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DELTA_IA-ASD_ASDA-E3_UM_EN_20230621

Delta ASDA-E3 Series
Basic Type AC Servo Drive User Manual

Delta ASDA-E3 Series Basic Type AC Servo Drive User Manual

www.deltaww.com

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Preface

Thank you for purchasing this product. This manual provides information about the ASDA-E3 series servo drives (E3) 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 a shielded control cabinet during operation. This servo drive uses precise feedback control and a digital signal processor (DSP) with high-speed calculation functions to control the current output generated by IGBT to operate the three-phase permanent magnet synchronous motors (PMSM) and to achieve precise positioning.

This product is used in industrial applications and should be installed in the control cabinet. Servo drives, wires, and motors should all be installed in an environment which complies with the minimum enclosure rating of UL Type 1.

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

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

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

Inspection

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

Installation

DANGER	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

DANGER	■ Connect the ground terminals to a Class 3 ground system. Ground resistance should not exceed 100 Ω. Improper grounding may result in electric shock or fire. ■ Do not connect the three-phase power source to the motor output terminals U, V, and W, or it may cause personnel 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

WARNING

- 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.

STOP

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

DANGER

- 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 personnel injury.
- In order to reduce the danger, make sure the servo motor can operate normally without load. Then try operating the motor with load.
- Do not touch the heat sink of the servo drive when it is operating to avoid scalding.

Maintenance and Inspection

STOP

- 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.
- After turning off the power, do not touch the wiring terminals until the “CHARGE” indicator is off, or the residual voltage may cause electric shock.
- Do not disassemble the servo motor, or it may cause electric shock or personnel injury.
- Do not change the wiring when the power is on, or it may cause electric shock or personnel injury.
- Only qualified electricians can install, wire, repair, and maintain the servo drive and servo motor.

Main Circuit Wiring

⚠ WARNING

- 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 feedback cables. The maximum length of the signal input cable is 3 meters (9.84 feet) and the maximum length of the encoder feedback cable is 20 meters (65.62 feet).
- High voltage may remain in the servo drive after the power is turned off. Wait until the “CHARGE” indicator is off before performing inspection.

STOP

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

Terminal Wiring of the Main Circuit

⚠ WARNING

- When wiring, securely tighten the screws of the terminal block.
- When wiring, do not short-circuit the wire with adjacent wires.
- Before applying power, inspect and ensure that the wiring is correct.

Leakage Current

⚠ WARNING

- 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 either one of the following specifications to ensure proper grounding:
  1. Copper wire cross-sectional area is at least 10 mm^2.
  2. Aluminum wire cross-sectional area is at least 16 mm^2.
- Failure to comply with the specifications may result in personnel injury.
- Before applying power, 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 abnormal vibration and noise.
	Check if there is any abnormal smell.
	Check if the servo drive has any visible damage.
	Check if the ventilation holes 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 holes, 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.

Replacing the parts

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 10.1.1.	
Motor	Bearing	20,000 hours	
	Oil seal	5,000 hours	

- When the part reaches the suggested replacement cycle, 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.

Table of Contents

Before Operation

1 Product Overview

2 Installation

3 Wiring

4 Test Operation and Panel Display

Tuning

5 Tuning

Operation and Motion Control

6

Control Mode

7 Motion Control

Parameter Setting

8 Parameters

9 Modbus Communication

10 Absolute System

11 EtherCAT Mode

Troubleshooting

12 Troubleshooting

Appendix

A Specifications

B Accessories

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Product Overview

1

Before using the servo drive, pay attention to the description for the components of the servo set, nameplate, and model type. You can find a suitable servo motor for your servo drive in Section 1.3.

1.1 Components of the servo set

A complete servo set includes:

(1) A servo drive and a servo motor.

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

(3) A yellow / green ground wire: connects to the ground terminal of the servo drive (optional purchase).

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

(5) Power supply for the servo drive:

Model	Main circuit	Regenerative resistor
All series	R, S, T terminal block	P⊕, D, C, ⊖ terminal block

(6) An installation instruction sheet.

Model-specific connectors

E3-L models:

(1) A 44-pin connector for CN1.

(2) A 6-pin connector for CN2 (optional purchase).

(3) A 6-pin connector to connect the CN3 of the servo drive for communication (RS-485 and RS-232) or PC connection (RS-232) (optional purchase).

E3-E models:

(1) A 15-pin connector for CN1.

(2) A 6-pin connector for CN2 (optional purchase).

(3) A 4-pin connector for CN4 (Mini USB connector) (optional purchase).

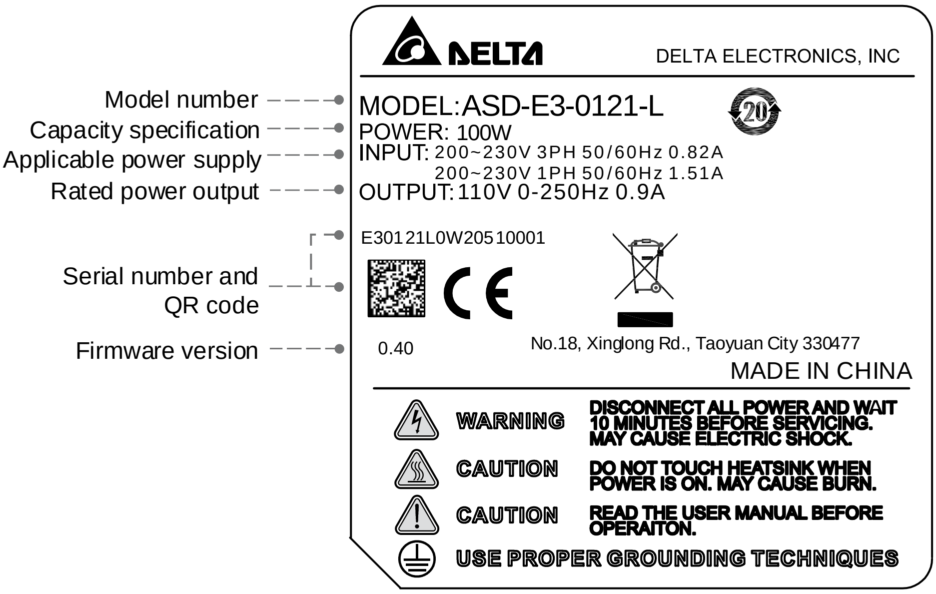
(4) An RJ45 connector for CN6, which is used for high-speed (EtherCAT) communication (optional purchase).

1.2 Model overview

1.2.1 Nameplate information

ASDA-E3 series servo drive

- **Nameplate information**



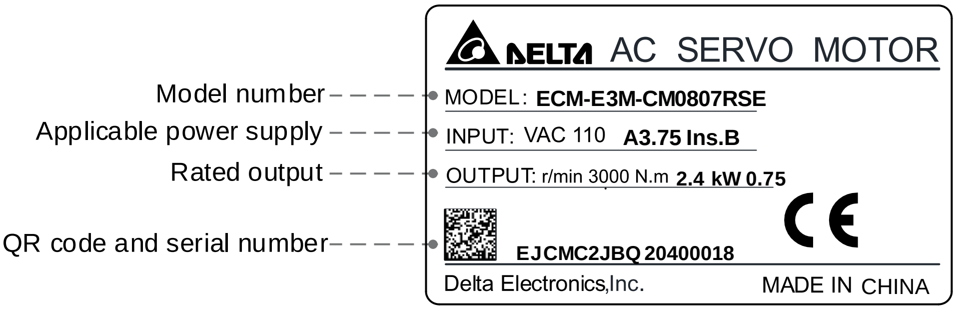
- **Serial number**

E30121L0	W	20	51	0001
(1)	(2)	(3)	(4)	(5)

(1) Model number
(2) Manufacturing plant (T: Taoyuan; W: 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)

ECM-E3 series servo motor

■ Nameplate information



MODEL: ECM-E3M-CM0807RSE
INPUT: VAC 110 A3.75 Ins.B
OUTPUT: r/min 3000 N.m 2.4 kW 0.75
EJCMC2JBQ 20400018
Delta Electronics,Inc. MADE IN CHINA

■ Serial number

EJCMC2JB	Q	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-E3 series servo drive

ASD – E3 – 04 21 – L

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

(1) Product name
ASD: AC Servo Drive

(2) Series
E3: E3 series

(3) Rated power output

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

(4) Input voltage and phase
21: 220V, single- / three-phase
23: 220V, three-phase

(5) Model type

Connector	Function	L	E
CN1	Number of DIs / DOs	9 / 6	6 / 3
	Analog voltage input / output	2 / 2	-
	Pulse input (Pulse / Sign)	✓	-
	Pulse output (OA / OB / OZ)	✓	-
	OCZ signal	✓	-
	High-speed Capture DI (PR)	-	-
	Touch Probe (EtherCAT)	-	DI1, DI2
	Number of CN1 pins	44	15
CN3	Communication function (to PC)	RS-485 RS-232 (PC)	-
CN4	Communication function (to PC)	-	Mini USB
CN6	Bus communication	-	EtherCAT
-	STO	-	-
-	Dynamic brake	-	-
-	PR mode	-	✓
-	Absolute function	-	✓
-	Two degree of freedom control function	-	✓
-	Vibration elimination	-	✓
-	One Touch tuning	-	-
-	Full-closed loop / Gantry	-	-

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.

ECM-E3 series servo motor

ECM	-	E	3	M	-	C	2	06	04	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

M: medium inertia

L: low inertia

(5) Rated voltage and speed

C: 220V and 3,000 rpm

E: 220V and 2,000 rpm

F: 220V and 1,500 rpm

(6) Encoder type

A: 22-bit absolute optical encoder
(resolution of single turn: 22-bit; number of revolutions: 16-bit)

2: 22-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)

Note:

1. The E3-L servo drive does not support the absolute function (including the single-turn absolute function). Therefore, the E3-L servo drive can only operate all motors as incremental type motors.
2. Number of revolutions means the maximum number of turns the encoder can record.

(7) Motor frame size

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

(8) Rated power output

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

(9) Shaft type and oil seal

	w/o brake with oil seal	with brake with oil seal
Keyway (with fixed screw holes)	R	S

(10) Shaft diameter and connector type
S: standard shaft diameter and standard 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 model numbers available for purchase.

1.3 ASDA-E3 servo drive and motor

Servo motor							Servo drive
Inertia	Rated / Max. speed	Power	Output (W)	Model number	Rated torque (N-m)	Max. torque (N-m)	Model number
Low inertia	3000 / 6000 rpm	Single- / three-phase	100	ECM-E3L-C2⃞0401 3⃞4⃞E	0.32	1.12	ASD-E3-0121-☐
Medium inertia			200	ECM-E3M-C2⃞0602 3⃞4⃞E	0.64	2.24	ASD-E3-0221-☐
			400	ECM-E3M-C2⃞0604 3⃞4⃞E	1.27	4.45	ASD-E3-0421-☐
			750	ECM-E3M-C2⃞0807 3⃞4⃞E	2.4	7.61	ASD-E3-0721-☐
					2.4	8.4	ASD-E3-1021-☐
	2000 / 3000 rpm		1000	ECM-E3M-E2⃞1310 3⃞4⃞E	4.77	14.3	ASD-E3-1021-☐
			1500	ECM-E3M-E2⃞1315 3⃞4⃞E	7.16	19.93	ASD-E3-1521-☐
					7.16	21.48	ASD-E3-2023-☐
		Three-phase	2000	ECM-E3M-E2⃞1320 3⃞4⃞E	9.55	28.65	ASD-E3-2023-☐
	1500 / 3000 rpm		3000	ECM-E3M-F2⃞1830 3⃞4⃞E	19.1	52.3	ASD-E3-3023-☐

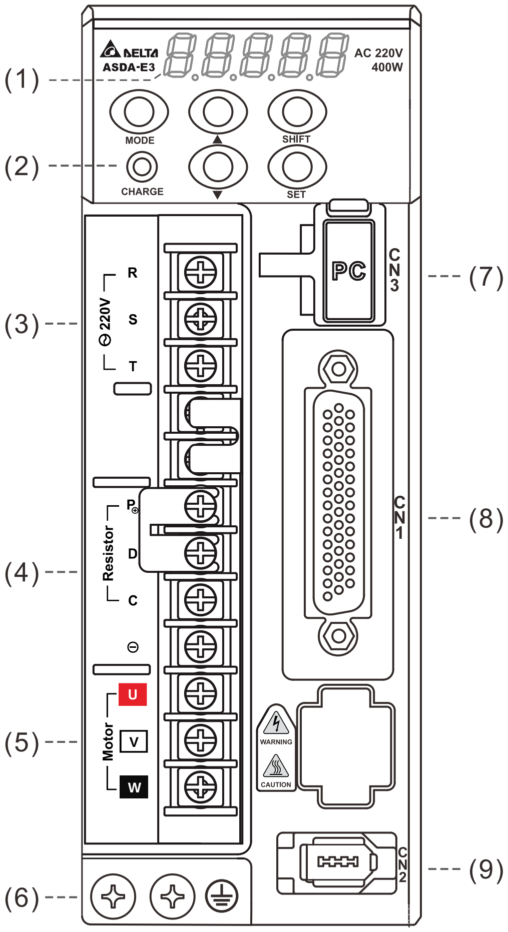
Note:

1. In the servo motor model number, 2⃞ represents the encoder type, 3⃞ represents the brake or keyway / oil seal type, and 4⃞ represents the shaft diameter and connector type.

2. In the servo drive model number, ☐ represents the model type.

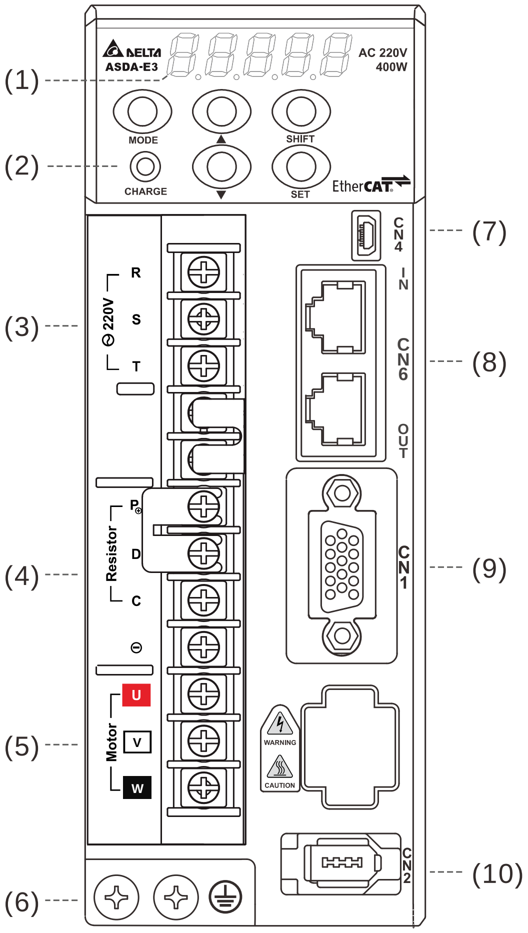
1.4 Description of the drive interface

1.4.1 -L models



No.	Name	Description
(1)	-	7-segment display.
(2)	CHARGE	Power indicator.
(3)	RST	Main circuit power input terminal. Connects to commercial power supply (200 - 230 V_{AC}, 50/60 Hz).
(4)	Regenerative resistor	Connects to an external regenerative resistor, the built-in regenerative resistor, or the external power regenerative unit.
(5)	UVW	Servo drive current output: connects to the motor power connector (U, V, W). Do not connect to the main circuit power. Incorrect wiring will cause damage to the servo drive.
(6)	Grounding screws	Connects to the ground wires for the power and servo motor.
(7)	CN3	Modbus communication port: for communication (RS-485 and RS-232) or PC connection (RS-232).
(8)	CN1	I/O signal interface: connects to PLC or controls I/O.
(9)	CN2	Encoder connector: connects to the encoder.

1.4.2 -E models



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

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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

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 an ambient 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.

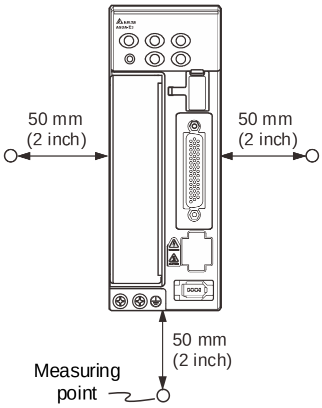
2.2 Ambient installation conditions

WARNING

Servo drive: the environment should be free of devices that generate excessive heat; no water, water vapor, dust, and oily dust; no corrosive and inflammable gas or liquids; no airborne dust or metal particles; and the environment should be solid without vibration and interference of electromagnetic noise.

Motor: the ambient temperature for the location of the ECM-E3 motors should be between -20°C (-4°F) and +60°C (+140°F)*. The environment should be free of devices that generate excessive heat; no water, water vapor, dust, and oily dust; no corrosive and inflammable gas or liquids; and no airborne dust or metal particles.

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 E3 motors.



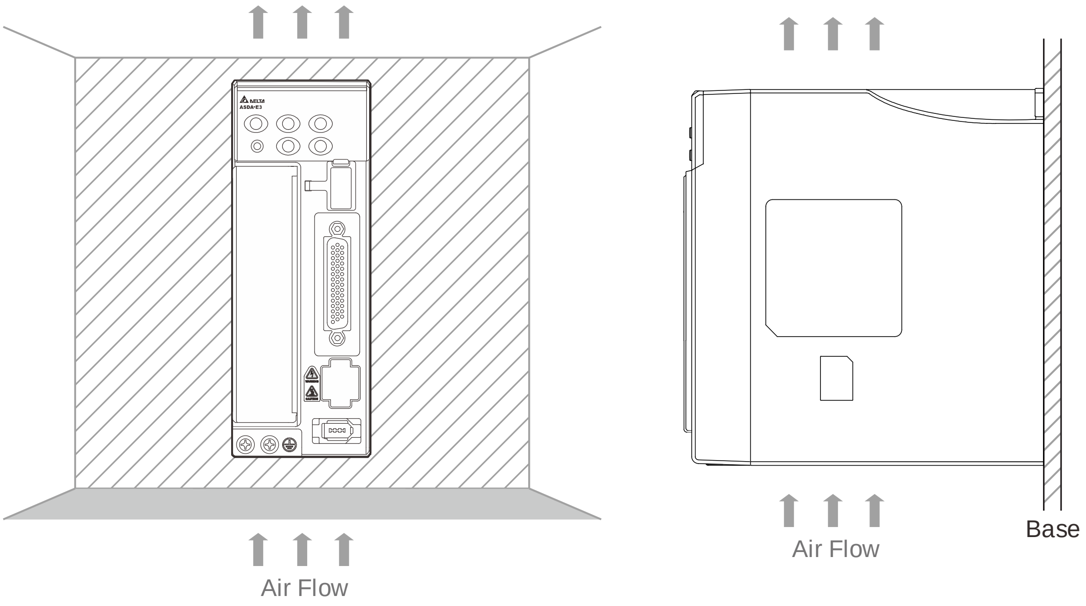
- The temperature of the operating environment for the servo drive is between 0°C (32°F) and 55°C (131°F). During long-term operation, it is advisable to keep the temperature of the operating environment under 45°C (113°F) to ensure the servo drive's performance.
- If the ambient temperature is over 45°C (113°F), place the product in a well-ventilated environment and **derate 10% of the average load for every 5°C (41°F) of temperature increase**.
- Mount the product vertically in the cabinet (see the illustration of the correct mounting direction in Section 2.3).
- Install a fan on the cabinet for heat dissipation. Make sure the size of the cabinet and its ventilation condition can prevent the internal electrical devices from overheating. Ensure that the temperature at the measuring point, which is the clearance of 50 mm (2 inches) beneath and on both sides of the servo drive, is kept under 55°C (131°F), and the servo drive must be kept clear of heat sources. In addition, check if the vibration of the machine affects the electrical devices in the cabinet.

2.3 Mounting direction and space

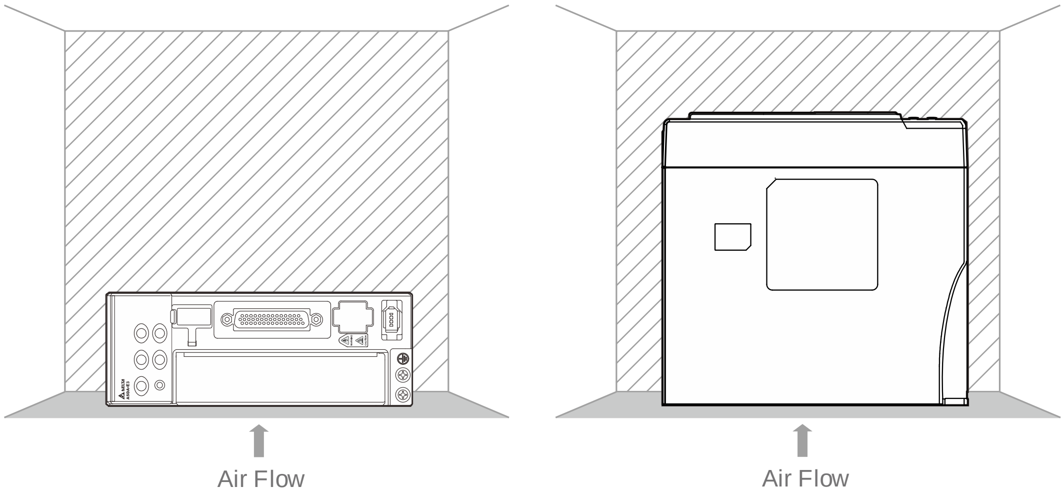
Important:

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

Correct

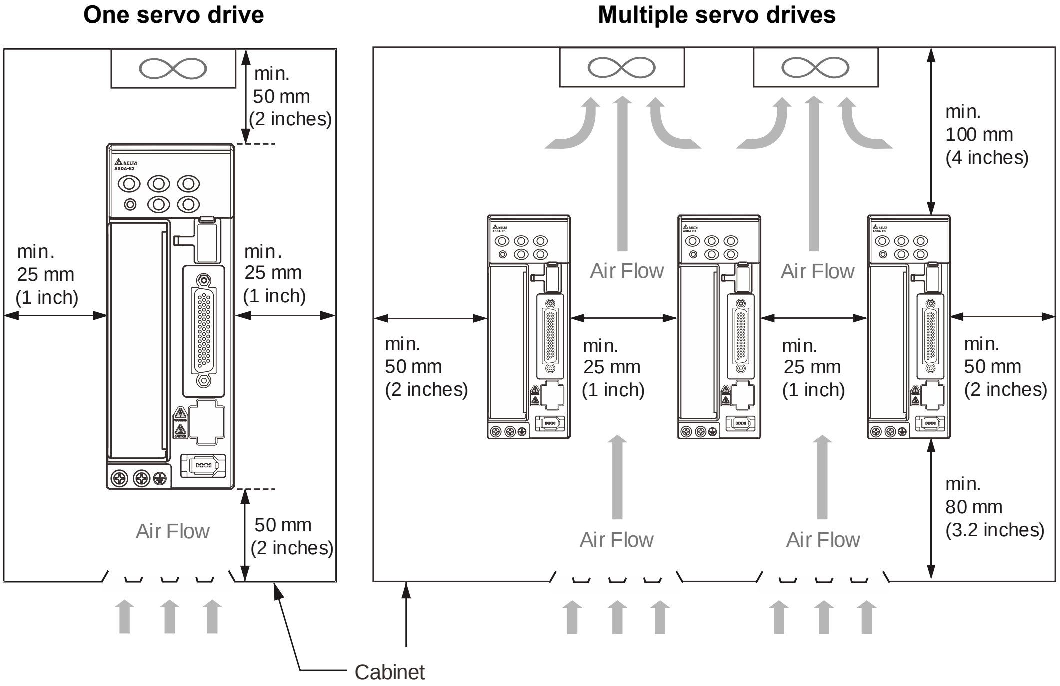


Incorrect



Heat dissipation requirements

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



Note: the 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 that you fully understand the motor specifications and the content of the operation manual. For your safety and correct use, read the precautions carefully before connecting the motor to 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 only the motor shaft.
- Do not hit the motor shaft. Impact force will damage the shaft and the encoder that is attached at 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 is 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 if storing the motor for more than six months.
- Ensure that the environmental conditions for storing the servo motor conform to the specifications in the instruction sheet.
- The encoder attached to the motor is easily damaged; take the necessary measures to avoid electromagnetic interference, vibration, and abnormal temperature changes.
- The magnetic field 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 will damage the encoder.

- When the motor or brake is undergoing high voltage tests, cut off the 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; otherwise 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 clamping, not for stopping the motor. Note that the built-in brake is not a device for safely stopping the machine. Install another safety device for stopping the machine. When the built-in brake is clamping the motor, rotation backlash can still occur and the maximum rotation is 1° to 2°. 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:

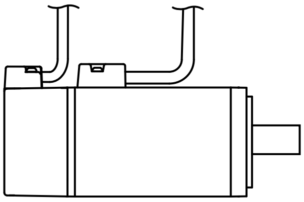
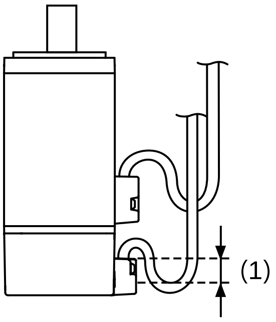
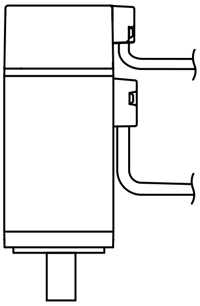
Possible cause	Checking method	Corrective action
There is a source of vibration in the connecting component.	Check if there is any foreign object, damage, or deformation in the movable parts of the connecting component.	Replace the connecting component (such as the coupling) or contact the manufacturer.
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 the encoder's rear cover for dust (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 (68°F).	Make sure the installation surface is flat. If there is any substance (such as paint or gasket) between the mounting surface and motor surface resulting in poor heat dissipation, remove the substance or use other methods to help 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.

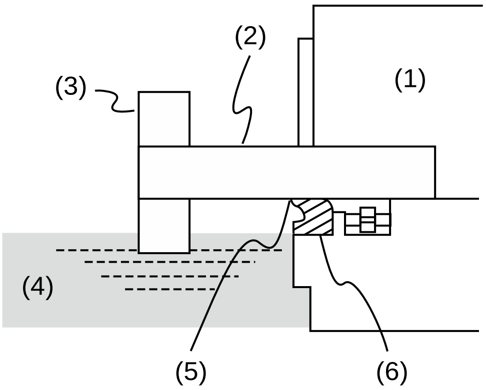
Mounting direction	Precautions
Horizontal 	If you are using a servo motor with an oil seal, refer to Section 2.4.5 for oil and water prevention measures for the servo motor.
Vertical - shaft end up 	■ When wiring, you need to install an oil trap (marked as (1) in the figure on the left) to prevent water 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:

- 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.

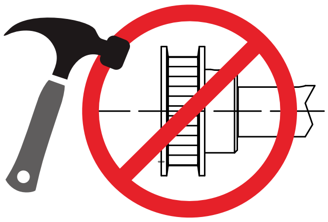


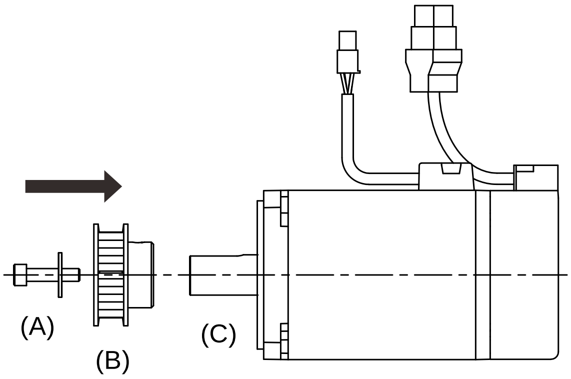
(1) Servo motor; (2) Motor shaft; (3) Gear; (4) Oil; (5) Oil seal lip; (6) Oil seal

- 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 you install 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. Use a screwdriver and screws when installing the motor shaft or motor shaft accessories.

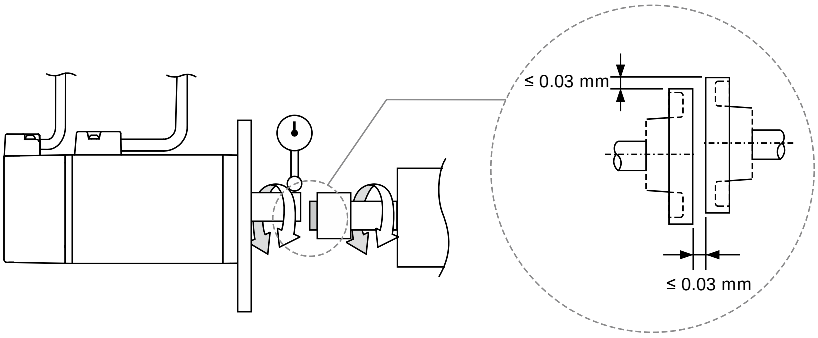




(A) Screw and gasket; (B) Belt pulley; (C) Servo motor shaft

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 couplings of appropriate size for the operating conditions. Improper use or connection may cause damage to the motor.
- Use the 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 axes and adjust it until it does not get stuck.

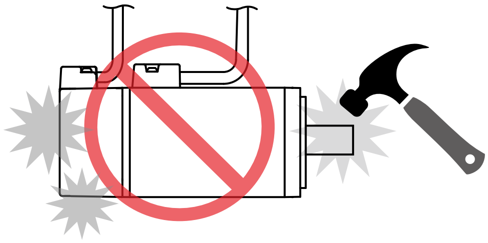


As shown in the previous figure, the distance is measured at four different positions on the circumference for the centering precision. The difference between the maximum and minimum measurements should be 0.03 mm or less. Even within this range, you can make adjustments to increase the centering precision.

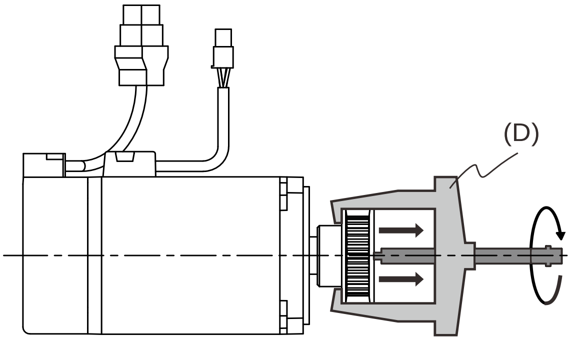
Important: when you are doing the measurements, rotate the coupling and the motor shaft together.

Installation safety precautions for motor shaft accessories

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



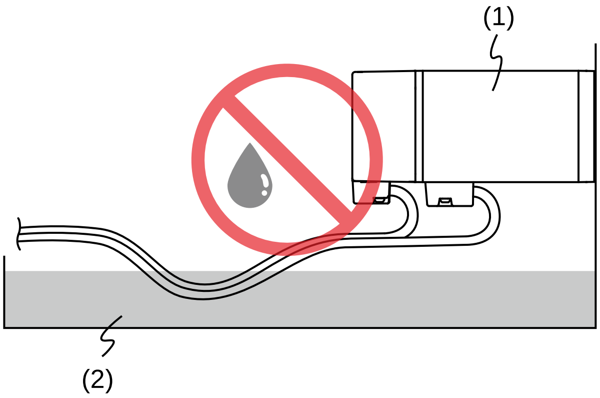
- If the coupling makes any abnormal noise, realign the shaft until the noise disappears.
- Ensure the axial load and radial load are within the specifications. Refer to the specifications for the maximum axial load (N) and maximum radial load (N) for each servo motor.
- Use a bearing puller (D) to remove 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

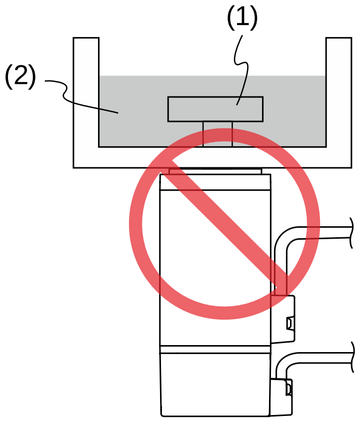
Follow these precautions and do not allow water, oil, or other foreign objects to enter the servo motor.

- Do not submerge the cable 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. Depending on the type of cutting fluids, the sealing materials, coated colloids, cables, or other components may be affected or even deteriorated.
- 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

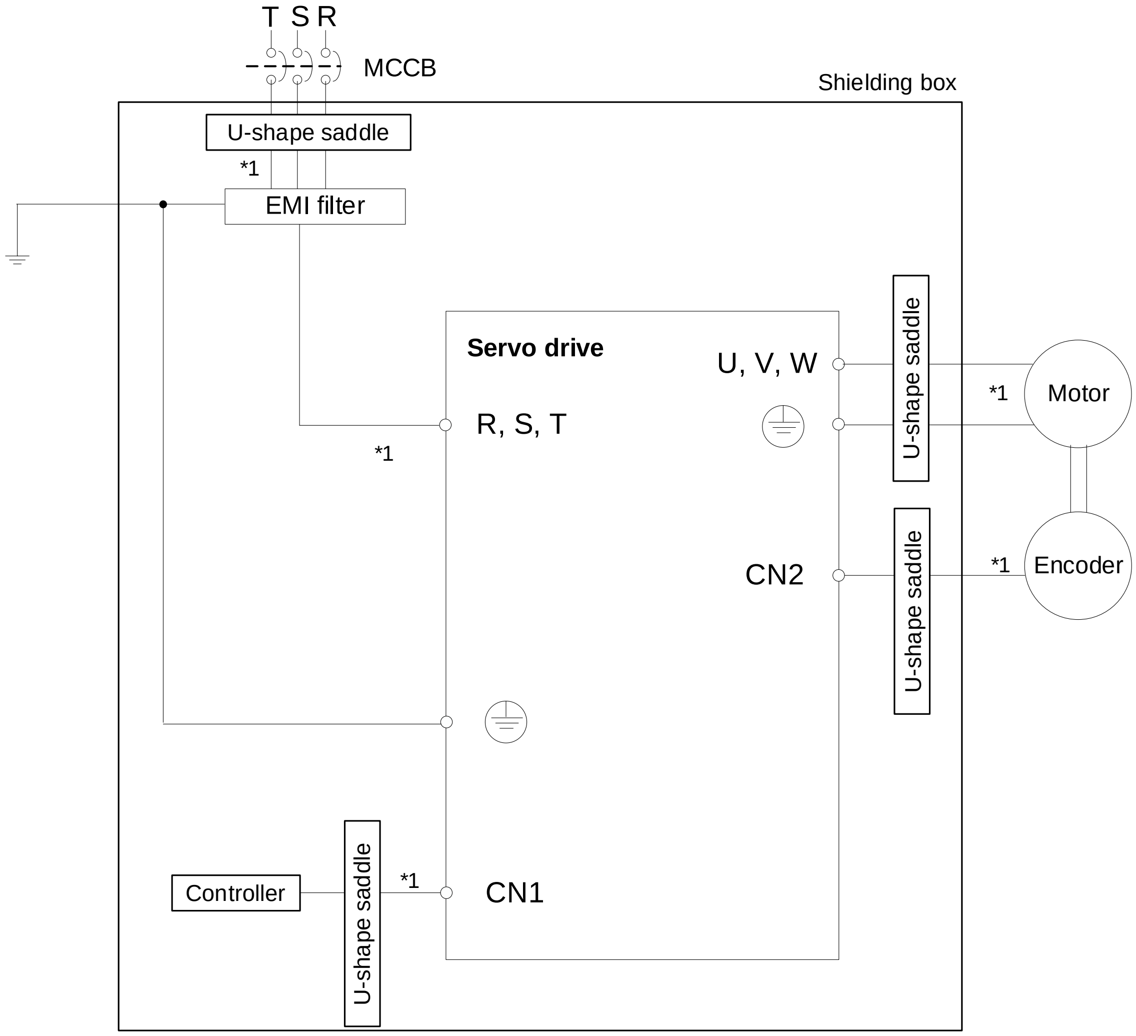
Servo drive model	Circuit breaker	Magnetic contactor	Fuse (Class T)
ASD-E3-0121-□	5 A	5 A	10 A
ASD-E3-0221-□	5 A	5 A	10 A
ASD-E3-0421-□	10 A	10 A	10 A
ASD-E3-0721-□	10 A	10 A	20 A
ASD-E3-1021-□	15 A	15 A	30 A
ASD-E3-1521-□	20 A	20 A	30 A
ASD-E3-2023-□	30 A	30 A	50 A
ASD-E3-3023-□	30 A	30 A	50 A

Note:

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

2.6 Installation requirements for EMC

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.



Note:

1. Use shielded wires.

2.6.1 EMI filters

All electronic equipment (including servo drives) generate 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 optimized performance, it is recommended that you use Delta's EMI filter for suppressing the interference.

Power	Servo drive model	Recommended EMI filter	
		1PH	3PH
100 W	ASD-E3-0121-□	EMF023A21A	EMF10AM23A
200 W	ASD-E3-0221-□	EMF023A21A	EMF10AM23A
400 W	ASD-E3-0421-□	EMF023A21A	EMF10AM23A
750 W	ASD-E3-0721-□	EMF023A21A	EMF10AM23A
1 kW	ASD-E3-1021-□	EMF023A21A	EMF10AM23A
1.5 kW	ASD-E3-1521-□	EMF023A21A	EMF10AM23A
2 kW	ASD-E3-2023-□	-	EMF021A23A
3 kW	ASD-E3-3023-□	-	EMF021A23A

Note: in the servo drive model name, □ represents the model type.

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, refer to these precautions:

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

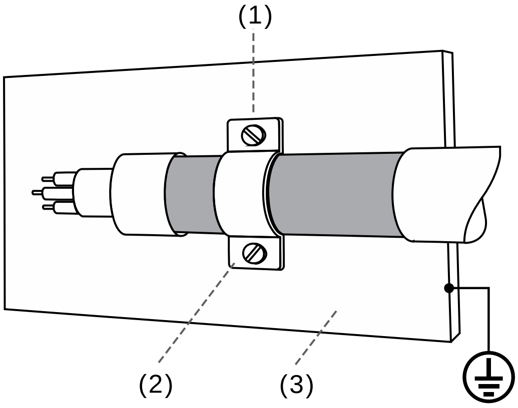
More specifications for mounting the EMI filter are listed as follows:

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

Motor power cable selection and installation precautions

The selection of motor power cable and installation accuracy determine the performance of the EMI filter. Follow these precautions:

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



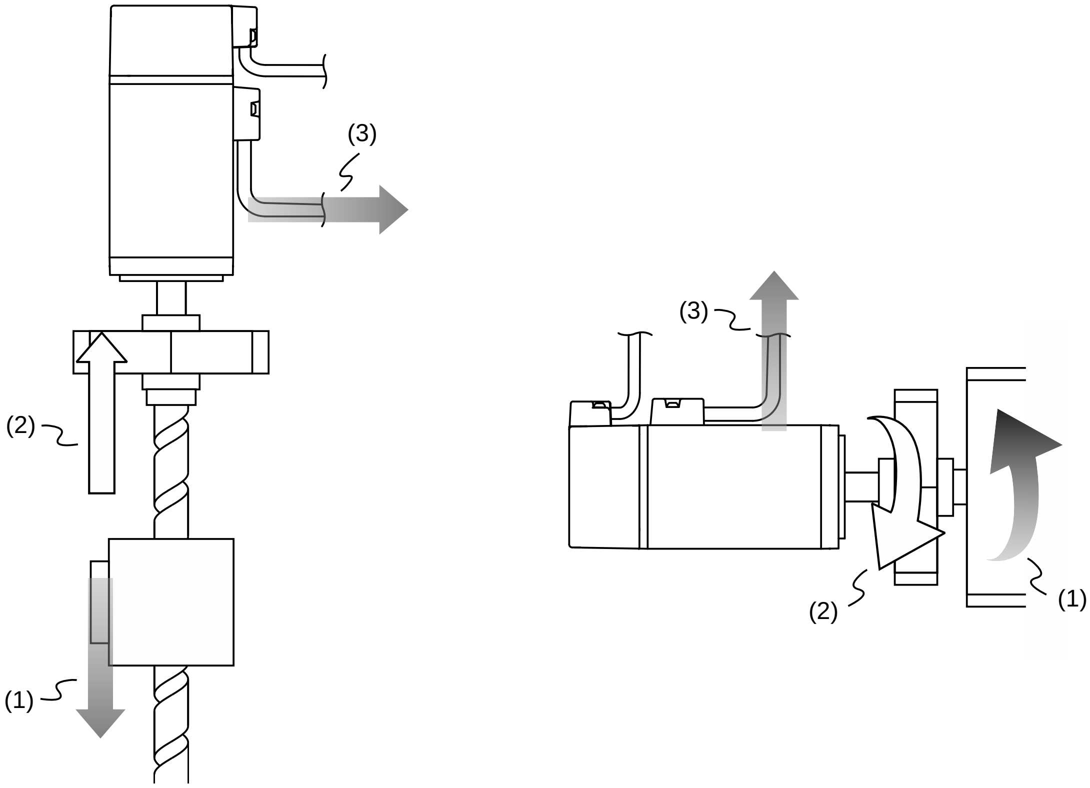
(1) Remove the protective paint on the U-shape saddle and metal plate to ensure good contact

(2) U-shape 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 direction of rotation, 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 a given value, the excess energy is consumed by a regenerative resistor. Refer to the following table to select the suitable regenerative resistor.



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

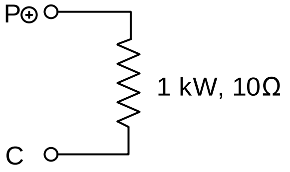
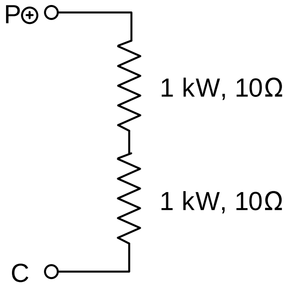
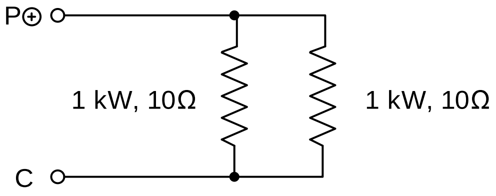
Specifications of the built-in regenerative resistor in the servo drive are as follows:

Servo drive (kW)	Specifications of the built-in regenerative resistor		Capacity of the built-in regenerative resistor (Watt)	Minimum allowable resistance value (reference for external resistors) (Ohm)
	Resistance (Ohm)	Capacity (Watt)		
0.1	-	-	-	60
0.2	-	-	-	60
0.4	-	-	-	60
0.75	100	40	20	60
1.0	100	40	20	30
1.5	100	40	20	30
2.0	20	80	40	15
3.0	20	80	40	15

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:

1. Correctly set the resistance value (P1.052) and capacity (P1.053) for the regenerative resistor; otherwise it might affect the performance.
2. When using an external regenerative resistor, ensure the total resistance value is greater than the minimum allowable resistance value of the servo drive.
3. For general applications, you can connect more than one resistor in series. If the resistance value (from resistors connected in series) exceeds the rated range, you can reduce the value by connecting the resistors in parallel. If you want to connect the resistors in parallel to increase the power of the regenerative resistors, make sure the resistance value meets the requirements.

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

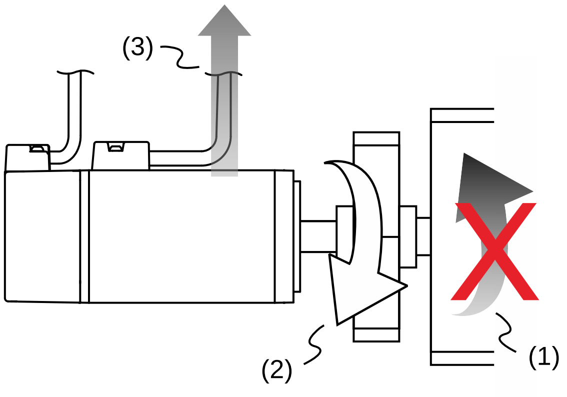
<table>
<tr><th colspan="2">Connect to one external regenerative resistor</th></tr>
<tr><td>
</td><td>P1.052 = 10 (Ω)
P1.053 = 1000 (W)</td></tr>
<tr><th colspan="2">Connect to external regenerative resistors (serial connection)</th></tr>
<tr><td>
</td><td>P1.052 = 20 (Ω)
P1.053 = 2000 (W)</td></tr>
<tr><th colspan="2">Connect to external regenerative resistors (parallel connection)</th></tr>
<tr><td>
</td><td>P1.052 = 5 (Ω)
P1.053 = 2000 (W)</td></tr>
</table>

4. Normally, if the capacity of the regenerative resistor (the average value) is within the rated capacity, the temperature of the resistor can increase to 120°C (248°F) or even higher under the condition that the regenerative energy continues to function. 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 P⊕ and D contacts open. It is recommended that you choose external regenerative resistors of the resistance values specified in the table on page 19. For easy calculation of the required regenerative resistor capacity, regardless of the energy consumed by IGBT, select the capacity of the external regenerative resistor according to the selected 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 following table when making calculations and selecting the required regenerative resistor.

Servo drive (kW)		Motor	Rotor inertia (× 10^{-4}kg.m^2)	Regenerative energy generated when the motor decelerates from the rated speed to a stop without load Eo (joule)	Maximum regenerative energy that can be absorbed by the capacitor Ec (joule)
Low inertia	0.1	ECM-E3L-C②0401③④E	0.0229	0.15	4.21
Medium inertia	0.2	ECM-E3M-C②0602③④E	0.141	0.70	5.62
	0.4	ECM-E3M-C②0604③④E	0.254	1.26	8.42
	0.75	ECM-E3M-C②0807③④E	1.07	5.29	18.25
	1.0	ECM-E3M-E②1310③④E	7.79	17.12	26.21
	1.5	ECM-E3M-E②1315③④E	11.22	24.66	34.94
	2.0	ECM-E3M-E②1320③④E	14.65	32.20	26.21
	3.0	ECM-E3M-F②1830③④E	53.63	66.3	31.82

Note: in the servo motor model name, ② represents the encoder type; ③ represents the brake or keyway / oil seal type; and ④ represents the shaft diameter and connector type.

Assuming that the load inertia is N times the motor inertia, when the motor decelerates from 3,000 rpm 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 power 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 motion cycle (T).	Manual input.
3	Set the rotation speed (wr).	Manual input or read the status with P0.002.
4	Set the ratio (N) of the load inertia to the motor inertia.	Manual input or read the status with P0.002.
5	Calculate the maximum regenerative energy (Eo).	$Eo = J \times wr^2 / 182$
6	Find the regenerative energy that can be absorbed by the capacitor (Ec).	Refer to the preceding table.
7	Calculate the required capacity of the regenerative resistor.	2 × ((N + 1) × Eo - Ec) / T

Take the 400 W motor (ECM-E3M-CA0604RSE) for example. When the reciprocating motion cycle (T) is 0.4 sec, the maximum rotation speed is 3,000 rpm, and the load inertia is 15 times of the motor inertia:

Servo drive (kW)	Motor	Rotor inertia J ($\times 10^{-4}$kg.m^2)	Regenerative energy generated when the motor decelerates from the rated speed to a stop without load Eo (joule)	Maximum regenerative energy that can be absorbed by the capacitor Ec (joule)
0.4	ECM-E3M-CA0604RSE	0.254	1.26	8.42

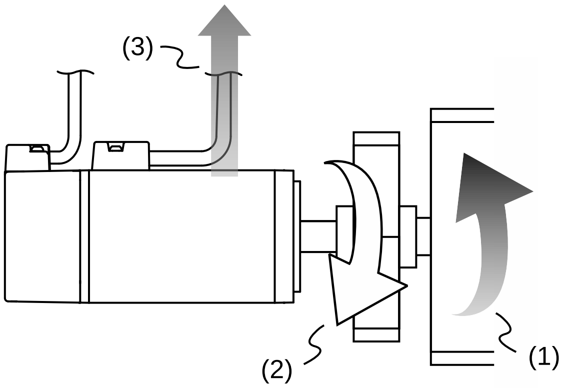
Find the maximum regenerative energy: Eo = 1.26 joules (from the preceding table).

Find the maximum regenerative energy that can be absorbed by the capacitor: Ec = 8.42 joules (from the preceding table).

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 W.

From the preceding calculation, the required power 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 is full and cannot store more energy, the excess energy is consumed by the regenerative resistor.

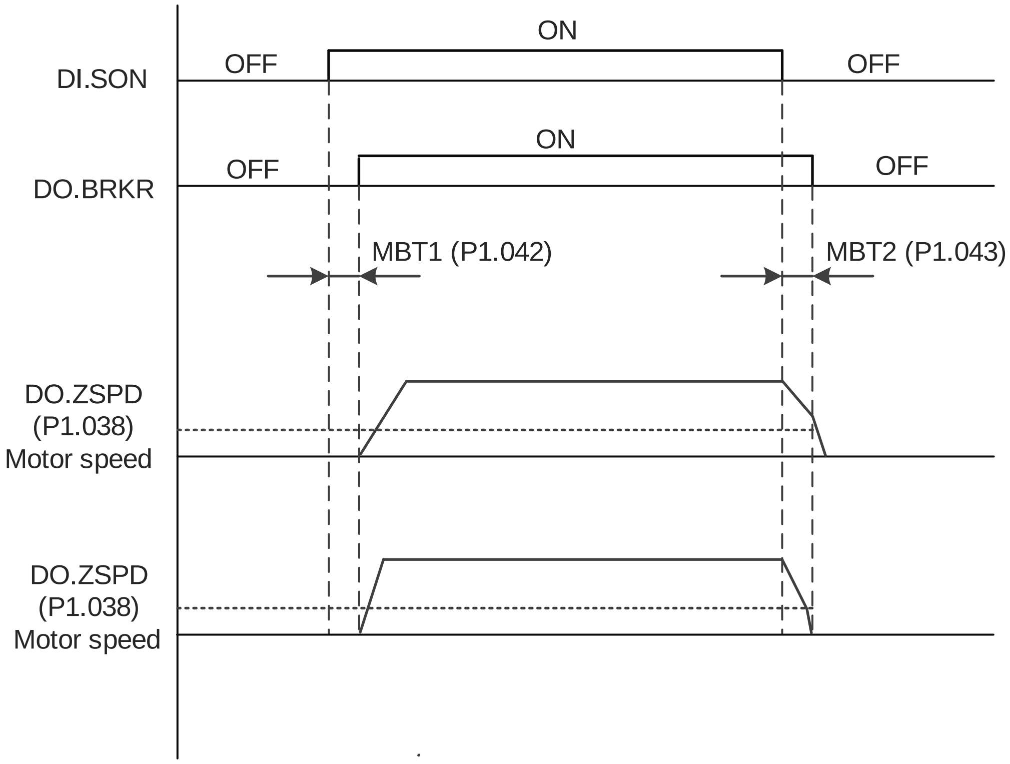
Example:
For the 400 W motor (ECM-E3M-CA0604RSE), when the torque of the external load is +70% of the rated torque (1.27 N-m) with the rotation speed up to 3,000 rpm, the required external regenerative resistor is: $2 \times (0.7 \times 1.27) \times (\frac{3000 \times 2 \times \pi}{60}) = 558$ W.
Therefore, a regenerative resistor of 560 W and 60 Ω* is needed.

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

2.8 The use of braking

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

Timing diagram of brake control:

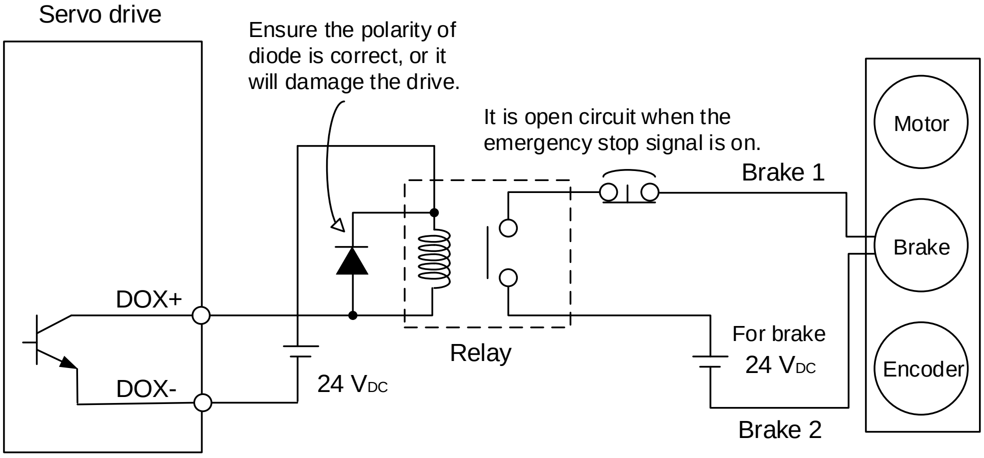


Output timing of the DO.BRKR signal:

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 clamped).
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 clamped).

Normally, DO.BRKR (0x08) should be on when the servo is in the Servo On state, which means the brake is operating and the motor can run freely. When in an emergency, press the emergency stop button to open the circuit and set DI.EMGS (0x21) to on. Then, AL013 is triggered, and the motor is immediately stopped.

Wiring of the brake:



Note:

1. Refer to Chapter 3 Wiring.
2. Use a 24 V_{DC} power supply for the brake. Do not share the same power supply with control signals.
3. There is no polarity for the brake coil.

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

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

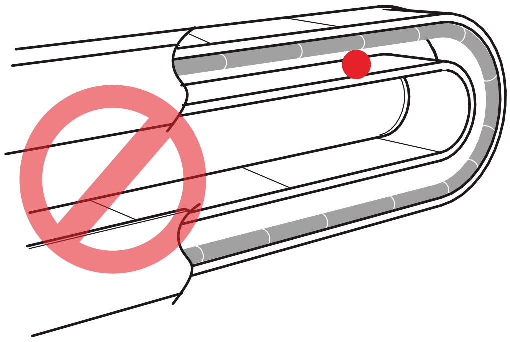
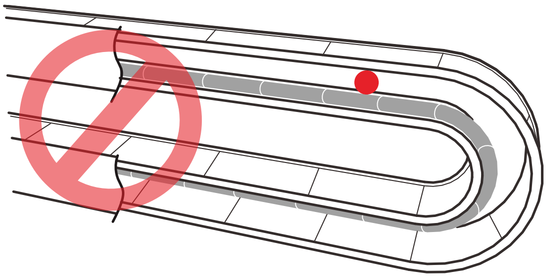
2.9 The use of cable

Precautions for using standard cable:

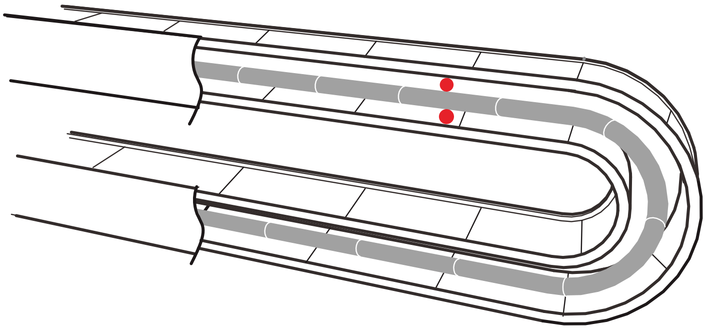
- Do not use the standard cable when the application requires the cable to move or bend. If required, use a flexible cable instead.

Precautions for using flexible cable:

- Inappropriate installation and wrong usage shorten the cable lifetime.
- Do not twist the cable when installing.
- 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.
- Prevent the connectors of the cable from being subject to stress.
- 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.

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.
- 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 bend the flexible cable under any normal circumstances. Refer to Section 3.1.6.4 for detailed flexible cable specifications.

Wiring

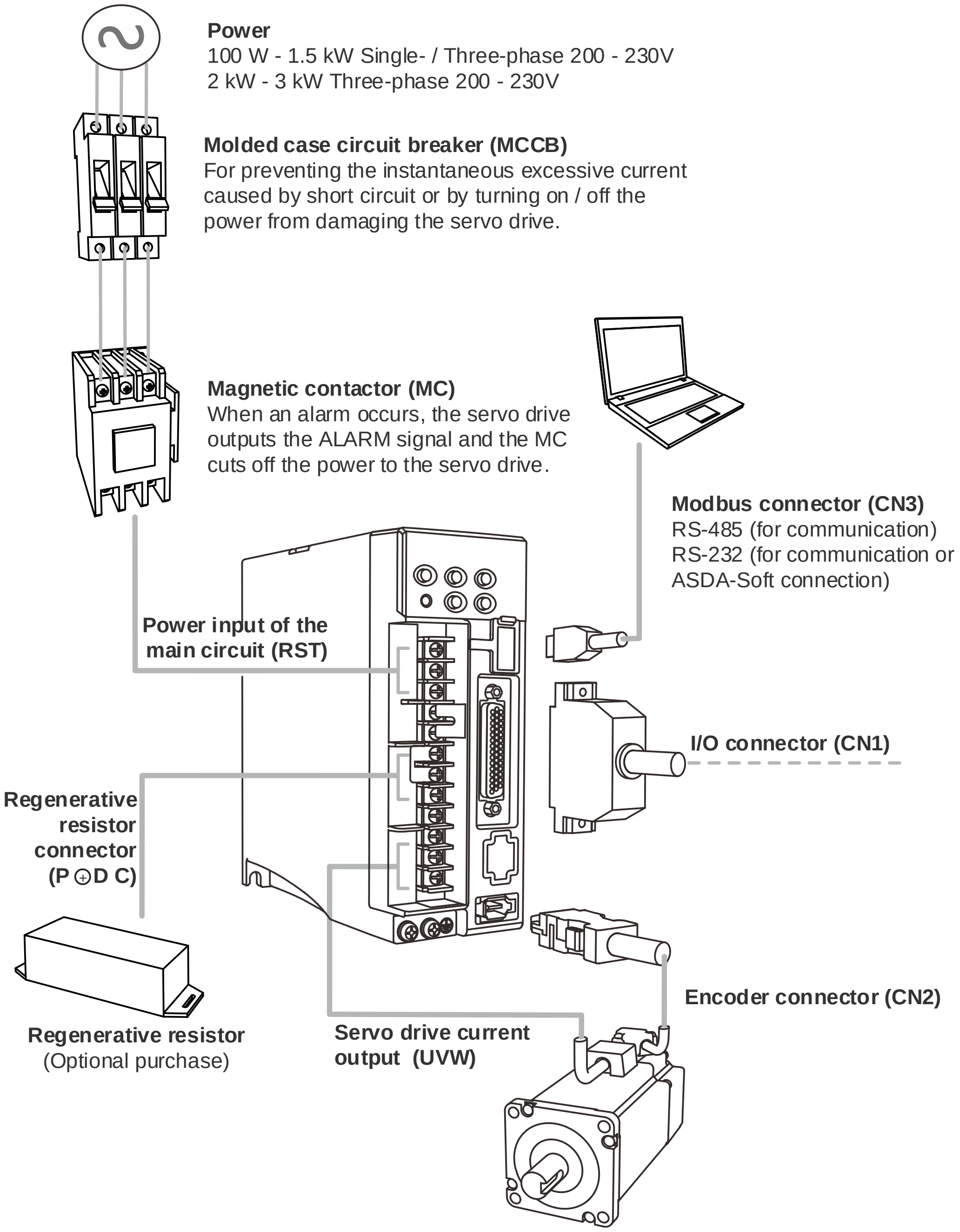
3

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

3.1 System connection

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

E3-L models



Power
100 W - 1.5 kW Single- / Three-phase 200 - 230V
2 kW - 3 kW Three-phase 200 - 230V

Molded case circuit breaker (MCCB)
For preventing the instantaneous excessive current caused by short circuit or by turning on / off the power from damaging the servo drive.

Magnetic contactor (MC)
When an alarm occurs, the servo drive outputs the ALARM signal and the MC cuts off the power to the servo drive.

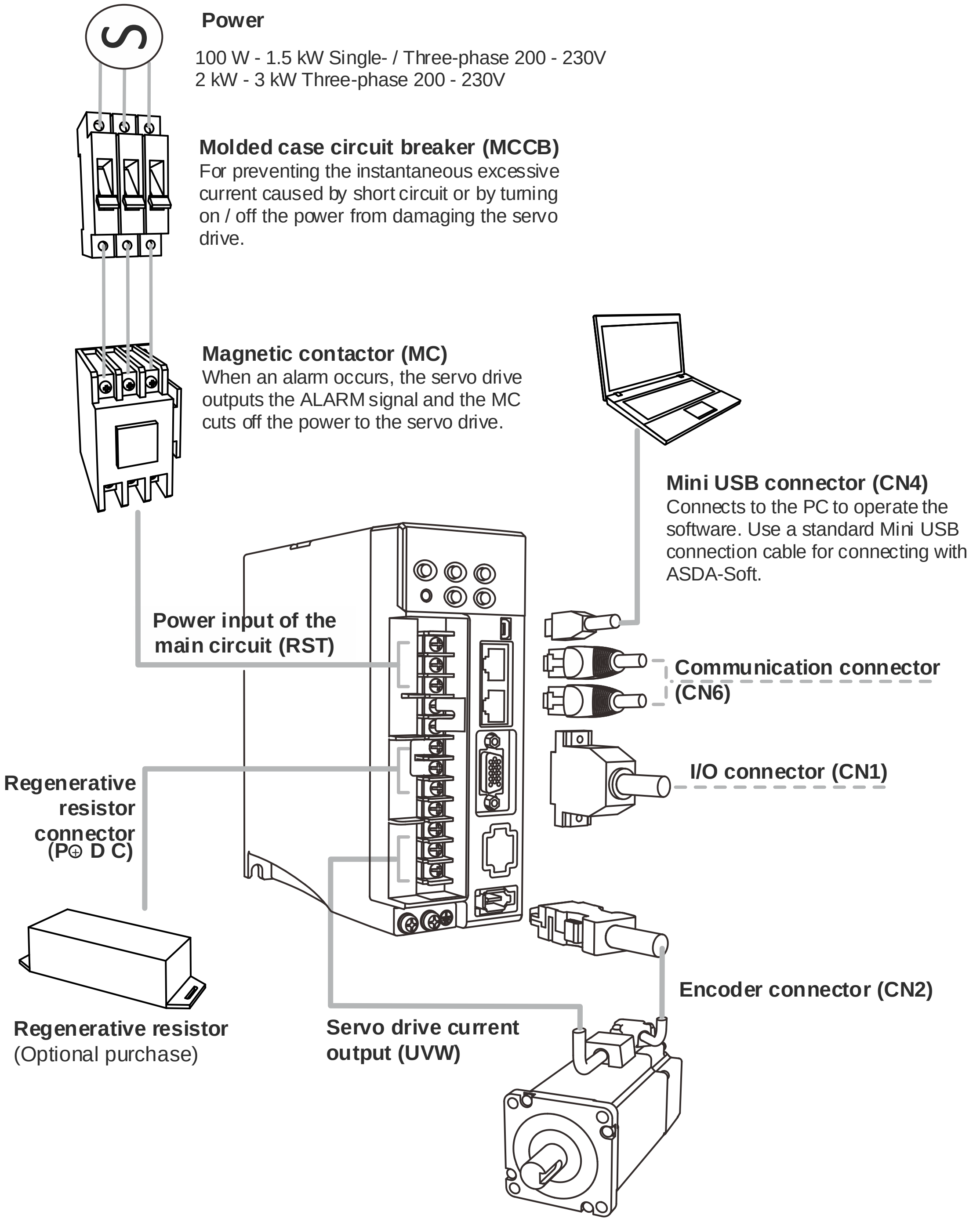
Modbus connector (CN3)
RS-485 (for communication)
RS-232 (for communication or ASDA-Soft connection)

Regenerative resistor
(Optional purchase)

Installation precautions:

1. Make sure the power supply and wiring for the RST terminal block 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 UVW terminal block is 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.

E3-E models



Installation precautions:

1. Make sure the power supply and wiring for the RST terminal block 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 UVW terminal block is 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.

3.1.2 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 for the main circuit</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="6">U, V, W, FG</td><td rowspan="6">Motor power connector</td><td colspan="3">Connect to the servo motor.</td></tr>
<tr><th>Terminal</th><th>Wire color</th><th>Description</th></tr>
<tr><td>U</td><td>Red</td><td rowspan="3">A three-phase main power cable for the motor.</td></tr>
<tr><td>V</td><td>White</td></tr>
<tr><td>W</td><td>Black</td></tr>
<tr><td>FG</td><td>Yellow / Green</td><td>Connect to the ground terminal ⏚ on the servo drive.</td></tr>
<tr><td rowspan="3">P⊕, D, C, ⊖</td><td rowspan="3">Regenerative resistor terminal or power regenerative unit</td><td colspan="2">Use the built-in resistor</td><td>Short-circuit P⊕ and D contacts, and leave P⊕ and C contacts open.</td></tr>
<tr><td colspan="2">Use an external resistor</td><td>Connect the resistor to P⊕ and C contacts, and leave P⊕ and D contacts open.</td></tr>
<tr><td colspan="2">Use an external power regenerative unit</td><td>Connect the power regenerative unit to P⊕ and ⊖ 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 connector</td><td colspan="3">Connect to the controller. Refer to Section 3.3 for more information.</td></tr>
<tr><td>CN2</td><td>Encoder connector</td><td colspan="3">Connect to the encoder. Refer to Section 3.4 for more information.</td></tr>
<tr><td>CN3</td><td>Modbus communication connector</td><td colspan="3">For E3-L models to communicate with Modbus devices (RS-485 or RS-232) or connect to PC (RS-232). Refer to Section 3.5 for more information.</td></tr>
<tr><td>CN4</td><td>Mini USB connector</td><td colspan="3">For E3-E models to connect to PC or laptop. Refer to Section 3.6 for more information.</td></tr>
<tr><td>CN6</td><td>EtherCAT communication connector</td><td colspan="3">For E3-E models to communicate with EtherCAT devices. Refer to Section 3.7 for more information.</td></tr>
</table>

Pay special attention to the following when wiring:

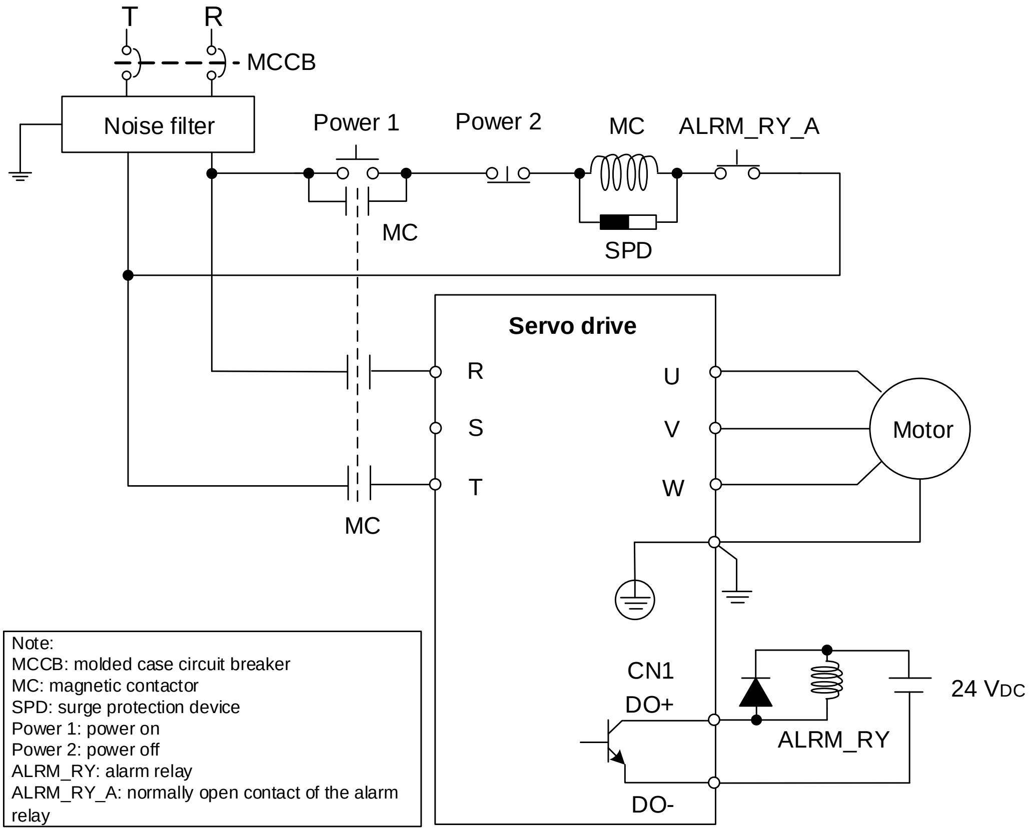
1. When the power is off, do not touch R, S, T and U, V, W, and P⊕, D, C, ⊖ wires since the built-in capacitor of the servo drive can still contain a dangerously large amount of electric charge. Wait until the “CHARGE” indicator is off.
2. Separate the RST power cable and the UVW power cable from other cables. The separation should be at least 30 cm (11.8 inches).
3. For the encoder cable used to connect CN2, use a metal braided shielded twisted-pair cable that conforms to the UL 2464 standard.
4. When using RS-485 or RS-232, use the shielded twisted-pair communication cable to ensure the communication quality.
5. When selecting the wires, refer to Section 3.1.6.
6. Do not use any external capacitors, or it may damage the servo drive.

3.1.3 Wiring for power supply

There are two methods for wiring the power supply: single-phase and three-phase.
The single-phase wiring is only applicable to models of 1.5 kW or below. 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 main power circuit.

Important: connecting the single-phase power to R and T terminals is recommended.

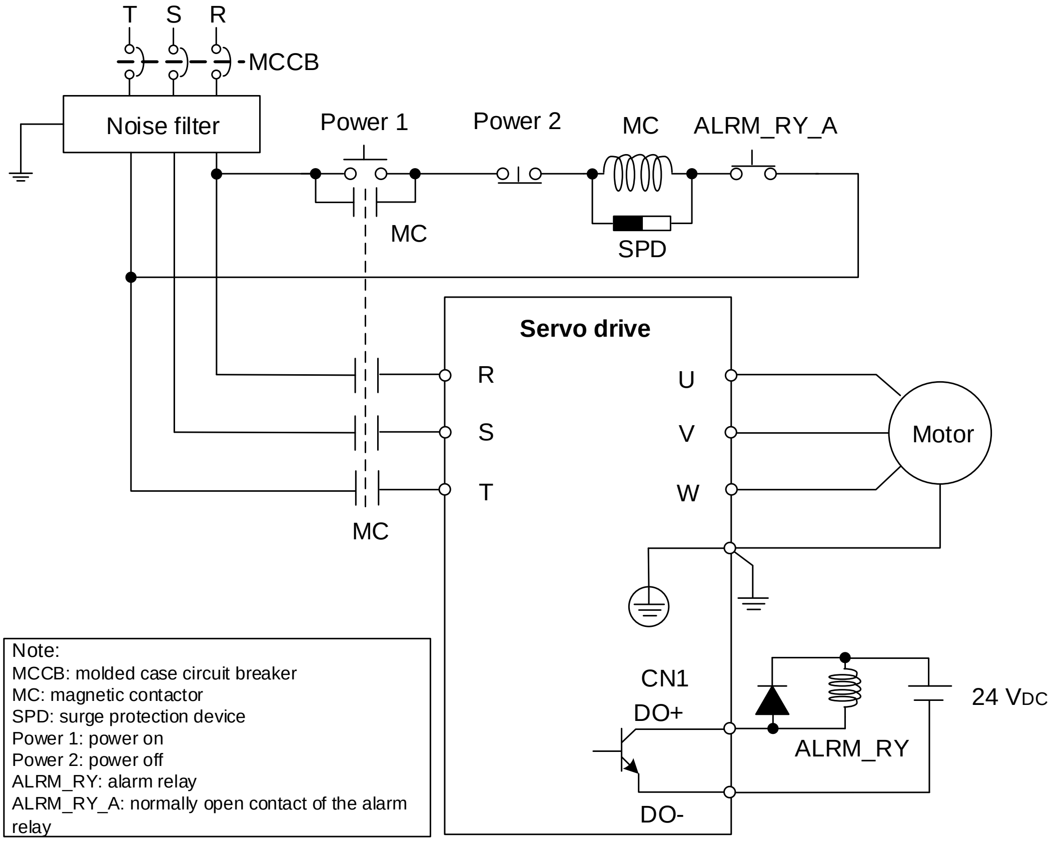
- Wiring method for single-phase power supply (for models of 1.5 kW or below)



Note:
MCCB: molded case circuit breaker
MC: magnetic contactor
SPD: surge protection device
Power 1: power on
Power 2: power off
ALRM_RY: alarm relay
ALRM_RY_A: normally open contact of the alarm relay

Note: wire the CN1 connector with the actual DO parameters of each model.

- Wiring method for three-phase power supply (for all series)

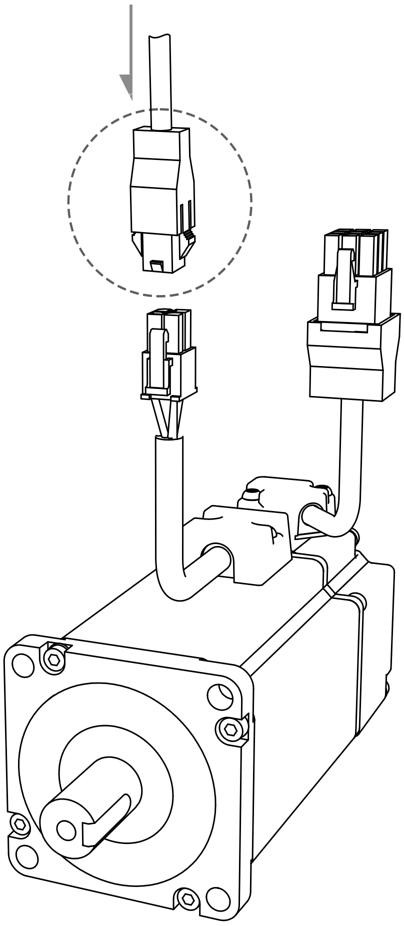


Note:
MCCB: molded case circuit breaker
MC: magnetic contactor
SPD: surge protection device
Power 1: power on
Power 2: power off
ALRM_RY: alarm relay
ALRM_RY_A: normally open contact of the alarm relay

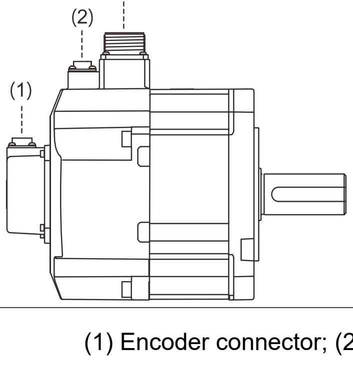
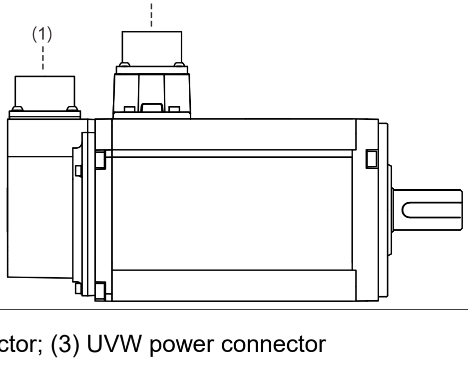
Note: wire the CN1 connector with the actual DO parameters of each model.

3.1.4 UVW power connector specifications

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

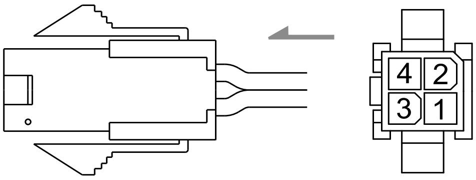
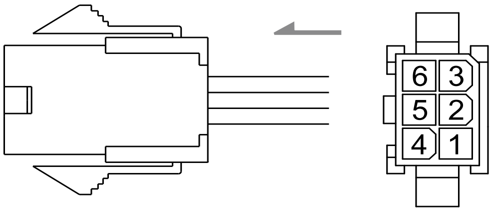


(2) and (3) in the following figures show the difference between the military connectors for the ECM-E3 motors and the ECMA / ECMC (old series) motors.

ECM-E3 (F130 - F180)	ECMA / ECMC (F100 - F180)
	

(1) Encoder connector; (2) Brake connector; (3) UVW power connector

3.1.4.1 F40 - F80 motors – Power connectors

<table>
<tr><th>Motor model</th><th colspan="6">UVW connector</th></tr>
<tr><td rowspan="8">ECM-E31⃞-C2⃞04013⃞4⃞E
ECM-E31⃞-C2⃞06023⃞4⃞E
ECM-E31⃞-C2⃞06043⃞4⃞E
ECM-E31⃞-C2⃞08073⃞4⃞E</td><td colspan="6"> </td></tr>
<tr><td colspan="6">Pin assignment</td></tr>
<tr><td>U (Red)</td><td>V (White)</td><td>W (Black)</td><td>CASE GROUND (Yellow / Green)</td><td>BRAKE1</td><td>BRAKE2</td></tr>
<tr><td>1</td><td>2</td><td>3</td><td>4</td><td>-</td><td>-</td></tr>
<tr><td colspan="6"> </td></tr>
<tr><td colspan="6">Pin assignment</td></tr>
<tr><td>U (Red)</td><td>V (White)</td><td>W (Black)</td><td>CASE GROUND (Yellow / Green)</td><td>BRAKE1^{*3}</td><td>BRAKE2^{*3}</td></tr>
<tr><td>1</td><td>2</td><td>4</td><td>5</td><td>3</td><td>6</td></tr>
</table>

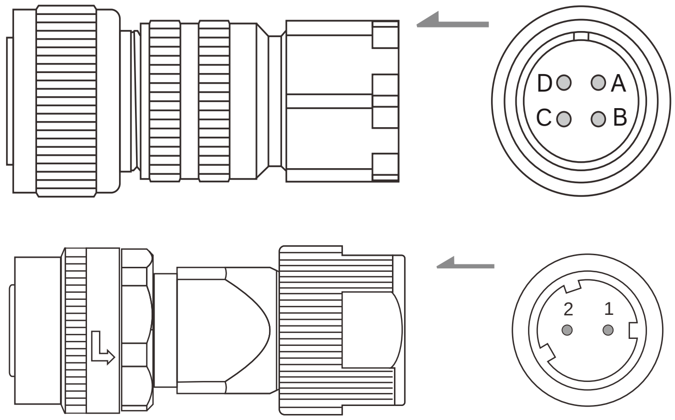
Note:

1. In the servo motor model number, 1⃞ represents the motor inertia, 2⃞ represents the encoder type, 3⃞ represents the brake or keyway / oil seal type, and 4⃞ represents the shaft diameter and connector type.
2. Use a 24 V_{DC} power supply for the brake. Do not share the same power supply with control signals.
3. The brake coil has no polarity. Its pin symbols are BRAKE1 and BRAKE2. Color of brake wires for motors with the frame size of 40 - 80 mm: brown and blue.
4. When selecting the wires, refer to Section 3.1.6 for details.

