification of the E-Gear ratio. Cause: 1. The servo drive is used for the first time, so the absolute origin position is not established. 2. Retaining the absolute position requires power supply, so when the battery is drained and the power to the servo drive is cut off, the absolute position of the servo is lost. 3. After the E-Gear ratio is modified, the position system of the communication type servo drive needs to be re-established. ■ AL06A occurs even after the absolute origin position is established and the drive is power cycled. Condition: 1. The encoder cable is damaged, including the exterior and internal wiring. 2. There is a momentary power failure in the battery power supply. 3. The absolute motor is in error. 4. The battery box is used with J1 and J2 reversely connected. 5. The voltage level of the battery is lower than 2.9V. Cause: 1. Power to the encoder is unstable due to cable damage. 2. The reason for the momentary power failure may be that the battery box connector is loose or excessive machine vibration. 3. The absolute encoder of this motor is in error. 4. If J1 and J2 are connected reversely, the battery cannot charge the capacitor. The capacitor functions as a buffer to supply power when the power supply of the servo drive power is switched to the battery due to a main power failure.
Checking method and corrective action	1. Check if the absolute origin position is established (refer to Section 9.3.1 for more information). 2. Replace the battery only when the servo drive is powered on, so the absolute encoder has continuous power supply. 3. Re-establish the absolute origin position. 4. Replace the encoder cable. Use the X-ray to check if the internal wiring is damaged. 5. Check if the wiring is loose. If the wiring is fine, replace the battery box for a cross-check. 6. Replace the servo motor. 7. Ensure J1 is connected to the battery and J2 is connected to the servo drive.
How to clear the alarm?	The alarm is automatically cleared after you establish the absolute origin position.

AL06B The error between the servo drive internal position and the encoder position is too large	
Trigger condition and cause	Condition: when the absolute motor is powered by the battery, the number of motor rotations exceeds one-fourth the number of revolutions of the encoder. Cause: the error between the servo drive internal position and the encoder position is too large.
Checking method and corrective action	The mechanical parts are not properly fastened when the machine is being transported, causing rotation of the motor.
How to clear the alarm?	Re-establish the absolute origin position.

AL06E Encoder type is unidentifiable	
Trigger condition and cause	The servo drive cannot identify the encoder type.
Checking method and corrective action	N/A
How to clear the alarm?	Replace the motor immediately.

AL06F The absolute position is not established	
Trigger condition and cause	Condition: the establishment of the absolute position has timed out. Cause: the process for establishing the absolute position of the servo drive is in error.
Checking method and corrective action	If the issue persists after you cycle power on the servo drive and re-establish the absolute origin position, contact your local distributor or technician.
How to clear the alarm?	Cycle power on the servo drive and re-establish the absolute origin position.

AL070 Encoder did not complete the read / write procedure	
Trigger condition and cause	Reading and writing commands are not complete.
Checking method and corrective action	Check if the wiring is correct and firmly connected. If not, correctly connect the wire again. Contact Delta if this error persists.
How to clear the alarm?	Cycle power on the servo drive.

AL071 Number of revolutions of the encoder is in error	
Trigger condition and cause	Condition: the number of revolutions of the encoder is in error. Cause: the internal signal of the encoder is abnormal, causing error in the number of revolutions of the encoder.
Checking method and corrective action	If you executed DI.ARST but the issue persists, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	DI.ARST

AL072 Encoder overspeed	
Trigger condition and cause	1. Encoder speed is over 8,800 rpm when powered by the servo drive. 2. Encoder speed is over 10,000 rpm when powered by the battery. 3. Battery voltage is too low.
Checking method and corrective action	1. Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is connected to the servo drive heat sink. 2. Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference. 3. Use a shielded encoder cable and correctly ground the shield. 4. Check the motor speed and make sure it is within the rated range. 5. Measure the battery voltage to see if it is below 3.1V. 6. Check if the battery wiring has poor contact. If the issue persists, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL073 Encoder memory error	
Trigger condition and cause	An error occurs when the encoder is reading data from or writing data to EEPROM.
Checking method and corrective action	1. Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is connected to the servo drive heat sink. 2. Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference. 3. Use a shielded encoder cable and correctly ground the shield. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL074 Encoder single-turn absolute position is in error	
Trigger condition and cause	The single-turn position in the encoder is in error.
Checking method and corrective action	1. Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is connected to the servo drive heat sink. 2. Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference. 3. Use a shielded encoder cable and correctly ground the shield. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL075 Encoder absolute number of revolutions is in error	
Trigger condition and cause	The absolute number of revolutions in the encoder is in error.
Checking method and corrective action	1. Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is connected to the servo drive heat sink. 2. Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference. 3. Use a shielded encoder cable and correctly ground the shield. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL077 Encoder internal error	
Trigger condition and cause	Encoder internal error (internal computing error).
Checking method and corrective action	1. Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is connected to the servo drive heat sink. 2. Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference. 3. Use a shielded encoder cable and correctly ground the shield. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL079 Encoder parameter setting incomplete	
Trigger condition and cause	The servo drive is not power cycled after the encoder parameter is written to the encoder, and therefore the parameter setting does not take effect.
Checking method and corrective action	Check if the encoder parameter is written. If so, cycle power to have the parameter setting take effect.
How to clear the alarm?	Cycle power on the servo drive.

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AL07A Encoder Z phase position is lost	
Trigger condition and cause	Encoder Z phase position is in error.
Checking method and corrective action	Send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	N/A

AL07B Encoder memory is busy	
Trigger condition and cause	The encoder memory is busy.
Checking method and corrective action	1. Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is connected to the servo drive heat sink. 2. Check if the connection for the encoder cable is normal. Make sure the encoder cable is separated from the power cable or any high-current cables to avoid interference. 3. Use a shielded encoder cable and correctly ground the shield. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, send your servo motor 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 cause	The command to clear the absolute position is issued when the motor speed is over 200 rpm.
Checking method and corrective action	1. Check if a command to clear the absolute position is issued when the motor speed is over 200 rpm. If so, reduce the motor speed until the speed is lower than 200 rpm, and then follow the procedure for clearing the absolute position to clear this alarm. 2. Do not issue a command to clear the absolute position when the motor speed is over 200 rpm.
How to clear the alarm?	DI.ARST or cycle power on the servo drive.

AL07D Motor stops operating when servo drive power is cycled before AL07C is cleared	
Trigger condition and cause	AL07C occurs and is not cleared before the power is cycled on the servo drive, and the motor stops operating.
Checking method and corrective action	Set DI.ARST = On to clear the alarm. Once this alarm is cleared, AL07C occurs. Follow the checking method and corrective action to clear AL07C.
How to clear the alarm?	DI.ARST or cycle power on the servo drive.

AL07E Error occurs when the encoder clears the procedure	
Trigger condition and cause	The number of retry attempts for the encoder to clear the procedure exceeds 11 times.
Checking method and corrective action	If the issue persists, set P0.002 = -80 to check the communication quality of the encoder. If the communication is normal, set DI.ARST = On to clear this alarm.
How to clear the alarm?	DI.ARST or cycle power on the servo drive.

AL07F Encoder version error	
Trigger condition and cause	The encoder version read by the servo drive is in error.
Checking method and corrective action	N/A
How to clear the alarm?	Replace the motor immediately.

AL083 Servo drive outputs excessive current	
Trigger condition and cause	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 caused by high current. Cause: 1. UVW of the servo drive is short-circuited. 2. Motor wiring is in error.
Checking method and corrective action	1. Check the motor power cable and power connector. If metal wire is exposed or the wire is torn, the UVW can short-circuit. In this case, replace the power cable to avoid a short circuit. 2. Refer to Chapter 3 Wiring and check the following items: (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 motor is correctly connected.
How to clear the alarm?	DI.ARST

AL085 Regeneration setting error	
Trigger condition and cause	Condition: regeneration control error. Cause: the Vbus voltage is higher than 390V, and it cannot fall within the normal range after the brake starts operating for a period of time.
Checking method and corrective action	Check the connection for the regenerative resistor and re-calculate the resistance value. Correctly set the values of P1.052 and P1.053. If the issue persists, send your servo drive back to Delta.
How to clear the alarm?	After the alarm occurs, wait until the time set in P2.123 has elapsed and then reset the alarm.

AL086 Regenerative resistor overload	
Trigger condition and cause	Condition: excessive energy in the capacitor of the servo drive is released to the regenerative resistor, causing overload of the resistor. Cause: 1. Incorrect selection of or no connection to an external regenerative resistor. 2. Incorrect parameter settings for P1.052 and P1.053. 3. Other energy (such as interference) is input to the servo drive or the input voltage is higher than the allowable rated voltage. 4. Malfunction of the servo drive hardware.
Checking method and corrective action	1. Check the connection for the regenerative resistor and correctly set the values of P1.052 and P1.053. 2. Reassess whether the regenerative energy exceeds the value of P1.053. If so, use another regenerative resistor of higher capacity. 3. Use a voltmeter to measure if the input voltage of the power supply is within the allowable rated voltage (refer to Appendix A Specifications). If not, remove the interference source. 4. Measure the voltage between P3 and ⊖ terminals. If it does not match the DC Bus voltage monitored by setting P0.002 to 14, the servo drive may be malfunctioning. Send your servo drive back to the distributor or contact Delta. 5. If you took the preceding actions and the issue persists, use a scope with a differential probe to measure whether the input voltage has high-frequency signal interference. If there is interference, remove the interference source, and use the correct power supply or install a regulator.
How to clear the alarm?	After the alarm occurs, wait until the time set in P2.123 has elapsed and then reset the alarm.

AL088 Servo function operational alarm	
Trigger condition and cause	Condition: too many motor control functions on the servo drive are enabled. Cause: servo function operational alarm.
Checking method and corrective action	If using a filter, see if using the filter is necessary.
How to clear the alarm?	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 (P1.089 - P1.094), Notch filter (1st to 5th sets), percentage of friction compensation (P1.062), and motor hard stop - torque percentage (P1.057).

AL089 Current detection interference	
Trigger condition and cause	Condition: current detection interference. Cause: current detection in the servo drive is affected by an external interference source.
Checking method and corrective action	Check the environment around the servo drive to see if there is any interference source.
How to clear the alarm?	1. Remove the interference source or move the servo drive away from the interference source. 2. Set P2.112 [Bit 1] = 0 to disable AL089. 3. If the issue persists, send your servo drive back to the distributor or contact Delta.

AL08A Auto tuning function - command error	
Trigger condition and cause	Condition: no command is issued within 15 seconds after the servo drive starts the auto tuning procedure. Cause: 1. When the command source is the controller, neither the controller nor the position register issued the command. 2. When the command source is the servo drive, Position 1 and Position 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 method and corrective action	1. Make sure a command is being issued. 2. Set Position 1 and Position 2 again. 3. Make sure the wiring between the controller and servo drive is correct.
How to clear the alarm?	DI.ARST

AL08B Auto tuning function - dwell time is too short	
Trigger condition and cause	Condition: the dwell time is too short when the command source is the controller 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 dwell time is too short. Cause: dwell time in the cycle is too short.
Checking method and corrective action	1. For a reciprocating motion between two points, pausing is required on the return, which has to be longer than 1 second. 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

AL08C Auto tuning function - inertia estimation error	
Trigger condition and cause	Condition: inertia estimation error occurs when the servo drive starts the auto tuning procedure. Cause: 1. Acceleration or deceleration time is too long. 2. Rotation speed is too low. 3. Load inertia of the machine is too large. 4. Variation of the machine inertia is too drastic.
Checking method and corrective action	1. The time for the motor to accelerate from 0 rpm to 3,000 rpm or decelerate from 3,000 rpm to 0 rpm must be within 1.5 seconds. 2. The lowest speed should be no less than 200 rpm. It is suggested that you set the speed to 500 rpm or higher. 3. The load inertia should be less than 50 times the motor inertia. 4. Avoid applications that require drastic variation in the inertia.
How to clear the alarm?	DI.ARST

AL095 Regenerative resistor is disconnected or regenerative circuit is in error	
Trigger condition and cause	1. The value of P1.053 (Regenerative resistor capacity) is greater than 0, but no external regenerative resistor is connected. 2. The regenerative circuit is in error.
Checking method and corrective action	1. Ensure to connect the regenerative resistor to the servo drive and check if the value of P1.053 is correct. 2. If the servo drive does not have a built-in regenerative resistor and does not need an external regenerative resistor, set P1.053 to 0. 3. Check if the regenerative resistor is disconnected. If the issue persists, send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL099 DSP firmware error	
Trigger condition and cause	EEPROM is not reset after DSP firmware is updated.
Checking method and corrective action	Check if the firmware is updated. If so, set P2.008 to 30, 28, and then cut off the power; wait until the CHARGE indicator is off and then cycle power on the servo drive. Contact Delta if this error persists.
How to clear the alarm?	Set P2.008 to 30, 28, and then cut off the power; wait until the CHARGE indicator is off and then cycle power on the servo drive.

AL09C Parameter reset failed	
Trigger condition and cause	Condition: the parameter reset process is not complete. Cause: an error occurred during the parameter reset process, so the reset process could not be completed.
Checking method and corrective action	Check if the power is cut off during the reset process. Check the power wiring and switch.
How to clear the alarm?	Set P2.008 to 30, 28, and then cut off the power; wait until the CHARGE indicator is off and then cycle power on the servo drive.

AL0A6 Absolute positions of the servo drive and motor do not match	
Trigger condition and cause	Condition: if the motor is changed after the servo drive has established the absolute origin position, and the new motor has already established the absolute origin position with another servo drive, AL0A6 will be triggered. Cause: the servo motor is changed.
Checking method and corrective action	Re-establish the absolute origin position.
How to clear the alarm?	Re-establish the absolute origin position.

AL111 Buffer overflow occurs when SDO is received	
Trigger condition and cause	SDO Rx Buffer overflows (two or more SDOs are received within 1 ms).
Checking method and corrective action	Check if the servo drive or the master receives or sends more than one SDO within 1 ms.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL112 Buffer overflow occurs when PDO is received	
Trigger condition and cause	PDO Rx Buffer overflows (two or more PDOs of the same COB-ID are received within 1 ms).
Checking method and corrective action	Check if the servo drive or the master receives or sends more than one PDO of the same COB-ID within 1 ms.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL113 TxPDO transmission failed	
Trigger condition and cause	PDO packet cannot be successfully sent.
Checking method and corrective action	Check if the communication circuit of the servo drive works normally.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL121 Object's index does not exist when PDO is accessed	
Trigger condition and cause	When the servo drive receives the PDO from the controller, the specified object's index number is incorrect, so the servo drive cannot identify it.
Checking method and corrective action	1. Check if the object's index number for PDO mapping of the controller is correct. 2. If the index number is correct, it means this specified object is not supported by the servo drive. Check if it is necessary to use this object or if you can substitute it with a different object.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL122 Object's sub-index does not exist when PDO is accessed	
Trigger condition and cause	When the servo drive receives the PDO from the controller, the specified object's sub-index number is incorrect, so the servo drive cannot identify it.
Checking method and corrective action	1. Check if the object's sub-index number for PDO mapping of the controller is correct. 2. If the sub-index number is correct, it means this specified object is not supported by the servo drive. Check if it is necessary to use this object or if you can substitute it with a different object.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL123 Data length error occurs when PDO is accessed	
Trigger condition and cause	Data length in the message does not match the length of the specified object.
Checking method and corrective action	Check if the data length of PDO mapping entry is changed when the servo drive receives or sends the PDO.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL124 Data range error occurs when PDO is accessed	
Trigger condition and cause	The data value in the message exceeds the range of the specified object.
Checking method and corrective action	Check if the written data is within range when the servo drive receives or sends the PDO.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

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AL125 PDO object is read-only and write-protected	
Trigger condition and cause	The specified object in the message is read-only and write-protected.
Checking method and corrective action	Check if the object for PDO mapping is read-only.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL126 Specified object does not support PDO mapping	
Trigger condition and cause	The specified object does not support PDO mapping.
Checking method and corrective action	Check if the specified object supports PDO mapping when the servo drive receives or sends the PDO.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL127 PDO object is write-protected when servo drive is on	
Trigger condition and cause	PDO object is write-protected (unchangeable) when the servo drive is on.
Checking method and corrective action	Make sure no specified object is written when the servo drive receives or sends the PDO in the Servo On state.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL128 Error occurs when PDO object is read from EEPROM	
Trigger condition and cause	An error occurs when the default value is loaded from ROM at start-up. All objects are automatically restored to default values.
Checking method and corrective action	Check if an error occurs because the specified object is read from EEPROM when the servo drive receives or sends the PDO.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL129 Error occurs when PDO object is written to EEPROM	
Trigger condition and cause	An error occurs when the PDO object is written to EEPROM.
Checking method and corrective action	Check if an error occurs because the specified object is written to EEPROM when the servo drive receives or sends the PDO.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL130 Accessing address of EEPROM is out of range	
Trigger condition and cause	The amount of data in the ROM exceeds the allowable capacity specified by the firmware. It is probably because the firmware has been updated, but the data in the ROM was stored by the previous firmware version.
Checking method and corrective action	Check if the specified object causes the accessing address in EEPROM exceeds the range when the servo drive receives or sends the PDO.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL131 EEPROM CRC calculation error	
Trigger condition and cause	The data in ROM is damaged. All objects are automatically restored to default values.
Checking method and corrective action	Check if the specified object causes a CRC calculation error in EEPROM when the servo drive receives or sends the PDO. Usually, this alarm is caused by an error in DSP.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL132 Parameter is write-protected	
Trigger condition and cause	When data is written to a parameter using bus communication, the parameter is currently write-protected.
Checking method and corrective action	Refer to the corresponding parameter description to write data to the parameter.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL170 Bus communication timeout	
Trigger condition and cause	The servo drive does not receive any PDO data within the set communication cycle time.
Checking method and corrective action	1. Check if the communication is normal. 2. Check if the wiring is correctly connected.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

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AL180 Bus communication timeout	
Trigger condition and cause	The servo drive does not receive any PDO data within the set communication cycle time.
Checking method and corrective action	1. Check if the communication is normal. 2. Check if the wiring is correctly connected.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL185 Bus hardware error	
Trigger condition and cause	Condition: bus communication is cut off. Cause: abnormal communication hardware.
Checking method and corrective action	1. Check if the communication cable is intact and firmly connected. 2. Check the communication quality; it is suggested that you use common grounding and shielded cables. 3. Check if the value of monitoring variable 120 increases continuously.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL186 Bus data transmission error	
Trigger condition and cause	Bus data transmission error.
Checking method and corrective action	1. Check if the communication cable is properly connected and whether there is any noise interference. Replace the communication cable or eliminate the noise if necessary. 2. There are excessive slave stations and the communication cycle time is too short. Lengthen the communication cycle.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL201 Initialization error of object dictionary data	
Trigger condition and cause	Condition: an error has occurred when the servo drive loads data from EEPROM. Cause: initialization error of CANopen data.
Checking method and corrective action	1. If the alarm is cleared after power cycling of the servo drive, it means the error occurred at the moment when the servo drive reads the data. 2. If the issue persists after power cycling of the servo drive, it means the data in the EEPROM is damaged and you need to write the correct values again. See the following methods: (a) To write the default value, set P2.008 to 30 and then 28, or use the CANopen object OD 1011h to complete the setting. (b) To write the current value, set the CANopen object OD 1010h. 3. If you took the corrective actions but the issue persists, it means the data array is incorrect. Set P2.008 = 10 to reset all parameters.
How to clear the alarm?	OD 6040h [Bit 7] (Fault reset), DI.ARST, or OD 1011h.

AL207 Parameter group of the data source for Type [8] PR is out of range	
Trigger condition and cause	Condition: when the data source for Type [8] PR path is specified as a parameter, the parameter group is out of range. Cause: parameter group exceeds the range.
Checking method and corrective action	Write a parameter using PR path: when the data source is a parameter and the group setting exceeds the range, check the setting range of the group for the written parameter.
How to clear the alarm?	DI.ARST

AL209 Parameter number of the data source for Type [8] PR is out of range	
Trigger condition and cause	Condition: when the data source for Type [8] PR path is specified as a parameter, the parameter number is out of range. Cause: parameter number exceeds the range.
Checking method and corrective action	Write a parameter using PR path: when the data source is a parameter and the parameter number setting exceeds the range, check the setting range of the number for the written parameter.
How to clear the alarm?	DI.ARST

AL211 Parameter format setting of Type [8] PR is in error	
Trigger condition and cause	Condition: parameter format setting of Type [8] PR path is in error. Cause: 1. Incorrect parameter format. 2. The ASDA-Soft software version and the firmware version are not compatible.
Checking method and corrective action	1. Check if the parameter format is correct. 2. Check if you are using the latest version of ASDA-Soft. If you took the corrective actions but the issue persists, contact the local distributor or technician.
How to clear the alarm?	DI.ARST

AL213 Parameter setting of Type [8] PR is in error	
Trigger condition and cause	Condition: when you use Type [8] PR path to write a parameter, the parameter value is incorrect. Cause: an error occurs when you write a parameter with Type [8] PR path.
Checking method and corrective action	Make sure the parameter value is within the correct range.
How to clear the alarm?	DI.ARST

AL215 Parameter written with Type [8] PR is read-only	
Trigger condition and cause	Condition: the read-only parameter is written with Type [8] PR path. Cause: an error occurs when you write the parameter with Type [8] PR path.
Checking method and corrective action	The specified parameter is read-only.
How to clear the alarm?	DI.ARST

AL217 Parameter written with Type [8] PR is write-protected when Servo On	
Trigger condition and cause	Condition: when you use Type [8] PR path to write a parameter, the parameter is write-protected when the servo drive is On or the parameter value exceeds the range. Cause: an error occurs when you write the parameter with Type [8] PR path.
Checking method and corrective action	Write parameters when the servo drive is Off and make sure the parameter value is within the range.
How to clear the alarm?	Modify the PR path and the parameter.