Connector specifications:

<table>
<tr><td rowspan="3">UVW</td><th>Brand</th><th>Model number</th></tr>
<tr><td>Delta</td><td>ACS3-CAPW1000</td></tr>
<tr><td>Molex</td><td>39-01-2041 (case)
39-00-0040 (terminal)</td></tr>
<tr><td rowspan="3">UVW with brake</td><th>Brand</th><th>Model number</th></tr>
<tr><td>Delta</td><td>ACS3-CAPW2000</td></tr>
<tr><td>Molex</td><td>39-01-2061 (case)
39-00-0040 (terminal)</td></tr>
</table>

3.1.4.2 F100 - F130 motors – Power connectors

<table>
<tr><th>Motor model</th><th colspan="6">UVW connector and brake connector</th></tr>
<tr><td rowspan="4">ECM-E31⃞-E2⃞13103⃞4⃞E
ECM-E31⃞-E2⃞13153⃞4⃞E
ECM-E31⃞-E2⃞13203⃞4⃞E</td><td colspan="6">
</td></tr>
<tr><td colspan="6">Pin assignment</td></tr>
<tr><td>U (Red)</td><td>V (White)</td><td>W (Black)</td><td>CASE GROUND (Yellow / Green)</td><td>BRAKE1^{*3}</td><td>BRAKE2^{*3}</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td>1</td><td>2</td></tr>
</table>

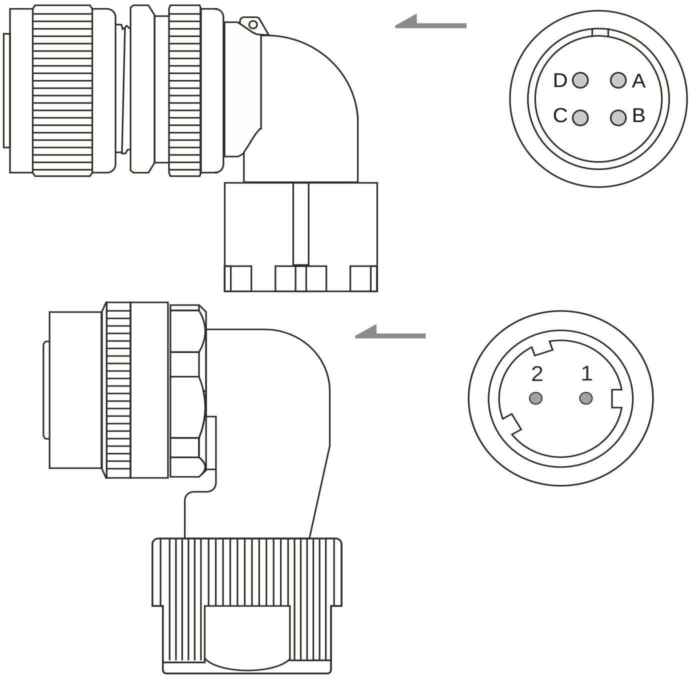
Note:

1. In the servo motor model number, 1⃞ represents the motor inertia, 2⃞ represents the encoder type, 3⃞ represents the brake or keyway / oil seal type, and 4⃞ represents the shaft diameter and connector type.
2. Use a 24 V_{DC} power supply for the brake. Do not share the same power supply with control signals.
3. The brake coil has no polarity. Its pin symbols are BRAKE1 and BRAKE2. Color of brake wires for motors with the frame size of 130 mm or above: red and black.
4. When selecting the wires, refer to Section 3.1.6 for details.

Connector specifications:

UVW	Brand	Model number	IP rating
MIL 18-10S	Delta	ACS3-CAPWA000	IP67
	SUNCHU	CMS3106A18-10SBI (connector & compression ring)	IP67
Brake	Brand	Model number	IP rating
CMV1-2S	Delta	ACS3-CABRA000	IP67
	DDK	CM1V1-SP2S-M1	IP67
	SUNCHU	SC-CMV1-SP02C	IP67

Note: refer to Section 3.1.7 for the wire diameter specification of the IP67 compliant Delta connectors. For connector specification of other brands, contact the manufacturers.

Motor model	UVW connector brake connector
ECM-E3①-E②1310③④E ECM-E3①-E②1315③④E ECM-E3①-E②1320③④E	

Pin assignment					
U (Red)	V (White)	W (Black)	CASE GROUND (Yellow / Green)	BRAKE1[*4]	BRAKE2[*4]
A	B	C	D	1	2

Note:

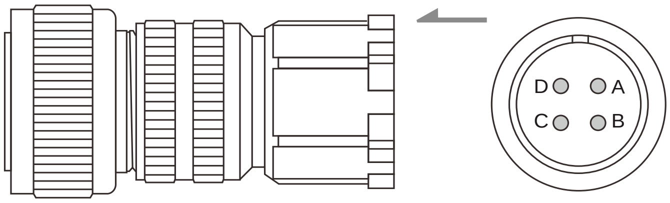
1. In the servo motor model number, ① represents the motor inertia, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, and ④ represents the shaft diameter and connector type.
2. Use a 24 V_{DC} power supply for the brake. Do not share the same power supply with control signals.
3. The brake coil has no polarity. Its pin symbols are BRAKE1 and BRAKE2. Color of brake wires for motors with the frame size of 130 mm or above: red and black.
4. When selecting the wires, refer to Section 3.1.6 for details.

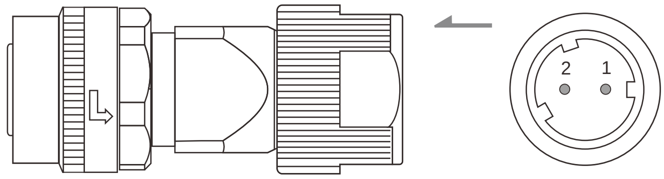
Connector specifications:

UVW	Brand	Model number	IP rating
MIL 18-10S	Delta	ACS3-CRPWA000	IP67
	SUNCHU	CMS3108A18-10SBI (connector & compression ring)	IP67
Brake	Brand	Model number	IP rating
CMV1-2S	Delta	ACS3-CRBRA000	IP67
	DDK	CMV1-AP2S-M1	IP67
	SUNCHU	SC-CMV1-AP02C	IP67

Note: refer to Section 3.1.7 for the wire diameter specification of the IP67 compliant Delta connectors. For connector specification of other brands, contact the manufacturers.

3.1.4.3 F180 motors – Power connectors

<table>
<tr><th>Motor model</th><th colspan="6">UVW connector and brake connector</th></tr>
<tr><td rowspan="4">ECM-E31⃞-F2⃞18303⃞4⃞E</td><td colspan="6">


</td></tr>
<tr><td colspan="6">Pin assignment</td></tr>
<tr><td>U (Red)</td><td>V (White)</td><td>W (Black)</td><td>CASE GROUND (Yellow / Green)</td><td>BRAKE1^{*3}</td><td>BRAKE2^{*3}</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td>1</td><td>2</td></tr>
</table>

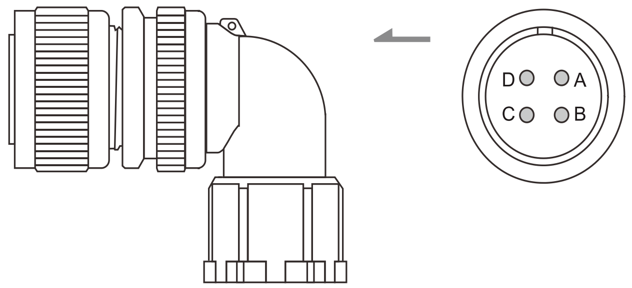
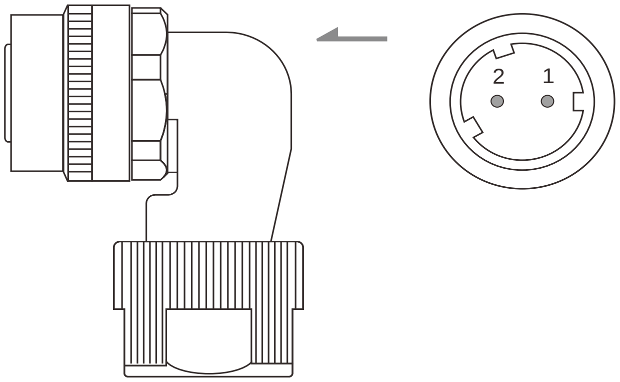
Note:

1. In the servo motor model number, 1⃞ represents the motor inertia, 2⃞ represents the encoder type, 3⃞ represents the brake or keyway / oil seal type, and 4⃞ represents the shaft diameter and connector type.
2. Use a 24 V_{DC} power supply for the brake. Do not share the same power supply with control signals.
3. The brake coil has no polarity. Its pin symbols are BRAKE1 and BRAKE2. Color of brake wires for motors with the frame size of 130 mm or above: red and black.
4. When selecting the wires, refer to Section 3.1.6 for details.

Connector specifications:

UVW	Brand	Model number	IP rating
MIL 22-22S	Delta	ACS3-CAPWC000	IP67
	SUNCHU	CMS3106A22-22SBI (connector & compression ring)	IP67
Brake	**Brand**	**Model number**	**IP rating**
CMV1-2S	Delta	ACS3-CABRA000	IP67
	DDK	CM1V1-SP2S-M1	IP67
	SUNCHU	SC-CMV1-SP02C	IP67

Note: refer to Section 3.1.7 for the wire diameter specification of the IP67 compliant Delta connectors. For connector specification of other brands, contact the manufacturers.

<table>
<tr><th>Motor model</th><th colspan="6">UVW connector and brake connector</th></tr>
<tr><td rowspan="4">ECM-E3①-F②1830③④E</td><td colspan="6">
 </td></tr>
<tr><td colspan="6">Pin assignment</td></tr>
<tr><td>U (Red)</td><td>V (White)</td><td>W (Black)</td><td>CASE GROUND (Yellow / Green)</td><td>BRAKE1^{*4}</td><td>BRAKE2^{*4}</td></tr>
<tr><td>A</td><td>B</td><td>C</td><td>D</td><td>1</td><td>2</td></tr>
</table>

Note:

1. In the servo motor model number, ① represents the motor inertia, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, and ④ represents the shaft diameter and connector type.
2. Use a 24 V_{DC} power supply for the brake. Do not share the same power supply with control signals.
3. The brake coil has no polarity. Its pin symbols are BRAKE1 and BRAKE2. Color of brake wires for motors with the frame size of 130 mm or above: red and black.
4. When selecting the wires, refer to Section 3.1.6 for details.

Connector specifications:

UVW	Brand	Model number	IP rating
MIL 22-22S	Delta	ACS3-CRPWC000	IP67
	SUNCHU	CMS3108A22-22SBI (connector & compression ring)	IP67
Brake	**Brand**	**Model number**	**IP rating**
CMV1-2S	Delta	ACS3-CRBRA000	IP67
	DDK	CMV1-AP2S-M1	IP67
	SUNCHU	SC-CMV1-AP02C	IP67

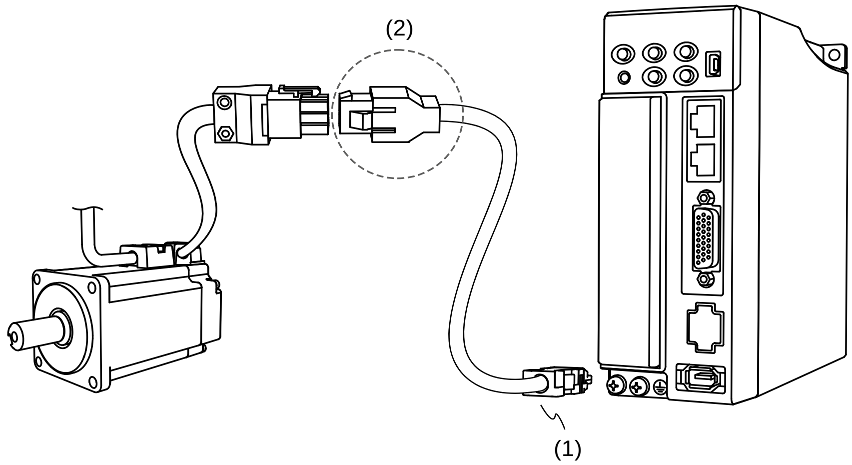
Note: refer to Section 3.1.7 for the wire diameter specification of the IP67 compliant Delta connectors. For connector specification of other brands, contact the manufacturers.

3.1.5 Specification for encoder cable and connector

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

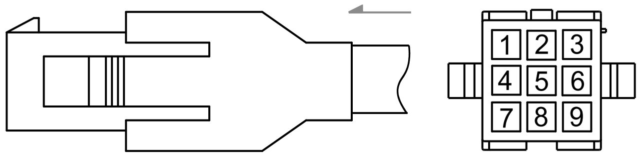
3.1.5.1 F40 - F80 motors – Encoder connectors

Encoder connection (Diagram 1): standard connector



(1) CN2 connector; (2) Standard connector

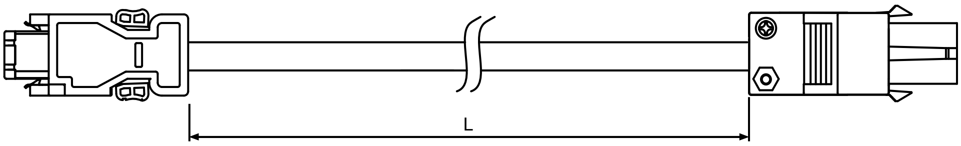
Note: the diagram shows the connection between the servo drive and the encoder, and it is not drawn to scale. The specification is subject to change depending on the selected servo drive and motor models.

Motor model	Standard connector	
ECM-E31⃞-C2⃞04013⃞4⃞E ECM-E31⃞-C2⃞06023⃞4⃞E ECM-E31⃞-C2⃞06043⃞4⃞E ECM-E31⃞-C2⃞08073⃞4⃞E		
	Recommended brand	Model number
	Delta	ACS3-CAEN0000
	TE Connectivity	1-172161-9 or 172161-1 (case) 170359-1 (tin-plated terminal) 170359-3 (gold-plated terminal)

Note:

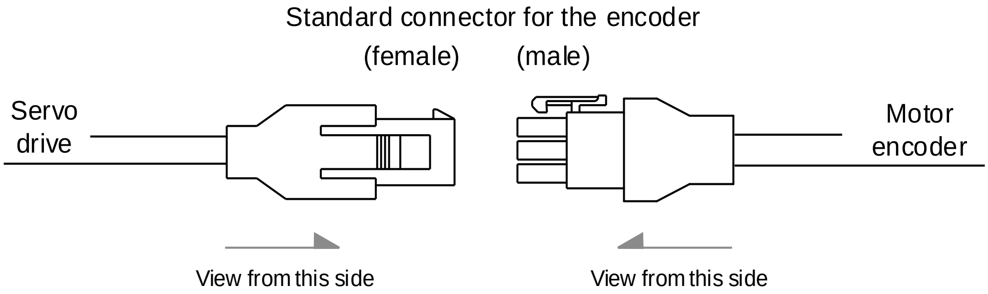
1. In the servo motor model number, 1⃞ represents the motor inertia, 2⃞ represents the encoder type, 3⃞ represents the brake or keyway / oil seal type, and 4⃞ represents the shaft diameter and connector type.
2. We recommend using the connector with tin-plated terminals since the connector of the encoder cable from the servo motor side is also tin-plated.
3. When selecting the wires, refer to Section 3.1.6 for details.

Specifications and pin assignment of the standard connector for the incremental encoder of E3 motors



Model number of incremental encoder cable	L	
	mm	inch
ACS3-CAE□0103	3000 ± 50	118 ± 2
ACS3-CAE□0105	5000 ± 50	197 ± 2
ACS3-CAE□0110	10000 ± 100	394 ± 4
ACS3-CAE□0120	20000 ± 100	787 ± 4

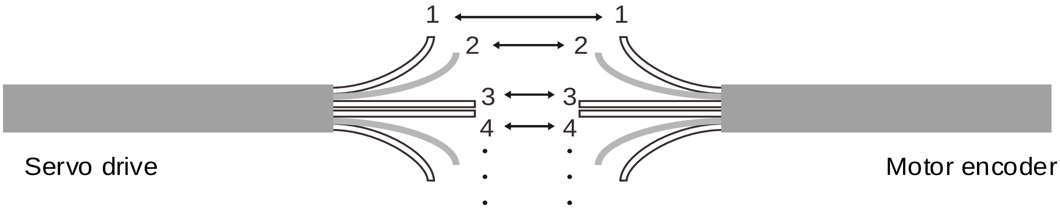
Note: select cables according to the □ in the model number. F represents flexible cables and N represents standard cables.



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

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

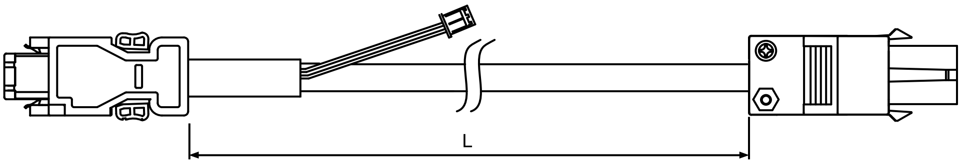
Note: the wire colors of the encoder cable for the servo drive are for reference only. Refer to the actual product.



To directly connect the wires without using the connectors, number the wires of the servo drive encoder cable in sequence, and then connect them to the wires of the motor encoder cable. For example, connect wire No. 1 of the servo drive encoder cable to wire No. 1 of the motor encoder cable, and so on.

[E3-L does not support the absolute functions]

Specifications and pin assignment of the standard connector for the absolute encoder of E3 motors

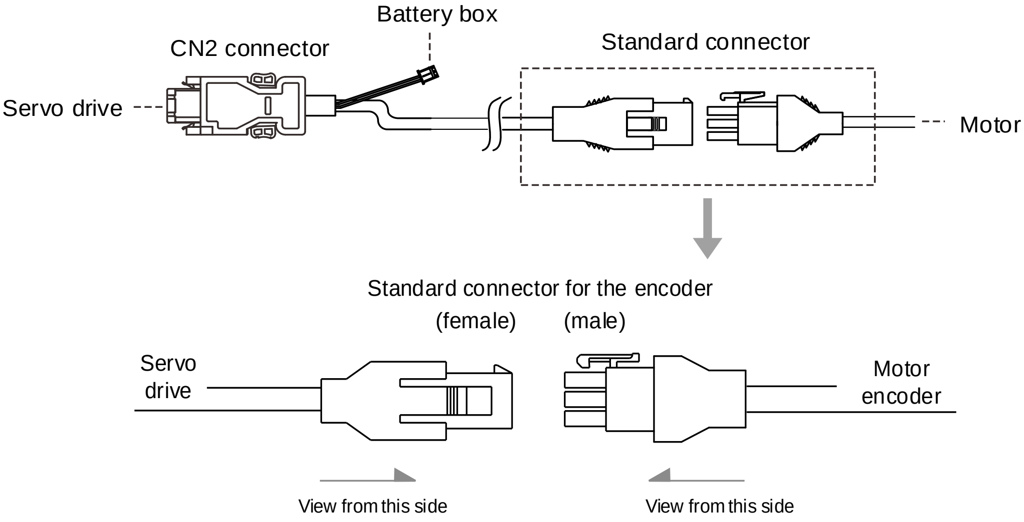


Model number of absolute encoder cable	L	
	mm	inch
ACS3-CAE□0103	3000 ± 50	118 ± 2
ACS3-CAE□0105	5000 ± 50	197 ± 2
ACS3-CAE□0110	10000 ± 100	394 ± 4
ACS3-CAE□0120	20000 ± 100	787 ± 4

Note: select cables according to the □ in the model number. B represents flexible cables and A represents standard cables.

Connection method:

Caution Follow these instructions when wiring. Incorrect wiring may cause battery explosion.



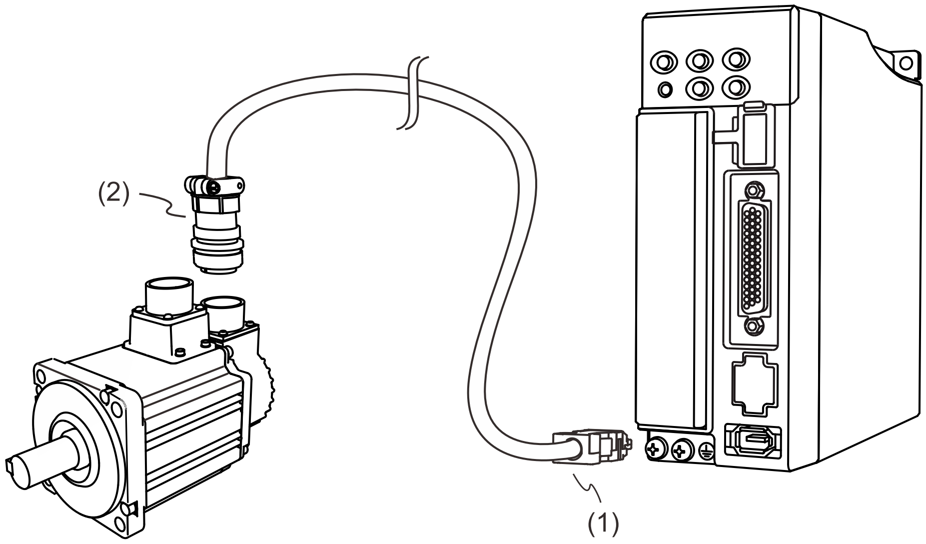
1 White T+	2 Red BAT+	3 Reserved
4 White/Red T-	5 Black BAT-	6 Reserved
7 Brown DC+5V	8 Blue GND	9 Shield

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

Note: the wire colors of the encoder cable for the servo drive are for reference only. Refer to the actual product.

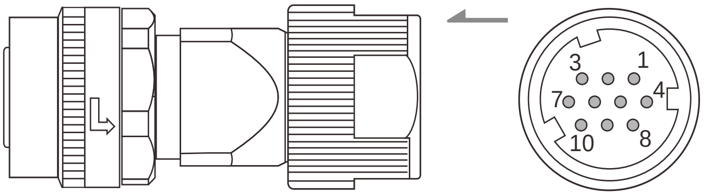
3.1.5.2 F100 - F180 motors – Encoder connectors

Encoder connection (Diagram 2): Military connector



(1) CN2 connector; (2) Military connector

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

Motor model	Military connector - straight
ECM-E31⃞-E2⃞13103⃞4⃞E ECM-E31⃞-E2⃞13153⃞4⃞E ECM-E31⃞-E2⃞13203⃞4⃞E ECM-E31⃞-F2⃞18303⃞4⃞E	

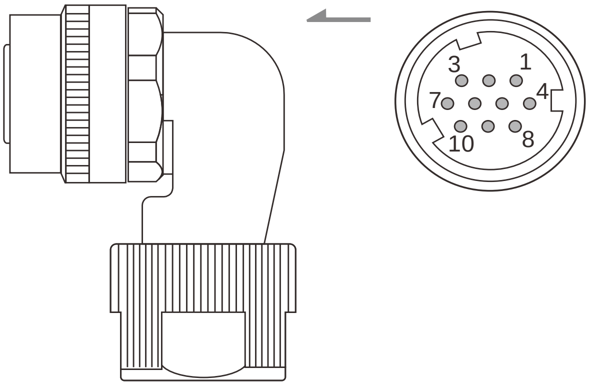
Note:

1. In the servo motor model number, 1⃞ represents the motor inertia, 2⃞ represents the encoder type, 3⃞ represents the brake or keyway / oil seal type, and 4⃞ represents the shaft diameter and connector type.
2. When selecting the wires, refer to Section 3.1.6 for details.

Connector specifications:

E3 encoder	Brand	Model number	IP rating
CMV1-SP10S	Delta	ACS3-CAENA000	IP67
	DDK	CMV1-SP10S-M1	IP67
	SUNCHU	SC-CMV1-SP10C	IP67

Note: refer to Section 3.1.7 for the wire diameter specification of the IP67 compliant Delta connectors. For connector specification of other brands, contact the manufacturers.

Motor model	Military connector - right angle
ECM-E31⃞-E2⃞13103⃞4⃞E ECM-E31⃞-E2⃞13153⃞4⃞E ECM-E31⃞-E2⃞13203⃞4⃞E ECM-E31⃞-F2⃞18303⃞4⃞E	

Note:

1. In the servo motor model number, 1⃞ represents the motor inertia, 2⃞ represents the encoder type, 3⃞ represents the brake or keyway / oil seal type, and 4⃞ represents the shaft diameter and connector type.
2. When selecting the wires, refer to Section 3.1.6 for details.

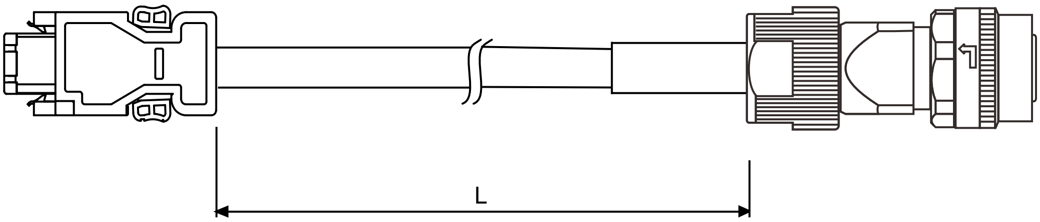
Connector specifications:

E3 encoder	Brand	Model number	IP rating
CMV1-AP10S	Delta	ACS3-CRENA000	IP67
	DDK	CMV1-AP10S-M1	IP67
	SUNCHU	SC-CMV1-AP10C	IP67

Note: refer to Section 3.1.7 for the wire diameter specification of the IP67 compliant Delta connectors. For connector specification of other brands, contact the manufacturers.

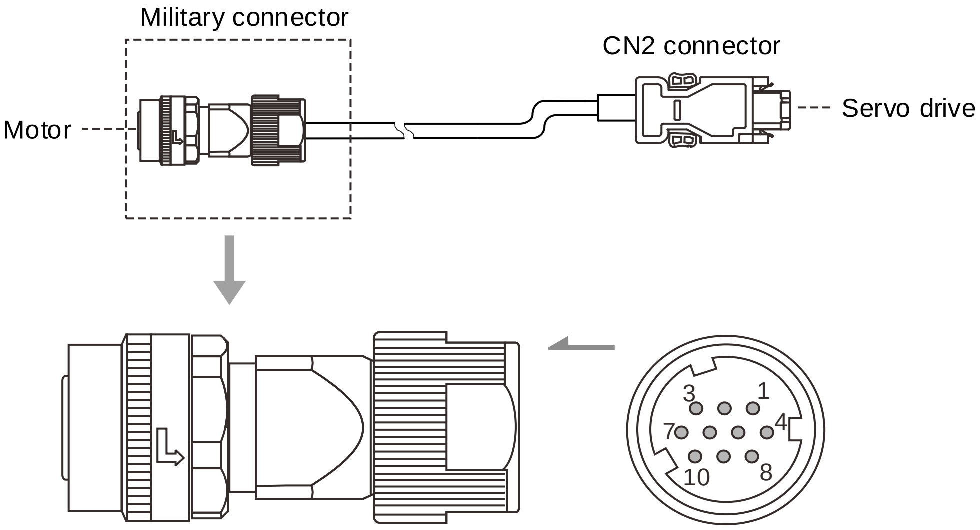
Specifications and pin assignment of the straight military connector for the incremental encoder of E3 motors

For the model number of the incremental encoder cable with the right angle connector, refer to Section B.4.2. The pin assignment is the same for both the straight and right angle connectors.



Model number of incremental encoder cable	Model number of connector	L	
		mm	inch
ACS3-CAE□A103	CMV1-SP10S	3000 ± 50	118 ± 2
ACS3-CAE□A105	CMV1-SP10S	5000 ± 50	197 ± 2
ACS3-CAE□A110	CMV1-SP10S	10000 ± 100	394 ± 4
ACS3-CAE□A120	CMV1-SP10S	20000 ± 100	787 ± 4

Note: select cables according to the □ in the model number. F represents flexible cables and N represents standard cables.

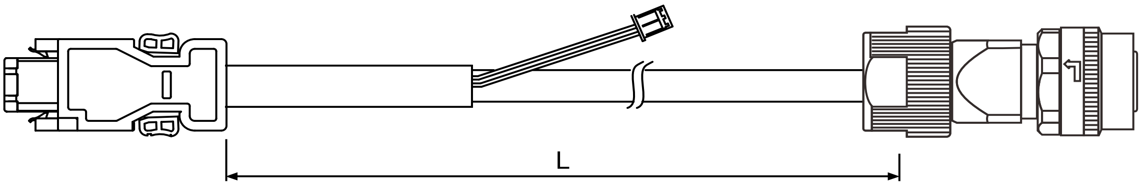


Pin No.	Terminal	Color
1	T+	White
2	T-	White/Red
3	–	–
4	DC+5V	Brown
5, 6, 7, 8	–	–
9	GND	Blue
10	Shield	–

[E3-L does not support the absolute functions]

Specifications and pin assignment of the straight military connector for the absolute encoder of E3 motors

For the model number of the absolute encoder cable with the right angle connector, refer to Section B.5.2. The pin assignment is the same for both the straight and right angle connectors.

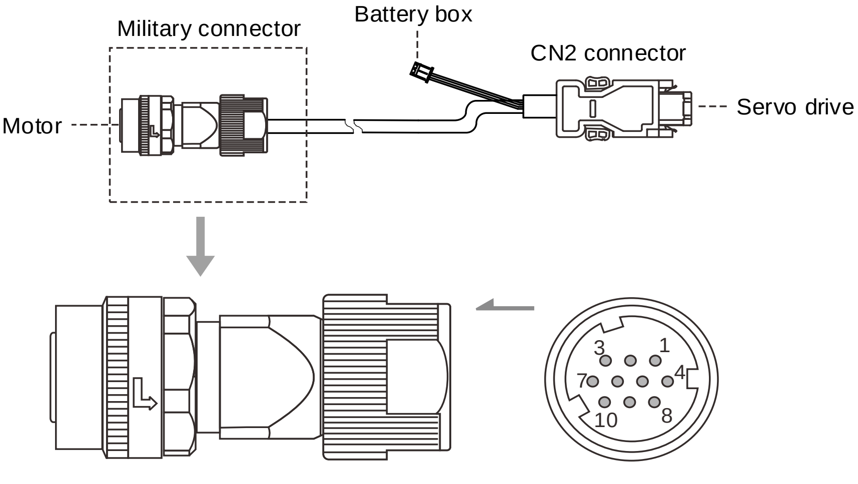


Model number of absolute encoder cable	Model number of connector	L	
		mm	inch
ACS3-CAE□A103	CMV1-SP10S	3000 ± 50	118 ± 2
ACS3-CAE□A105	CMV1-SP10S	5000 ± 50	197 ± 2
ACS3-CAE□A110	CMV1-SP10S	10000 ± 100	394 ± 4
ACS3-CAE□A120	CMV1-SP10S	20000 ± 100	787 ± 4

Note: select cables according to the □ in the model number. B represents flexible cables and A represents standard cables.

Connection method:

Caution Follow these instructions when wiring. Incorrect wiring may cause battery explosion.



Pin No.	Terminal	Color
1	T+	White
2	T-	White/Red
3	–	–
4	DC+5V	Brown
5	BAT-	Black
6	BAT+	Red
7, 8	–	–
9	GND	Blue
10	Shield	–

3.1.6 Wire selection

3.1.6.1 Wire size / screw terminal block dimensions / screw and tightening torque specifications

The recommended wires for connectors and signal wiring for the servo drive are listed in the following tables:

1. The shield should connect to the ground terminal ⏚.
2. When wiring, use the wires suggested in this section to avoid danger.

Servo drive model	Wire size	K.S. Terminals Inc.		Kise Terminal		Kss Terminal	
	U, V, W	Fork terminal	Ring terminal	Fork terminal	Ring terminal	Fork terminal	Ring terminal
ASD-E3-0121-2⃞	18 AWG 0.82 mm^2	SVBL1-3.7	RVBM1-3.7	SVS 1.25-3.5	RVS 1.25-3.5	YF1.25-3	RF1.25-3
ASD-E3-0221-2⃞							
ASD-E3-0421-2⃞							
ASD-E3-0721-2⃞							
ASD-E3-1021-2⃞	14 AWG 2.1 mm^2	SVBL2-3.7	RVBM2-3.7	SV 3.5-3	RVS 2-3.5	YF3.5-3S	RF2-3
ASD-E3-1521-2⃞							
ASD-E3-2023-2⃞	12 AWG 3.3 mm^2	SVB3-4	RVB3-4	SV 3.5-4	RV 3.5-4	YF3.5-4	RF3.5-4
ASD-E3-3023-2⃞							

Servo drive model	Wire size	K.S. Terminals Inc.		Kise Terminal		Kss Terminal	
	R, S, T	Fork terminal	Ring terminal	Fork terminal	Ring terminal	Fork terminal	Ring terminal
ASD-E3-0121-2⃞	22 AWG 0.32 mm^2	SVBL1-3.7	RVBM1-3.7	SV 1.25-3	RV 1.25-3	YF1.25-3	RF1.25-3
ASD-E3-0221-2⃞							
ASD-E3-0421-2⃞	20 AWG 0.52 mm^2						
ASD-E3-0721-2⃞	16 AWG 1.3 mm^2						
ASD-E3-1021-2⃞	14 AWG 2.1 mm^2	SVBL2-3.7	RVBM2-3.2	SV 3.5-3	RV 2-3	YF3.5-3S	RF2-3
ASD-E3-1521-2⃞	12 AWG 3.3 mm^2	-	-		-		-
ASD-E3-2023-2⃞	12 AWG 3.3 mm^2	SVBS5-4	RVBS5-4	SVS 5.5-4	RVS 5.5-4	YF5.5-4	RF5.5-4
ASD-E3-3023-2⃞	10 AWG 5.3 mm^2						

Servo drive model	Wire size	K.S. Terminals Inc.		Kise Terminal		Kss Terminal	
	P⊕, C	Fork terminal	Ring terminal	Fork terminal	Ring terminal	Fork terminal	Ring terminal
ASD-E3-0121-2⃞	14 AWG 2.1 mm^2	SVBL2-3.7	RVBM2-3.2	SV 3.5-3	RV 2-3	YF3.5-3S	RF2-3
ASD-E3-0221-2⃞							
ASD-E3-0421-2⃞							
ASD-E3-0721-2⃞							
ASD-E3-1021-2⃞							
ASD-E3-1521-2⃞							
ASD-E3-2023-2⃞		SVBL2-4	RVBL2-4	SV 3.5-4	RV 3.5-4	YF2-4	RF2-4
ASD-E3-3023-2⃞							

If you choose terminals of other brands, refer to the following terminal block dimensions.

Servo drive model	Screw terminal block dimensions
ASD-E3-0121-□	7 mm
ASD-E3-0221-□	
ASD-E3-0421-□	
ASD-E3-0721-□	
ASD-E3-1021-□	
ASD-E3-1521-□	
ASD-E3-2023-□	9.5 mm
ASD-E3-3023-□	

Note:

1. Choose the corresponding terminals for the servo drive to comply with the wiring specifications.
2. Use a crimping tool to properly crimp the terminals and wires.
3. Do not use bare wires for wiring, or the loose wires may cause accidents.
4. In the servo drive model number, □ represents the model type.

Refer to the following screws specifications and ensure the tightening torque does not exceed the following specifications.

Screw specification and tightening torque (kgf-cm)										
Servo drive model	R, S, T		U, V, W		P⊕, D, C, ⊖		Ground screw ⏚		CN1	
ASD-E3-0121-□	M3	6 - 7	M3	6 - 7	M3	6 - 7	M4	12 - 14	-	2 - 2.5
ASD-E3-0221-□										
ASD-E3-0421-□										
ASD-E3-0721-□										
ASD-E3-1021-□										
ASD-E3-1521-□										
ASD-E3-2023-□	M4	10 - 11	M4	10 - 11	M4	10 - 11				
ASD-E3-3023-□										

3.1.6.2 Encoder cable specifications

Item	Standard cable	Flexible cable
Model number	ACS3-CAEN01XX ACS3-CAENA1XX	ACS3-CAEF01XX ACS3-CAEFA1XX
Cable type	UL2464 (Temp. rating: 80°C / 176°F)	UL2464 (Temp. rating: 80°C / 176°F)
DC+5V, GND	AWG#22-2C (0.3 mm²) Outer diameter of insulated wire: Φ1.3 mm	AWG#22-2C (0.3 mm²) Outer diameter of insulated wire: Φ1.3 mm
T+, T-	AWG#24-2P (0.2 mm²) Outer diameter of insulated wire: Φ1.1 mm	AWG#24-2P (0.2 mm²) Outer diameter of insulated wire: Φ1.1 mm
Cable diameter	Φ7 mm	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.

3.1.6.3 Power cable specifications

Motor frame: F40 - F80

Item	Standard cable	Flexible cable
Model number	ACS3-CAPW11XX ACS3-CAPW21XX	ACS3-CAPF11XX ACS3-CAPF21XX
Cable type	UL2586 (Temp. rating: 105°C / 221°F)	UL2586 (Temp. rating: 105°C / 221°F)
UVW wire	AWG#18-4C (0.82 mm^2) Outer diameter of insulated wire: Φ2.1 mm Voltage rating: 600 V_{AC}	AWG#18-4C (0.82 mm^2) Outer diameter of insulated wire: Φ2.1 mm Voltage rating: 600 V_{AC}
Brake wire	AWG#22-2C (0.3 mm^2) Outer diameter of insulated wire: Φ1.6 mm Voltage rating: 600 V_{AC}	AWG#22-2C (0.3 mm^2) Outer diameter of insulated wire: Φ1.6 mm Voltage rating: 600 V_{AC}
Cable diameter	Power cable w/o 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	

Motor frame: F130

Item		Standard cable	Flexible cable
Power cable	Model number	ACS3-CAPWA2XX ACS3-CRPWA2XX	ACS3-CAPFA2XX ACS3-CRPFA2XX
	Specification	UL2586 (Temp. rating: 105°C / 221°F) AWG#16-4C (1.3 mm^2) Outer diameter of insulated wire: Φ3.2 mm Cable diameter: Φ11 mm Voltage rating: 600 V_{AC}	UL2586 (Temp. rating: 105°C / 221°F) AWG#16-4C (1.3 mm^2) Outer diameter of insulated wire: Φ3.2 mm Cable diameter: Φ11 mm Voltage rating: 600 V_{AC}
	Model number	ACS3-CAPWA3XX ACS3-CRPWA3XX	ACS3-CAPFA3XX ACS3-CRPFA3XX
	Specification	UL2586 (Temp. rating: 105°C / 221°F) AWG#14-4C (2.1 mm^2) Outer diameter of insulated wire: Φ2.8 mm Cable diameter: Φ9.5 mm Voltage rating: 600 V_{AC}	UL2586 (Temp. rating: 105°C / 221°F) AWG#14-4C (2.1 mm^2) Outer diameter of insulated wire: Φ2.8 mm Cable diameter: Φ9.5 mm Voltage rating: 600 V_{AC}
Brake cable	Model number	ACS3-CABRA1XX ACS3-CRBRA1XX	ACS3-CABFA1XX ACS3-CRBFA1XX
	Specification	UL2517 (Temp. rating: 105°C / 221°F) AWG#20-2C (0.5 mm^2) Outer diameter of insulated wire: Φ1.8 mm Cable diameter: Φ5.5 mm Voltage rating: 300 V_{AC}	UL2517 (Temp. rating: 105°C / 221°F) AWG#20-2C (0.5 mm^2) Outer diameter of insulated wire: Φ1.8 mm Cable 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	

Motor frame: F180

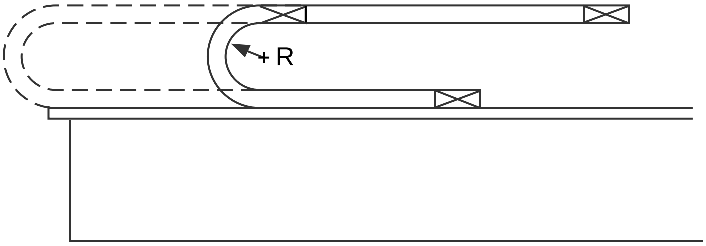
Item		Standard cable	Flexible cable
Power cable	Model number	ACS3-CAPWC3XX ACS3-CRPWC3XX	ACS3-CAPFC3XX ACS3-CRPFC3XX
	Specification	UL2586 (Temp. rating: 105°C / 221°F) AWG#14-4C (2.1 mm²) Outer diameter of insulated wire: Φ2.8 mm Cable diameter: Φ9.5 mm Voltage rating: 600 V_{AC}	UL2586 (Temp. rating: 105°C / 221°F) AWG#14-4C (2.1 mm²) Outer diameter of insulated wire: Φ2.8 mm Cable diameter: Φ9.5 mm Voltage rating: 600 V_{AC}
	Model number	ACS3-CAPWC4XX ACS3-CRPWC4XX	ACS3-CAPFC4XX ACS3-CRPFC4XX
	Specification	UL2586 (Temp. rating: 105°C / 221°F) AWG#12-4C (3.3 mm²) Outer diameter of insulated wire: Φ4.0 mm Cable diameter: Φ14.5 mm Voltage rating: 600 V_{AC}	UL2586 (Temp. rating: 105°C / 221°F) AWG#12-4C (3.3 mm²) Outer diameter of insulated wire: Φ4.0 mm Cable diameter: Φ14.5 mm Voltage rating: 600 V_{AC}
Brake cable	Model number	ACS3-CABRA1XX ACS3-CRBRA1XX	ACS3-CABFA1XX ACS3-CRBFA1XX
	Specification	UL2517 (Temp. rating: 105°C / 221°F) AWG#20-2C (0.5 mm²) Outer diameter of insulated wire: Φ1.8 mm Cable diameter: Φ5.5 mm Voltage rating: 300 V_{AC}	UL2517 (Temp. rating: 105°C / 221°F) AWG#20-2C (0.5 mm²) Outer diameter of insulated wire: Φ1.8 mm Cable 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	

Note:

1. Refer to Section 3.1.6.1 for detailed specifications for wire size, screw terminal block dimensions, screws, and tightening torque.
2. Apart from these specifications, refer to Section 2.6.1 for the motor power cable selection and installation precautions.

3.1.6.4 Flexible cable specifications

Delta provides two types of power and encoder cables*1: standard cables and flexible cables. Use flexible cable when connecting to a moving machinery. Refer to the following table for flexible cable specifications.



R = bend radius

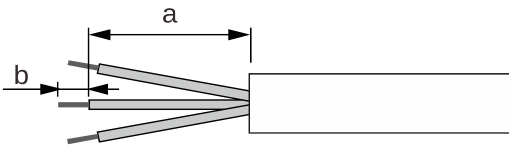
Item	Specification
Bend radius	10 times of the cable outer diameter
Number of bending times	10 million times*2
Speed	3 m/s
Acceleration	15 m/s^2

Note:

1. Delta provides both standard and flexible power and encoder cables. Refer to Appendix B for more details.
2. Bending the cable into a curve and then straightening it is considered as one time.
3. For precautions relevant to the use of cables, refer to Section 2.9.

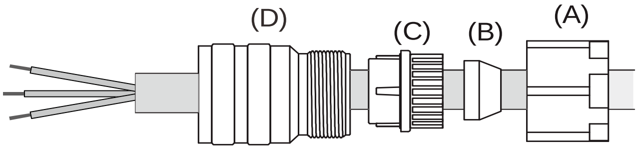
3.1.7 Wiring for IP67 waterproof connectors

3.1.7.1 F130 - F180 motors – Waterproof connector installation and wiring



Step 1:

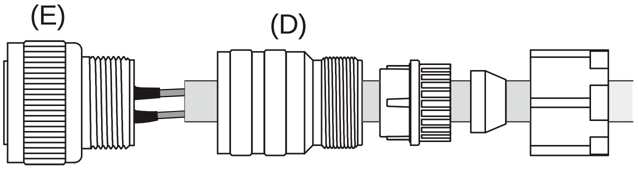
Cut and strip the cable. The exposed wire length (a) should be 23 - 27 mm (0.9 - 1.06 inches) for straight connectors and 28 - 32 mm (1.1 - 1.26 inches) for right angle connectors, and the exposed tinned wire length (b) should be 3 - 5 mm (0.12 - 0.2 inches).



Step 2:

Place the (A) seals nut, (B) rubber ring, (C) black compression ring, and (D) straight or angle housing on the cable in sequence.

Important: in order to meet the IP67 standard, select the rubber ring according to the cable diameter.

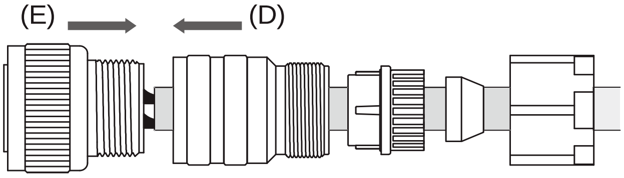


Step 3:

(1) For the power connector, refer to Section 3.1.4 for the pin assignment to connect the wires.

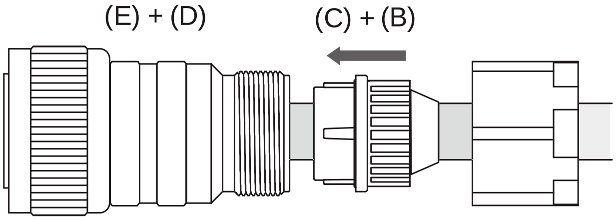
(2) For the encoder connector, refer to Section 3.1.5 for the pin assignment to connect the wires.

Important: it is advisable to use 20 mm (0.79 inches) heat shrink for straight connectors, and 25 mm (0.98 inches) heat shrink for right angle connectors.



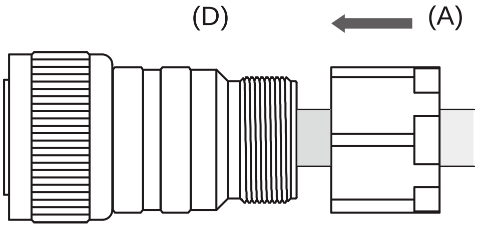
Step 4:

Tighten (D) and (E) with adequate torque. For the torque value, refer to Section 3.1.7.2 for IP67 waterproof connector installation and wiring specifications.



Step 5:

Place (B) in (C), and then place (C) + (B) in (D).



Step 6:

Tighten (A) and (D) at the torque of 10 Nm.

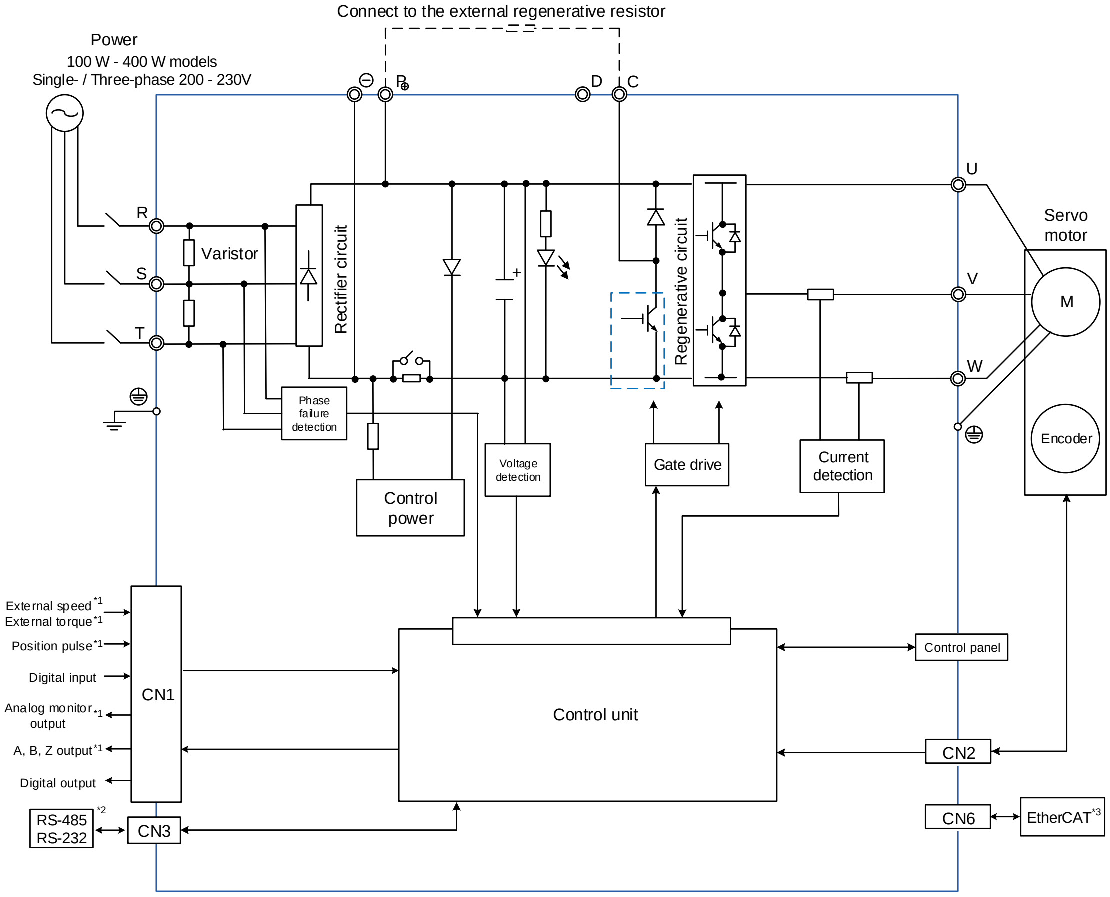
3.1.7.2 IP67 waterproof connector installation and wiring specifications

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 3.1.6.

Model number of connector	Diameter of rubber ring (mm)	Torque for tightening the connector
ACS3-CAPWA000	Two sets of rubber rings attached Φ9 - Φ10 and Φ11 - Φ12	8 - 9 Nm (Φ9 - Φ10) 9 - 10 Nm (Φ11 - Φ12)
ACS3-CRPWA000		
ACS3-CAPWC000	Two sets of rubber rings attached Φ11 - Φ12 and Φ15 - Φ16	7.5 - 8.5 Nm (Φ11 - Φ12) 7.5 Nm (Φ15 - Φ16)
ACS3-CRPWC000		
ACS3-CABRA000	Two sets of rubber rings attached Φ4.5 - Φ5.1 and Φ5.5 - Φ6.1	1 Nm
ACS3-CRBRA000		
ACS3-CAENA000	Two sets of rubber rings attached Φ6.5 - Φ7.1 and Φ8.5 - Φ9.1	1 Nm
ACS3-CRENA000		

3.2 Wiring diagrams for the servo system

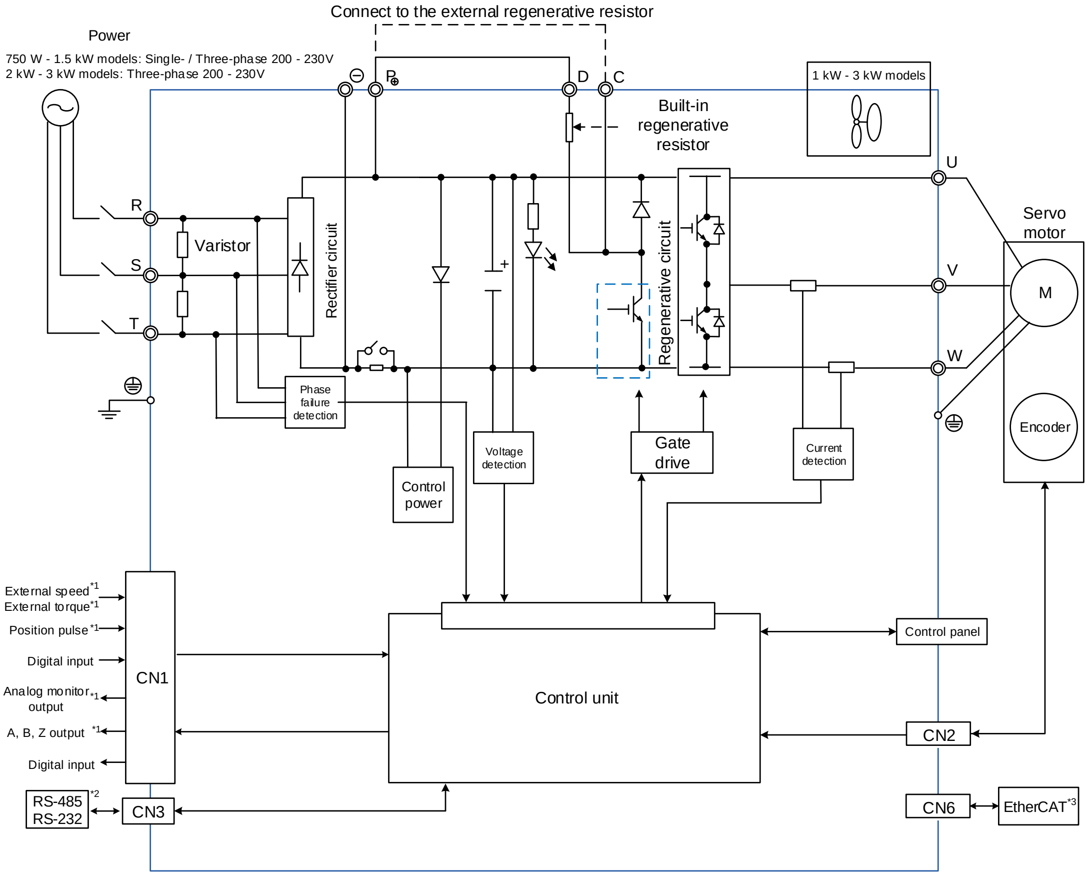
Models of 100 W - 400 W



Note:

1. These functions are not available on E3-E models.
2. Serial communication (RS-485 and RS-232) is available on E3-L models only.
3. EtherCAT is available on E3-E models only.

Models of 750 W - 3 kW



Note:

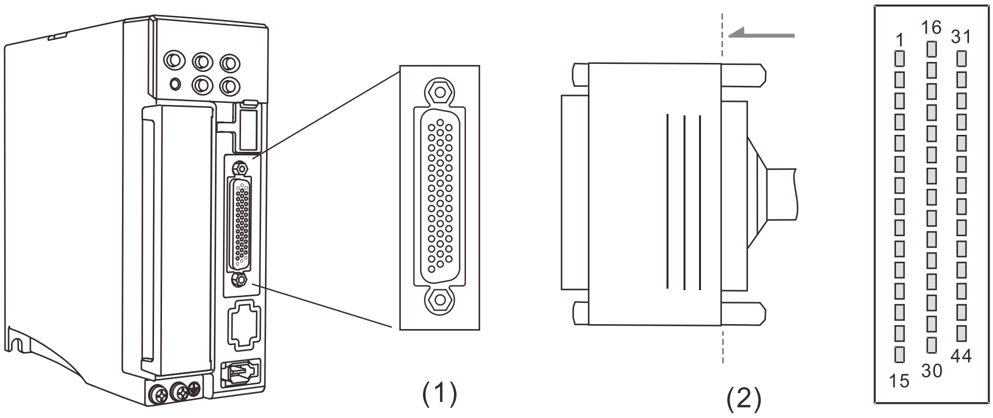
1. These functions are not available on E3-E models.
2. Serial communication (RS-485 and RS-232) is available on E3-L models only.
3. EtherCAT is available on E3-E models only.

3.3 Wiring for the CN1 I/O connector

Pin assignments of the CN1 terminal differ from model types. Refer to the corresponding wiring information based on the model.

3.3.1 CN1 I/O connector (-L models)

On E3-L models, the CN1 I/O connector includes 9 inputs and 6 outputs for you to define their functions. The differential output signals (OA, /OA, OB, /OB, OZ, and /OZ) for the encoder are provided. Analog torque command input, analog speed / position command input, and position pulse input are also available. 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	DO4+	Digital output	23	/OB	Differential output for encoder /B pulse
2	DO3-	Digital output	24	/OZ	Differential output for encoder /Z pulse
3	DO3+	Digital output	25	OB	Differential output for encoder B pulse
4	DO2-	Digital output	26	DO4-	Digital output
5	DO2+	Digital output	27	DO5-	Digital output
6	DO1-	Digital output	28	DO5+	Digital output
7	DO1+	Digital output	29	GND	Ground for analog and differential output signals
8	DI4-	Digital input	30	DI8-	Digital input
9	DI1-	Digital input	31	DI7-	Digital input
10	DI2-	Digital input	32	DI6-	Digital input
11	COM+	Power input (24V ± 10%)	33	DI5-	Digital input
12	DI9-	Digital input	34	DI3-	Digital input
13	OZ	Differential output for encoder Z pulse	35	PULL HI_S (Sign)	External power for pulse commands input to SIGN pins (24V ± 10%)
14	MON2	Analog monitor output 2	36	PULL HI_P (Pulse)	External power for pulse commands input to PULSE pins (24V ± 10%)
15	DO6-	Digital output	37	SIGN-	Position sign (-)
16	DO6+	Digital output	38	NC	Reserved
17	MON1	Analog monitor output 1	39	SIGN+	Position sign (+)
18	T_REF	Analog torque command input	40	GND	Ground for analog and differential output signals
19	GND	Ground for analog and differential output signals	41	PULSE-	Position pulse (-)
20	V_REF	Analog speed / position command input (+)	42	NC	Reserved
21	OA	Differential output for encoder A pulse	43	PULSE+	Position pulse (+)
22	/OA	Differential output for encoder /A pulse	44	OCZ	Open collector output for encoder Z pulse

Note:

1. NC represents “No connection”, which is for internal use only. Do not connect to NC, or it may damage the servo drive.
2. **When the source of the pulse input is open collector NPN or PNP type equipment, you must connect the external power (24V ± 10%) to the PULL HI pins.**
   - **Do not connect the 24V power to the SIGN+ and SIGN- pins at the same time, or the circuit elements will be damaged.**
   - **Do not connect the 24V power to the PULSE+ and PULSE- pins at the same time, or the circuit elements will be damaged.**

3.3.2 CN1 I/O connector signal description (-L models)

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

General signals:

Signal		Pin No.	Description	Wiring method (refer to Section 3.3.6)
Analog command (input)	V_REF	20	(1) When the motor speed command is set to -10V to +10V, it means the rotation speed is -3000 rpm to +3000 rpm (default). You can set the parameter to change the corresponding range. (2) When the motor position command is set to -10V to +10V, it means the range of the rotation position is -3 to +3 cycles (default).	C1
	T_REF	18	When the motor torque command is set to -10V to +10V, it means the rated torque is -100% to +100%.	
Analog monitor (output)	MON1 MON2	17 14	The operation status of motor, such as speed and current, can be displayed in analog voltage. This servo drive provides 2 output channels. You can select the data to be monitored with P0.003. This signal is based on the power ground (GND).	C2
Position pulse (input)	PULSE+ PULSE-	43 41	Position pulse can be sent by line driver (single-phase max. frequency 4 MHz) or open collector (single-phase max. frequency 200 kHz). Three command types can be selected with P1.000, CW/CCW pulse, pulse train + sign, and A phase + B phase.	C3 / C4
	SIGN+ SIGN-	39 37		
	PULL HI_P PULL HI_S	36 35	If using open collector type when sending position pulses, ensure to use an external power supply (24V ± 10%) for pull high.	
Position pulse (output)	OA /OA	21 22	Differential output (line driver) for the encoder A, B, and Z phase signals.	C9 / C10
	OB /OB	25 23		
	OZ /OZ	13 24		
	OCZ	44	Open collector output for the encoder Z phase signal.	C11
Power	COM+	11	NPN: COM+ is the positive terminal of the voltage source for DI and requires an external power supply (24V ± 10%). PNP: COM+ is the negative terminal of the voltage source for DI and requires an external power supply (24V ± 10%).	-
	GND	19 29 40	The ground for analog signals and differential output signals.	
Others	NC	38 42	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 I/O configuration differs for each mode. This servo drive provides user-defined I/O for you to set functions according to 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 signals of each control mode:

DI	Control mode					
	PT	S / Sz	T / Tz	PT-S	PT-T	S-T
	Default	Default	Default	Default	Default	Default
	Name	Name	Name	Name	Name	Name
1	0x01	0x01	0x01	0x01	0x01	0x01
	SON	SON	SON	SON	SON	SON
2	0x04	0x09	0x10	0x04	0x04	0x00
	CCLR	TRQLM	SPDLM	CCLR	CCLR	-
3	0x16	0x14	0x16	0x14	0x16	0x14
	TCM0	SPD0	TCM0	SPD0	TCM0	SPD0
4	0x17	0x15	0x17	0x15	0x17	0x15
	TCM1	SPD1	TCM1	SPD1	TCM1	SPD1
5	0x02	0x02	0x02	0x00	0x00	0x16
	ARST	ARST	ARST	-	-	TCM0
6	0x22	0x22	0x22	0x00	0x00	0x17
	NL	NL	NL	-	-	TCM1
7	0x23	0x23	0x23	0x18	0x20	0x19
	PL	PL	PL	S-P	T-P	S-T
8	0x21	0x21	0x21	0x21	0x21	0x21
	EMGS	EMGS	EMGS	EMGS	EMGS	EMGS
9	0x00	0x00	0x00	0x00	0x00	0x00
	-	-	-	-	-	-

Note:

1. Description of each DI signal:

DI name	Description	DI name	Description	DI name	Description
SON	Servo On	NL	Negative limit	PL	Positive limit
CCLR	Pulse clear	ARST	Alarm reset	EMGS	Emergency stop
TRQLM	Torque limit	TCM0	Torque command 0	TCM1	Torque command 1
SPDLM	Speed limit	SPD0	Speed selection 0	SPD1	Speed selection 1
S-P	Switch between S and P modes (dual / multi-mode)	T-P	Switch between T and P modes (dual / multi-mode)	S-T	Switch between S and T modes (dual / multi-mode)

2. Refer to the C7 and C8 diagrams in Section 3.3.6 for wiring.

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

DO	Control mode					
	PT	S / Sz	T / Tz	PT-S	PT-T	S-T
	Default	Default	Default	Default	Default	Default
	Name	Name	Name	Name	Name	Name
1	0x01	0x01	0x01	0x01	0x01	0x01
	SRDY	SRDY	SRDY	SRDY	SRDY	SRDY
2	0x03	0x03	0x03	0x03	0x03	0x03
	ZSPD	ZSPD	ZSPD	ZSPD	ZSPD	ZSPD
3	0x09	0x04	0x04	0x04	0x04	0x04
	HOME	TSPD	TSPD	TSPD	TSPD	TSPD
4	0x05	0x08	0x08	0x05	0x05	0x00
	TPOS	BRKR	BRKR	TPOS	TPOS	-
5	0x07	0x07	0x07	0x07	0x07	0x07
	ALRM	ALRM	ALRM	ALRM	ALRM	ALRM
6	0x00	0x00	0x00	0x00	0x00	0x00
	-	-	-	-	-	-

Note:

1. Description of each DO signal:

DO name	Description	DO name	Description	DO name	Description
SRDY	Servo ready	HOME	Homing is complete	TSPD	Target speed reached
ZSPD	Zero motor speed	TPOS	Target position reached	ALRM	Servo alarm
BRKR	Magnetic brake	-	-	-	-

2. Refer to the C5 and C6 diagrams in Section 3.3.6 for wiring.

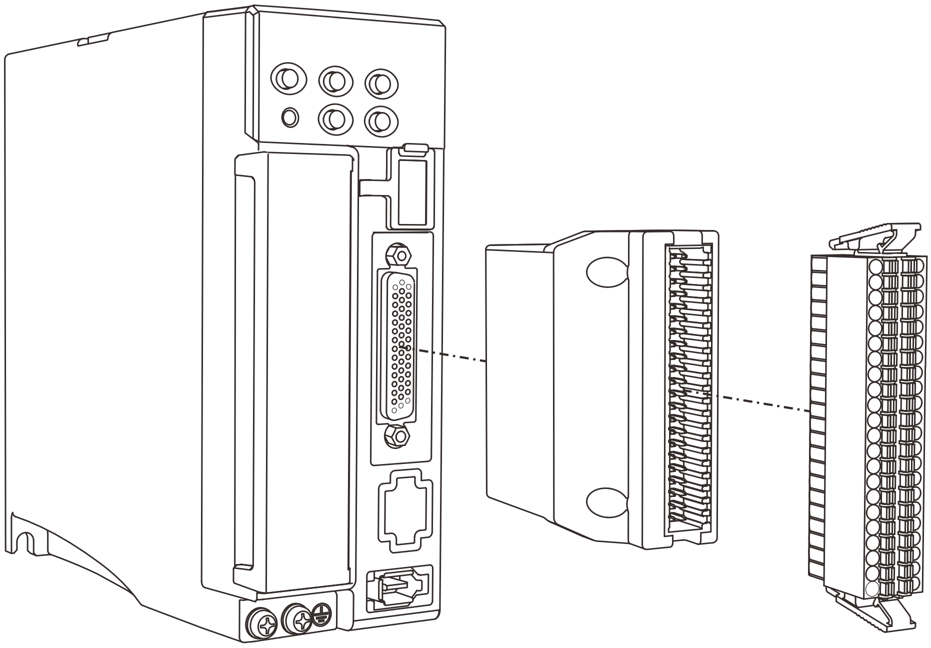
If the default DI/DO functions cannot meet the application requirement, you can refer to the following tables and specify the DI/DO functions by setting the DI and DO codes to the corresponding parameters.

Signal		CN1 Pin No.	Corresponding parameter	Signal		CN1 Pin No.	Corresponding parameter
Standard DI	DI1-	9	P2.010	Standard DI	DI6-	32	P2.015
	DI2-	10	P2.011		DI7-	31	P2.016
	DI3-	34	P2.012		DI8-	30	P2.017
	DI4-	8	P2.013		DI9-	12	P2.036
	DI5-	33	P2.014		-	-	-

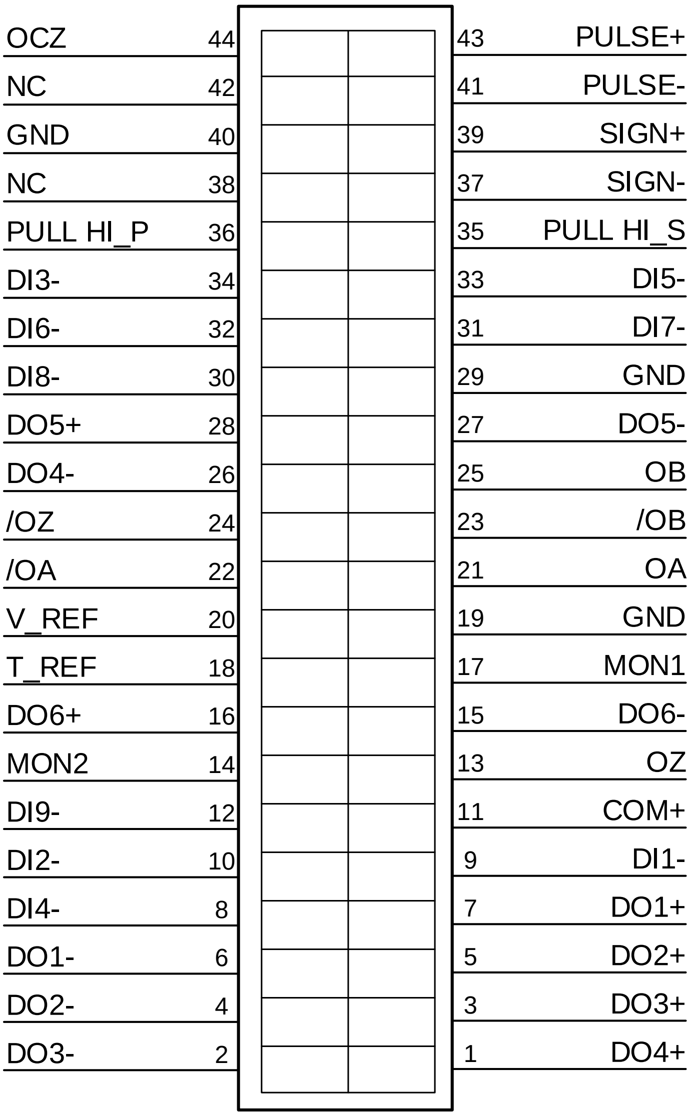
Signal		CN1 Pin No.	Corresponding parameter	Signal		CN1 Pin No.	Corresponding parameter
Standard DO	DO1+	7	P2.018	Standard DO	DO4+	1	P2.021
	DO1-	6			DO4-	26	
	DO2+	5	P2.019		DO5+	28	P2.022
	DO2-	4			DO5-	27	
	DO3+	3	P2.020		DO6+	16	P2.041
	DO3-	2			DO6-	15	

3.3.3 Wiring with CN1 quick connector (-L models)

The CN1 quick connector ACS3-IFSC4444 is applicable to E3-L and B3-L servo drives. You do not need to solder the wires; the spring-loaded terminals prevent the wires from loosening caused by vibration, which makes it a good choice for wiring.



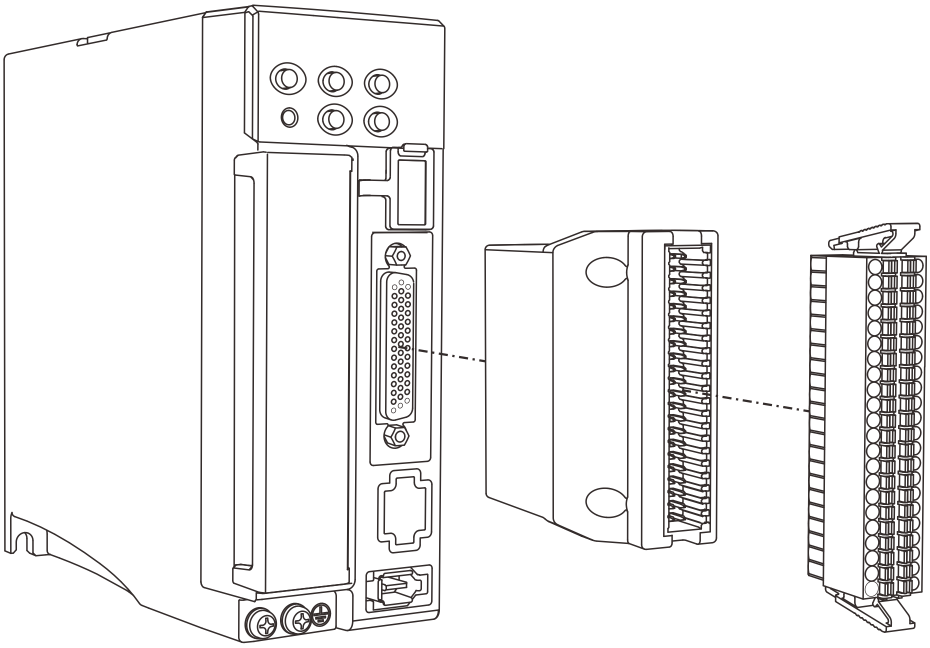
The pin assignments of the CN1 quick connector (ACS3-IFSC4444) are as follows:



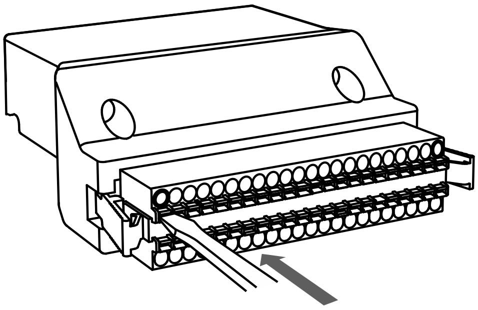
Note: NC represents “No connection”.

Installation and wiring for the CN1 quick connector (ACS3-IFSC4444):

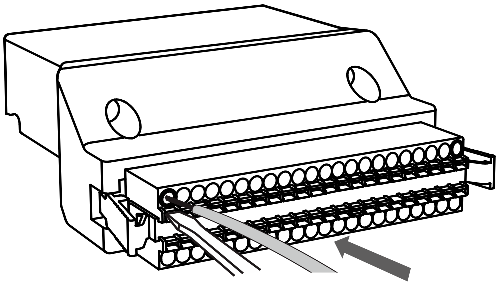
Installation



Wiring



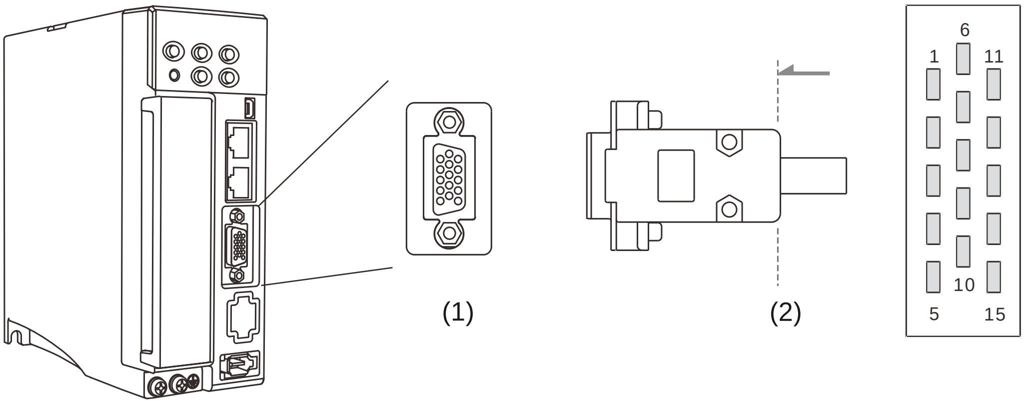
(1) The CN1 quick connector (ACS3-IFSC4444) has multiple spring-loaded terminals. Determine which terminal is to be wired in advance. Use a flathead screwdriver to press the spring down to open the pin.



(2) Insert the stripped wire into the pin. Then, withdraw the screwdriver to complete the wiring.

3.3.4 CN1 I/O connector pin assignment (-E models)

On E3-E models, the CN1 I/O connector includes 6 inputs and 3 outputs for you to define their functions. 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	Reserved
7	DI6-	Digital input	15	NC	Reserved
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.

3.3.5 CN1 I/O connector signal description (-E models)

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

General signals:

Signal		Pin No.	Description	Wiring method (refer to Section 3.3.6)
Power	COM+	1	NPN: COM+ is the positive terminal of the voltage source for DI and requires an external power supply (24V ± 10%). PNP: COM+ is the negative terminal of the voltage source for DI 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 I/O configuration differs for each mode. This servo drive provides user-defined I/O for you to set functions according to 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 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 signals of each control mode:

DI	Control mode						
	PR	S / Sz	T / Tz	PR-S	PR-T	S-T	Communi-cation
	Default	Default	Default	Default	Default	Default	Default
	Name	Name	Name	Name	Name	Name	Name
1	0x01	0x01	0x01	0x01	0x01	0x01	0x00
	SON	SON	SON	SON	SON	SON	-
2	0x22	0x22	0x22	0x22	0x22	0x22	0x22
	NL	NL	NL	NL	NL	NL	NL
3	0x23	0x23	0x23	0x23	0x23	0x23	0x23
	PL	PL	PL	PL	PL	PL	PL
4	0x21	0x21	0x21	0x21	0x21	0x21	0x21
	EMGS	EMGS	EMGS	EMGS	EMGS	EMGS	EMGS
5	0x00	0x00	0x00	0x00	0x00	0x00	0x00
	-	-	-	-	-	-	-
6	0x00	0x00	0x00	0x00	0x00	0x00	0x00
	-	-	-	-	-	-	-

Note:

1. Description of each DI signal:

DI name	Description	DI name	Description	DI name	Description
SON	Servo On	NL	Negative limit	PL	Positive limit
EMGS	Emergency stop	-	-	-	-

2. Refer to the C7 and C8 diagrams in Section 3.3.6 for wiring.

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

DO	Control mode
	PR, S, Sz, T, Tz, communication
	Default
	Name
1	0x01
	SRDY
2	0x07
	ALRM
3	0x00
	-

Note:

1. Description of each DO signal:

DO name	Description	DO name	Description	DO name	Description
SRDY	Servo ready	ALRM	Servo alarm	-	-

2. Refer to the C5 and C6 diagrams in Section 3.3.6 for wiring.

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

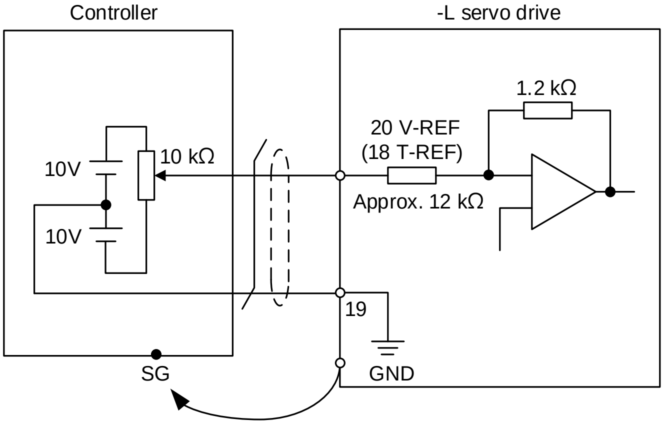
Signal		CN1 Pin No.	Corresponding parameter	Signal		CN1 Pin No.	Corresponding parameter
Standard DO	DO1+	9	P2.018	Standard DO	DO3+	13	P2.020
	DO1-	8			DO3-	12	
	DO2+	11	P2.019		-	-	-
	DO2-	10			-	-	

3.3.6 CN1 wiring diagrams

The wiring diagrams in this section take the E3-L model for example. For detailed information, refer to the notes of each diagram. Refer to Chapter 1 for the functions supported by each model.

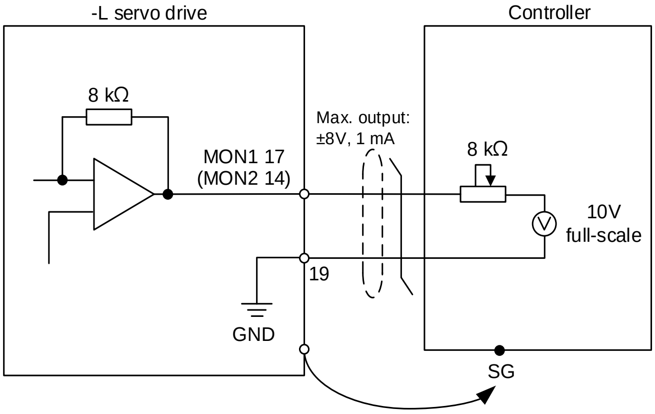
For the analog speed command and the analog torque (thrust) command, the valid voltage is between -10V and +10V. You can set the command value that corresponds to the voltage range with the relevant parameters.

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



Note: this function is available on E3-L models only.

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



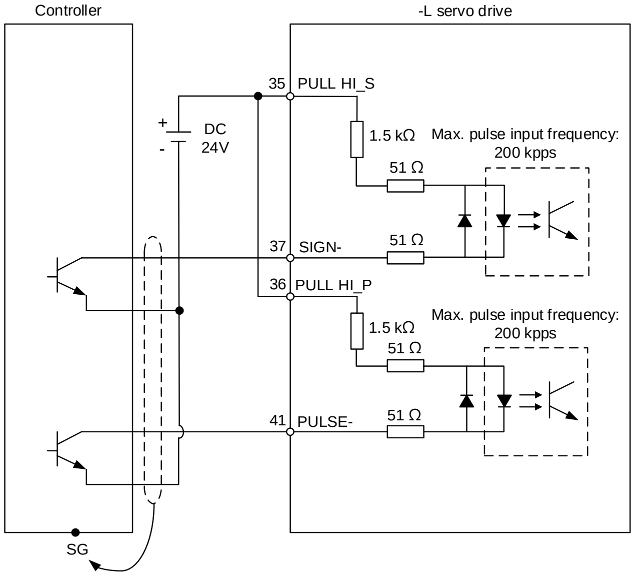
Note: this function is available on E3-L models only.

You can input the pulse command with the open collector or differential line driver. The maximum pulse input is 4 Mpps for the differential line driver and 200 Kpps for the open collector.

Caution: when the source for the pulse input is open collector NPN type or PNP type equipment, you must connect the external power (24V ± 10%) to the PULL HI pins.

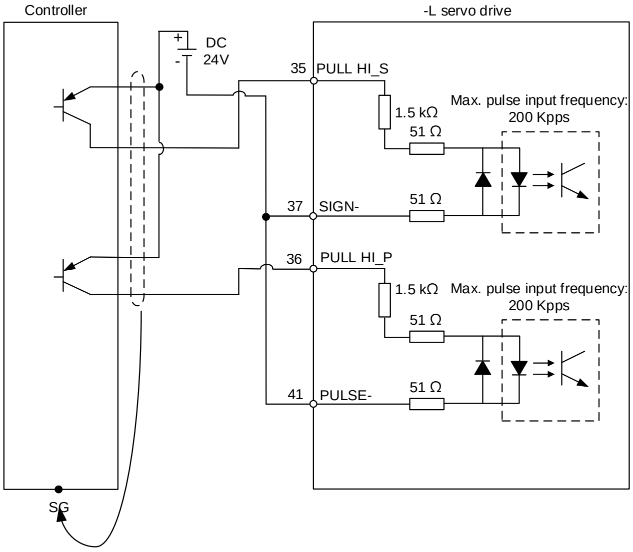
- **Do not connect the 24V power to the SIGN+ and SIGN- pins at the same time, or the circuit elements will be damaged.**
- **Do not connect the 24V power to the PULSE+ and PULSE- pins at the same time, or the circuit elements will be damaged.**

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



Note: this function is available on E3-L models only.

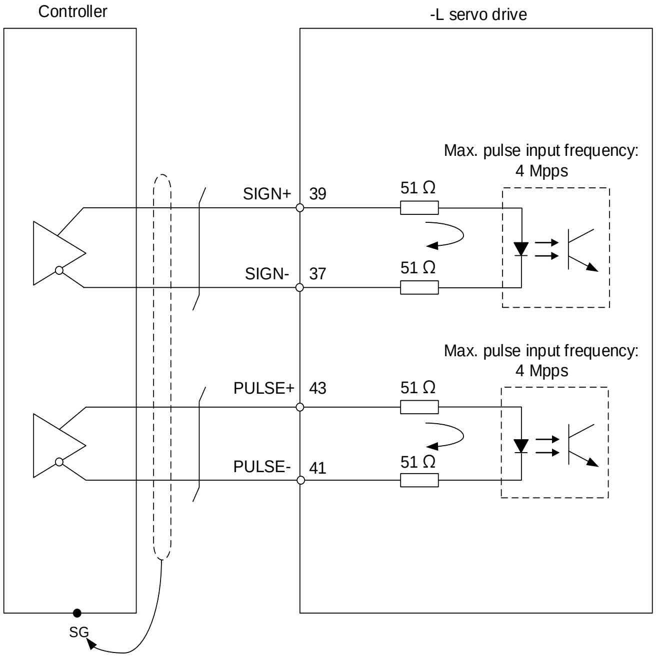
C3-2: the source for the pulse input is open collector PNP type equipment, which uses the external power supply.



Note: this function is available on E3-L models only.

C4: pulse input (differential input) can only be used with 2.8V - 3.6V power systems. **Do not use it with 24V power**.

Pulse	Type		Maximum input frequency
High speed pulse	Differential signal	Pulse train + sign	4 Mpps
		CW and CCW pulses	
		A phase + B phase	2 Mpps
Low speed pulse	Differential signal		200 Kpps



Note:

1. This function is available on E3-L models only.
2. Refer to the description of P1.000 in Chapter 8 for setting details.

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

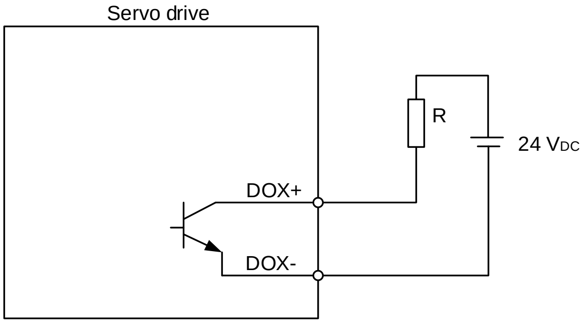
DO specification:

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

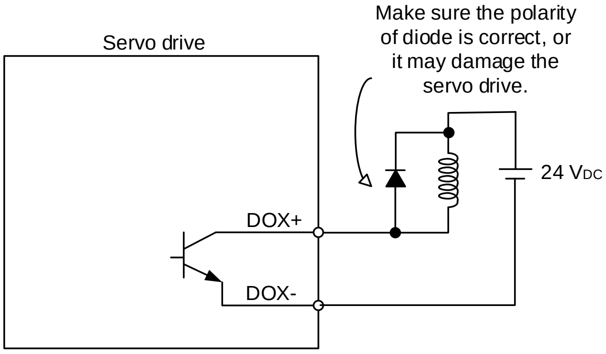
Diode specification:

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.



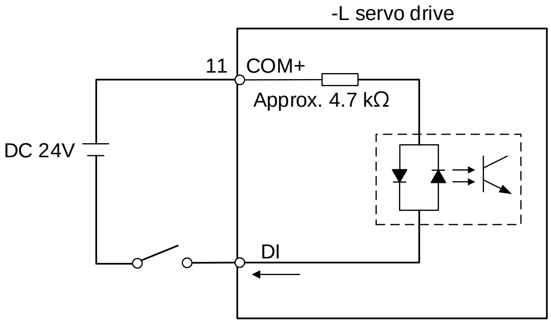
DI wiring - input signals by relay or open collector transistor.

Conditions of DI On / Off:

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

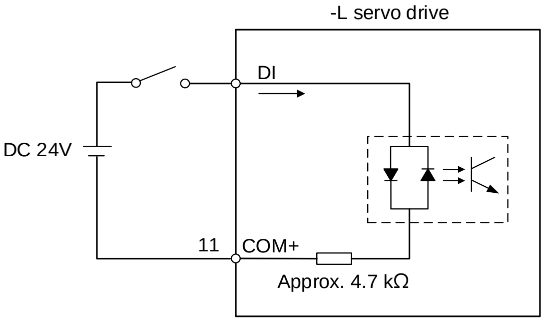
OFF: 5V or below; the input current must not be higher than 0.5 mA.

C7: NPN transistor (SINK mode)



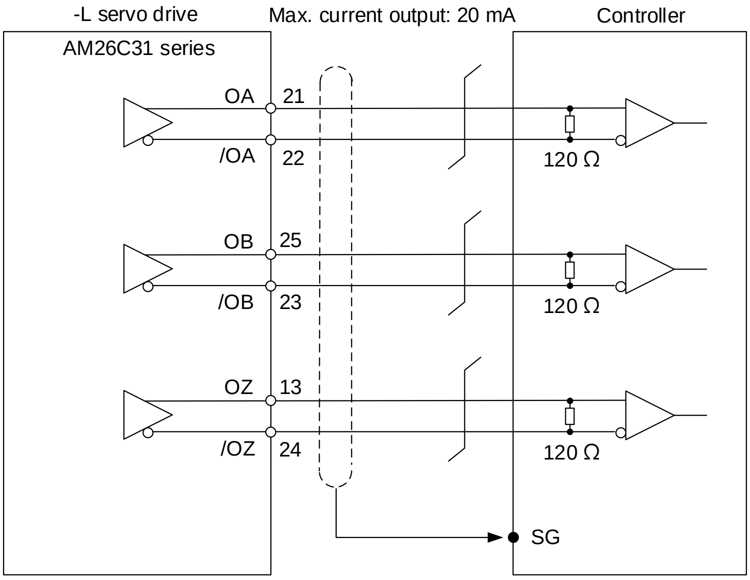
Note: the pin no. is 1 for COM+ on E3-E models.

C8: PNP transistor (SOURCE mode)



Note: the pin no. is 1 for COM+ on E3-E models.

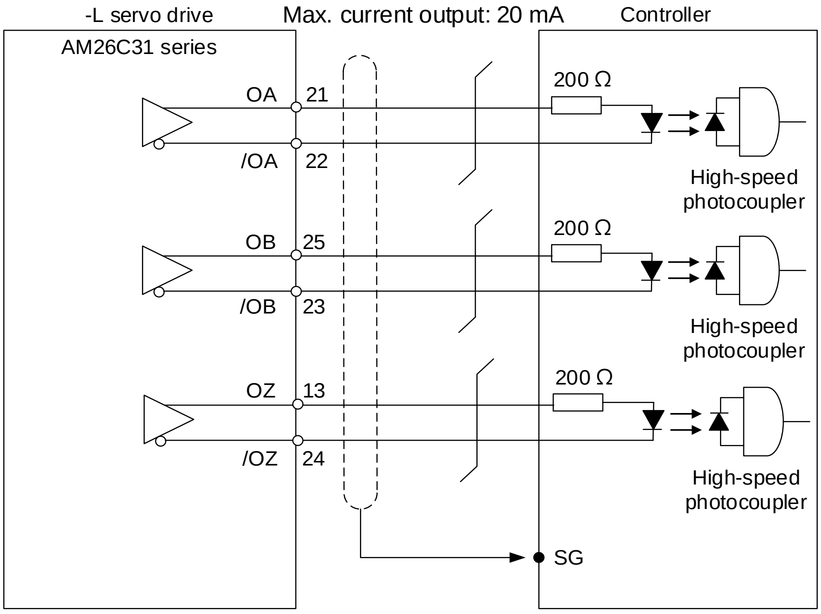
C9: output for encoder position signal (line driver)



Note:

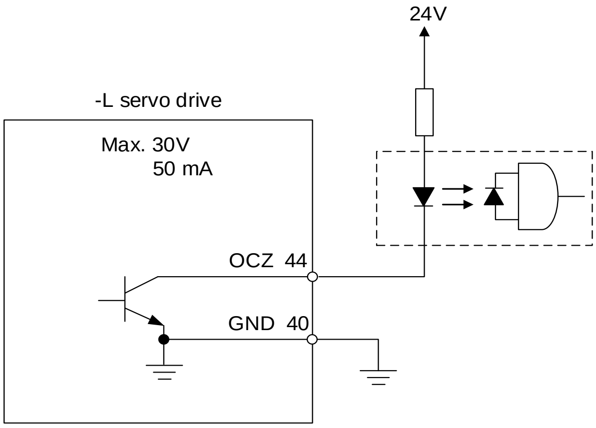
1. It is suggested that you connect the GND of the controller and the GND of the servo drive in parallel when the voltage difference between the two GND terminals is too great.
2. This function is available on E3-L models only.

C10: output for encoder position signal (photocoupler)



Note: this function is available on E3-L models only.

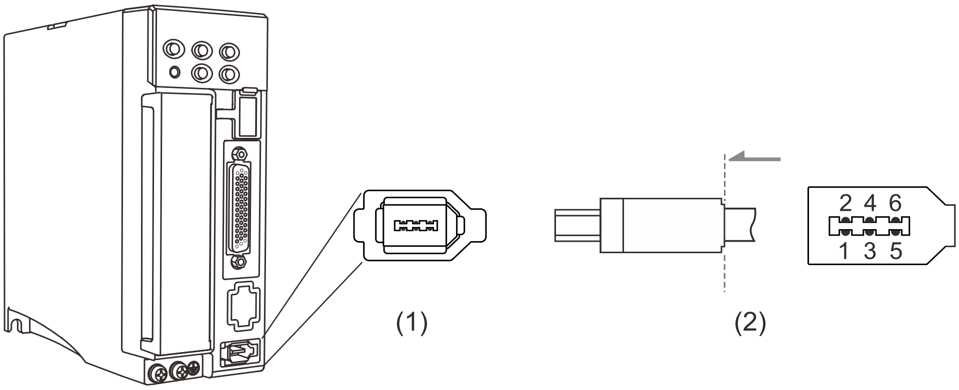
C11: output for encoder OCZ signal (open collector output for Z pulse)



Note: this function is available on E3-L models only.

3.4 Wiring for the CN2 encoder connector

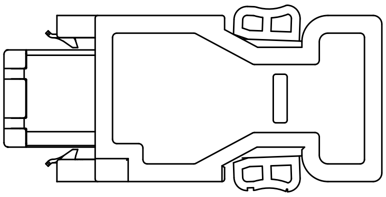
The wiring of the CN2 encoder connector is shown as follows:



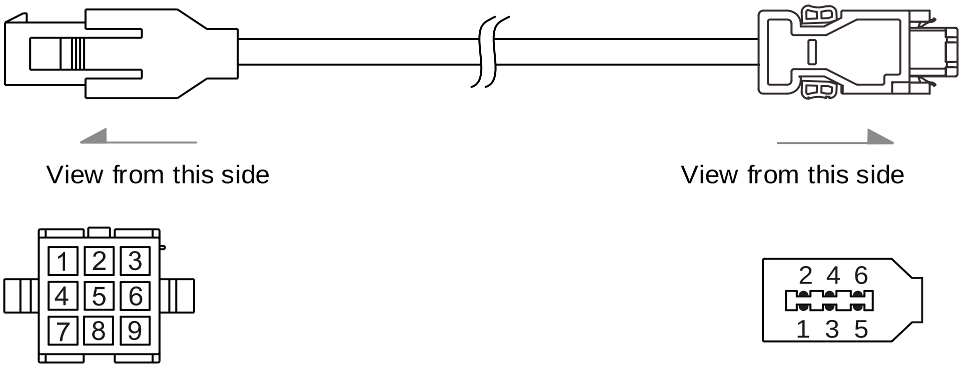
(1) CN2 connector (female); (2) CN2 connector (male)

WARNING

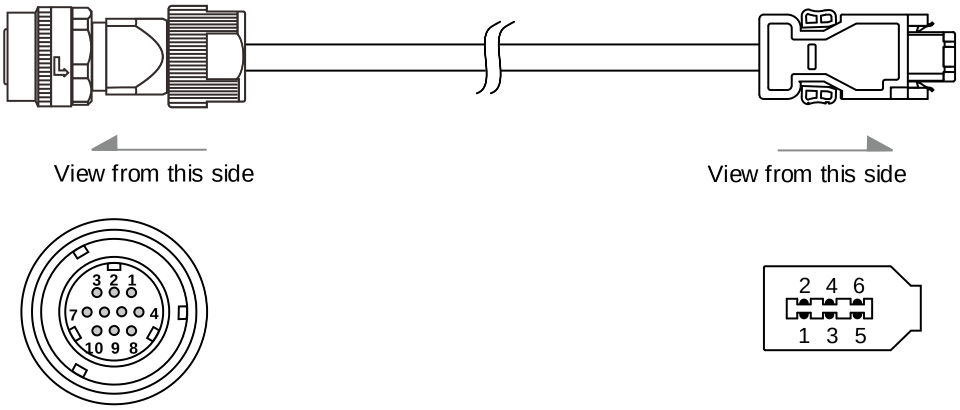
- DO NOT connect to Pin 3 and Pin 4 of the servo drive CN2 connector. These pins are for internal use only. Wiring them will cause damage to the internal circuit.
- When an absolute encoder is used, the battery supplies power directly to the encoder, so wiring the battery wires to the CN2 connector of the servo drive is not required. (E3-L models do not support the absolute functions.)

Illustration of connector	Recommended brand	Model number
	Delta	ACS3-CNENC200
	JAWS	IES06G7AQB1

Connectors (standard connector / CN2 connector) of the encoder cable (for ECM-E3 F40 to F80 motors):



Connectors (military connector / CN2 connector) of the encoder cable (for ECM-E3 F130 to F180 motors):

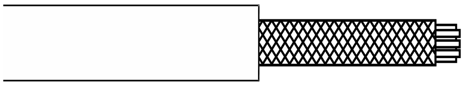


Pin assignment of CN2 connector:

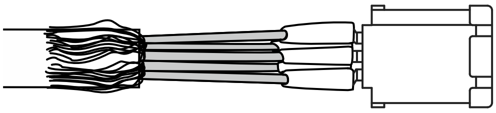
Encoder cable connector (female)			CN2 of servo drive		
Standard connector	Military connector	Color	Pin No.	Signal	Description
7	4	Brown	1	DC+5V	+5V power supply
8	9	Blue	2	GND	Power ground
-	-	-	3	-	**Do not connect this pin. For internal use only.**
-	-	-	4	-	**Do not connect this pin. For internal use only.**
1	1	White	5	T+	Serial communication signal (+)
4	2	White/Red	6	T-	Serial communication signal (-)
9	10	-	Case	Shield	Shielding
2	6	Red	-	-	+3.6V battery (Not supported by E3-L)
5	5	Black	-	-	Battery ground (Not supported by E3-L)

Note: for the wiring details of the absolute encoder connector, refer to Section 3.1.5 Specification for encoder cable and connector. (E3-L models do not support the absolute functions.)

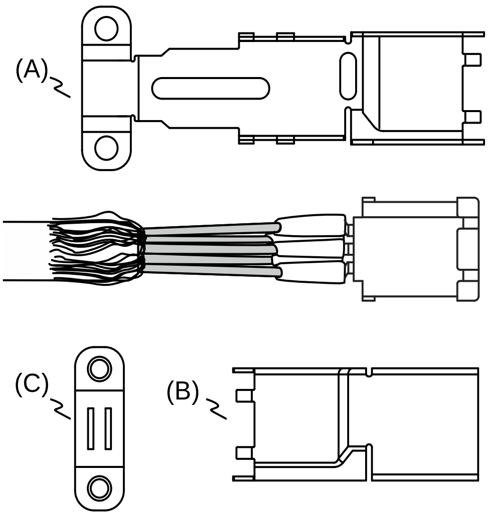
Connect the shielded wires to the CN2 connector as follows:



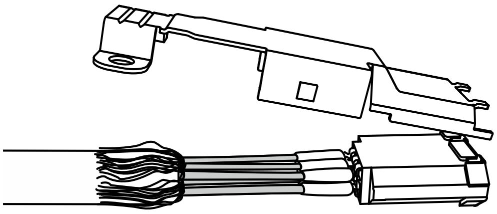
Step 1:
Strip the cable and expose the wires covered by the metal shield. The exposed wire length should be 20 - 30 mm (0.79 - 1.18 inches).



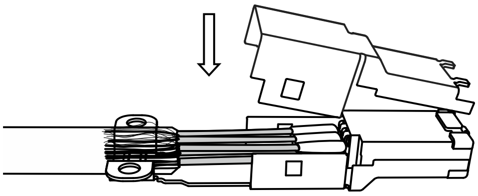
Step 2:
Spread the metal shield and fold it back. Refer to the pin assignment in the preceding table to connect the wires.



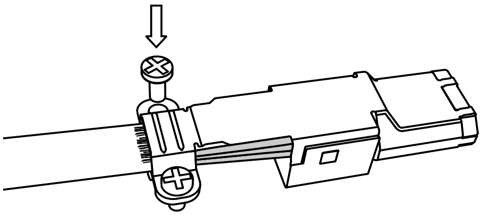
Step 3:
You need the following items to assemble the connector:
(A) Big metal case
(B) Small metal case
(C) U-shaped bracket



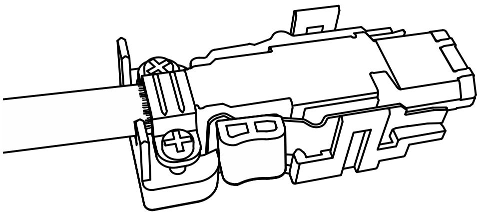
Step 4:
Place the big metal case to cover the exposed metal shield. Make sure the metal shield is completely covered to maintain the integrity of the shielding.



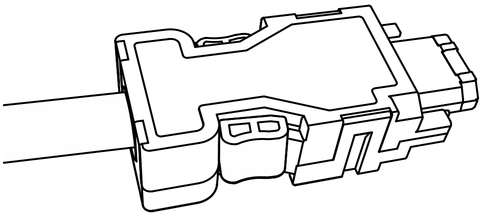
Step 5:
Fasten the small metal case on the other side.



Step 6:
Place the U-shaped bracket over the big metal case and fasten them with screws.



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

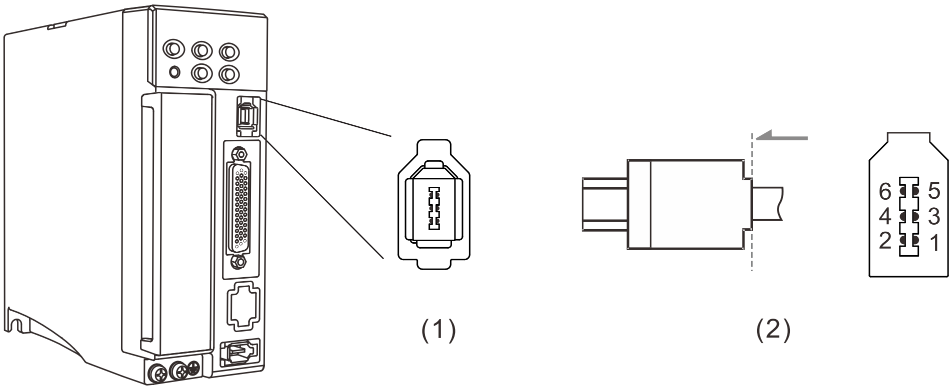


Step 8:
Place and fasten the other side of the case to complete assembling the connector.

3.5 Wiring for the CN3 connector (-L models)

E3-L servo drives can connect to the PC, PLC, or HMI through Modbus communication. The CN3 communication connector supports both RS-232 and RS-485 interfaces. The maximum transmission distance for RS-232 communication is 15 meters (50 ft), while RS-485 communication supports long-distance transmission and connecting multiple servo drives simultaneously.

When the servo drive and ASDA-Soft are connecting, the software automatically sets P3.005.X to 1 for selecting RS-232 for communication. After completing the operation with the software, you need to manually set P3.005.X to 0 or cycle power on the servo drive to use the RS-232 / RS-485 standard Modbus communication. Refer to the description of P3.005 in Chapter 8 Parameters.



(1) CN3 connector (female); (2) CN3 connector (male)

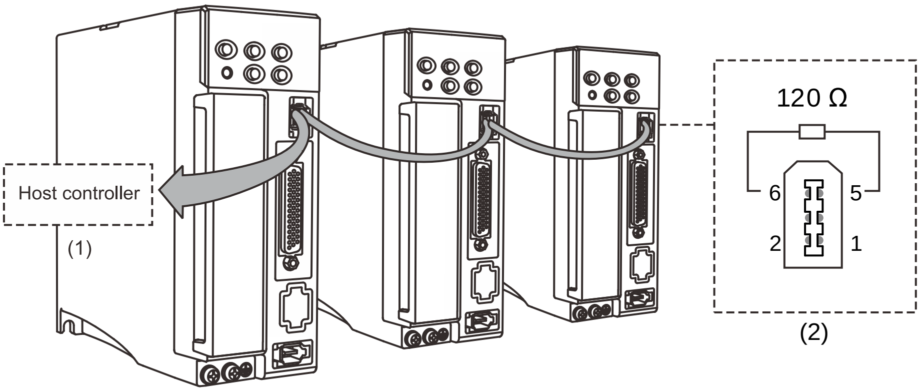
Pin assignment:

Pin No.	Signal	Description
1	GND	Ground for +5V power and signals.
2	RS-232_TX	For the servo drive to transmit data. Connects to the RX pin of the RS-232 port on PC.
3	-	Reserved
4	RS-232_RX	For the servo drive to receive data. Connects to the TX pin of the RS-232 port on PC.
5	RS-485+	The positive terminal for the servo drive to transmit and receive differential signals.
6	RS-485-	The negative terminal for the servo drive to transmit and receive differential signals.

Note:

1. Refer to Section 9.1 for the RS-485 wiring.
2. There are two types of IEEE 1394 communication cables on the market. Do not use the type whose internal ground terminal (Pin 1) is short-circuited with the shield; using this type of cable will result in corrupted communication. Do not short circuit the ground wire of the communication cable with the terminal case.

Connecting multiple servo drives through RS-485:



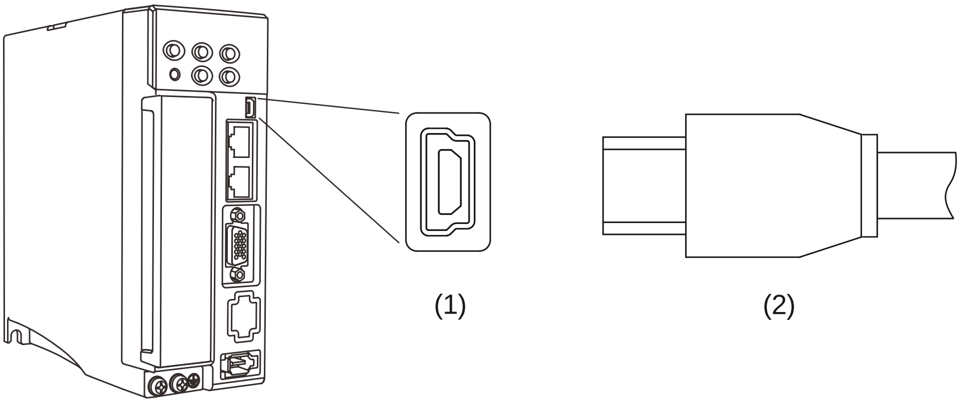
(1) Connect to the controller / PLC; (2) Wiring for RS-485 terminal resistor

Note:

1. You can connect up to 32 axes through RS-485. The communication quality and the allowable number of connected axes are determined by the controller's specifications, quality of wires, grounding, interference, and whether a shielded twisted-pair cable is used.
2. It is suggested that you use a terminal resistor of 120 Ω (Ohm) and 0.5 W (or more).
3. Connect multiple servo drives in parallel through the Modbus connector and put the terminal resistor in the last servo drive.
4. When using RS-485 Modbus communication to connect two or more servo drives in series, the interval between each communication command should be at least 160 ms.

3.6 CN4 connector (Mini USB) (-E models)

The CN4 is a serial communication port for connecting the E3-E servo drive to a PC and operate the servo drive with the software. This is a Type B Mini USB connector 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.



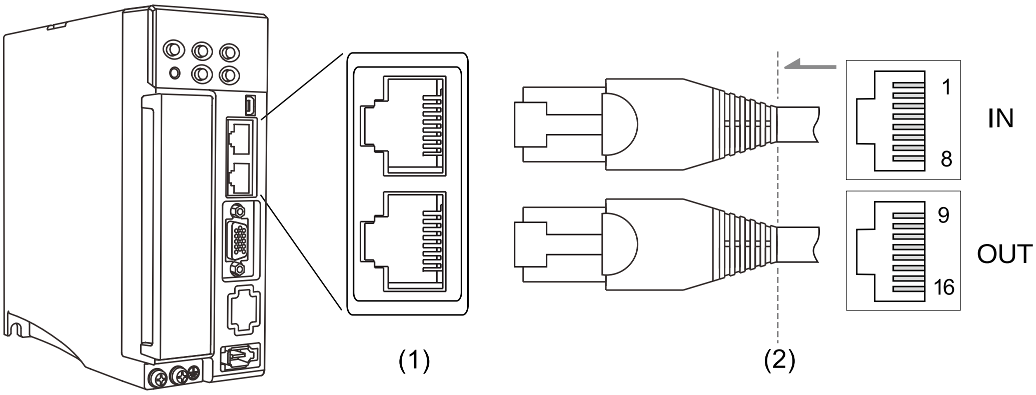
(1) Mini USB connector (female); (2) Mini USB connector (male)

ATTENTION

E3-E models do not support USB power supply.

3.7 Wiring for the CN6 connector (-E models)

The CN6 connector of the E3-E models provides two EtherCAT ports for connecting multiple servo drives, with one way in and the other way out.



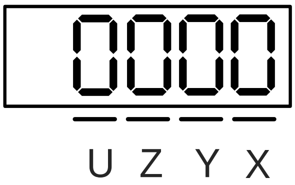
(1) CN6 connector (female); (2) CN6 connector (male)

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 with 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 power cycling and the initialization of the servo drive is complete, the communication has not yet started, but the controller can access the servo drive’s register.
1	Operational	SDO, TxPDO, and RxPDO data packets can be transmitted.
2	Pre-Operational	The controller can exchange data through the mailbox.
3	Safe-Operational	The servo drive can use the SDO and TxPDO data packets to exchange data with the controller.

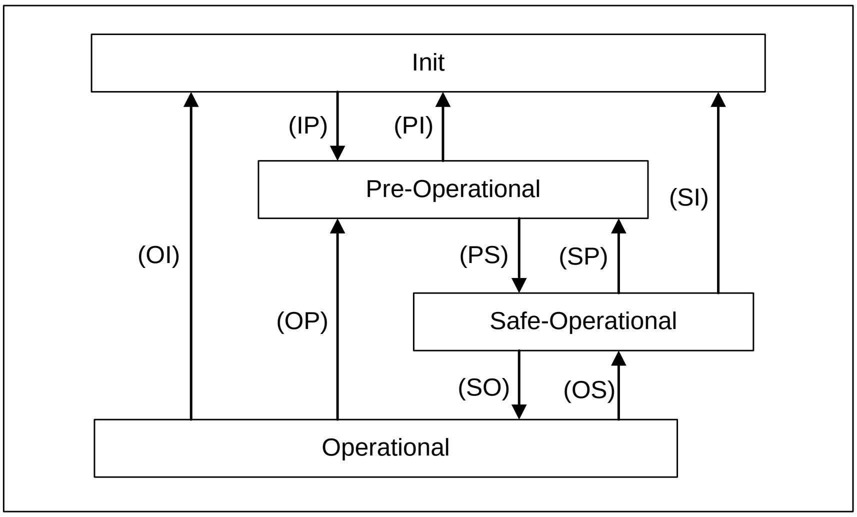
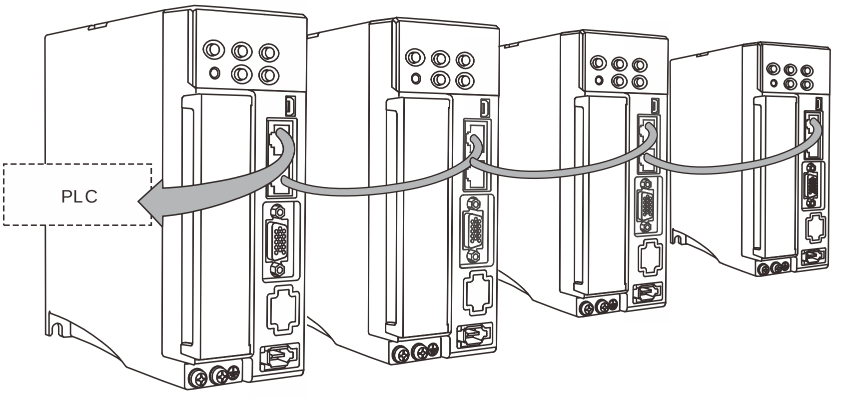


Figure 3.7.1 EtherCAT State Machine

Connecting multiple servo drives:

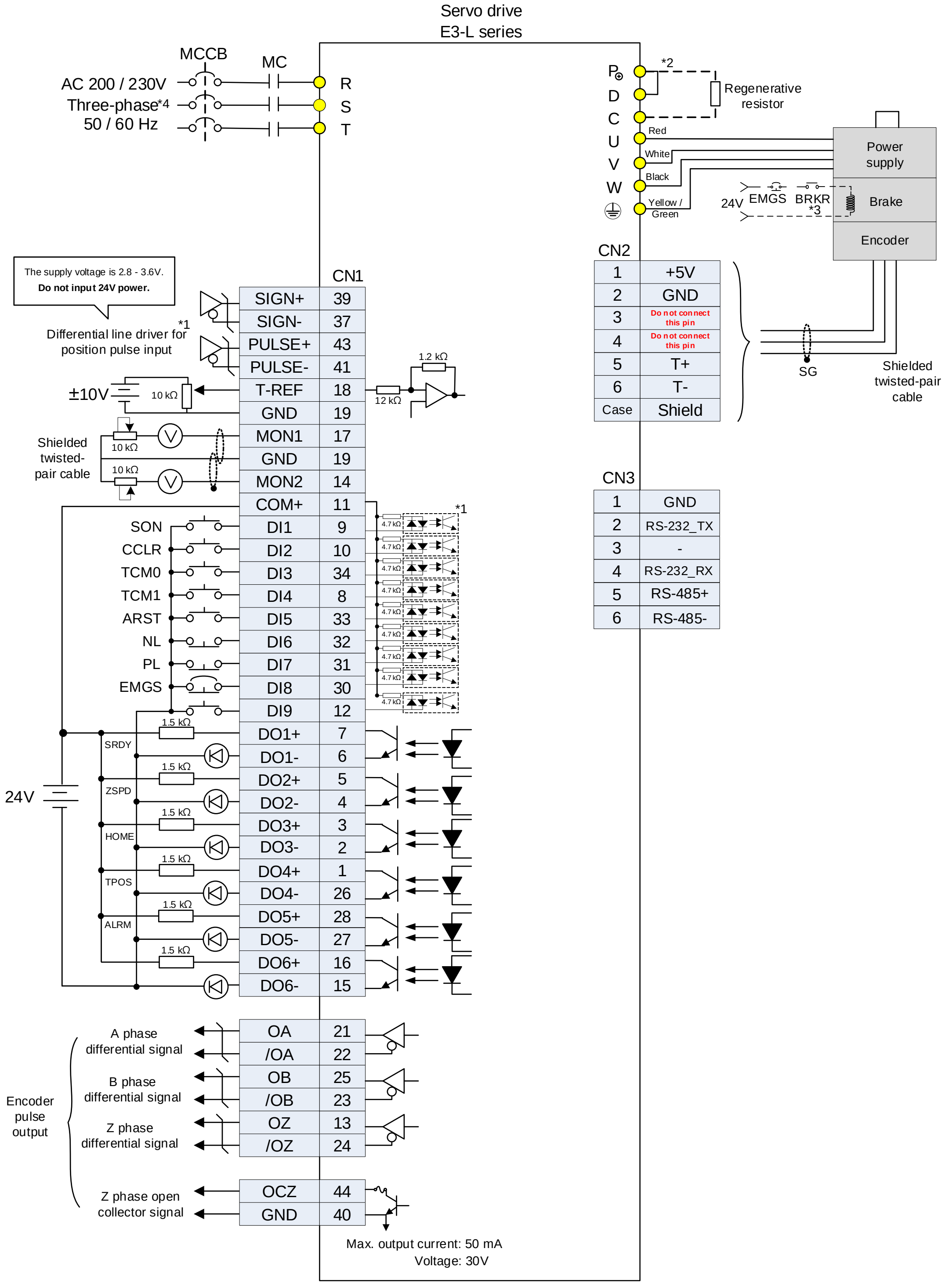


Note:

1. When multiple servo drives are connected, the maximum distance between each drive is 50 m (164.04 inches)
2. Use CAT5e STP cable.
3. It is suggested that you use a Beckhoff cable (model number: ZB9020).
4. 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.

3.8 Standard wiring example

3.8.1 Position (PT) control mode – differential line driver input



Note:

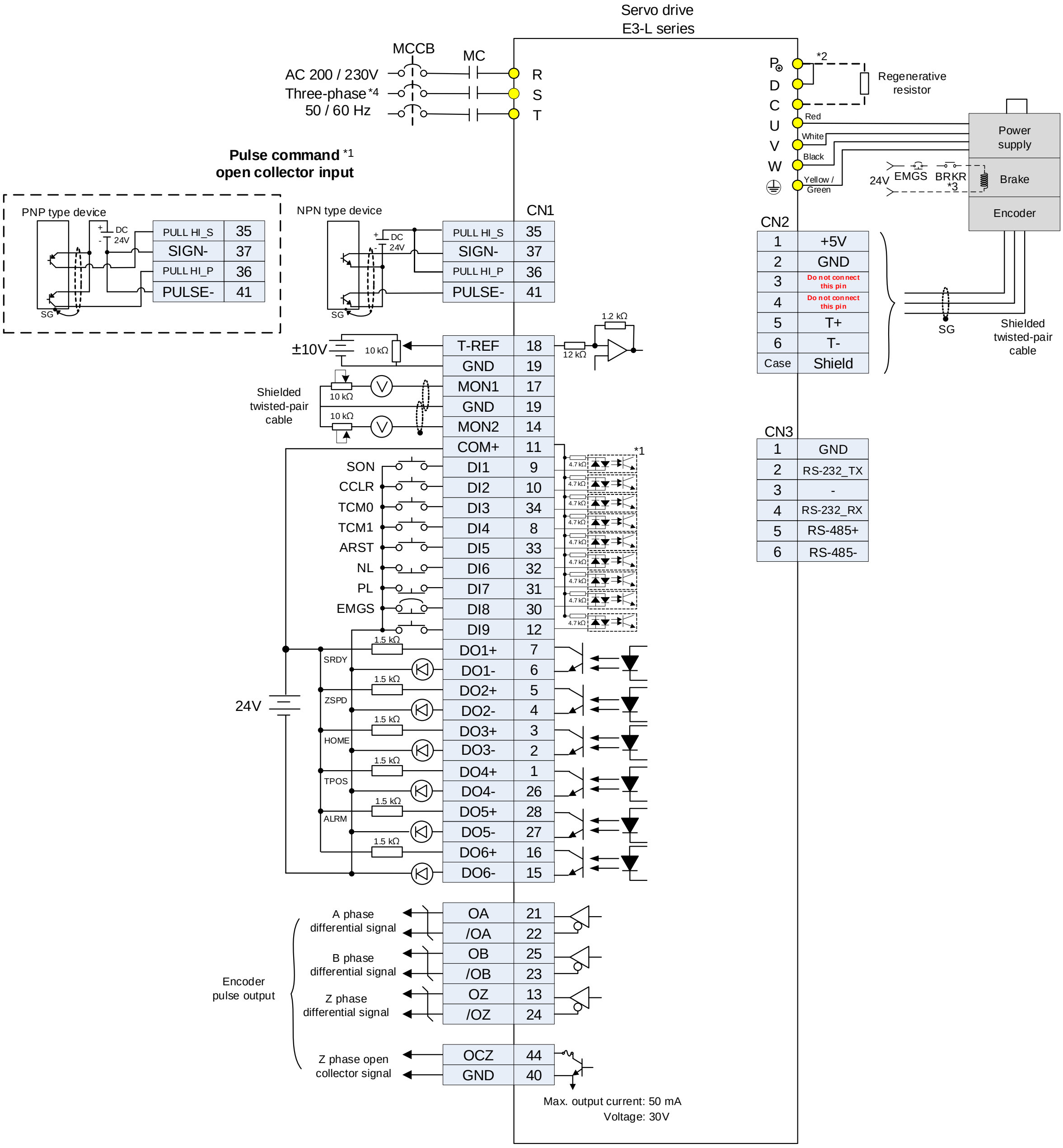
*1. The preceding figure uses the differential line driver for position pulse input. For open collector input or other wiring methods, refer to Section 3.3.6.

*2. The 400 W models and below have no built-in regenerative resistor.

*3. The brake coil has no polarity.

*4. The 1.5 kW models and below can use single-phase power supply.

3.8.2 Position (PT) control mode – open collector input



Note:

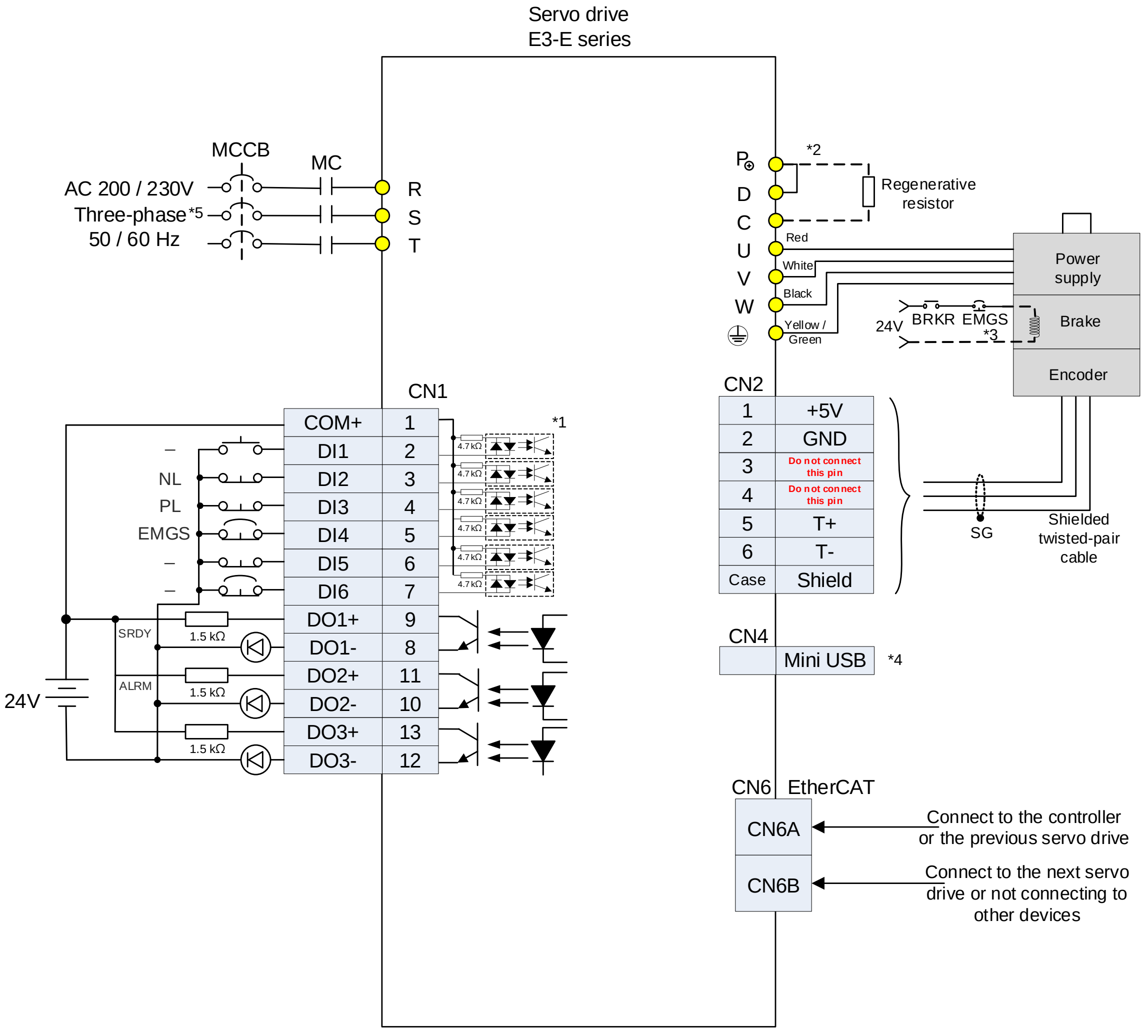
*1. The preceding figure uses the open collector for position pulse input. For differential line driver input or other wiring methods, refer to Section 3.3.6.

*2. The 400 W models and below have no built-in regenerative resistor.

*3. The brake coil has no polarity.

*4. The 1.5 kW models and below can use single-phase power supply.

3.8.3 Position (PR) control mode – internal position commands



Note:

*1. Refer to Section 3.3.6 for wiring.

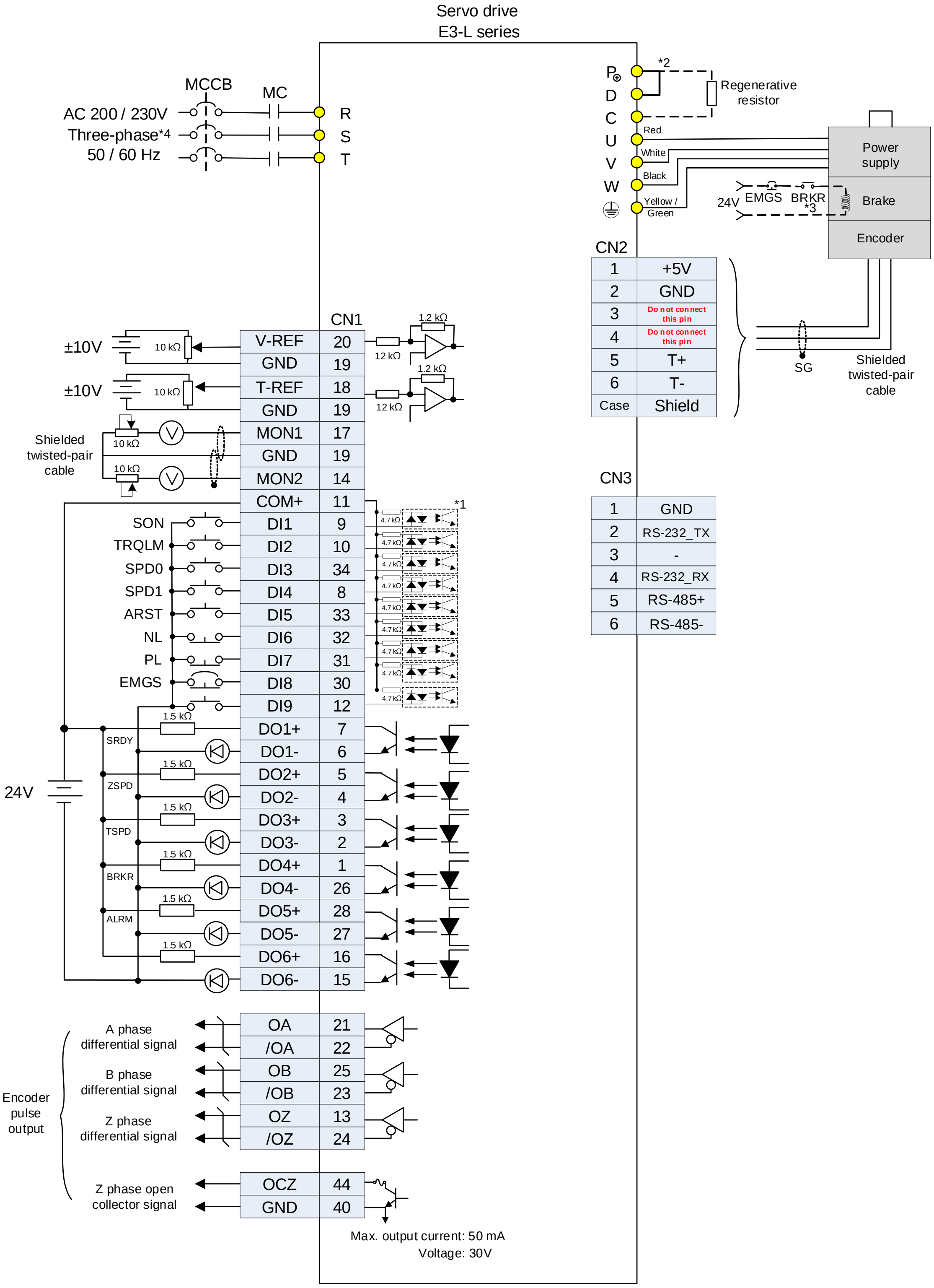
*2. The 400 W models and below have no built-in regenerative resistor.

*3. The brake coil has no polarity.

*4. The Mini USB connector for connecting to the PC.

*5. The 1.5 kW models and below can use single-phase power supply.

3.8.4 Speed (S) control mode



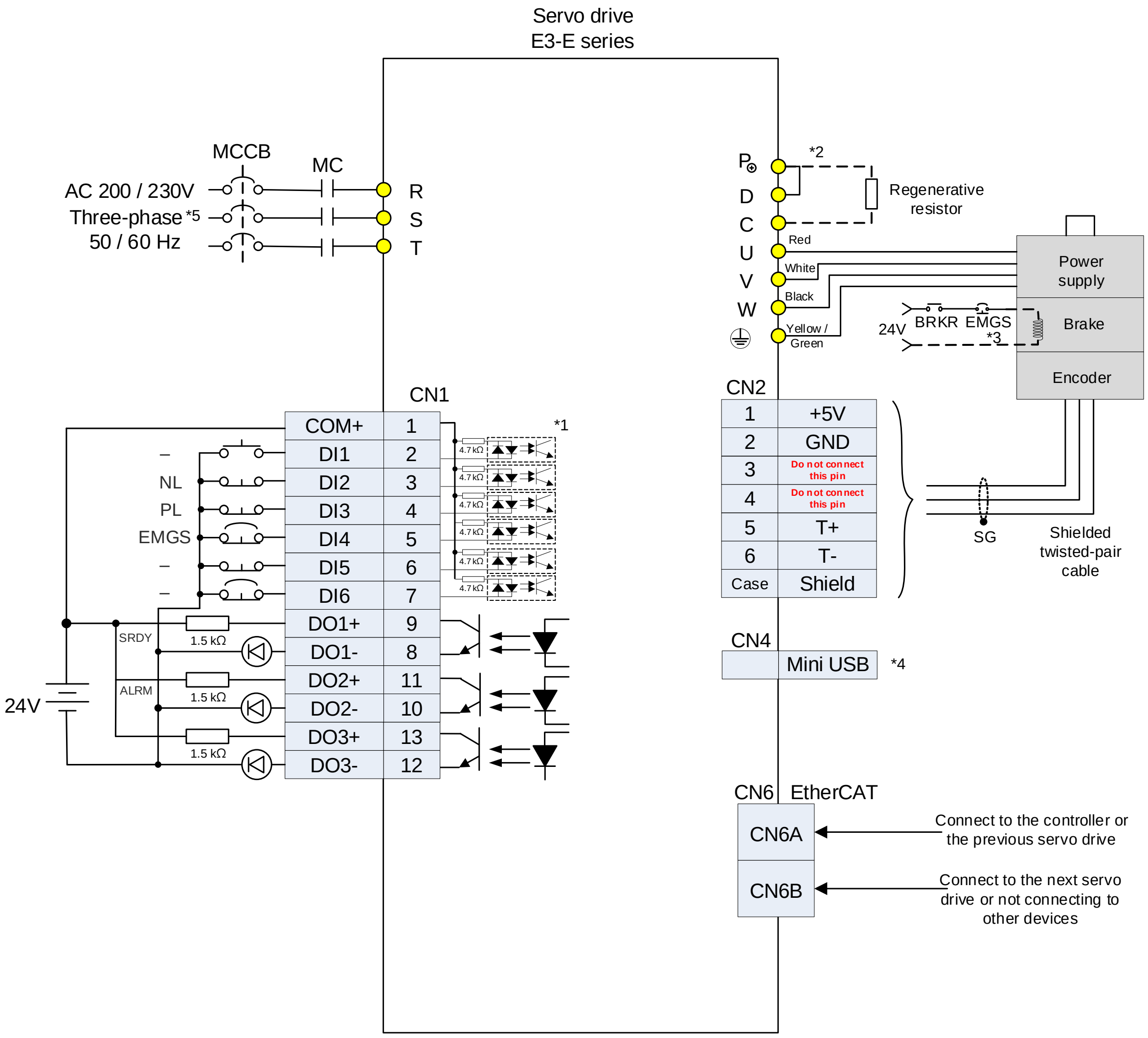
Note:

*1. Refer to Section 3.3.6 for wiring.

*2. The 400 W models and below have no built-in regenerative resistor.

*3. The brake coil has no polarity.

*4. The 1.5 kW models and below can use single-phase power supply.



Note:

*1. Refer to Section 3.3.6 for wiring.

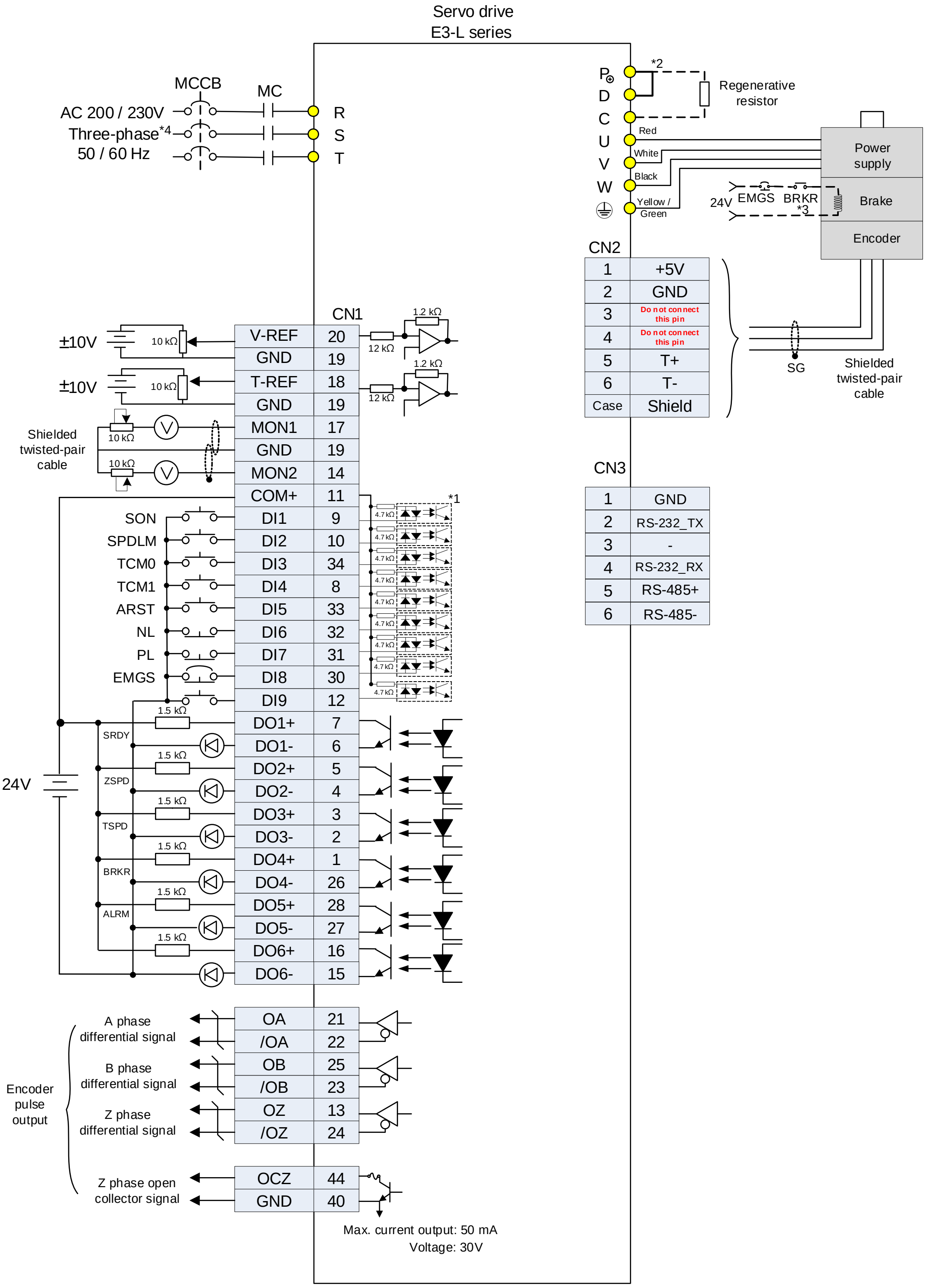
*2. The 400 W models and below have no built-in regenerative resistor.

*3. The brake coil has no polarity.

*4. The Mini USB connector for connecting to the PC.

*5. The 1.5 kW models and below can use single-phase power supply.

3.8.5 Torque (T) control mode



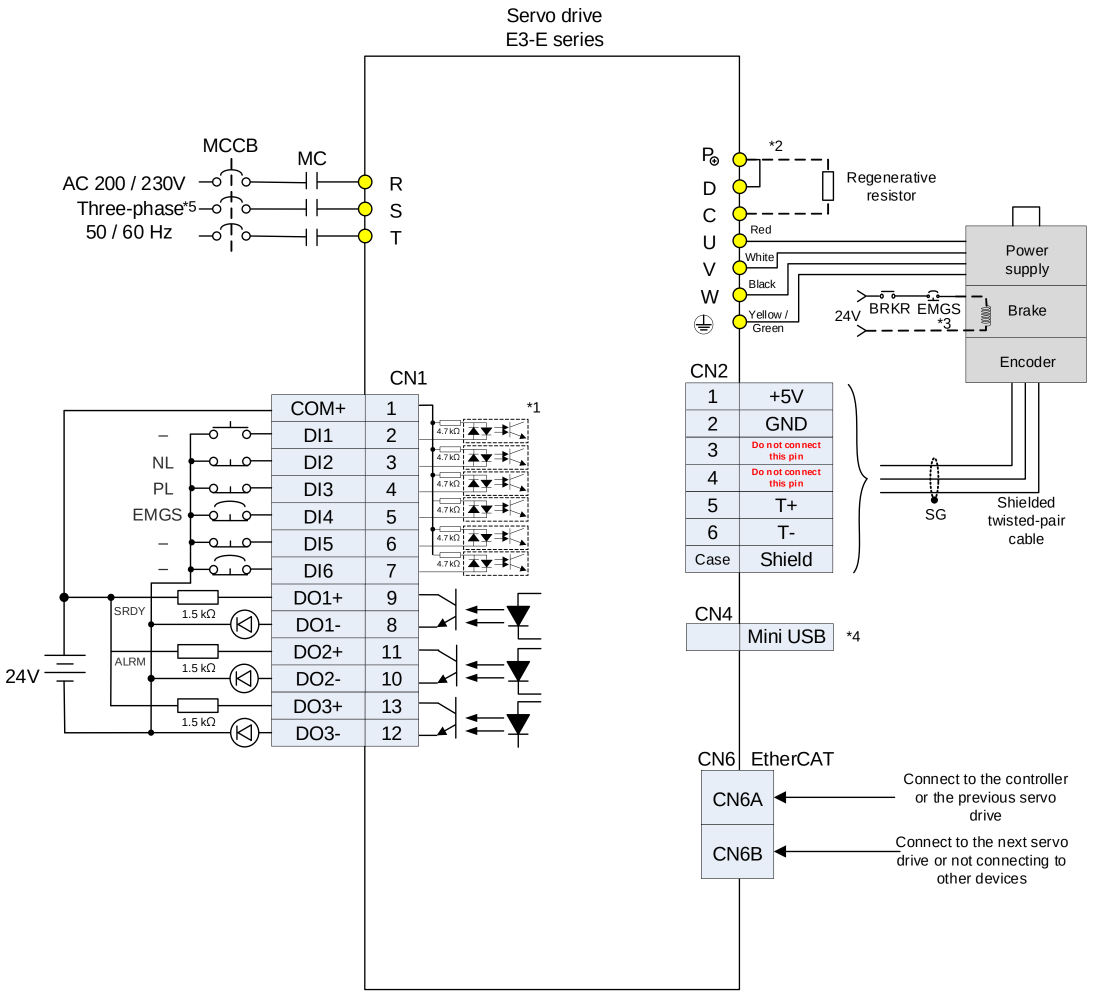
Note:

*1. Refer to Section 3.3.6 for wiring.

*2. The 400 W models and below have no built-in regenerative resistor.

*3. The brake coil has no polarity.

*4. The 1.5 kW models and below can use single-phase power supply.



Note:

*1. Refer to Section 3.3.6 for wiring.

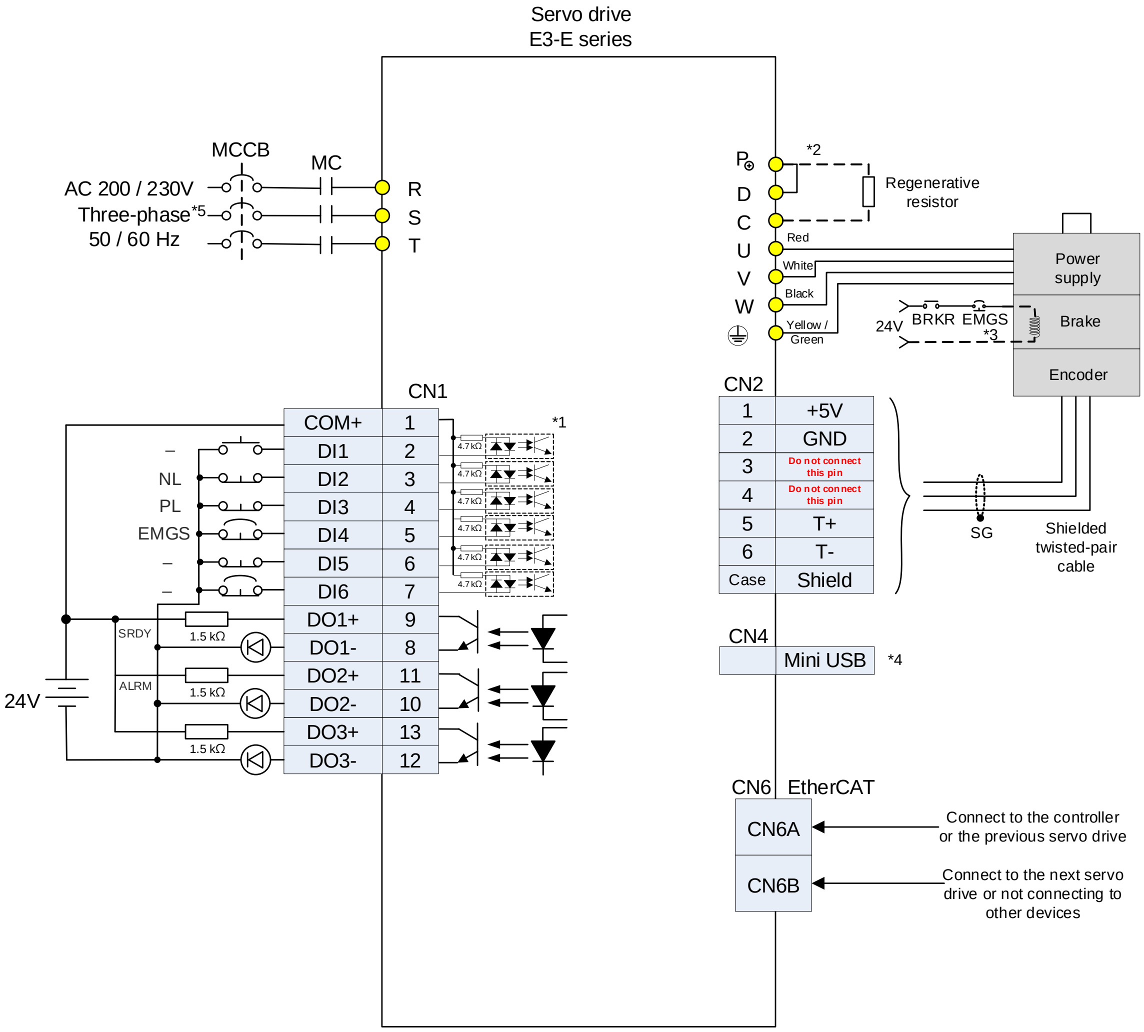
*2. The 400 W models and below have no built-in regenerative resistor.

*3. The brake coil has no polarity.

*4. The Mini USB connector for connecting to the PC.

*5. The 1.5 kW models and below can use single-phase power supply.

3.8.6 Communication mode – EtherCAT



Note:

*1. Refer to Section 3.3.6 for wiring.

*2. The 400 W models and below have no built-in regenerative resistor.

*3. The brake coil has no polarity.

*4. The Mini USB connector for connecting to the PC.

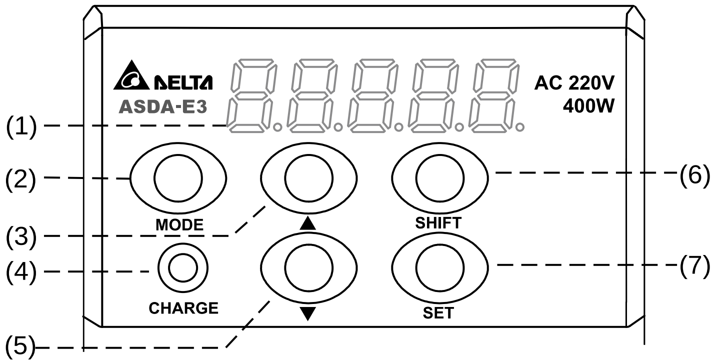
*5. The 1.5 kW models and below can use single-phase power supply.

Test Operation and Panel Display

4

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

4.1 Panel description



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

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

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

(4) CHARGE: the LED indicator is on when the power is applied to the main circuit.

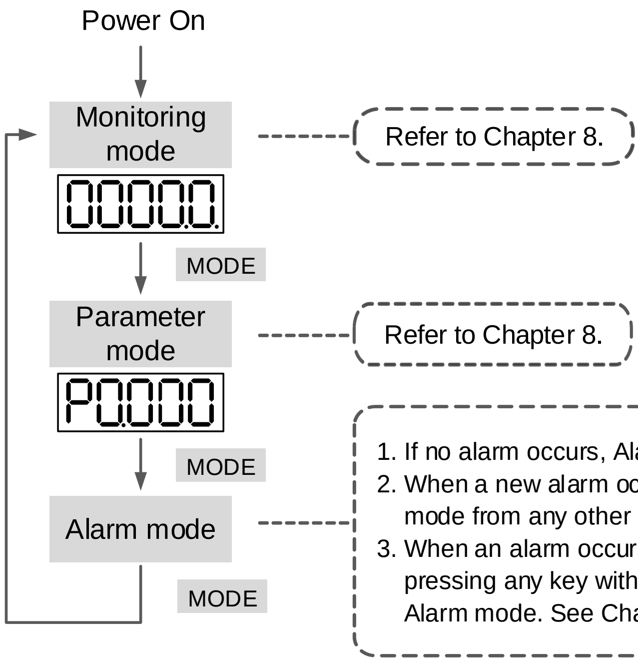
(5) DOWN (▼) key: changes the monitoring codes, parameter numbers, and setting values.

(6) SHIFT key: in Monitoring mode, pressing the SHIFT key switches the display of high and low words. In Parameter mode, pressing the SHIFT key changes the group number. In Editing mode, pressing the SHIFT key moves the flashing (selected) digit to the left, so you can adjust the higher setting bit.

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

4.2 Parameter setting procedure

Switching modes:



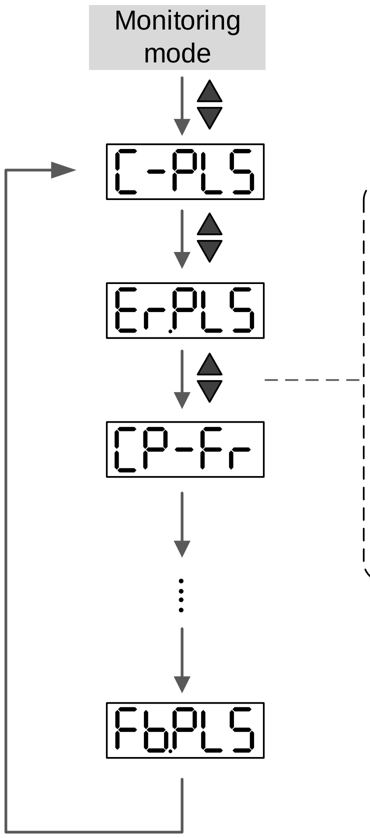
Refer to Chapter 8.

Refer to Chapter 8.

1. If no alarm occurs, Alarm mode is skipped.
2. When a new alarm occurs, the display switches to Alarm mode from any other mode.
3. When an alarm occurs, if you switch to other modes without pressing any key within 20 seconds, the display returns to Alarm mode. See Chapter 12 for detailed alarm information.

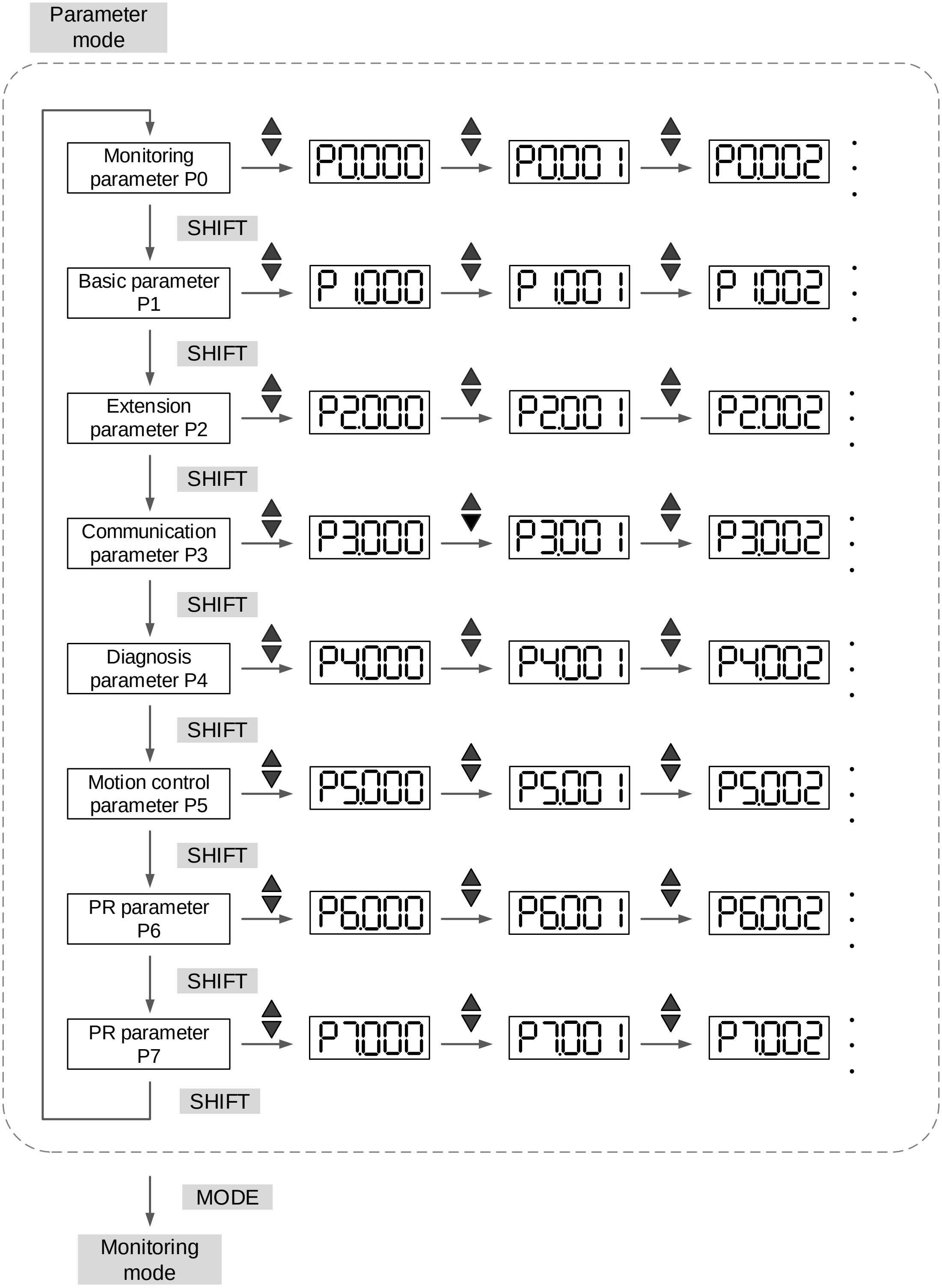
Operating in each mode:

Monitoring mode

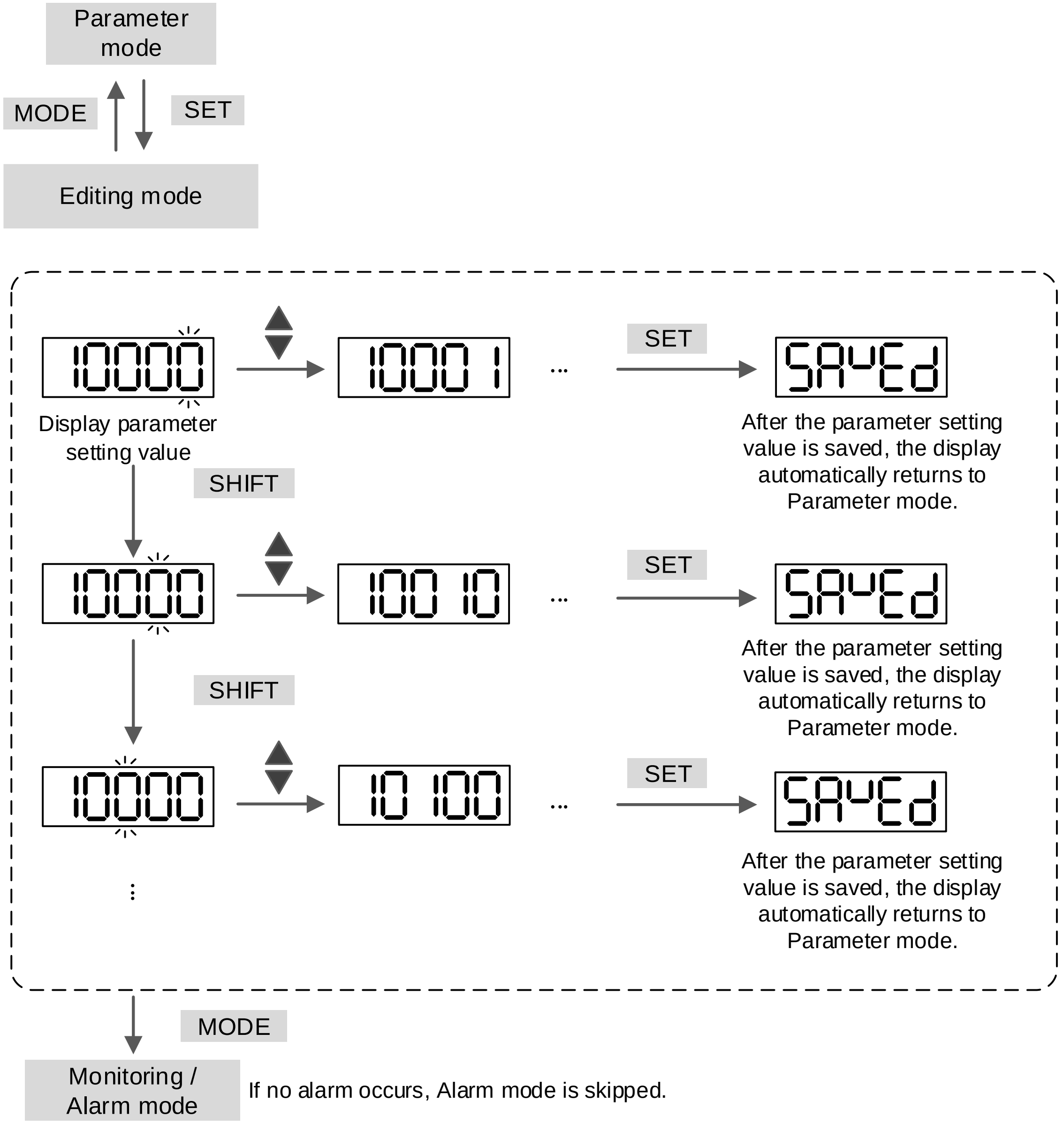


1. Press ▲▼ keys to select monitoring variables. Refer to Section 4.3.5 for detailed information.
2. Directly enter the code of monitoring variables via P0.002. Refer to Chapter 8 for a detailed description of P0.002.
3. Press the SHIFT key to switch the display of high and low words of monitoring variables.

Parameter mode



Editing mode



Display parameter setting value

After the parameter setting value is saved, the display automatically returns to Parameter mode.

After the parameter setting value is saved, the display automatically returns to Parameter mode.

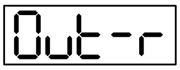
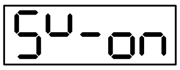
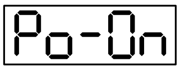
After the parameter setting value is saved, the display automatically returns to Parameter mode.

If no alarm occurs, Alarm mode is skipped.

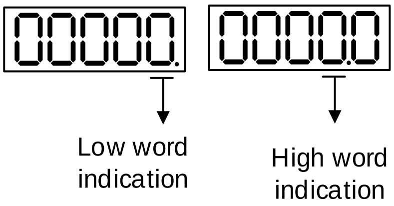
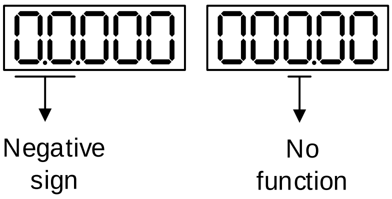
4.3 Status display

4.3.1 Data save status

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

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

4.3.2 Decimal points

Displayed symbol	Description
	High word / low word indication: this indicates the current 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-bit or 32-bit data is displayed in decimal format. In hexadecimal format, it only shows positive values.

4.3.3 Alarm messages

Displayed symbol	Description
AL.nnn	When an alarm occurs, the servo drive panel displays 'AL' as the alarm symbol and 'nnn' as the alarm code. Refer to Chapter 8 Parameters for a detailed description of P0.001 or Chapter 12 Troubleshooting for alarm details.

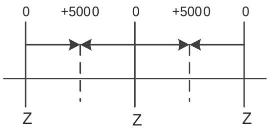
4.3.4 Positive and negative value setting

Displayed symbol	Description
02468	In Editing mode, press the UP (▲) and DOWN (▼) keys to change the displayed value. Press the SHIFT key to change the selected digit (the selected digit is flashing).
2.4.680	In Editing mode, press and hold the SHIFT key for two seconds to switch between the positive and negative values. If the parameter setting value is out of range after you switch the positive or negative value, the display switches back to the original value.

4.3.5 Monitoring display

When you apply power to the drive, the display shows the monitoring displayed 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 the monitoring symbol "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	Monitoring displayed symbol	Description	Unit
0	Fb.PUU	Motor feedback pulse number (after the scaling of E-Gear ratio)	PUU
1	C-PUU	Input number of pulse commands (after the scaling of E-Gear ratio)	PUU
2	Er.PUU	The deviation between control command pulse and feedback pulse number	PUU
3	Fb.PLS	Motor feedback pulse number (encoder unit)	pulse
4	C-PLS	Input number of pulse commands (before the scaling of E-Gear ratio) (encoder unit)	pulse
5	Er.PLS	Error pulse number (after the scaling of E-Gear ratio) (encoder unit)	pulse
6	CP-Fr	Input frequency of pulse commands	Kpps
7	SPEEd	Motor speed	rpm
8	CSPd1	Speed command	Volt
9	CSPd2	Speed command	rpm

P0.002 setting value	Monitoring displayed symbol	Description	Unit
10	C-tq 1	Torque command	Volt
11	C-tq2	Torque command	%
12	AUG-L	Average torque	%
13	PE-L	Peak torque	%
14	U buS	Main circuit voltage	Volt
15	J-L	Load / motor inertia ratio Note: if the display shows 13.0, it means the load inertia ratio is 13.	1 times
16	IGbt.t	IGBT temperature	°C
17	rSn.Fr	Resonance frequency (low word is the first resonance point and high word is the second resonance point)	Hz
18	d IFF.2 	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	MAP 1	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.

Example of the displayed value	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 first digit 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.

Example of the displayed value	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 you can switch the high / low word and the display format (Dec / Hex). As for parameters, each parameter only supports one display format and switching the display format is not allowed. Refer to the definitions in Chapter 8.