AL219 Parameter written with Type [8] PR is write-protected	
Trigger condition and cause	Condition: the parameter written with Type [8] PR path is write-protected. Cause: the parameter write-protected function is enabled.
Checking method and corrective action	Check if the parameter and data array protection function (P5.097) is enabled.
How to clear the alarm?	Disable the parameter and data array protection function or reset the parameters.

AL231 Monitoring variable code specified with Type [8] PR is out of range	
Trigger condition and cause	Condition: when the data source for Type [8] PR path is specified as a monitoring variable, the monitoring variable code is out of range. Cause: the monitoring variable code is out of range.
Checking method and corrective action	Write a parameter using PR path: when the data source is a monitoring variable and the code exceeds the range, check the setting range of the code for the monitoring variable.
How to clear the alarm?	DI.ARST

AL235 Position counter overflow warning	
Trigger condition and cause	Condition: a positioning command is executed after the position command counter overflows. Cause: the position command counter overflows.
Checking method and corrective action	Incremental system: When the motor keeps operating in one direction, this leads to overflow of the position feedback register (FB_PUU), and the position system cannot display the correct position. Executing a positioning command after the overflow results in AL235. Use the Scope function of ASDA-Soft to check if the position feedback has overflowed and then execute the homing procedure. Absolute system: AL235 occurs when the absolute positioning command is issued in the following conditions: 1. Position feedback register (FB_PUU) overflows. 2. Absolute origin position is not established after the setting of P1.001.Z is changed. 3. Absolute origin position is not established after the E-Gear ratio (P1.044 and P1.045) is changed. 4. The absolute origin position is established, but the homing procedure is incomplete. 5. When AL060 and AL062 occur, use the Scope function of ASDA-Soft to check if the position feedback has overflowed. Check whether the preceding conditions have occurred and then establish the absolute origin position.
How to clear the alarm?	Incremental system: perform homing procedure after setting DI.ARST = On. Absolute system: establish the absolute origin position.

AL237 Rotary axis position is undefined	
Trigger condition and cause	The starting point of the rotary axis position is not defined before you operate the rotary axis position control and execute the rotary axis positioning command. This alarm occurs because the servo drive cannot identify the rotary axis position system.
Checking method and corrective action	Check if the rotary axis position is undefined: perform the homing procedure before using the rotary axis position control to avoid triggering this alarm.
How to clear the alarm?	DI.ARST

AL245 PR positioning timeout	
Trigger condition and cause	Condition: PR positioning function is triggered. Cause: the time for executing positioning is too long.
Checking method and corrective action	Check if the conditions for completing the PR paths are not set or not triggered, causing the PR path to be incomplete.
How to clear the alarm?	DI.ARST or cycle power on the servo drive.

AL249 PR path is out of range	
Trigger condition and cause	Condition: the triggered PR path exceeds the maximum. Cause: the No. of the triggered PR is higher than 99.
Checking method and corrective action	1. Check if the specified jump target of a PR path exceeds the range. 2. Check if the PR path format is correct.
How to clear the alarm?	DI.ARST or cycle power on the servo drive.

AL283 Software positive limit	
Trigger condition and cause	Condition: the position feedback exceeds the software positive limit. Cause: the software positive limit is triggered.
Checking method and corrective action	Software positive limit triggering is determined by the position feedback. Set an appropriate deceleration time to achieve the desired effect. For more information, refer to the description of P5.003.
How to clear the alarm?	The alarm is automatically cleared after the motor moves away from the limit.

AL285 Software negative limit	
Trigger condition and cause	Condition: the position feedback exceeds the software negative limit. Cause: the software negative limit is triggered.
Checking method and corrective action	Software negative limit triggering is determined by the position feedback. Set an appropriate deceleration time to achieve the desired effect. For more information, refer to the description of P5.003.
How to clear the alarm?	The alarm is automatically cleared after the motor moves away from the limit.

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AL289 Position counter overflows	
Trigger condition and cause	Position counter overflows.
Checking method and corrective action	1. Set the E-Gear ratio according to the actual application requirements and the total traveling distance of the absolute motor to avoid overflow of the feedback counter. 2. If P2.069.Z = 1 (enabling the function of preventing the rotary axis position offset when overflow occurs), set P2.070 [Bit 2] to 1 (no overflow warning).
How to clear the alarm?	DI.ARST

AL305 SYNC period error	
Trigger condition and cause	Condition: CANopen 301 OD 1006h Data Error. Cause: SYNC period is in error.
Checking method and corrective action	Check the value of OD 1006h. If it is smaller than or equal to 0, this alarm occurs.
How to clear the alarm?	NMT: reset node or OD 6040h [Bit 7] (Fault reset).

AL35F Quick stop during deceleration	
Trigger condition and cause	The rising edge of DI.PFQS (0x47) is triggered, and then the motor decelerates to 0 and triggers AL3CF.
Checking method and corrective action	Check if any of the parameters P2.010 - P2.017 and P2.036 - P2.040 is set to 0x47 and the corresponding DI is triggered.
How to clear the alarm?	Cycle power on the servo drive.

AL380 Position offset alarm for DO.MC_OK	
Trigger condition and cause	DO.MC_OK is On and then turns Off.
Checking method and corrective action	Refer to the description of P1.048. After DO.MC_OK is On, DO.MC_OK then turns Off because DO.TPOS is Off. There might be an external force causing the position offset of the motor after positioning is complete. Disable this alarm by setting P1.048.Y to 0.
How to clear the alarm?	DI.ARST

AL3CF Quick stop	
Trigger condition and cause	After AL35F is triggered and the motor has decelerated to 0, this alarm occurs.
Checking method and corrective action	Check if any of the parameters P2.010 - P2.017 and P2.036 - P2.040 is set to 0x47 and the corresponding DI is triggered.
How to clear the alarm?	DI.ARST

AL3E2 Communication synchronization signal is sent too soon	
Trigger condition and cause	Condition: the synchronization signal is received too early. Cause: the communication synchronization signal is sent too soon.
Checking method and corrective action	1. Make sure the setting of communication cycle period (OD 1006h) is identical to that of the controller. 2. 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 OD 6040h [Bit 7] (Fault reset).

AL3E3 Communication synchronization signal timeout	
Trigger condition and cause	The target command is not received within a continuous communication cycle in the CSP / CSV / CST mode.
Checking method and corrective action	1. Make sure the communication between the servo drive and controller is good. 2. Make sure the setting of communication cycle period (OD 1006h) is identical to that of the controller. 3. Relax the setting of P3.022.YX (AL3E3 trigger condition). 4. 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 OD 6040h [Bit 7] (fault reset).

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AL3F1 Absolute position command of the communication type servo drive is in error	
Trigger condition and cause	Condition: when the bus communication type (EtherCAT) servo drive is used with an incremental motor and the position overflow occurs with the absolute origin position unestablished, the absolute positioning command is issued. Cause: 1. The absolute origin position is not established. 2. Overflow occurs since the motor keeps rotating in the same direction.
Checking method and corrective action	Establish the absolute origin position.
How to clear the alarm?	Establish the absolute origin position.

AL400 Rotary axis position setting error	
Trigger condition and cause	Condition: the position offset of the motor in 1 ms exceeds the setting of P2.052 (Rotary axis position scale). Cause: the value of P2.052 is set too small.
Checking method and corrective action	Check if P2.052 is set according to the specifications in the manual.
How to clear the alarm?	DI.ARST

AL401 NMT reset command is received when servo is on	
Trigger condition and cause	NMT reset command is received when the servo is on.
Checking method and corrective action	Check if the NMT reset command is received when the servo is on.
How to clear the alarm?	NMT: reset node, OD 6040h [Bit 7] (Fault reset), or DI.ARST.

AL404 PR special filter setting value is too great	
Trigger condition and cause	The value of the PR command special filter (P1.022) is set too great, causing the following error of the internal position to exceed the allowable range.
Checking method and corrective action	Check the setting of P1.022. If the value is too great, the following error exceeds the allowable range in a short time. Properly adjust the value of P1.022.
How to clear the alarm?	DI.ARST

AL422 Write-in failed caused by power supply cut-off	
Trigger condition and cause	Condition: when P2.069.Z = 1 (enabling the function of preventing rotary axis position offset when overflow occurs) and the power supply is cut off, the motor fails to store the current position. Cause: 1. The load is over the rated range and the servo drive is in a continuous overload condition. 2. After firmware update, the internal variables vary with the firmware versions. 3. The servo drive hardware EEPROM is abnormal. 4. The hardware of the servo drive is short-circuited. 5. AL520 occurred and causes malfunction of the servo drive.
Checking method and corrective action	1. Set P0.002 = 12 to monitor if the average load rate [%] is continuously over 100%. If so, increase the motor capacity or reduce the load. Refer to Appendix A for Graph of load and operating time. 2. If the issue persists, send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL500 STO function is activated	
Trigger condition and cause	Safe torque off function (STO) is activated.
Checking method and corrective action	Safe torque off function (STO) is activated. Check why it is activated.
How to clear the alarm?	1. Reset by setting DI.ARST (Alarm reset) = On, OD 6040h [Bit 7] (Fault reset) = 1, or P0.001 = 0x0000. 2. If not using the STO function, plug the STO connector into CN10 or short-circuit the CN10 STO terminal. Follow the instructions in Chapter 3 for the STO wiring.

AL501 SF1 lost (signal loss or signal error)	
Trigger condition and cause	Loss of SF1 signal, or SF1 and SF2 signals are not synchronized for more than 1 second.
Checking method and corrective action	Make sure the wiring of SF1 is correct.
How to clear the alarm?	Cycle power on the servo drive. If the issue persists, contact the distributor.

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AL502 SF2 lost (signal loss or signal error)	
Trigger condition and cause	Loss of SF2 signal, or SF1 and SF2 signals are not synchronized for more than 1 second.
Checking method and corrective action	Make sure the wiring of SF2 is correct.
How to clear the alarm?	Cycle power on the servo drive. If the issue persists, contact the distributor.

AL503 STO self-diagnostic error	
Trigger condition and cause	An error occurs during STO self-diagnosis, which may be caused by an abnormality in the STO circuit.
Checking method and corrective action	N/A
How to clear the alarm?	Contact the distributor.

AL510 Internal parameter update program of the servo drive is abnormal	
Trigger condition and cause	Internal parameter update program of the servo drive is abnormal.
Checking method and corrective action	Cycle power on the servo drive and re-execute the operation which is prior to the occurrence of this alarm.
How to clear the alarm?	Cycle power on the servo drive.

AL520 Calculation program timeout	
Trigger condition and cause	Servo drive calculation program timeout.
Checking method and corrective action	1. Cycle power on the servo drive. 2. If the issue persists, disable the vibration elimination function by setting P2.094 [Bit 8] & [Bit 9] = 0.
How to clear the alarm?	N/A

AL521 Vibration elimination parameter error	
Trigger condition and cause	Condition: the input value for the vibration elimination parameter is not appropriate. Cause: 1. Your input value for the vibration elimination parameter is not appropriate. 2. The Bode plot is in error due to other factors when the System Analysis tool of ASDA-Soft is in operation.
Checking method and corrective action	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, disable the vibration elimination function by setting P2.094 [Bit 8] & [Bit 9] = 0.

AL555 System failure	
Trigger condition and cause	Servo drive DSP is in error.
Checking method and corrective action	If this alarm occurs, send your servo drive directly back to Delta without making any modification.
How to clear the alarm?	N/A

AL809 PR motion setting error or command decoding error	
Trigger condition and cause	Condition: an error occurs when the servo drive decodes the motion command. Cause: incorrect motion command or abnormal software compiling may cause error in the PR program.
Checking method and corrective action	1. If this alarm occurs when the servo is not in the PR mode, save the parameter file and provide it to the distributor. 2. For advanced users: save the scope screenshot when the alarm occurs. Set two of the channels to P5.007 and P0.001, and then save the oscillogram.
How to clear the alarm?	Cycle power on the servo drive.

ALC31 Motor power cable disconnection	
Trigger condition and cause	Condition: disconnection of the motor power cable (U, V, W) and ground (GND). Cause: disconnection of the motor power cable (U, V, W) and ground (GND). The detection for motor power cable disconnection is set by P2.065 [Bit 9], which is enabled by default.
Checking method and corrective action	Check if the motor power cable (U, V, W) and ground (GND) are firmly connected. Follow the instructions in this user manual to properly connect the motor power cable and ground wire.
How to clear the alarm?	Cycle power on the servo drive.

ALCDB Servo drive model type error	
Trigger condition and cause	Servo drive model type error.
Checking method and corrective action	1. Update the firmware again. 2. If the issue persists after the firmware is updated, send your servo drive back to Delta.
How to clear the alarm?	Cycle power on the servo drive.

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A

A.1 ASDA-E3C-E servo drive

A.1.1 Specifications of the ASDA-E3C-E servo drive

A.1.1.1 220V models

ASD-E3C-			400 W	400 W	750 W	1 kW	1.5 kW
			0421-E1	0421-E 0421-EF	0721-E 0721-EF	1021-E 1021-EF	1521-E 1521-EF
Main circuit power	Phase / Voltage		Single-phase 220 V_{AC}				
	Permissible voltage		Single-phase 200 to 230 V_{AC}, -15% to +10%				
	Input current (1PH) (Arms)		3.7	3.7	6.37	10.0	11.3
Continuous output current (Arms)			2.65	2.65	5.1	7.3	8.3
Max. instantaneous output current (Arms)			10.6	10.6	14.14	21.21	27
Regenerative resistor	Built-in	Resistance (ohm)	100	-	100	100	100
		Capacity (Watt)	36	-	36	40	40
	External	Minimum allowable resistance (ohm)	60	60	60	30	30
Dynamic brake*2			N/A	N/A	N/A	N/A	N/A
Cooling method			Air convection cooling			Fan cooling	

Note:

1. The input current is the actual value measured at 220 V_{AC} when the servo drive is under the rated output condition.
2. The dynamic brake is activated when power to the servo drive is lost.

A

Specification table

Item		Specification
Servo drive resolution		24-bit (16777216 p/rev)
Main circuit control		SVPWM control
Tuning mode		Manual / Auto
Position control mode	Command source	Register
	Smoothing method	Low-pass filter; S-curve filter; moving filter
	E-Gear ratio	E-Gear ratio: N/M times; 1 ≤ N/M ≤ 262144
	Torque limit	Parameter settings
	Feedforward compensation	Parameter settings
Speed control mode	Speed control range[*1]	1 : 6000
	Command source	Register
	Smoothing method	Low-pass filter; S-curve filter; moving filter
	Torque limit	Parameter settings
	Bandwidth	2.5 kHz
	Speed calibration ratio[*2]	Max. ±0.01% at 0% to 100% load fluctuation
		Max. ±0.01% at ±10% power fluctuation
		Max. ±0.01% at ambient temperature of 0°C to 45°C (32°F to 113°F)
Torque control mode	Command source	Register
	Smoothing method	Low-pass filter
	Speed limit	Parameter settings
Digital input		6 DI points. Refer to Chapter 8 for the function settings.
Digital output		3 DO points. Refer to Chapter 8 for the function settings.
Protection function		Overcurrent, Overvoltage, Undervoltage, Abnormal IGBT temperature, Regeneration error, Overload, Excessive deviation of Speed command, Excessive deviation of Position command, CN2 communication failed, Emergency stop, Positive / negative limit error, Main power error, Short-circuit protection for terminals U, V, W, and so on.
Communication interface		Mini USB / EtherCAT
Environment	Installation site	Indoors (avoid direct sunlight), no corrosive vapor (avoid fumes, flammable gases, and dust)
	Altitude	Less than 2,000 m above sea level
	Atmospheric pressure	86 kPa - 106 kPa
	Ambient temperature	0°C to 55°C (32°F to 131°F) (If the ambient temperature is above 45°C (113°F), a derating of 10% at every temperature increase of 5°C (9°F) and forced cooling are required.)
	Storage temperature	-20°C to +65°C (-4°F to +149°F)
	Humidity	10 - 90% RH (non-condensing)
	Vibration	10 Hz to 57 Hz: 0.075 mm amplitude; 58 Hz to 150 Hz: 1 G
	IP rating	IP20
	Power system	TN system / TT system
	Approvals	IEC/EN 61800-5-1 CE

Note:
1. Within the rated load, the speed ratio is: the minimum speed (smooth operation) / rated speed.
2. Within the rated speed, the speed calibration ratio is: (rotation speed with no load - rotation speed with full load) / rated speed.
3. Use a single-phase three-wire power system for models using a single-phase power supply.
4. To meet the functional safety requirement, install the servo drive in the control cabinet with a rating of IP54 or higher.

A.1.1.2 400V models

ASD-E3C-			1 kW	1.5 kW	2 kW	3 kW
			1043-E	1543-E	2043-E	3043-E
Main circuit power	Phase / Voltage		Three-phase 400 V_{AC}			
	Permissible voltage		Three-phase 380 to 440 V_{AC}, -10% to +10%			
	Input current (1PH) (Arms)		2.91	3.52	5.06	6.14
Continuous output current (Arms)			3.37	4.09	5.96	9.11
Max. instantaneous output current (Arms)			7.07	10.6	18.98	27.33
Regenerative resistor	Built-in	Resistance (ohm)	100	100	50	50
		Capacity (Watt)	80	80	80	80
	External	Minimum allowable resistance (ohm)	80	60	45	40
Dynamic brake*2			Built-in	Built-in	Built-in	Built-in
Cooling method			Fan cooling			

Note:
1. The input current is the actual value measured at 400 V_{AC} when the servo drive is under the rated output condition.
2. The dynamic brake is activated when power to the servo drive is lost.

A

Specification table

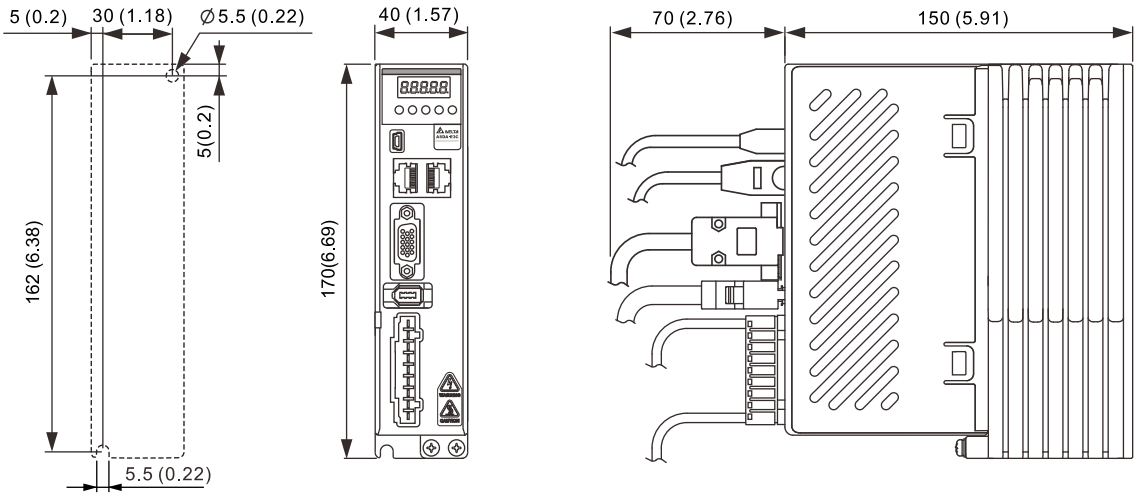
Item		Specification
Servo drive resolution		24-bit (16777216 p/rev)
Main circuit control		SVPWM control
Tuning mode		Manual / Auto
Position control mode	Command source	Register
	Smoothing method	Low-pass filter; S-curve filter; moving filter
	E-Gear ratio	E-Gear ratio: N/M times; 1 ≤ N/M ≤ 262144
	Torque limit	Parameter settings
	Feedforward compensation	Parameter settings
Speed control mode	Speed control range[*1]	1 : 6000
	Command source	Register
	Smoothing method	Low-pass filter; S-curve filter; moving filter
	Torque limit	Parameter settings
	Bandwidth	2.5 kHz
	Speed calibration ratio[*2]	Max. ±0.01% at 0% to 100% load fluctuation
		Max. ±0.01% at ±10% power fluctuation
		Max. ±0.01% at ambient temperature of 0°C to 45°C (32°F to 113°F)
Torque control mode	Command source	Register
	Smoothing method	Low-pass filter
	Speed limit	Parameter settings
Digital input		6 DI points. Refer to Chapter 8 for the function settings.
Digital output		3 DO points. Refer to Chapter 8 for the function settings.
Protection function		Overcurrent, Overvoltage, Undervoltage, Abnormal IGBT temperature, Regeneration error, Overload, Excessive deviation of Speed command, Excessive deviation of Position command, CN2 communication failed, Emergency stop, Positive / negative limit error, Main power error, Short-circuit protection for terminals U, V, W, and so on.
Communication interface		Mini USB / EtherCAT
Environment	Installation site	Indoors (avoid direct sunlight), no corrosive vapor (avoid fumes, flammable gases, and dust)
	Altitude	Less than 2,000 m above sea level
	Atmospheric pressure	86 kPa - 106 kPa
	Ambient temperature	0°C to 55°C (32°F to 131°F) (If the ambient temperature is above 45°C (113°F), a derating of 10% at every temperature increase of 5°C (9°F) and forced cooling are required.)
	Storage temperature	-20°C to +65°C (-4°F to +149°F)
	Humidity	10 - 90% RH (non-condensing)
	Vibration	10 Hz to 57 Hz: 0.075 mm amplitude; 58 Hz to 150 Hz: 1 G
	IP rating	IP20
	Power system	TN system / TT system
	Approvals	IEC/EN 61800-5-1 CE

Note:
1. Within the rated load, the speed ratio is: the minimum speed (smooth operation) / rated speed.
2. Within the rated speed, the speed calibration ratio is: (rotation speed with no load - rotation speed with full load) / rated speed.
3. To meet the functional safety requirement, install the servo drive in the control cabinet with a rating of IP54 or higher.