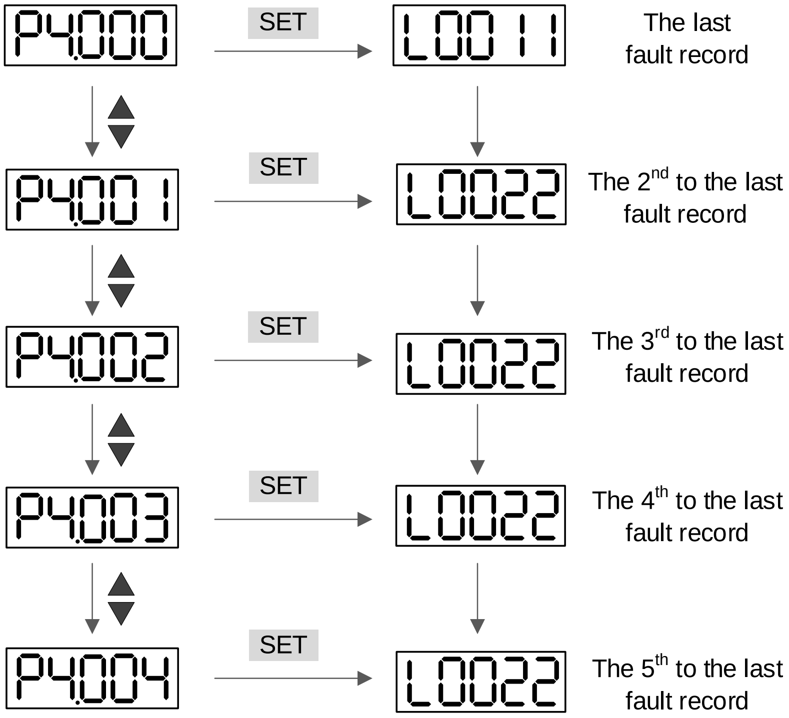
4.3.6 Display when power is off

Displayed 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 General functions

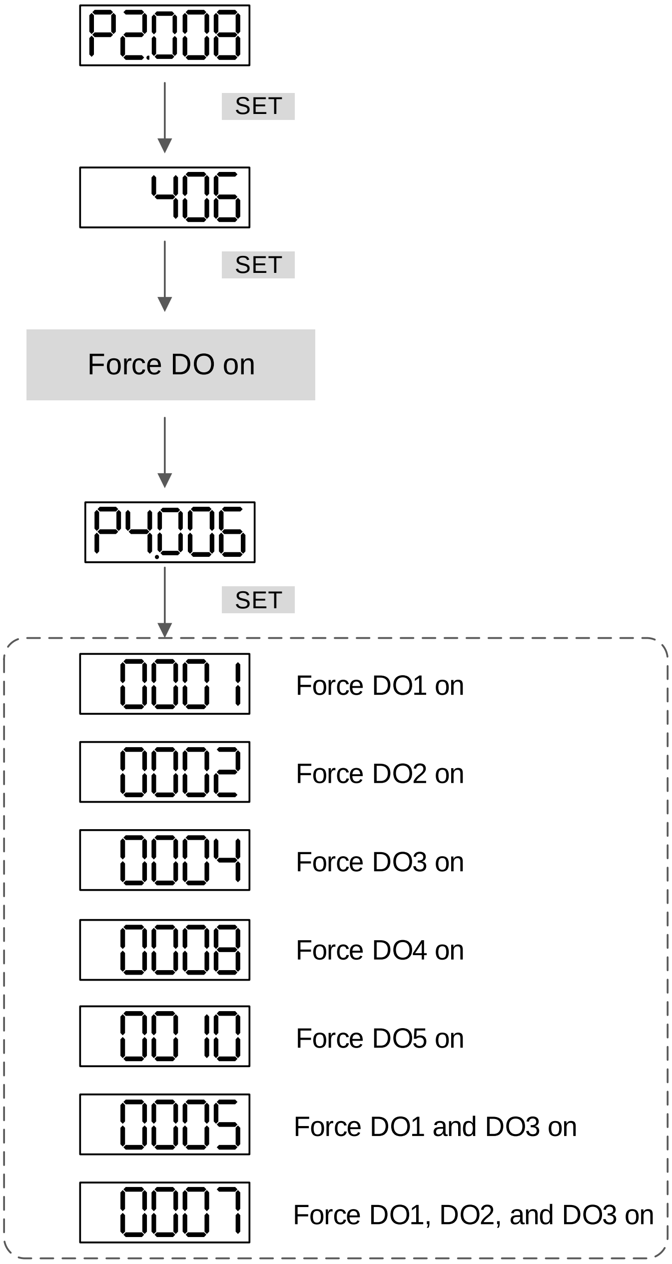
4.4.1 Operation of fault record display

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



4.4.2 Force DO on

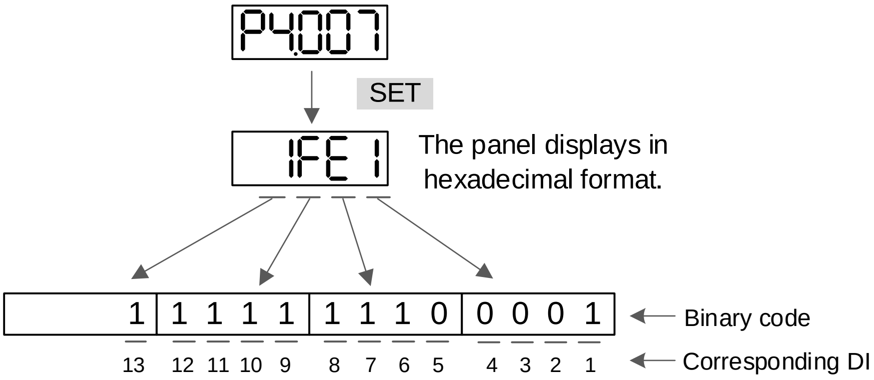
You can switch to the Diagnosis mode by the following steps. Set P2.008 to 406 to enable the function of forcing DO on. Then, set the DO by binary method with P4.006. When the value of P4.006 is 0x0002, it forces DO2 on. When the value is 0x0005, it forces DO1 and DO3 on. These settings are volatile, so the servo 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.



4.4.3 Digital input diagnosis

You can switch to the Diagnosis mode by the following steps. When DI1 - DI9 are triggered by the external signals, 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 is 1110 in binary format, indicating that DI6 - DI8 are on.

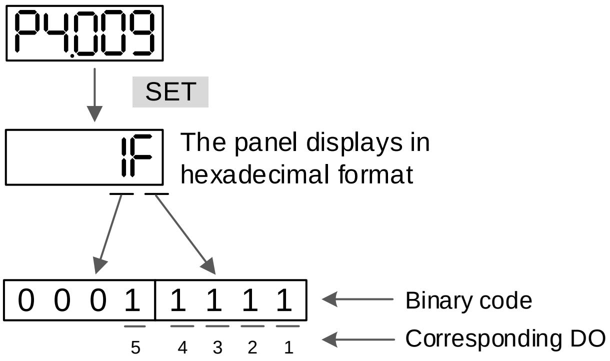


The panel displays in hexadecimal format.

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 signals, 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 is 1111 in binary format, indicating that DO1 - DO4 are on.



The panel displays in hexadecimal format

4.5 Testing

This section introduces the testing operations without load. 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 the 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 personnel injury or equipment damage during operation.

Caution: to prevent danger, it is strongly recommended that you first check if the motor runs normally without load during normal operation. Then, try operating the motor with load.

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

Inspection before operation	■ 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 electrically conductive objects, including sheet metal 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 if the stop and circuit breaker functions are working normally. ■ Reduce the electromagnetic interference if there is electromagnetic interference with the peripheral devices. ■ Make sure the external voltage level of the servo drive is correct.
Inspection during operation	■ 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 machinery has different characteristics. Adjust the parameters according to the characteristics of each machine. ■ 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 if the power indicator and LED display work properly.

4.5.2 Apply power to the servo drive

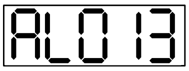
Follow these instructions.

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) The encoder cable for the motor is correctly connected to CN2: if you only want to use the JOG function, connecting CN1 and CN3 is not necessary. Refer to Chapter 3 for the wiring for CN2.

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

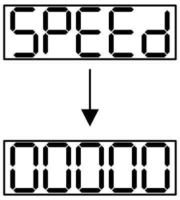
2. Connect the power circuit for the servo drive:
   Servo drive: connect the power to the servo drive. Refer to Chapter 3 for the wiring for power supply.
3. Turn on the power:
   Servo drive power supply: apply power to the main circuit (R, S, T).

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



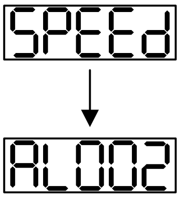
The default settings for the DIs are negative limit (NL), positive limit (PL), and emergency stop (EMGS). If not using the default settings, you must set the values of the corresponding parameters to 0 (disable the DI function) or some other values for different functions.

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



When the display shows no text, check if the voltage of the power input is too low.

- When the display shows:



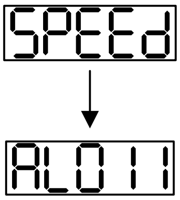
Overvoltage warning:

This means 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 display shows:



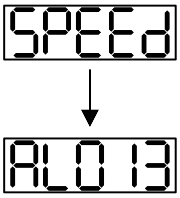
CN2 communication failure warning:

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.

- When the display shows:



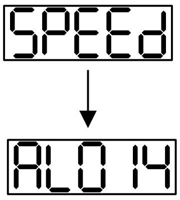
Emergency stop warning:

Check if any of the digital inputs DI1 - DI9 are set to emergency stop (EMGS).

Corrective action:

1. If you do not want to set the emergency stop (EMGS) as one of the digital inputs, make sure none of the digital inputs DI1 - DI9 are set to emergency stop (EMGS) (make sure that none of the parameters, P2.010 - P2.017 and P2.036, are set to 21).
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 display shows:



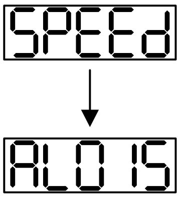
Negative limit error warning:

Check if any of the digital inputs DI1 - DI9 are set to negative limit (NL) and that DI is off.

Corrective action:

1. If you do not want to set the negative limit (NL) as one of the digital inputs, make sure none of the digital inputs DI1 - DI9 are set to negative limit (NL) (make sure that none of the parameters, P2.010 - P2.017 and P2.036, are set to 22).
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 display shows:



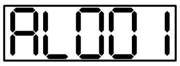
Positive limit error warning:

Check if any of the digital inputs DI1 - DI9 are set to positive limit (PL) and make sure that DI is off.

Corrective action:

1. If you do not want to set the positive limit (PL) as one of the digital inputs, make sure none of the digital inputs DI1 - DI9 are set to positive limit (PL) (make sure that none of the parameters, P2.010 - P2.017 and P2.036, are set to 23).
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 display 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 part of the wiring is not exposed.

- When the display 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:

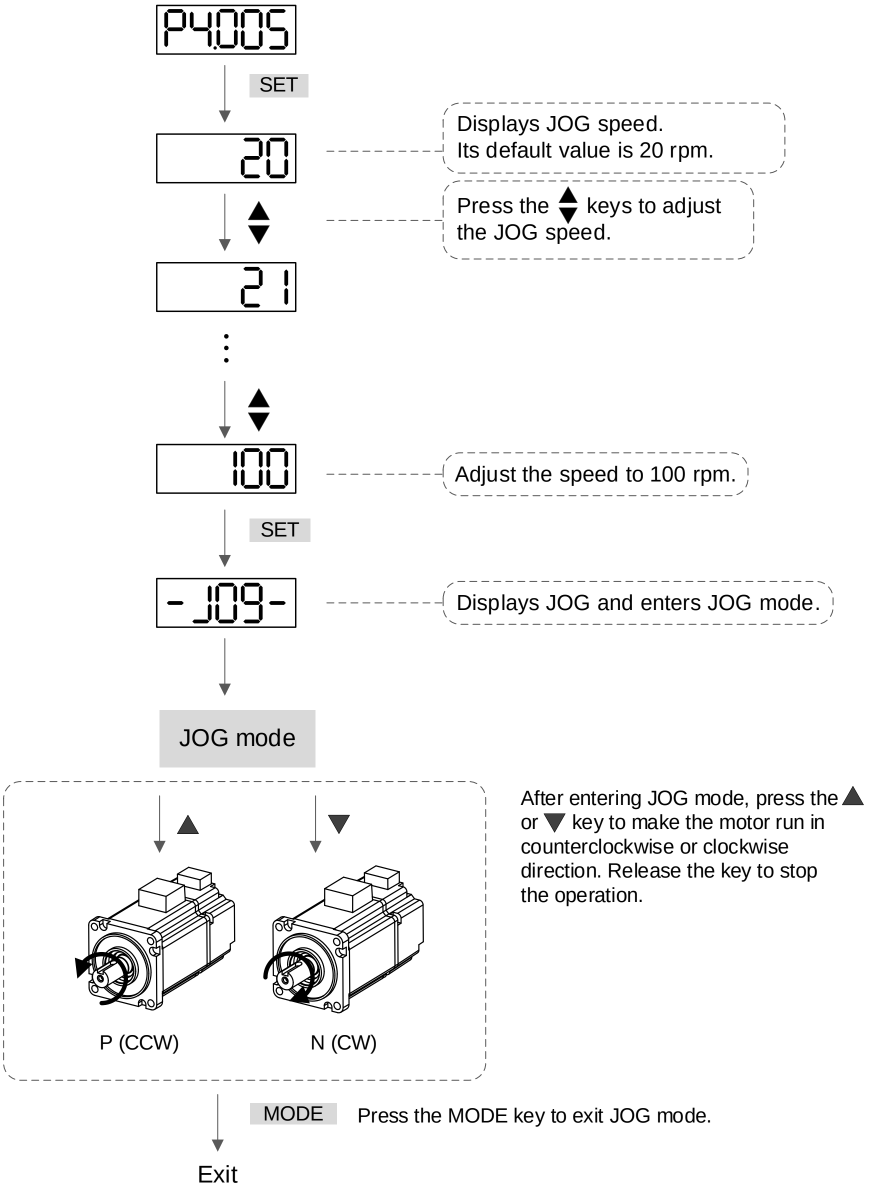
Step 1: JOG trial run is available only when the servo drive is in the Servo On state. The drive can be forced into the Servo On state by setting P2.030 to 1 or with the controller. JOG trial run with panel operation is not available in the Communication mode (P1.001.X = C).

Step 2: set the JOG speed (unit: rpm) with P4.005. Press the SET key to display the JOG speed. The default 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 MODE key to exit JOG mode after completing the trial run.



Displays JOG speed.
Its default value is 20 rpm.

Press the ▲▼ keys to adjust the JOG speed.

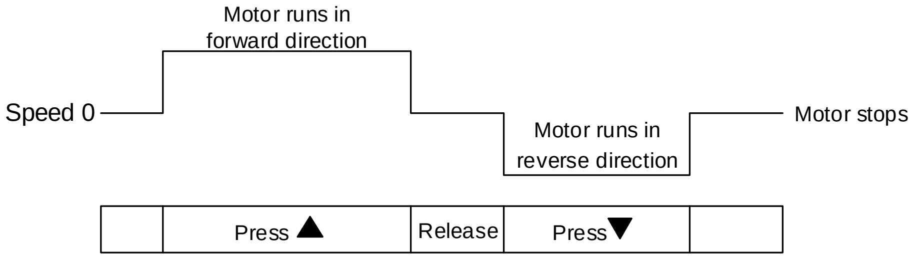
Adjust the speed to 100 rpm.

Displays JOG and enters JOG mode.

After entering JOG mode, press the ▲ or ▼ key to make the motor run in counterclockwise or clockwise direction. Release the key to stop the operation.

Press the MODE key to exit JOG mode.

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 U, V, W phase sequence is correct.

4.5.4 Trial run without load (Speed mode)

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

Step 1: set P1.001.YX to 02 to set the control mode of the servo drive to Speed mode. Then cycle the power to the servo drive.

Step 2: in Speed 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- = 9
DI2	P2.011 = 0x0109	TRQLM	Torque limit	DI2- = 10
DI3	P2.012 = 0x0114	SPD0	Speed selection 0	DI3- = 34
DI4	P2.013 = 0x0115	SPD1	Speed selection 1	DI4- = 8
DI5	P2.014 = 0x0102	ARST	Alarm reset	DI5- = 33
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	-

The preceding settings take the -L model for example. 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 the power to 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	Range
	SPD1	SPD0					
S1	0	0	Mode	S	External analog signal	Voltage difference between V-REF and GND	-10V to +10V
				Sz	N/A	Speed command is 0	0
S2	0	1	Internal register parameter			P1.009	+/- 7500 rpm
S3	1	0				P1.010	+/- 7500 rpm
S4	1	1				P1.011	+/- 7500 rpm

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

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

The parameter setting range of the internal register is from -75000 to +75000.

Rotation speed = 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 running direction:

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

Step 3:

(a) Switch on DI1 to have the drive be in the Servo On state.

(b) When both DI3 (SPD0) and DI4 (SPD1) are off, that means the drive executes the S1 command. The motor rotates according to the analog voltage command.

(c) When DI3 (SPD0) is on, that means the drive executes the S2 command. The rotation speed is +3000 rpm.

(d) When DI4 (SPD1) is on, that means the drive executes the S3 command. The rotation speed is +100 rpm.

(e) When both DI3 (SPD0) and DI4 (SPD1) are on, that means the drive executes the S4 command. The rotation speed is -3000 rpm.

(f) You can repeatedly execute steps (c), (d), and (e).

(g) If you want to stop the motor, switch off DI1 (Servo Off).

4.5.5 Trial run without load (Position mode)

⚠ **You cannot perform this trial run for E3-L models which do not support PR mode.**

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

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

Step 2: in Position (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	-

The preceding settings take the -E model for example. 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 the power to the servo drive or set DI5 to On to clear the alarm. Refer to Section 4.5.2.

Refer to Section 3.8.3 for the wiring for Position (PR) control mode. 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#1	0	0	0	0	0	0	1	↑	P6.002
									P6.003
…									…
PR#50	0	1	1	0	0	1	0	↑	P6.098
									P6.099
PR#51	0	1	1	0	0	1	1	↑	P7.000
									P7.001
…									…
PR#99	1	1	0	0	0	1	1	↑	P7.098
									P7.099

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.

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Tuning

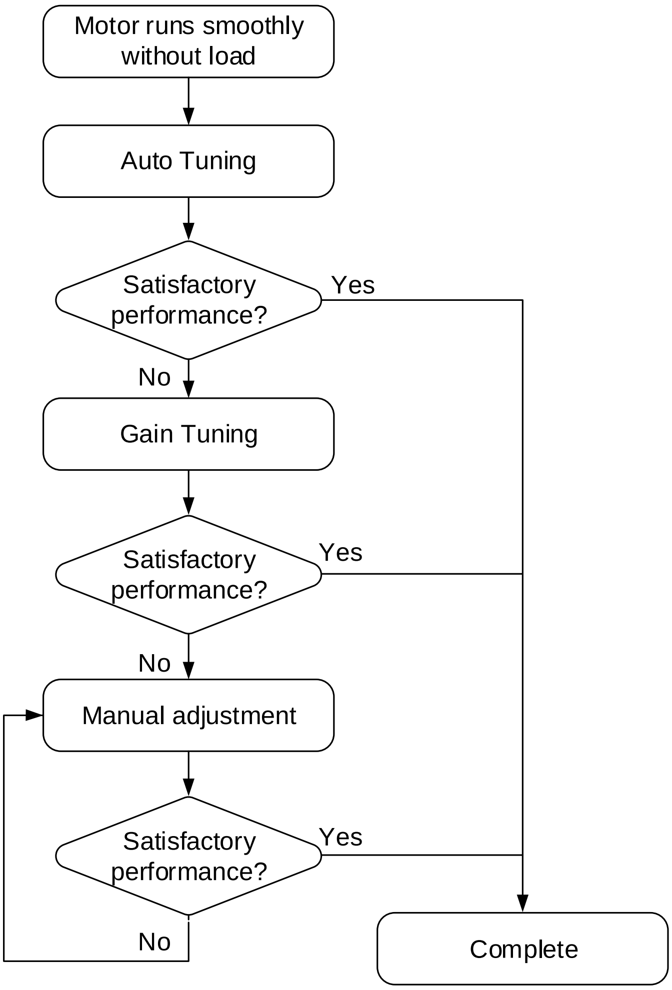
5

This chapter contains information about Auto tuning and gain adjustment modes. Advanced users can also tune the servo system in Manual mode.

5.1 Tuning procedure and modes

5.1.1 Flowchart of the tuning procedure

You can tune the servo drive by following this flowchart. First, start from **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	Adjustment mode	Inertia estimation	Parameter	
			Manual	Auto
0	Manual	Fixed set value of P1.037	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102	N/A
1	Gain adjustment mode 1	Real-time estimation	P2.031	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102
2	Gain adjustment mode 2	Fixed set value of P1.037	P1.037 P2.031	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102
3[*2]	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 = 1 for the 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 = 2 for the 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:

1. For more information about the parameter functions, refer to the tables in Section 5.2.
2. E3-L models do not support Gain adjustment mode 3.

5.2 Auto tuning

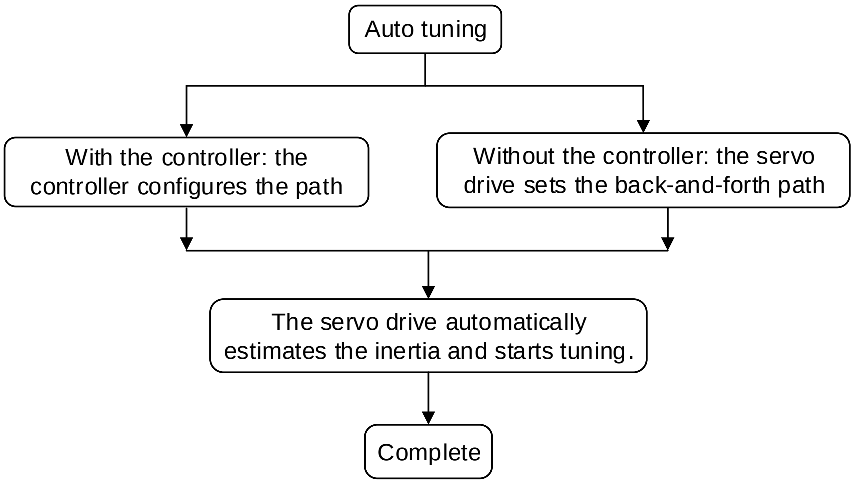
The auto tuning function enables the system to perform real-time machine inertia estimation and downloads the optimized parameters to the servo drive. You can start auto tuning with ASDA-Soft (software) or through the drive panel. The following tables list the parameters that change according to the 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 control gain	P2.032	Gain adjustment mode
P2.002	Position feed forward gain	P2.089	Command response gain
P2.004	Speed control 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	-	-

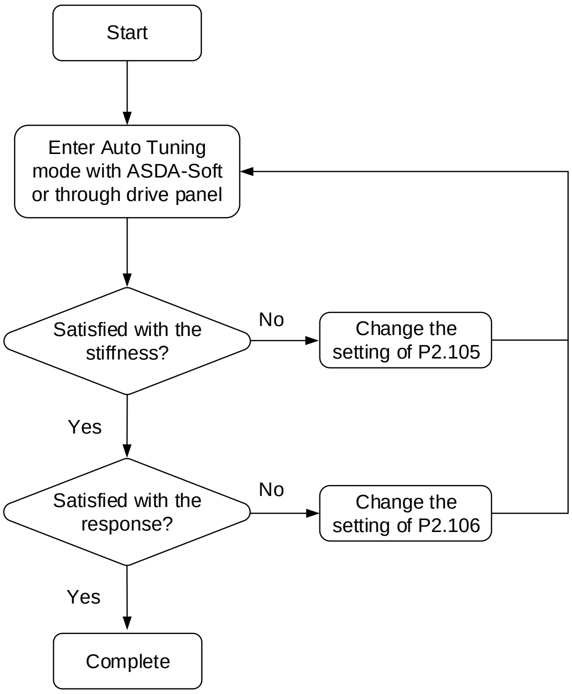
5.2.1 Flowchart of auto tuning

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 delay time is added to the operation cycle. Otherwise, an alarm occurs and the servo drive cannot complete auto tuning.

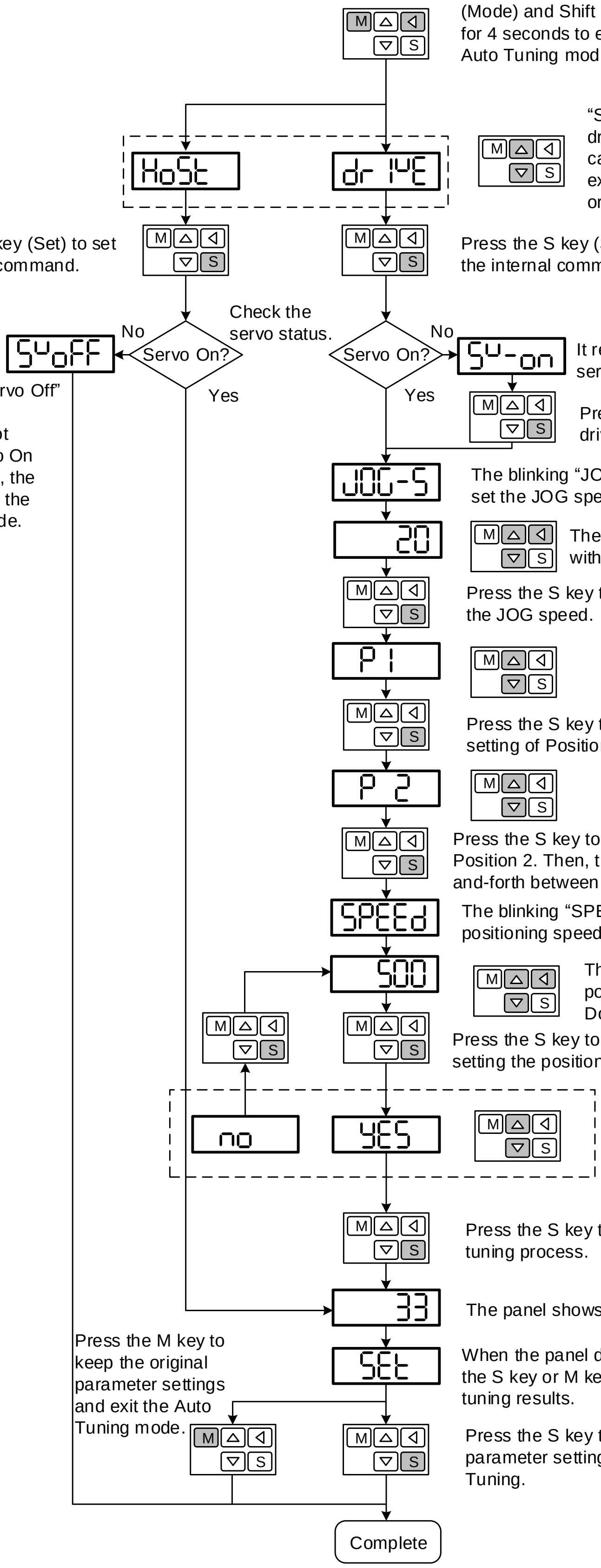
You can use P2.105 and P2.106 to adjust the stiffness and response during the auto tuning process. See the following flowchart.



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 positive and negative limit switches work properly before you start to tune the system.

Flowchart of auto tuning



Press and hold the M key (Mode) and Shift key (◁) for 4 seconds to enter the Auto Tuning mode.

“S-Cmd” displayed on the drive panel is blinking. You can select the internal or external command with the Up or Down key.

Press the S key (Set) to set the external command.

Press the S key (Set) to set the internal command.

Check the servo status.

It reminds you to change the servo status to Servo On.

Press the S key to set the drive to Servo On.

The blinking “Servo Off” reminds you the controller has not issued the Servo On command. Then, the servo drive exits the Auto Tuning mode.

The blinking “JOG-S” reminds you to set the JOG speed.

Then, you can set the JOG speed with the Up, Down, and Shift keys.

Press the S key to complete setting the JOG speed.

Press the Up and Down keys to set Position 1.

Press the S key to complete the setting of Position 1.

Press the Up, Down, and S keys to set Position 2.

Press the S key to complete the setting of Position 2. Then, the motor starts moving back-and-forth between the two positioning points.

The blinking “SPEED” reminds you to adjust the positioning speed.

Then, you can set the positioning speed with the Up, Down, and Shift keys.

Press the S key to complete setting the positioning speed.

Press the Up and Down keys to select YES or NO. Select “YES” to complete the setting. Select “NO” to keep adjusting the speed.

Press the S key to continue the tuning process.

The panel shows the progress in percentage.

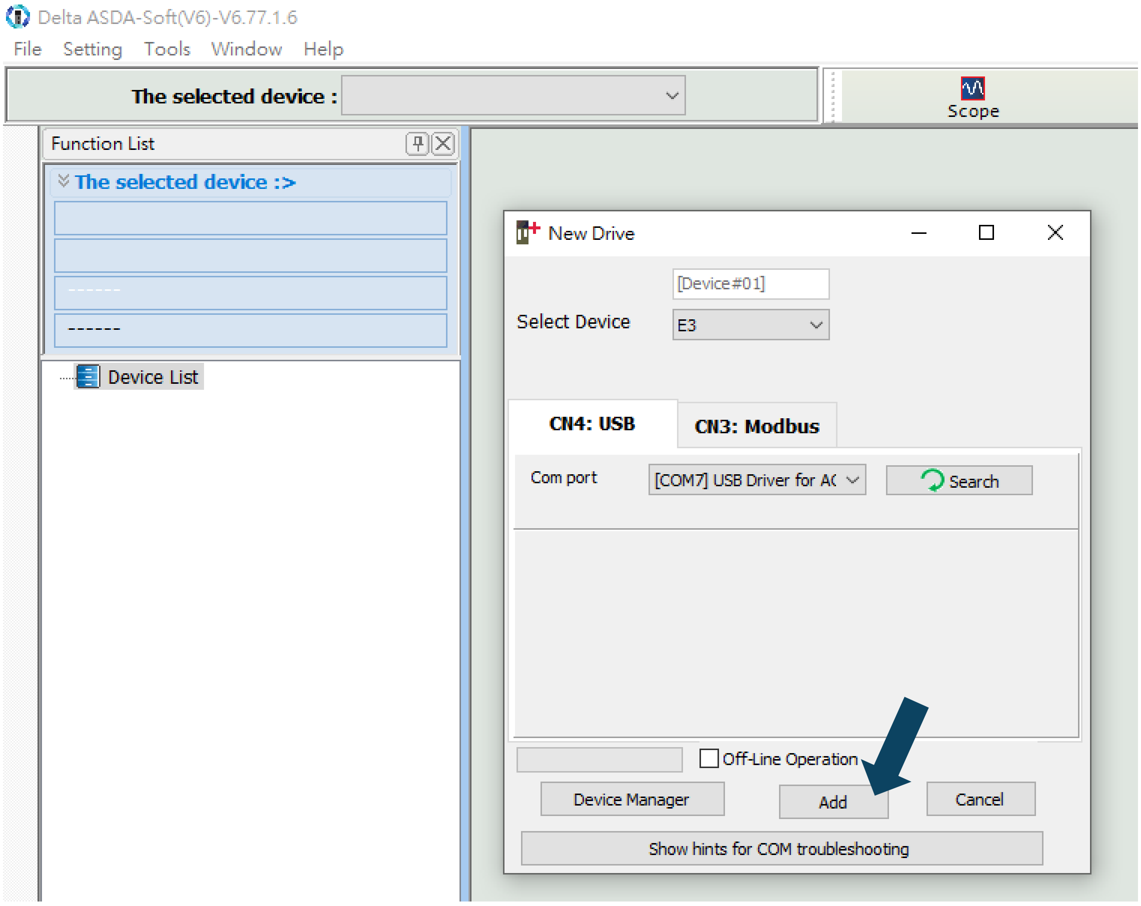
When the panel displays “Set”, you can press the S key or M key to keep or discard the tuning results.

Press the M key to keep the original parameter settings and exit the Auto Tuning mode.

Press the S key to adopt the parameter settings after Auto Tuning.

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.



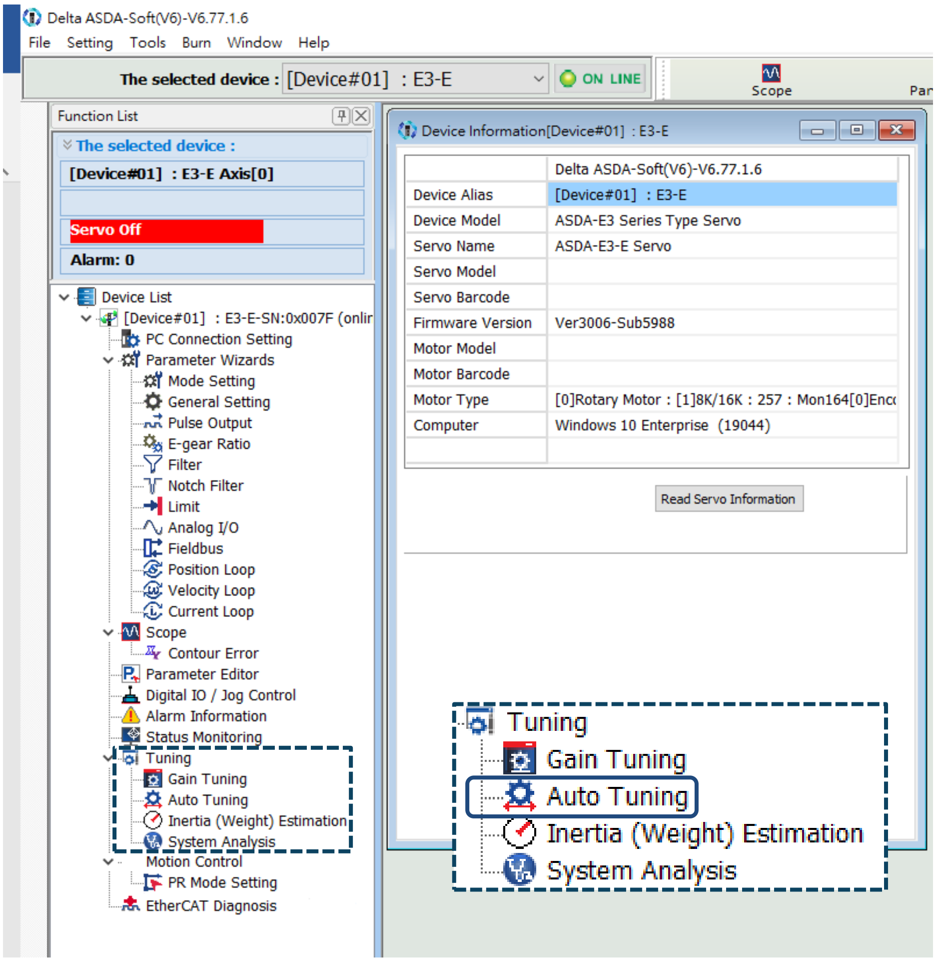
Make sure your servo drive, servo motor, and power are all properly connected. Then click **Add** for the ASDA-Soft to be in online mode.

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.



The selected device : [Device#01] : E3-E

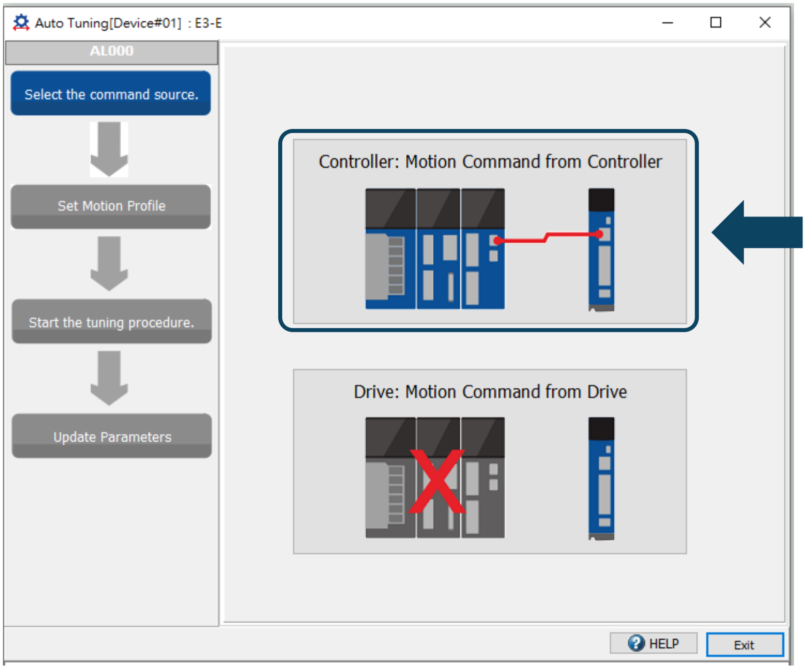
The selected device :
[Device#01] : E3-E Axis[0]
Servo Off
Alarm: 0

Device Information[Device#01] : E3-E

	Delta ASDA-Soft(V6)-V6.77.1.6
Device Alias	[Device#01] : E3-E
Device Model	ASDA-E3 Series Type Servo
Servo Name	ASDA-E3-E Servo
Servo Model	
Servo Barcode	
Firmware Version	Ver3006-Sub5988
Motor Model	
Motor Barcode	
Motor Type	[0]Rotary Motor : [1]8K/16K : 257 : Mon164[0]Enc
Computer	Windows 10 Enterprise (19044)

Step 2:

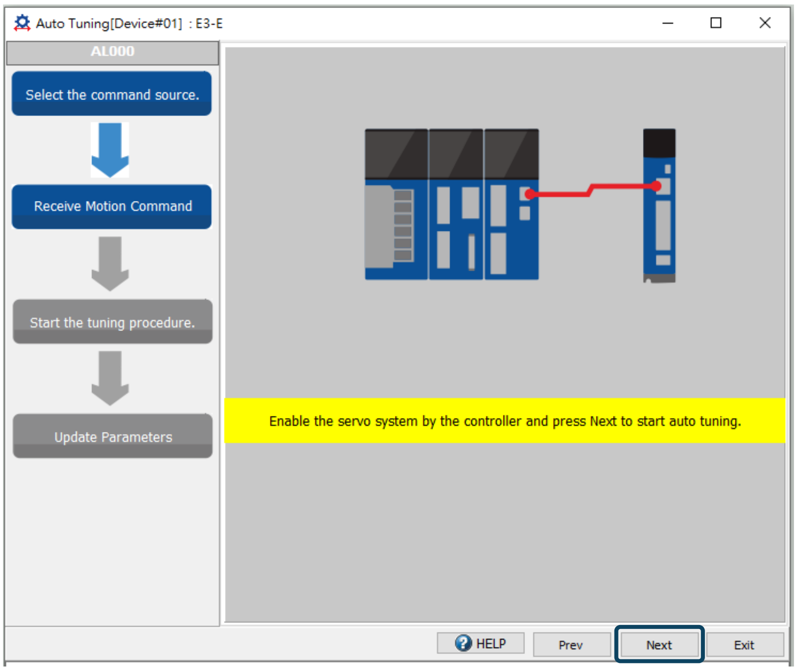
Click **Controller: Motion Command from Controller** and check for the motion / machining path.



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

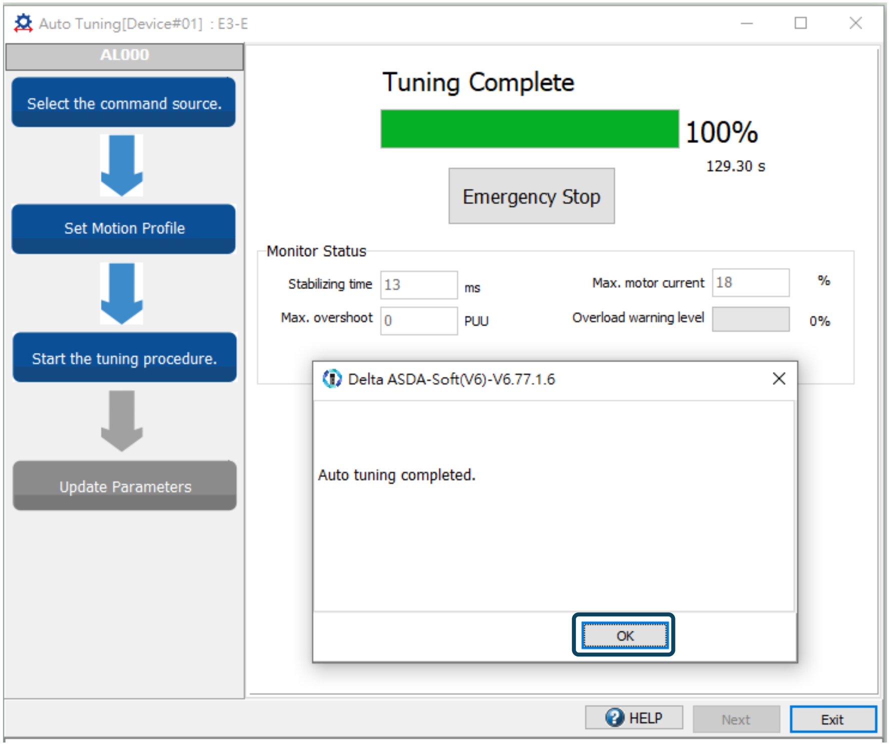
Step 3:

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



Enable the servo system by the controller and press Next to start auto tuning.

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



Tuning Complete

100%

129.30 s

Monitor Status

Stabilizing time 13 ms

Max. overshoot 0 PUU

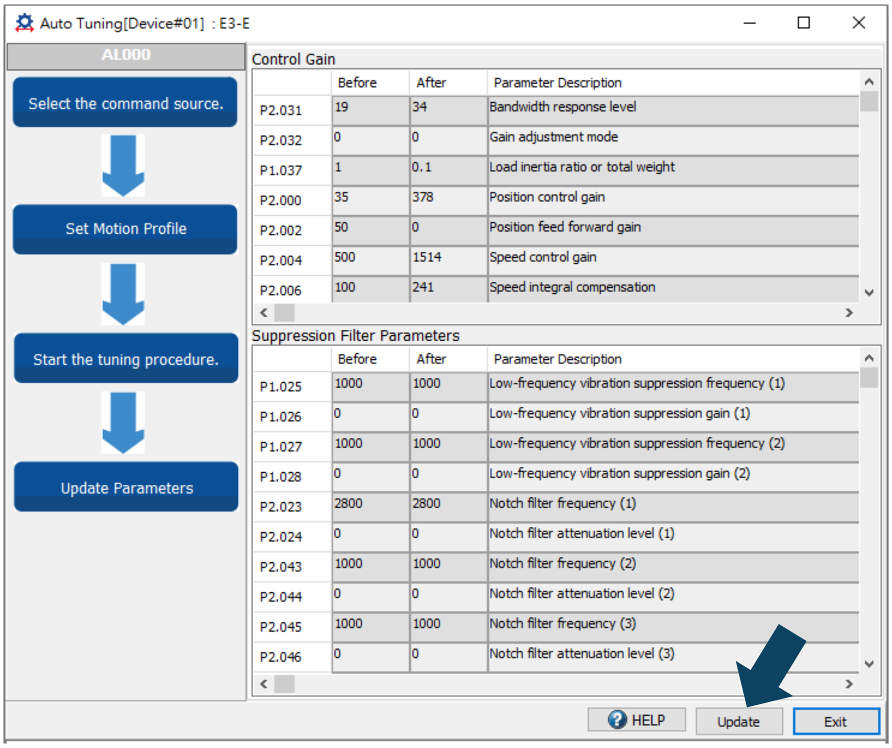
Max. motor current 18 %

Overload warning level 0%

Delta ASDA-Soft(V6)-V6.77.1.6

Auto tuning completed.

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



Control Gain

	Before	After	Parameter Description
P2.031	19	34	Bandwidth response level
P2.032	0	0	Gain adjustment mode
P1.037	1	0.1	Load inertia ratio or total weight
P2.000	35	378	Position control gain
P2.002	50	0	Position feed forward gain
P2.004	500	1514	Speed control gain
P2.006	100	241	Speed integral compensation

Suppression Filter Parameters

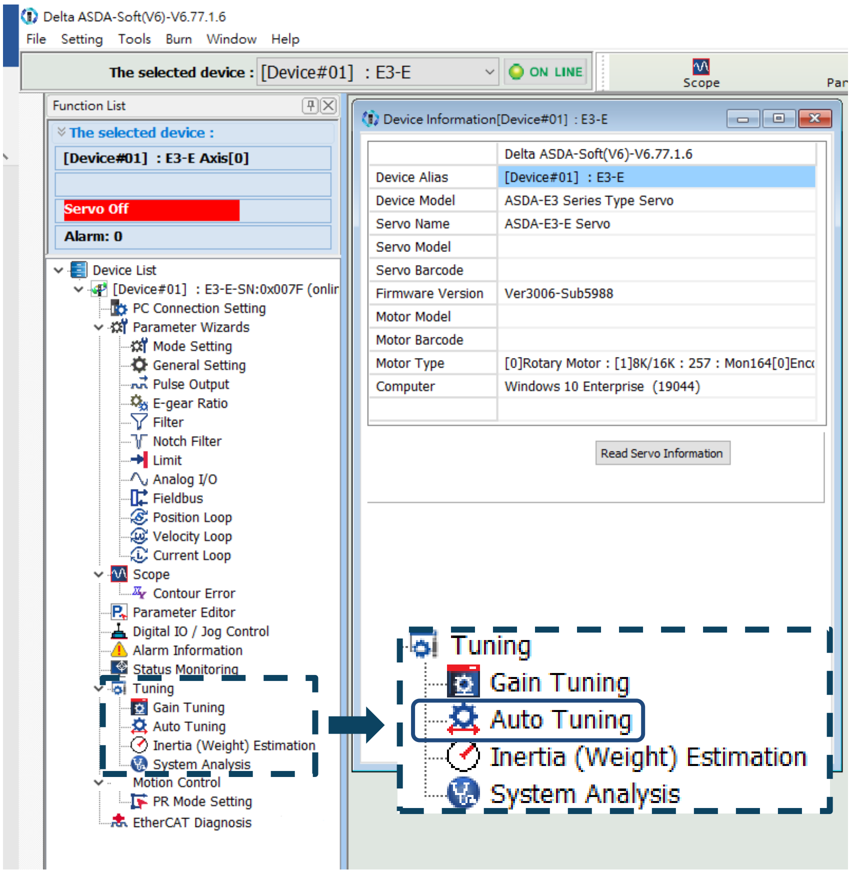
	Before	After	Parameter Description
P1.025	1000	1000	Low-frequency vibration suppression frequency (1)
P1.026	0	0	Low-frequency vibration suppression gain (1)
P1.027	1000	1000	Low-frequency vibration suppression frequency (2)
P1.028	0	0	Low-frequency vibration suppression gain (2)
P2.023	2800	2800	Notch filter frequency (1)
P2.024	0	0	Notch filter attenuation level (1)
P2.043	1000	1000	Notch filter frequency (2)
P2.044	0	0	Notch filter attenuation level (2)
P2.045	1000	1000	Notch filter frequency (3)
P2.046	0	0	Notch filter attenuation level (3)

Click **Update** to complete auto tuning.

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

Step 1:

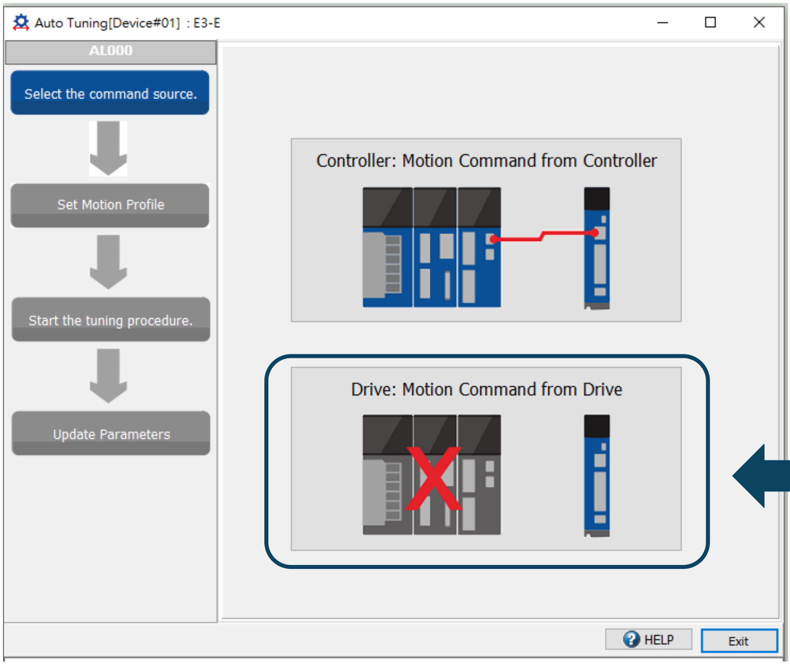
When ASDA-Soft is in online mode, the program window appears as follows. Click **Auto Tuning** in the Function List tree view.



	Delta ASDA-Soft(V6)-V6.77.1.6
Device Alias	[Device#01] : E3-E
Device Model	ASDA-E3 Series Type Servo
Servo Name	ASDA-E3-E Servo
Servo Model	
Servo Barcode	
Firmware Version	Ver3006-Sub5988
Motor Model	
Motor Barcode	
Motor Type	[0]Rotary Motor : [1]8K/16K : 257 : Mon164[0]Enc
Computer	Windows 10 Enterprise (19044)

Step 2:

Click **Drive: Motion Command from Drive** to enter the path setting screen.



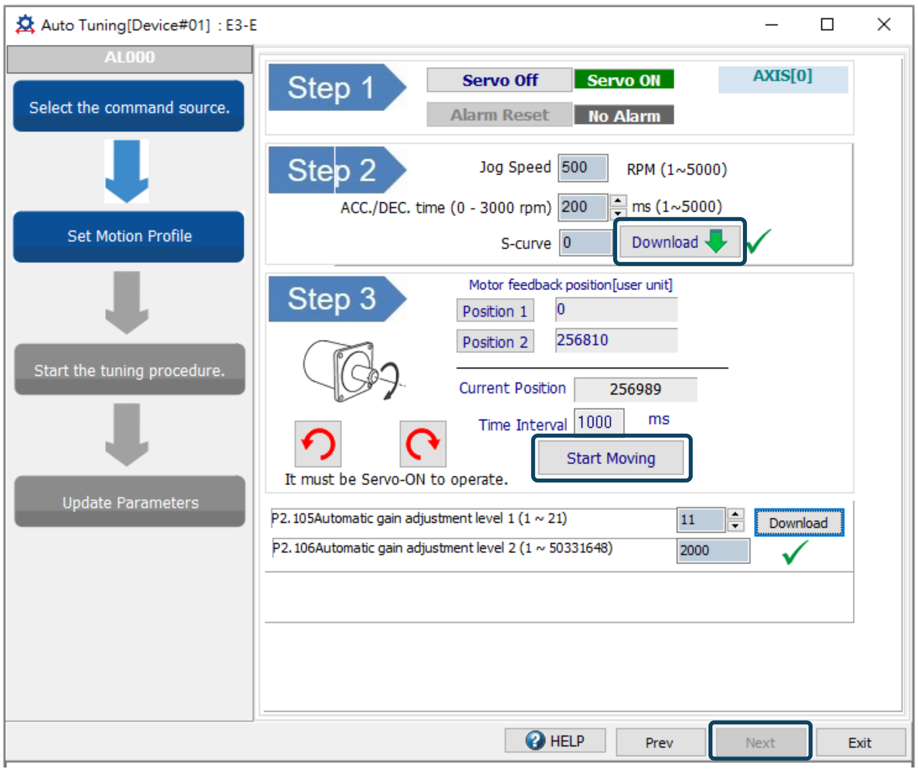
Follow these steps to set the motor running path:

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 500 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 the forward and reverse directions.

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



Jog Speed 500 RPM (1~5000)

ACC./DEC. time (0 - 3000 rpm) 200 ms (1~5000)

S-curve 0

Motor feedback position[user unit]

Position 1 0

Position 2 256810

Current Position 256989

Time Interval 1000 ms

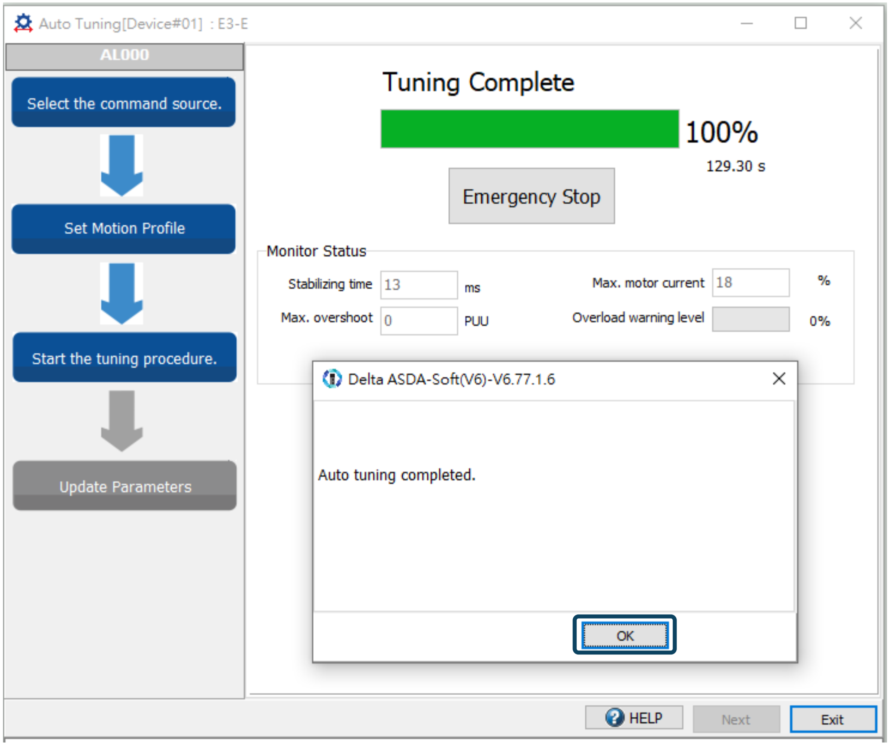
It must be Servo-ON to operate.

P2.105Automatic gain adjustment level 1 (1 ~ 21) 11

P2.106Automatic gain adjustment level 2 (1 ~ 50331648) 2000

Step 3:

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



Tuning Complete

100%

129.30 s

Monitor Status

Stabilizing time 13 ms

Max. motor current 18 %

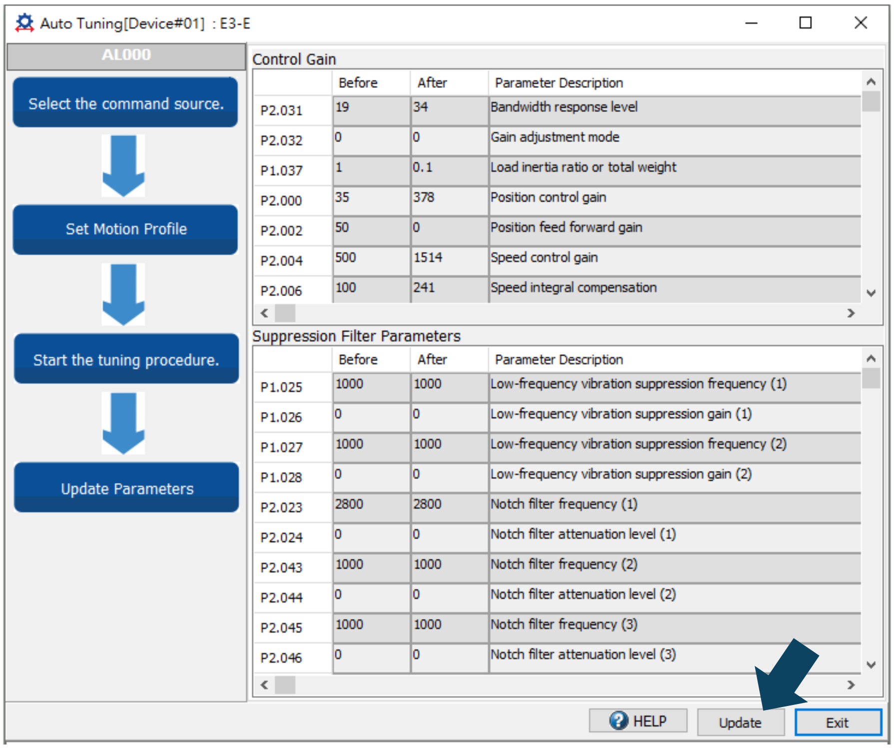
Max. overshoot 0 PUU

Overload warning level 0%

Delta ASDA-Soft(V6)-V6.77.1.6

Auto tuning completed.

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



Control Gain

	Before	After	Parameter Description
P2.031	19	34	Bandwidth response level
P2.032	0	0	Gain adjustment mode
P1.037	1	0.1	Load inertia ratio or total weight
P2.000	35	378	Position control gain
P2.002	50	0	Position feed forward gain
P2.004	500	1514	Speed control gain
P2.006	100	241	Speed integral compensation

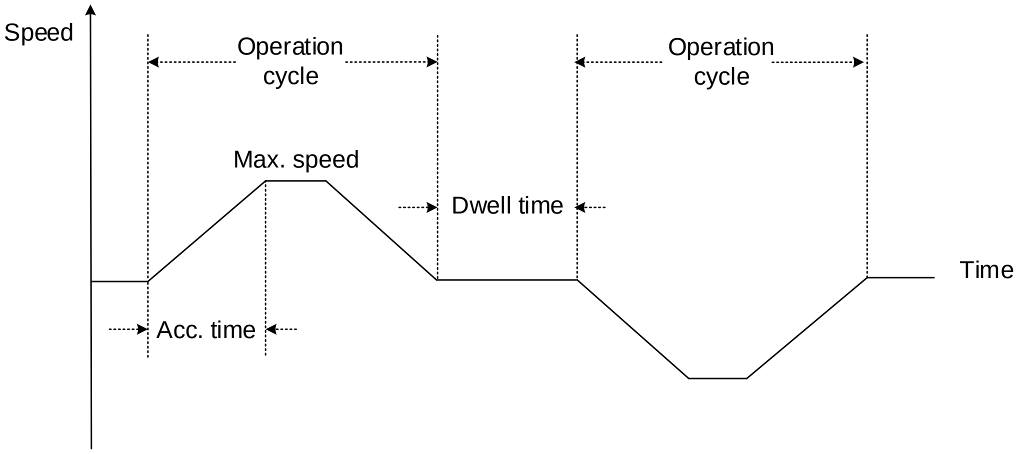
Suppression Filter Parameters

	Before	After	Parameter Description
P1.025	1000	1000	Low-frequency vibration suppression frequency (1)
P1.026	0	0	Low-frequency vibration suppression gain (1)
P1.027	1000	1000	Low-frequency vibration suppression frequency (2)
P1.028	0	0	Low-frequency vibration suppression gain (2)
P2.023	2800	2800	Notch filter frequency (1)
P2.024	0	0	Notch filter attenuation level (1)
P2.043	1000	1000	Notch filter frequency (2)
P2.044	0	0	Notch filter attenuation level (2)
P2.045	1000	1000	Notch filter frequency (3)
P2.046	0	0	Notch filter attenuation level (3)

Click **Update** to complete auto tuning.

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 acceleration, constant speed, and deceleration) 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. Check the alarm causes and take corrective actions.

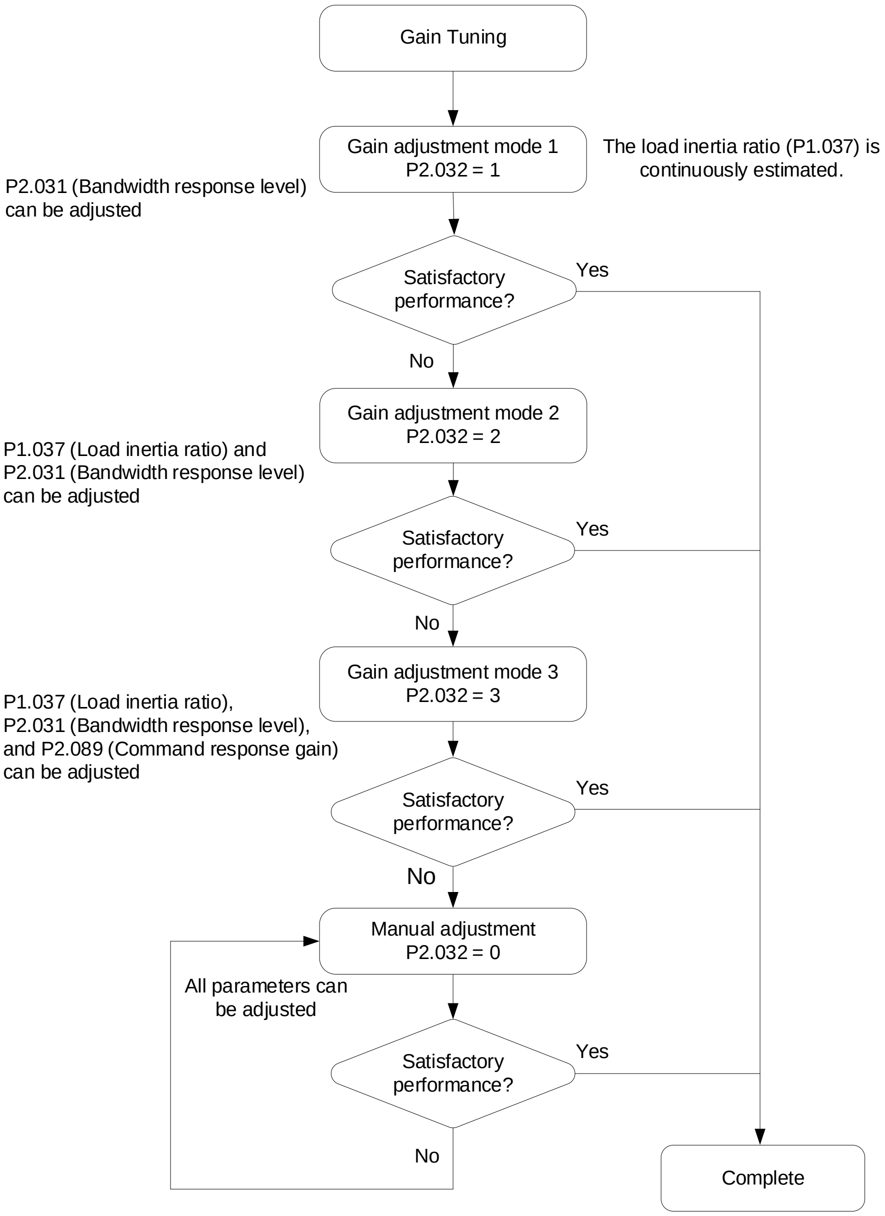


Alarm	Alarm name
AL08A	Auto tuning function - command error
AL08B	Auto tuning function - dwell time is too short
AL08C	Auto tuning function - inertia estimation error

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). Follow the tuning procedure in Section 5.1.1.

5.3.1 Flowchart of gain adjustment mode



5.3.2 Gain adjustment mode 1

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

P2.032 value	Adjustment 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 Gain adjustment mode 1 cannot meet the requirements, 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	Adjustment 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 parameter value too high, it might cause position overshoot and machinery 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. However, 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.

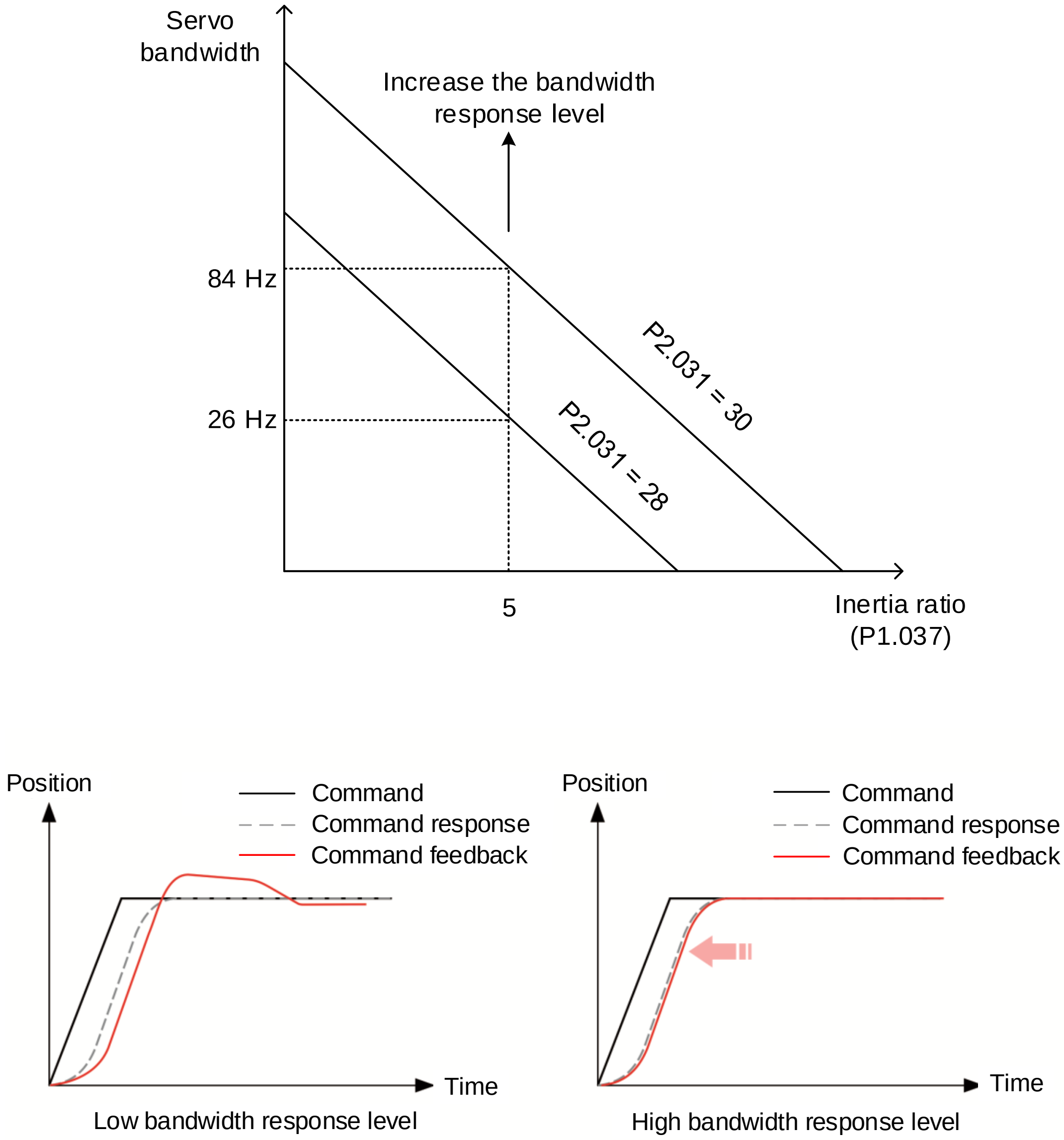
Note: E3-L models do not support this mode.

P2.032 value	Adjustment 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

5.3.5 Parameters related to gain adjustment modes

5.3.5.1 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.



Low bandwidth response level

High bandwidth response level

Figure 5.3.5.1.1 Adjust the bandwidth response level

5.3.5.2 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.

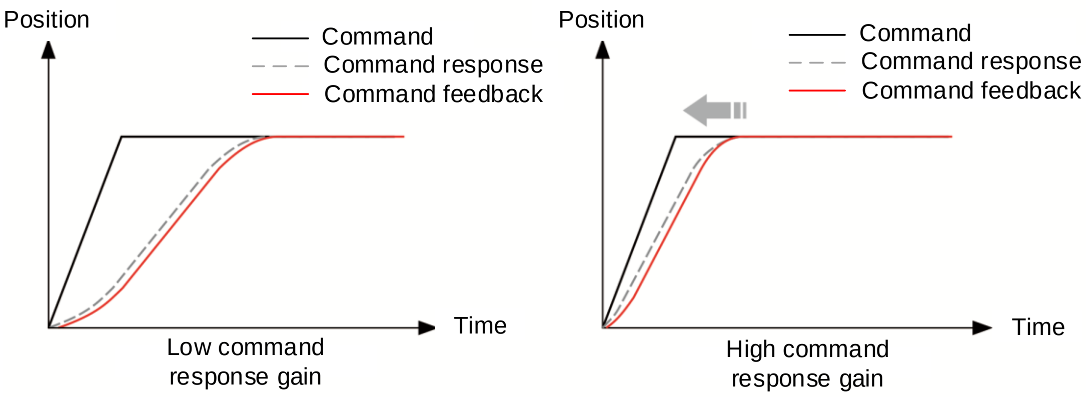


Figure 5.3.5.2.1 Adjust the command response gain

5.4 Manual tuning of gain parameters

The response bandwidth of the position or speed loop 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, machinery with higher stiffness is used to solve this problem. When the response bandwidth of the machine is unknown, you can gradually increase the gain parameter values to increase the response bandwidth. Then, decrease the gain parameter values until you hear the sound of the resonance. The following are the descriptions of the gain adjustment parameters.

- Position control gain (KPP, P2.000)

  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:

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

- Speed control gain (KVP, P2.004)

  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:

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

  JM: motor inertia; JL: load inertia

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

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

- Speed integral compensation (KVI, P2.006)

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

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

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

  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 might 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:

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

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

  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.

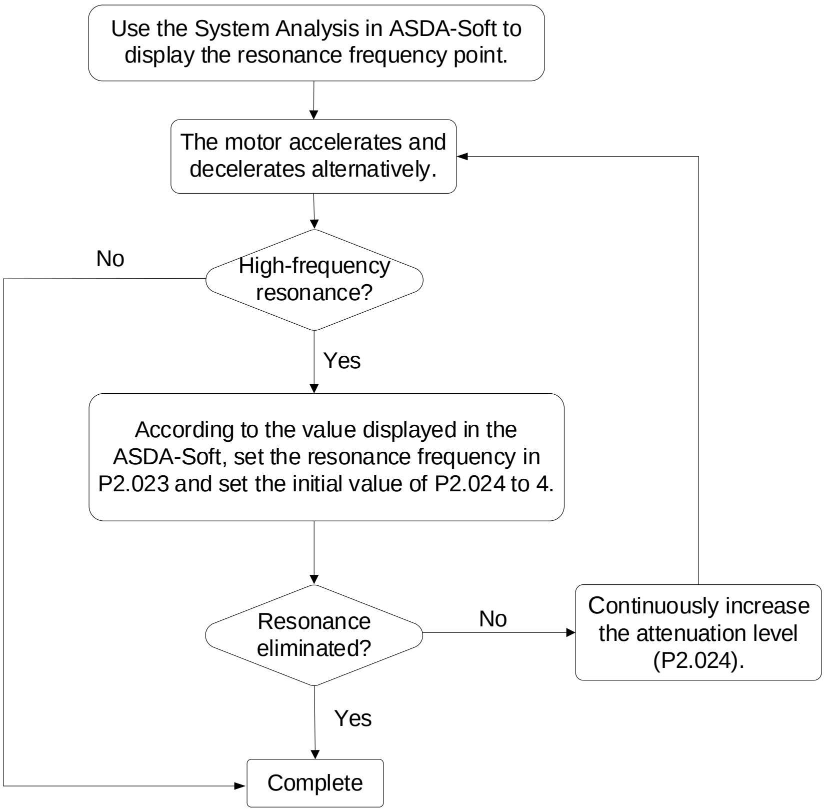
- Position feed forward gain (PFG, P2.002)

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

5.5 Mechanical resonance suppression

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 (P2.047). In addition, you can suppress the resonance manually.

Flowchart of manual resonance suppression:



Control Mode

6

This chapter describes the control structure of each mode, including the use of gain adjustment and filters. For Position mode, you use the external pulse and commands from the internal registers. For Speed mode and Torque mode, apart from the commands from the internal registers, you can also control the servo drive by the analog voltage input. In addition to the single modes, dual modes and multi-modes are also available for meeting the application requirements.

6.1 Selecting the control mode

This servo drive provides three basic control modes, Position, Speed, and Torque, and one communication mode. For the basic control mode, you can choose from single mode, dual mode, and multi-mode. The following table lists all the available modes and corresponding descriptions.

Mode		Short name	Code	Description
Single mode	Position mode (Terminal block input)	PT	00	The servo drive receives the Position command and commands the motor to run to the target position. The Position commands are pulse signals input from the external terminal block.
	Position mode (Internal register)	PR	01	The servo drive receives the Position command and commands the motor to run 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	The servo drive receives the Speed command and commands the motor to run at the target speed. The Speed commands are issued from the internal registers (3 sets in total) or by the analog voltage (-10V to +10V) input from the external terminal block. Select the command with DI signals.
	Speed mode (No analog input)	Sz	04	The servo drive receives the Speed command and commands the motor to run at the target speed. The Speed command can only be issued from the internal registers (3 sets in total) instead of through the external terminal block. Select the command with DI signals.
	Torque mode	T	03	The servo drive receives the Torque command and commands the motor to run with the target torque. The Torque commands are issued from the internal registers (3 sets in total) or by the analog voltage (-10V to +10V) input from the external terminal block. Select the command with DI signals.
	Torque mode (No analog input)	Tz	05	The servo drive receives the Torque command and commands the motor to run with the target torque. The Torque command can only be issued from the internal registers (3 sets in total) instead of through the external terminal block. Select the command with DI signals.
Dual mode		PT-S	06	Switch between PT and S modes with DI signal.
		PT-T	07	Switch between PT and T modes with DI signal.
		PR-S	08	Switch between PR and S modes with DI signal.
		PR-T	09	Switch between PR and T modes with DI signal.
		S-T	0A	Switch between S and T modes with DI signal.
		PT-PR	0D	Switch between PT and PR modes with DI signal.
Communication mode		EtherCAT	0C	EtherCAT mode.
Multi-mode		PT-PR-S	0E	Switch between PT, PR, and S modes with DI signals.
		PT-PR-T	0F	Switch between PT, PR, and T modes with DI signals.

Here are the steps to switch the control modes:

1. Switch the servo drive to Servo Off status. 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 the parameter, cycle the power to 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 servo drive can receive two types of position control commands: external pulse (PT mode) and internal register (PR mode). In PT mode, the servo drive receives the pulse command for the moving direction (motor runs forward or reverse). You can control the rotation angle of the motor with the input pulse. The servo drive can receive pulse commands of up to 4 Mpps.

The internal register (PR mode) allows you to accomplish position control without the external pulse command. The servo drive provides 100 command registers. Set the required registers before switching the drive to Servo On status. 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 PT mode

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

Parameter	Function
P1.000	External pulse input type

6.2.2 Position command in PR mode

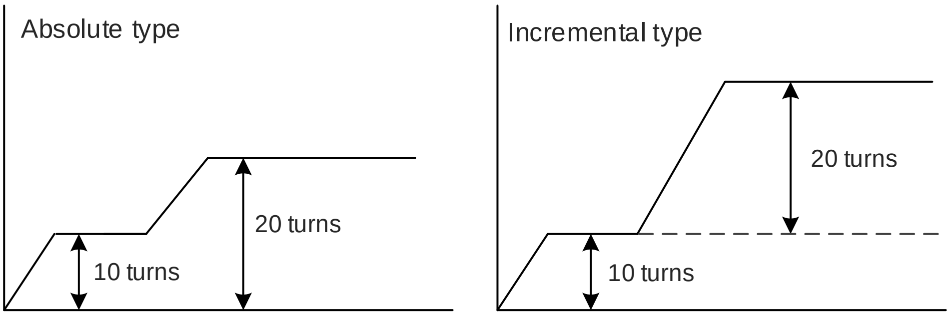
The PR command source is the 100 sets of internal command registers (P6.000 - P7.099). Use DI.POS0 - DI.POS6 (0x11, 0x12, 0x13, 0x1A, 0x1B, 0x1C, 0x1E) of CN1 to select one of the 100 sets as the Position command and then trigger the command with DI.CTRG (0x08). See the following table for more details.

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#1	0	0	0	0	0	0	1	↑	P6.002 P6.003
…									…
PR#50	0	1	1	0	0	1	0	↑	P6.098 P6.099
PR#51	0	1	1	0	0	1	1	↑	P7.000 P7.001
…									…
PR#99	1	1	0	0	0	1	1	↑	P7.098 P7.099

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

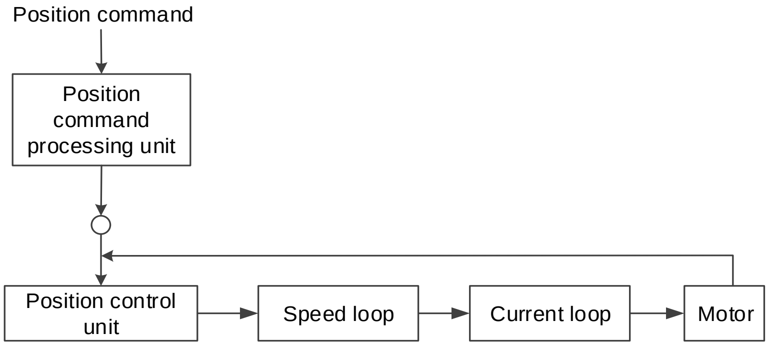
CTRG ↑: this indicates the moment the DI is switched from off to on.

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#1 is 10 turns and PR#2 is 20 turns, when PR#1 is issued first and PR#2 comes second, the difference between absolute and incremental positioning is shown in the following diagrams.

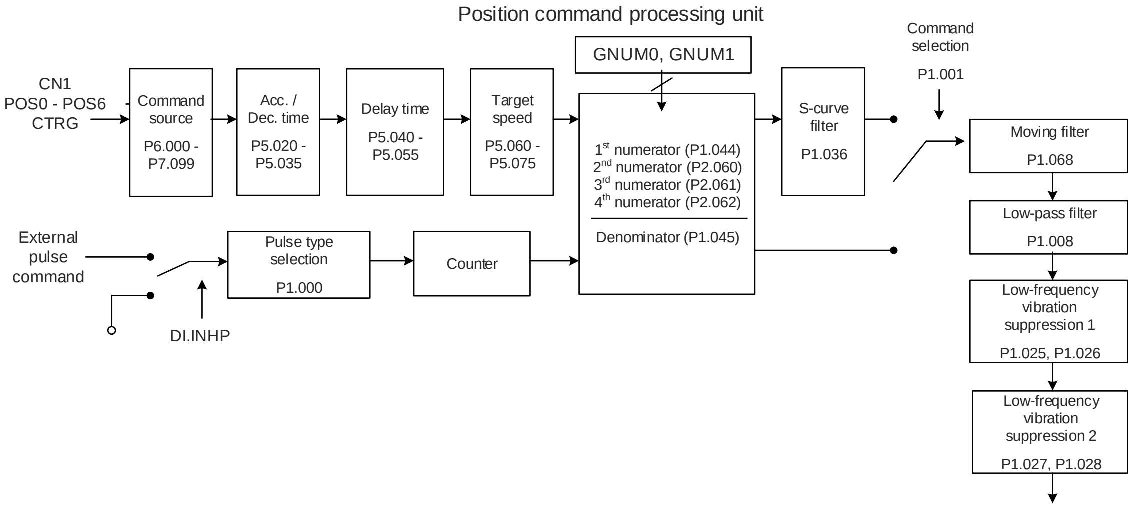


6.2.3 Control structure of Position mode

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



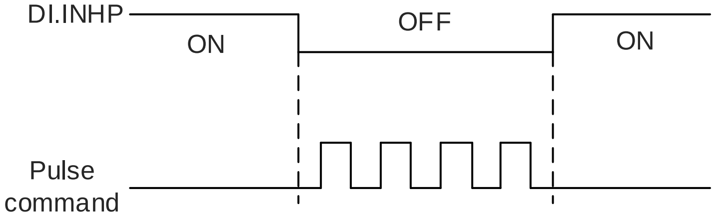
For better control, the pulse signals are processed by the Position command processing unit. The structure is shown in the following diagram.



In the diagram, the upper path is the PR mode and the lower one is the PT mode, which you can select with P1.001. You can set the E-Gear ratio in both modes to adjust the positioning resolution. In addition, you can use either a moving filter or low-pass filter to smooth the command. Refer to the following sections for more details.

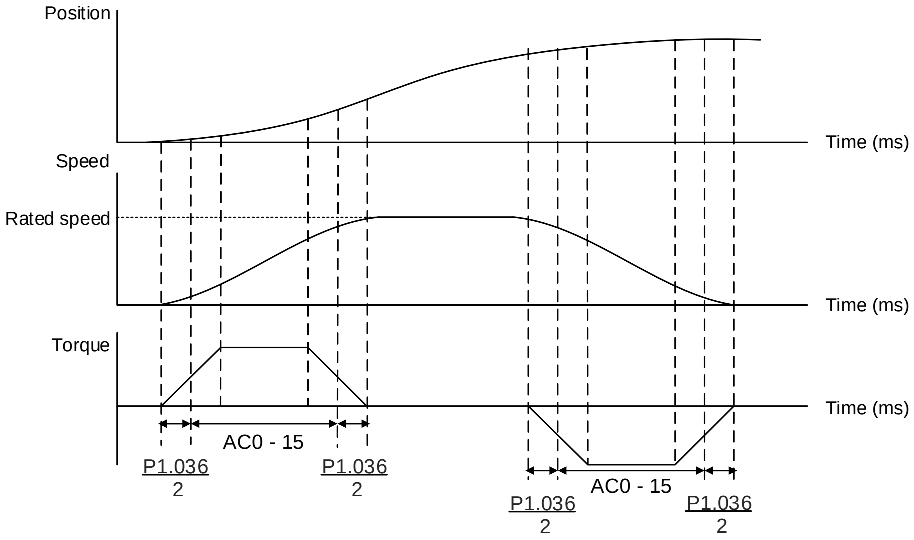
The Pulse Command Input Inhibit (INHP) function

In PT mode, when DI.INHP is on, the servo drive stops receiving external pulse commands and the motor stops running. As this function is only supported by P2.017 (DI8 functional planning), setting P2.017 to 0x45 (DI.INHP) is required.

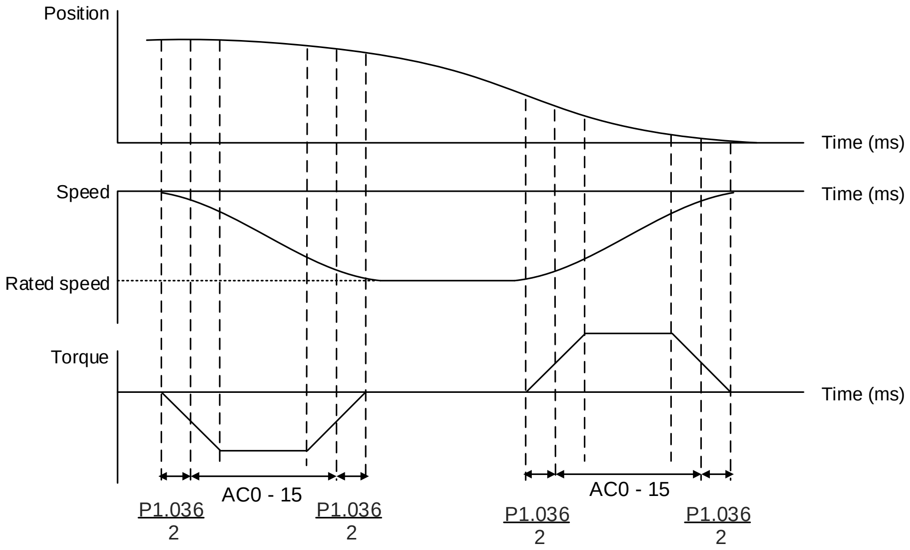


6.2.4 S-curve filter for Position commands

The S-curve filter for Position commands smoothes the motion command in PR mode. The filter makes the speed and acceleration continuous and reduces jerking, resulting in a smoother mechanical operation. If the load inertia increases, the motor operation is affected by friction and inertia generated when the motor starts or stops rotating. Setting a larger acceleration / deceleration smoothing constant for the S-curve (P1.036) and the acceleration / deceleration time in P5.020 - P5.035 can increase the smoothness of operation. When the Position command source is the pulse input, the speed and angular acceleration are continuous, so the S-curve command filter is not necessary.



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)

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

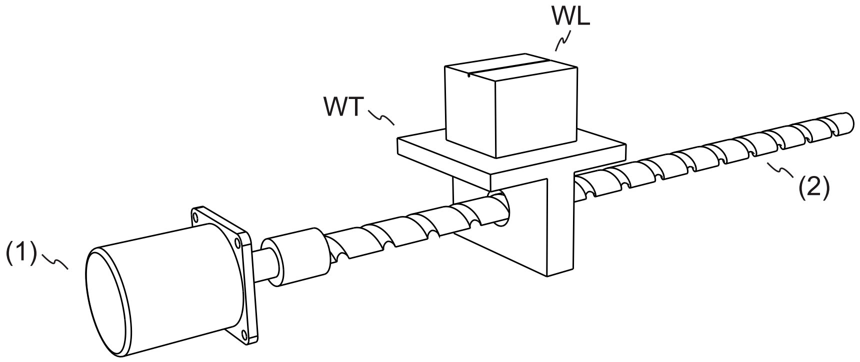
Parameter	Function
P1.036	S-curve acceleration / deceleration smoothing constant
P5.020 - P5.035	Acceleration / deceleration times (#0 - 15)

6.2.5 Electronic gear ratio (E-Gear ratio)

The electronic gear 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 22-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 command filter or a low-pass filter.

For example, if the 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.



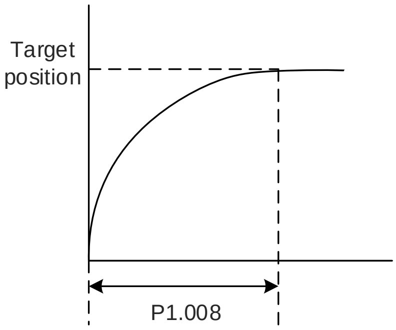
(1) Motor; (2) Ball screw pitch: 3 mm (equals 3,000 μm); WL: workpiece; WT: platform

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

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

Parameter	Function
P1.044	E-Gear ratio - numerator N1
P1.045	E-Gear ratio - denominator M

6.2.6 Low-pass filter

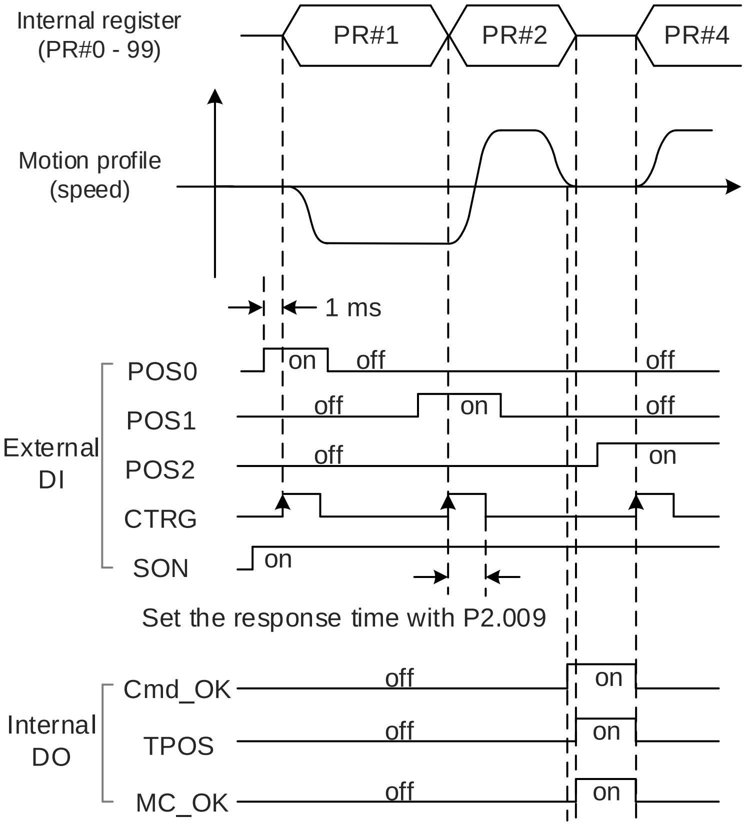


Refer to Chapter 8 for detailed descriptions of the relevant parameter.

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

6.2.7 Timing diagram of PR mode

In PR mode, the Position command is selected with the DI signals (POS0 - POS6 and CTRG) of CN1. Refer to Section 6.2.2 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 value set by P1.054; MC_OK is on when Cmd_OK and TPOS are both on.

6.2.8 Gain adjustment of the position loop

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

- Auto

The servo drive can complete the gain adjustment with the Auto Tuning function. Refer to Chapter 5 Tuning for a detailed description.

- Manual

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 control gain (KPP, P2.000) and position feed forward gain (PFG, P2.002).

Description:

1. Position control gain: the higher the gain, the larger response bandwidth for the position loop.
2. Position feed forward gain: the higher the gain, the smaller the deviation of phase delay.

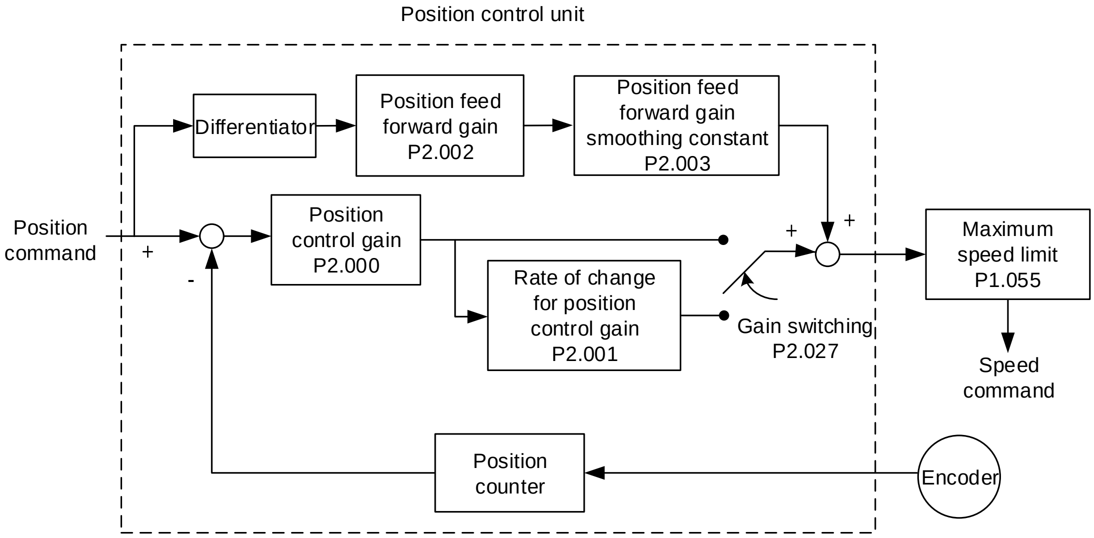
Note that the position loop bandwidth should not be larger than the speed loop bandwidth.

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

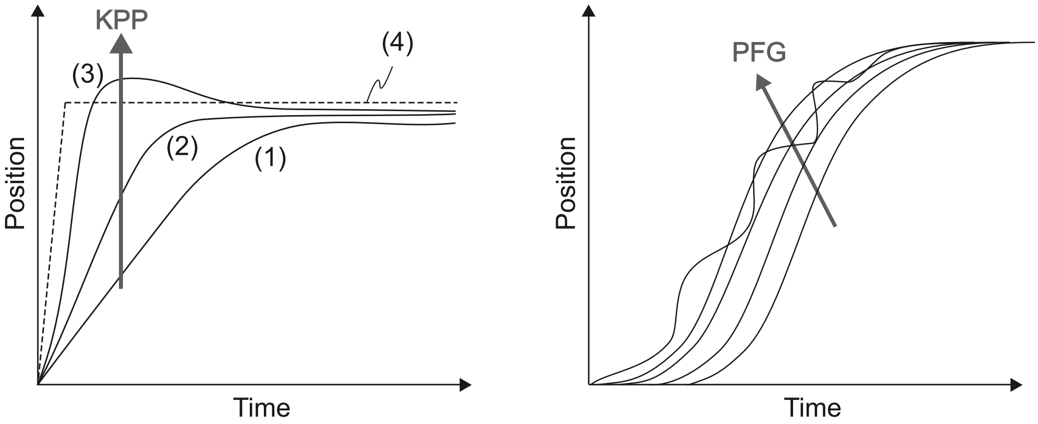
fp: response bandwidth (Hz) of position loop)

KPP = 2 × π × fp

Example: if the desired response bandwidth of the position loop is 20 Hz, then adjust KPP (P2.000) to 125. (2 × π × 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. Meanwhile, the rotor rotates and vibrates in the forward and reverse directions. Then, you have to decrease the KPP value until the rotor stops vibrating. However, when there is an external torque (e.g. 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.

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

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

6.2.9 Low-frequency vibration suppression in Position mode

If the machine is too flexible, the 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.

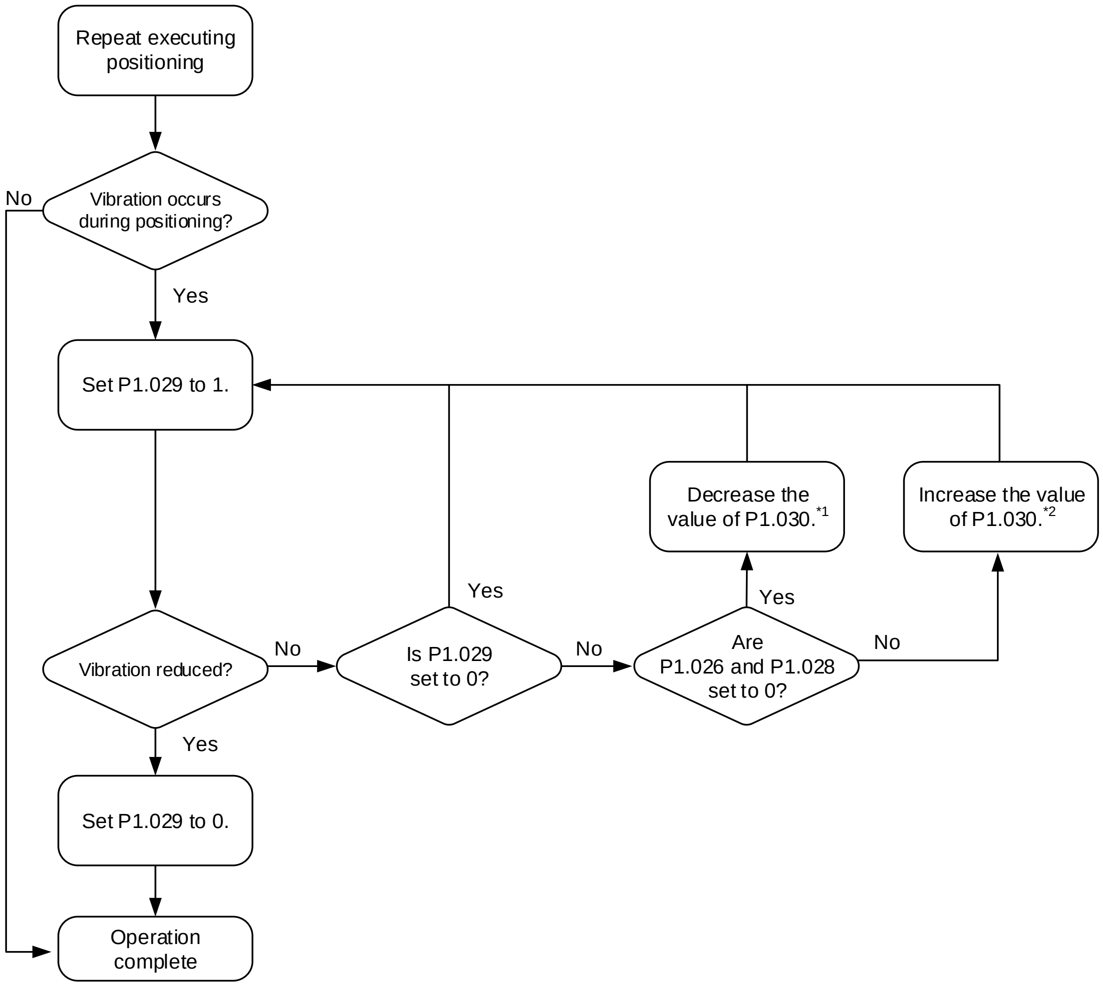
- Auto setting

If you have difficulty finding the frequency, enable the auto low-frequency vibration suppression function (P1.029 = 1), which automatically searches for the vibration frequency.
When you set P1.029 to 1, the system automatically disables the low-frequency vibration suppression filters (by setting P1.026 and P1.028 to 0) and then starts to search for the vibration frequency. When the detected frequency remains at the same level, the system automatically changes the settings in the following order.

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

When P1.029 is automatically reset to 0, but the low-frequency vibration persists, check if P1.026 or P1.028 is set to 1. If either P1.026 or P1.028 is 1, increase the setting of P1.030 (low-frequency vibration detection). If the values of P1.026 and P1.028 are both 0, it means no vibration 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. Note that when you set the detection level too low, it might detect noise as the low-frequency vibration.

Flowchart for the auto suppression of low-frequency vibration:



Note:

1. When the values of P1.026 and P1.028 are both 0, it means the frequency cannot be found. It is probably because the detection level is set too high, causing the low-frequency vibration to be ignored.
2. When the value of P1.026 or P1.028 is greater than 0, but the vibration cannot be suppressed, it is probably because the detection level is too low, causing the system to detect minor frequency or noise as low-frequency vibration.
3. 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 low frequency.

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 value of P1.030 is too high and exceeds the vibration range. If so, it is suggested that you decrease the value of P1.030. Note that if the value is too small, the system might detect noise as the low-frequency vibration. 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.

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

There are two sets of low-frequency vibration suppression parameters: one is parameters P1.025 - P1.026 and the other is parameters P1.027 - P1.028. You can use these two sets of low-frequency vibration suppression parameters to reduce two different low-frequency vibrations.

Use P1.025 and P1.027 to set the frequencies when the low-frequency vibrations occur. The suppression function works only when the set frequency 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 sets of 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

There are two types of Speed command sources: analog input and internal register (parameters). The analog command controls the motor speed by scaled external voltage input. The command register controls the motor speed in two ways. Before operation, respectively set the speed values in the three registers. Then, you can switch between the three sets of speed either by using DI.SPD0 and DI.SPD1 of CN1 or by changing the value in the register through 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

There are two types of Speed command sources: analog voltage input and internal register (parameters). Select the command source with DI signals of CN1. See the following table for more details.

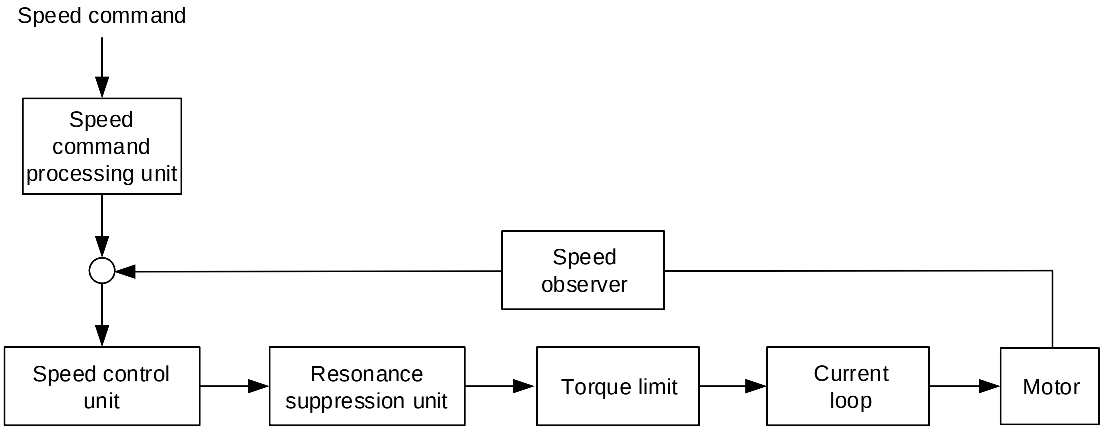
Speed command number	CN1 DI signal		Command source			Content	Range
	SPD1	SPD0					
S1	0	0	Mode	S	External analog signal	Voltage difference between V_REF and GND	-10V to +10V
				Sz	N/A	Speed command is 0	0
S2	0	1	Internal register (parameter)			P1.009	-75000 to +75000
S3	1	0				P1.010	-75000 to +75000
S4	1	1				P1.011	-75000 to +75000

- 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, if the drive is in Sz mode, the command is 0. Thus, if there is no need to use the analog voltage for the Speed command, you can use Sz mode to avoid the problem of zero drift in the voltage. If the drive is in S mode, then the command is the voltage difference between V_REF and GND. The range of the input voltage is between -10V and +10V, and you can adjust the corresponding speed with P1.040.
- When either one of SPD0 and SPD1 is not 0, the internal parameters become the source for the Speed command. The command takes effect once the status of SPD0 and SPD1 are switched. There is no need to use DI.CTRG for triggering.
- The parameter (internal register) setting range is -75000 to +75000.
  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.

You can use the Speed command in Speed mode (S or Sz) and Torque mode (T or Tz). When the drive is in Torque mode, you can use the Speed command input as the speed limit.

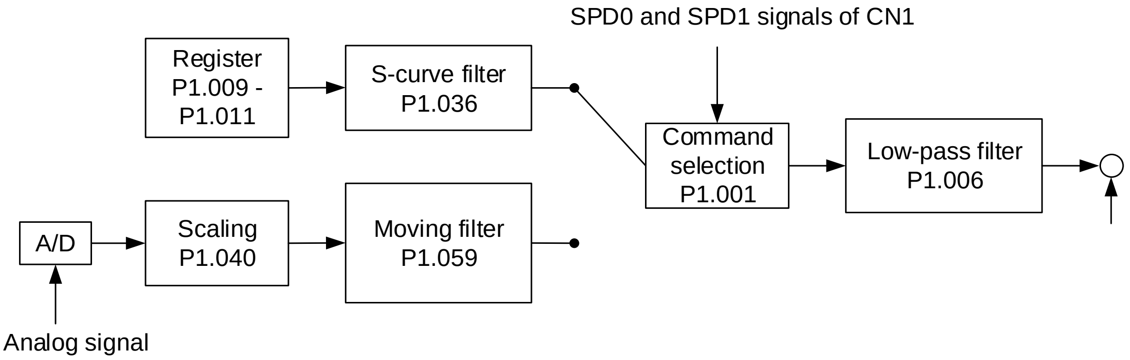
6.3.2 Control structure of Speed mode

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 scaling parameter (P1.040) for setting the rotation speed corresponding to the analog voltage and 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 following diagram introduces the function of Speed command processing unit. Its structure is shown as follows.



The upper path is the command from the register and the lower one is the command from the external analog voltage, which you can select 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 three-phase motion profile of the S-curve filter provides a smoother motion. Using the S-curve filter avoids jerk (rapid change of acceleration), resonance, and noise caused by abrupt changes in the speed input. You can use the following parameters for adjustment.

- The S-curve acceleration constant (P1.034) adjusts the slope of the change in acceleration.
- The S-curve deceleration constant (P1.035) adjusts the slope of the change in deceleration.
- The S-curve acceleration / deceleration constant (P1.036) improves the stability of the motor when it starts and stops.

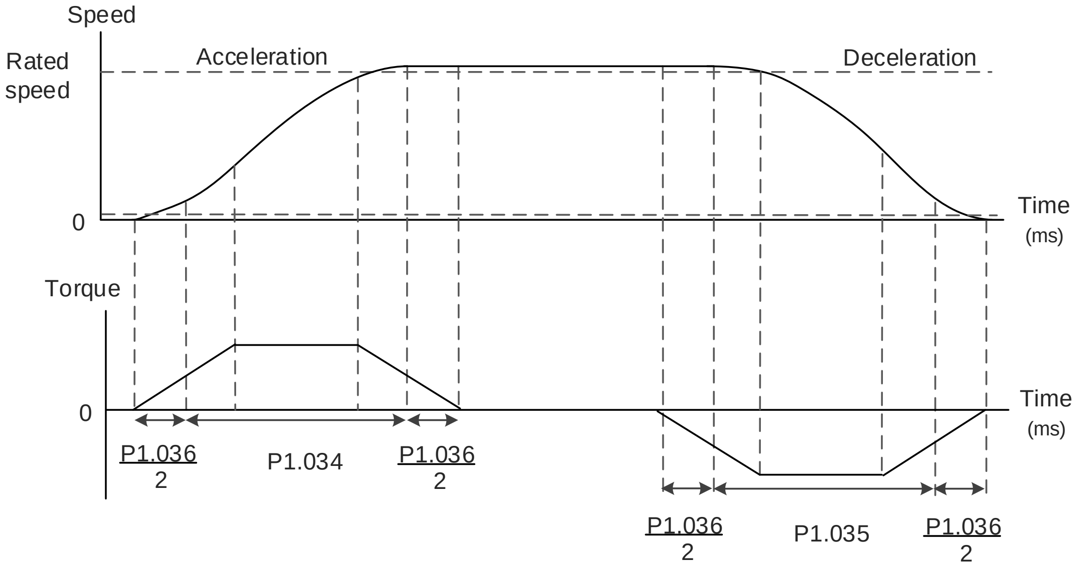


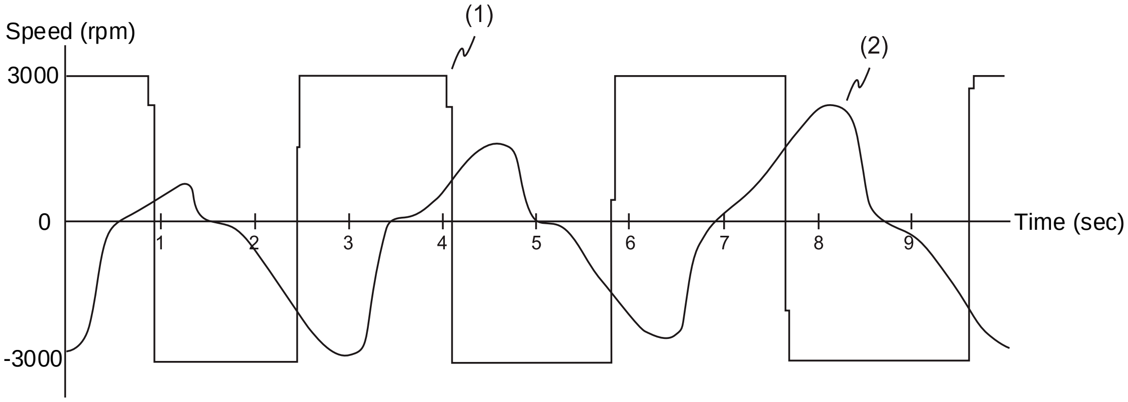
Figure 6.3.3.1 S-curve speed profile and time setting

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

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

Analog Speed command filter

The Analog Speed command filter provided by the servo drive helps to stabilize the motor operation when the analog input signal (speed) changes rapidly.

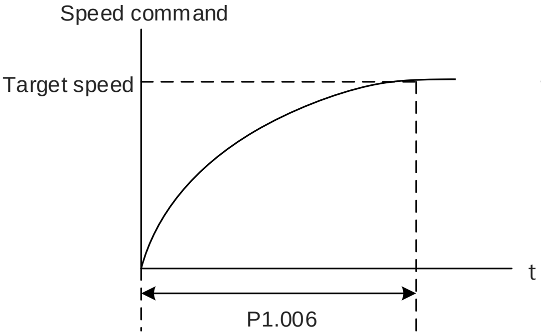


(1) Analog Speed command; (2) Motor speed

The filter for smoothing the analog input commands is the same as the S-curve filter in terms of the time planning as well as the continuous speed and acceleration curves. In the preceding diagram, the slopes of the Speed command in acceleration and deceleration are different. Adjust the time settings (P1.034, P1.035, and P1.036) according to the actual application to improve the performance.

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.

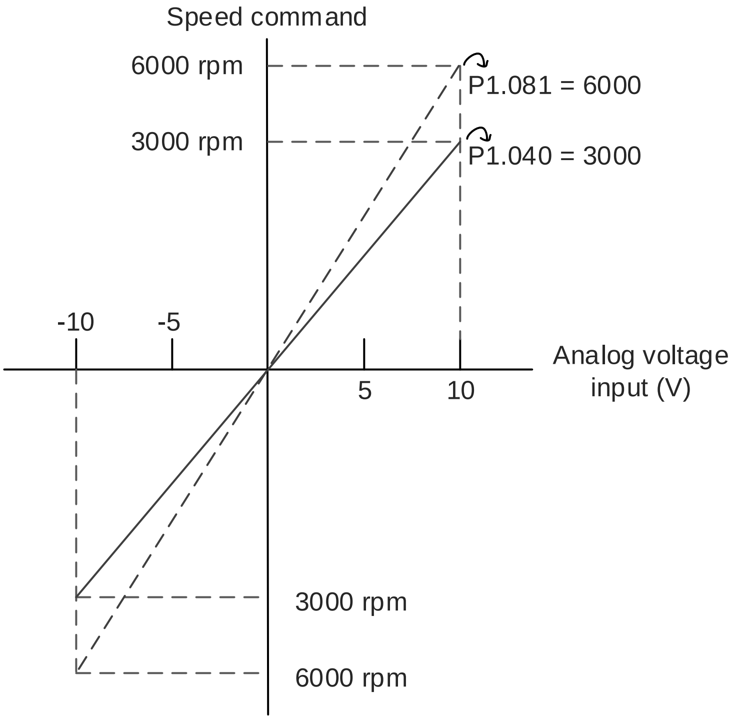


Refer to Chapter 8 for detailed descriptions of the relevant parameter.

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

6.3.4 Scaling of the analog command

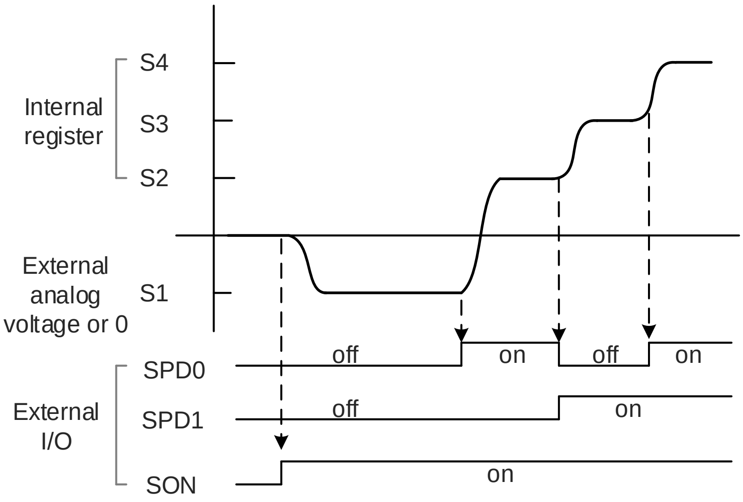
The Speed command is controlled by the analog voltage difference between V_REF and GND. Use P1.040 and P1.081 to adjust the slope of the speed change and the setting range of the command. Moreover, you can use P1.082 to change the time constant for switching between P1.040 and P1.081.



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

Parameter	Function
P1.040	Maximum motor speed for analog Speed command 1
P1.081	Maximum motor speed for analog Speed command 2
P1.082	Time constant for switching between P1.040 and P1.081

6.3.5 Timing diagram of Speed mode

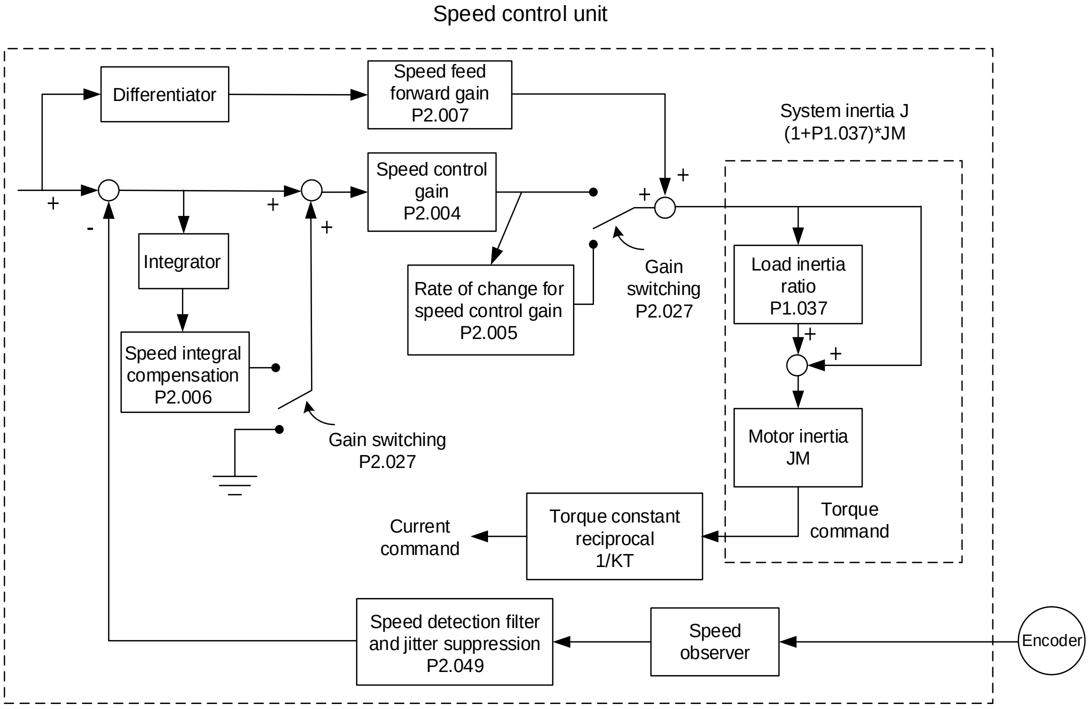


Note:

1. “off” means that DI is off (the circuit is open); “on” means that DI is on (the circuit is closed).
2. When the drive is in Sz mode, the Speed command S1 = 0; when the drive is in S mode, the Speed command S1 refers to the external analog voltage input.
3. In Servo On state, the command is selected according to the status of SPD0 and SPD1.

6.3.6 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 gain parameters manually or by using the multiple gain adjustment modes.

Manual mode: manually set the parameters with all auto or auxiliary functions disabled.

Gain adjustment mode: refer to Chapter 5 Tuning.

- Manual mode

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

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

Speed integral compensation: increasing this gain increases the low frequency rigidity and reduces the steady-state error. However, the phase margin becomes smaller. If you set this gain too high, it reduces the system stability.

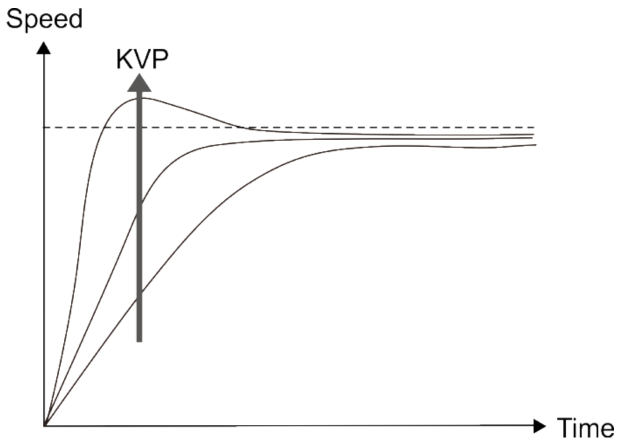
Speed feed forward gain: the higher the gain, the smaller the deviation of phase delay.

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

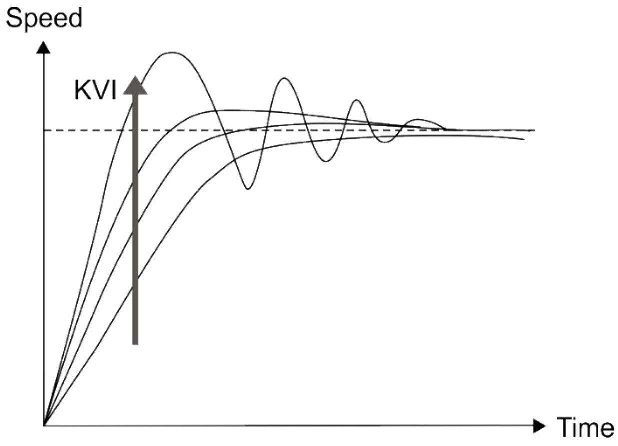
Parameter	Function
P2.004	Speed control gain
P2.006	Speed integral compensation
P2.007	Speed feed forward gain

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

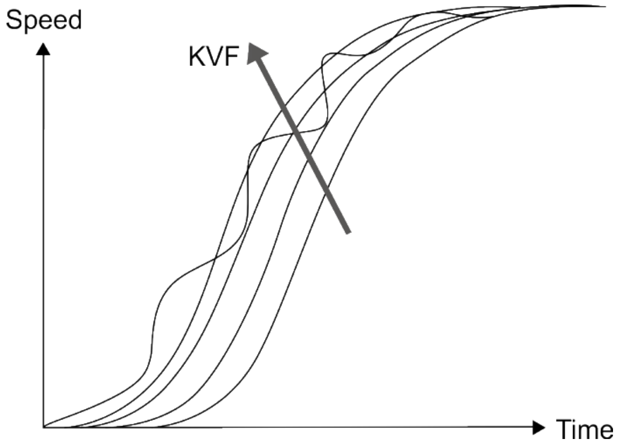
Time domain



The higher the KVP value, the larger the bandwidth. The time of the speed increase 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.



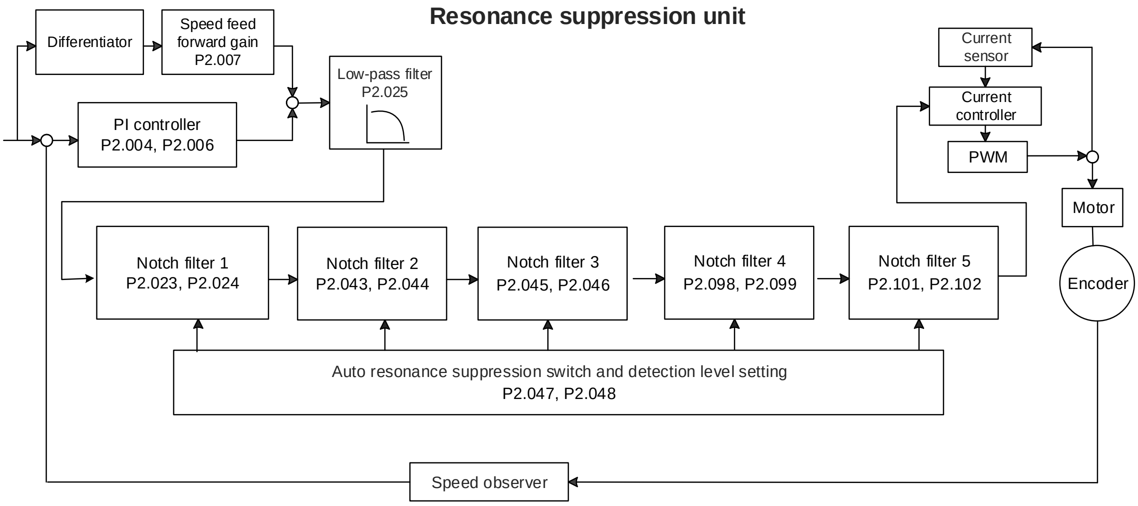
The higher the KVI value, the larger the low-frequency gain. It shortens the time for the steady-state error to reduce to zero but reduces the phase margin. However, it does not significantly reduce the following error.



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.

6.3.7 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. In addition, 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 if you want the control parameters to remain unchanged.



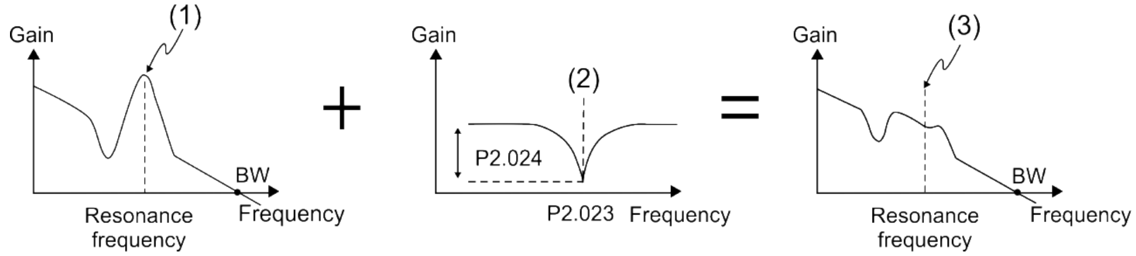
Refer to Chapter 8 for detailed descriptions of the relevant parameters.

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 methods to suppress the resonance: one is using the Notch filters and the other is using the low-pass filter. See the following diagrams for the effects of these filters.

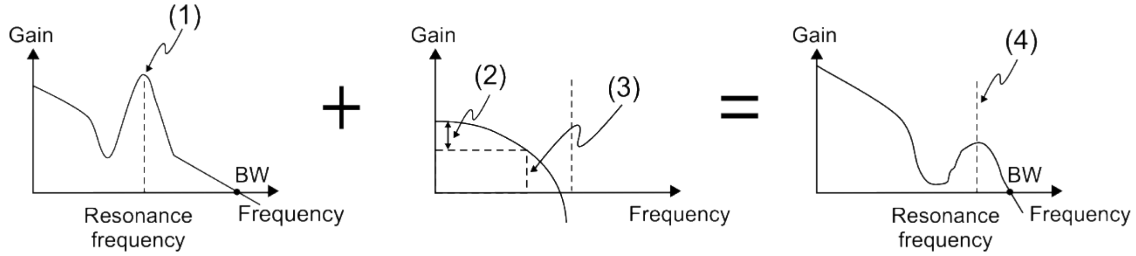
System open-loop gain with resonance:

- 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 setting range for the frequency of 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

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

6.4.1 Selecting the Torque command source

There are two types of Torque command sources: analog voltage input and internal register (parameters).

Select the command source with DI signals of CN1. See the following table for more details.

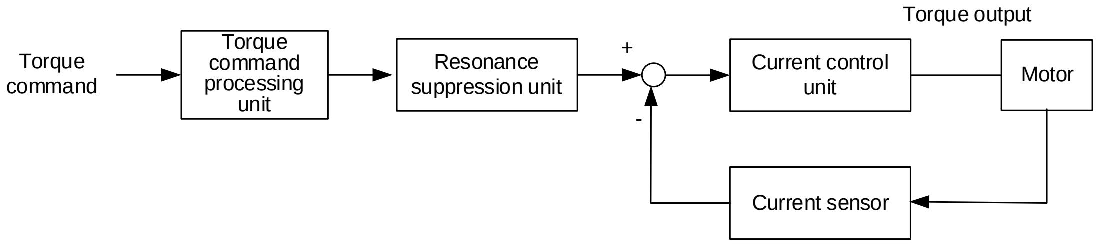
<table>
<tr><th rowspan="2">Torque command number</th><th colspan="2">CN1 DI signal</th><th rowspan="2" colspan="3">Command source</th><th rowspan="2">Content</th><th rowspan="2">Range</th></tr>
<tr><th>TCM1</th><th>TCM0</th></tr>
<tr><td rowspan="2">T1</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">Mode</td><td>T</td><td>External analog signal</td><td>Voltage difference between T_REF and GND</td><td>-10V to +10V</td></tr>
<tr><td>Tz</td><td>N/A</td><td>Torque command is 0</td><td>0</td></tr>
<tr><td>T2</td><td>0</td><td>1</td><td rowspan="3" colspan="3">Internal register (parameter)</td><td>P1.012</td><td>-500% to +500%</td></tr>
<tr><td>T3</td><td>1</td><td>0</td><td>P1.013</td><td>-500% to +500%</td></tr>
<tr><td>T4</td><td>1</td><td>1</td><td>P1.014</td><td>-500% to +500%</td></tr>
</table>

- 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, if the drive is in Tz mode, the command is 0. Thus, if there is no need to use the analog voltage for the Torque command, you can use Tz mode to avoid the problem of zero drift in the voltage. If the drive is in T mode, then the command is the voltage difference between T_REF and GND. The range of the input voltage is between -10V and +10V, and you can adjust the corresponding torque with P1.041.
- When either one of TCM0 or TCM1 is not 0, the internal parameters become the source for the Torque command. The command takes effect once the status of TCM0 and TCM1 are switched. There is no need to use DI.CTRG for triggering.

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

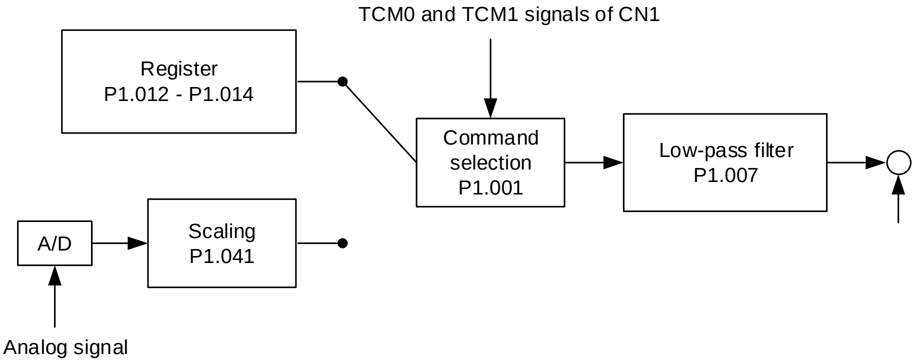
6.4.2 Control structure of Torque mode

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



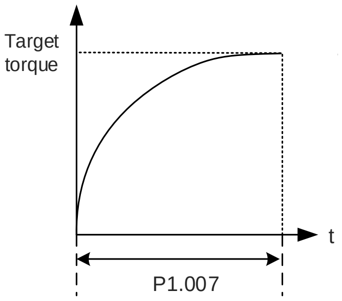
The Torque command processing unit selects the command source (see Section 6.4.1), including the scaling parameter (P1.041) for setting the torque corresponding to the analog voltage and the low-pass filter (P1.007) for smoothing the torque. The current control unit manages the gain parameters for the servo drive and calculates the current for servo motor in real-time.

The structure of Torque command processing unit is as follows.



The upper path is the command from the register and the lower one is the command from the external analog voltage, which you can select with the status of TCM0 and TCM1, and P1.001 (T or Tz). Adjust the torque with the analog voltage scaling (P1.041) and smooth the response with the low-pass filter (P1.007).

6.4.3 Smoothing the Torque command



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

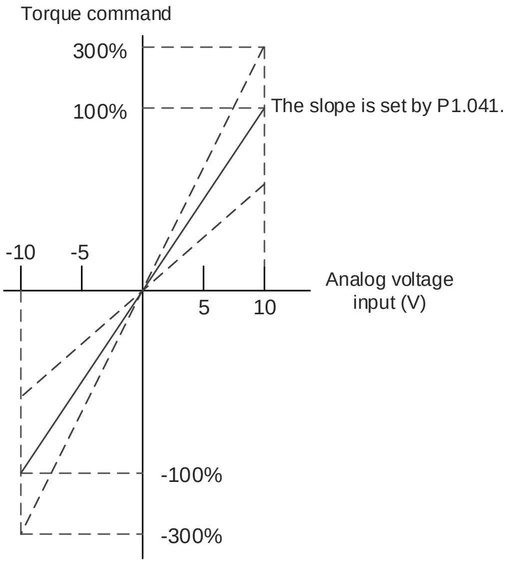
Parameter	Function
P1.007	Torque command - smoothing constant (low-pass filter)

6.4.4 Scaling of the analog command

The Torque command is controlled by the analog voltage difference between T_REF and GND. Adjust the torque slope and the setting range of the command with P1.041.

For example:

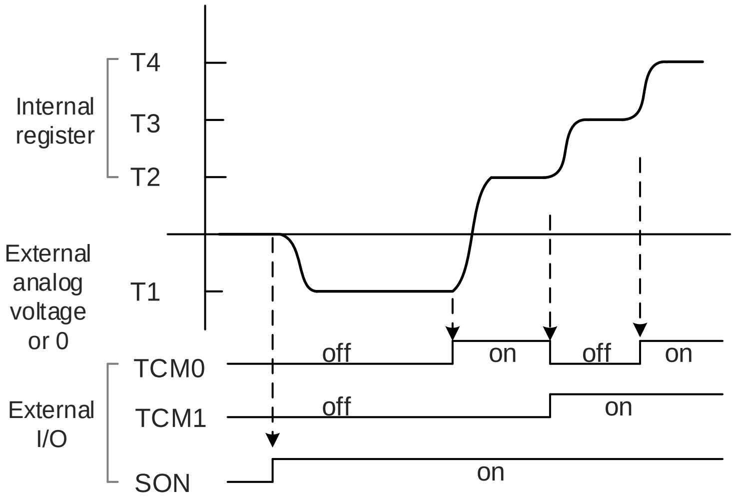
1. If you set P1.041 to 100 and the external input voltage is 10V, the Torque command is 100% of the rated torque.
2. If you set P1.041 to 300 and the external input voltage is 10V, the Torque command is 300% of the rated torque.



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

Parameter	Function
P1.041	Maximum output for analog Torque command

6.4.5 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. When the drive is in Tz mode, the Torque command T1 = 0; when the drive is in T mode, the Torque command T1 refers to the external analog voltage input.
3. In Servo On state, the command is selected according to the status of TCM0 and TCM1.

6.5 Dual modes and multi-modes

Apart from the single modes for controlling the position, speed, and torque of the motor, there are also dual modes and multi-modes available for operation (see Section 6.1).

Mode	Short name	Code	Description
Dual mode	PT-S	06	Switch between PT and S modes with DI.S-P.
	PT-T	07	Switch between PT and T modes with DI.T-P.
	PR-S	08	Switch between PR and S modes with DI.S-P.
	PR-T	09	Switch between PR and T modes with DI.T-P.
	S-T	0A	Switch between S and T modes with DI.S-T.
	PT-PR	0D	Switch between PT and PR modes with DI.PT-PR.
Multi-mode	PT-PR-S	0E	Switch between PT, PR, and S modes with DI.S-P and DI.PT-PR.
	PT-PR-T	0F	Switch between PT, PR, and T modes with DI.T-P and DI.PT-PR.

The dual mode for Sz and Tz is not supported. To avoid occupying too many digital inputs in the dual mode or multi-mode, Speed and Torque modes can use the external analog voltage as the command source to reduce the use of DIs (SPD0, SPD1 or TCM0, TCM1). In addition, the PT mode can use the pulse input to reduce the use of DIs (POS0 - POS6).

To refer to the table of default DI/DO functions or to change the DI/DO functions, see Section 3.3 for more information.

6.5.1 Speed / Position dual mode

Speed / Position dual mode includes PT-S and PR-S. The command source for PT-S is from the external pulse while the source for PR-S is from the internal parameters (P6.000 - P7.099). You can control the Speed command with the external analog voltage or the internal parameters (P1.009 - P1.011). The switch between Speed and Position modes is controlled by DI.S-P (0x18). The switch between PT and PR for Position mode is controlled by DI.PT-PR (0x2B). The following timing diagram illustrates the PR-S mode. The switch between Position and Speed commands in PR-S mode is controlled by DI signals.

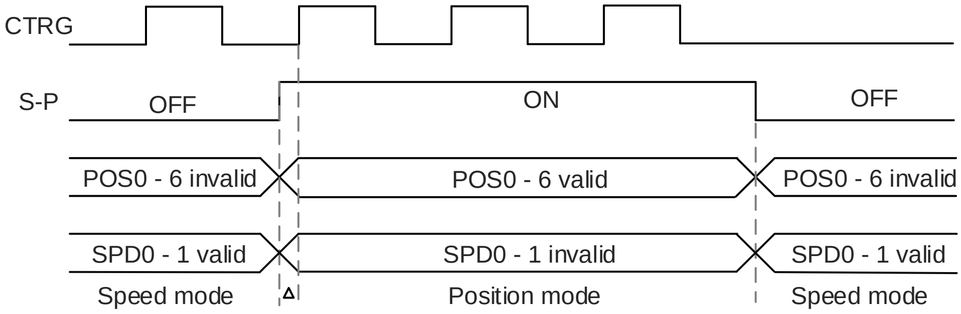


Figure 6.5.1.1 Speed / Position dual mode

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 drive switches 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 of each single mode for the DI signals and the selected commands.

6.5.2 Speed / Torque dual mode

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

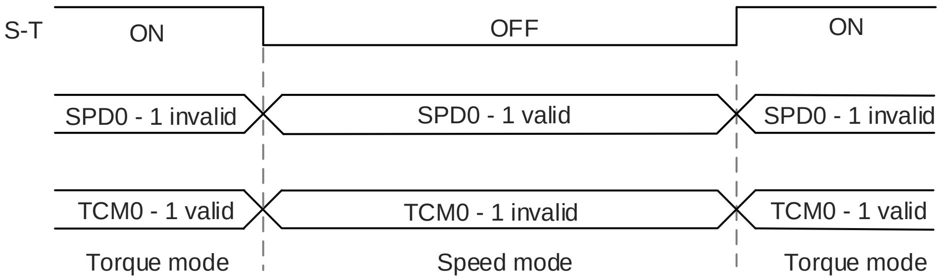


Figure 6.5.2.1 Speed / Torque dual mode

In Torque mode (DI.S-T is on), you select the Torque command with DI.TCM0 and DI.TCM1. When the drive switches to Speed mode (DI.S-T is off), you select the Speed command with DI.SPD0 and DI.SPD1. 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 of each single mode for the DI signals and the selected commands.

6.5.3 Torque / Position dual mode

Torque / Position dual mode includes PT-T and PR-T. The command source for PT-T comes from the external pulse while the source for PR-T comes from the internal parameters (P6.000 - P7.099). You can control the Torque command with the external analog voltage or the internal parameters (P1.012 - P1.014). The switch between Torque and Position modes is controlled by DI.T-P (0x20). The switch between PT and PR for Position mode is controlled by DI.PT-PR (0x2B). The following timing diagram illustrates the PR-T mode. The switch between Position and Torque commands in PR-T mode is controlled by DI signals.

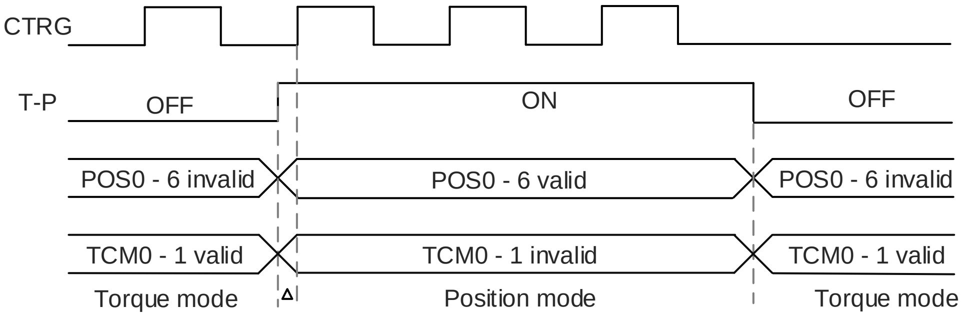


Figure 6.5.3.1 Torque / Position dual mode

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 drive switches to Position mode (DI.T-P is off), since the Position command has not been issued (it waits for the rising edge of DI.CTRG), the motor stops (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 of each single mode for the DI signals and the selected commands.

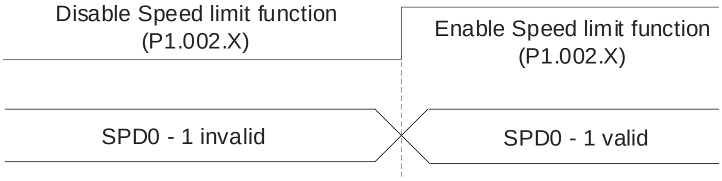
6.6 Others

6.6.1 Applying the speed limit

The maximum motor speed in all modes (Position, Speed, and Torque) is determined by the internal parameter P1.055.

The methods for using the Speed limit command and Speed command are the same. You can use either the external analog voltage or the internal parameters (P1.009 - P1.011). Refer to Section 6.3.1 for more details.

The Speed limit command is applicable only in Torque mode (T or Tz) for limiting the motor speed. If you are using the external analog voltage in Torque mode, you can use the available DI signals to set SPD0 and SPD1 for the motor speed limit value (internal parameters). If there is no DI signals available, use the analog voltage input for the Speed limit command. 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.

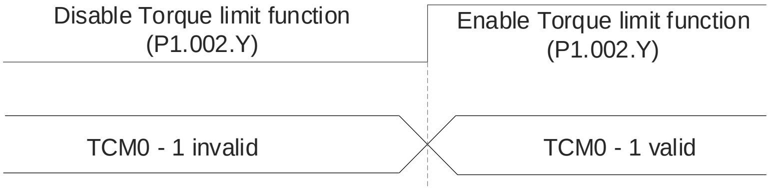


Source selection for Speed limit command

6.6.2 Applying the torque limit

The methods for using the Torque limit command and Torque command are the same. You can use either the external analog voltage or the internal parameters (P1.012 - P1.014). Refer to Section 6.4.1 for more details.

The Torque limit command is applicable in Position mode (PT or PR) or Speed mode (S) for limiting the motor torque output. If you are using the external pulse in Position mode or using the external analog voltage in Speed mode, you can use the available DI signals to set TCM0 and TCM1 for the torque limit command (internal parameters). If there is no DI signals available, use the analog voltage input for the Torque limit command. 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

6.6.3 Analog monitoring

You can find the required voltage signal with analog monitoring. The servo drive provides two analog channels. Refer to Chapter 3 for more information about wiring.

Example:

If the analog voltage output is 8V when the motor speed is 1,000 rpm and the maximum speed of the motor is 5,000 rpm, the setting of P1.004 is as follows.

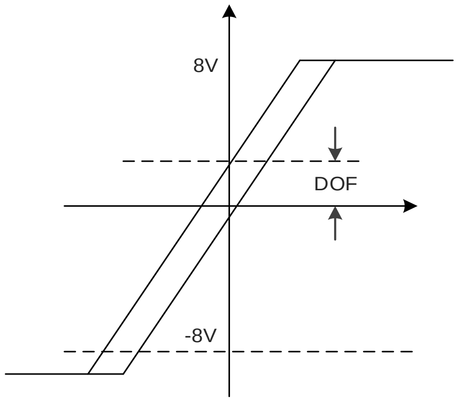
$$\text{P1.004} = \frac{\text{Required speed}}{\text{Max. speed}} \text{ x } 100\% = \frac{\text{1000 rpm}}{\text{5000 rpm}} \times 100\% = 20\%$$

You can calculate the voltage output corresponding to the current motor speed with the following formula.

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

Voltage drift

When voltage drift occurs, the voltage level defined as zero voltage is different from the set zero point. To fix this problem, use DOF1 (P4.020) and DOF2 (P4.021) to calibrate the offset voltage output. The voltage level for analog monitoring output is ±8V. If the output voltage exceeds the range, it is limited within ±8V. The resolution is 10 bits, which is equivalent to 13 mV/LSB.



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

Parameter	Function
P0.003	Analog output monitoring
P1.003	Encoder pulse output polarity
P1.004	MON1 analog monitor output proportion
P1.005	MON2 analog monitor output proportion
P4.020	Analog monitor output (Ch1) - offset compensation value
P4.021	Analog monitor output (Ch2) - offset compensation value

Motion Control

7

This chapter introduces internal motion commands of the servo drive in PR mode. In this mode, 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.

7.1 PR mode description

PR mode is only supported by the E3-E models. In PR mode, the servo drive automatically generates the motion commands and saves all parameter settings in the servo drive parameter file. Thus, changing parameter settings simultaneously changes the PR commands. 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 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#1 path is defined by parameters P6.002 and P6.003. P6.002 specifies the property of PR#1, 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#2 path 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.

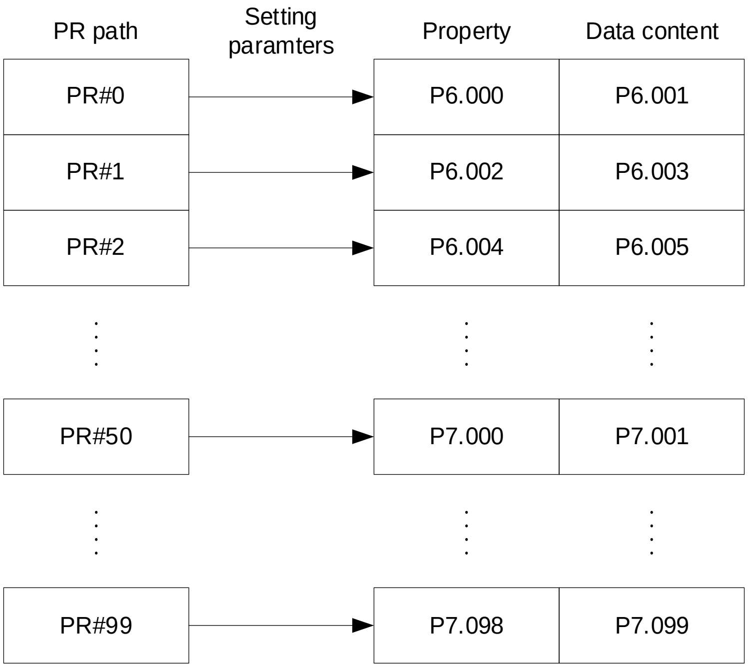
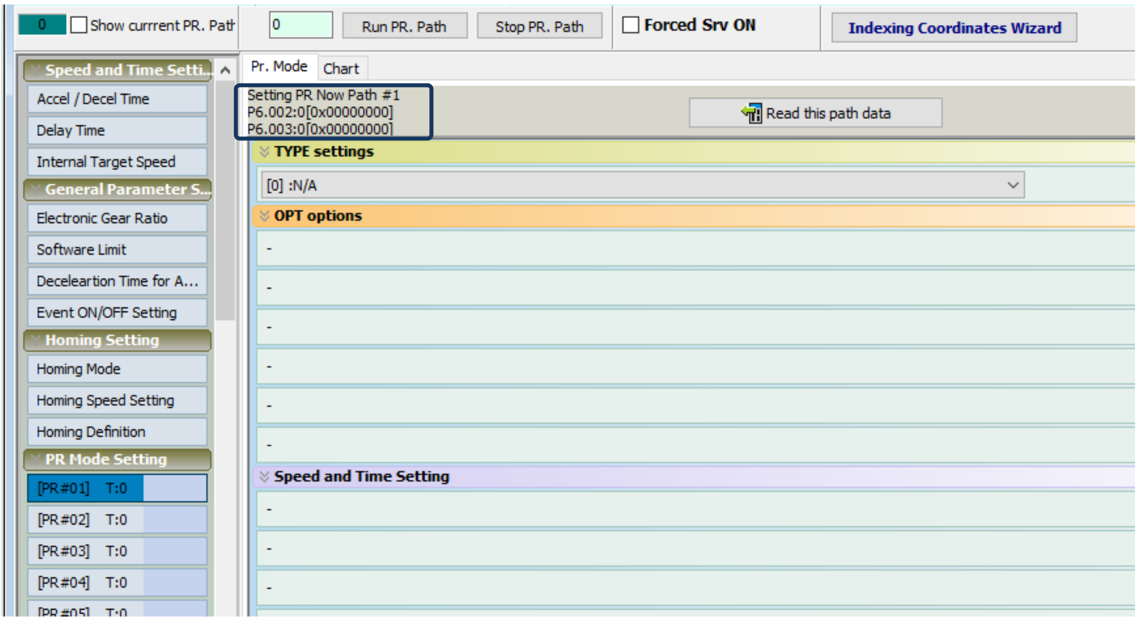


Figure 7.1.1 Setting parameters for each PR path

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



Setting PR Now Path #1
P6.002:0[0x00000000]
P6.003:0[0x00000000]

[0] :N/A

Figure 7.1.2 PR Mode interface in ASDA-Soft

Table 7.1.1 Example of PR#1 property and data content

Bit PR#1	31 - 28	27 - 24	23 - 20	19 - 16	15 - 12	11 - 8	7 - 4	3 - 0
P6.002	-	AUTO	DLY	SPD	DEC	ACC	OPT	TYPE
P6.003	Data content (32-bit)							

Note:

TYPE: path type

Setting value of TYPE	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 V6 provides a graphical interface for editing PR paths (see Figure 7.1.3). It is easier to set PR paths in ASDA-Soft, where you can set the options of command triggering, command types, and other properties.

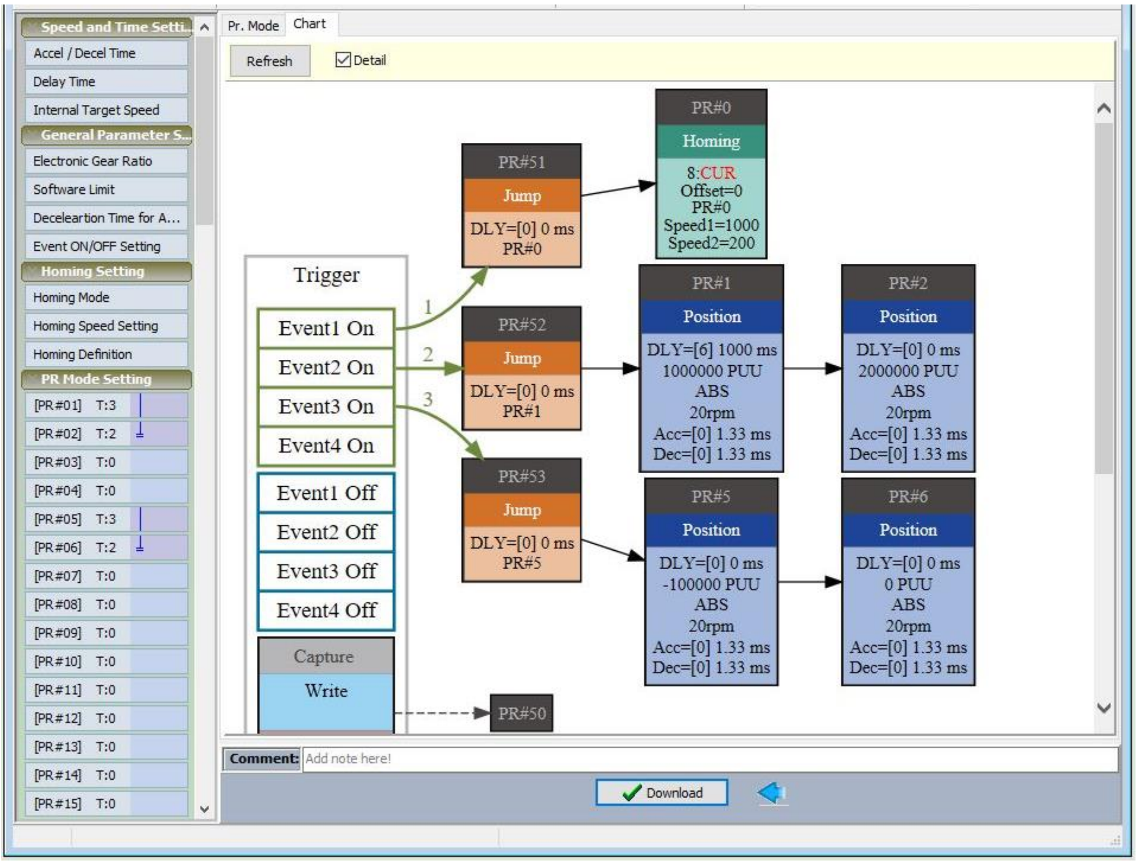


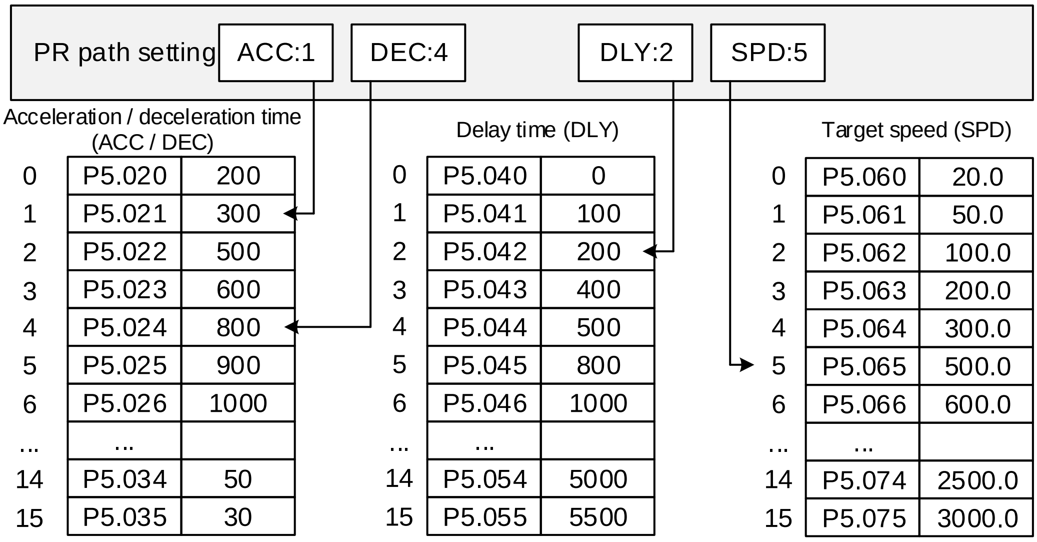
Figure 7.1.3 Graphical interface for PR paths in ASDA-Soft

7.1.1 Shared parameters for PR paths

The servo drive provides 16 acceleration / deceleration time settings (P5.020 - P5.035), 16 delay time settings (P5.040 - P5.055), and 16 target speed settings (P5.060 - P5.075) for you to set the PR paths (as shown in Figure 7.1.1.1). If you change a parameter that is used by multiple PR paths, then all PR paths using this parameter are changed as well. For example, if multiple PR commands 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 commands are changed as well. Please 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 of ASDA-Soft also 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, if the acceleration time is set to 50 ms, the required acceleration time is 50 ms when the target speed for the motion command is 3000 rpm, and the required acceleration time is 25 ms when the target speed for the motion command is 1500 rpm. The acceleration / deceleration time setting is like a fixed slope for acceleration or deceleration; the slope does not change when you change the target speed settings.



Acceleration / deceleration time (ACC / DEC)

0	P5.020	200
1	P5.021	300
2	P5.022	500
3	P5.023	600
4	P5.024	800
5	P5.025	900
6	P5.026	1000
...	...	
14	P5.034	50
15	P5.035	30

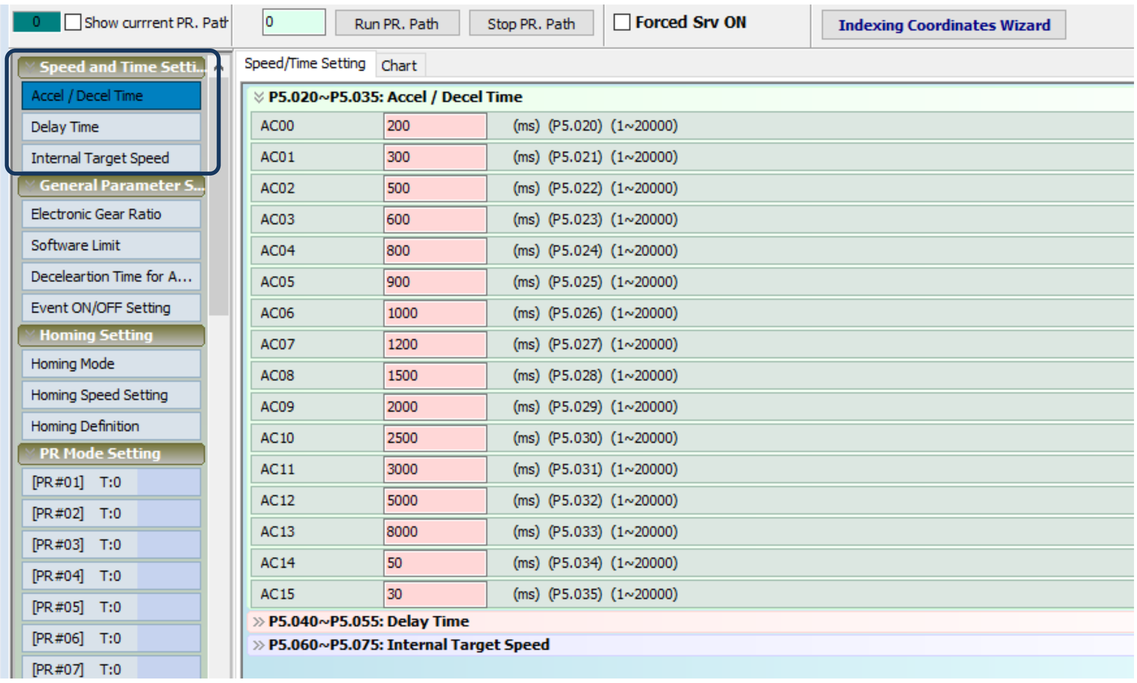
Delay time (DLY)

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
...	...	
14	P5.054	5000
15	P5.055	5500

Target speed (SPD)

0	P5.060	20.0
1	P5.061	50.0
2	P5.062	100.0
3	P5.063	200.0
4	P5.064	300.0
5	P5.065	500.0
6	P5.066	600.0
...	...	
14	P5.074	2500.0
15	P5.075	3000.0

Figure 7.1.1.1 Shared parameter data for PR paths



P5.020~P5.035: Accel / Decel Time

AC00	200	(ms) (P5.020) (1~20000)
AC01	300	(ms) (P5.021) (1~20000)
AC02	500	(ms) (P5.022) (1~20000)
AC03	600	(ms) (P5.023) (1~20000)
AC04	800	(ms) (P5.024) (1~20000)
AC05	900	(ms) (P5.025) (1~20000)
AC06	1000	(ms) (P5.026) (1~20000)
AC07	1200	(ms) (P5.027) (1~20000)
AC08	1500	(ms) (P5.028) (1~20000)
AC09	2000	(ms) (P5.029) (1~20000)
AC10	2500	(ms) (P5.030) (1~20000)
AC11	3000	(ms) (P5.031) (1~20000)
AC12	5000	(ms) (P5.032) (1~20000)
AC13	8000	(ms) (P5.033) (1~20000)
AC14	50	(ms) (P5.034) (1~20000)
AC15	30	(ms) (P5.035) (1~20000)

P5.040~P5.055: Delay Time

P5.060~P5.075: Internal Target Speed

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

7.1.2 Monitoring variables of PR mode

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

1. Position command (PUU): monitoring variable code 001, simplified as Cmd_O (Command Operation). 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). The target position of the PR command. When a command is triggered, the servo drive calculates the target position and then updates this register.
3. Feedback position (PUU): monitoring variable code 000, simplified as Fb_PUU (Feedback PUU). The current feedback position of the motor encoder.
4. Following error (PUU): monitoring variable code 002, simplified as Err_PUU (Error PUU). The difference between Position command (PUU) and Feedback position (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 based on 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 feedback position and Err_PUU is the difference of subtracting Fb_PUU from Cmd_O.

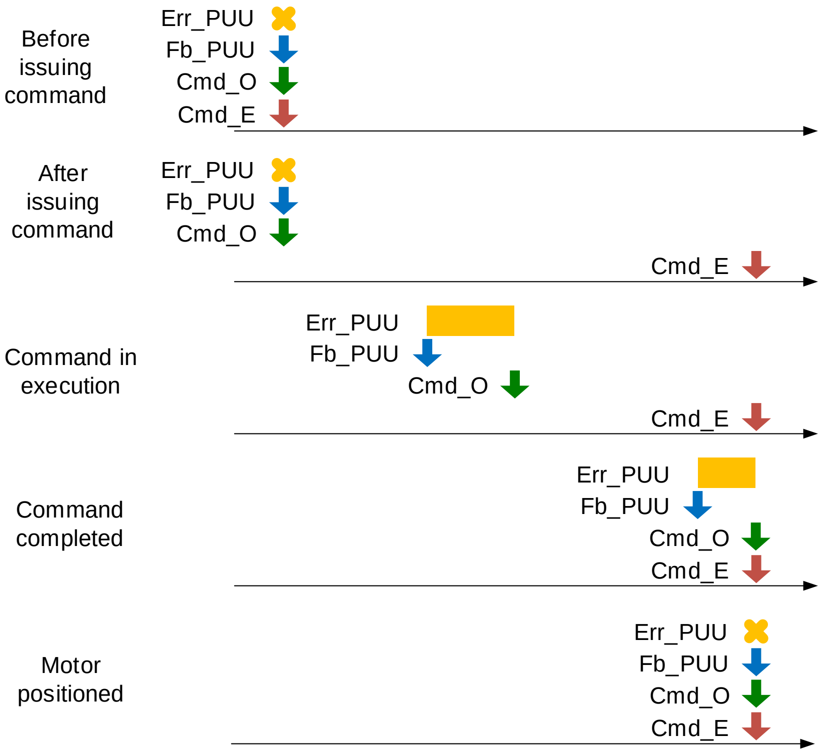


Figure 7.1.2.1 Timing diagram for PR mode monitoring variables

The detailed behavior of the servo drive at the stage of command execution is illustrated in Figure 7.1.2.2. Cmd_E is the command endpoint which is set when the PR path is triggered. Fb_PUU is the feedback position, which is motor's actual position. Divide this motion command into 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 feedback position of this cycle.

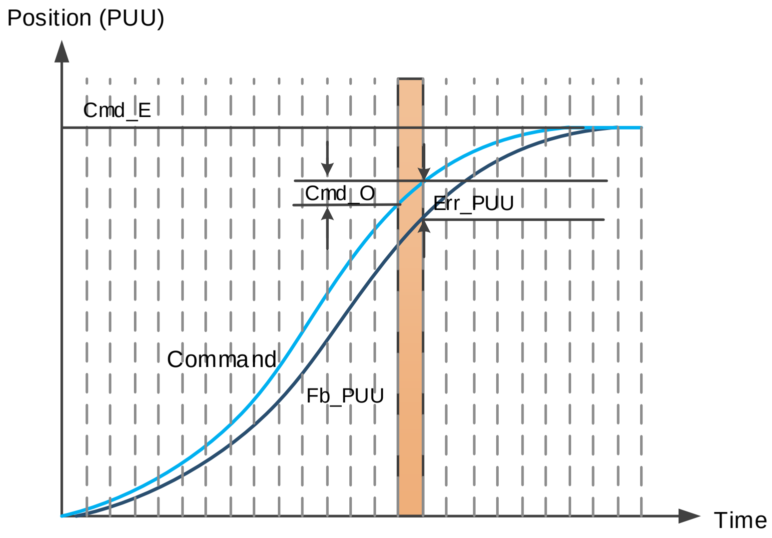


Figure 7.1.2.2 Monitoring variable status when a command is executed in PR mode

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 the motion command with DI.CTRG (0x08), the servo drive operates based on 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. After DO.Cmd_OK (0x15) and DO.TPOS (0x05) are both on, the servo outputs the DO.MC_OK (0x17) signal 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, when the motor reaches the target position, DO.TPOS (0x05) is set to on. When the delay time is over, DO.Cmd_OK (0x15) is set to on. After these two DO signals are both on, the servo outputs the DO.MC_OK (0x17) signal to signify that it has completed this PR path. The operation is as shown in Figure 7.1.2.4.