A.1.2 Dimensions of the servo drive

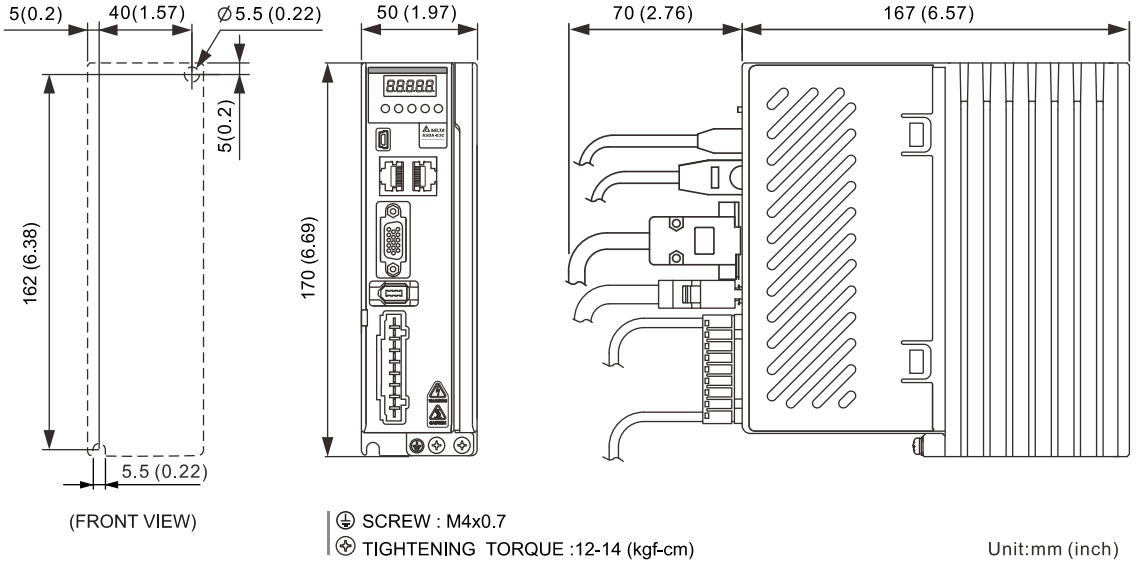
A.1.2.1 220V models

400 W



Weight	0.75 kg (1.65 lb)

750 W



Weight	1.15 kg (2.54 lb)

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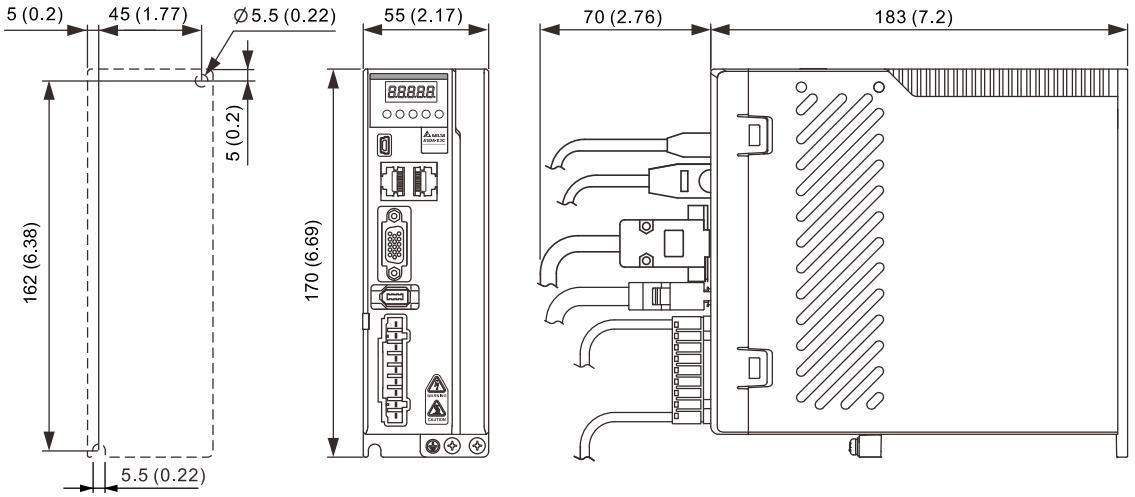
1 kW / 1.5 kW

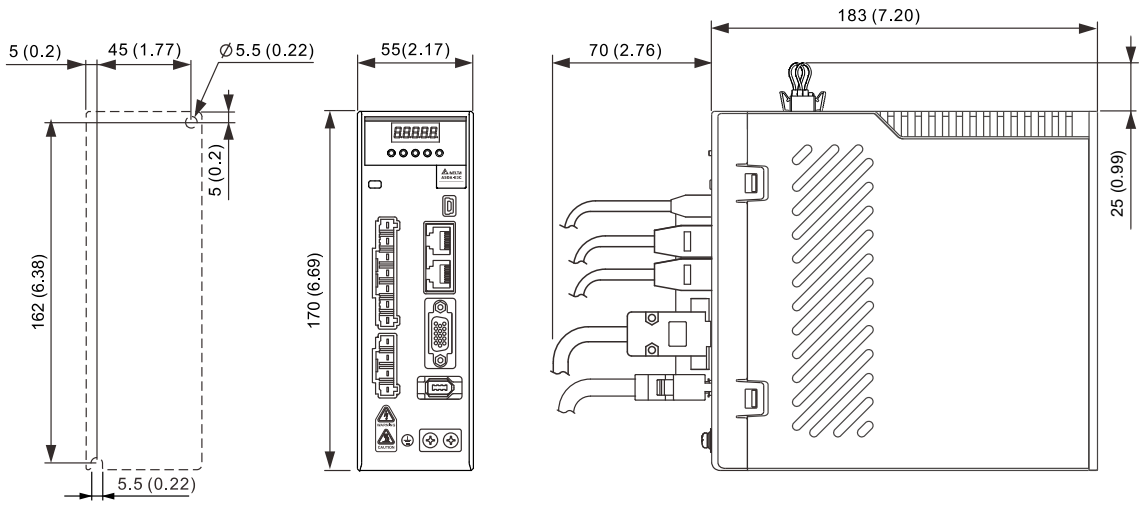


Weight	1.08 kg (2.4 lb)

Note: dimensions and weights of the servo drives may be updated without prior notice.

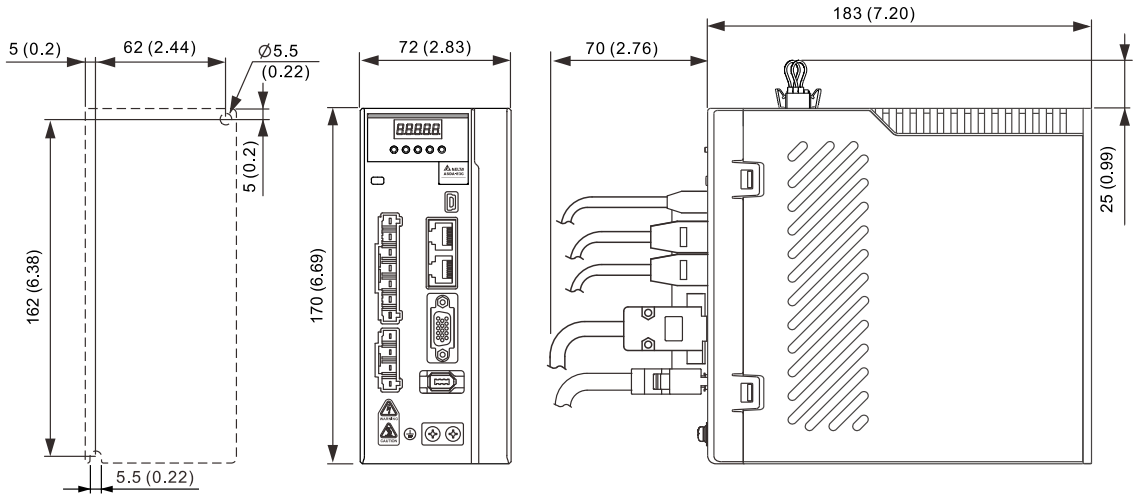
A.1.2.2 400V models

1 kW / 1.5 kW



Weight	1.23 kg (2.7 lb)

2 kW / 3 kW



Weight	1.53 kg (3.37 lb)

Note: dimensions and weights of the servo drives may be updated without prior notice.

A.2 ECM-E3 series servo motor

A.2.1 Specifications of ECM-E3 motors

A.2.1.1 220V models

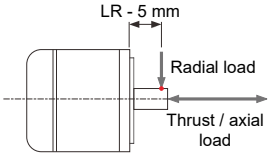
A

F80 and below motors (low & medium inertia)

ECM-		E3L-C□0401□□E	E3M-C□0602□□E	E3M-C□0604□□E	E3M-C□0807□□E
Rated power (kW)		0.1	0.2	0.4	0.75
Rated torque (N·m)[*1]		0.32	0.64	1.27	2.4
Max. torque (N·m)		1.12	2.24	4.45	8.4
Rated speed (rpm)		3000			
Max. speed (rpm)		6000			
Rated current (Arms)		0.857	1.42	2.40	4.27
Max. instantaneous current (Arms)		3.44	6.62	9.47	15.8
Change of rated power (kW/s)	No brake	34.25	29.05	63.50	53.83
	With brake	32.51	27.13	61.09	50.97
Rotor inertia ($\times 10^{-4}$ kg·m^2)	No brake	0.0299	0.141	0.254	1.07
	With brake	0.0315	0.151	0.264	1.13
Mechanical time constant (ms)	No brake	0.50	0.91	0.52	0.54
	With brake	0.53	0.97	0.54	0.57
Torque constant-KT (N·m/Arms)		0.374	0.45	0.53	0.56
Voltage constant-KE (mVrms/rpm)		13.8	16.96	19.76	20.17
Armature resistance (ohm)		8.22	4.71	2.04	0.55
Armature inductance (mH)		19.1	12.18	6.50	2.81
Electrical time constant (ms)		2.32	2.59	3.19	5.11
Weight (kg)	No brake	0.5	0.9	1.2	2.34
	With brake	0.7	1.3	1.6	3.15
Max. radial load (N)		78	245	245	392
Max. axial load (N)		54	74	74	147
Brake operating voltage		24 V_{DC} ± 10%			
Brake power consumption (at 20°C (68°F)) [W]		6.1	7.6	7.6	8.5
Brake holding torque [N·m (Min)][*2]		0.3	1.3	1.3	3.2
Brake release time [ms (Max)]		20	20	20	30
Brake pull-in time [ms (Max)]		35	50	50	60
Derating rate (with oil seal) (%)		10	10	5	5
Insulation class		Class A (UL), Class B (CE)			
Insulation resistance		100 MΩ min. (at 500 V_{DC})			
Insulation strength		1.8 kV_{AC}, 1 sec			
Vibration grade		V15			
Ambient temperature		-20°C to +60°C (-4°F to +140°F)[*3]			
Storage temperature		-20°C to +80°C (-4°F to +176°F)			
Ambient and storage humidity		20 - 90% RH (non-condensing)			
Vibration capacity		2.5 G			
IP rating		IP67 (for models using waterproof connectors and shaft seals or oil seals)			
Approvals		CE			

Note:

1. The rated torque is the permissible continuous torque when the motor mounted with the heat sink of the following dimensions is operating in a temperature range of 0°C - 40°C (32°F - 104°F).
   F40, F60, and F80: 250 mm x 250 mm x 6 mm
   Material: aluminum
2. The built-in motor brake is only for keeping the machine connected to the motor in a stopped state. Do not use it for deceleration or as a dynamic brake.
3. If the ambient temperature is over 40°C (104°F), refer to Section A.2.3 Power derating curves of the ECM-E3 motors.
4. Follow the load specification for the motor shaft during operation. The load types for the motor shaft are defined as follows.



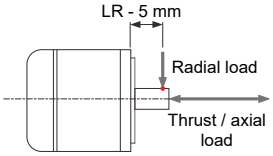
A

F80 and below motors (high inertia)

ECM-		E3H-C□0602□□E	E3H-C□0604□□E	E3H-C□0807□□E
Rated power (kW)		0.2	0.4	0.75
Rated torque (N·m)[*1]		0.64	1.27	2.4
Max. torque (N·m)		2.43	4.83	9.12
Rated speed (rpm)		3000	3000	3000
Max. speed (rpm)		6700	6700	6700
Rated current (Arms)		1.51	2.21	4.19
Max. instantaneous current (Arms)		6.12	8.46	16.3
Change of rated power (kW/s)	No brake	15.5	30.8	37.2
	With brake	14.6	30.0	35.6
Rotor inertia ($\times 10^{-4}$ kg·m^2)	No brake	0.265	0.523	1.55
	With brake	0.280	0.538	1.62
Mechanical time constant (ms)	No brake	1.78	1.31	0.825
	With brake	1.88	1.34	0.862
Torque constant-KT (N·m/Arms)		0.424	0.575	0.573
Voltage constant-KE (mVrms/rpm)		15.3	20.8	20.2
Armature resistance (ohm)		4.17	2.85	0.588
Armature inductance (mH)		2	3.5	1
Electrical time constant (ms)		0.48	1.23	1.70
Weight (kg)	No brake	0.70	1.05	2.15
	With brake	1.23	1.6	2.95
Max. radial load (N)		245	245	392
Max. axial load (N)		74	74	147
Brake operating voltage		24 V_{DC} ± 10%		
Brake power consumption (at 20°C (68°F)) [W]		7.6	7.6	8.5
Brake holding torque [N·m (Min)][*2]		1.3	1.3	3.2
Brake release time [ms (Max)]		20	20	30
Brake pull-in time [ms (Max)]		50	50	60
Derating rate (with oil seal) (%)		10	5	5
Insulation class		Class A (UL), Class B (CE)		
Insulation resistance		100 MΩ min. (at 500 V_{DC})		
Insulation strength		1.8 kV_{AC}, 1 sec		
Vibration grade		V15		
Ambient temperature		-20°C to +60°C (-4°F to +140°F)[*3]		
Storage temperature		-20°C to +80°C (-4°F to +176°F)		
Ambient and storage humidity		20 - 90% RH (non-condensing)		
Vibration capacity		2.5 G		
IP rating		IP67 (for models using waterproof connectors and shaft seals or oil seals)		
Approvals		CE		

Note:

1. The rated torque is the permissible continuous torque when the motor mounted with the heat sink of the following dimensions is operating in a temperature range of 0°C - 40°C (32°F - 104°F).
   F60 and F80: 250 mm x 250 mm x 6 mm
   Material: aluminum
2. The built-in motor brake is only for keeping the machine connected to the motor in a stopped state. Do not use it for deceleration or as a dynamic brake.
3. If the ambient temperature is over 40°C (104°F), refer to Section A.2.3 Power derating curves of the ECM-E3 motors.
4. Follow the load specification for the motor shaft during operation. The load types for the motor shaft are defined as follows.



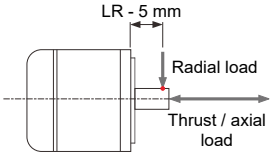
A

F130 motors (medium & high inertia)

ECM-		E3M-E□1310□□E	E3M-E□1315□□E	E3H-F□1308□□E	E3H-F□1313□□E
Rated power (kW)		1	1.5	0.85	1.3
Rated torque (N·m)[*1]		4.77	7.16	5.39	8.34
Max. torque (N·m)		14.3	21.48	16.17	25.02
Rated speed (rpm)		2000	2000	1500	1500
Max. speed (rpm)		3000	3000	4000	4000
Rated current (Arms)		5.96	8.17	6.65	7.70
Max. instantaneous current (Arms)		19.9	26.82	20.0	23.9
Change of rated power (kW/s)	No brake	29.21	45.69	23.4	38.6
	With brake	28.66	45.09	23.0	38.3
Rotor inertia ($\times 10^{-4}$ kg·m^2)	No brake	7.79	11.22	12.44	18.00
	With brake	7.94	11.37	12.62	18.14
Mechanical time constant (ms)	No brake	1.46	1.10	2.48	1.98
	With brake	1.49	1.12	2.52	1.99
Torque constant-KT (N·m/Arms)		0.80	0.88	0.811	1.08
Voltage constant-KE (mVrms/rpm)		29.30	31.69	29.8	38.8
Armature resistance (ohm)		0.419	0.260	0.460	0.440
Armature inductance (mH)		4	2.81	2.50	2.76
Electrical time constant (ms)		9.55	10.81	5.43	6.27
Weight (kg)	No brake	4.9	6.0	6.0	7.0
	With brake	6.3	7.4	7.5	8.5
Max. radial load (N)		490	686	490	686
Max. axial load (N)		98	343	98	343
Brake operating voltage		24 V_{DC} ± 10%			
Brake power consumption (at 20°C (68°F)) [W]		21.5	21.5	24	24
Brake holding torque [N·m (Min)][*2]		10	10	16	16
Brake release time [ms (Max)]		50	50	60	60
Brake pull-in time [ms (Max)]		110	110	120	120
Derating rate (with oil seal) (%)		5	5	5	5
Insulation class		Class A (UL), Class B (CE)		Class F (UL), Class F (CE)	
Insulation resistance		100 MΩ min. (at 500 V_{DC})			
Insulation strength		1.8 kV_{AC}, 1 sec			
Vibration grade		V15			
Ambient temperature		-20°C to +60°C (-4°F to +140°F)[*3]			
Storage temperature		-20°C to +80°C (-4°F to +176°F)			
Ambient and storage humidity		20 - 90% RH (non-condensing)			
Vibration capacity		2.5 G			
IP rating		IP67 (for models using shaft seals or oil seals)			
Approvals		CE			

Note:

1. The rated torque is the permissible continuous torque when the motor mounted with the heat sink of the following dimensions is operating in a temperature range of 0°C - 40°C (32°F - 104°F).
   F130: 400 mm x 400 mm x 20 mm
   Material: aluminum
2. The built-in motor brake is only for keeping the machine connected to the motor in a stopped state. Do not use it for deceleration or as a dynamic brake.
3. If the ambient temperature is over 40°C (104°F), refer to Section A.2.3 Power derating curves of the ECM-E3 motors.
4. Follow the load specification for the motor shaft during operation. The load types for the motor shaft are defined as follows.



A.2.1.2 400V models

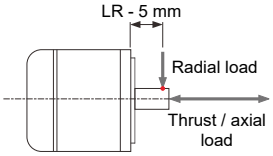
F80 and below motors (medium inertia)

A

ECM-		E3M-J□0807□□E
Rated power (kW)		0.75
Rated torque (N·m)[*1]		2.4
Max. torque (N·m)		8.4
Rated speed (rpm)		3000
Max. speed (rpm)		6000
Rated current (Arms)		2.15
Max. instantaneous current (Arms)		7.90
Change of rated power (kW/s)	No brake	53.83
	With brake	50.97
Rotor inertia ($\times 10^{-4}$ kg·m^2)	No brake	1.07
	With brake	1.13
Mechanical time constant (ms)	No brake	0.55
	With brake	0.58
Torque constant-KT (N·m/Arms)		1.12
Voltage constant-KE (mVrms/rpm)		40.34
Armature resistance (ohm)		2.20
Armature inductance (mH)		11.2
Electrical time constant (ms)		5.09
Weight (kg)	No brake	2.34
	With brake	3.15
Max. radial load (N)		392
Max. axial load (N)		147
Brake operating voltage		24 V_{DC} ± 10%
Brake power consumption (at 20°C (68°F)) [W]		8.5
Brake holding torque [N·m (Min)][*2]		3.2
Brake release time [ms (Max)]		40
Brake pull-in time [ms (Max)]		60
Derating rate (with oil seal) (%)		5
Insulation class		Class A (UL), Class B (CE)
Insulation resistance		100 MΩ min. (at 500 V_{DC})
Insulation strength		2.3 kV_{AC}, 1 sec
Vibration grade		V15
Ambient temperature		-20°C to +60°C (-4°F to +140°F)[*3]
Storage temperature		-20°C to +80°C (-4°F to +176°F)
Ambient and storage humidity		20 - 90% RH (non-condensing)
Vibration capacity		2.5 G
IP rating		IP67 (for models using waterproof connectors and shaft seals or oil seals)
Approvals		CE c UL us

Note:

1. The rated torque is the permissible continuous torque when the motor mounted with the heat sink of the following dimensions is operating in a temperature range of 0°C - 40°C (32°F - 104°F).
   F80: 250 mm x 250 mm x 6 mm
   Material: aluminum
2. The built-in motor brake is only for keeping the machine connected to the motor in a stopped state. Do not use it for deceleration or as a dynamic brake.
3. If the ambient temperature is over 40°C (104°F), refer to Section A.2.3 Power derating curves of the ECM-E3 motors.
4. Follow the load specification for the motor shaft during operation. The load types for the motor shaft are defined as follows.



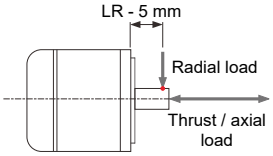
A

F100 motors (medium inertia)

ECM-		E3M-J□1010□□E	E3M-J□1015□□E	E3M-J□1020□□E
Rated power (kW)		1	1.5	2
Rated torque (N·m)[*1]		3.18	4.77	6.37
Max. torque (N·m)		9.54	14.31	19.11
Rated speed (rpm)		3000		
Max. speed (rpm)		6000		
Rated current (Arms)		3.03	3.73	5.00
Max. instantaneous current (Arms)		9.21	11.4	15.3
Change of rated power (kW/s)	No brake	36.4	61.7	86.7
	With brake	33.0	57.3	82.0
Rotor inertia ($\times 10^{-4}$ kg·m^2)	No brake	2.78	3.69	4.68
	With brake	3.06	3.97	4.95
Mechanical time constant (ms)	No brake	0.737	0.546	0.528
	With brake	0.811	0.587	0.559
Torque constant-KT (N·m/Arms)		1.05	1.28	1.27
Voltage constant-KE (mVrms/rpm)		39.5	47.8	47.2
Armature resistance (ohm)		1.05	0.864	0.646
Armature inductance (mH)		7.50	6.63	4.89
Electrical time constant (ms)		7.14	7.67	7.57
Weight (kg)	No brake	3.56	4.37	5.09
	With brake	4.88	5.68	6.505
Max. radial load (N)		490	490	490
Max. axial load (N)		196	196	196
Brake operating voltage		24 V_{DC} ± 10%		
Brake power consumption (at 20°C (68°F)) [W]		17.6	17.6	17.6
Brake holding torque [N·m (Min)][*2]		9.5	9.5	9.5
Brake release time [ms (Max)]		50	50	50
Brake pull-in time [ms (Max)]		110	110	110
Derating rate (with oil seal) (%)		5	5	5
Insulation class		Class A (UL), Class B (CE)		
Insulation resistance		100 MΩ min. (at 500 V_{DC})		
Insulation strength		2.3 kV_{AC}, 1 sec		
Vibration grade		V15		
Ambient temperature		-20°C to +60°C (-4°F to +140°F)[*3]		
Storage temperature		-20°C to +80°C (-4°F to +176°F)		
Ambient and storage humidity		20 - 90% RH (non-condensing)		
Vibration capacity		2.5 G		
IP rating		IP67 (for models using shaft seals or oil seals)		
Approvals				

Note:

1. The rated torque is the permissible continuous torque when the motor mounted with the heat sink of the following dimensions is operating in a temperature range of 0°C - 40°C (32°F - 104°F).
   F100: 300 mm x 300 mm x 12 mm
   Material: aluminum
2. The built-in motor brake is only for keeping the machine connected to the motor in a stopped state. Do not use it for deceleration or as a dynamic brake.
3. If the ambient temperature is over 40°C (104°F), refer to Section A.2.3 Power derating curves of the ECM-E3 motors.
4. Follow the load specification for the motor shaft during operation. The load types for the motor shaft are defined as follows.



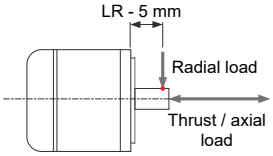
A

F130 motors (medium & high inertia)

ECM-		E3M-K□1310□□E	E3M-K□1315□□E	E3M-K□1320□□E	E3H-L□1308□□E	E3H-L□1313□□E	E3H-L□1318□□E
Rated power (kW)		1.0	1.5	2.0	0.85	1.3	1.8
Rated torque (N·m)[*1]		4.77	7.16	9.55	5.39	8.34	11.5
Max. torque (N·m)		14.3	21.48	28.65	16.17	25.02	34.5
Rated speed (rpm)		2000			1500		
Max. speed (rpm)		3000			4000		
Rated current (Arms)		3.00	4.09	5.30	3.35	3.85	5.75
Max. instantaneous current (Arms)		9.95	13.37	17.1	10.0	12.0	18.1
Change of rated power (kW/s)	No brake	29.21	45.69	62.25	23.4	38.6	58.5
	With brake	28.66	45.09	61.62	23.0	38.3	58.0
Rotor inertia ($\times 10^{-4}$ kg·m^2)	No brake	7.79	11.22	14.65	12.44	18.00	22.60
	With brake	7.94	11.37	14.80	12.62	18.14	22.80
Mechanical time constant (ms)	No brake	1.47	1.10	1.03	2.50	1.97	1.69
	With brake	1.50	1.12	1.04	2.54	1.99	1.71
Torque constant-KT (N·m/Arms)		1.59	1.75	1.80	1.61	2.17	2.00
Voltage constant-KE (mVrms/rpm)		58.60	63.38	65.40	59.5	77.6	70.7
Armature resistance (ohm)		1.68	1.04	0.792	1.84	1.76	1.01
Armature inductance (mH)		16.0	11.2	8.72	10.0	11.0	6.80
Electrical time constant (ms)		9.52	10.8	11.0	5.43	6.25	6.73
Weight (kg)	No brake	4.9	6.0	7.0	6.0	7.0	8.0
	With brake	6.3	7.4	8.5	7.5	8.5	9.5
Max. radial load (N)		490	686	980	490	686	980
Max. axial load (N)		98	343	392	98	343	392
Brake operating voltage		24 V_{DC} ± 10%					
Brake power consumption (at 20°C (68°F)) [W]		21.5	21.5	21.5	24	24	24
Brake holding torque [N·m (Min)][*2]		10	10	10	16	16	16
Brake release time [ms (Max)]		50	50	50	60	60	60
Brake pull-in time [ms (Max)]		110	110	110	120	120	120
Derating rate (with oil seal) (%)		5	5	5	5	5	5
Insulation class		Class A (UL), Class B (CE)			Class F (UL), Class F (CE)		
Insulation resistance		100 MΩ min. (at 500 V_{DC})					
Insulation strength		2.3 kV_{AC}, 1 sec					
Vibration grade		V15					
Ambient temperature		-20°C to +60°C (-4°F to +140°F)[*3]					
Storage temperature		-20°C to +80°C (-4°F to +176°F)					
Ambient and storage humidity		20 - 90% RH (non-condensing)					
Vibration capacity		2.5 G					
IP rating		IP67 (for models using shaft seals or oil seals)					
Approvals		CE cULus					

Note:

1. The rated torque is the permissible continuous torque when the motor mounted with the heat sink of the following dimensions is operating in a temperature range of 0°C - 40°C (32°F - 104°F).
   F130: 400 mm x 400 mm x 20 mm
   Material: aluminum
2. The built-in motor brake is only for keeping the machine connected to the motor in a stopped state. Do not use it for deceleration or as a dynamic brake.
3. If the ambient temperature is over 40°C (104°F), refer to Section A.2.3 Power derating curves of the ECM-E3 motors.
4. Follow the load specification for the motor shaft during operation. The load types for the motor shaft are defined as follows.



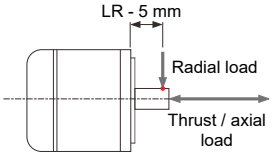
A

F180 motors (medium inertia)

ECM-		E3M-K□1820□□E	E3M-L□1830□□E	E3M-L□1845□□E	E3M-L□1855□□E	E3M-L□1875□□E
Rated power (kW)		2	3	4.5	5.5	7.5
Rated torque (N·m)[*1]		9.55	19.1	28.65	35.01	47.75
Max. torque (N·m)		28.65	57.29	71.6	105	119
Rated speed (rpm)		2000	1500	1500		
Max. speed (rpm)		3000	3000	4000		
Rated current (Arms)		5.7	9.1	13.3	15.3	22.1
Max. instantaneous current (Arms)		18.1	29.45	35.35	49.29	56.68
Change of rated power (kW/s)	No brake	31.33	68.02	121	124	169
	With brake	30.02	66.45	119	122	167
Rotor inertia (× 10^{-4} kg·m^2)	No brake	29.11	53.63	67.73	98.88	134.95
	With brake	30.38	54.9	69.15	100.1	136.24
Mechanical time constant (ms)	No brake	1.83	1.21	1.07	1.01	1.01
	With brake	1.91	1.24	1.09	1.02	1.02
Torque constant-KT (N·m/Arms)		1.68	2.10	2.15	2.29	2.16
Voltage constant-KE (mVrms/rpm)		63.2	75.8	78.8	81.8	77.4
Armature resistance (ohm)		0.636	0.344	0.255	0.182	0.120
Armature inductance (mH)		9.36	6.08	4.68	3.48	2.27
Electrical time constant (ms)		14.72	17.67	18.4	19.1	18.9
Weight (kg)	No brake	10	13.9	16.5	21.2	27.2
	With brake	13.7	17.6	20.2	24.9	30.9
Max. radial load (N)		1470	1470	1470	1764	1764
Max. axial load (N)		490	490	490	588	588
Brake operating voltage		24 V_{DC} ± 10%				
Brake power consumption (at 20°C (68°F)) [W]		31	31	31	31	31
Brake holding torque [N·m (Min)][*2]		25	25	55	55	55
Brake release time [ms (Max)]		30	30	50	50	50
Brake pull-in time [ms (Max)]		120	120	150	150	150
Derating rate (with oil seal) (%)		5	5	0	0	0
Insulation class		Class A (UL), Class B (CE)		Class F (UL), Class F (CE)		
Insulation resistance		100 MΩ min. (at 500 V_{DC})				
Insulation strength		2.3 kV_{AC}, 1 sec				
Vibration grade		V15				
Ambient temperature		-20°C to +60°C (-4°F to +140°F)[*3]				
Storage temperature		-20°C to +80°C (-4°F to +176°F)				
Ambient and storage humidity		20 - 90% RH (non-condensing)				
Vibration capacity		2.5 G				
IP rating		IP67 (for models using shaft seals or oil seals)				
Approvals		CE c UL us				

Note:

1. The rated torque is the permissible continuous torque when the motor mounted with the heat sink of the following dimensions is operating in a temperature range of 0°C - 40°C (32°F - 104°F).
   F180: 550 mm x 550 mm x 30 mm
   Material: aluminum
2. The built-in motor brake is only for keeping the machine connected to the motor in a stopped state. Do not use it for deceleration or as a dynamic brake.
3. If the ambient temperature is over 40°C (104°F), refer to Section A.2.3 Power derating curves of the ECM-E3 motors.
4. Follow the load specification for the motor shaft during operation. The load types for the motor shaft are defined as follows.



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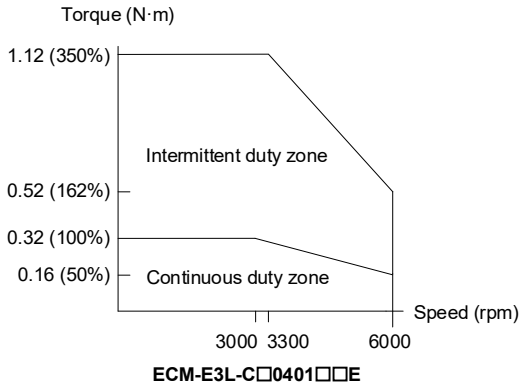
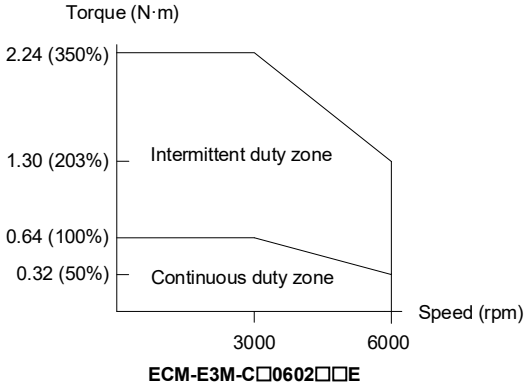
A.2.2 Torque features (T-N curves) of the ECM-E3 motors

A.2.2.1 220V models

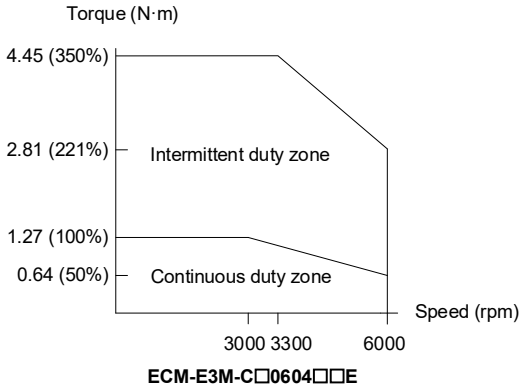
F80 and below motors



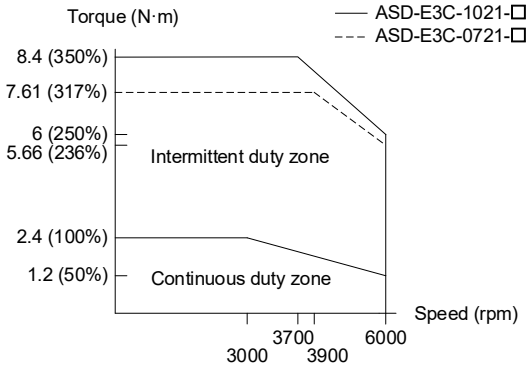
ECM-E3L-C□0401□□E



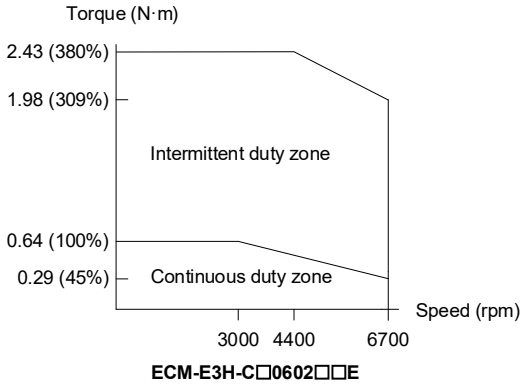
ECM-E3M-C□0602□□E



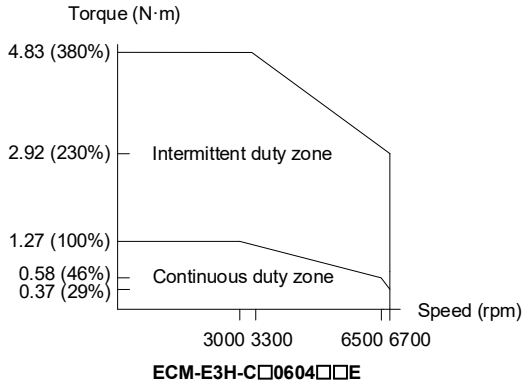
ECM-E3M-C□0604□□E



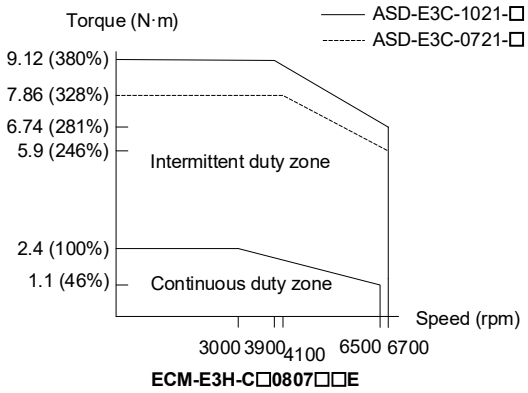
ECM-E3M-C□0807□□E



ECM-E3H-C□0602□□E

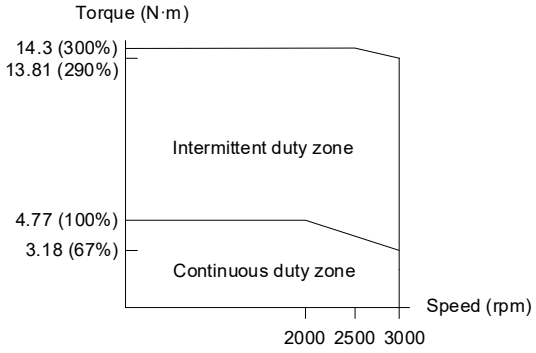


ECM-E3H-C□0604□□E

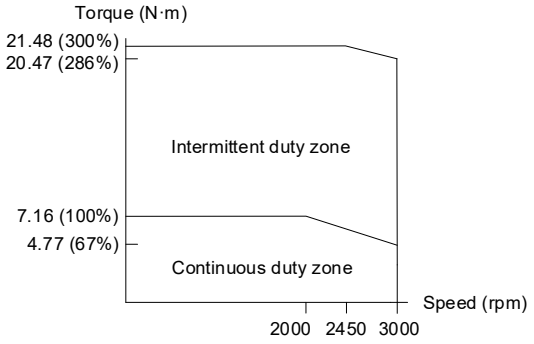


ECM-E3H-C□0807□□E

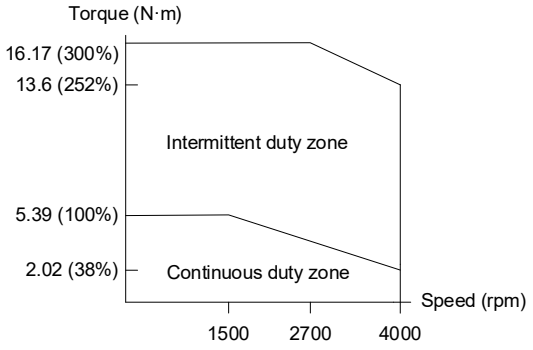
F130 motors



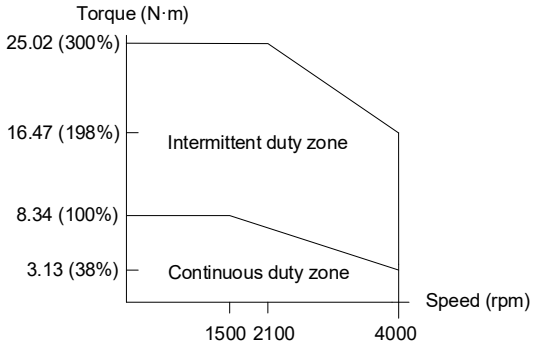
ECM-E3M-E□1310□□E



ECM-E3M-E□1315□□E



ECM-E3H-F□1308□□E



ECM-E3H-F□1313□□E

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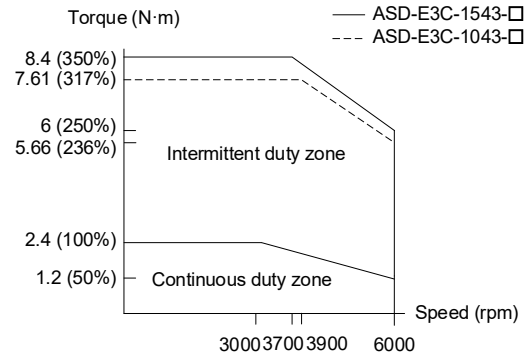
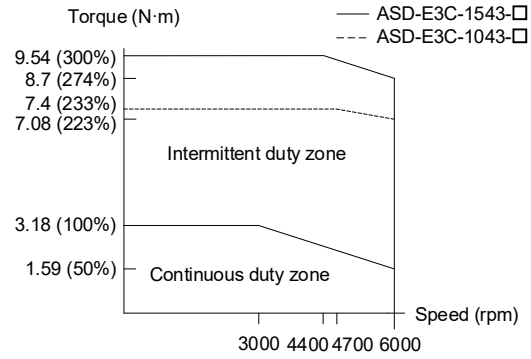
A.2.2.2 400V models