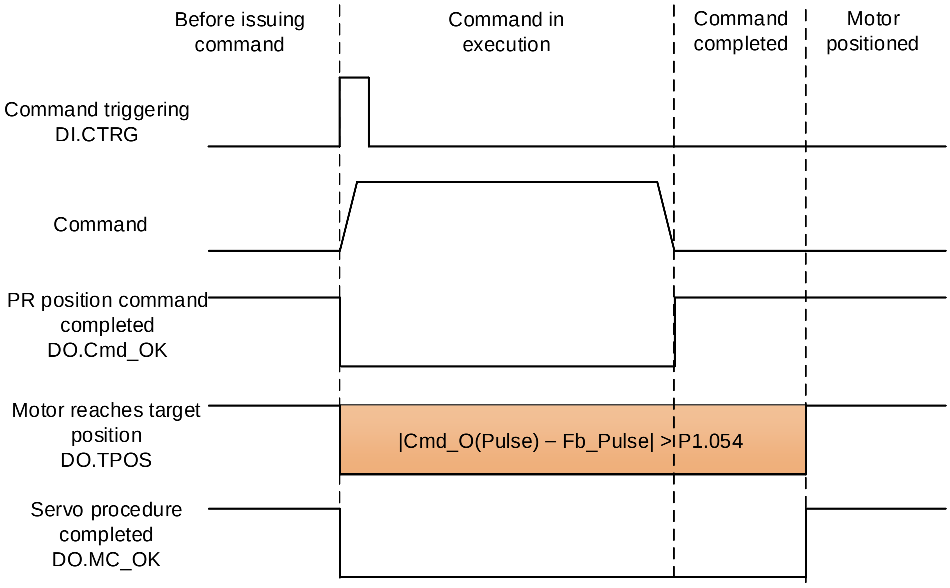


Figure 7.1.2.3 Operation of DI/DO signals in PR mode

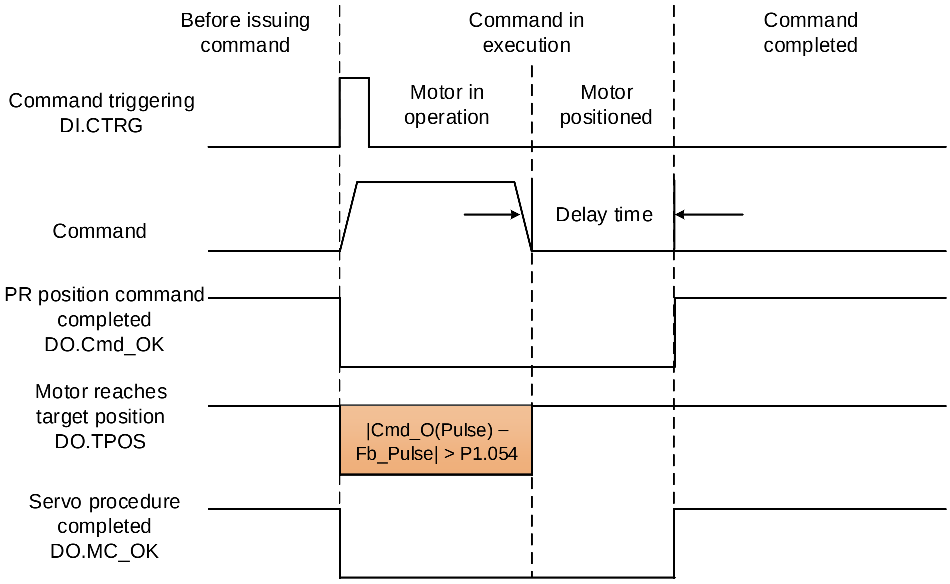


Figure 7.1.2.4 Operation of DI/DO signals in PR mode (including delay time)

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 command (Index Position). 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-selections 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:	-E		

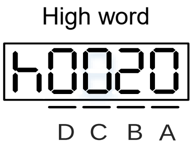
Settings:

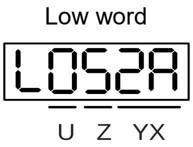
Definition of each setting value:

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:	-E		

Settings:





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#1 - 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

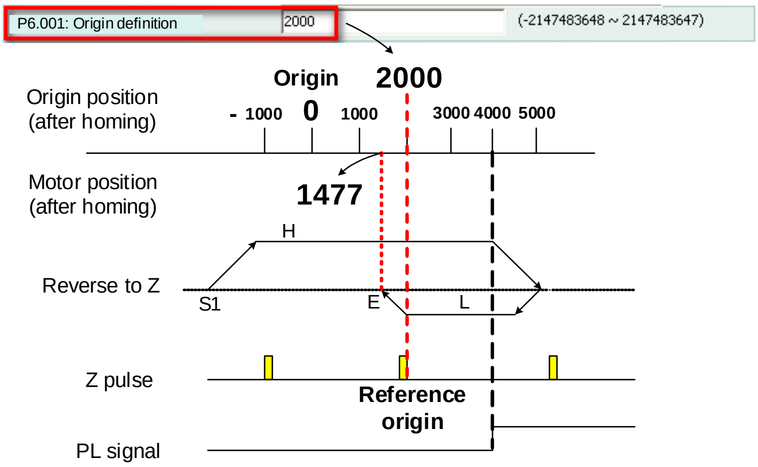
- D: BOOT: whether to execute homing automatically when the drive is powered on

  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. From the position system that it established, the system automatically calculates the position of 0 (origin). Now the motor can move to the specified position as soon as the PR motion command is issued.



P6.001: Origin definition 2000 (-2147483648 ~ 2147483647)

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:	-E		

Settings:

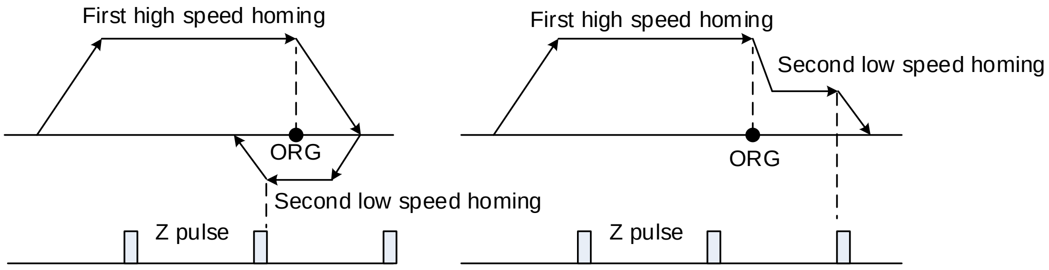
Origin definition.

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 accurately (such as the Z pulse). The speeds for the two stages are defined by P5.005 and P5.006.

P5.005	**High speed homing (first speed setting)**			**Address: 050AH 050BH**
Operation interface:	Panel / software	Communication	Control mode:	PR (set with P5.004)
Default:	100.0	1000	Data size:	32-bit
Unit:	1 rpm	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:	-E			

Settings:

The first speed setting for high speed homing.

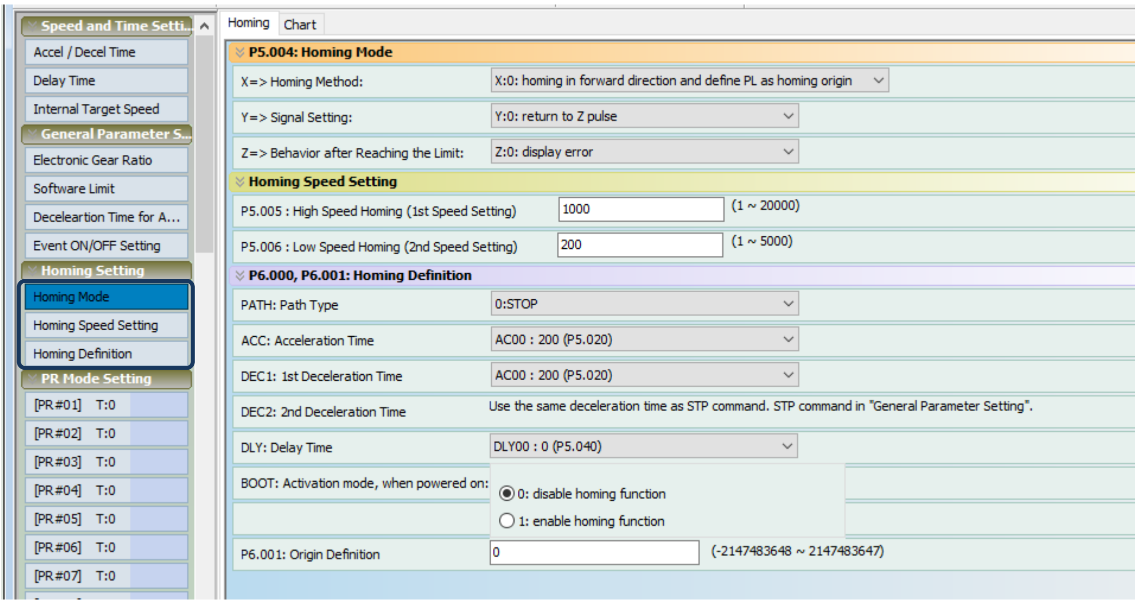


P5.006	**Low speed homing (second speed setting)**			**Address: 050CH 050DH**
Operation interface:	Panel / software	Communication	Control mode:	PR (set with P5.004)
Default:	20.0	200	Data size:	32-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.1 to 500.0	1 to 5000	-	-
Format:	DEC	DEC	-	-
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-
Model:	-E			

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).



Speed and Time Setti...
Accel / Decel Time
Delay Time
Internal Target Speed
General Parameter S...
Electronic Gear Ratio
Software Limit
Deceleartion Time for A...
Event ON/OFF Setting
Homing Setting
Homing Mode
Homing Speed Setting
Homing Definition
PR Mode Setting
[PR#01] T:0
[PR#02] T:0
[PR#03] T:0
[PR#04] T:0
[PR#05] T:0
[PR#06] T:0
[PR#07] T:0

Homing | Chart

P5.004: Homing Mode
X=> Homing Method: X:0: homing in forward direction and define PL as homing origin
Y=> Signal Setting: Y:0: return to Z pulse
Z=> Behavior after Reaching the Limit: Z:0: display error

Homing Speed Setting
P5.005 : High Speed Homing (1st Speed Setting) 1000 (1 ~ 20000)
P5.006 : Low Speed Homing (2nd Speed Setting) 200 (1 ~ 5000)

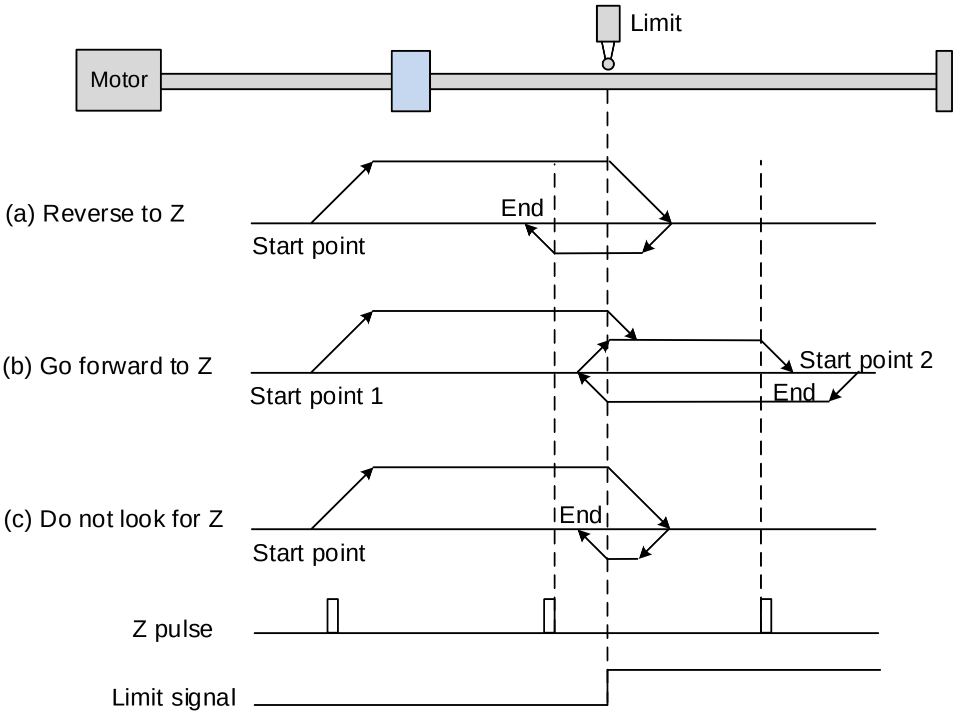
P6.000, P6.001: Homing Definition
PATH: Path Type 0:STOP
ACC: Acceleration Time AC00 : 200 (P5.020)
DEC1: 1st Deceleration Time AC00 : 200 (P5.020)
DEC2: 2nd Deceleration Time Use the same deceleration time as STP command. STP command in "General Parameter Setting".
DLY: Delay Time DLY00 : 0 (P5.040)
BOOT: Activation mode, when powered on: ● 0: disable homing function ○ 1: enable homing function
P6.001: Origin Definition 0 (-2147483648 ~ 2147483647)

Figure 7.1.3.1.2 Homing 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) and then decelerates once it reaches 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.

(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) and then decelerates once it reaches 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.

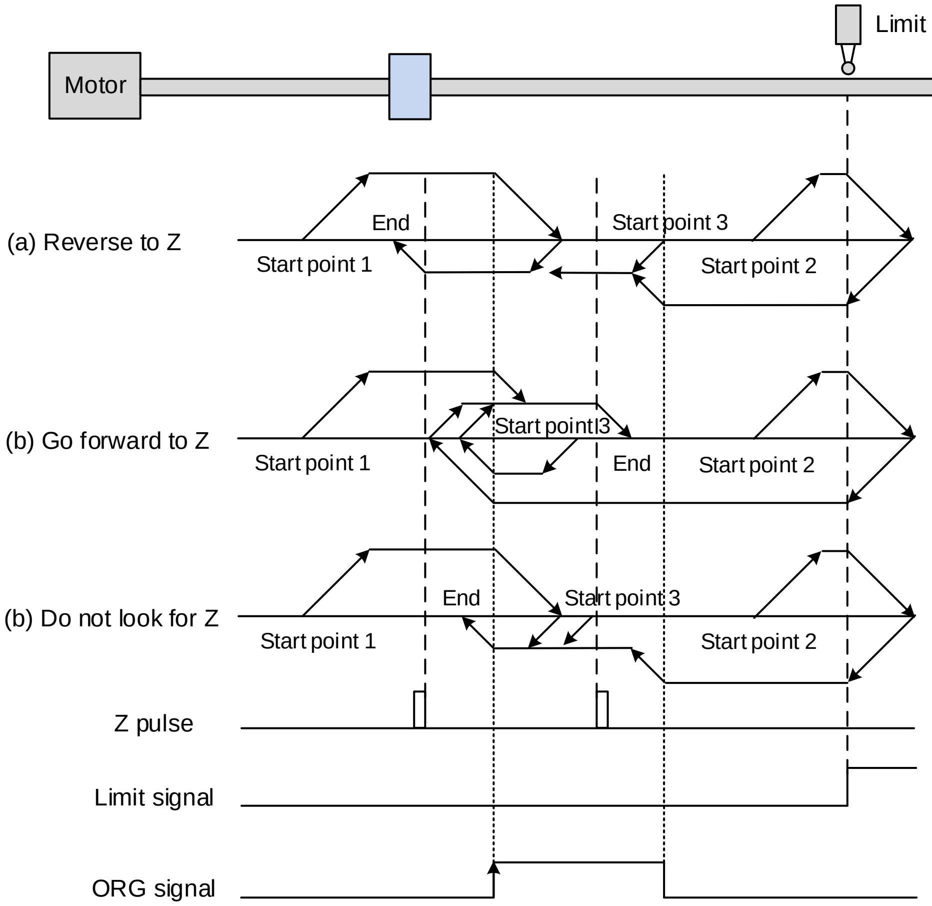
If you set the servo to look for the Z pulse in the forward direction and the limit signal at the start position is triggered (high, Start point 2), the servo operates at low speed (second speed setting) in the reverse direction to look for the rising-edge limit signal. Then the servo starts to look for the Z pulse in the forward direction once it reaches 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) and then decelerates once it reaches 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 ORG signal.

   This method uses the rising edge of the home sensor (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) and then decelerates once it reaches 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.

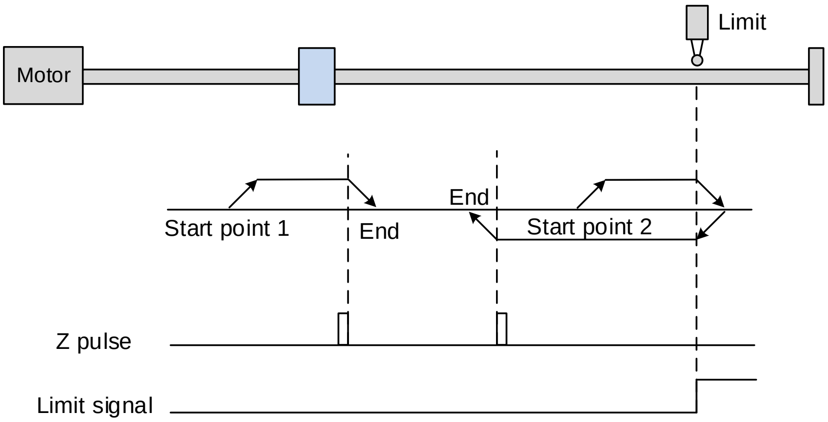
If the ORG signal at the start point is un-triggered and the current position is relatively closer to the limit switch (Start point 2), the servo operates at high speed (first speed setting) until reaching the limit switch. You can set whether to show an error or reverse the operating direction when the servo reaches the limit switch. If you set the servo to reverse direction, it reverses to reach the home sensor (ORG), 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.

(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.

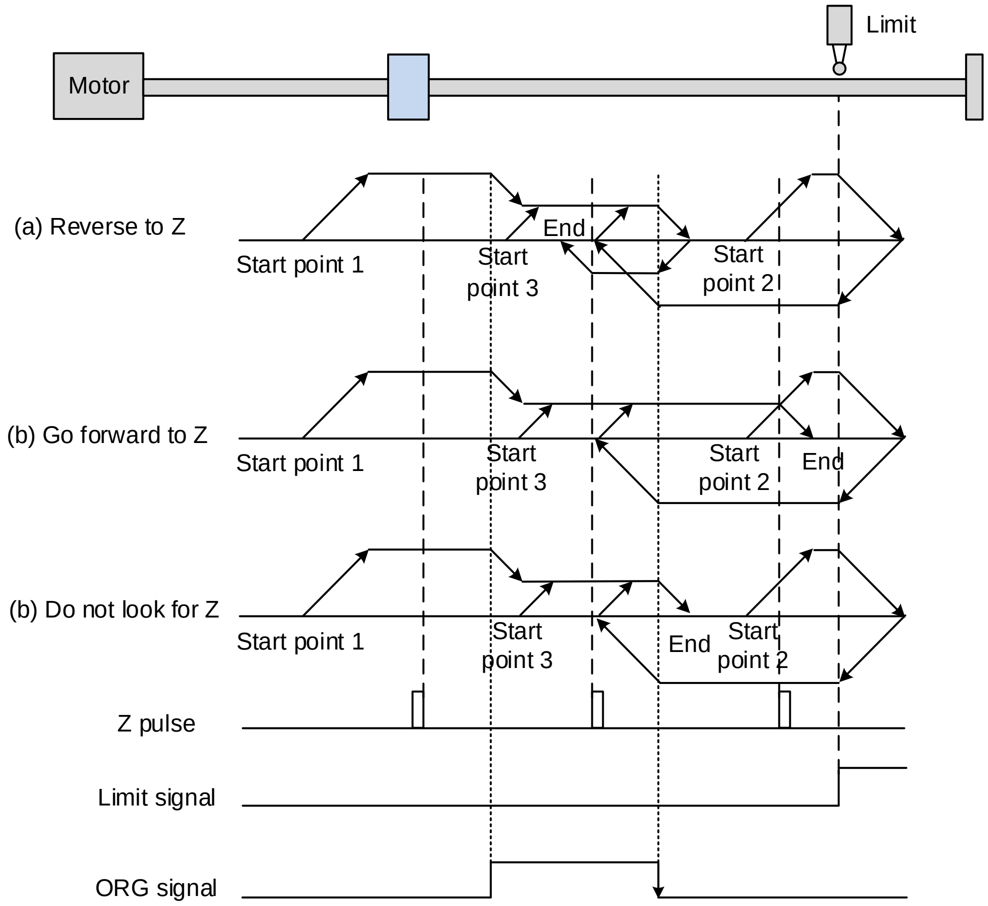
3. Referencing the Z pulse.

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



4. Referencing the falling edge of the ORG signal.

   This method uses the falling edge of the home sensor (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.



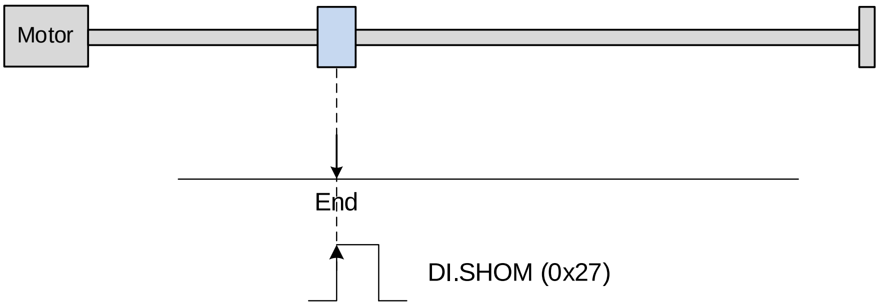
(a) If you set the servo to look for the Z pulse in the reverse direction, when the ORG signal at the start point is un-triggered (low, Start point 1), the servo operates at high speed (first speed setting) until reaching the rising edge of the ORG signal. Then it decelerates and switches to low speed (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 and the current position is relatively closer to the limit switch (Start point 2), 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 operating direction when the servo reaches the limit switch. If you set the servo to reverse direction, it reverses to reach the home sensor (ORG), 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.

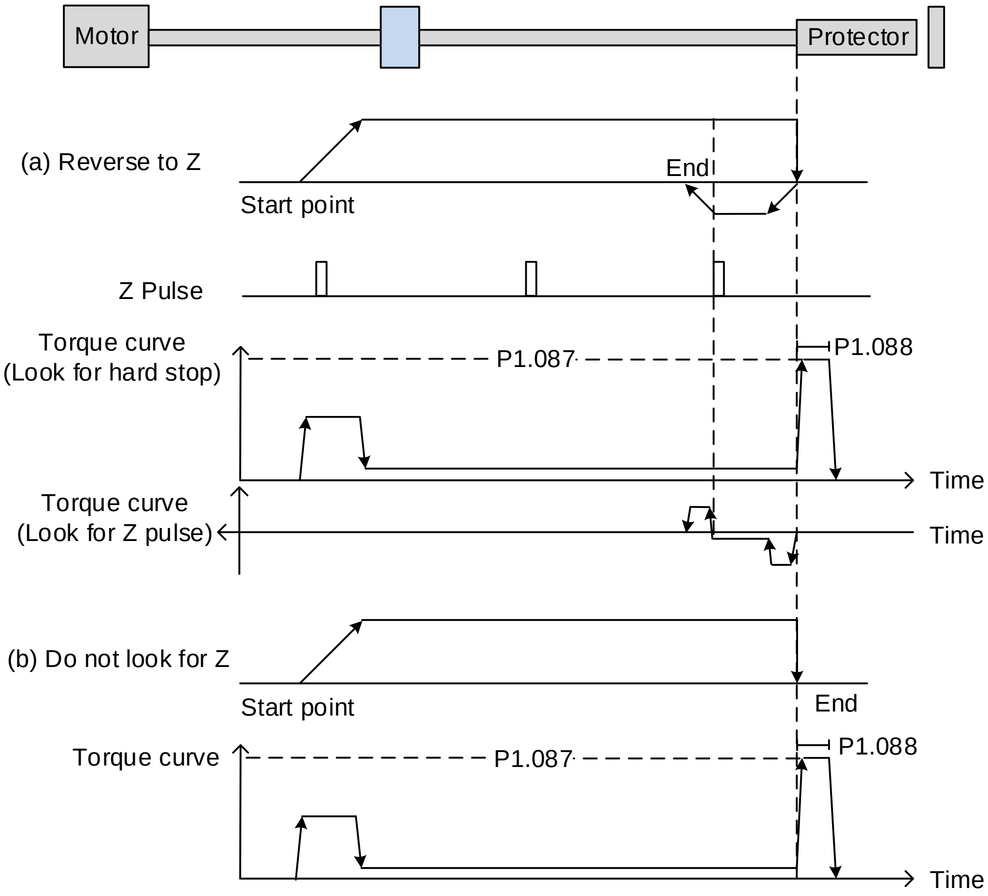
(b) If you set the servo to look for the Z pulse in the forward direction or not to look for the Z pulse (this is similar to method (a) Reverse to Z), refer to the preceding timing diagram.

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 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 not to 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.

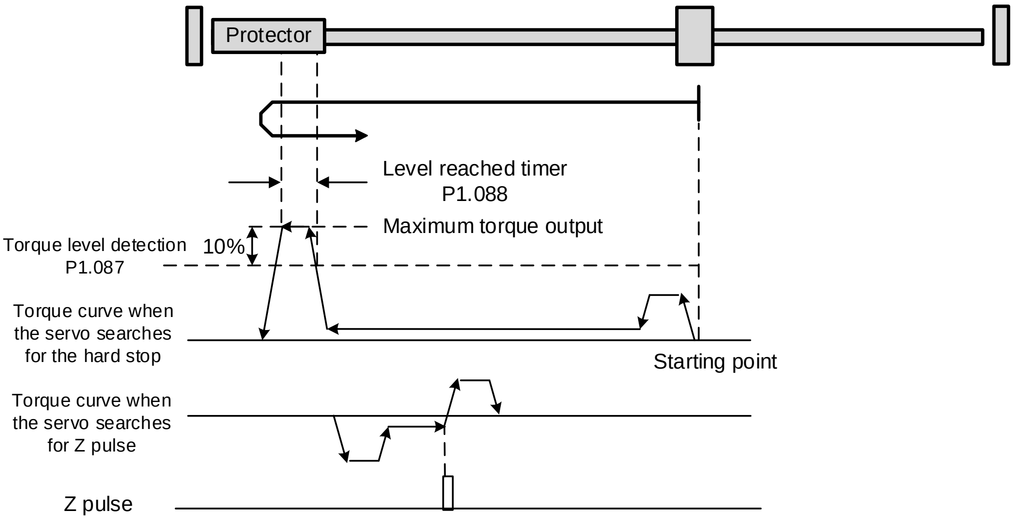
Pay special attention when executing the Torque homing procedure. The motor’s actual maximum torque output is 10% greater than the torque level detection setting (P1.087); excessive impact may cause damage to the machine.

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:	-E		

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:	-E		

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, there are four monitoring variables for you to monitor the servo commands and feedback status in the PR mode. These variables are Position command PUU (Cmd_O), Register of PR command endpoint (Cmd_E), Feedback position 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 commands are issued after the 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.

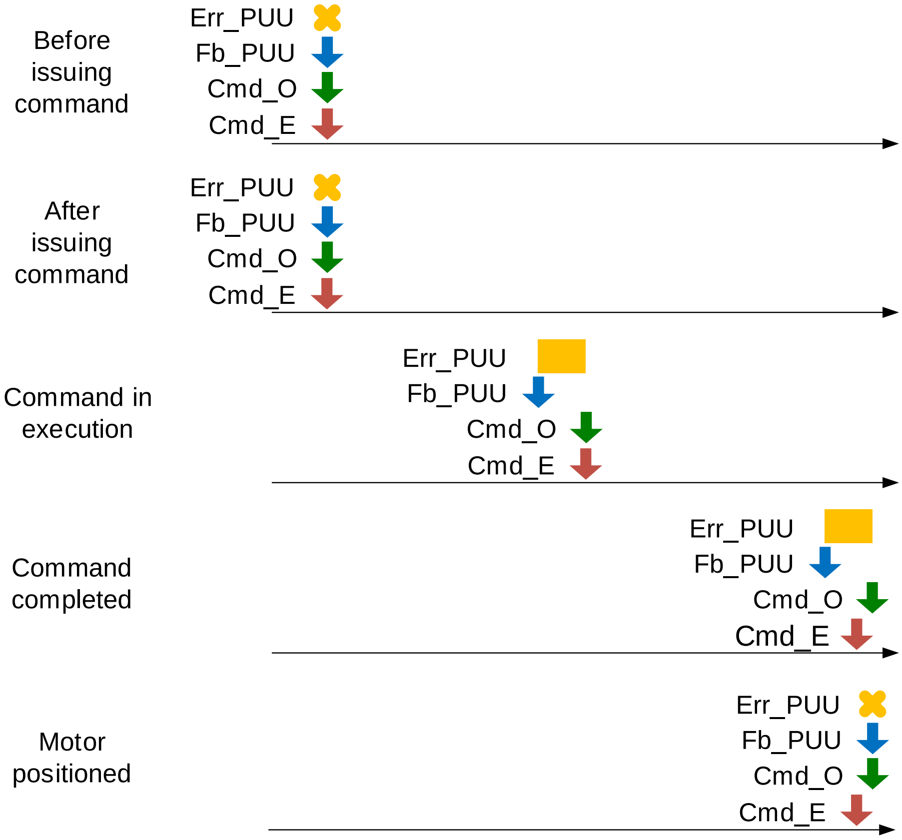


Figure 7.1.3.1.3 Timing diagram for monitoring variables in Homing mode

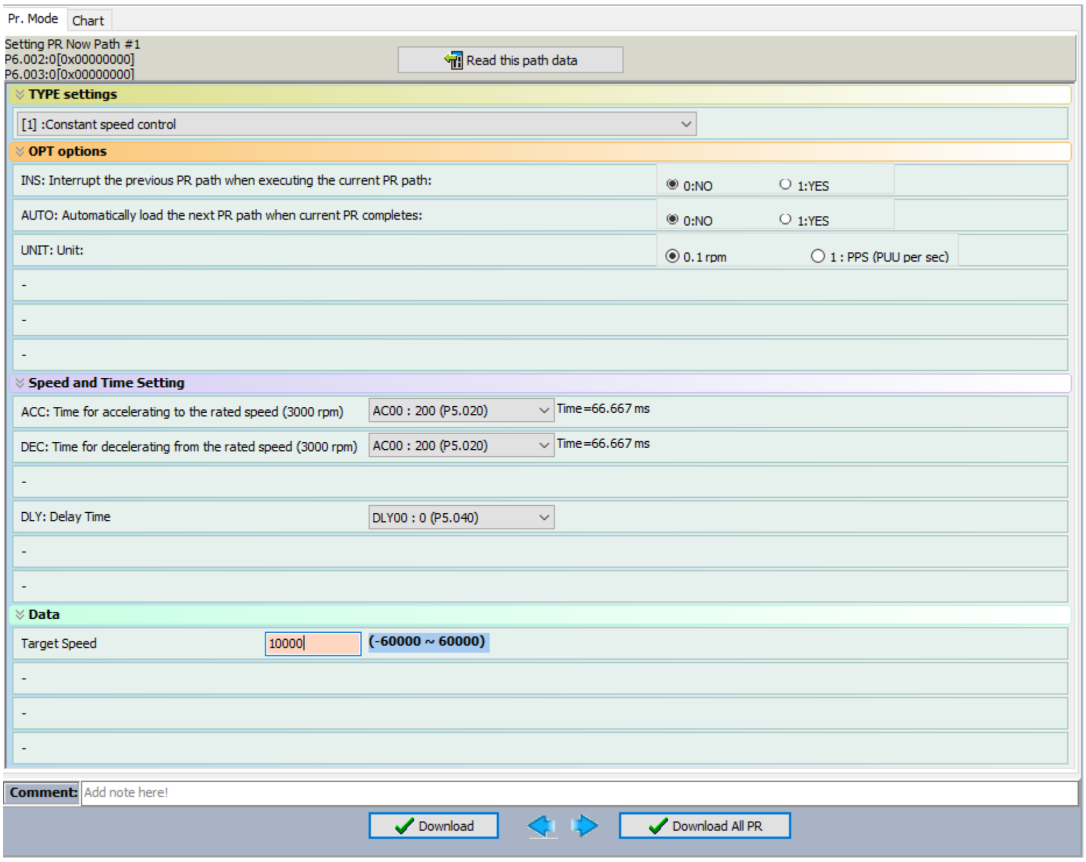
7.1.3.2 Speed command

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

- INS is the interrupt function that allows the next command to interrupt the previous motion command. 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 accelerating from 0 to the target speed or for decelerating 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.

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 Speed control command is in operation.



Setting PR Now Path #1
P6.002:0[0x00000000]
P6.003:0[0x00000000]

TYPE settings

[1] :Constant speed control

OPT options

INS: Interrupt the previous PR path when executing the current PR path: ● 0:NO ○ 1:YES

AUTO: Automatically load the next PR path when current PR completes: ● 0:NO ○ 1:YES

UNIT: Unit: ● 0.1 rpm ○ 1 : PPS (PUU per sec)

-

-

-

Speed and Time Setting

ACC: Time for accelerating to the rated speed (3000 rpm) AC00 : 200 (P5.020) Time=66.667 ms

DEC: Time for decelerating from the rated speed (3000 rpm) AC00 : 200 (P5.020) Time=66.667 ms

-

DLY: Delay Time DLY00 : 0 (P5.040)

-

-

Data

Target Speed 10000 **(-60000 ~ 60000)**

-

-

-

Comment: Add note here!

Figure 7.1.3.2.1 PR mode Speed control screen in ASDA-Soft

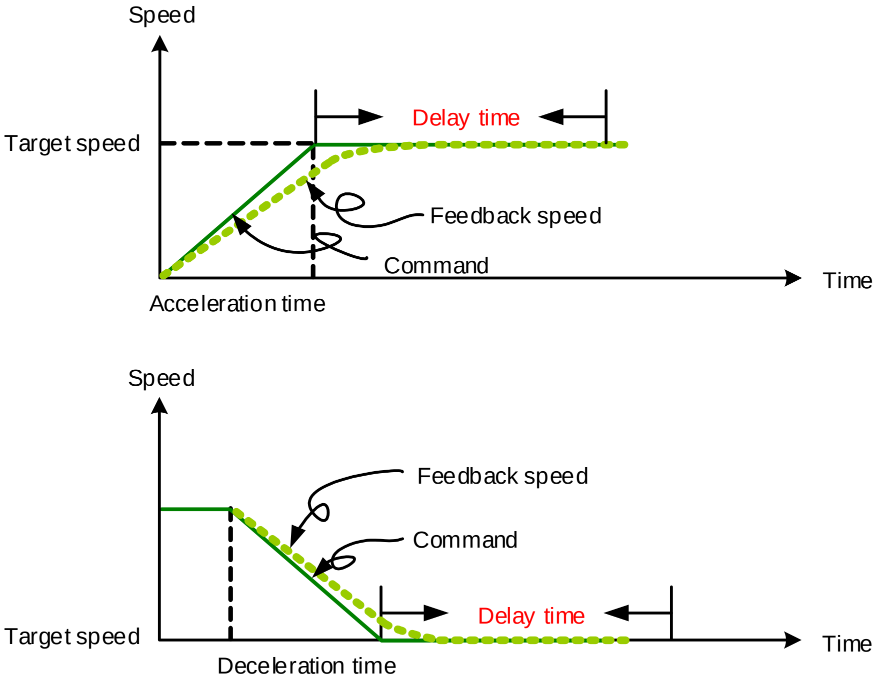


Figure 7.1.3.2.2 Parameters for PR mode speed control

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	3	2	1	0
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.

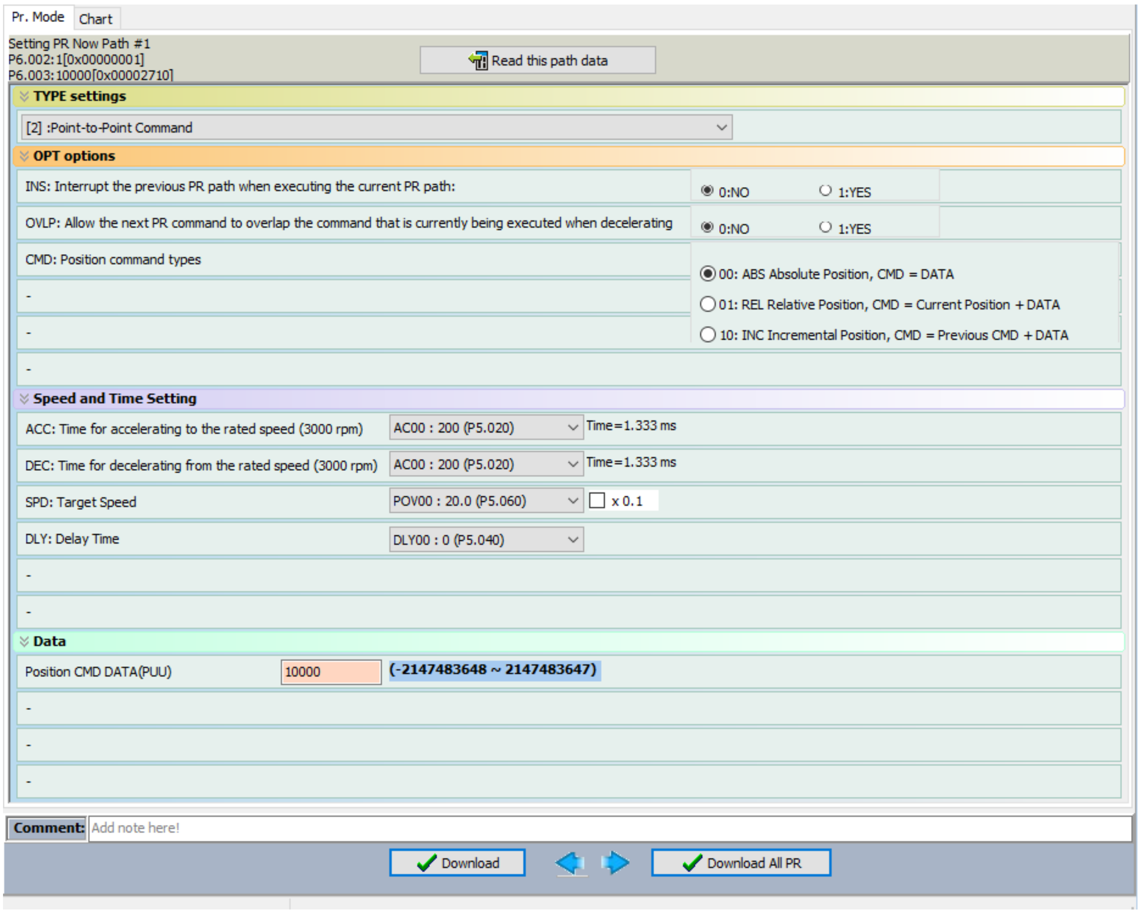
7.1.3.3 Position command

The PR mode includes a position control function 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 screen in ASDA-Soft. Refer to Figure 7.1.3.3.1.

- INS is the interrupt function that allows the next command to interrupt the previous motion command. Refer to Section 7.1.6 for more details.
- OVLP is the function that allows the next PR command to overlap the command currently being executed when decelerating. 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 accelerating from 0 to the target speed or for decelerating 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 (Postion CMD DATA) is user-defined and its unit is PUU.

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.



Setting PR Now Path #1
P6.002:1[0x00000001]
P6.003:10000[0x00002710]

TYPE settings

[2] :Point-to-Point Command

OPT options

INS: Interrupt the previous PR path when executing the current PR path: ● 0:NO ○ 1:YES

OVLP: Allow the next PR command to overlap the command that is currently being executed when decelerating ● 0:NO ○ 1:YES

CMD: Position command types

● 00: ABS Absolute Position, CMD = DATA
○ 01: REL Relative Position, CMD = Current Position + DATA
○ 10: INC Incremental Position, CMD = Previous CMD + DATA

Speed and Time Setting

ACC: Time for accelerating to the rated speed (3000 rpm) AC00 : 200 (P5.020) Time=1.333 ms
DEC: Time for decelerating from the rated speed (3000 rpm) AC00 : 200 (P5.020) Time=1.333 ms
SPD: Target Speed POV00 : 20.0 (P5.060) ☐ x 0.1
DLY: Delay Time DLY00 : 0 (P5.040)

Data

Position CMD DATA(PUU) 10000 (-2147483648 ~ 2147483647)

Comment: Add note here!

Figure 7.1.3.3.1 PR mode Position control screen in ASDA-Soft

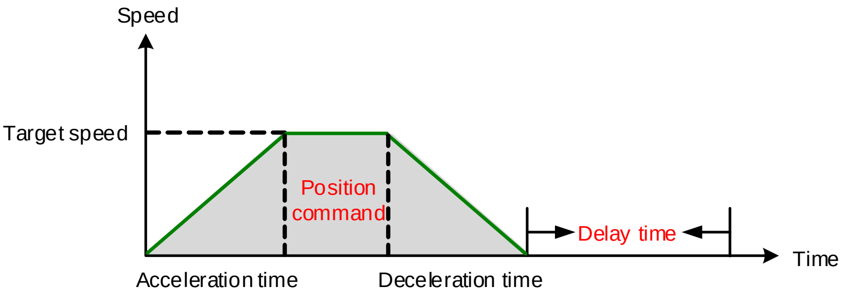


Figure 7.1.3.3.2 Parameters for PR mode position control

There are three types of position commands for the PR mode. You can choose the position command according to the application requirements. The functions of each type are described in the following examples. Note that the condition in these examples is that a position command is still being executed and another type of command interrupts. To see the definition of each command 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.

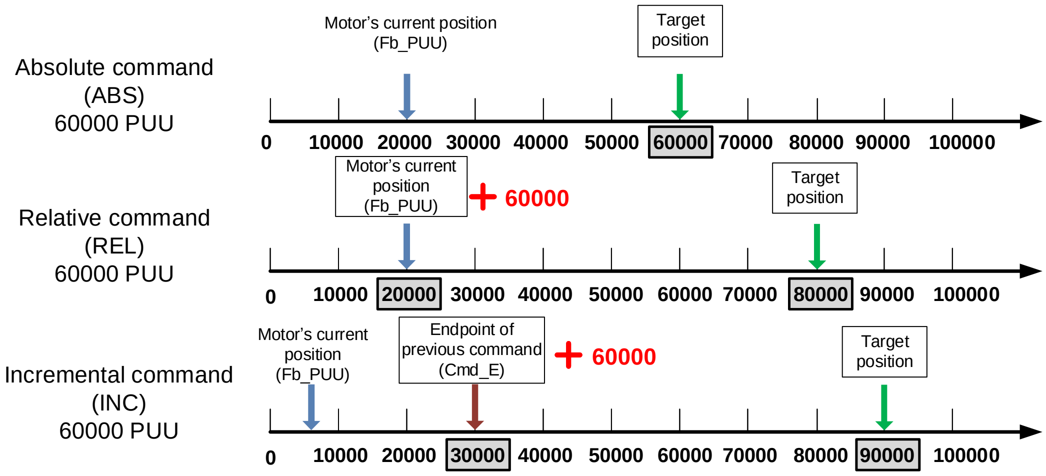


Figure 7.1.3.3.3 Three types of Position command

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]							

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	3	2	1	0	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 screen in ASDA-Soft (see Figure 7.1.3.4.2).

- INS is the interrupt function that allows the next command to interrupt the previous motion command. 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#0 - PR#99.

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

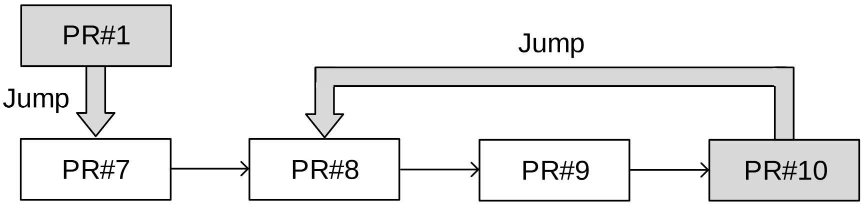
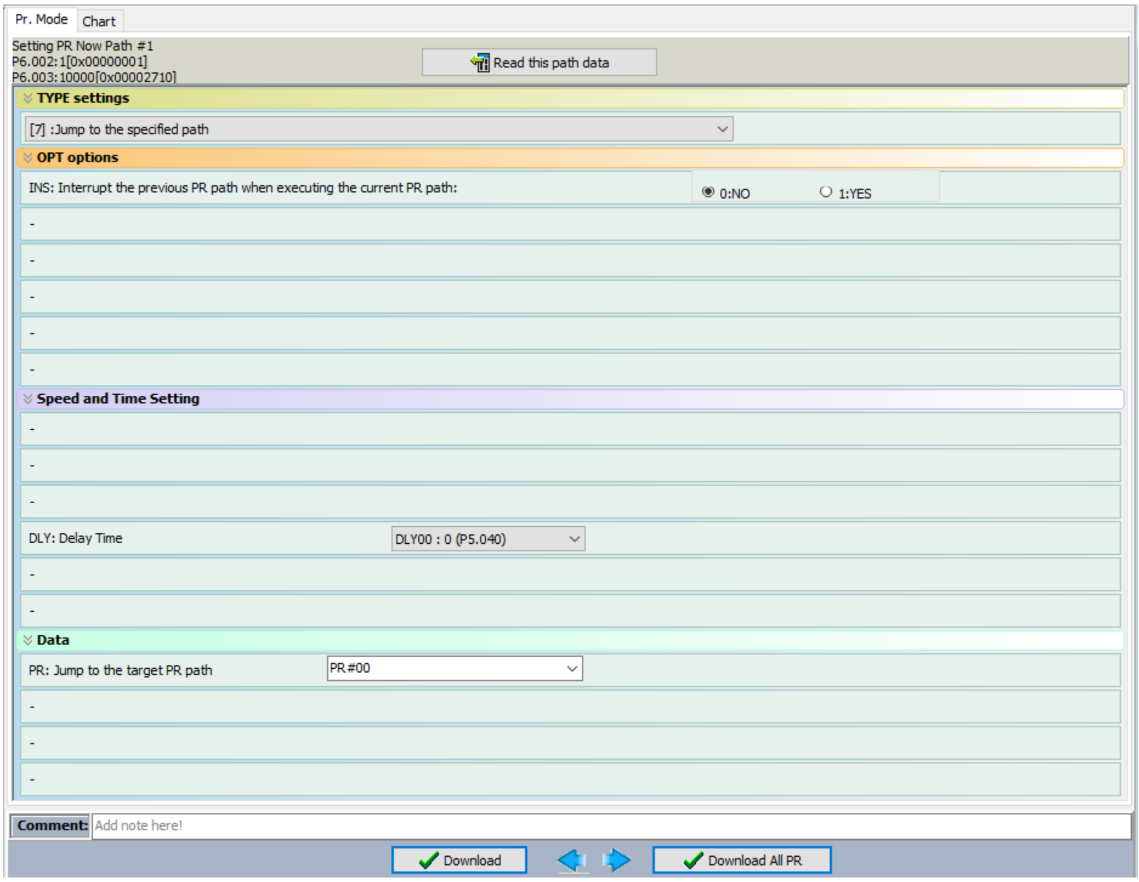


Figure 7.1.3.4.1 Jump command in PR mode



Setting PR Now Path #1
P6.002:1[0x00000001]
P6.003:10000[0x00002710]

TYPE settings

[7] :Jump to the specified path

OPT options

INS: Interrupt the previous PR path when executing the current PR path: ● 0:NO ○ 1:YES

Speed and Time Setting

DLY: Delay Time: DLY00 : 0 (P5.040)

Data

PR: Jump to the target PR path: PR#00

Comment: Add note here!

Figure 7.1.3.4.2 PR mode Jump command screen in ASDA-Soft

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#0 - PR#99)							

Note:

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

Bit	3	2	1	0
Property	-	-	-	INS

INS: interrupts the previous path when the current path is executed.

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

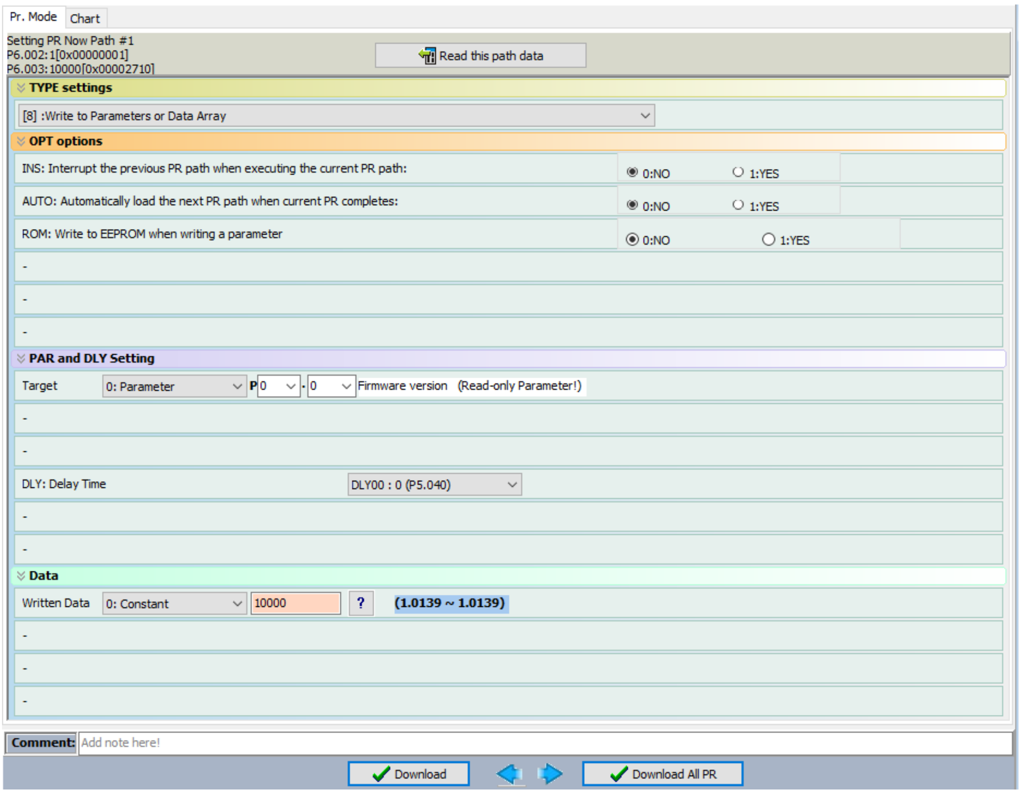
7.1.3.5 Write command

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 screen in ASDA-Soft (see Figure 7.1.3.5.1).

- INS is the interrupt function that allows the next command to interrupt the previous motion command. 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 life 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 and data source (Written Data).

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

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



Setting PR Now Path #1
P6.002:1[0x00000001]
P6.003:10000[0x00002710]

TYPE settings

[8] :Write to Parameters or Data Array

OPT options

INS: Interrupt the previous PR path when executing the current PR path: ● 0:NO ○ 1:YES

AUTO: Automatically load the next PR path when current PR completes: ● 0:NO ○ 1:YES

ROM: Write to EEPROM when writing a parameter ● 0:NO ○ 1:YES

PAR and DLY Setting

Target 0: Parameter P0 - 0 Firmware version (Read-only Parameter!)

DLY: Delay Time DLY00 : 0 (P5.040)

Data

Written Data 0: Constant 10000 ? (1.0139 ~ 1.0139)

Figure 7.1.3.5.1 PR mode Write command screen in ASDA-Soft

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	3	2	1	0
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	3	2	1	0	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 command (Index Position)

The PR mode includes a Rotary Axis Position command, which creates a rotary axis position system and positions the motor within the position system. Unlike other feedback positions 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 using the Rotary Axis Position command 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 10.

You can click **Indexing Coordinates Wizard** in the PR mode screen in 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 0 PUU to PR#1, 10000 PUU to PR#2, 20000 PUU to PR#3, and so on up to PR#8. 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 an interrupt function that interrupts the previous motion command. Refer to Section 7.1.6 for more details.
- OVLP is the function that allows the next PR command to overlap the command currently being executed when decelerating. 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).

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 feedback position 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.

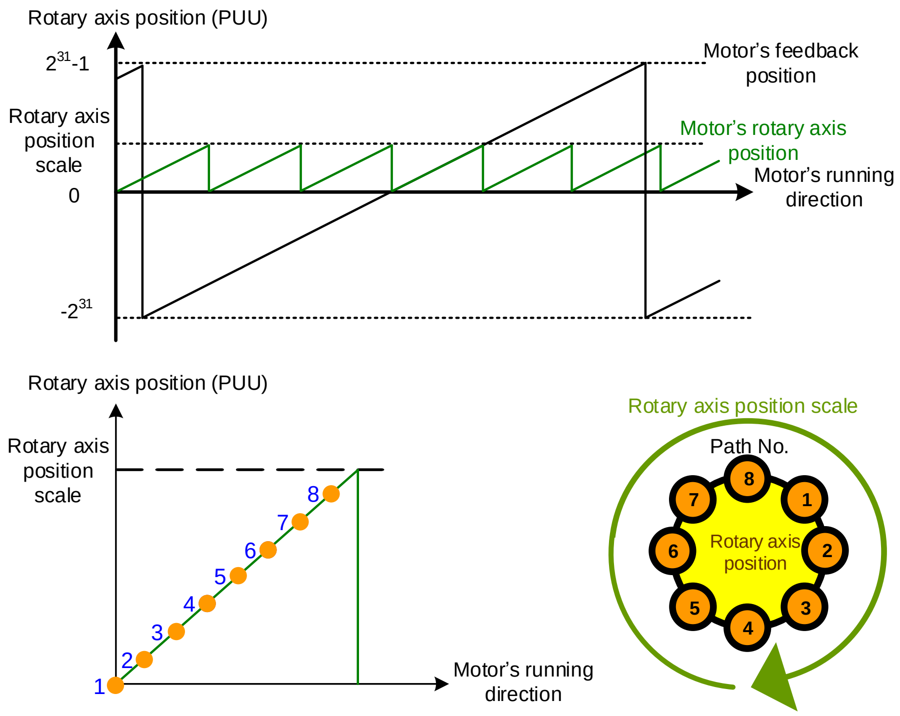
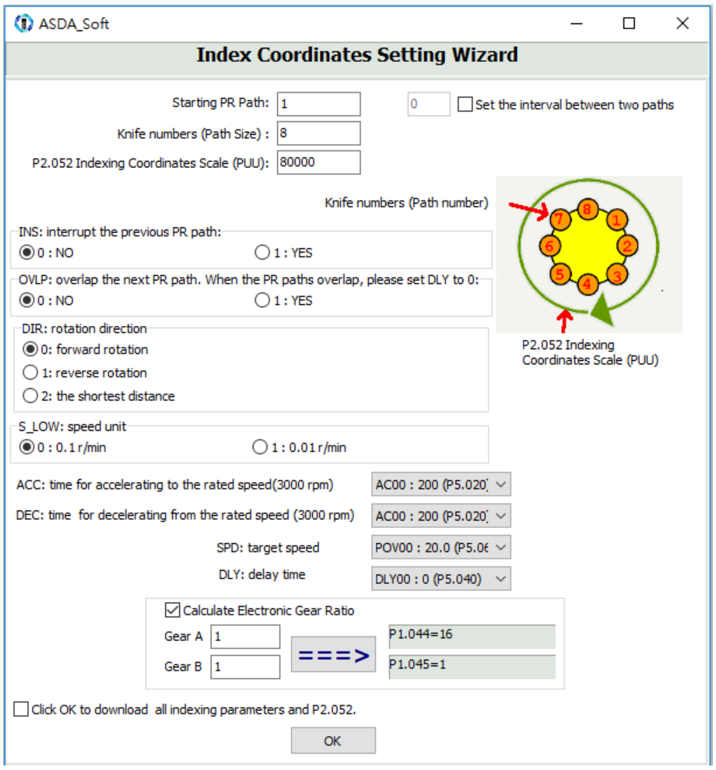


Figure 7.1.3.6.1 Rotary axis position in PR mode



Index Coordinates Setting Wizard

Starting PR Path: 1
0 ☐ Set the interval between two paths
Knife numbers (Path Size) : 8
P2.052 Indexing Coordinates Scale (PUU): 80000

INS: interrupt the previous PR path:
● 0 : NO ○ 1 : YES

OVLP: overlap the next PR path. When the PR paths overlap, please set DLY to 0:
● 0 : NO ○ 1 : YES

DIR: rotation direction
● 0: forward rotation
○ 1: reverse rotation
○ 2: the shortest distance

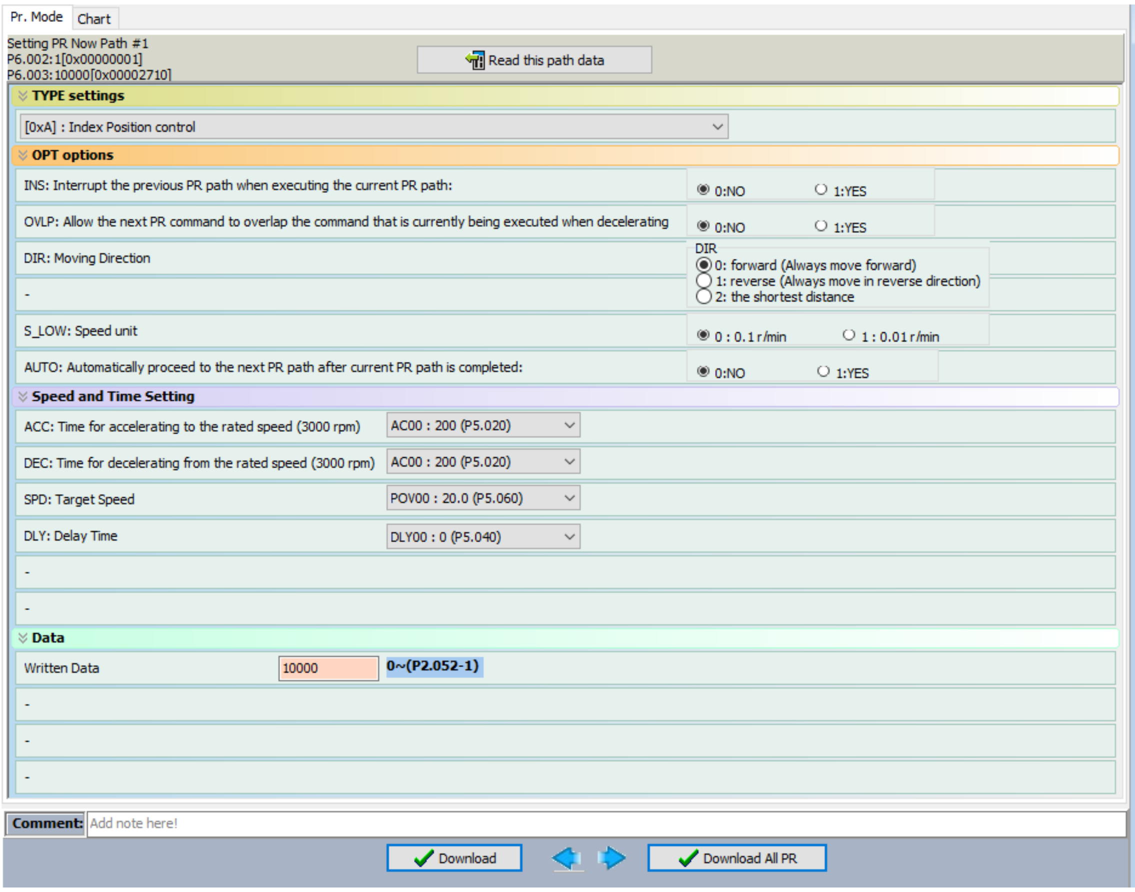
S_LOW: speed unit
● 0 : 0.1 r/min ○ 1 : 0.01 r/min

ACC: time for accelerating to the rated speed(3000 rpm) AC00 : 200 (P5.020)
DEC: time for decelerating from the rated speed (3000 rpm) AC00 : 200 (P5.020)
SPD: target speed POV00 : 20.0 (P5.06
DLY: delay time DLY00 : 0 (P5.040)

☑ Calculate Electronic Gear Ratio
Gear A 1 ===> P1.044=16
Gear B 1 P1.045=1

☐ Click OK to download all indexing parameters and P2.052.

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



Setting PR Now Path #1
P6.002:1[0x00000001]
P6.003:10000[0x00002710]

TYPE settings

[0xA] : Index Position control

OPT options

INS: Interrupt the previous PR path when executing the current PR path: ● 0:NO ○ 1:YES

OVLP: Allow the next PR command to overlap the command that is currently being executed when decelerating ● 0:NO ○ 1:YES

DIR: Moving Direction
DIR
● 0: forward (Always move forward)
○ 1: reverse (Always move in reverse direction)
○ 2: the shortest distance

S_LOW: Speed unit ● 0 : 0.1 r/min ○ 1 : 0.01 r/min

AUTO: Automatically proceed to the next PR path after current PR path is completed: ● 0:NO ○ 1:YES

Speed and Time Setting

ACC: Time for accelerating to the rated speed (3000 rpm) AC00 : 200 (P5.020)

DEC: Time for decelerating from the rated speed (3000 rpm) AC00 : 200 (P5.020)

SPD: Target Speed POV00 : 20.0 (P5.060)

DLY: Delay Time DLY00 : 0 (P5.040)

Data

Written Data 10000 **0~(P2.052-1)**

Comment: Add note here!

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

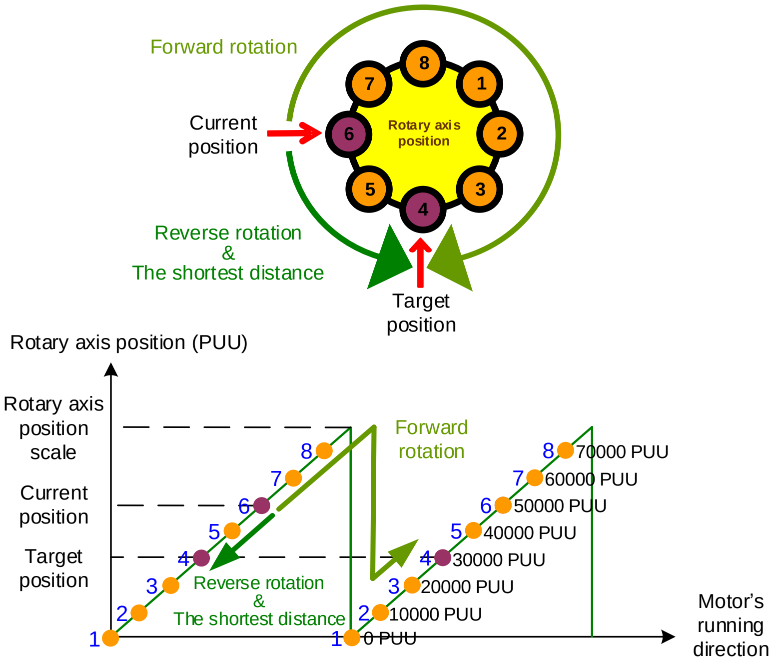


Figure 7.1.3.6.4 Motor's operation direction and rotary axis position

Table 7.1.3.6.1 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	3	2	1	0	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	3	2	1	0
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 procedure

In the PR mode, there are six types of commands. To make users understand how the PR procedure works, ASDA-Soft presents the execution order and calling sequence of all PR procedures. The symbols and contents in the PR diagram are shown as follows, including five parts: number, command execution type (property), command type, next PR command, and command information. See Figure 7.1.4.1.

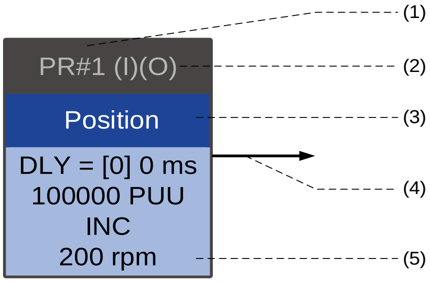


Figure 7.1.4.1 Overview of the PR procedure

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

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

(3) Command type: there are six types of PR commands: 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 command: if the current path is followed by a PR command, 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#0 always signifies the homing procedure, which is marked as “Homing”. See Figure 7.1.4.2.

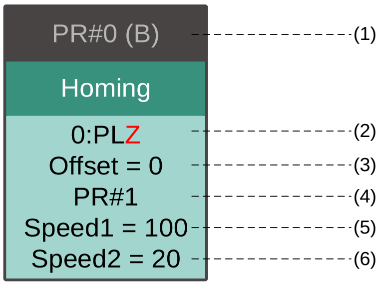


Figure 7.1.4.2 Homing methods display

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

(2) Method selection: including the homing methods and Z pulse setting which are shown in the following table.

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#1 to PR#99. It is marked as “Speed”. See Figure 7.1.4.3.

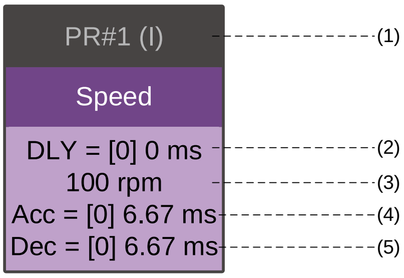


Figure 7.1.4.3 Speed command display

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

(2) Delay time (DLY): determined by 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 accelerating from 0 to the target speed.

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

Position command

You can use the Position command in any PR paths from PR#1 to PR#99. It is marked as "Position", and includes the options of "stop once the positioning is complete" and "automatically loads the next PR path once the positioning is complete". The only difference between the two options is that the latter shows an arrow pointing to the next PR path. See Figure 7.1.4.4.

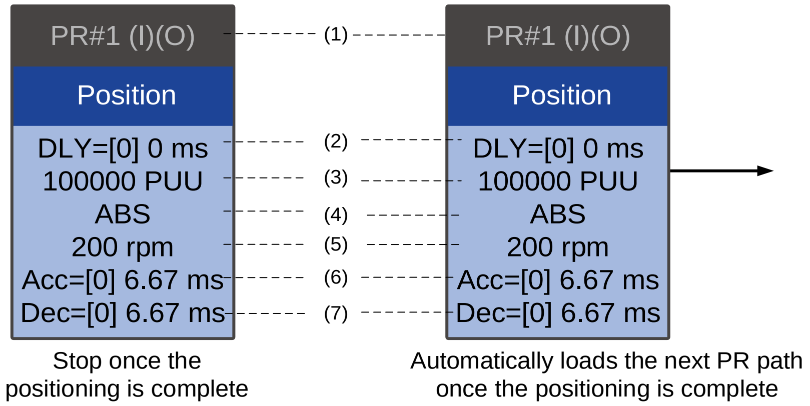


Figure 7.1.4.4 Position command display

(1) Command execution type (property): a Position command can interrupt (INS) the previous PR path. If the Interrupt function is enabled, it displays (I); 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, it displays (O); 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 accelerating from 0 to the target speed.

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

Jump command

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

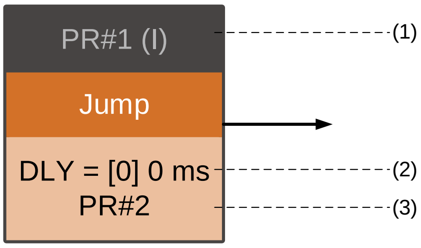


Figure 7.1.4.5 Jump command display

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

(2) Delay time (DLY): determined by 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#1 to PR#99. It is marked as “Write”. See Figure 7.1.4.6.

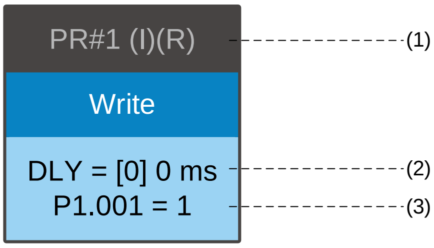


Figure 7.1.4.6 Write command display

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

(2) Delay time (DLY): determined by 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[#])

Rotary Axis Position command (Index Position)

You can use the Rotary Axis Position command in any PR paths from PR#1 to PR#99. The setting of the number of PR paths for the Rotary Axis Position command determines the number of path segments. It is marked as “Index Position”. See Figure 7.1.4.7.

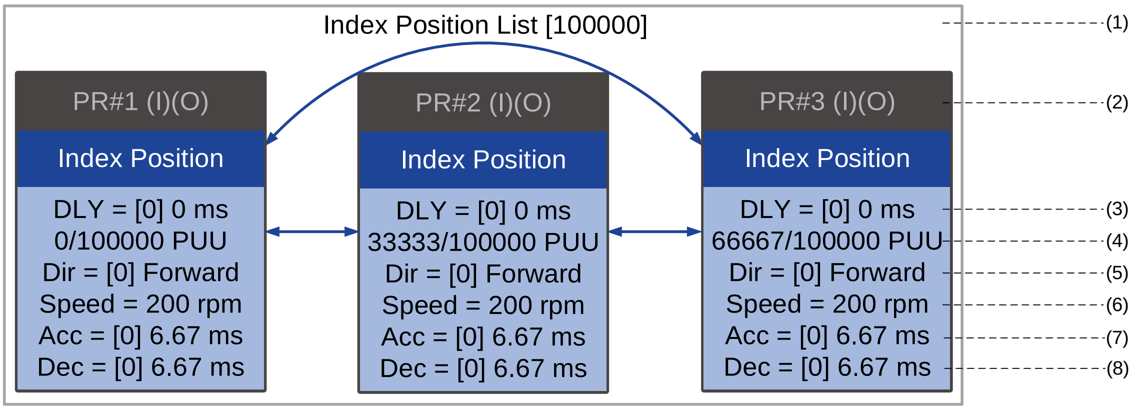


Figure 7.1.4.7 Rotary Axis Position command (Index Position) display

(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, it displays (I); 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, it displays (O); 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 accelerating from 0 to the target speed.

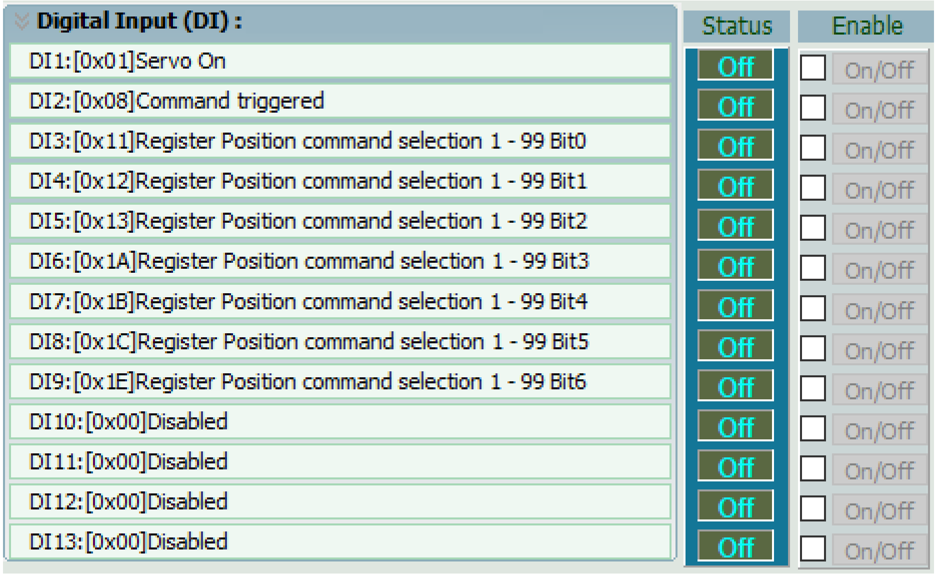
(8) Deceleration time (Dec): determined by the shared parameters. The software calculates and displays the required duration for decelerating from the target speed to 0.

7.1.5 Trigger methods for the PR command

There are three types of PR trigger methods: Digital input (DI) triggering, Event triggering, and PR command trigger register (P5.007). Choose the most suitable trigger method according to the applications and requirements.

Digital input (DI) triggering

You can choose the PR path to be executed by using the internal command registers (POS0 - POS6) and use the CTRG command to trigger the selected PR path. Before triggering the PR command with the digital inputs (DIs), you must define the functions of the 8 sets 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.



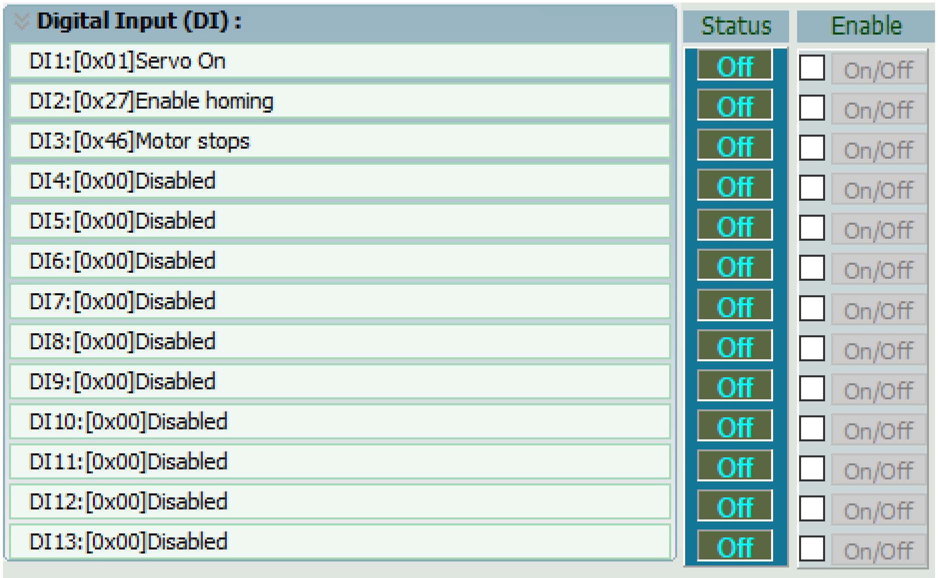
Digital Input (DI) :	Status	Enable
DI1:[0x01]Servo On	Off	☐ On/Off
DI2:[0x08]Command triggered	Off	☐ On/Off
DI3:[0x11]Register Position command selection 1 - 99 Bit0	Off	☐ On/Off
DI4:[0x12]Register Position command selection 1 - 99 Bit1	Off	☐ On/Off
DI5:[0x13]Register Position command selection 1 - 99 Bit2	Off	☐ On/Off
DI6:[0x1A]Register Position command selection 1 - 99 Bit3	Off	☐ On/Off
DI7:[0x1B]Register Position command selection 1 - 99 Bit4	Off	☐ On/Off
DI8:[0x1C]Register Position command selection 1 - 99 Bit5	Off	☐ On/Off
DI9:[0x1E]Register Position command selection 1 - 99 Bit6	Off	☐ On/Off
DI10:[0x00]Disabled	Off	☐ On/Off
DI11:[0x00]Disabled	Off	☐ On/Off
DI12:[0x00]Disabled	Off	☐ On/Off
DI13:[0x00]Disabled	Off	☐ On/Off

Figure 7.1.5.1 Digital IO setting screen in ASDA-Soft

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

Position command	POS 6	POS 5	POS 4	POS 3	POS 2	POS 1	POS 0	CTRG	Correspon-ding parameter
Homing	0	0	0	0	0	0	0	↑	P6.000 P6.001
PR#1	0	0	0	0	0	0	1	↑	P6.002 P6.003
…									…
PR#50	0	1	1	0	0	1	0	↑	P6.098 P6.099
PR#51	0	1	1	0	0	1	1	↑	P7.000 P7.001
…									…
PR#99	1	1	0	0	0	1	1	↑	P7.098 P7.099

In addition, there are two sets of DIs for special functions: DI.SHOM (0x27) and DI.STP (0x46). If the former is triggered, the servo drive executes homing based on the homing setting. If the latter is triggered, the servo drive stops the motor. You can use the Digital IO setting screen in ASDA-Soft to set these functions, as shown in Figure 7.1.5.2.



Digital Input (DI) :	Status	Enable
DI1:[0x01]Servo On	Off	☐ On/Off
DI2:[0x27]Enable homing	Off	☐ On/Off
DI3:[0x46]Motor stops	Off	☐ On/Off
DI4:[0x00]Disabled	Off	☐ On/Off
DI5:[0x00]Disabled	Off	☐ On/Off
DI6:[0x00]Disabled	Off	☐ On/Off
DI7:[0x00]Disabled	Off	☐ On/Off
DI8:[0x00]Disabled	Off	☐ On/Off
DI9:[0x00]Disabled	Off	☐ On/Off
DI10:[0x00]Disabled	Off	☐ On/Off
DI11:[0x00]Disabled	Off	☐ On/Off
DI12:[0x00]Disabled	Off	☐ On/Off
DI13:[0x00]Disabled	Off	☐ On/Off

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 commands, 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.

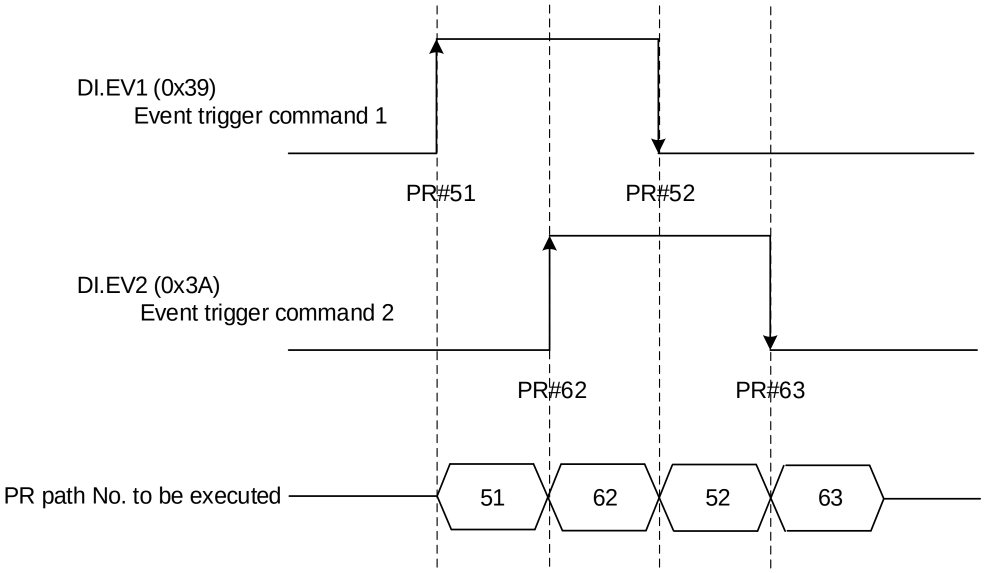
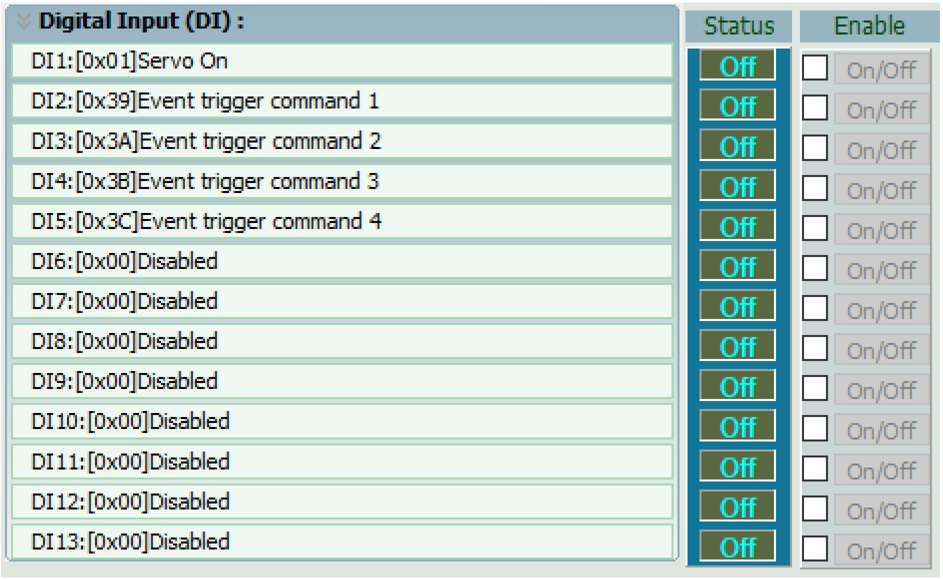


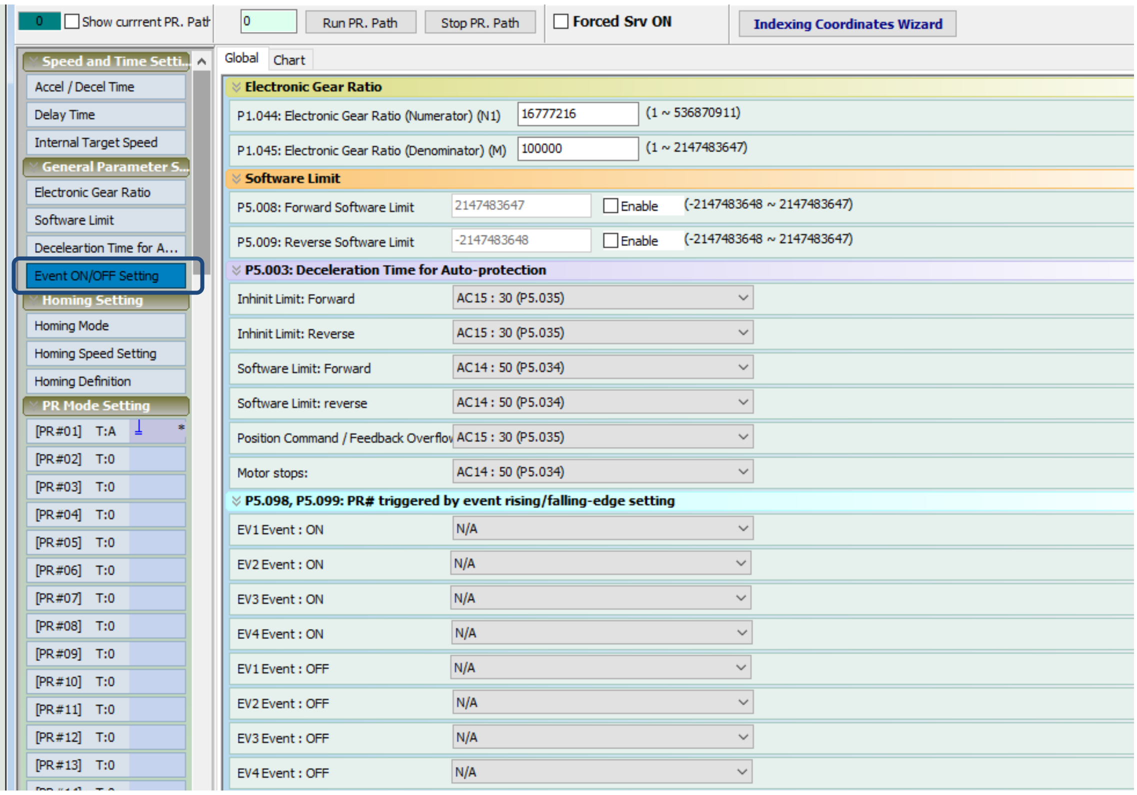
Figure 7.1.5.3 Example of event triggering timing diagram



Digital Input (DI) :	Status	Enable
DI1:[0x01]Servo On	Off	☐ On/Off
DI2:[0x39]Event trigger command 1	Off	☐ On/Off
DI3:[0x3A]Event trigger command 2	Off	☐ On/Off
DI4:[0x3B]Event trigger command 3	Off	☐ On/Off
DI5:[0x3C]Event trigger command 4	Off	☐ On/Off
DI6:[0x00]Disabled	Off	☐ On/Off
DI7:[0x00]Disabled	Off	☐ On/Off
DI8:[0x00]Disabled	Off	☐ On/Off
DI9:[0x00]Disabled	Off	☐ On/Off
DI10:[0x00]Disabled	Off	☐ On/Off
DI11:[0x00]Disabled	Off	☐ On/Off
DI12:[0x00]Disabled	Off	☐ On/Off
DI13:[0x00]Disabled	Off	☐ On/Off

Figure 7.1.5.4 Digital IO setting screen in ASDA-Soft

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 trigger of PR paths. See Figure 7.1.5.5.



Electronic Gear Ratio

P1.044: Electronic Gear Ratio (Numerator) (N1) 16777216 (1 ~ 536870911)

P1.045: Electronic Gear Ratio (Denominator) (M) 100000 (1 ~ 2147483647)

Software Limit

P5.008: Forward Software Limit 2147483647 ☐ Enable (-2147483648 ~ 2147483647)

P5.009: Reverse Software Limit -2147483648 ☐ Enable (-2147483648 ~ 2147483647)

P5.003: Deceleration Time for Auto-protection

Inhinit Limit: Forward AC15 : 30 (P5.035)

Inhinit Limit: Reverse AC15 : 30 (P5.035)

Software Limit: Forward AC14 : 50 (P5.034)

Software Limit: reverse AC14 : 50 (P5.034)

Position Command / Feedback Overflov AC15 : 30 (P5.035)

Motor stops: AC14 : 50 (P5.034)

P5.098, P5.099: PR# triggered by event rising/falling-edge setting

EV1 Event : ON N/A

EV2 Event : ON N/A

EV3 Event : ON N/A

EV4 Event : ON N/A

EV1 Event : OFF N/A

EV2 Event : OFF N/A

EV3 Event : OFF N/A

EV4 Event : OFF N/A

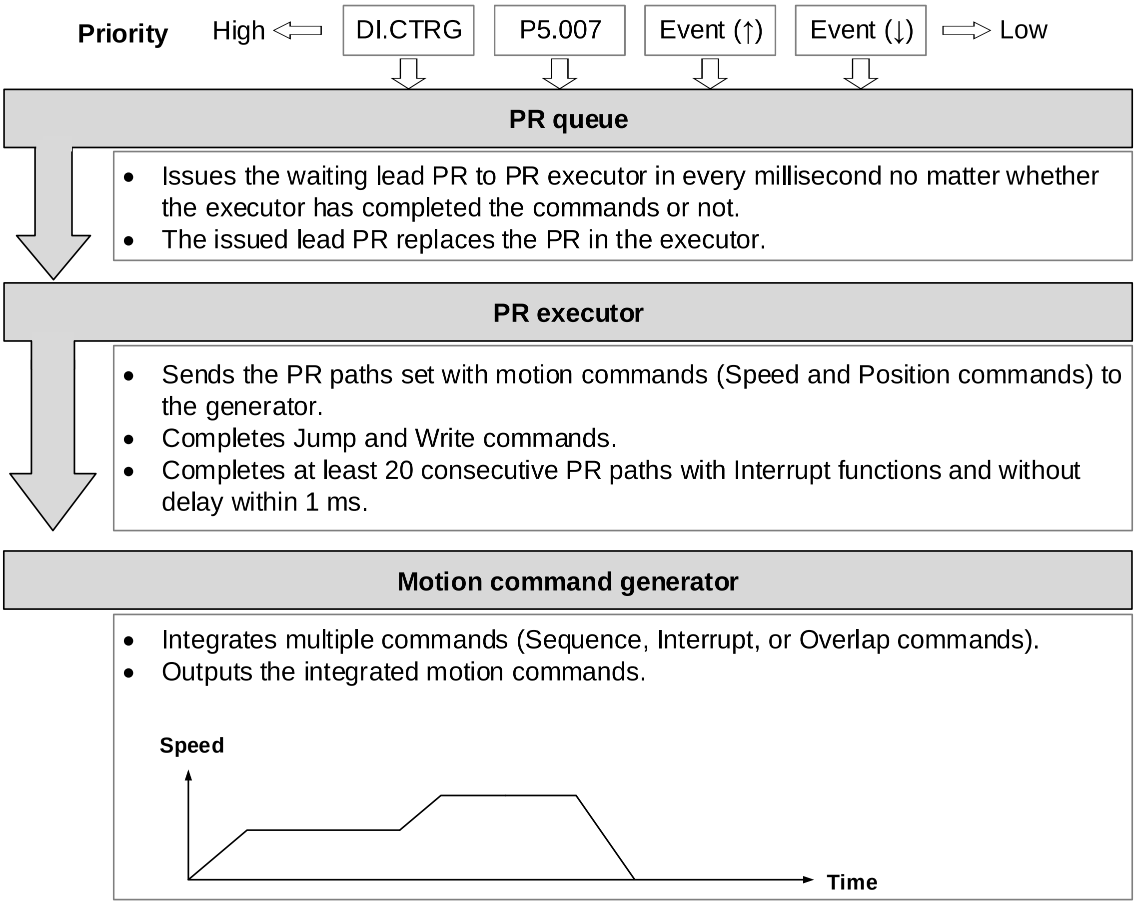
Figure 7.1.5.5 Event ON / OFF setting screen in ASDA-Soft

PR command trigger register (P5.007)

You can write the PR number 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 commands. Refer to the setting descriptions of P5.007 in Chapter 8.

7.1.6 PR procedure 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 commands. Once a PR procedure is triggered, it goes through three processing units, which are PR queue, PR executor, and motion command generator.



PR queue

- Issues the waiting lead PR to PR executor in every millisecond no matter whether the executor has completed the commands or not.
- The issued lead PR replaces the PR in the executor.

PR executor

- Sends the PR paths set with motion commands (Speed and Position commands) to the generator.
- Completes Jump and Write commands.
- Completes at least 20 consecutive PR paths with Interrupt functions and without delay within 1 ms.

Motion command generator

- Integrates multiple commands (Sequence, Interrupt, or Overlap commands).
- Outputs the integrated motion commands.

Figure 7.1.6.1 PR execution flow in the servo drive

■ **Trigger mechanism**

As mentioned in Section 7.1.5, the servo drive provides multiple trigger methods. A PR procedure is executed as long as a trigger signal is output. When two different trigger commands are generated within the same millisecond, the priority is as follows: DI triggering (DI.CTRG) > PR command trigger register (P5.007) > Rising-edge event triggering (Event ↑) > Falling-edge event triggering (Event ↓). Within this millisecond, the command with higher priority is executed first and then the command with lower priority is sent in the next millisecond. If three trigger commands are generated in the same millisecond, the third 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 will be 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 Interrupt functions (INS) without delay (DLY) within 1 ms. If there are PR paths that have not been completed within 1 ms, and the PR queue has already sent a new PR group to the PR executor, then the new PR group replaces the previous PR group. 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 ms 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 with the Interrupt setting 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.

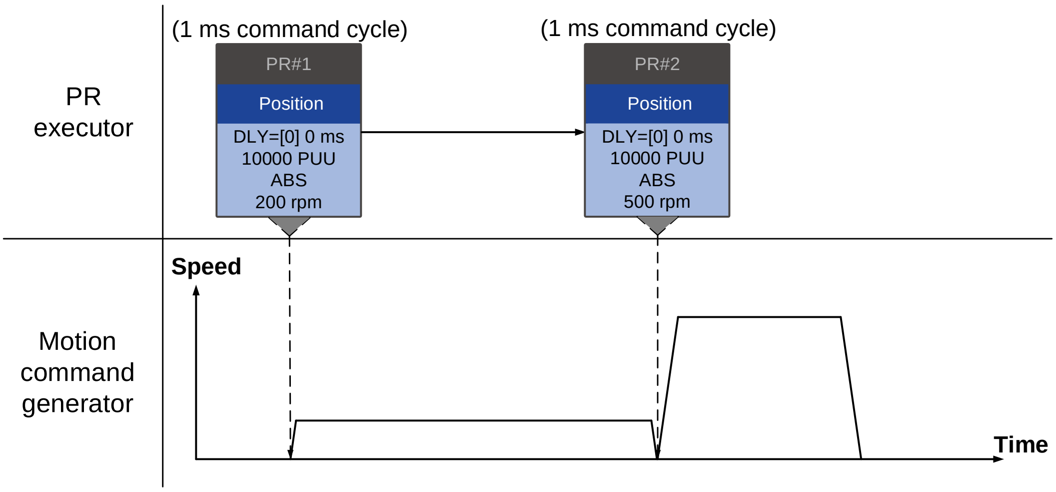
Sequence command

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 following command is only executed after the delay time (DLY) set in the previous command. 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.

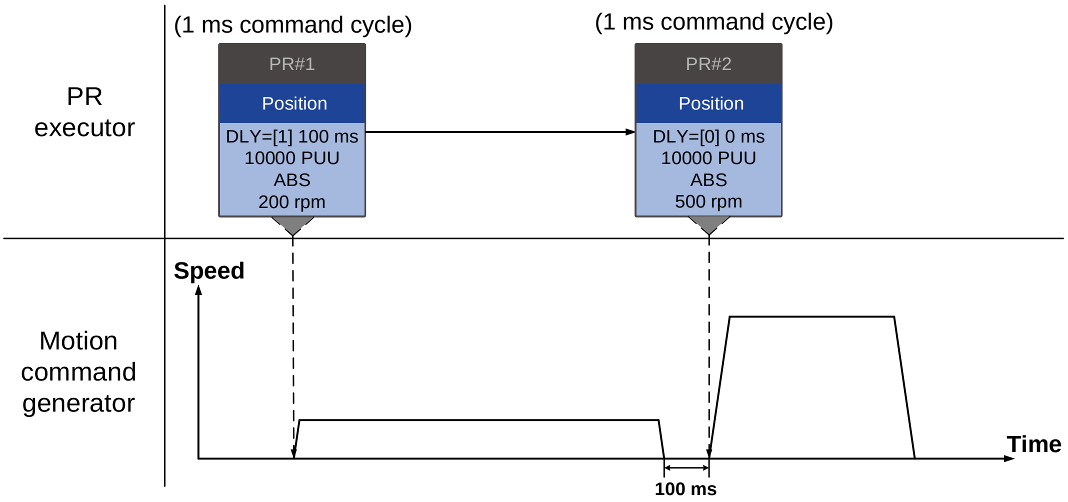
- Position command ▶ Position command

When the PR executor receives two consecutive Position commands without the Interrupt or Overlap function, the PR executor issues the first Position command to the motion command generator, and the generator starts the first part of position control. After the first Position command completes, if no delay time is set, the PR executor issues the second Position command for the generator to start the second part of position control, 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 issues 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



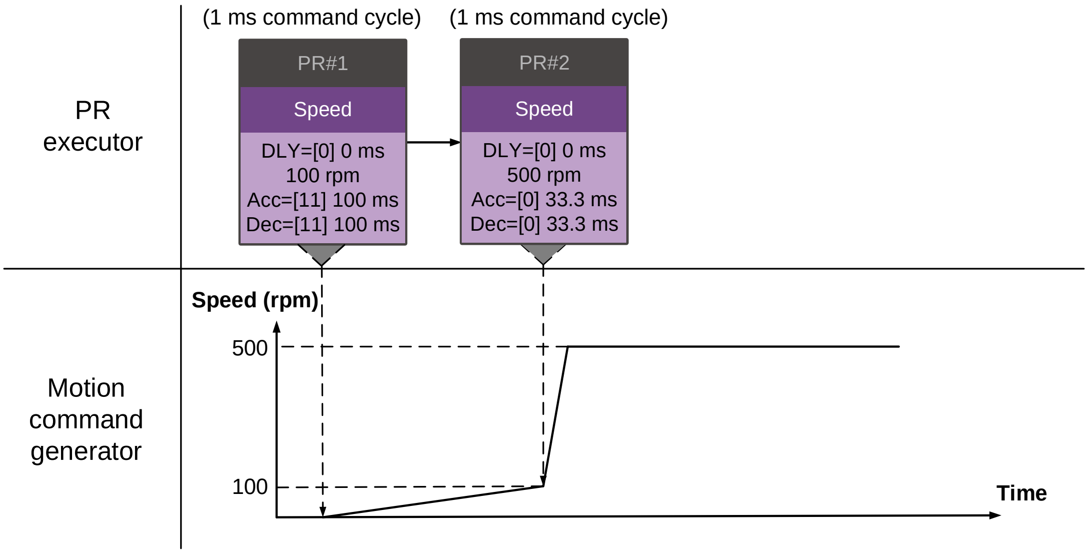
(b) Position command with delay

Figure 7.1.6.2 Position Sequence command

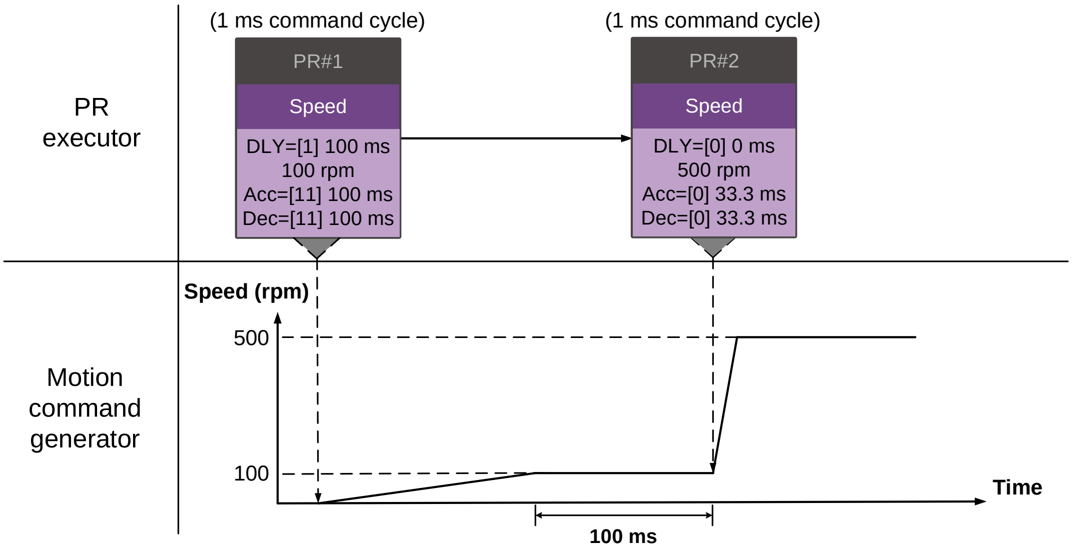
- Speed command ▶ Speed command

When the PR executor receives two consecutive Speed commands without the Interrupt or Overlap function, the PR executor issues the first Speed command to the motion command generator, and the generator starts the first part of speed control. After the first Speed command completes, if no delay time is set, the PR executor issues the second Speed command 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 issues 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 command

- 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 millisecond after the 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.

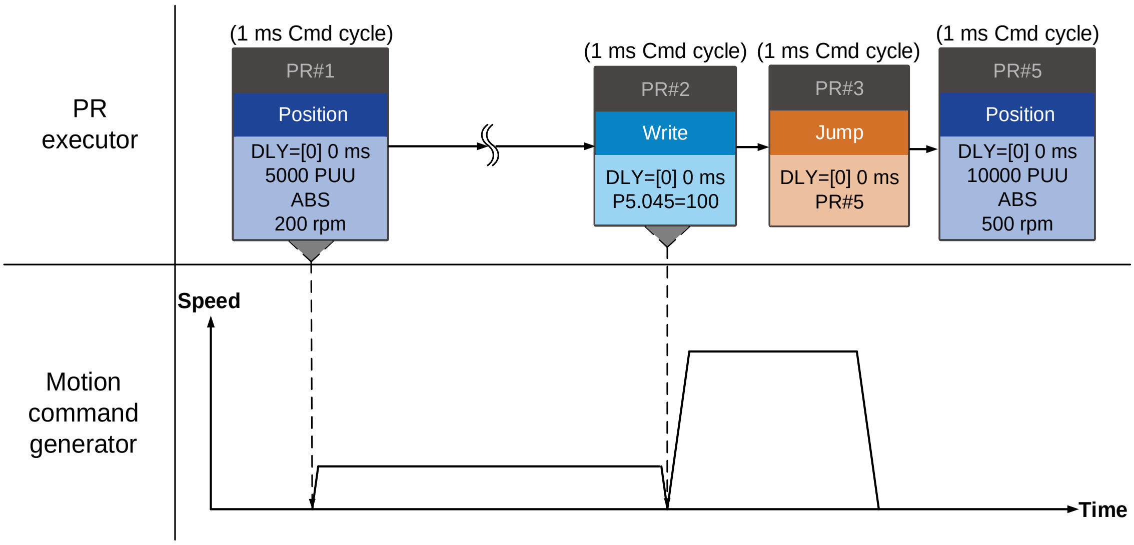


Figure 7.1.6.4 Multiple Sequence commands

Command interruption

Interruption (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.

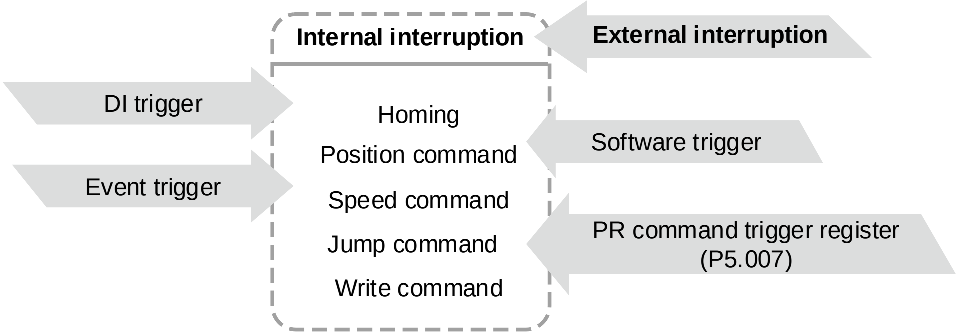


Figure 7.1.6.5 Internal and external interruption

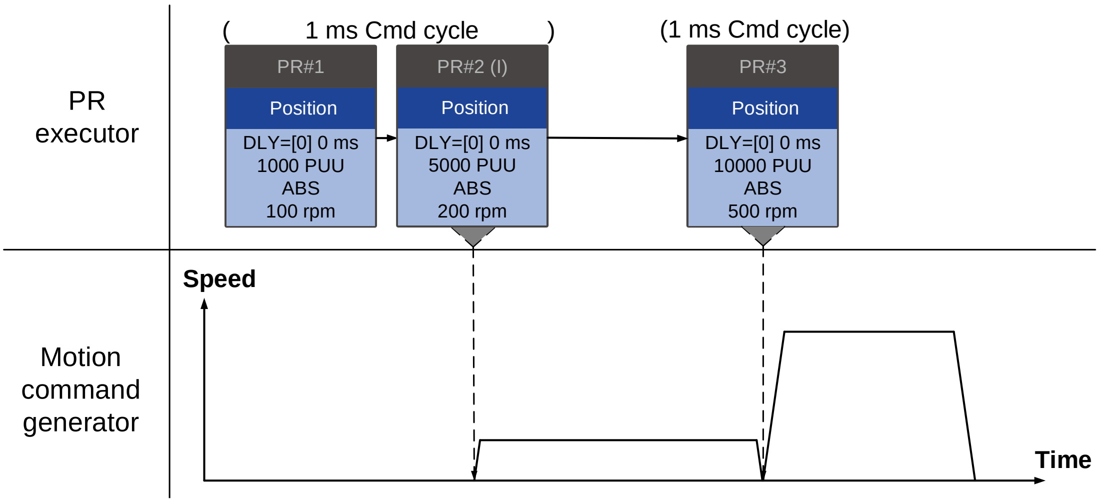
1. Internal interruption

For a series of PR paths, if one PR path includes an 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 an 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.

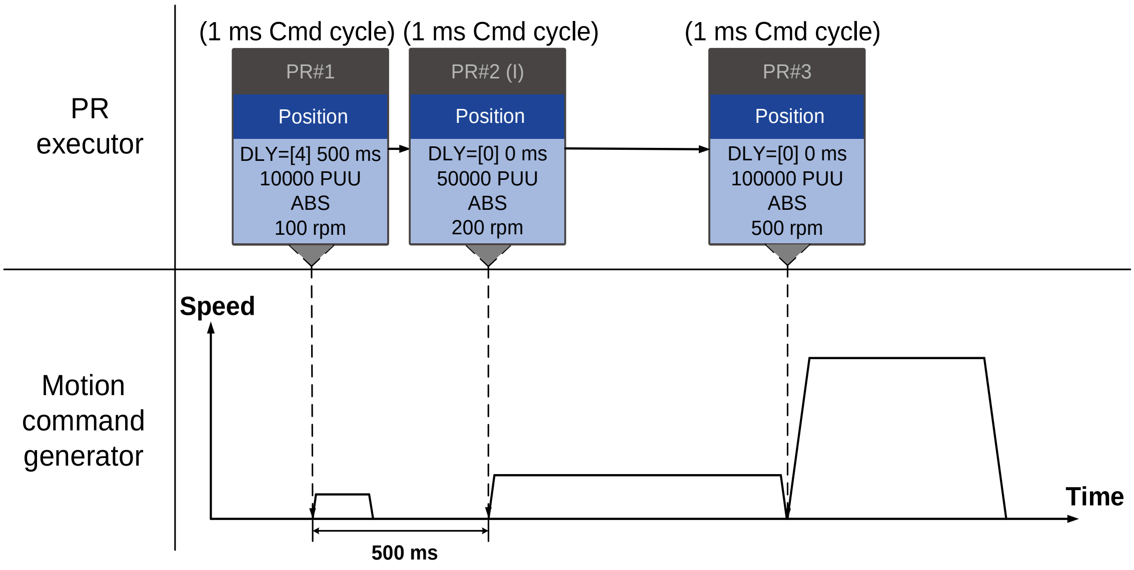
- Position command ▶ Position command (I) ▶ Position command

When the PR executor receives three consecutive Position commands with the second command set with an Interrupt function, it treats the first and the 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 command and only sends the second command 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 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. 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 command

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.

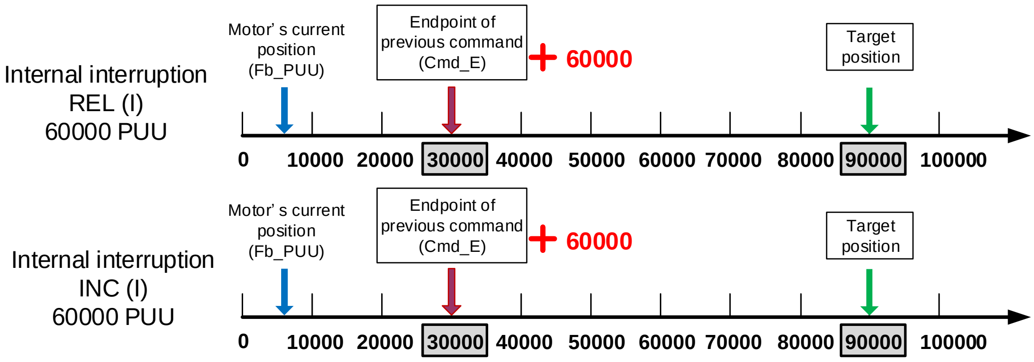
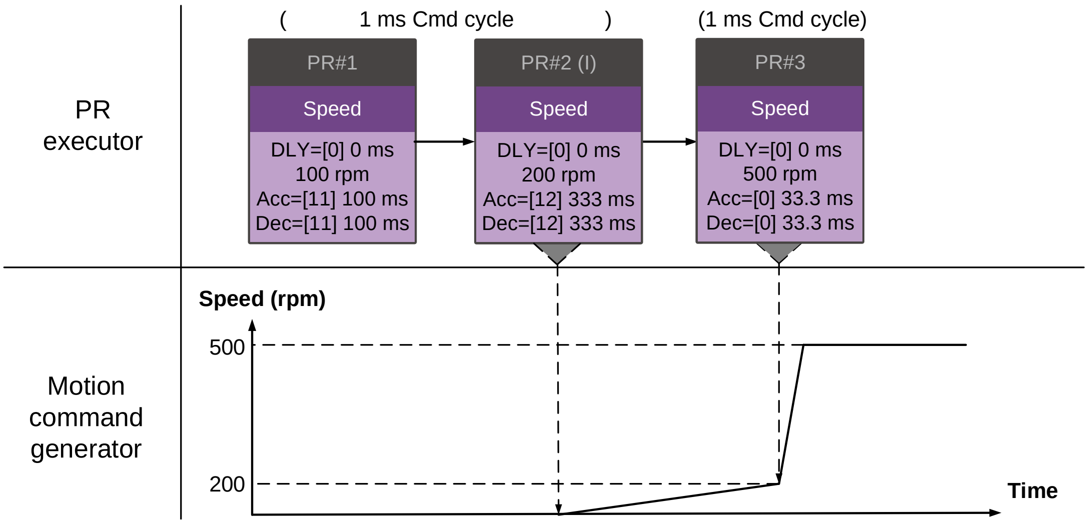


Figure 7.1.6.7 Example of relative and incremental position commands for internal interruption

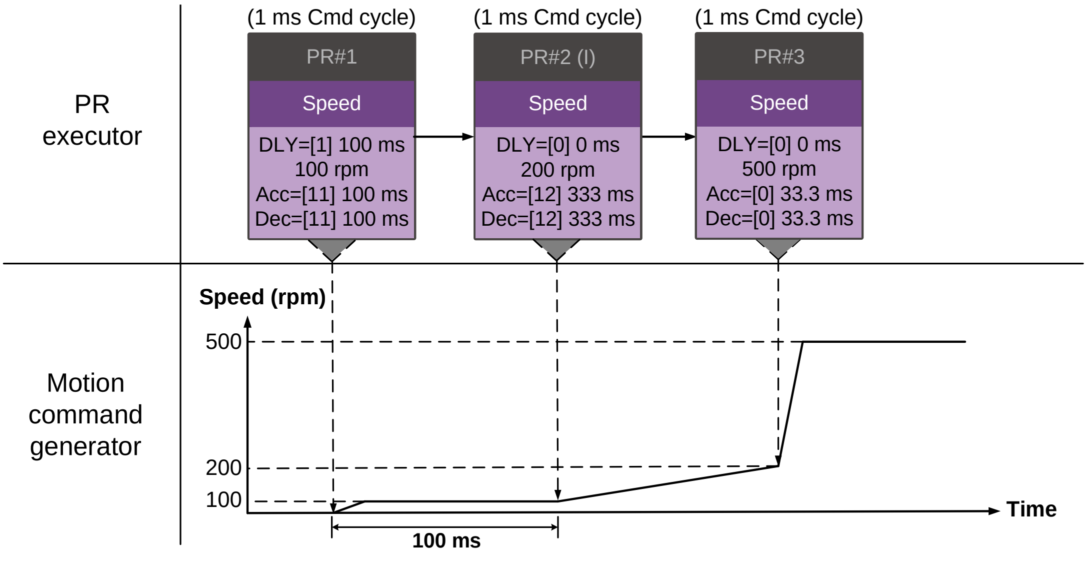
- Speed command ▶ Speed command (I) ▶ Speed command

When the PR executor receives three consecutive Speed commands with the second command set with an Interrupt function, it treats the first and the second 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 command and only sends the second command 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 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



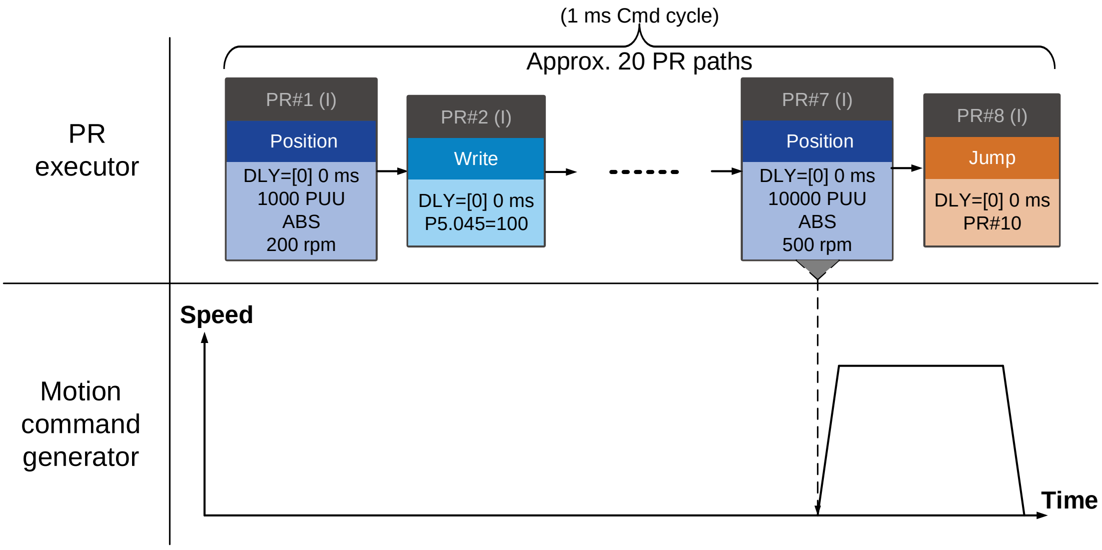
(b) Speed command with delay

Figure 7.1.6.8 Internal interruption - Speed command

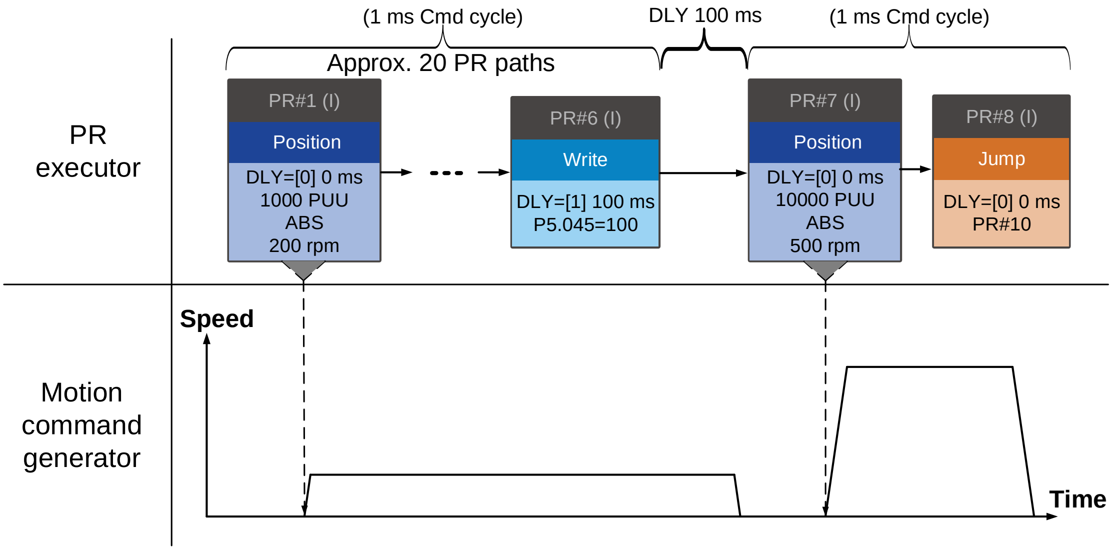
- Multiple interruptions

The PR queue updates the commands every millisecond. If all PR paths are consecutive with Interrupt functions and without delay, the PR queue can read at least 20 PR paths in 1 ms, 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



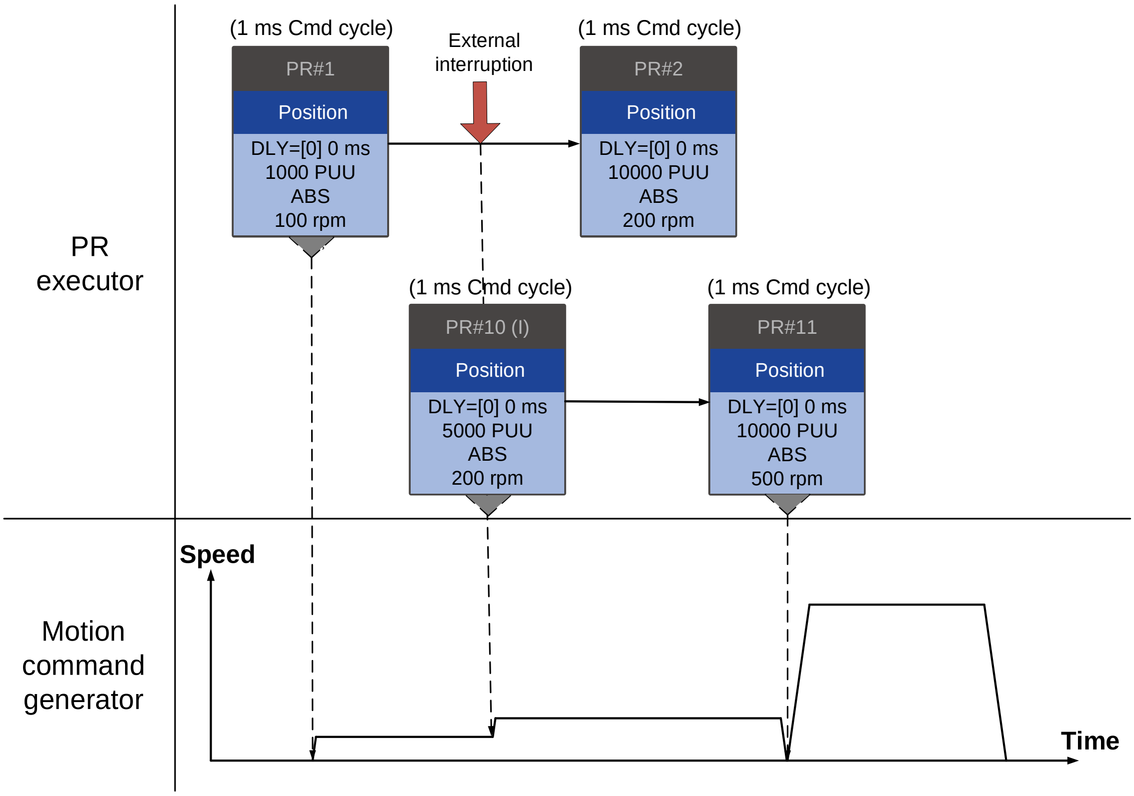
(b) Multiple commands with delay

Figure 7.1.6.9 Internal interruption - Multiple commands

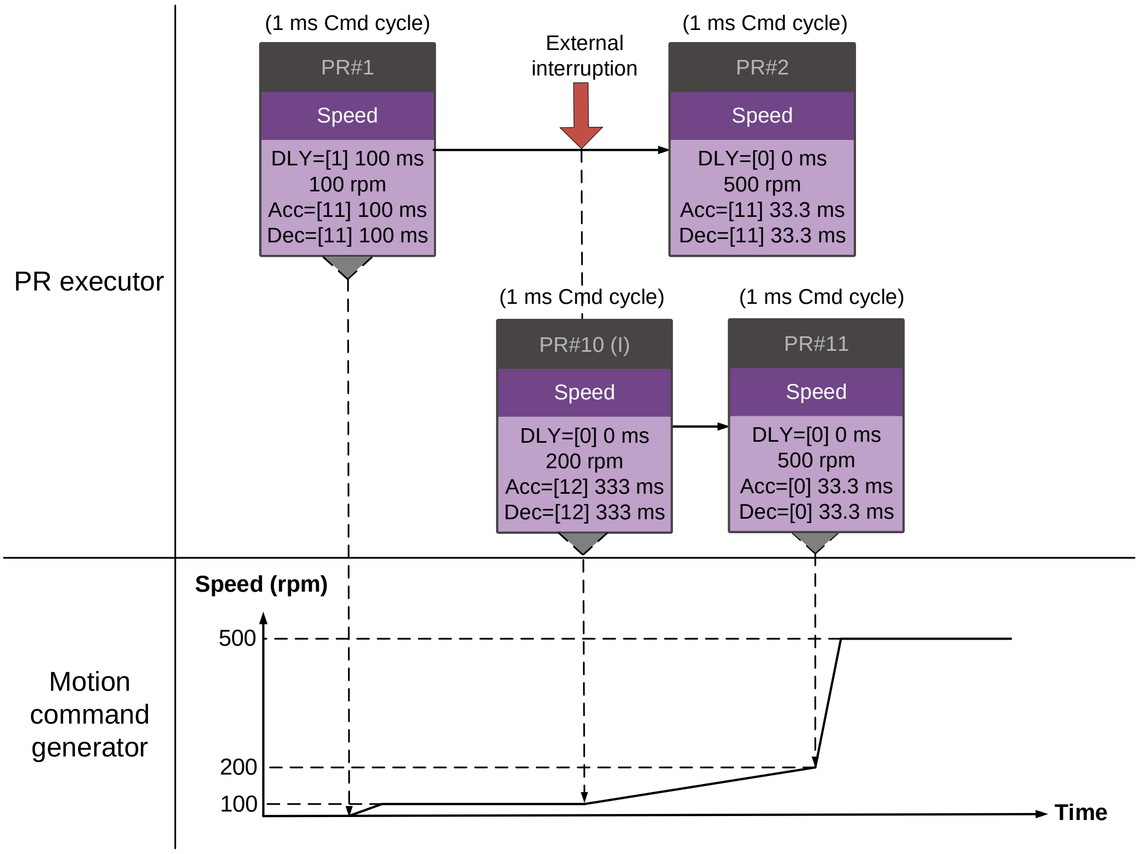
2. External interruption

When a PR path is being executed, if another PR path is forced to execute with any of the trigger methods for the PR command (refer to Section 7.1.5 for PR trigger methods), the PR queue receives a PR path with an 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 an Interrupt function through external interruption, the motion commands in the latter part are 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 an 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

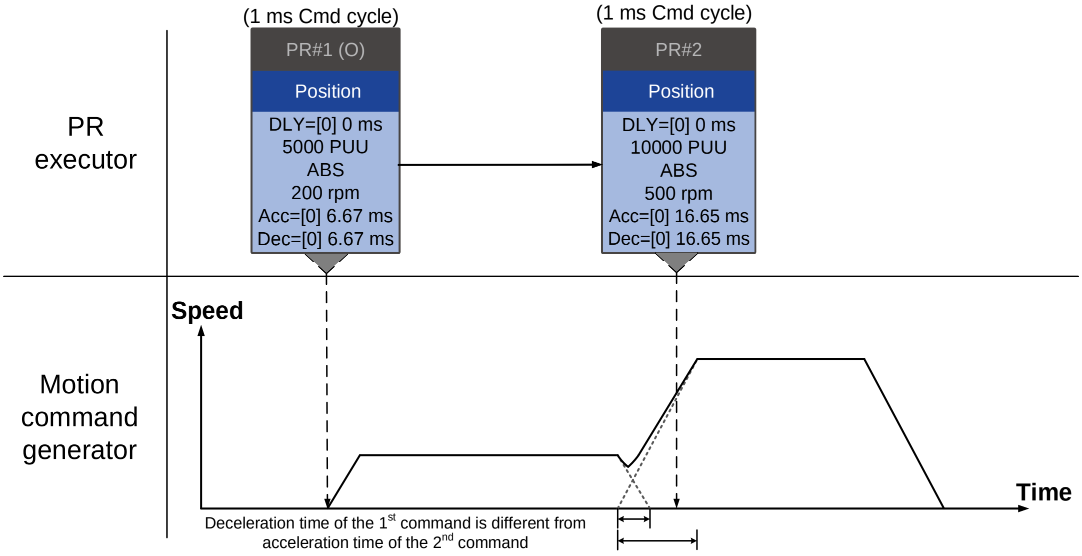
Command overlapping

If the previous position command includes an 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 an Overlap function, the delay time 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).

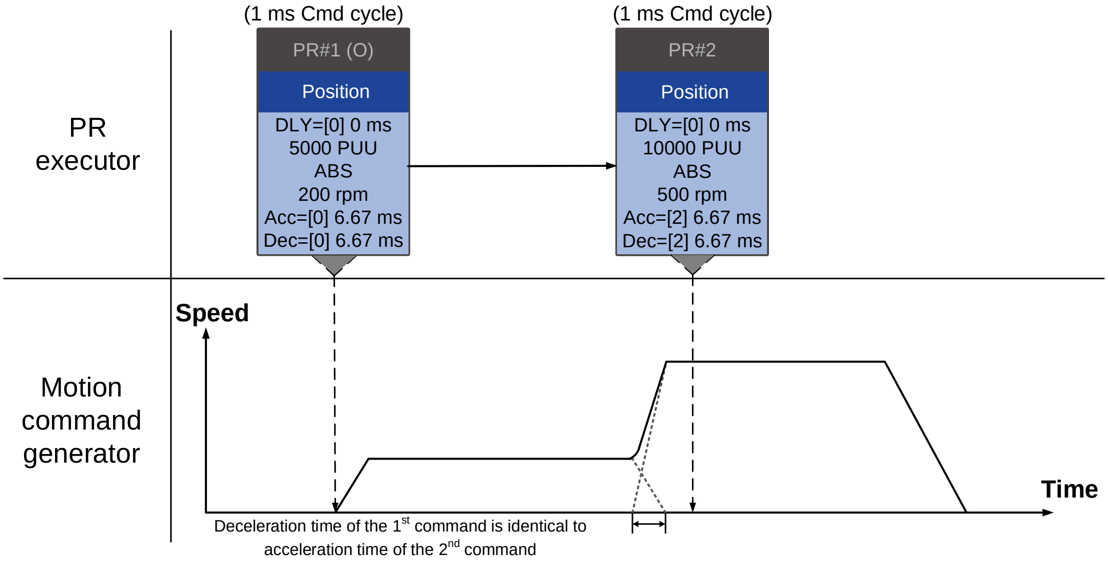
The relationship between the 1st target speed and its deceleration time and the relationship between the 2nd target speed and its acceleration time are as follows.

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

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



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



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

Figure 7.1.6.11 Command overlapping

Interpret 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) settings 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 ms, 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 of 32-bit data (0 - 127). 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 with P5.012 and P5.013 differ. Refer to Table 7.2.1.1 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 accumulates and exceeds the maximum value, the return content of the address is 0. Refer to Table 7.2.1.2 for descriptions and examples.

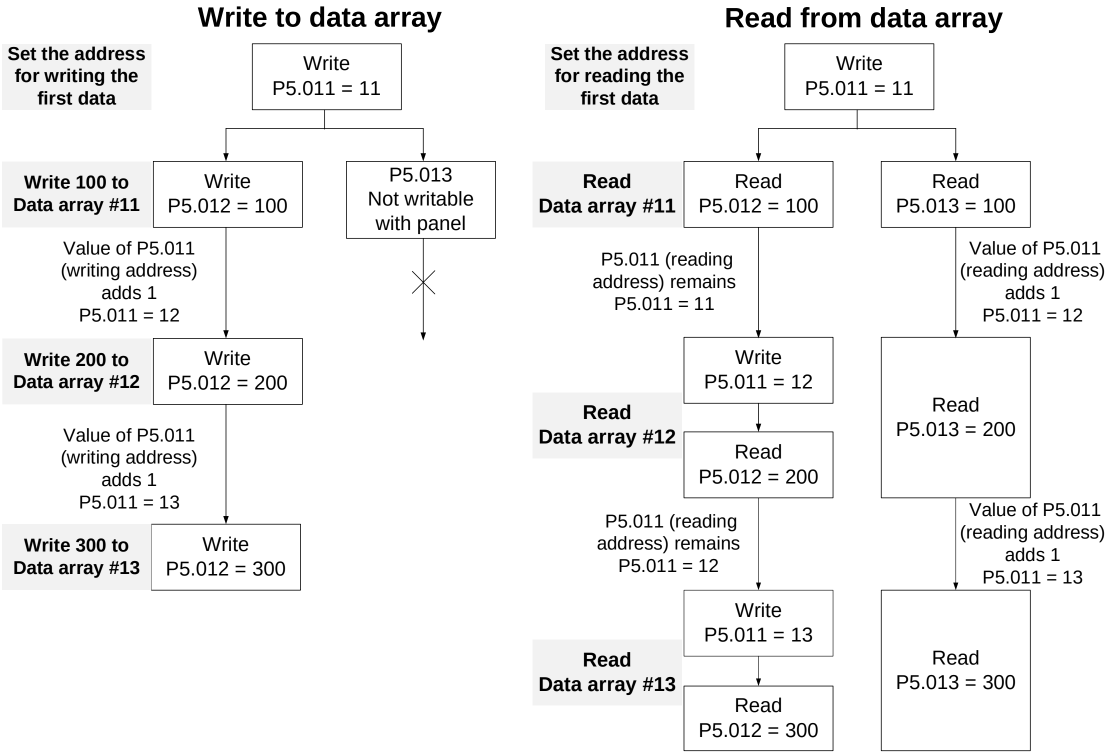
Table 7.2.1.1 Group 1 parameters for reading and writing the data array

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	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	Panel	Value of P5.011 adds 1	**Not writable with the 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 with 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 7.2.1.2 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.

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 parameter indicator, expressed in hexadecimal. The parameter groups are:

Group 0: Monitoring parameters (Example: P0.xxx)
Group 1: Basic parameters (Example: P1.xxx)
Group 2: Extension parameters (Example: P2.xxx)
Group 3: Communication parameters (Example: P3.xxx)
Group 4: Diagnosis parameters (Example: P4.xxx)
Group 5: Motion control parameters (Example: P5.xxx)
Group 6: PR parameters* (Example: P6.xxx)
Group 7: PR parameters* (Example: P7.xxx)

Note: the -L model does not support this function.

Control mode description:

PT: Position control (command input through terminal block)*1
PR: Position control (command sent from internal register)*2
S: Speed control
T: Torque control
EtherCAT: Communication control*2

Note:

1. The -E model does not support this function.
2. The -L model does not support this function.

Special symbol description:

Icon of parameter property	Description
★	Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.001.
▲	Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.
●	Parameter changes become valid after power cycling. For example, P1.001 and P3.000.
■	Parameter resets to its default value after power cycling. For example, P3.006.

8.2 List of parameters

Monitoring and general output parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P0.000★	Firmware version	Factory setting	-	✓	✓	✓	✓
P0.001■	Current drive alarm code (seven-segment display)	-	-	✓	✓	✓	✓
P0.002	Drive status	1	-	✓	✓	✓	✓
P0.003	Analog output monitoring	0x0000	-	✓	✓	✓	✓
P0.008★	Total servo drive operation time	0x00000000	hour	✓	✓	✓	✓
P0.009★■	Status monitoring register 1	-	-	✓	✓	✓	✓
P0.010★■	Status monitoring register 2	-	-	✓	✓	✓	✓
P0.011★■	Status monitoring register 3	-	-	✓	✓	✓	✓
P0.012★■	Status monitoring register 4	-	-	✓	✓	✓	✓
P0.013★■	Status monitoring register 5	-	-	✓	✓	✓	✓
P0.017	Select content displayed by status monitoring register 1	0	-	✓	✓	✓	✓
P0.018	Select content displayed by status monitoring register 2	0	-	✓	✓	✓	✓
P0.019	Select content displayed by status monitoring register 3	0	-	✓	✓	✓	✓
P0.020	Select content displayed by status monitoring register 4	0	-	✓	✓	✓	✓
P0.021	Select content displayed by status monitoring register 5	0	-	✓	✓	✓	✓
P0.025■	Mapping parameter 1	-	-	✓	✓	✓	✓
P0.026■	Mapping parameter 2	-	-	✓	✓	✓	✓
P0.027■	Mapping parameter 3	-	-	✓	✓	✓	✓
P0.028■	Mapping parameter 4	-	-	✓	✓	✓	✓
P0.029■	Mapping parameter 5	-	-	✓	✓	✓	✓
P0.030■	Mapping parameter 6	-	-	✓	✓	✓	✓
P0.031■	Mapping parameter 7	-	-	✓	✓	✓	✓
P0.032■	Mapping parameter 8	-	-	✓	✓	✓	✓
P0.035	Target setting for mapping parameter P0.025	-	-	✓	✓	✓	✓
P0.036	Target setting for mapping parameter P0.026	-	-	✓	✓	✓	✓
P0.037	Target setting for mapping parameter P0.027	-	-	✓	✓	✓	✓
P0.038	Target setting for mapping parameter P0.028	-	-	✓	✓	✓	✓
P0.039	Target setting for mapping parameter P0.029	-	-	✓	✓	✓	✓
P0.040	Target setting for mapping parameter P0.030	-	-	✓	✓	✓	✓
P0.041	Target setting for mapping parameter P0.031	-	-	✓	✓	✓	✓
P0.042	Target setting for mapping parameter P0.032	-	-	✓	✓	✓	✓

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P0.044★■	Status monitoring register (for PC software)	0	-	✓	✓	✓	✓
P0.045■	Status monitoring register content selection (for PC software)	0	-	✓	✓	✓	✓
P0.046★■	Servo drive digital output (DO) status	0x0000	-	✓	✓	✓	✓
P0.050★■	Absolute position system status	0x0000	-	✓	✓	✓	✓
P0.063★	Total duration of DC Bus voltage exceeding 400V	0	ms	✓	✓	✓	✓
P0.079★	IGBT highest temperature	0	°C	✓	✓	✓	✓
P1.004	MON1 analog monitor output proportion	100	% (full scale)	✓	✓	✓	✓
P1.005	MON2 analog monitor output proportion	100	% (full scale)	✓	✓	✓	✓
P1.101■	Analog monitor output voltage 1	0	mV	✓	✓	✓	✓
P1.102■	Analog monitor output voltage 2	0	mV	✓	✓	✓	✓

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.001.

(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.

(●) Parameter changes become valid after power cycling. For example, P1.001 and P3.000.

(■) Parameter resets to its default value after power cycling. For example, P3.006.

Filter and resonance suppression parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.006	Speed command - smoothing constant (low-pass filter)	0	ms	-	-	✓	-
P1.007	Torque command - smoothing constant (low-pass filter)	0	ms	-	-	-	✓
P1.008	Position command - smoothing constant (low-pass filter)	0	10 ms	✓	✓	-	-
P1.025	Low-frequency vibration suppression frequency 1	1000	0.1 Hz	✓	✓	-	-
P1.026	Low-frequency vibration suppression gain 1	0	-	✓	✓	-	-
P1.027	Low-frequency vibration suppression frequency 2	1000	0.1 Hz	✓	✓	-	-
P1.028	Low-frequency vibration suppression gain 2	0	-	✓	✓	-	-
P1.029	Auto low-frequency vibration suppression mode	0	-	✓	✓	-	-
P1.030	Low-frequency vibration detection	8000	pulse	✓	✓	-	-
P1.034	S-curve acceleration constant	200	ms	-	-	✓	-
P1.035	S-curve deceleration constant	200	ms	-	-	✓	-
P1.036	S-curve acceleration / deceleration smoothing constant	0	ms	-	✓	✓	-
P1.061	Viscous friction compensation	0	0.1%/1000 rpm	✓	✓	✓	-
P1.062	Percentage of friction compensation	0	%	✓	✓	✓	-
P1.063	Constant of friction compensation	100	%	✓	✓	✓	-
P1.068	Position command - moving filter	4	ms	✓	✓	-	-
P1.089	Vibration elimination 1 - anti-resonance frequency	4000	0.1 Hz	✓	✓	-	-
P1.090	Vibration elimination 1 - resonance frequency	4000	0.1 Hz	✓	✓	-	-
P1.091	Vibration elimination 1 - resonance difference	10	0.1 dB	✓	✓	-	-
P1.092	Vibration elimination 2 - anti-resonance frequency	4000	0.1 Hz	✓	✓	-	-
P1.093	Vibration elimination 2 - resonance frequency	4000	0.1 Hz	✓	✓	-	-
P1.094	Vibration elimination 2 - resonance difference	10	0.1 dB	✓	✓	-	-
P2.023	Notch filter 1 - frequency	1000	Hz	✓	✓	✓	✓
P2.024	Notch filter 1 - attenuation level	0	-dB	✓	✓	✓	✓
P2.025	Resonance suppression low-pass filter	1.0 (panel / software) 10 (communication)	1 ms (panel / software) 0.1 ms (communication)	✓	✓	✓	✓
P2.043	Notch filter 2 - frequency	1000	Hz	✓	✓	✓	✓
P2.044	Notch filter 2 - attenuation level	0	-dB	✓	✓	✓	✓
P2.045	Notch filter 3 - frequency	1000	Hz	✓	✓	✓	✓
P2.046	Notch filter 3 - attenuation level	0	-dB	✓	✓	✓	✓
P2.047	Auto resonance suppression mode	0x0001	-	✓	✓	✓	✓
P2.048	Auto resonance detection level	100	-	✓	✓	✓	✓

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P2.049	Speed detection filter and jitter suppression	1.0 (panel / software) 10 (communication)	1 ms (panel / software) 0.1 ms (communication)	✓	✓	✓	✓
P2.095	Notch filter 1 - Q factor	5	-	✓	✓	✓	✓
P2.096	Notch filter 2 - Q factor	5	-	✓	✓	✓	✓
P2.097	Notch filter 3 - Q factor	5	-	✓	✓	✓	✓
P2.098	Notch filter 4 - frequency	1000	Hz	✓	✓	✓	✓
P2.099	Notch filter 4 - attenuation level	0	-dB	✓	✓	✓	✓
P2.100	Notch filter 4 - Q factor	5	-	✓	✓	✓	✓
P2.101	Notch filter 5 - frequency	1000	Hz	✓	✓	✓	✓
P2.102	Notch filter 5 - attenuation level	0	-dB	✓	✓	✓	✓
P2.103	Notch filter 5 - Q factor	5	-	✓	✓	✓	✓

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.001.

(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.

(●) Parameter changes become valid after power cycling. For example, P1.001 and P3.000.

(■) Parameter resets to its default value after power cycling. For example, P3.006.

Gain and switching parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.037	Load inertia ratio or total weight	2.0 (panel / software) 20 (communication)	1 times (panel / software) 0.1 times (communication)	✓	✓	✓	✓
P1.078	Gain switching delay time	0	ms	✓	✓	✓	-
P1.079	Rate of change for gain values during gain switching delay	100	%	✓	✓	✓	-
P1.080	Rate of change for speed detection filter and jitter suppression	100	%	✓	✓	✓	-
P2.000	Position control gain	35	rad/s	✓	✓	-	-
P2.001	Rate of change for position control gain	100	%	✓	✓	-	-
P2.002	Position feed forward gain	50	%	✓	✓	-	-
P2.003	Position feed forward gain smoothing constant	5	ms	✓	✓	-	-
P2.004	Speed control gain	500	rad/s	✓	✓	✓	✓
P2.005	Rate of change for speed control gain	100	%	✓	✓	✓	✓
P2.006	Speed integral compensation	100	rad/s	✓	✓	✓	✓
P2.007	Speed feed forward gain	0	%	✓	✓	✓	✓
P2.026	Anti-interference gain	0	rad/s	✓	✓	✓	✓
P2.027	Gain switching condition and method selection	0x0000	-	✓	✓	✓	✓
P2.028	Gain switching time constant	10	ms	✓	✓	✓	✓
P2.029	Gain switching condition	16777216	pulse Kpps rpm	✓	✓	✓	✓
P2.031	Bandwidth response level	19	-	✓	✓	✓	✓
P2.032	Gain adjustment mode	0x0000	-	✓	✓	✓	✓
P2.053	Position integral compensation	0	rad/s	✓	✓	✓	✓
P2.089	Command response gain	25	rad/s	✓	✓	-	-
P2.090	Two degree of freedom mode - anti-interference gain	850	0.001	✓	✓	-	-
P2.091	Two degree of freedom mode - position feed forward gain	1000	0.1%	✓	✓	-	-
P2.092	Two degree of freedom mode - speed feed forward gain	1000	0.1%	✓	✓	-	-
P2.094▲	Special bit register 3	0x0090	-	✓	✓	✓	-
P2.104	Torque command condition for P/PI switching	800	%	✓	✓	-	-
P2.105	Automatic gain adjustment level 1	11	-	✓	✓	-	-
P2.106	Automatic gain adjustment level 2	2000	pulse	✓	✓	-	-
P2.107	Rate of change for resonance suppression low-pass filter	100	%	✓	✓	✓	-
P2.112▲	Special bit register 4	0x2018	-	✓	✓	✓	-
P2.126	Bandwidth for speed loop response	40	Hz	✓	✓	✓	-

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.001.

(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.

(●) Parameter changes become valid after power cycling. For example, P1.001 and P3.000.

(■) Parameter resets to its default value after power cycling. For example, P3.006.

Position control parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.001●	Input for control mode and control command	0x0000	-	✓	✓	✓	✓
P1.002▲	Speed and torque limits	0x0000	-	✓	✓	✓	✓
P1.003	Encoder pulse output polarity	0x0000	-	✓	✓	✓	✓
P1.012 - P1.014	Internal Torque command / internal torque limit 1 - 3	100	%	✓	✓	✓	✓
P1.044▲	E-Gear ratio - numerator N1	16777216	pulse	✓	✓	✓	✓
P1.045▲	E-Gear ratio - denominator M	100000	pulse	✓	✓	✓	✓
P1.046▲	Encoder pulse number output (OA, OB)	2500	pulse	✓	✓	✓	✓
P1.055	Maximum speed limit	Rated speed	rpm	✓	✓	✓	✓
P1.076▲	Maximum speed for encoder output (OA, OB)	5500	rpm	✓	✓	✓	✓
P1.097▲	Encoder output denominator (OA, OB)	0	-	✓	✓	✓	✓
P1.111	Overspeed protection level	Maximum motor speed x 1.1	rpm	✓	✓	✓	✓
P1.112	Single-direction torque limit	500	%	✓	✓	✓	✓
P2.035	Excessive deviation warning condition of Position command	50331648	pulse	✓	✓	-	-
P2.068	Following error compensation switch	0x0000	-	✓	✓	✓	✓
P5.003	Deceleration time for auto-protection	0xEEEFEEFF	-	-	✓	✓	✓
P5.016■	Axis position - main encoder	0	PUU	✓	✓	✓	✓
P5.018	Axis position - pulse command	0	pulse	✓	✓	✓	✓
P5.020 - P5.035	Acceleration / deceleration times (#0 - #15)	Refer to description of each parameter	ms	-	✓	-	-

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.001.

(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.

(●) Parameter changes become valid after power cycling. For example, P1.001 and P3.000.

(■) Parameter resets to its default value after power cycling. For example, P3.006.

Position control parameters - external pulse control command (PT mode)

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.000▲	External pulse input type	0x1042	-	✓	-	-	-
P2.060	E-Gear ratio - numerator N2	16777216	pulse	✓	✓	✓	✓
P2.061	E-Gear ratio - numerator N3	16777216	pulse	✓	✓	✓	✓
P2.062	E-Gear ratio - numerator N4	16777216	pulse	✓	✓	✓	✓

Position control parameters - internal register control command (PR mode)

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P5.004	Homing methods	0x0000	-	-	✓	-	-
P5.005	High speed homing (first speed setting)	100.0 (panel / software)	1 rpm (panel / software)	-	✓	-	-
		1000 (communication)	0.1 rpm (communication)	-	✓	-	-
P5.006	Low speed homing (second speed setting)	20.0 (panel / software)	1 rpm (panel / software)	-	✓	-	-
		200 (communication)	0.1 rpm (communication)	-	✓	-	-
P5.007■	Trigger Position command (PR mode only)	0	-	-	✓	-	-
P5.008	Positive software limit	2147483647	PUU	-	✓	-	-
P5.009	Negative software limit	-2147483648	PUU	-	✓	-	-
P5.015■	PATH 1 - PATH 2 volatile setting	0x0000	-	-	✓	-	-
P5.040 - P5.055	Delay time #0 - 15 after position reached	0 - 5500	ms	-	✓	-	-
P5.060 - P5.075	Target speed setting #0 - #15	20.0 - 3000.0 (panel / software)	1 rpm (panel / software)	-	✓	-	-
		200 - 30000 (communication)	0.1 rpm (communication)				
P5.098	PR number triggered by event rising-edge	0x0000	-	-	✓	-	-
P5.099	PR number triggered by event falling-edge	0x0000	-	-	✓	-	-
P6.002 - P7.099	Internal Position commands #1 - #99	0x00000000	-	-	✓	-	-

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.001.

(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.

(●) Parameter changes become valid after power cycling. For example, P1.001 and P3.000.

(■) Parameter resets to its default value after power cycling. For example, P3.006.

Speed control parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.001●	Input for control mode and control command	0x0000	-	✓	✓	✓	✓
P1.002▲	Speed and torque limits	0x0000	-	✓	✓	✓	✓
P1.003	Encoder pulse output polarity	0x0000	-	✓	✓	✓	✓
P1.009 - P1.011	Internal Speed command / internal speed limit 1 - 3	1000 - 3000	0.1 rpm	-	-	✓	✓
P1.012 - P1.014	Internal Torque command / internal torque limit 1 - 3	100	%	✓	✓	✓	✓
P1.040	Maximum motor speed for analog Speed command 1	Rated speed	rpm	-	-	✓	✓
P1.041▲	Maximum output for analog Torque command	100	%	✓	✓	✓	✓
P1.046▲	Encoder pulse number output (OA, OB)	2500	pulse	✓	✓	✓	✓
P1.055	Maximum speed limit	Rated speed	rpm	✓	✓	✓	✓
P1.076▲	Maximum speed for encoder output (OA, OB)	5500	rpm	✓	✓	✓	✓
P1.081	Maximum motor speed for analog Speed command 2	Rated speed	rpm	-	-	✓	✓
P1.097▲	Encoder output denominator (OA, OB)	0	-	✓	✓	✓	✓
P1.111	Overspeed protection level	Maximum motor speed x 1.1	rpm	✓	✓	✓	✓
P1.112	Single-direction torque limit	500	%	✓	✓	✓	✓
P2.034	Excessive deviation warning condition of Speed command	5000	rpm	-	-	✓	-
P2.112▲	Special bit register 4	0x2018	-	✓	✓	✓	-

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.001.

(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.

(●) Parameter changes become valid after power cycling. For example, P1.001 and P3.000.

(■) Parameter resets to its default value after power cycling. For example, P3.006.

Torque control parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.001●	Input for control mode and control command	0x0000	-	✓	✓	✓	✓
P1.002▲	Speed and torque limits	0x0000	-	✓	✓	✓	✓
P1.003	Encoder pulse output polarity	0x0000	-	✓	✓	✓	✓
P1.009 - P1.011	Internal Speed command / internal speed limit 1 - 3	1000 - 3000	0.1 rpm	-	-	✓	✓
P1.012 - P1.014	Internal Torque command / internal torque limit 1 - 3	100	%	✓	✓	✓	✓
P1.040	Maximum motor speed for analog Speed command 1	Rated speed	rpm	-	-	✓	✓
P1.041▲	Maximum output for analog Torque command	100	%	✓	✓	✓	✓
P1.046▲	Encoder pulse number output (OA, OB)	2500	pulse	✓	✓	✓	✓
P1.055	Maximum speed limit	Rated speed	rpm	✓	✓	✓	✓
P1.081	Maximum motor speed for analog Speed command 2	Rated speed	rpm	-	-	✓	✓
P1.111	Overspeed protection level	Maximum motor speed x 1.1	rpm	✓	✓	✓	✓
P1.112	Single-direction torque limit	500	%	✓	✓	✓	✓

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.001.

(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.

(●) Parameter changes become valid after power cycling. For example, P1.001 and P3.000.

(■) Parameter resets to its default value after power cycling. For example, P3.006.

Digital input / Digital output functional planning parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P0.053	General range compare digital output - filter time	0x0000	-	✓	✓	✓	✓
P0.054	General range compare digital output 1 - lower limit	0	-	✓	✓	✓	✓
P0.055	General range compare digital output 1 - upper limit	0	-	✓	✓	✓	✓
P0.056	General range compare digital output 2 - lower limit	0	-	✓	✓	✓	✓
P0.057	General range compare digital output 2 - upper limit	0	-	✓	✓	✓	✓
P0.058	General range compare digital output 3 - lower limit	0	-	✓	✓	✓	✓
P0.059	General range compare digital output 3 - upper limit	0	-	✓	✓	✓	✓
P0.060	General range compare digital output 4 - lower limit	0	-	✓	✓	✓	✓
P0.061	General range compare digital output 4 - upper limit	0	-	✓	✓	✓	✓
P1.038	Zero speed range	10.0 (panel / software)	1 rpm (panel / software)	✓	✓	✓	✓
		100 (communication)	0.1 rpm (communication)				
P1.039	Target speed detection level	3000	rpm	✓	✓	✓	✓
P1.042	Delay time for enabling the magnetic brake	0	ms	✓	✓	✓	✓
P1.043	Delay time for disabling the magnetic brake	0	ms	✓	✓	✓	✓
P1.047	Speed reached (DO.SP_OK) range	10	rpm	-	-	✓	-
P1.054	Pulse range for position reached	167772	pulse	✓	✓	-	-
P1.056	Motor output overload warning level	120	%	✓	✓	✓	✓
P2.009	DI response filter time	2	ms	✓	✓	✓	✓
P2.010	DI1 functional planning	0x0101 (-L) 0x0100 (-E)	-	✓	✓	✓	✓
P2.011	DI2 functional planning	0x0104 (-L) 0x0022 (-E)	-	✓	✓	✓	✓
P2.012	DI3 functional planning	0x0116 (-L) 0x0023 (-E)	-	✓	✓	✓	✓
P2.013	DI4 functional planning	0x0117 (-L) 0x0021 (-E)	-	✓	✓	✓	✓
P2.014	DI5 functional planning	0x0102 (-L) 0x0100 (-E)	-	✓	✓	✓	✓
P2.015	DI6 functional planning	0x0022 (-L) 0x0100 (-E)	-	✓	✓	✓	✓
P2.016	DI7 functional planning	0x0023 (-L) 0x0100 (-E)	-	✓	✓	✓	✓
P2.017	DI8 functional planning	0x0021 (-L) 0x0100 (-E)	-	✓	✓	✓	✓

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P2.018	DO1 functional planning	0x0101	-	✓	✓	✓	✓
P2.019	DO2 functional planning	0x0103 (-L) 0x0100 (-E)	-	✓	✓	✓	✓
P2.020	DO3 functional planning	0x0109 (-L) 0x0100 (-E)	-	✓	✓	✓	✓
P2.021	DO4 functional planning	0x0105	-	✓	✓	✓	✓
P2.022	DO5 functional planning	0x0007	-	✓	✓	✓	✓
P2.036	DI9 functional planning	0x0100	-	✓	✓	✓	✓
P2.037	DI10 functional planning	0x0100	-	✓	✓	✓	✓
P2.038	DI11 functional planning	0x0100	-	✓	✓	✓	✓
P2.039	DI12 functional planning	0x0100	-	✓	✓	✓	✓
P2.040	DI13 functional planning	0x0100	-	✓	✓	✓	✓
P2.041	DO6 functional planning	0x0100	-	✓	✓	✓	✓

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.001.

(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.

(●) Parameter changes become valid after power cycling. For example, P1.001 and P3.000.

(■) Parameter resets to its default value after power cycling. For example, P3.006.

Communication parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P3.000●	Address	0x007F	-	✓	✓	✓	✓
P3.001●	Transmission speed	0x0033	-	✓	✓	✓	✓
P3.002	Modbus communication protocol	0x0006	-	✓	✓	✓	✓
P3.003	Modbus communication error handling	0x0000	-	✓	✓	✓	✓
P3.004	Modbus communication timeout	0	sec	✓	✓	✓	✓
P3.006■	Digital input (DI) control switch	0x0000	-	✓	✓	✓	✓
P3.007	Modbus communication response delay time	1	0.5 ms	✓	✓	✓	✓
P3.009	Communication synchronization	0x5055	-	-	-	-	-
P3.012	Communication support setting	0x1000	-	-	-	-	-
P3.018	EtherCAT special function switch	0x00002000	-	-	-	-	-
P3.022	EtherCAT PDO timeout setting	0xFF04	-	-	-	-	-

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.001.

(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.

(●) Parameter changes become valid after power cycling. For example, P1.001 and P3.000.

(■) Parameter resets to its default value after power cycling. For example, P3.006.

Diagnosis parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P4.000	Fault record (last)	0x00000000	-	✓	✓	✓	✓
P4.001★	Fault record (second to the last)	0x00000000	-	✓	✓	✓	✓
P4.002★	Fault record (third to the last)	0x00000000	-	✓	✓	✓	✓
P4.003★	Fault record (fourth to the last)	0x00000000	-	✓	✓	✓	✓
P4.004★	Fault record (fifth to the last)	0x00000000	-	✓	✓	✓	✓
P4.005	Servo motor JOG control	20	rpm	✓	✓	✓	✓
P4.006■	Software digital output register (readable and writable)	0x0000	-	✓	✓	✓	✓
P4.007■	Multi-function for digital input	0x0000	-	✓	✓	✓	✓
P4.008★	Input status of servo drive panel (read-only)	-	-	✓	✓	✓	✓
P4.009★	Digital output status (read-only)	-	-	✓	✓	✓	✓
P4.010▲■	Hardware calibration options	0	-	✓	✓	✓	✓
P4.011	Analog speed input 1 - hardware offset calibration	Factory setting	-	✓	✓	✓	✓
P4.012	Analog speed input 2 - hardware offset calibration	Factory setting	-	✓	✓	✓	✓
P4.013	Analog torque input 1 - hardware offset calibration	Factory setting	-	✓	✓	✓	✓
P4.014	Analog torque input 2 - hardware offset calibration	Factory setting	-	✓	✓	✓	✓
P4.015	Current detector (V1 phase) - hardware offset calibration	Factory setting	-	✓	✓	✓	✓
P4.016	Current detector (V2 phase) - hardware offset calibration	Factory setting	-	✓	✓	✓	✓
P4.017	Current detector (W1 phase) - hardware offset calibration	Factory setting	-	✓	✓	✓	✓
P4.018	Current detector (W2 phase) - hardware offset calibration	Factory setting	-	✓	✓	✓	✓
P4.019	IGBT NTC calibration level (cannot reset)	Factory setting	-	✓	✓	✓	✓
P4.020	Analog monitor output (Ch1) - offset compensation value	0	mV	✓	✓	✓	✓
P4.021	Analog monitor output (Ch2) - offset compensation value	0	mV	✓	✓	✓	✓
P4.022	Analog speed input - offset compensation value	0	mV	-	-	✓	-
P4.023	Analog torque input - offset compensation value	0	mV	-	-	-	✓

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.001.

(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.

(●) Parameter changes become valid after power cycling. For example, P1.001 and P3.000.

(■) Parameter resets to its default value after power cycling. For example, P3.006.

Encoder parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P0.049■	Update encoder absolute position	0x0000	-	✓	✓	✓	✓
P0.051★■	Encoder absolute position - number of revolutions	0	rev	✓	✓	✓	✓
P0.052★■	Encoder absolute position - pulse number within single turn or PUU	0	pulse or PUU	✓	✓	✓	✓
P2.069●	Absolute encoder	0x0000	-	✓	✓	✓	✓

Special function parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.057	Motor hard stop 1 - torque percentage	0	%	✓	✓	✓	✓
P1.058	Motor hard stop - protection time	1	ms	✓	✓	✓	✓
P1.060	Motor hard stop 1 - level offset	0	%	✓	✓	✓	✓
P1.105	Motor hard stop 2 - torque upper limit	0	%	✓	✓	✓	✓
P1.106	Motor hard stop 2 - torque lower limit	0	%	✓	✓	✓	✓
P2.112▲	Special bit register 4	0x2018	-	✓	✓	✓	-
P2.121	Special bit register 6	0x00000000	-	✓	✓	✓	✓
P2.125	Special bit register 7	0x0000	-	✓	✓	✓	✓
P4.044	Special bit register 5	0x0000	-	✓	✓	✓	✓

(★) Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.001.

(▲) Parameter cannot be changed when servo is in Servo On status. For example, P1.000 and P1.046.

(●) Parameter changes become valid after power cycling. For example, P1.001 and P3.000.

(■) Parameter resets to its default value after power cycling. For example, P3.006.

8.3 Parameter descriptions

P0.xxx Monitoring parameters

P0.000★	**Firmware version**		**Address: 0000H 0001H**
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	-
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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:	-E, -L		

Settings:

For the list of alarms, refer to Section 12.1 Alarm list.

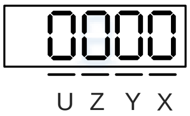
P0.002	**Drive status**		**Address: 0004H 0005H**
Default:	1	Control mode:	All
Unit:	-	Setting range:	-300 to +127
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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 Table 8.3 Monitoring variables descriptions.

P0.003	**Analog output monitoring**		**Address: 0006H 0007H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0077
Format:	HEX	Data size:	16-bit
Model:	-L		

Settings:



X	MON2 setting value	Z	Reserved
Y	MON1 setting value	U	Reserved

X & Y setting value	Description	X & Y setting value	Description
0	Motor speed (+/- 8 volts / Maximum speed)	4	Torque command (+/- 8 volts / Maximum Torque command)
1	Motor torque (+/- 8 volts / Maximum torque)	5	VBUS voltage (+/- 8 volts / 450V)
2	Pulse command frequency (+8 volts / 4.5 Mpps)	6	Analog output voltage is the setting value of P1.101
3	Speed command (+/- 8 volts / Maximum Speed command)	7	Analog output voltage is the setting value of P1.102

Note: refer to P1.004 and P1.005 for the proportional setting for the analog output voltage.

For example: when you set P0.003 to 0x0001 (MON1 is the analog output of motor speed; MON2 is the analog output of motor torque):

$$\text{MON1 output voltage} = 8 \times \frac{\text{Motor speed}}{(\text{Maximum speed} \times \frac{\text{P1.004}}{100})} \text{ (Unit: volts)}$$

$$\text{MON2 output voltage} = 8 \times \frac{\text{Motor torque}}{(\text{Maximum torque} \times \frac{\text{P1.005}}{100})} \text{ (Unit: volts)}$$

P0.004 - P0.007	**Reserved**

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:	-E, -L		

Settings:

Displays the total servo drive Power On and Servo On time. The time is recorded in hours and durations of less than 1 hour are not recorded. The recorded hours are saved when the power is off.

High word

Low word

DCBA	Total time of Servo On	UZYX	Total servo power applied time

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

Settings:

Set the value to be monitored in P0.017 through the drive panel or communication (refer to P0.002). To get the status, read the communication address through the communication port or monitor the value from 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:	-E, -L		

Settings:

Set the value to be monitored in P0.018 through the drive panel or communication (refer to P0.002). To get the status, read the communication address through the communication port or monitor the value from 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:	-E, -L		

Settings:

Set the value to be monitored in P0.019 through the drive panel or communication (refer to P0.002). To get the status, read the communication address through the communication port or monitor the value from 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:	-E, -L		

Settings:

Set the value to be monitored in P0.020 through the drive panel or communication (refer to P0.002). To get the status, read the communication address through the communication port or monitor the value from 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:	-E, -L		

Settings:

Set the value to be monitored in P0.021 through the drive panel or communication (refer to P0.002). To get the status, read the communication address through the communication port.

P0.014 - P0.016	**Reserved**

P0.017	**Select content displayed by status monitoring register 1**		**Address: 0022H 0023H**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-300 to +127
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to Table 8.3 for the available values.

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

P0.018	**Select content displayed by status monitoring register 2**		**Address: 0024H 0025H**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-300 to +127
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to Table 8.3 for the available values.

P0.019	**Select content displayed by status monitoring register 3**		**Address: 0026H 0027H**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-300 to +127
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to Table 8.3 for the available values.

P0.020	**Select content displayed by status monitoring register 4**		**Address: 0028H 0029H**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-300 to +127
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to Table 8.3 for the available values.

P0.021	**Select content displayed by status monitoring register 5**		**Address: 002AH 002BH**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-300 to +127
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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:	Determined by the corresponding parameter P0.035
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

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:	Determined by the corresponding parameter P0.036
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.036.

P0.027■	**Mapping parameter 3**		**Address: 0036H 0037H**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.037
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.037.

P0.028■	**Mapping parameter 4**		**Address: 0038H 0039H**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.038
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.038.

P0.029■	**Mapping parameter 5**		**Address: 003AH 003BH**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.039
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.039.

P0.030■	**Mapping parameter 6**		**Address: 003CH 003DH**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.040
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.040.

P0.031■	**Mapping parameter 7**		**Address: 003EH 003FH**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.041
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.041.

P0.032■	**Mapping parameter 8**		**Address: 0040H 0041H**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.042
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.042.

P0.033 - P0.034	**Reserved**

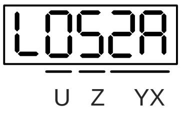
P0.035	**Target setting for mapping parameter P0.025**		**Address: 0046H 0047H**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:

The formats of the parameter high word (PH) and parameter low word (PL) are:

High word

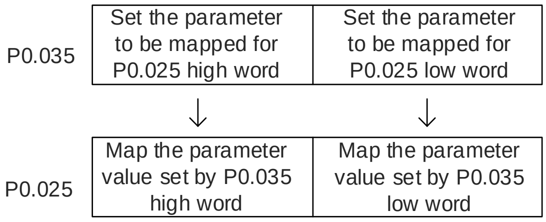
Low word



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)



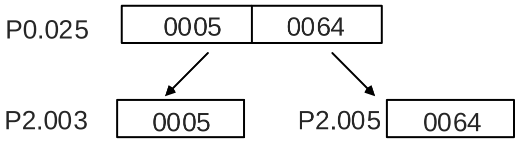
1. When PH ≠ PL, it indicates that the content of P0.025 includes two 16-bit parameters.

   Example: Target: set P2.003 to 0 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.

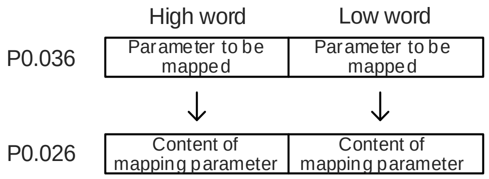
   Setting: set both the high word and low word of P0.035 to 060A (P6.010).

   Thus, P0.035 = 0x060A060A.

Write: set 0x00050064 to the mapping parameter P0.025, and P6.010 changes immediately.