F80 and below motors

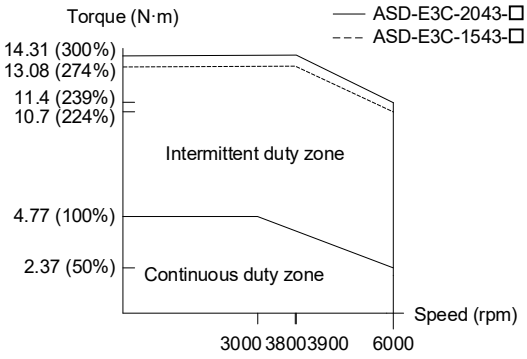


ECM-E3M-J□0807□□E

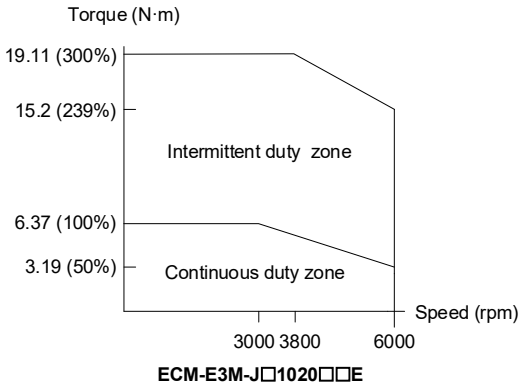
F100 motors



ECM-E3M-J□1010□□E

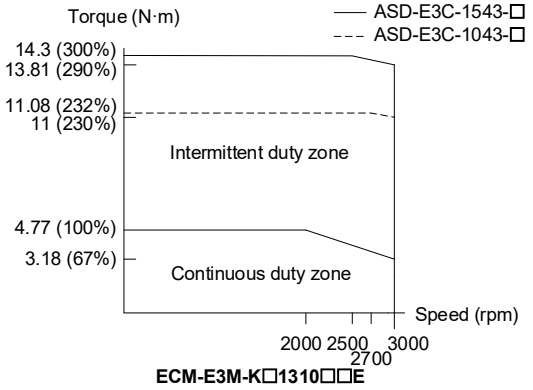


ECM-E3M-J□1015□□E

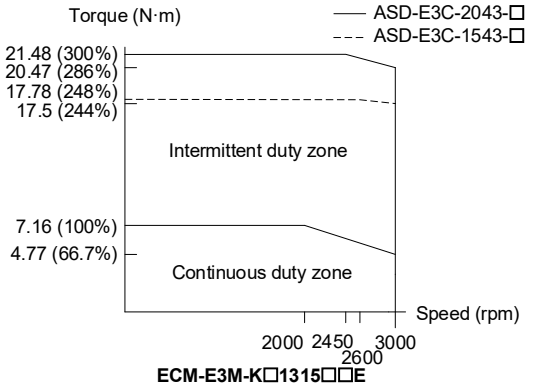


ECM-E3M-J□1020□□E

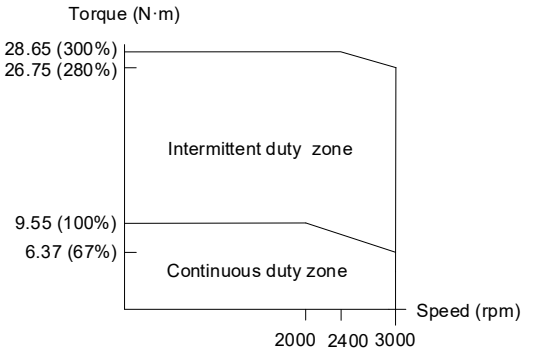
F130 motors



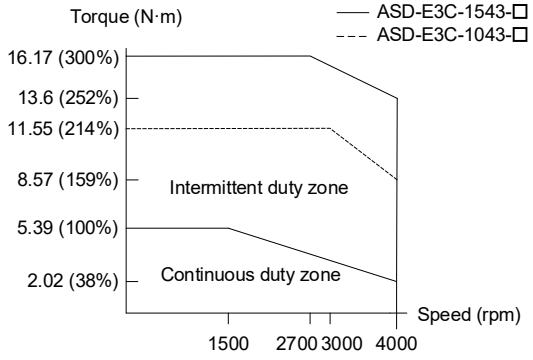
ECM-E3M-K□1310□□E



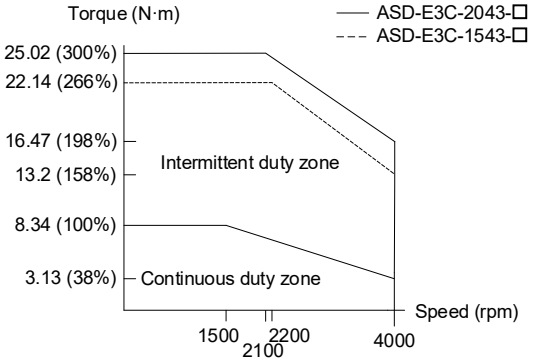
ECM-E3M-K□1315□□E



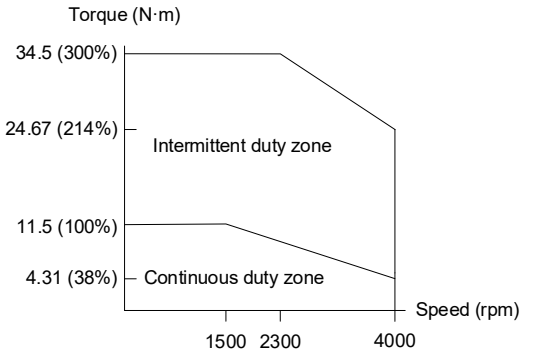
ECM-E3M-K□1320□□E



ECM-E3H-L□1308□□E

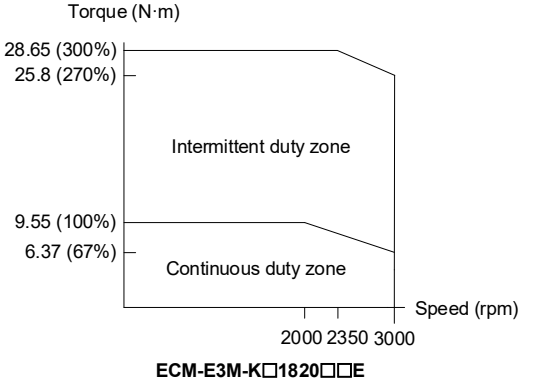


ECM-E3H-L□1313□□E

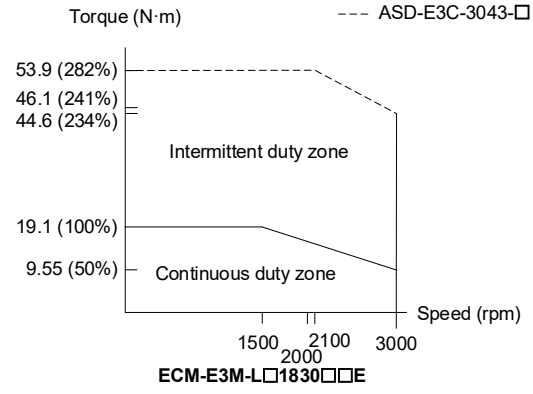


ECM-E3H-L□1318□□E

F180 motors



ECM-E3M-K□1820□□E



ECM-E3M-L□1830□□E

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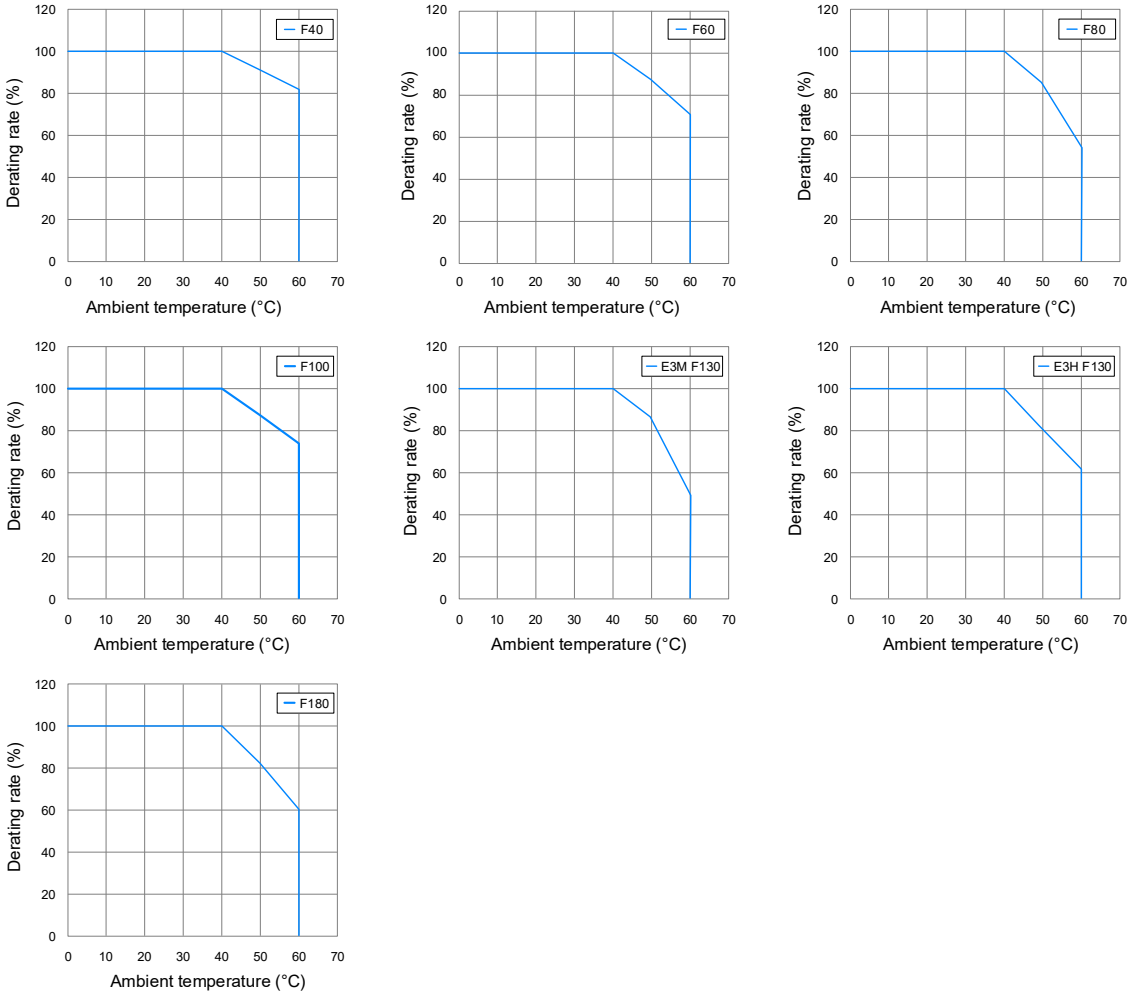
A.2.3 Power derating curves of the ECM-E3 motors



Note: the preceding specifications are applicable to 220V and 400V models.

A.2.4 Overload features

Definition of overload protection

The overload protection prevents the motor from overheating.

A

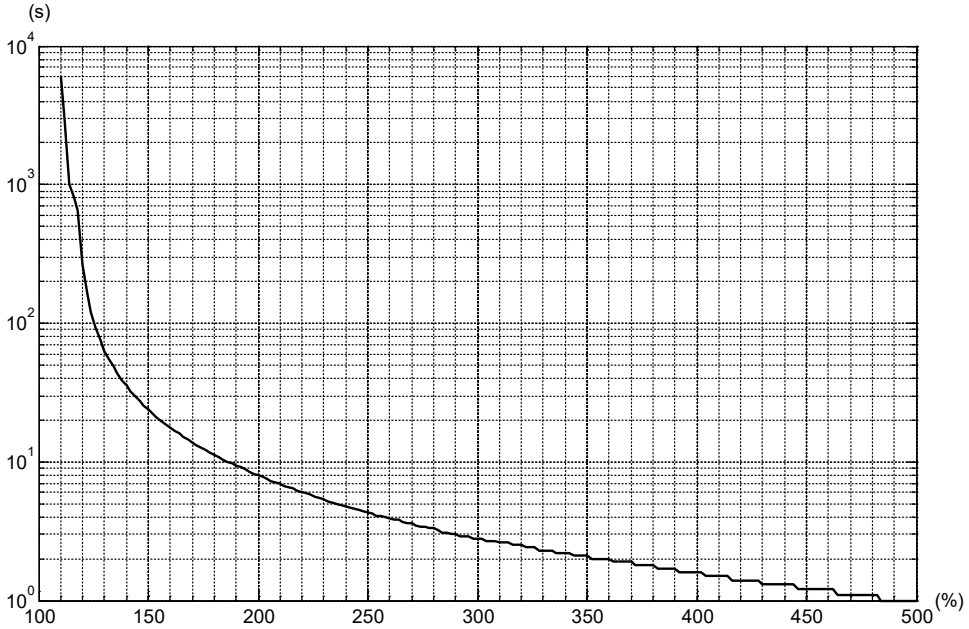
Causes of overload

1. The motor's operating torque exceeds the rated range and the operation exceeds the allowable operating time.
2. The inertia ratio is too high and the motor frequently accelerates and decelerates.
3. Incorrect wiring of the power and encoder cables.
4. Incorrect servo gain setting causes motor resonance.
5. A motor with a built-in brake operates without the brake released.

Graph of load ratio and operating time

220V models: low inertia (ECM-E3L-C motors), medium inertia (ECM-E3M-C motors), high inertia (ECM-E3H-C motors)

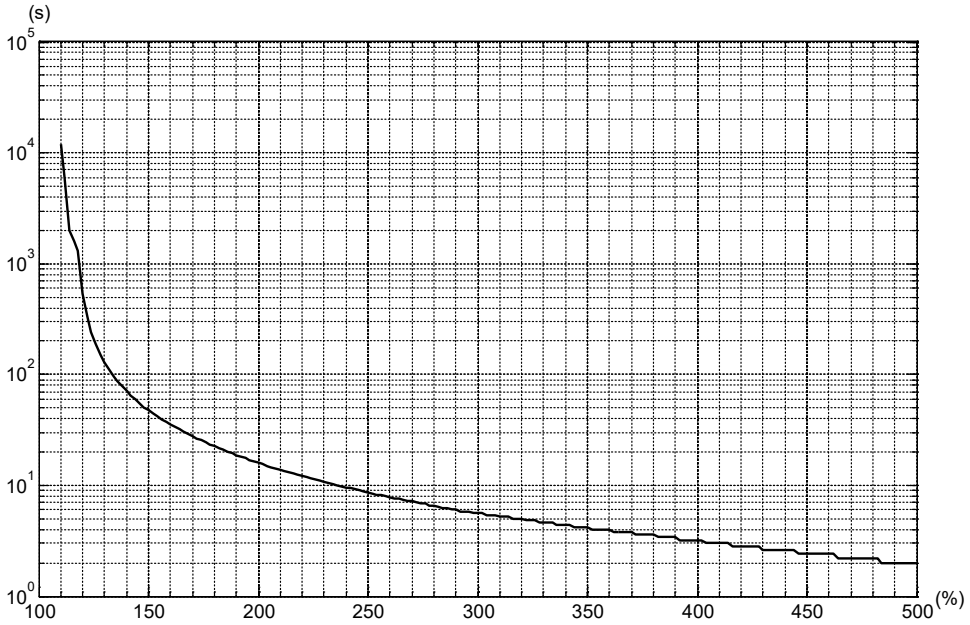
400V models: medium inertia (ECM-E3M-J motors)



Load ratio	120%	140%	160%	180%	200%	220%	240%
Operating time	263.8 s	35.2 s	17.6 s	11.2 s	8 s	6.1 s	4.8 s
Load ratio	260%	280%	300%	350%	400%	450%	500%
Operating time	3.9 s	3.3 s	2.8 s	2.1 s	1.6 s	1.2 s	1 s

220V models: medium inertia (ECM-E3M-E / F motors)

400V models: medium inertia (ECM-E3M-K / L motors), high inertia (ECM-E3H-L motors)

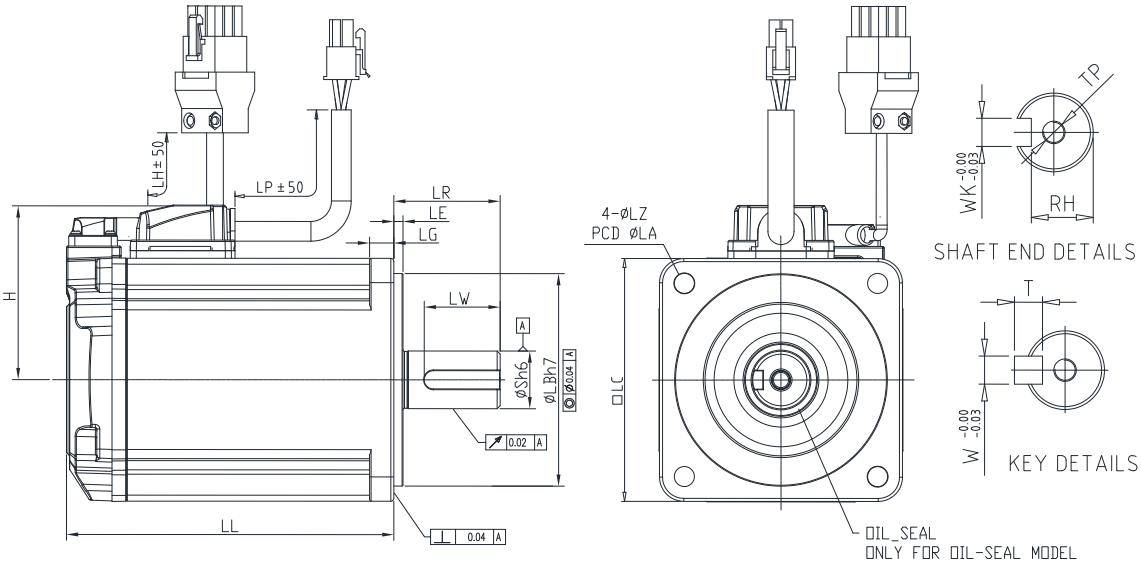


Load ratio	120%	140%	160%	180%	200%	220%	240%
Operating time	527.6 s	70.4 s	35.2 s	22.4 s	16 s	12.2 s	9.6 s
Load ratio	260%	280%	300%	350%	400%	450%	500%
Operating time	7.8 s	6.6 s	5.6 s	4.2 s	3.2 s	2.4 s	2 s

A.2.5 Dimensions of ECM-E3 series servo motor

A.2.5.1 220V models

F80 and below motors with cables (low & medium inertia)

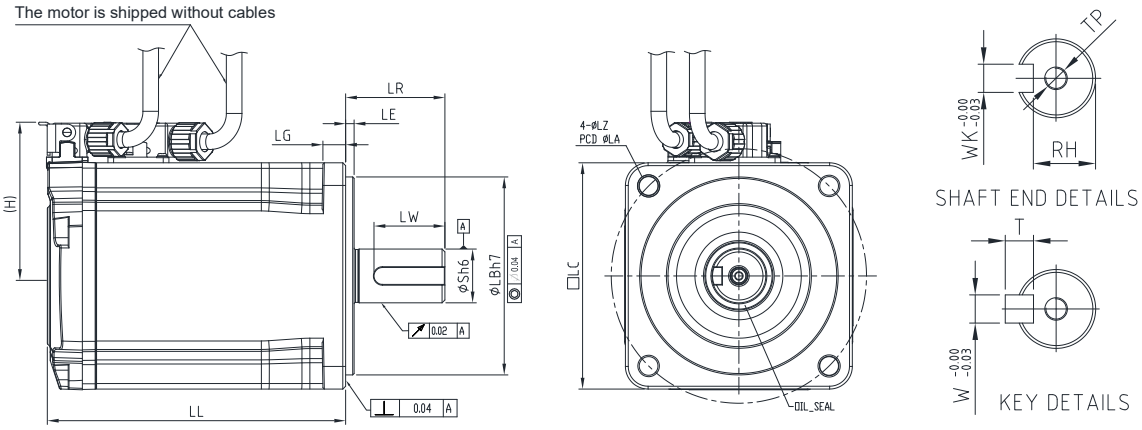


Unit: mm

ECM-	E3L-C□0401□□E	E3M-C□0602□□E	E3M-C□0604□□E	E3M-C□0807□□E
LC	40	60	60	80
LZ	4.5	5.5	5.5	6.6
LA	46	70	70	90
S	$8(^{+0}_{-0.009})$	$14(^{+0}_{-0.011})$	$14(^{+0}_{-0.011})$	$19(^{+0}_{-0.013})$
LB	$30(^{+0}_{-0.021})$	$50(^{+0}_{-0.025})$	$50(^{+0}_{-0.025})$	$70(^{+0}_{-0.030})$
LL (no brake)	77.6	72.5	91	105.2
LL (with brake)	111.7	109.4	127.9	144.8
LH	300	300	300	300
LP	300	300	300	300
H	36.5	47.5	47.5	57.5
LR	25	30	30	35
LE	2.5	3	3	3
LG	5	7.5	7.5	8
LW	16	20	20	25
RH	6.2	11	11	15.5
WK	3	5	5	6
W	3	5	5	6
T	3	5	5	6
TP	M3 Depth 8	M4 Depth 15	M4 Depth 15	M6 Depth 20

A

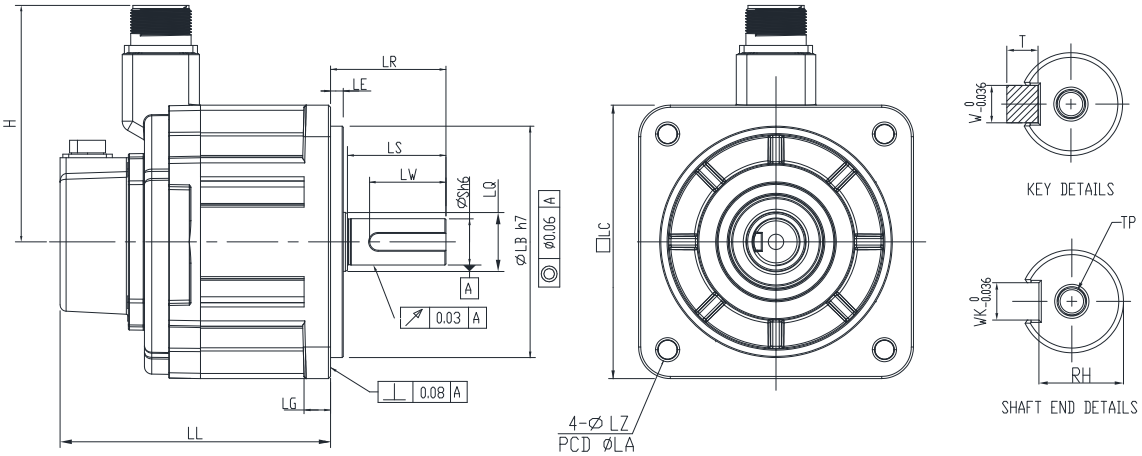
F80 and below motors with bulkhead receptacles (low & medium & high inertia)



Unit: mm

ECM-	E3L-C□0401□BE	E3M-C□0602□BE	E3M-C□0604□BE	E3M-C□0807□BE	E3H-C□0602□BE	E3H-C□0604□BE	E3H-C□0807□BE
LC	40	60	60	80	60	60	80
LZ	4.5	5.5	5.5	6.6	5.5	5.5	6.6
LA	46	70	70	90	70	70	90
S	$8(^{+0}_{-0.009})$	$14(^{+0}_{-0.011})$	$14(^{+0}_{-0.011})$	$19(^{+0}_{-0.013})$	$14(^{+0}_{-0.011})$	$14(^{+0}_{-0.011})$	$19(^{+0}_{-0.013})$
LB	$30(^{+0}_{-0.021})$	$50(^{+0}_{-0.025})$	$50(^{+0}_{-0.025})$	$70(^{+0}_{-0.030})$	$50(^{+0}_{-0.025})$	$50(^{+0}_{-0.025})$	$70(^{+0}_{-0.030})$
LL (no brake)	76.2	72.5	91	105.2	69.6	87.45	95.4
LL (with brake)	107.7	104.4	122.9	140.8	101.5	119.35	131
H	34	44	44	54	44	44	54
LR	25	30	30	35	30	30	35
LE	2.5	3	3	3	3	3	3
LG	5	7.5	7.5	8	7.5	7.5	8
LW	16	20	20	25	20	20	25
RH	6.2	11	11	15.5	11	11	15.5
WK	3	5	5	6	5	5	6
W	3	5	5	6	5	5	6
T	3	5	5	6	5	5	6
TP	M3 Depth 8	M4 Depth 15	M4 Depth 15	M6 Depth 20	M4 Depth 15	M4 Depth 15	M6 Depth 20

F130 motors (medium & high inertia)



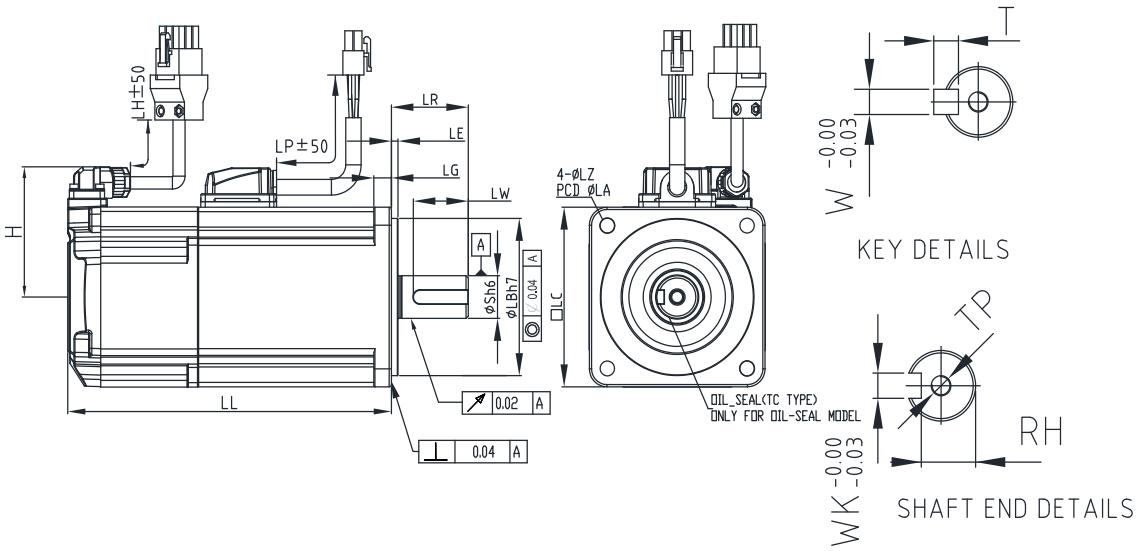
Unit: mm

ECM-	E3M-E□1310□□E	E3M-E□1315□□E	E3H-F□1308□□E	E3H-F□1313□□E
LC	130	130	130	130
LZ	9	9	9	9
LA	145	145	145	145
S	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$
LB	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$
LL (no brake)	127.9	139.9	127.9	139.9
LL (with brake)	168.5	180.5	168.5	180.5
H	115	115	115	115
LS	47	47	47	47
LR	55	55	55	55
LQ	28	28	28	28
LE	6	6	6	6
LG	12.5	12.5	12.5	12.5
LW	36	36	36	36
RH	18	18	18	18
WK	8	8	8	8
W	8	8	8	8
T	7	7	7	7
TP	M6 Depth 12	M6 Depth 12	M6 Depth 12	M6 Depth 12

A.2.5.2 400V models

F80 and below motors with cables (medium inertia)

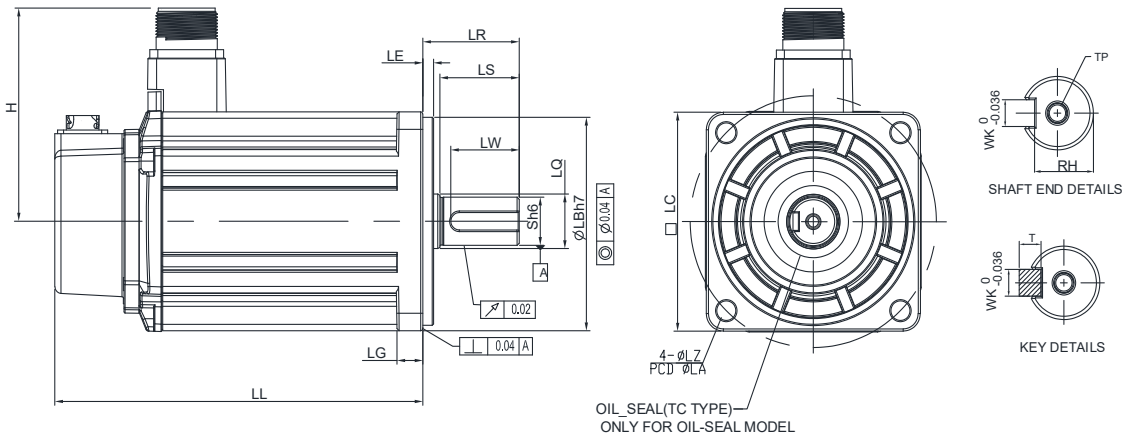
A



Unit: mm

ECM-	E3M-J□0807□□E
LC	80
LZ	6.6
LA	90
S	$19(^{+0}_{-0.013})$
LB	$70(^{+0}_{-0.030})$
LL (no brake)	105.2
LL (with brake)	144.8
LH	300
LP	300
H	58.5
LR	35
LE	3
LG	8
LW	25
RH	15.5
WK	6
W	6
T	6
TP	M6 Depth 20

F100 models (medium inertia)

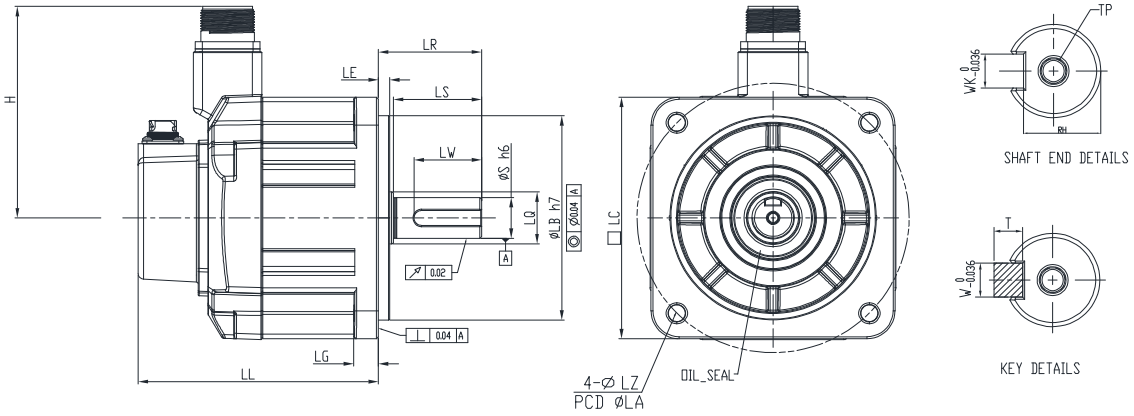


Unit: mm

ECM-	E3M-J□1010□□E	E3M-J□1015□□E	E3M-J□1020□□E
LC	100	100	100
LZ	9	9	9
LA	115	115	115
S	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$
LB	$95(^{+0}_{-0.030})$	$95(^{+0}_{-0.030})$	$95(^{+0}_{-0.030})$
LL (no brake)	141.8	156.8	171.8
LL (with brake)	179.9	194.9	209.9
H	97.4	97.4	97.4
LS	37	37	37
LR	45	45	45
LQ	25	25	25
LE	5	5	5
LG	12	12	12
LW	32	32	32
RH	18	18	18
WK	8	8	8
W	8	8	8
T	7	7	7
TP	M6 Depth 12	M6 Depth 12	M6 Depth 12

A

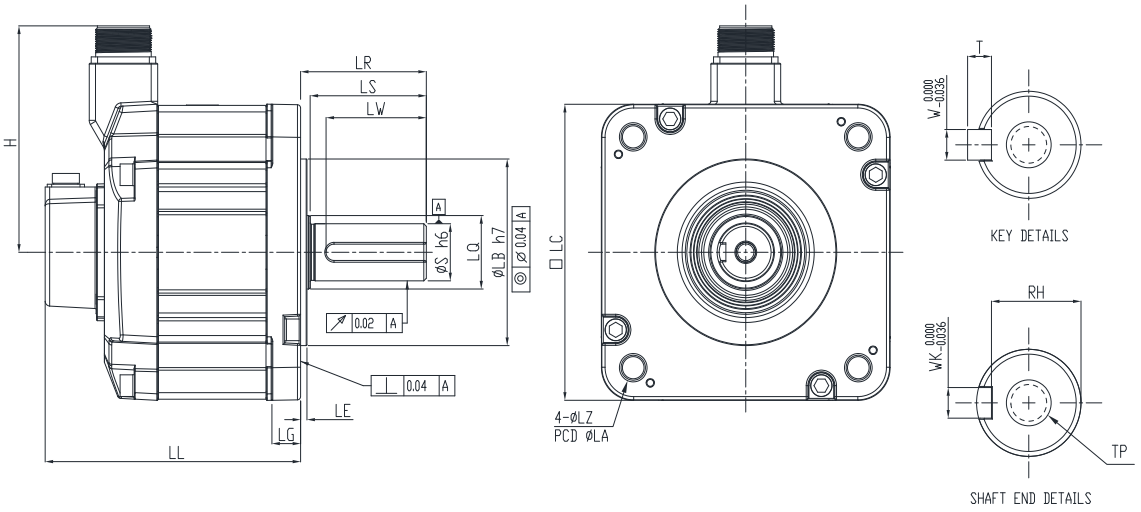
F130 motors (medium & high inertia)



Unit: mm

ECM-	E3M-K□1310□□E	E3M-K□1315□□E	E3M-K□1320□□E	E3H-L□1308□□E	E3H-L□1313□□E	E3H-L□1318□□E
LC	130	130	130	130	130	130
LZ	9	9	9	9	9	9
LA	145	145	145	145	145	145
S	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$
LB	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$
LL (no brake)	127.9	139.9	151.9	127.9	139.9	151.9
LL (with brake)	168.5	180.5	192.5	168.5	180.5	192.5
H	115	115	115	115	115	115
LS	47	47	47	47	47	47
LR	55	55	55	55	55	55
LQ	28	28	28	28	28	28
LE	6	6	6	6	6	6
LG	12.5	12.5	12.5	12.5	12.5	12.5
LW	36	36	36	36	36	36
RH	18	18	18	18	18	18
WK	8	8	8	8	8	8
W	8	8	8	8	8	8
T	7	7	7	7	7	7
TP	M6 Depth 12	M6 Depth 12	M6 Depth 12	M6 Depth 12	M6 Depth 12	M6 Depth 12

F180 motors (medium inertia)



Unit: mm

ECM-	E3M-K□1820□□E	E3M-L□1830□□E
LC	180	180
LZ	13.5	13.5
LA	200	200
S	$35(^{+0}_{-0.016})$	$35(^{+0}_{-0.016})$
LB	$114.3(^{+0}_{-0.035})$	$114.3(^{+0}_{-0.035})$
LL (no brake)	137.5	160.5
LL (with brake)	189.5	212.5
H	139	139
LS	73	73
LR	79	79
LQ	45	45
LE	4	4
LG	18	18
LW	63	63
RH	30	30
WK	10	10
W	10	10
T	8	8
TP	M12 Depth 25	M12 Depth 25

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A

Accessories Appendix B

This chapter is a guide to select the accessories.

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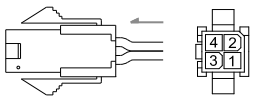
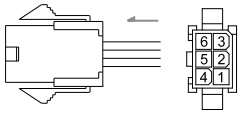
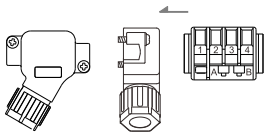
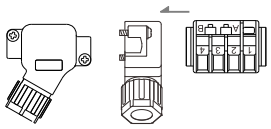
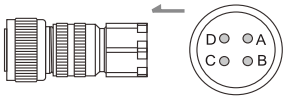
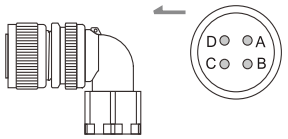
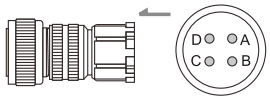
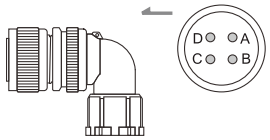
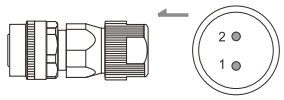
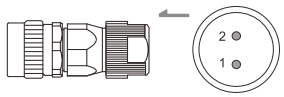
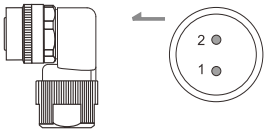
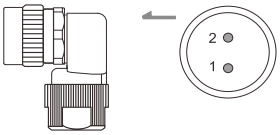
B

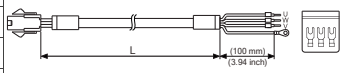
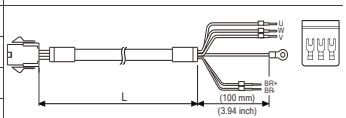
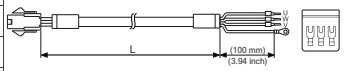
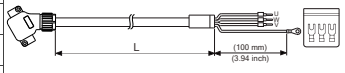
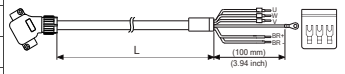
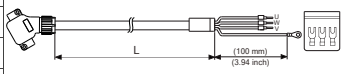
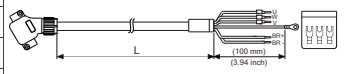
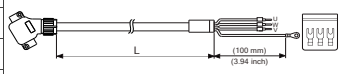
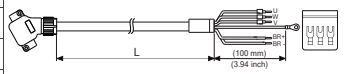
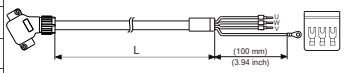
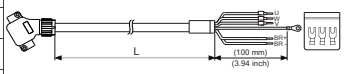
B.1 Power connectors

Motor series	Frame size	Applicable model	Connector				Model number	Illustration
			Type	UVW	Brake	IP rating		
ECM-E3	F40 - F80	220V 400V	Standard	●	-	IP20	ACS3-CAPW1000	
		220V 400V	Standard	●	●	IP20	ACS3-CAPW2000	
		220V 400V	Bulkhead - cable exit direction towards motor shaft	●	●	IP67	ACS3-AFPWSS00	
		220V 400V	Bulkhead - cable exit direction towards encoder	●	●	IP67	ACS3-ABPWSS00	
	F100 - F130	220V 400V	Military - straight 3106A-18-10S	●	-	IP67	ACS3-CAPWA000	
		220V 400V	Military - right angle 3108A-18-10S	●	-	IP67	ACS3-CRPWA000	
	F180	220V 400V	Military - straight 3106A-22-22S	●	-	IP67	ACS3-CAPWC000	
		220V 400V	Military - right angle 3108A-22-22S	●	-	IP67	ACS3-CRPWC000	
	F100 - F180	220V 400V	Military - straight CMV1-SP2S [bayonet]	-	●	IP67	ACS3-CABRA000	
		220V 400V	Military - straight [threaded, M17.5]	-	●	IP67	ACS3-CABRM000	
		220V 400V	Military - right angle CMV1-AP2S [bayonet]	-	●	IP67	ACS3-CRBRA000	
		220V 400V	Military - right angle [threaded, M17.5]	-	●	IP67	ACS3-CRBRM000	

Note: motors with bayonet receptacles are not compatible with threaded military connectors. See Section B.11 for details.

B.2 Power cables

B.2.1 F40 - F80 motors

Motor series	Applicable model	Connector type	Wire spec. AWG (mm²) UVW	Wire spec. AWG (mm²) Brake	Length (L) mm (inch)	Model number Standard	Model number Flexible	Illustration
ECM-E3	220V no brake	Standard	18 (0.82)	-	3000 ± 50 (118 ± 2)	ACS3-CAPW1103	ACS3-CAPF1103	
					5000 ± 50 (197 ± 2)	ACS3-CAPW1105	ACS3-CAPF1105	
					10000 ± 100 (394 ± 4)	ACS3-CAPW1110	ACS3-CAPF1110	
					20000 ± 100 (787 ± 4)	ACS3-CAPW1120	ACS3-CAPF1120	
	220V 400V with brake	Standard	18 (0.82)	22 (0.32)	3000 ± 50 (118 ± 2)	ACS3-CAPW2103	ACS3-CAPF2103	
					5000 ± 50 (197 ± 2)	ACS3-CAPW2105	ACS3-CAPF2105	
					10000 ± 100 (394 ± 4)	ACS3-CAPW2110	ACS3-CAPF2110	
					20000 ± 100 (787 ± 4)	ACS3-CAPW2120	ACS3-CAPF2120	
	400V no brake	Standard	18 (0.82)	-	3000 ± 50 (118 ± 2)	ACS3-CAPW3103	ACS3-CAPF3103	
					5000 ± 50 (197 ± 2)	ACS3-CAPW3105	ACS3-CAPF3105	
					10000 ± 100 (394 ± 4)	ACS3-CAPW3110	ACS3-CAPF3110	
					20000 ± 100 (787 ± 4)	ACS3-CAPW3120	ACS3-CAPF3120	
	220V no brake	Bulkhead - cable exit direction towards motor shaft	20 (0.52)	-	3000 ± 50 (118 ± 2)	ACS3-AFPWSR03	ACS3-AFPRSR03	
					5000 ± 50 (197 ± 2)	ACS3-AFPWSR05	ACS3-AFPRSR05	
					10000 ± 100 (394 ± 4)	ACS3-AFPWSR10	ACS3-AFPRSR10	
					20000 ± 100 (787 ± 4)	ACS3-AFPWSR20	ACS3-AFPRSR20	
	220V with brake	Bulkhead - cable exit direction towards motor shaft	20 (0.52)	24 (0.21)	3000 ± 50 (118 ± 2)	ACS3-AFPWSS03	ACS3-AFPRSS03	
					5000 ± 50 (197 ± 2)	ACS3-AFPWSS05	ACS3-AFPRSS05	
					10000 ± 100 (394 ± 4)	ACS3-AFPWSS10	ACS3-AFPRSS10	
					20000 ± 100 (787 ± 4)	ACS3-AFPWSS20	ACS3-AFPRSS20	
	400V no brake	Bulkhead - cable exit direction towards motor shaft	20 (0.52)	-	3000 ± 50 (118 ± 2)	ACS3-AFPWSA03	ACS3-AFPRSA03	
					5000 ± 50 (197 ± 2)	ACS3-AFPWSA05	ACS3-AFPRSA05	
					10000 ± 100 (394 ± 4)	ACS3-AFPWSA10	ACS3-AFPRSA10	
					20000 ± 100 (787 ± 4)	ACS3-AFPWSA20	ACS3-AFPRSA20	
	400V with brake	Bulkhead - cable exit direction towards motor shaft	20 (0.52)	24 (0.21)	3000 ± 50 (118 ± 2)	ACS3-AFPWSB03	ACS3-AFPRSB03	
					5000 ± 50 (197 ± 2)	ACS3-AFPWSB05	ACS3-AFPRSB05	
					10000 ± 100 (394 ± 4)	ACS3-AFPWSB10	ACS3-AFPRSB10	
					20000 ± 100 (787 ± 4)	ACS3-AFPWSB20	ACS3-AFPRSB20	
	220V no brake	Bulkhead - cable exit direction towards encoder	20 (0.52)	-	3000 ± 50 (118 ± 2)	ACS3-ABPWSR03	ACS3-ABPRSR03	
					5000 ± 50 (197 ± 2)	ACS3-ABPWSR05	ACS3-ABPRSR05	
					10000 ± 100 (394 ± 4)	ACS3-ABPWSR10	ACS3-ABPRSR10	
					20000 ± 100 (787 ± 4)	ACS3-ABPWSR20	ACS3-ABPRSR20	
	220V with brake	Bulkhead - cable exit direction towards encoder	20 (0.52)	24 (0.21)	3000 ± 50 (118 ± 2)	ACS3-ABPWSS03	ACS3-ABPRSS03	
					5000 ± 50 (197 ± 2)	ACS3-ABPWSS05	ACS3-ABPRSS05	
					10000 ± 100 (394 ± 4)	ACS3-ABPWSS10	ACS3-ABPRSS10	
					20000 ± 100 (787 ± 4)	ACS3-ABPWSS20	ACS3-ABPRSS20	
	400V no brake	Bulkhead - cable exit direction towards encoder	20 (0.52)	-	3000 ± 50 (118 ± 2)	ACS3-ABPWSA03	ACS3-ABPRSA03	
					5000 ± 50 (197 ± 2)	ACS3-ABPWSA05	ACS3-ABPRSA05	
					10000 ± 100 (394 ± 4)	ACS3-ABPWSA10	ACS3-ABPRSA10	
					20000 ± 100 (787 ± 4)	ACS3-ABPWSA20	ACS3-ABPRSA20	
	400V with brake	Bulkhead - cable exit direction towards encoder	20 (0.52)	24 (0.21)	3000 ± 50 (118 ± 2)	ACS3-ABPWSB03	ACS3-ABPRSB03	
					5000 ± 50 (197 ± 2)	ACS3-ABPWSB05	ACS3-ABPRSB05	
					10000 ± 100 (394 ± 4)	ACS3-ABPWSB10	ACS3-ABPRSB10	
					20000 ± 100 (787 ± 4)	ACS3-ABPWSB20	ACS3-ABPRSB20	

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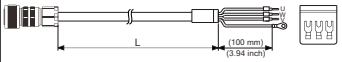
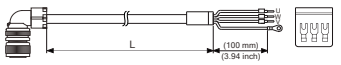
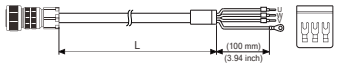
B.2.2 F100 - F130 motors

Motor series	Applicable model	Connector type	Wire spec. AWG (mm²) UVW	Length (L) mm (inch)	Model number Standard	Model number Flexible	Illustration
ECM-E3	220V 400V no brake with brake*	Military - straight 3106A-18-10S	14 (2.1)	3000 ± 50 (118 ± 2)	ACS3-CAPWA303	ACS3-CAPFA303	
				5000 ± 50 (197 ± 2)	ACS3-CAPWA305	ACS3-CAPFA305	
				10000 ± 100 (394 ± 4)	ACS3-CAPWA310	ACS3-CAPFA310	
				20000 ± 100 (787 ± 4)	ACS3-CAPWA320	ACS3-CAPFA320	
	220V 400V no brake with brake*	Military - right angle 3108A-18-10S	14 (2.1)	3000 ± 50 (118 ± 2)	ACS3-CRPWA303	ACS3-CRPFA303	
				5000 ± 50 (197 ± 2)	ACS3-CRPWA305	ACS3-CRPFA305	
				10000 ± 100 (394 ± 4)	ACS3-CRPWA310	ACS3-CRPFA310	
				20000 ± 100 (787 ± 4)	ACS3-CRPWA320	ACS3-CRPFA320	

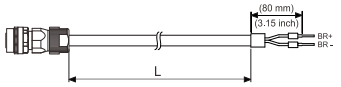
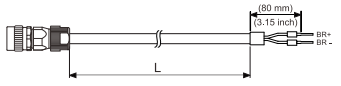
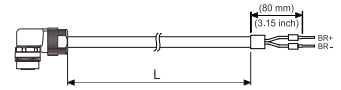
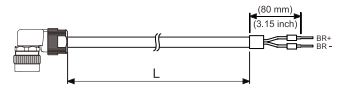
Note: for models with a brake, you need to purchase the brake cable listed in Section B.2.4.

B.2.3 F180 motors

Motor series	Applicable model	Connector type	Wire spec. AWG (mm²) UVW	Length (L) mm (inch)	Model number Standard	Model number Flexible	Illustration
ECM-E3	220V 400V no brake with brake*	Military - straight 3106A-22-22S	14 (2.1)	3000 ± 50 (118 ± 2)	ACS3-CAPWC303	ACS3-CAPFC303	
				5000 ± 50 (197 ± 2)	ACS3-CAPWC305	ACS3-CAPFC305	
				10000 ± 100 (394 ± 4)	ACS3-CAPWC310	ACS3-CAPFC310	
				20000 ± 100 (787 ± 4)	ACS3-CAPWC320	ACS3-CAPFC320	
	220V 400V no brake with brake*	Military - right angle 3108A-22-22S	14 (2.1)	3000 ± 50 (118 ± 2)	ACS3-CRPWC303	ACS3-CRPFC303	
				5000 ± 50 (197 ± 2)	ACS3-CRPWC305	ACS3-CRPFC305	
				10000 ± 100 (394 ± 4)	ACS3-CRPWC310	ACS3-CRPFC310	
				20000 ± 100 (787 ± 4)	ACS3-CRPWC320	ACS3-CRPFC320	

Note: for models with a brake, you need to purchase the brake cable listed in Section B.2.4.

B.2.4 Brake cables for F100 - F180 motors

Motor series	Applicable model	Connector type	Wire spec. AWG (mm²) Brake	Length (L) mm (inch)	Model number Standard	Model number Flexible	Illustration
ECM-E3	220V 400V with brake	Military - straight CMV1-SP2S [bayonet]	20 (0.52)	3000 ± 50 (118 ± 2)	ACS3-CABRA103	ACS3-CABFA103	
				5000 ± 50 (197 ± 2)	ACS3-CABRA105	ACS3-CABFA105	
				10000 ± 100 (394 ± 4)	ACS3-CABRA110	ACS3-CABFA110	
				20000 ± 100 (787 ± 4)	ACS3-CABRA120	ACS3-CABFA120	
		Military - straight [threaded, M17.5]	20 (0.52)	3000 ± 50 (118 ± 2)	ACS3-CABRM103	ACS3-CABFM103	
				5000 ± 50 (197 ± 2)	ACS3-CABRM105	ACS3-CABFM105	
				10000 ± 100 (394 ± 4)	ACS3-CABRM110	ACS3-CABFM110	
				20000 ± 100 (787 ± 4)	ACS3-CABRM120	ACS3-CABFM120	
		Military - right angle CMV1-AP2S [bayonet]	20 (0.52)	3000 ± 50 (118 ± 2)	ACS3-CRBRA103	ACS3-CRBFA103	
				5000 ± 50 (197 ± 2)	ACS3-CRBRA105	ACS3-CRBFA105	
				10000 ± 100 (394 ± 4)	ACS3-CRBRA110	ACS3-CRBFA110	
				20000 ± 100 (787 ± 4)	ACS3-CRBRA120	ACS3-CRBFA120	
		Military - right angle [threaded, M17.5]	20 (0.52)	3000 ± 50 (118 ± 2)	ACS3-CRBRM103	ACS3-CRBFM103	
				5000 ± 50 (197 ± 2)	ACS3-CRBRM105	ACS3-CRBFM105	
				10000 ± 100 (394 ± 4)	ACS3-CRBRM110	ACS3-CRBFM110	
				20000 ± 100 (787 ± 4)	ACS3-CRBRM120	ACS3-CRBFM120	

Note: motors with bayonet receptacles are not compatible with threaded military connectors. See Section B.11 for details.

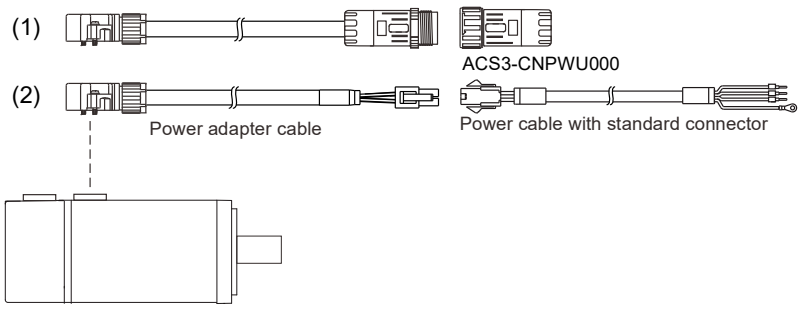
B.3 Power adapter cables and counterpart connector (for motors with bulkhead receptacles)

For motors with bulkhead receptacles, use a power adapter cable to connect the motor and a power cable with standard connector. The following illustrates where it is installed.

Connection methods:

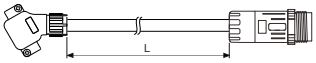
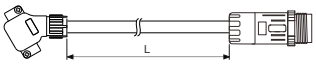
(1) Power adapter cable with waterproof connector + counterpart of waterproof connector; you need to prepare the cable yourself.

(2) Power adapter cable with standard connector + power cable with standard connector

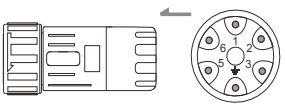


B.3.1 F40 - F80 motors

■ Power adapter cable with waterproof connector (IP67 rated): when mating the connector to the counterpart, ensure they are fully locked and meet the IP67 standard.

Motor series	Applicable model	Connector type	Wire spec. AWG (mm²) UVW	Wire spec. AWG (mm²) Brake	Length (L) mm (inch)	Model number Standard	Model number Flexible	Illustration
ECM-E3	220V 400V no brake with brake	Bulkhead - cable exit direction towards motor shaft	20 (0.52)	24 (0.21)	300 ± 20 (11.8 ± 0.8)	ACS3-AFESSW0C	ACS3-AFEFSW0C	
	220V 400V no brake with brake	Bulkhead - cable exit direction towards encoder	20 (0.52)	24 (0.21)	300 ± 20 (11.8 ± 0.8)	ACS3-ABESSW0C	ACS3-ABEFSW0C	

■ Counterpart of the preceding waterproof connector

Motor series	Frame size	Applicable model	Connector Type	Connector UVW	Connector Brake	Connector IP rating	Model number	Illustration
-	F40 - F80	220V 400V no brake with brake	Dedicated connector adapter	●	●	IP67	ACS3-CNPWU000	

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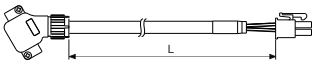
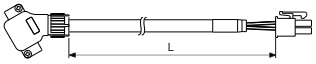
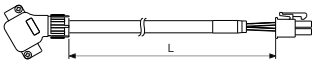
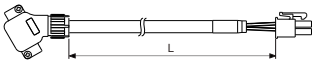
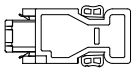
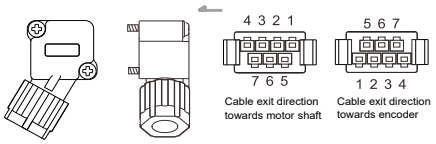
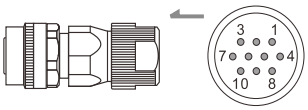
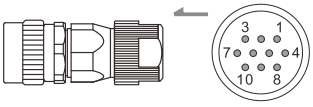
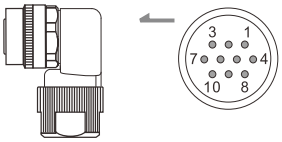
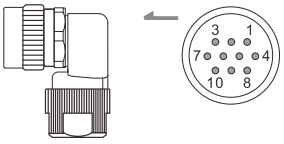
■ Power adapter cable with standard connector (not IP67 rated): do not use the cable in an environment which is exposed to oil or water.

Motor series	Applicable model	Connector type	Wire spec. AWG (mm^2)		Length (L) mm (inch)	Model number		Illustration
			UVW	Brake		Standard	Flexible	
ECM-E3	220V 400V no brake	Bulkhead - cable exit direction towards motor shaft	20 (0.52)	-	300 ± 20 (11.8 ± 0.8)	ACS3-AFPWSR0C	ACS3-AFPRSR0C	
					500 ± 20 (19.7 ± 0.8)	ACS3-AFPWSR0E	ACS3-AFPRSR0E	
					700 ± 30 (27.6 ± 1.2)	ACS3-AFPWSR0G	ACS3-AFPRSR0G	
					900 ± 30 (35.4 ± 1.2)	ACS3-AFPWSR0J	ACS3-AFPRSR0J	
	220V 400V with brake	Bulkhead - cable exit direction towards motor shaft	20 (0.52)	24 (0.21)	300 ± 20 (11.8 ± 0.8)	ACS3-AFPWSS0C	ACS3-AFPRSS0C	
					500 ± 20 (19.7 ± 0.8)	ACS3-AFPWSS0E	ACS3-AFPRSS0E	
					700 ± 30 (27.6 ± 1.2)	ACS3-AFPWSS0G	ACS3-AFPRSS0G	
					900 ± 30 (35.4 ± 1.2)	ACS3-AFPWSS0J	ACS3-AFPRSS0J	
	220V 400V no brake	Bulkhead - cable exit direction towards encoder	20 (0.52)	-	300 ± 20 (11.8 ± 0.8)	ACS3-ABPWSR0C	ACS3-ABPRSR0C	
					500 ± 20 (19.7 ± 0.8)	ACS3-ABPWSR0E	ACS3-ABPRSR0E	
					700 ± 30 (27.6 ± 1.2)	ACS3-ABPWSR0G	ACS3-ABPRSR0G	
					900 ± 30 (35.4 ± 1.2)	ACS3-ABPWSR0J	ACS3-ABPRSR0J	
	220V 400V with brake	Bulkhead - cable exit direction towards encoder	20 (0.52)	24 (0.21)	300 ± 20 (11.8 ± 0.8)	ACS3-ABPWSS0C	ACS3-ABPRSS0C	
					500 ± 20 (19.7 ± 0.8)	ACS3-ABPWSS0E	ACS3-ABPRSS0E	
					700 ± 30 (27.6 ± 1.2)	ACS3-ABPWSS0G	ACS3-ABPRSS0G	
					900 ± 30 (35.4 ± 1.2)	ACS3-ABPWSS0J	ACS3-ABPRSS0J	

B.4 Encoder connectors

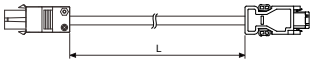
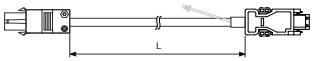
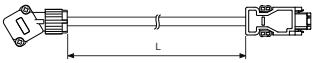
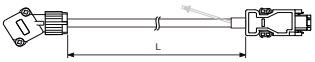
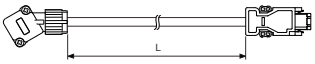
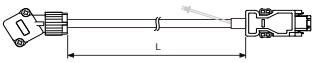
Motor series	Frame size	Connector type	IP rating	Model number	Illustration
ECM-E3	-	For connecting to the servo drive end	-	ACS3-CNENC200	
	F40 - F80	Standard	IP20	ACS3-CAEN0000	
		Bulkhead - cable exit direction towards motor shaft	IP67	ACS3-AFEASA00	 The preceding figure illustrates the difference between the two cable exit directions; only one wiring terminal is included.
		Bulkhead - cable exit direction towards encoder			
	F100 - F180	Military - straight CMV1-SP10S [bayonet]	IP67	ACS3-CAENA000	
		Military - straight [threaded, M17.5]	IP67	ACS3-CAENM000	
		Military - right angle CMV1-AP10S [bayonet]	IP67	ACS3-CRENA000	
		Military - right angle [threaded, M17.5]	IP67	ACS3-CRENM000	

Note: motors with bayonet receptacles are not compatible with threaded military connectors. See Section B.11 for details.

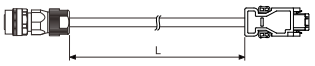
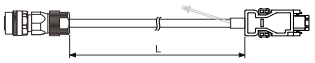
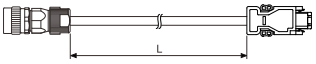
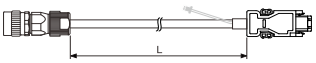
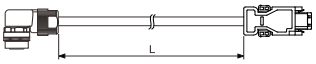
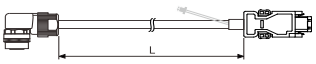
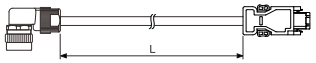
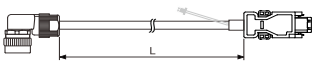
B.5 Encoder cables

B.5.1 F40 - F80 motors

B

Motor series	Connector type	Encoder type	Length (L) mm (inch)	Model number		Illustration
				Standard	Flexible	
ECM-E3	Standard	Incremental	3000 ± 50 (118 ± 2)	ACS3-CAEN0103	ACS3-CAEF0103	
			5000 ± 50 (197 ± 2)	ACS3-CAEN0105	ACS3-CAEF0105	
			10000 ± 100 (394 ± 4)	ACS3-CAEN0110	ACS3-CAEF0110	
			20000 ± 100 (787 ± 4)	ACS3-CAEN0120	ACS3-CAEF0120	
		Absolute	3000 ± 50 (118 ± 2)	ACS3-CAEA0103	ACS3-CAEB0103	
			5000 ± 50 (197 ± 2)	ACS3-CAEA0105	ACS3-CAEB0105	
			10000 ± 100 (394 ± 4)	ACS3-CAEA0110	ACS3-CAEB0110	
			20000 ± 100 (787 ± 4)	ACS3-CAEA0120	ACS3-CAEB0120	
	Bulkhead - cable exit direction towards motor shaft	Incremental	3000 ± 50 (118 ± 2)	ACS3-AFEASI03	ACS3-AFERSI03	
			5000 ± 50 (197 ± 2)	ACS3-AFEASI05	ACS3-AFERSI05	
			10000 ± 100 (394 ± 4)	ACS3-AFEASI10	ACS3-AFERSI10	
			20000 ± 100 (787 ± 4)	ACS3-AFEASI20	ACS3-AFERSI20	
		Absolute	3000 ± 50 (118 ± 2)	ACS3-AFEASA03	ACS3-AFERSA03	
			5000 ± 50 (197 ± 2)	ACS3-AFEASA05	ACS3-AFERSA05	
			10000 ± 100 (394 ± 4)	ACS3-AFEASA10	ACS3-AFERSA10	
			20000 ± 100 (787 ± 4)	ACS3-AFEASA20	ACS3-AFERSA20	
	Bulkhead - cable exit direction towards encoder	Incremental	3000 ± 50 (118 ± 2)	ACS3-ABEASI03	ACS3-ABERSI03	
			5000 ± 50 (197 ± 2)	ACS3-ABEASI05	ACS3-ABERSI05	
			10000 ± 100 (394 ± 4)	ACS3-ABEASI10	ACS3-ABERSI10	
			20000 ± 100 (787 ± 4)	ACS3-ABEASI20	ACS3-ABERSI20	
		Absolute	3000 ± 50 (118 ± 2)	ACS3-ABEASA03	ACS3-ABERSA03	
			5000 ± 50 (197 ± 2)	ACS3-ABEASA05	ACS3-ABERSA05	
			10000 ± 100 (394 ± 4)	ACS3-ABEASA10	ACS3-ABERSA10	
			20000 ± 100 (787 ± 4)	ACS3-ABEASA20	ACS3-ABERSA20	

B.5.2 F100 - F180 motors

Motor series	Connector type	Encoder type	Length (L) mm (inch)	Model number		Illustration
				Standard	Flexible	
ECM-E3	Military - straight CMV1-SP10S [bayonet]	Incremental	3000 ± 50 (118 ± 2)	ACS3-CAENA103	ACS3-CAEFA103	
			5000 ± 50 (197 ± 2)	ACS3-CAENA105	ACS3-CAEFA105	
			10000 ± 100 (394 ± 4)	ACS3-CAENA110	ACS3-CAEFA110	
			20000 ± 100 (787 ± 4)	ACS3-CAENA120	ACS3-CAEFA120	
		Absolute	3000 ± 50 (118 ± 2)	ACS3-CAEAA103	ACS3-CAEBA103	
			5000 ± 50 (197 ± 2)	ACS3-CAEAA105	ACS3-CAEBA105	
			10000 ± 100 (394 ± 4)	ACS3-CAEAA110	ACS3-CAEBA110	
			20000 ± 100 (787 ± 4)	ACS3-CAEAA120	ACS3-CAEBA120	
	Military - straight [threaded, M17.5]	Incremental	3000 ± 50 (118 ± 2)	ACS3-CAENM103	ACS3-CAEFM103	
			5000 ± 50 (197 ± 2)	ACS3-CAENM105	ACS3-CAEFM105	
			10000 ± 100 (394 ± 4)	ACS3-CAENM110	ACS3-CAEFM110	
			20000 ± 100 (787 ± 4)	ACS3-CAENM120	ACS3-CAEFM120	
		Absolute	3000 ± 50 (118 ± 2)	ACS3-CAEAM103	ACS3-CAEBM103	
			5000 ± 50 (197 ± 2)	ACS3-CAEAM105	ACS3-CAEBM105	
			10000 ± 100 (394 ± 4)	ACS3-CAEAM110	ACS3-CAEBM110	
			20000 ± 100 (787 ± 4)	ACS3-CAEAM120	ACS3-CAEBM120	
	Military - right angle CMV1-AP10S [bayonet]	Incremental	3000 ± 50 (118 ± 2)	ACS3-CRENA103	ACS3-CREFA103	
			5000 ± 50 (197 ± 2)	ACS3-CRENA105	ACS3-CREFA105	
			10000 ± 100 (394 ± 4)	ACS3-CRENA110	ACS3-CREFA110	
			20000 ± 100 (787 ± 4)	ACS3-CRENA120	ACS3-CREFA120	
		Absolute	3000 ± 50 (118 ± 2)	ACS3-CREAA103	ACS3-CREBA103	
			5000 ± 50 (197 ± 2)	ACS3-CREAA105	ACS3-CREBA105	
			10000 ± 100 (394 ± 4)	ACS3-CREAA110	ACS3-CREBA110	
			20000 ± 100 (787 ± 4)	ACS3-CREAA120	ACS3-CREBA120	
	Military - right angle [threaded, M17.5]	Incremental	3000 ± 50 (118 ± 2)	ACS3-CRENM103	ACS3-CREFM103	
			5000 ± 50 (197 ± 2)	ACS3-CRENM105	ACS3-CREFM105	
			10000 ± 100 (394 ± 4)	ACS3-CRENM110	ACS3-CREFM110	
			20000 ± 100 (787 ± 4)	ACS3-CRENM120	ACS3-CREFM120	
		Absolute	3000 ± 50 (118 ± 2)	ACS3-CREAM103	ACS3-CREBM103	
			5000 ± 50 (197 ± 2)	ACS3-CREAM105	ACS3-CREBM105	
			10000 ± 100 (394 ± 4)	ACS3-CREAM110	ACS3-CREBM110	
			20000 ± 100 (787 ± 4)	ACS3-CREAM120	ACS3-CREBM120	

Note: motors with bayonet receptacles are not compatible with threaded military connectors. See Section B.11 for details.

B.6 Encoder adapter cables and counterpart connector (for motors with bulkhead receptacles)

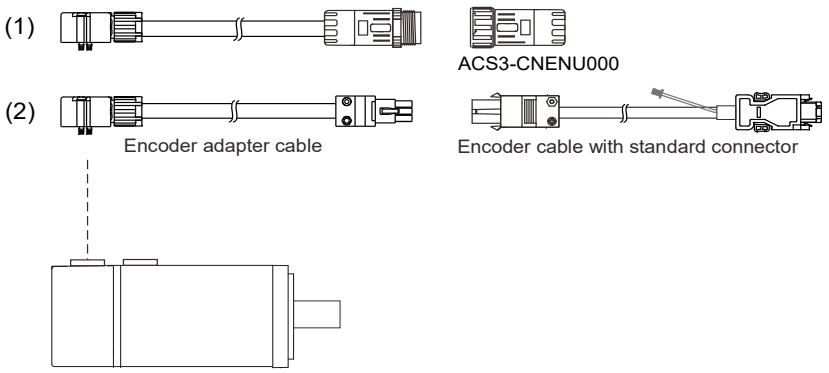
B

For motors with bulkhead receptacles, use an encoder adapter cable to connect the motor and an encoder cable with standard connector. The following illustrates where it is installed.

Connection methods:

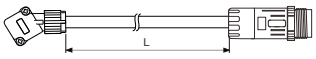
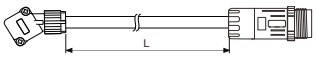
(1) Encoder adapter cable with waterproof connector + counterpart of waterproof connector; you need to prepare the cable yourself.

(2) Encoder adapter cable with standard connector + encoder cable with standard connector.

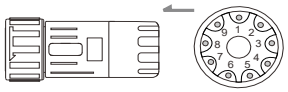


B.6.1 F40 - F80 motors

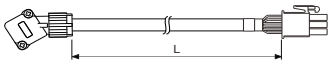
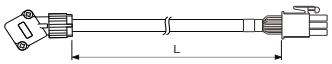
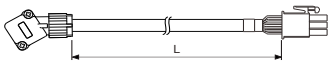
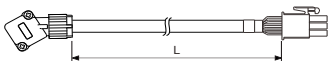
■ Encoder adapter cable with waterproof connector (IP67 rated): when mating the connector to the counterpart, ensure they are fully locked and meet the IP67 standard.

Motor series	Connector type	Encoder type	Length (L) mm (inch)	Model number		Illustration
				Standard	Flexible	
ECM-E3	Bulkhead - cable exit direction towards motor shaft	Incremental Absolute	300 ± 20 (11.8 ± 0.8)	ACS3-AFENSW0C	ACS3-AFEBSW0C	
	Bulkhead - cable exit direction towards encoder	Incremental Absolute	300 ± 20 (11.8 ± 0.8)	ACS3-ABENSW0C	ACS3-ABEBSW0C	

■ Counterpart of the preceding waterproof connector

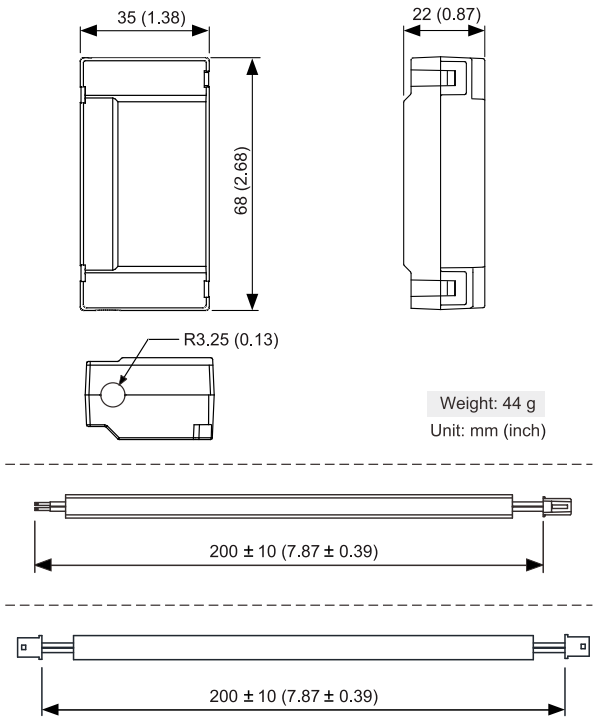
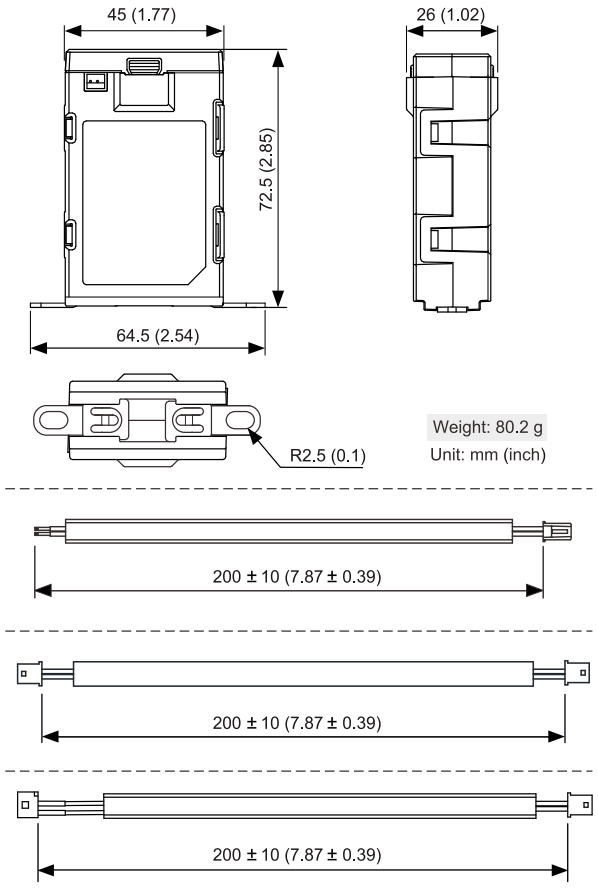
Motor series	Frame size	Connector type	IP rating	Model number	Illustration
-	F40 - F80	Dedicated connector adapter	IP67	ACS3-CNENU000	

■ Power adapter cable with standard connector (not IP67 rated): do not use the cable in an environment which is exposed to oil or water.

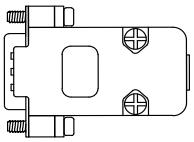
Motor series	Connector type	Encoder type	Length (L) mm (inch)	Model number		Illustration
				Standard	Flexible	
ECM-E3	Bulkhead - cable exit direction towards motor shaft	Incremental	300 ± 20 (11.8 ± 0.8)	ACS3-AFEASI0C	ACS3-AFERSI0C	
			500 ± 20 (19.7 ± 0.8)	ACS3-AFEASI0E	ACS3-AFERSI0E	
			700 ± 30 (27.6 ± 1.2)	ACS3-AFEASI0G	ACS3-AFERSI0G	
			900 ± 30 (35.4 ± 1.2)	ACS3-AFEASI0J	ACS3-AFERSI0J	
		Absolute	300 ± 20 (11.8 ± 0.8)	ACS3-AFEASA0C	ACS3-AFERSA0C	
			500 ± 20 (19.7 ± 0.8)	ACS3-AFEASA0E	ACS3-AFERSA0E	
			700 ± 30 (27.6 ± 1.2)	ACS3-AFEASA0G	ACS3-AFERSA0G	
			900 ± 30 (35.4 ± 1.2)	ACS3-AFEASA0J	ACS3-AFERSA0J	
	Bulkhead - cable exit direction towards encoder	Incremental	300 ± 20 (11.8 ± 0.8)	ACS3-ABEASI0C	ACS3-ABERSI0C	
			500 ± 20 (19.7 ± 0.8)	ACS3-ABEASI0E	ACS3-ABERSI0E	
			700 ± 30 (27.6 ± 1.2)	ACS3-ABEASI0G	ACS3-ABERSI0G	
			900 ± 30 (35.4 ± 1.2)	ACS3-ABEASI0J	ACS3-ABERSI0J	
		Absolute	300 ± 20 (11.8 ± 0.8)	ACS3-ABEASA0C	ACS3-ABERSA0C	
			500 ± 20 (19.7 ± 0.8)	ACS3-ABEASA0E	ACS3-ABERSA0E	
			700 ± 30 (27.6 ± 1.2)	ACS3-ABEASA0G	ACS3-ABERSA0G	
			900 ± 30 (35.4 ± 1.2)	ACS3-ABEASA0J	ACS3-ABERSA0J	

B

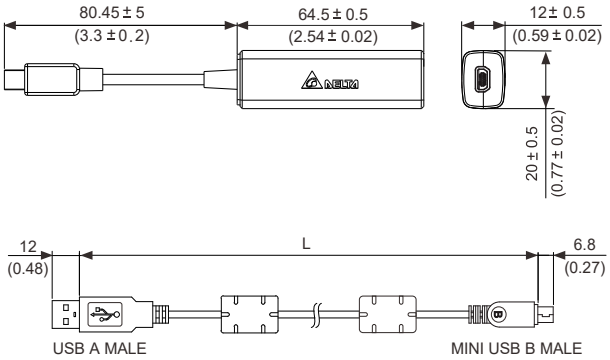
B.7 Battery boxes

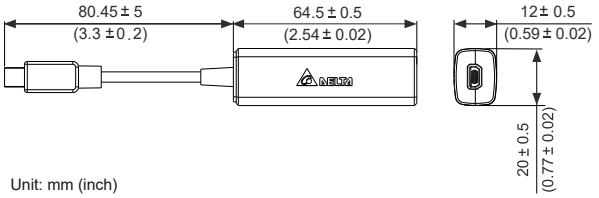
Model number	Description	Illustration
ASD-MDBT0100	Single battery box (including one battery and two cables)	
ASD-MDBT0200	Dual battery box (including two batteries and three cables)	

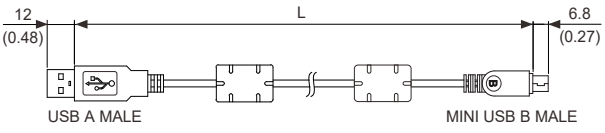
B.8 CN1 I/O connector

Model number	Description	Illustration
ASD-CNDS0015	CN1 connector	

B.9 CN4 Mini USB communication module

<table>
<tr><th>Model number</th><th>Description</th><th>Illustration</th></tr>
<tr><td rowspan="4">UC-PRG015-01B
UC-PRG030-01B</td><td rowspan="4">Including USB cable and isolator</td><td> 

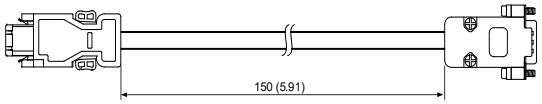
Unit: mm (inch)</td></tr>
<tr><td><table>
<tr><th rowspan="2">Model number</th><th colspan="2">Length (L)</th></tr>
<tr><th>mm</th><th>inch</th></tr>
<tr><td>UC-PRG015-01B</td><td>1500 ± 100</td><td>59 ± 4</td></tr>
<tr><td>UC-PRG030-01B</td><td>3000 ± 100</td><td>118 ± 4</td></tr>
</table></td></tr>
<tr><td>UC-ADP01-A</td><td>USB isolator</td><td> 

Unit: mm (inch)</td></tr>
<tr><td rowspan="2">UC-PRG015-01A
UC-PRG030-01A</td><td rowspan="2">USB cable</td><td> 

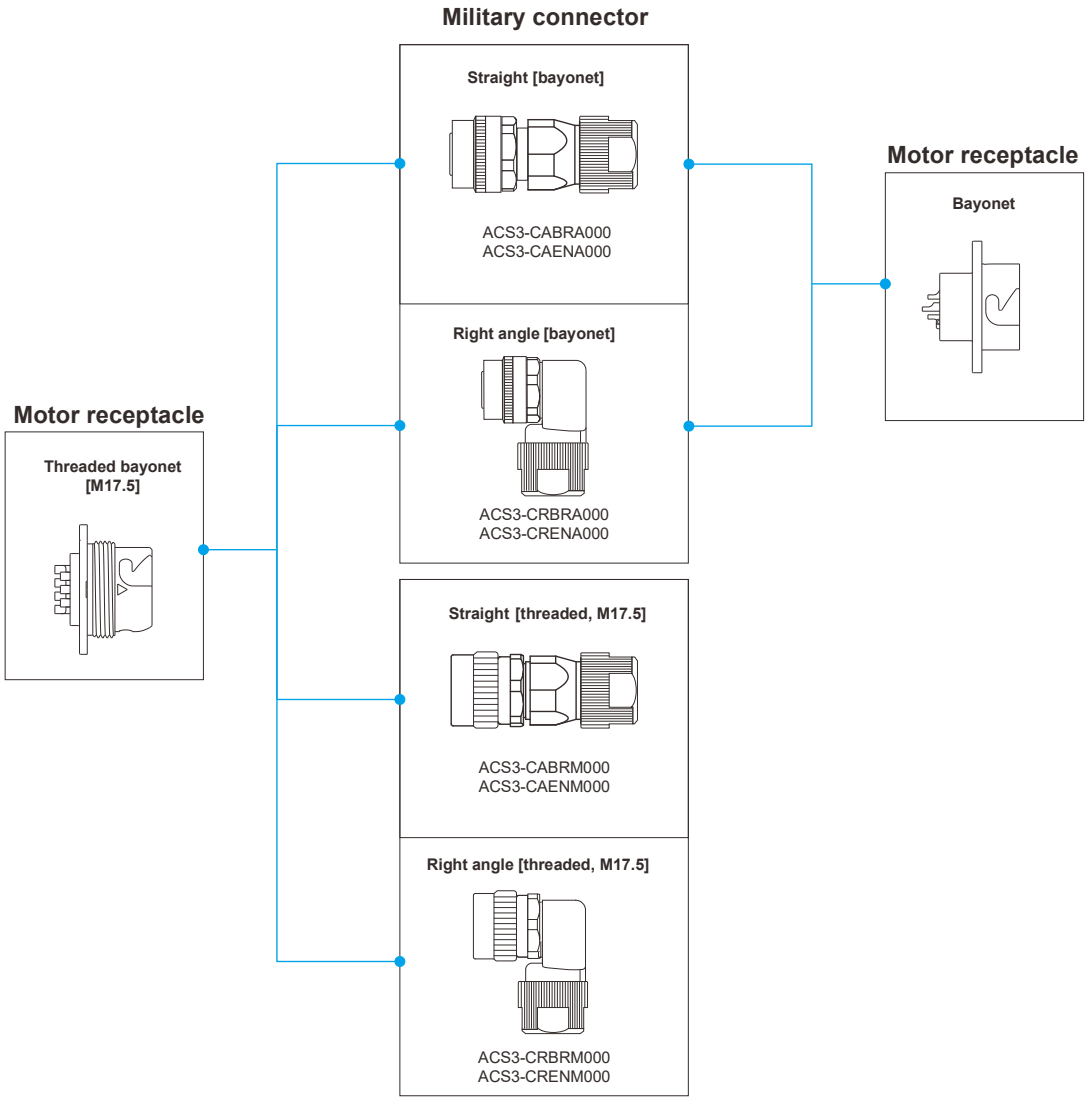
Unit: mm (inch)</td></tr>
<tr><td><table>
<tr><th rowspan="2">Model number</th><th colspan="2">Length (L)</th></tr>
<tr><th>mm</th><th>inch</th></tr>
<tr><td>UC-PRG015-01A</td><td>1500 ± 100</td><td>59 ± 4</td></tr>
<tr><td>UC-PRG030-01A</td><td>3000 ± 100</td><td>118 ± 4</td></tr>
</table></td></tr>
</table>

B

B.10 E3C–B2 adapter cable

Model number	Description	Illustration
ACS3-CABDC2	CN2 adapter cable	 Unit: mm (inch)

B.11 Selecting brake and encoder connectors (or cables) for F100 - F180 motors



Revision History

Release date	Version	Chapter	Revision contents
June, 2026	V2.0 (Second edition)	A.1.2.2	Corrected the information in the 400V 2 kW / 3 kW servo drive dimensional drawing: the horizontal spacing of the rear mounting holes is changed from 60 (2.36) to 62 (2.44); unit: mm (inch).
March, 2026	V1.0 (First edition)	-	-

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*We reserve the right to change the information in this manual without prior notice.

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