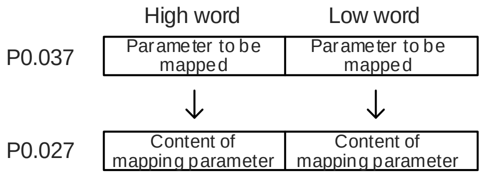
P0.036	**Target setting for mapping parameter P0.026**		**Address: 0048H 0049H**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:



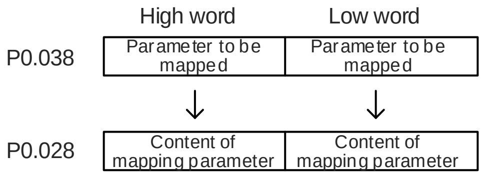
P0.037	**Target setting for mapping parameter P0.027**		**Address: 004AH 004BH**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:



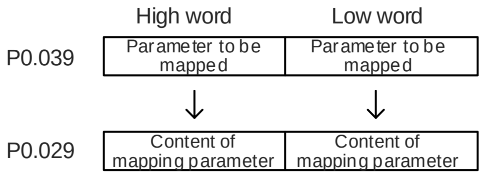
P0.038	**Target setting for mapping parameter P0.028**		**Address: 004CH 004DH**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:



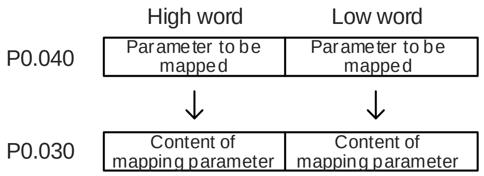
P0.039	**Target setting for mapping parameter P0.029**		**Address: 004EH 004FH**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:



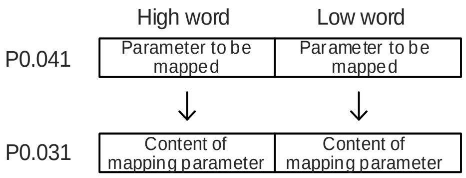
P0.040	**Target setting for mapping parameter P0.030**		**Address: 0050H 0051H**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:



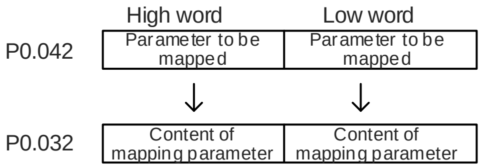
P0.041	**Target setting for mapping parameter P0.031**		**Address: 0052H 0053H**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:



P0.042	**Target setting for mapping parameter P0.032**		**Address: 0054H 0055H**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:



P0.043	**Reserved**

P0.044★■	**Status monitoring register (for PC software)**		**Address: 0058H 0059H**
Default:	0	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	DEC	Data size:	32-bit
Model:	-E, -L		

Settings:

This setting is the same as P0.009.

P0.045■	**Status monitoring register content selection (for PC software)**		**Address: 005AH 005BH**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-300 to +127
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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:	-E -L (does not support Bit 8)		

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

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 (magnetic brake control output)	15	Reserved

P0.047 - P0.048	**Reserved**

P0.049■	**Update encoder absolute position**		**Address: 0062H 0063H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0002
Format:	HEX	Data size:	16-bit
Model:	-E		

Settings:

X	Command processing	Z	Reserved
Y	Reserved	U	Reserved

- ■ X: command processing

  0: N/A

  1: update the encoder data to P0.050 - P0.052.

  2: update P0.050 - 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.

P0.050★■	**Absolute position system status**		**Address: 0064H 0065H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x001F
Format:	HEX	Data size:	16-bit
Model:	-E		

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:	-E		

Settings:

When you set P2.070 [Bit 1] to 1 for reading the pulse number, this parameter displays the encoder's absolute position in the form of number of revolutions. When you set P2.070 [Bit 1] to 0 for reading the PUU number, this parameter 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:	-E		

Settings:

When you set P2.070 [Bit 1] to 1 for reading the pulse number, this parameter displays the encoder's absolute position in the form of pulse number within a single turn. When you set P2.070 [Bit 1] to 0 for reading the PUU number, this parameter displays the motor's absolute position in PUU.

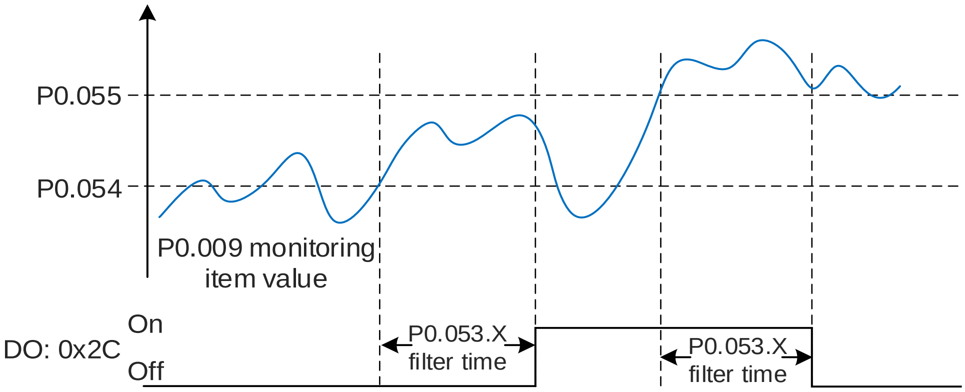
P0.053	**General range compare digital output - filter time**		**Address: 006AH 006BH**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x000F (-L) 0x0000 to 0xFFFF (-E)
Format:	HEX	Data size:	16-bit
Model:	-E -L (only supports P0.053.X)		

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:	-E, -L		

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 the monitoring item value of P0.009 is within the range set in 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:	-E, -L		

Settings:

Refer to the description of P0.054.

P0.056	**General range compare digital output 2 - lower limit**		**Address: 0071H 0072H**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	-E		

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 the monitoring item value of P0.010 is within the range set in 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: 0073H 0074H**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	-E		

Settings:

Refer to the description of P0.056.

P0.058	**General range compare digital output 3 - lower limit**		**Address: 0075H 0076H**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	-E		

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 the monitoring item value of P0.011 is within the range set in 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: 0077H 0078H**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	-E		

Settings:

Refer to the description of P0.058.

P0.060	**General range compare digital output 4 - lower limit**		**Address: 0079H 007AH**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	-E		

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 the monitoring item value of P0.012 is within the range set in 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: 007BH 007CH**
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	-E		

Settings:

Refer to the description of P0.060.

P0.062	**Reserved**

P0.063★	**Total duration of DC Bus voltage exceeding 400V**		**Address: 007EH 007FH**
Default:	0	Control mode:	All
Unit:	ms	Setting range:	0 to 2147483647
Format:	DEC	Data size:	32-bit
Model:	-E, -L		

Settings:

Records the total time during which the voltage of the DC Bus exceeded 400V.

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:	-E, -L		

Settings:

Records the highest IGBT temperature.

P0.080 - P0.100	**Reserved**

P1.xxx Basic parameters

P1.000▲	**External pulse input type**		**Address: 0100H 0101H**
Default:	0x1042	Control mode:	PT
Unit:	-	Setting range:	0x0000 to 0x31F2
Format:	HEX	Data size:	16-bit
Model:	-L		

Settings:

X	Pulse type	Z	Logic type
Y	Filter width	U	Filter width

- X: pulse type

  0: AB phase pulse (4x)

  1: clockwise and counterclockwise pulses

  2: pulse train + sign

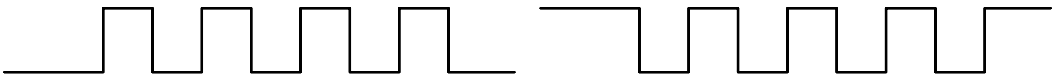
- Z: logic type

  0: positive logic

  1: negative logic

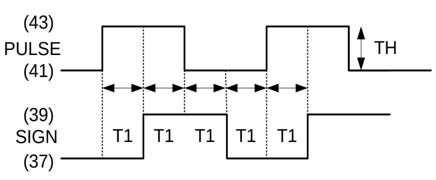
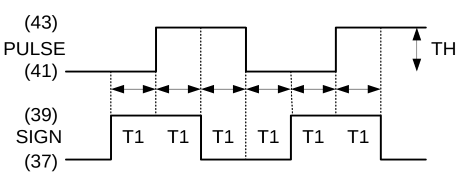
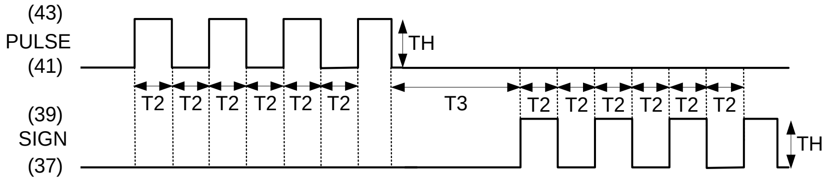
  Digital circuits use 0 and 1 to represent the high and low voltage levels. In positive logic, 1 represents high voltage and 0 represents low voltage; in negative logic, 1 represents low voltage and 0 represents high voltage.

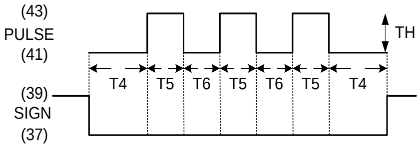
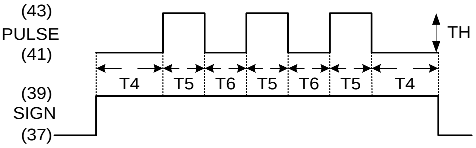
  Example:



Positive logic

Negative logic

Logic type	Pulse type	Pulse input	
		Forward	Reverse
		Pulse phase lead	Pulse phase lag
Z = 0	X = 0		
	X = 1		

Logic type	Pulse type	Pulse input	
		Forward	Reverse
Z = 0	X = 2	Sign = low	Sign = high
			

Pulse type		Maximum input frequency (single-phase)	Minimum allowed time width					
			T1	T2	T3	T4	T5	T6
Differential signal	Pulse train + sign	4 Mpps	62.5 ns	125 ns	250 ns	200 ns	125 ns	125 ns
	CW and CCW pulses							
	A phase + B phase	2 Mpps	125 ns	250 ns	250 ns	200 ns	250 ns	250 ns
Open-collector		200 Kpps	1.25 μs	2.5 μs	5 μs	5 μs	2.5 μs	2.5 μs

Pulse	Parameter settings	Type		Maximum input frequency (single-phase)	Voltage	Forward current
High speed pulse	Refer to the U & Y settings in the following table	Differential signal	Pulse train + sign	4 Mpps	5V	< 25 mA
			CW and CCW pulses			
			A phase + B phase	2 Mpps		
		Open-collector		200 Kpps	24V (max.)	< 25 mA
Low speed pulse^{Note}	U = 2 and Y = 0	Differential signal		200 Kpps	5V	< 25 mA
		Open-collector		200 Kpps	24V (max.)	< 25 mA

Note:

1. When the low speed pulse is used (U = 2), parameter Y has to be 0 (no filter function).
2. It is suggested that you use the low speed pulse function when there is high frequency interference.
3. The low speed pulse function is only supported by the servo drives of the production week W2113 or later.

■ U, Y: filter width

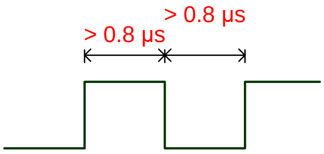
If the pulse frequency is suddenly too high, causing a pulse width smaller than the set filter width, then this pulse gets filtered out as noise. Therefore, set the filter width smaller than the actual pulse width. You should set the filter width as 4 times smaller than the actual pulse width.

U and Y values	Filter width Unit: μs (kHz)	U and Y values	Filter width Unit: μs (kHz)
0, 0	No filter function	1, 0	No filter function
0, 1	2 (250)	1, 1	0.2 (2500)
0, 2	3 (166)	1, 2	0.3 (1666)
0, 3	4 (125)	1, 3	0.4 (1250)
0, 4	5 (100)	1, 4	0.5 (1000)
0, 5	6 (83)	1, 5	0.6 (833)
0, 6	7 (71)	1, 6	0.7 (714)
0, 7	8 (62)	1, 7	0.8 (625)
0, 8	9 (55)	1, 8	0.9 (555)

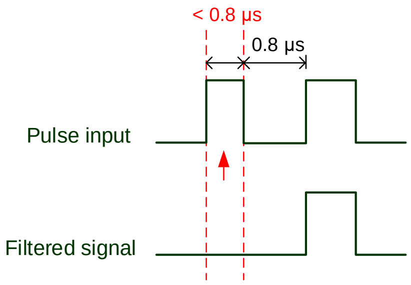
U and Y values	Filter width Unit: μs (kHz)	U and Y values	Filter width Unit: μs (kHz)
0, 9	10 (50)	1, 9	1 (500)
0, A	11 (45)	1, A	1.1 (454)
0, B	12 (41)	1, B	1.2 (416)
0, C	13 (38)	1, C	1.3 (384)
0, D	14 (35)	1, D	1.4 (357)
0, E	15 (33)	1, E	1.5 (333)

Example:

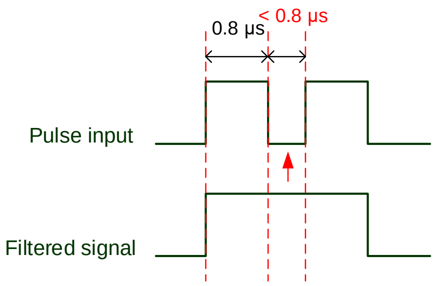
When you set U and Y both to 1 (filter width = 0.2 μs), and when the widths of the command pulse at high and low levels are both larger than 0.8 μs (four times the filter width 0.2 μs), then the pulse command is not filtered out.



When the width of the pulse at high or low level is smaller than the filter width, then the pulse is filtered out.



If the first pulse width is smaller than 0.8 μs, the pulse may be filtered out, and thus two input pulses will be regarded as one pulse. If the pulse width is smaller than 0.2 μs, the pulse will be filtered out.



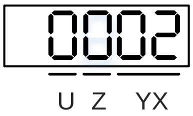
If the low level pulse width is smaller than 0.8 μs, the pulse may be filtered out, and thus two input pulses will be regarded as one pulse. If the low level pulse width is smaller than 0.2 μs, the pulse will be filtered out.

If you use a 125 ns (4 Mpps) input pulse, set the filter width value Y to 0 to disable the filter function.

Note: when the signal is a high-speed pulse (4 Mpps) and the value of the filter width is 0, then the pulse is not filtered out.

P1.001●	**Input for control mode and control command**		**Address: 0102H 0103H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x112F
Format:	HEX	Data size:	16-bit
Model:	-E (does not support PT mode or any PT dual / multi-modes) -L (does not support PR mode, any PR dual / multi-modes, or communication mode)		

Settings:



YX	Control mode setting	Z	Direction control
-	-	U	DIO value control

- YX: control mode setting

Mode	PT	PR	S	T	Sz	Tz
00	▲					
01		▲				
02			▲			
03				▲		
04					▲	
05						▲
Dual mode						
06	▲		▲			
07	▲			▲		
08		▲	▲			
09		▲		▲		
0A			▲	▲		
0C	EtherCAT mode					
0D	▲	▲				
Multi-mode						
0E	▲	▲	▲			
0F	▲	▲		▲		

PT: Position control mode; the command source is from the external pulse and the external analog voltage.

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: Speed control mode; the command source is from the external analog voltage and the internal registers which you can select with DI.SPD0 and DI.SPD1.

T: Torque control mode; the command source is from the external analog voltage and the internal registers which you can select with DI.TCM0 and DI.TCM1.

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.

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.

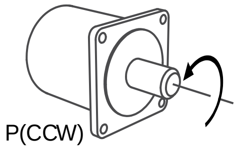
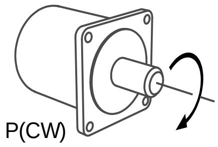
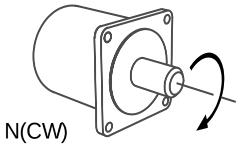
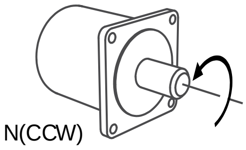
Dual mode: you can switch between two modes with the external DI. For example, you can use DI.S-P to switch the dual mode of PT-S (control mode setting: 06). Refer to Table 8.1 for further information.

Multi-mode: you can switch between three modes with the external DI. For example, you can use DI.S-P and DI.PT-PR to switch the multi-mode of PT-PR-S (control mode setting: 0E). 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.

Note: if the command source is the external analog voltage, make sure to connect the voltage source properly to avoid floating connection causing misoperation.

- 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: for the default settings of -L models, refer to Section 3.3.2. For the default settings of -E models, refer to Section 3.3.5.

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:	-E, -L		

Settings:

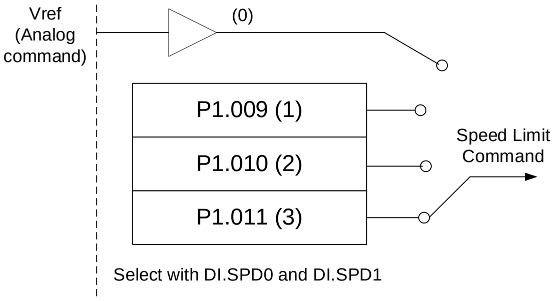
X	Disable / enable Speed Limit function	Z	Reserved
Y	Disable / enable Torque Limit function	U	Reserved

- 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:

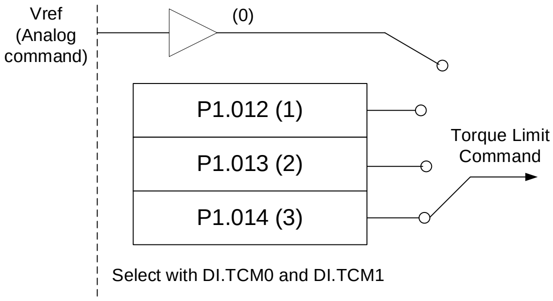


- Y: disable / enable Torque Limit function

  0: disable Torque Limit function

  1: enable Torque Limit function

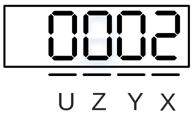
  See the following diagram for Torque Limit setting:



When using the Torque Limit function, set P1.002.Y to 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	**Encoder pulse output polarity**		**Address: 0106H 0107H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0013
Format:	HEX	Data size:	16-bit
Model:	-L		

Settings:



X	Polarity of monitor analog output	Z	Reserved
Y	Direction of encoder pulse output	U	Reserved

- X: polarity of monitor analog output

  0: MON1(+), MON2(+)

  1: MON1(+), MON2(-)

  2: MON1(-), MON2(+)

  3: MON1(-), MON2(-)

- Y: direction of encoder pulse output

  0: forward

  1: reverse

P1.004	**MON1 analog monitor output proportion**		**Address: 0108H 0109H**
Default:	100	Control mode:	All
Unit:	% (full scale)	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

Refer to P0.003 for the analog output setting.

Example:

If the analog voltage output is 8V when the motor speed is 1,000 rpm and the maximum speed of the motor is 5,000 rpm, the setting is as follows.

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

You can calculate the voltage output corresponding to the current motor speed with the following formula.

Motor speed	MON1 analog monitor output
300 rpm	$\text{MON1} = 8\text{V} \times \frac{\text{Current speed}}{\text{Maximum speed} \times \frac{\text{P1.004}}{100}} \times 100\% = 8\text{V} \times \frac{300\text{ rpm}}{5000\text{ rpm} \times \frac{20}{100}} \times 100\% = 2.4\text{V}$
900 rpm	$\text{MON1} = 8\text{V} \times \frac{\text{Current speed}}{\text{Maximum speed} \times \frac{\text{P1.004}}{100}} \times 100\% = 8\text{V} \times \frac{900\text{ rpm}}{5000\text{ rpm} \times \frac{20}{100}} \times 100\% = 7.2\text{V}$

P1.005	**MON2 analog monitor output proportion**		**Address: 010AH 010BH**
Default:	100	Control mode:	All
Unit:	% (full scale)	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

Refer to P0.003 for the analog output setting.

P1.006	**Speed command - smoothing constant (low-pass filter)**		**Address: 010CH 010DH**
Default:	0	Control mode:	S / Sz
Unit:	ms	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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:	-E, -L		

Settings:

0: disable this function.

P1.008	**Position command - smoothing constant (low-pass filter)**		**Address: 0110H 0111H**
Default:	0	Control mode:	PT / PR
Unit:	10 ms	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Example:	11 = 110 ms		
Model:	-E, -L		

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:	-E, -L		

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:	-E, -L		

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:	-E, -L		

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 PT / PR / S / Sz: internal torque limit 1
Unit:	%	Setting range:	-5000 to +5000
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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.

Example of internal torque limit:

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.

Example of internal torque limit:

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 PT / PR / S / Sz: internal torque limit 2
Unit:	%	Setting range:	-5000 to +5000
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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.

Example of internal torque limit:

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.

Example of internal torque limit:

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 PT / PR / S / Sz: internal torque limit 3
Unit:	%	Setting range:	-5000 to +5000
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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.

Example of internal torque limit:

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.

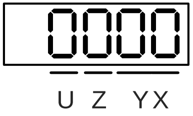
Example of internal torque limit:

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:	-E		

Settings:



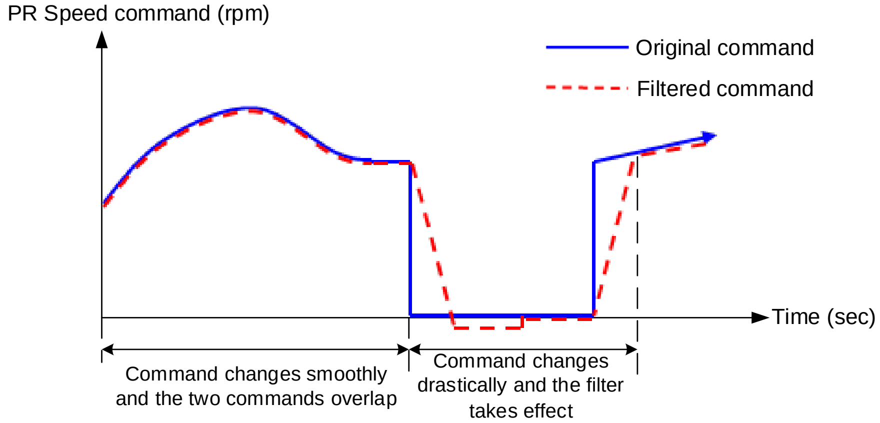
YX	Acceleration / deceleration time limit (0 - 1270 ms)	Z	Reserved
-	-	U	Reverse inhibit

- YX: acceleration / deceleration time limit (0 - 1270 ms)

  If the PR 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 lag 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 command is shorter than 180 ms, the filter takes effect. If the acceleration / deceleration time of the PR command is longer than 180 ms, the filter does not take effect.

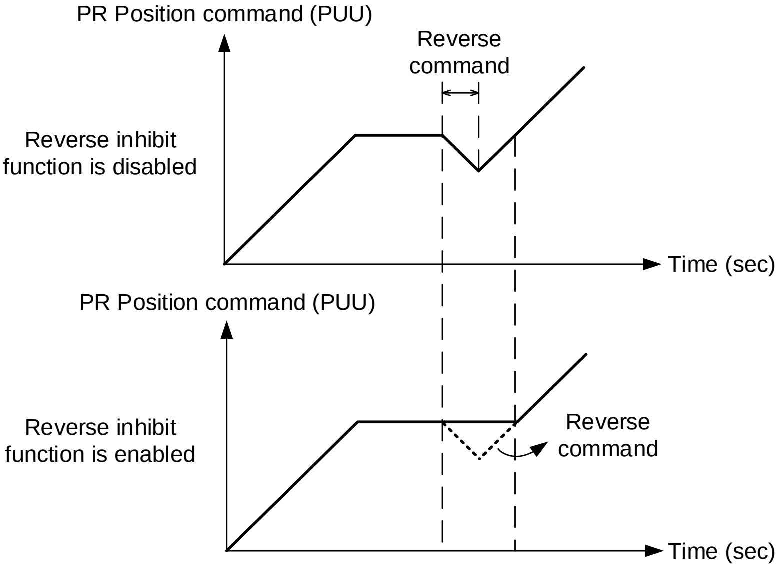


Note: if the command keeps changing drastically, the following error of the internal position exceeds the allowable range and then triggers AL404.

- U: reverse inhibit

  0: disable this function

  1: enable this function. When the value of the current 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:	PT / PR
Unit:	0.1 Hz	Setting range:	10 to 1000
Format:	DEC	Data size:	16-bit
Example:	150 = 15 Hz	-	-
Model:	-E, -L		

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:	PT / PR
Unit:	-	Setting range:	0 to 9
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

The gain of the first low-frequency vibration suppression filter. Increase the value to improve the position response. If you set the value too high, the motor may not operate smoothly. The suggested value is 1. Set P1.026 to 0 to disable the first low-frequency vibration suppression filter.

P1.027	Low-frequency vibration suppression frequency 2		Address: 0136H 0137H
Default:	1000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 to 1000
Format:	DEC	Data size:	16-bit
Example:	150 = 15 Hz	-	-
Model:	-E, -L		

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:	PT / PR
Unit:	-	Setting range:	0 to 9
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

The gain of the second low-frequency vibration suppression filter. Increase the value to improve the position response. If you set the value too high, the motor may not operate smoothly. The suggested value is 1. Set P1.028 to 0 to disable the second low-frequency vibration suppression filter.

P1.029	**Auto low-frequency vibration suppression mode**		**Address: 013AH 013BH**
Default:	0	Control mode:	PT / PR
Unit:	-	Setting range:	0 to 1
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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.

P1.030	**Low-frequency vibration detection**		**Address: 013CH 013DH**
Default:	8000	Control mode:	PT / PR
Unit:	pulse	Setting range:	1 to 128000
Format:	DEC	Data size:	32-bit
Model:	-E, -L		

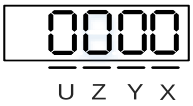
Settings:

Sets the detection level when automatic vibration suppression is enabled (P1.029 = 1). The lower the value, the more sensitive the detection, but the system may treat noise or minor low-frequency vibrations as frequencies to be suppressed. If the value is high, the system is less likely to misjudge, but if the vibration of the machine is small, the system may not properly detect low-frequency vibrations.

P1.031	**Reserved**

P1.032	**Motor stop mode**		**Address: 0140H 0141H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0020
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:



X	Reserved	Z	Reserved
Y	Motor stop mode	U	Reserved

- Y: motor stop mode

Bit	7	6	5	4	3	2	1	0
		Y						
Bit	15	14	13	12	11	10	9	8

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 (PT, PR, S, and Sz) modes and is effective only when P1.043 (Delay time for disabling the magnetic 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:	-E, -L		

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 follow a trapezoidal curve; when an analog command is used, you must set P1.036 larger than 0 so that the acceleration and deceleration 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:	-E, -L		

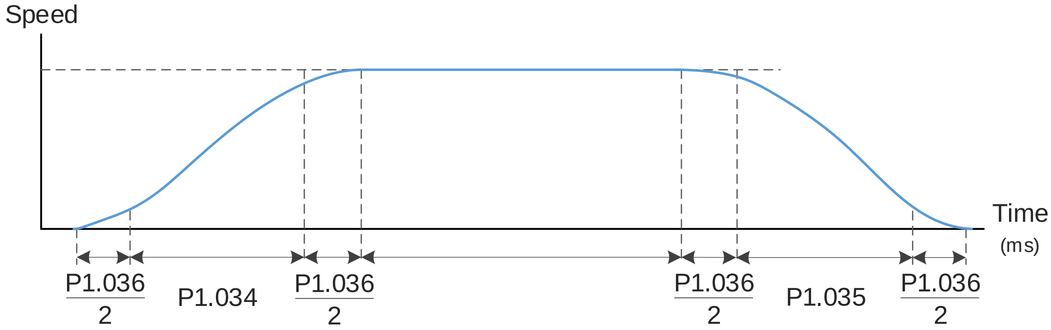
Settings:

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 follow a trapezoidal curve; when an analog command is used, you must set P1.036 larger than 0 so that the acceleration and deceleration 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:	-E, -L		

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:	16-bit
Unit:	1 times	0.1 times	-	-
Setting range:	0.0 to 200.0	0 to 2000	-	-
Format:	One decimal	DEC	-	-
Example:	1.5 = 1.5 times	15 = 1.5 times	-	-
Model:	-E, -L			

Settings:

Load inertia ratio of servo motor (rotary motor): (J_load / J_motor)

J_motor: rotor inertia of the servo motor

J_load: total equivalent inertia of external mechanical load

P1.038	**Zero speed range**			**Address: 014CH 014DH**
Operation interface:	Panel / software	Communication	Control mode:	All
Default:	10.0	100	Data size:	16-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 to 200.0	0 to 2000	-	-
Format:	One decimal	DEC	-	-
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-
Model:	-E, -L			

Settings:

Sets the range for the zero-speed signal (ZSPD). 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:	-E, -L		

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	**Maximum motor speed for analog Speed command 1**		**Address: 0150H 0151H**
Default:	Rated speed	Control mode:	S / T
Unit:	rpm	Setting range:	0 to 50000
Format:	DEC	Data size:	32-bit
Model:	-L		

Settings:

In Speed mode:

Sets the motor speed corresponding to 10V (maximum voltage) for the analog Speed command.

$$\text{Speed control command} = \frac{\text{Input voltage} \times \text{P1.040}}{10}$$

If the value is 2000 and the external voltage input is 5V, then the speed control command = $\frac{5\text{V} \times 2000\text{ rpm}}{10}$ = 1000 rpm

In Torque mode:

Sets the motor speed limit corresponding to 10V (maximum voltage) for the analog speed limit.

$$\text{Speed limit command} = \frac{\text{Input voltage} \times \text{P1.040}}{10}$$

If the value is 2000 and the external voltage input is 5V, then the speed limit command = $\frac{5\text{V} \times 2000\text{ rpm}}{10}$ = 1000 rpm.

P1.041▲	**Maximum output for analog Torque command**		**Address: 0152H 0153H**
Default:	100	Control mode:	All
Unit:	%	Setting range:	-1000 to +1000
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

In Torque mode:

Sets the torque corresponding to 10V (maximum voltage) for the analog Torque command.

$$\text{Torque control command} = \frac{\text{Input voltage} \times \text{P1.041}}{10} \text{ (Unit: \%)}$$

In Speed and PT modes:

Sets the torque limit corresponding to 10V (maximum voltage) for the analog torque limit.

$$\text{Torque limit command} = \frac{\text{Input voltage} \times \text{P1.041}}{10} \text{ (Unit: \%)}$$

Example:

If P1.041 = 10,

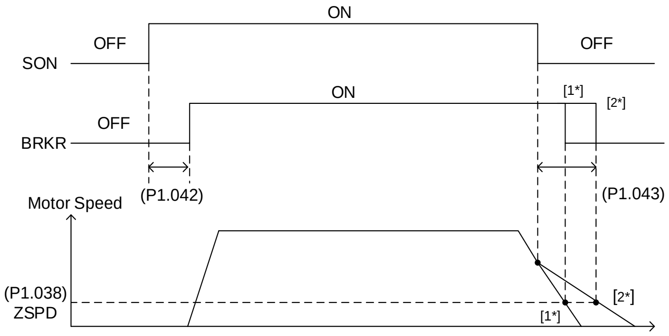
(a) when the external analog voltage input is 10V, the torque control (limit) command = $\frac{10\text{V} \times 10}{10}$ = 10%

(b) when the external analog voltage input is 5V, the torque control (limit) command = $\frac{5\text{V} \times 10}{10}$ = 5%

P1.042	**Delay time for enabling the magnetic brake**		**Address: 0154H 0155H**
Default:	0	Control mode:	All
Unit:	ms	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Sets the delay time from Servo On status to the activation of the magnetic 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 magnetic brake signal (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 magnetic brake signal (BRKR) is disabled.

P1.043	**Delay time for disabling the magnetic brake**		**Address: 0156H 0157H**
Default:	0	Control mode:	All
Unit:	ms	Setting range:	-1000 to +1000
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Sets the delay time from Servo Off status to the deactivation of the magnetic 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:	-E, -L		

Settings:

For the E-Gear ratio setting, refer to Section 6.2.5. For multiple E-Gear ratio (numerator) settings, refer to P2.060 - P2.062.

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 P1.045 to be reset to the default value, 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:	-E, -L		

Settings:

If the setting is incorrect, the servo motor is prone to sudden unintended acceleration. Follow these instructions.

E-Gear ratio setting: $f2 = f1 \times \frac{N}{M}$

$$\begin{array}{c}\text{Pulse of User Unit (PUU)}\\ \text{(f1)}\end{array} \rightarrow \boxed{\frac{N}{M}} \rightarrow \begin{array}{c}\text{Resolution determined by}\\ \text{servo drive (pulse)}\\ \text{(f2)}\end{array}$$

Range of E-gear ratio: $1 \leq Nx / M \leq 262144$.

For the E-Gear ratio setting, refer to Section 6.2.5.

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 P1.045 to be reset to the default value, set P3.012.Z to 1. Refer to P3.012 for details.

P1.046▲	**Encoder pulse number output (OA, OB)**		**Address: 015CH 015DH**
Default:	2500	Control mode:	All
Unit:	pulse	Setting range:	1 to 536870912
Format:	DEC	Data size:	32-bit
Model:	-L		

Settings:

The number of single-phase pulse outputs per revolution. The maximum output frequency of the hardware is 19.8 MHz. For the OA / OB settings, refer to P1.074.Y (selection of OA / OB / OZ output source) and P1.097 (encoder output denominator (OA, OB)).

Note:
In the following circumstances, pulse output of the encoder may exceed the maximum allowable output pulse frequency of the drive, causing AL018 or AL048:

1. Encoder error.
2. The motor speed is faster than the setting of P1.076.
3. If P1.074.Y = 0 and P1.097 = 0, motor speed (rpm)/60 x P1.046 x 4 > 19.8 x 10^6

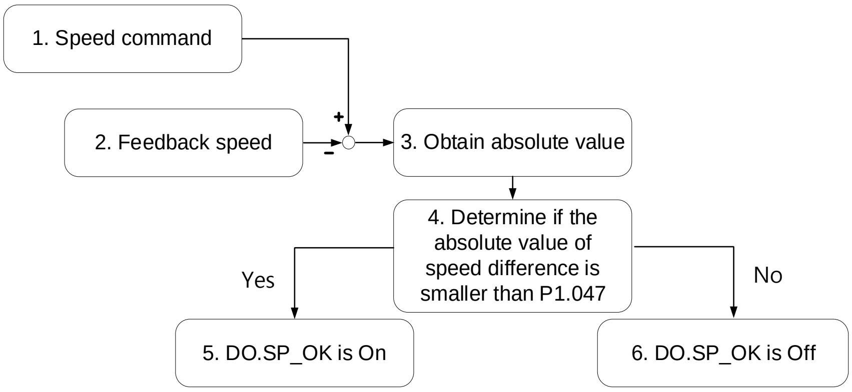
P1.047	**Speed reached (DO.SP_OK) range**		**Address: 015EH 015FH**
Default:	10	Control mode:	S / Sz
Unit:	rpm	Setting range:	0 to 300
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

In Speed mode, when the absolute value of the difference between the Speed command and the motor feedback speed 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 feedback speed exceeds the range set in P1.047, the system recalculates the duration.

Diagram:

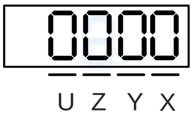


1. Speed command: the command that you input without acceleration or deceleration, rather than the command from the front end speed circuit. Its source is from the register.
2. Feedback speed: the actual speed of the motor which has been filtered.
3. Obtain the absolute value.
4. Determine whether the absolute value of the speed 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 selection**		**Address: 0160H 0161H**
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 to 0x0011
Format:	HEX	Data size:	16-bit
Model:	-E		

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

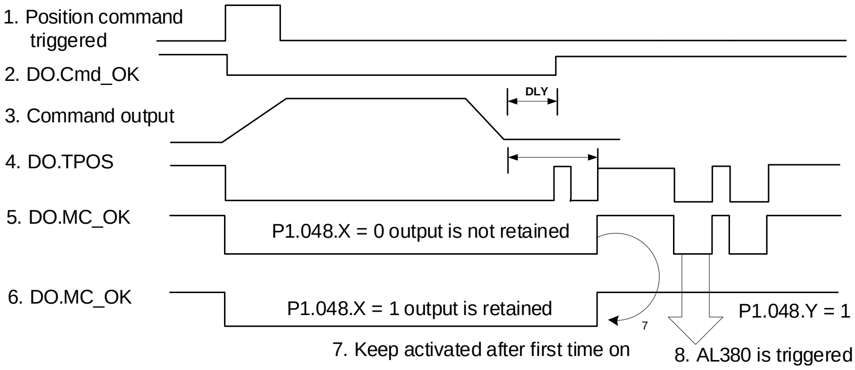
  1: output status is retained

- ■ Y: position offset alarm (AL380) option

  0: AL380 not functioning

  1: AL380 functioning

Diagram:



Description:

1. Command triggered: new PR 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 DO.Cmd_OK and DO.TPOS are both on.

6. DO.MC_OK (retains digital output status): same as 5, except that once this DO is on, its status is retained regardless of the signal 4 status.
7. Either signal 5 or signal 6 can be output, 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 to enable AL380 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:	-E, -L		

Settings:

In Speed mode, when the absolute value of the difference between the Speed command and the motor feedback speed 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 (DO: 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 table.	Control mode:	All
Unit:	Ohm	Setting range:	Refer to the following table.
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Model	Default (Ω)	Setting range (Ω)
750 W or below	100	60 to 750
1 to 1.5 kW	100	30 to 750
2 to 3 kW	20	15 to 750

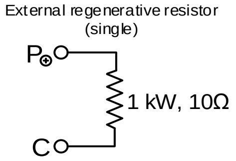
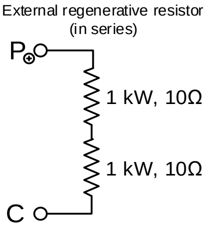
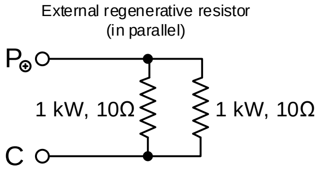
Refer to the description of P1.053 for the parameter values when connecting the regenerative resistor through different methods.

P1.053	**Regenerative resistor capacity**		**Address: 016AH 016BH**
Default:	Determined by the model. Refer to the following table.	Control mode:	All
Unit:	Watt	Setting range:	0 to 15000
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Model	Default (Watt)
400 W or below	0
750 W to 1.5 kW	40
2 kW to 3 kW	80

Setting the parameter value when connecting the regenerative resistor with different methods:

External regenerative resistor	Setting
	Setting: P1.052 = 10 (Ω) P1.053 = 1000 (W)
	Setting: P1.052 = 20 (Ω) P1.053 = 2000 (W)
	Setting: P1.052 = 5 (Ω) P1.053 = 2000 (W)

P1.054	**Pulse range for position reached**		**Address: 016CH 016DH**
Default:	167772	Control mode:	PT / PR
Unit:	pulse	Setting range:	0 to 16777216
Format:	DEC	Data size:	32-bit
Model:	-E, -L		

Settings:

In Position (PT) mode, when the pulse number error is smaller than the range set by P1.054, DO.TPOS is on.

In Position Register (PR) mode, when the difference between the target position and the actual motor position is smaller than the range set by P1.054, 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:	-E, -L		

Settings:

Sets the maximum 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:	-E, -L		

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:	-E, -L		

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:	-E, -L		

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).

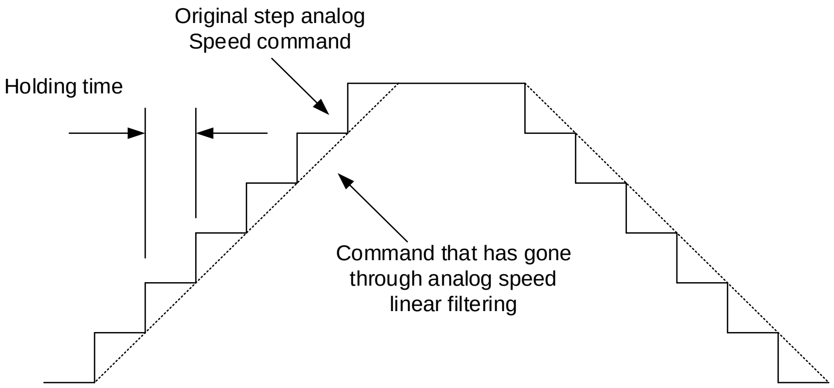
P1.059	**Speed command - moving filter**			**Address: 0176H 0177H**
Operation interface:	Panel / software	Communication	Control mode:	S
Default:	0.0	0	Data size:	16-bit
Unit:	1 ms	0.1 ms	-	-
Format:	One decimal	DEC	-	-
Setting range:	0.0 to 4.0	0 to 40	-	-
Example:	1.5 = 1.5 ms	15 = 1.5 ms	-	-
Model:	-E, -L			

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:	-E, -L		

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.

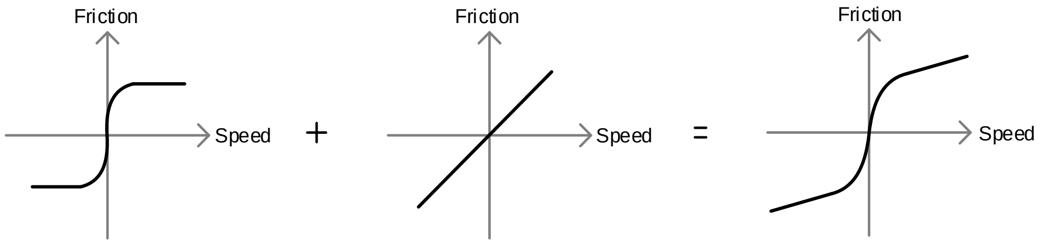
Suggested setting value = (Average torque at constant speed in forward direction + Average torque at constant speed in reverse direction) / 2

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:	PT / PR / S / Sz
Unit:	0.1%/1000 rpm	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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

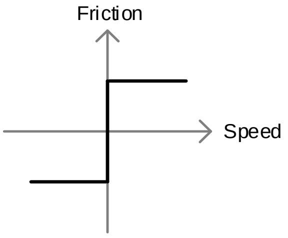
P1.061 Viscous friction compensation

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:	PT / PR / S / Sz
Unit:	%	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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 to reduce the position error at the moment the motion starts.



P1.062 Percentage of friction compensation

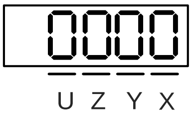
P1.063	**Constant of friction compensation**		**Address: 017EH 017FH**
Default:	100	Control mode:	PT / PR / S / Sz
Unit:	%	Setting range:	1 to 1000
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Sets the speed for the friction compensation value to reach the setting value of P1.062. Based on the default setting of 100%, the smaller the setting value of P1.063, the faster the setting value of P1.062 is reached; the bigger the setting value of P1.063, the slower the setting value of P1.062 is reached.

P1.064	**Analog position command - activation control**		**Address: 0180H 0181H**
Default:	0x0000	Control mode:	PT
Unit:	-	Setting range:	0x0000 to 0x0011
Format:	HEX	Data size:	16-bit
Model:	-L		

Settings:



X	Setting for position command issued by the analog signal	Z	Reserved
Y	Initial position setting	U	Reserved

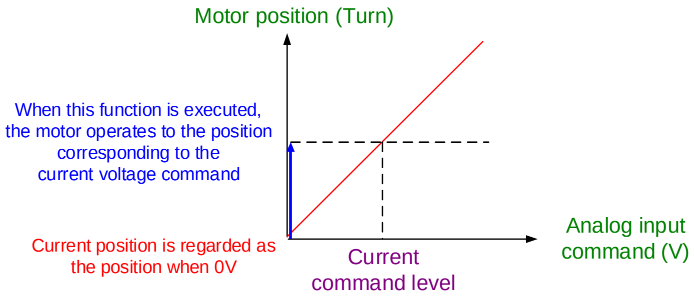
- X: setting for position command issued by the analog signal

  0: disable

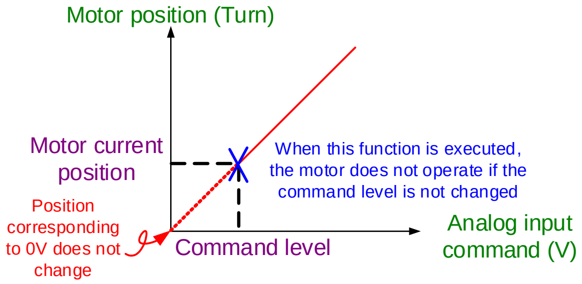
  1: enable

- Y: initial position setting

  0: after the servo is on, the motor regards the current position as the position when the voltage is 0V. Then the motor operates to the corresponding position according to the analog input command.



1: after the servo is on, if the command level is not changed, the motor does not operate. The position the motor stops at is the position corresponding to the current command level.



P1.065	**Analog Position command - smoothing constant**		**Address: 0182H 0183H**
Default:	1	Control mode:	PT
Unit:	10 ms	Setting range:	1 to 1000
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

The smoothing constant of analog Position command is only effective to analog Position command.

P1.066	**Analog Position command - maximum cycle number**			**Address: 0184H 0185H**
Operation interface:	Panel / software	Communication	Control mode:	PT
Default:	0.0	0	Data size:	16-bit
Unit:	1 cycle	0.1 cycle	-	-
Format:	One decimal	DEC	-	-
Setting range:	0.0 to 200.0	0 to 2000	-	-
Example:	1.5 = 1.5 cycles	15 = 1.5 cycles	-	-
Model:	-L			

Settings:

Rotation number setting when the maximum voltage (10V) is input to the analog Position command.

If the setting on the panel is 3.0 and the external voltage input is +10V, then the Position command is +3 cycles. If the input is +5V, then the Position command is +1.5 cycles. If the input is -10V, then the Position command is -3 cycles.

Position control command = Input voltage x P1.066 setting value / 10

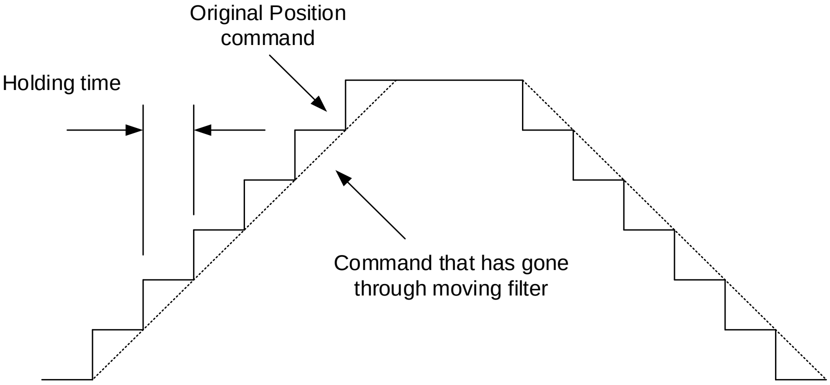
P1.067	**Reserved**

P1.068	**Position command - moving filter**		**Address: 0188H 0189H**
Default:	4	Control mode:	PT / PR
Unit:	ms	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

0: disable this function.

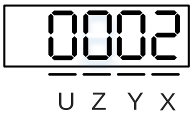
The moving filter smooths the beginning and end of the step command, but it also delays the command.



P1.069 - P1.073	**Reserved**

P1.074	**Output source of OA / OB / OZ**		**Address: 0194H 0195H**
Default:	0x0000	Control mode:	PT
Unit:	-	Setting range:	0x0000 to 0x0030
Format:	HEX	Data size:	16-bit
Model:	-L		

Settings:



X	Reserved	Z	Reserved
Y	Selection of OA / OB / OZ output source	U	Reserved

- Y: selection of OA / OB / OZ output source

  0: CN2 encoder is the output source

  1: reserved

  2: CN1 pulse command is the output source

  (If P1.097 = 0, the OA / OB output must be 1:1. If you need to change the output ratio, refer to the settings of P1.046 and P1.097.)

P1.075	**Reserved**

P1.076▲	**Maximum speed for encoder output (OA, OB)**		**Address: 0198H 0199H**
Default:	5500	Control mode:	All
Unit:	rpm	Setting range:	0 to 6000 (0: disable this function)
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

Set a value which is slightly higher than the required maximum speed of motor.

P1.077	**Reserved**

P1.078	**Gain switching delay time**		**Address: 019CH 019DH**
Default:	0	Control mode:	P / S
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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:	-E, -L		

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 control gain) and P2.004 (Speed control 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:	-E, -L		

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, the stronger the filtering effect.)

P1.081	**Maximum motor speed for analog Speed command 2**		**Address: 01A2H 01A3H**
Default:	Rated speed	Control mode:	S / T
Unit:	rpm	Setting range:	0 to 50000
Format:	DEC	Data size:	32-bit
Model:	-L		

Settings:

Refer to the description of P1.040.

P1.082	**Time constant for switching between P1.040 and P1.081**		**Address: 01A4H 01A5H**
Default:	0	Control mode:	S / T
Unit:	ms	Setting range:	0 to 1000 (0: disable this function)
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

0: disable this function.

P1.083	**Abnormal analog input voltage level**		**Address: 01A6H 01A7H**
Default:	0	Control mode:	S
Unit:	mV	Setting range:	0 to 12000 (0: disable this function)
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

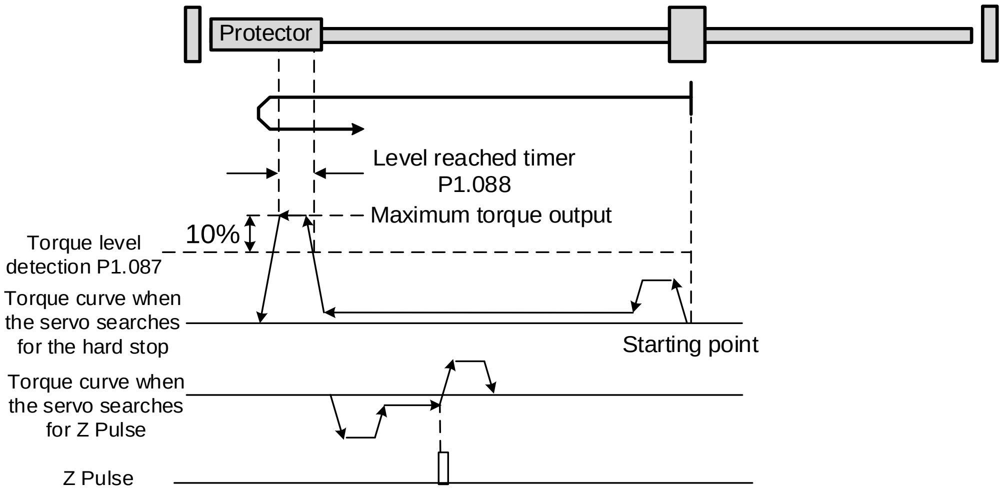
When the absolute value of the analog input voltage is higher than the set value of this parameter for more than 50 ms, AL042 occurs. The comparison value for this parameter is the original analog input voltage which has not been changed by an offset value through P4.022 (Analog speed input - offset compensation value).

P1.084 - 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:	-E		

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:	-E		

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:	PT / PR
Unit:	0.1 Hz	Setting range:	10 to 4000
Format:	DEC	Data size:	16-bit
Model:	-E		

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:	PT / PR
Unit:	0.1 Hz	Setting range:	10 to 4000
Format:	DEC	Data size:	16-bit
Model:	-E		

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:	PT / PR
Unit:	0.1 dB	Setting range:	10 to 4000
Format:	DEC	Data size:	16-bit
Model:	-E		

Settings:

Attenuation rate for the first set of low frequency vibration elimination.

P1.092	**Vibration elimination 2 - anti-resonance frequency**		**Address: 01B8H 01B9H**
Default:	4000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 to 4000
Format:	DEC	Data size:	16-bit
Model:	-E		

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:	PT / PR
Unit:	0.1 Hz	Setting range:	10 to 4000
Format:	DEC	Data size:	16-bit
Model:	-E		

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:	PT / PR
Unit:	0.1 dB	Setting range:	10 to 4000
Format:	DEC	Data size:	16-bit
Model:	-E		

Settings:

Attenuation rate for the second set of low frequency vibration elimination.

P1.095 - P1.096	**Reserved**

P1.097▲	**Encoder output denominator (OA, OB)**		**Address: 01C2H 01C3H**
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 to 160000
Format:	DEC	Data size:	32-bit
Model:	-L		

Settings:

1. When P1.074.Y = 0 (output source is from the encoder connected to CN2):
   - When P1.097 = 0, OA / OB pulse output refers to the setting of P1.046. (Refer to Example 1.)
   - When P1.097 ≠ 0, OA / OB pulse output refers to the settings of P1.046 and P1.097. (Refer to Example 2.)
2. When P1.074.Y = 2 (output source is the pulse command from CN1):
   - When P1.097 = 0, OA / OB pulse output does not refer to the setting of P1.046, but outputs according to the ratio of 1:1 instead.
   - When P1.097 ≠ 0, OA / OB pulse output refers to the settings of P1.046 and P1.097. (Refer to Example 2.)

Example 1 (the value must be multiplied by 4 times the frequency):

When P1.097 = 0 and P1.046 = 2500, indicating OA / OB outputs P1.046 * 4 = 10,000 pulses when the motor rotates 1 cycle.

Example 2 (the calculated value does not need to be multiplied by 4 times the frequency):
When P1.097 = 7 and P1.046 = 2500, indicating OA / OB outputs 2,500 pulses when the motor rotates 7 cycles.

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:	-E, -L		

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 to 0 to use the servo's default response time.

When P1.098 is not set to 0, the range 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 - P1.100	**Reserved**

P1.101■	Analog monitor output voltage 1		Address: 01CAH 01CBH
Default:	0	Control mode:	All
Unit:	mV	Setting range:	-10000 to +10000
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

When you set P0.003 (Analog output monitoring) to 0x0006, then the analog monitor output voltage refers to the voltage value of P1.101.

Note: the valid setting range of P1.101 is -8V to +8V.

P1.102■	Analog monitor output voltage 2		Address: 01CCH 01CDH
Default:	0	Control mode:	All
Unit:	mV	Setting range:	-10000 to +10000
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

When you set P0.003 (Analog output monitoring) to 0x0007, then the analog monitor output voltage refers to the voltage value of P1.102.

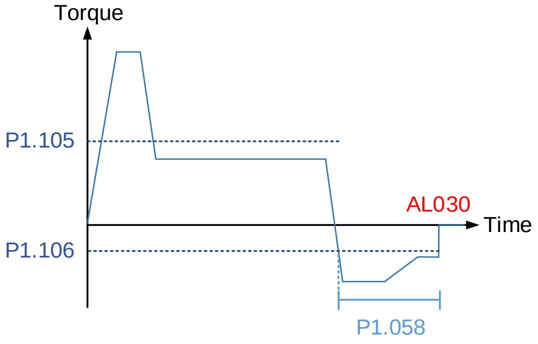
Note: the valid setting range of P1.102 is -8V to +8V.

P1.103 - 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:	-E, -L		

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:	-E, -L		

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 66000
Format:	DEC	Data size:	32-bit
Model:	-E, -L		

Settings:

This function is to protect the motor from overspeeding, which can be applied to all control modes. 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:	-E		

Settings:

Refer to the description of P4.044 for more details.

P2.xxx Extension parameters

P2.000	**Position control gain**		**Address: 0200H 0201H**
Default:	35	Control mode:	PT / PR
Unit:	rad/s	Setting range:	0 to 2047
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Increasing the position control gain can enhance the position response and reduce the position errors. If you set the value too high, it may cause vibration and noise.

P2.001	**Rate of change for position control gain**		**Address: 0202H 0203H**
Default:	100	Control mode:	PT / PR
Unit:	%	Setting range:	10 to 500
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Adjust the rate of change for the position control gain (P2.000) according to the gain switching condition.

P2.002	**Position feed forward gain**		**Address: 0204H 0205H**
Default:	50	Control mode:	PT / PR
Unit:	%	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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:	PT / PR
Unit:	ms	Setting range:	2 to 100
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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 control gain**		**Address: 0208H 0209H**
Default:	500	Control mode:	All
Unit:	rad/s	Setting range:	0 to 8191
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Increasing the speed control gain can enhance the speed response. If you set the value too high, it may cause vibration and noise.

P2.005	**Rate of change for speed control gain**		**Address: 020AH 020BH**
Default:	100	Control mode:	All
Unit:	%	Setting range:	10 to 500
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Adjust the rate of change for the speed control 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:	-E, -L		

Settings:

Increasing the value of the integral speed control can enhance the speed response and reduce the deviation in speed control. If you set the value too high, it may cause vibration and noise.

P2.007	**Speed feed forward gain**		**Address: 020EH 020FH**
Default:	0	Control mode:	All
Unit:	%	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

If the speed control command changes speed 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.

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:	-E, -L		

Settings:

Code	Function
10	Reset parameter groups P0 - P7 (cycle the power after reset).
20	P4.010 is writable.
22	P4.011 - P4.021 are writable.
406	Enable forced DO mode.
400	When forced DO mode is enabled, switch back to the normal DO mode.

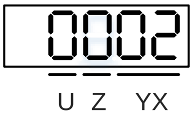
P2.009	**DI response filter time**		**Address: 0212H 0213H**
Default:	2	Control mode:	All
Unit:	ms	Setting range:	0 to 100
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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:	0x0101 (-L) 0x0100 (-E)	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:



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)

When these parameters are modified, re-start the servo drive to ensure it functions normally. Use P3.006 to change the source for the digital input signal, which can be either an external terminal block or the communication parameter P4.007.

P2.011	**DI2 functional planning**		**Address: 0216H 0217H**
Default:	0x0104 (-L) 0x0022 (-E)	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to the description of P2.010.

P2.012	**DI3 functional planning**		**Address: 0218H 0219H**
Default:	0x0116 (-L) 0x0023 (-E)	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to the description of P2.010.

P2.013	**DI4 functional planning**		**Address: 021AH 021BH**
Default:	0x0117 (-L) 0x0021 (-E)	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to the description of P2.010.

P2.014	**DI5 functional planning**		**Address: 021CH 021DH**
Default:	0x0102 (-L) 0x0100 (-E)	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to the description of P2.010.

P2.015	**DI6 functional planning**		**Address: 021EH 021FH**
Default:	0x0022 (-L) 0x0100 (-E)	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to the description of P2.010.

P2.016	**DI7 functional planning**		**Address: 0220H 0221H**
Default:	0x0023 (-L) 0x0100 (-E)	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to the description of P2.010. There is no physical pin for DI7 on the -E 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.

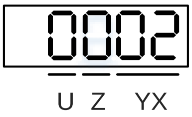
P2.017	**DI8 functional planning**		**Address: 0222H 0223H**
Default:	0x0021 (-L) 0x0100 (-E)	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to the description of P2.010. There is no physical pin for DI8 on the -E 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 0x013F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

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).

When these parameters are modified, re-start the servo drive to ensure it functions normally.

P2.019	**DO2 functional planning**		**Address: 0226H 0227H**
Default:	0x0103 (-L) 0x0100 (-E)	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x013F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to the description of P2.018.

P2.020	**DO3 functional planning**		**Address: 0228H 0229H**
Default:	0x0109 (-L) 0x0100 (-E)	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x013F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to the description of P2.018.

P2.021	**DO4 functional planning**		**Address: 022AH 022BH**
Default:	0x0105 (-L) 0x0100 (-E)	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x013F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit
Model:	-L		

Settings:

Refer to the description of P2.018.

P2.022	**DO5 functional planning**		**Address: 022CH 022DH**
Default:	0x0007	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x013F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit
Model:	-L		

Settings:

Refer to the description of P2.018.

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:	-E, -L		

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:	-E, -L		

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:	-E, -L			

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:	-E, -L		

Settings:

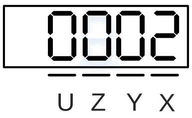
Increasing this parameter can increase the damping of the speed loop and reduce the speed loop response. Setting the value of P2.026 to the same value of P2.006 is recommended. See the following for setting P2.026:

1. In Speed mode, increase the value of this parameter to reduce speed overshoot.
2. In Position mode, decrease the value of this parameter to reduce position overshoot.

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:	-E, -L		

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 control mode, position error is larger than P2.029.	P	-
3	Frequency of Position command is larger than P2.029.	P	Supported
4	Speed of servo motor is faster than P2.029.	All	-
5	Signal of gain switching (DI.GAINUP: 0x03) is off.	All	-
6	In Position control mode, position error is smaller than P2.029.	P	-
7	Frequency of Position command is smaller than P2.029.	P	Supported
8	Speed of servo motor is slower than P2.029.	All	-

- Y: gain switching method

0: gain rate switching

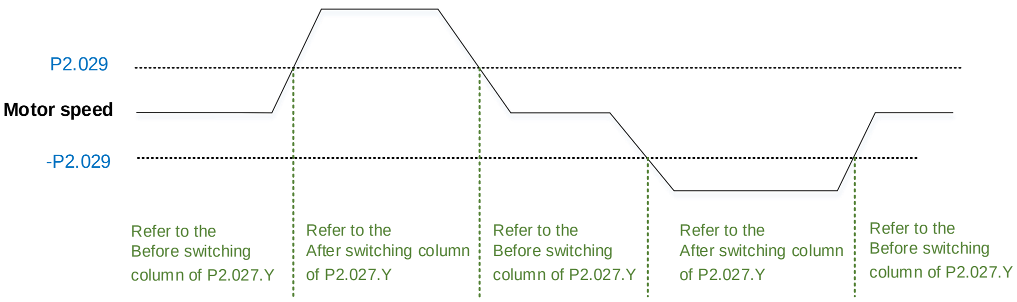
1: integrator switching (switch from P controller to PI controller)

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 x100%	P2.049 x100%	
	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.

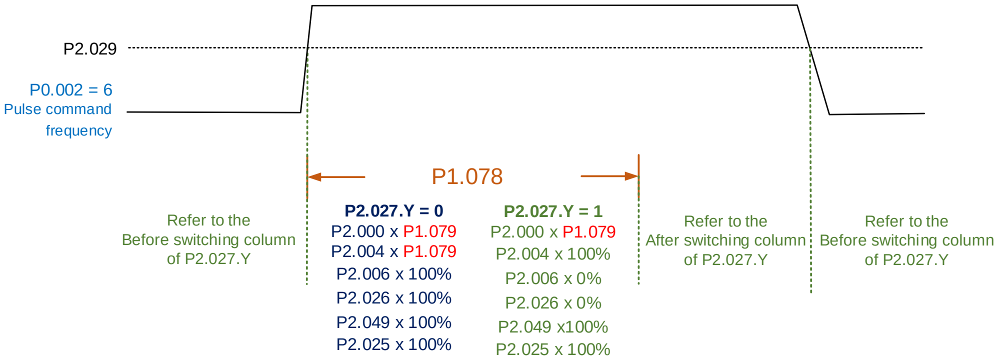
When P2.027.X is set to 0, 1, 2, 4, 5, 6, or 8, P1.078 (Gain switching delay time) is not supported. P2.027.X = 4 is taken as the example in the following figure.

P2.027.X = 4

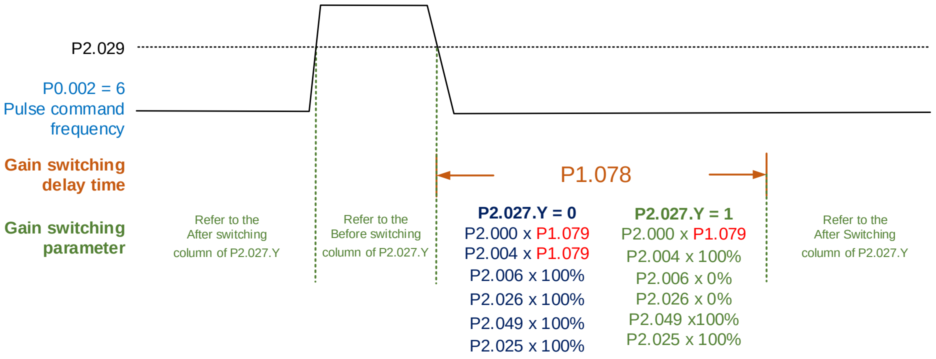


When P2.027.X is set to 3 or 7 and P1.078 (Gain switching delay time) is set, the gain parameter during the delay time is adjusted as follows.

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
Unit:	ms	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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
Unit:	pulse; Kpps; rpm	Setting range:	0 to 50331648
Format:	DEC	Data size:	32-bit
Model:	-E, -L		

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:	-E, -L		

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 DSP Error (variable 0x6F) is read as 0, and P0.001 only shows the external error code (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 for 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	Disable the functions of 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.

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:	-E, -L		

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:	-E -L (does not support gain adjustment mode 3)		

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	Adjustment mode	Inertia estimation	Parameter	
			Manual	Auto
0	Manual	Fixed set value of P1.037	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102	N/A
1	Gain adjustment mode 1	Real-time estimation	P2.031	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102
2	Gain adjustment mode 2	Fixed set value of P1.037	P1.037 P2.031	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102
3	Gain adjustment mode 3	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 deviation warning condition of Speed command**		**Address: 0244H 0245H**
Default:	5000	Control mode:	S / Sz
Unit:	rpm	Setting range:	1 to 30000
Format:	DEC	Data size:	16-bit
Model:	-E -L (does not support PR mode)		

Settings:

In Speed mode, this parameter sets the acceptable difference between the command speed and the feedback speed. If the difference is greater than this value, AL007 occurs.

Note: when P2.094 [Bit 6] = 1, this parameter is available in Position (PT, PR) and Speed (S, Sz) modes.

P2.035	**Excessive deviation warning condition of Position command**		**Address: 0246H 0247H**
Default:	50331648	Control mode:	PT / PR
Unit:	pulse	Setting range:	1 to 1677721600
Format:	DEC	Data size:	32-bit
Model:	-E, -L		

Settings:

In Position mode, this parameter sets the acceptable difference between the command position and the feedback position. If the difference is greater than this value, AL009 occurs.

P2.036	**DI9 functional planning**		**Address: 0248H 0249H**
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:

Refer to the description of P2.010. There is no physical pin for DI9 on the -E 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:	-E		

Settings:

Refer to the description of P2.010. There is no physical pin for DI10 on the -E 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:	-E		

Settings:

Refer to the description of P2.010. There is no physical pin for DI11 on the -E 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:	-E		

Settings:

Refer to the description of P2.010. There is no physical pin for DI12 on the -E 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:	-E		

Settings:

Refer to the description of P2.010. There is no physical pin for DI13 on the -E 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	**DO6 functional planning**		**Address: 0252H 0253H**
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x013F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit
Model:	-L		

Settings:

Refer to the description of P2.018.

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:	-E, -L		

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:	-E, -L		

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:	-E, -L		

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.

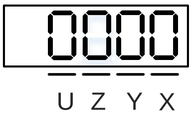
P2.046	**Notch filter 3 - attenuation level**		**Address: 025CH 025DH**
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 to 40
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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:	-E, -L		

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,

(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	3	2	1	0

Bit	Function	Description
0	Notch 1 auto / manual setting	0: auto resonance suppression 1: manually set the first set of resonance suppression parameters
1	Notch 2 auto / manual setting	0: auto resonance suppression 1: manually set the second set of resonance suppression parameters
2	Notch 3 auto / manual setting	0: auto resonance suppression 1: manually set the third set of resonance suppression parameters
3	Notch 4 auto / manual setting	0: auto resonance suppression 1: manually set the fourth set of resonance suppression parameters

■ Z: fixed resonance suppression parameter

In auto resonance suppression mode, you can set the resonance suppression parameters manually by setting P2.047.Z.

Bit	3	2	1	0

Bit	Function	Description
0	Notch 5 auto / manual setting	0: auto resonance suppression 1: manually set the fifth set of resonance suppression parameters
1 to 3	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 [Bit 1] to 1, 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:	-E, -L		

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:	-E, -L			

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:	PT, PR
Unit:	-	Setting range:	0x0000 to 0x0001
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

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:	1000000000	Control mode:	All
Unit:	PUU	Setting range:	0 to 1000000000
Format:	DEC	Data size:	32-bit
Model:	-E		

Settings:

Sets the scale of the rotary axis position, rotary axis command position, and rotary axis feedback position. If the value is too small, it may cause errors in the rotary axis position system.

The input range of P2.052 is:

$$\text{P2.052} > 1.05 \text{ x Maximum motor speed (rpm) x } \frac{16777216}{60000} \text{ x } \frac{\text{P1.045}}{\text{P1.044}}$$

P2.053	**Position integral compensation**		**Address: 026AH 026BH**
Default:	0	Control mode:	All
Unit:	rad/s	Setting range:	0 to 1023
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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 - P2.059	**Reserved**

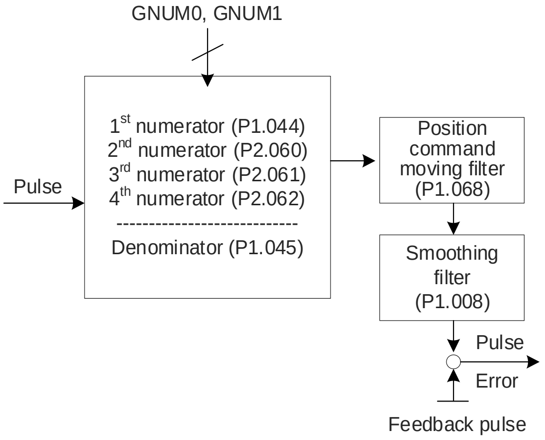
P2.060	**E-Gear ratio - numerator N2**		**Address: 0278H 0279H**
Default:	16777216	Control mode:	All
Unit:	pulse	Setting range:	1 to (2^{29}-1)
Format:	DEC	Data size:	32-bit
Model:	-E, -L		

Settings:

The numerator of the E-Gear ratio can be selected with DI.GNUM0 and DI.GNUM1 (refer to Table 8.1).

If both DI.GNUM0 and DI.GNUM1 are not defined, P1.044 is the default numerator of the E-Gear ratio.

Switch the numerator only when the servo is stopped in order to avoid mechanical vibration.



P2.061	**E-Gear ratio - numerator N3**		**Address: 027AH 027BH**
Default:	16777216	Control mode:	All
Unit:	pulse	Setting range:	1 to (2^{29}-1)
Format:	DEC	Data size:	32-bit
Model:	-E, -L		

Settings:

Refer to the description of P2.060.

P2.062	**E-Gear ratio - numerator N4**		**Address: 027CH 027DH**
Default:	16777216	Control mode:	All
Unit:	pulse	Setting range:	1 to (2^{29}-1)
Format:	DEC	Data size:	32-bit
Model:	-E, -L		

Settings:

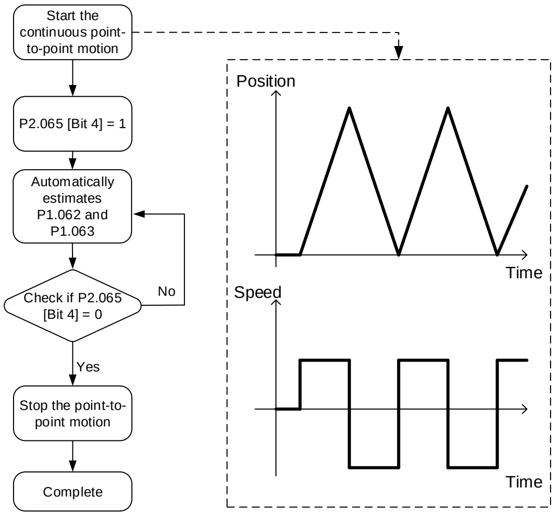
Refer to the description of P2.060.

P2.063 - P2.064	**Reserved**

P2.065	**Special bit register 1**		**Address: 0282H 0283H**
Default:	0x0300	Control mode:	PT / PR / S / Sz
Unit:	-	Setting range:	0x0000 to 0xFFFF
Format:	HEX	Data size:	-
Model:	-E (does not support Bit 15) -L (does not support Bit 4)		

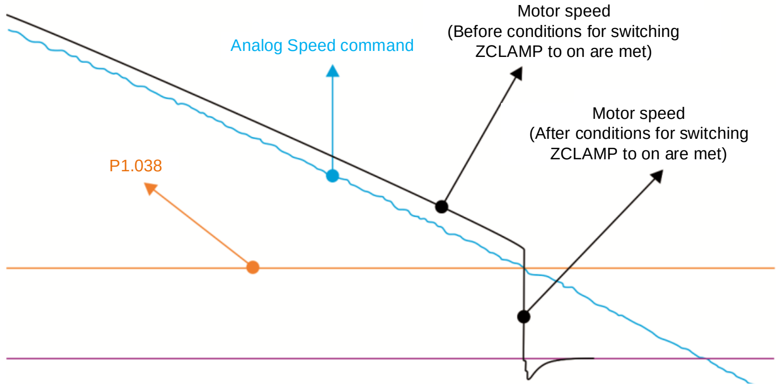
Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

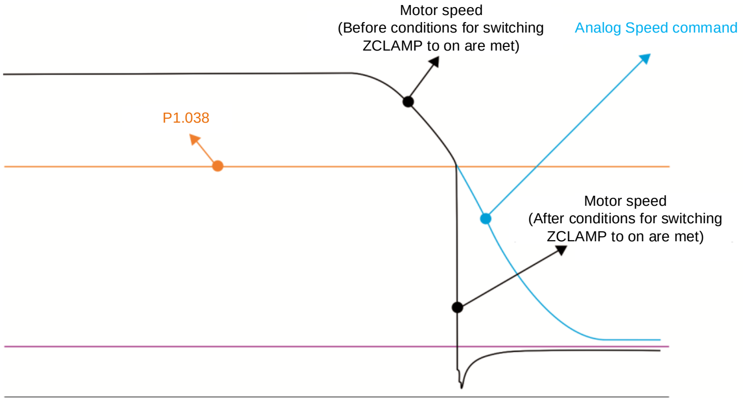
Bit	Function	Description
Bit 0 - Bit 3	Reserved	-
Bit 4	Automatic friction estimation	After enabling this function, you must conduct the continuous point-to-point motion to automatically write the estimated values to P1.062 and P1.063. 0: disable the function. 1: enable the function. 
Bit 5	Switch for AL003 (Undervoltage) and AL022 (RST power error) in Servo Off status	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	Pulse error (pulse frequency is too high) protection function in PT mode	0: enable the function. 1: disable the function.
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

Bit 10 description

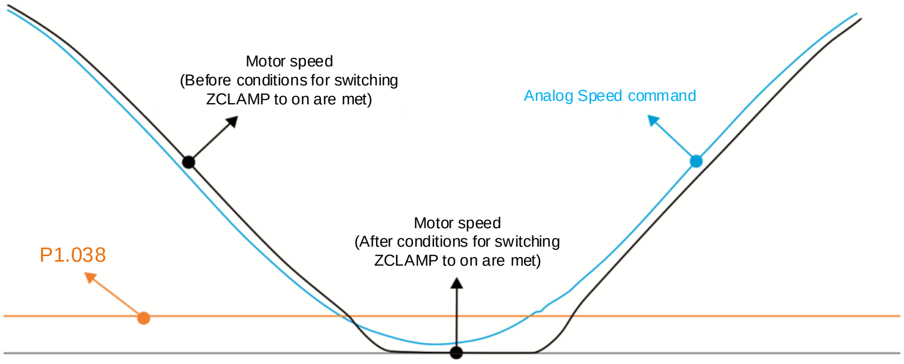
Bit 10 = 0 and command source is the analog voltage. The ZCLAMP function uses the analog Speed command without acceleration or deceleration to determine if this function should be enabled. The motor is clamped at the position where ZCLAMP conditions are met.

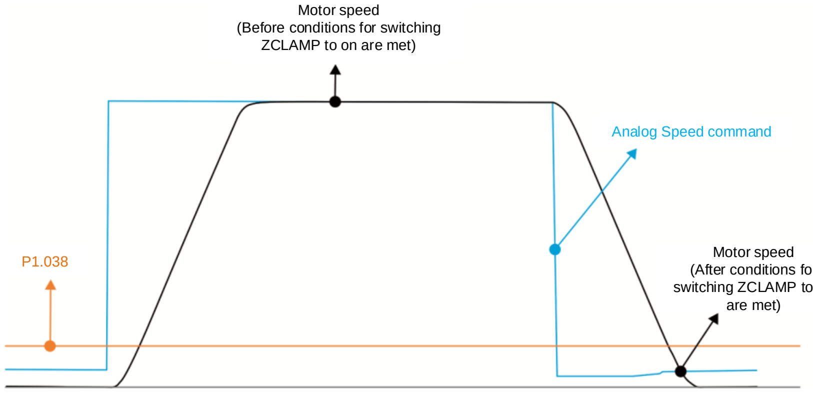


Bit 10 = 0 and command source is the internal register. The ZCLAMP function uses the register Speed command with acceleration or deceleration to determine if this function should be enabled. The motor is clamped at the position where ZCLAMP conditions are met.

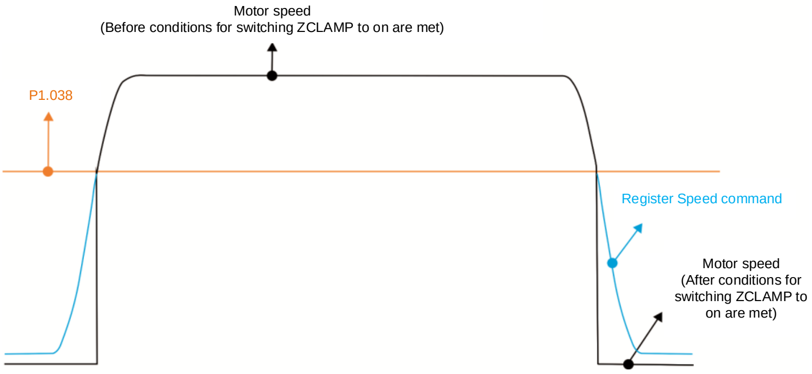


Bit 10 = 1 and command source is the analog voltage. The ZCLAMP function uses the analog Speed command without acceleration or deceleration to determine if this function should be enabled. When ZCLAMP conditions are met, the motor speed decelerates to 0 rpm by S-curve deceleration. If ZCLAMP conditions are not met, the motor follows the analog Speed command through the S-curve.





Bit 10 description
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	Pulse inhibit function in PT mode	0: disable PL / NL pulse inhibit function. In PT mode, the servo drive receives pulse position commands for both positive- and negative-direction operations whether the motor reaches the PL or NL. 1: enable PL / NL pulse inhibit function. In PT mode, if the motor reaches the PL, the servo drive receives pulse position commands for negative-direction operation and stops receiving pulse position commands for positive-direction operation. In PT mode, if the motor reaches the NL, the servo drive receives pulse position commands for positive-direction operation and stops receiving pulse position commands for negative-direction operation.
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	OA and OB output error (AL018 / AL048) detection	0: enable OA and OB output error (AL018 / AL048) detection. 1: disable OA and OB output error (AL018 / AL048) detection.
Bit 14	Reserved	-
Bit 15	Friction compensation mode selection	0: the compensation value remains unchanged when the motor speed is lower than the setting value of P1.038. 1: the compensation value reduces to 0 when the motor speed is lower than the setting value of P1.038.

P2.066	**Special bit register 2**		**Address: 0284H 0285H**
Default:	0x0020	Control mode:	PT / PR / S / Sz
Unit:	-	Setting range:	0x0000 to 0x187F
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

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 overload 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:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0101
Format:	HEX	Data size:	16-bit
Model:	-E -L (only supports P2.068.X)		

Settings:

X	Following error compensation switch	Z	DI.STP triggering method
Y	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

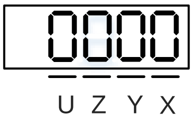
- Z: DI.STP triggering method

  0: rising-edge triggered

  1: level triggered

P2.069●	**Absolute encoder**		**Address: 028AH** **028BH**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x1211
Format:	HEX	Data size:	16-bit
Model:	-E		

Settings:



X	Operation mode setting	Z	Function of preventing rotary axis position loss when overflow occurs
Y	Pulse command setting when absolute position is lost	U	Single-turn absolute function

- 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 loss when overflow occurs

  0: rotary axis position is lost when overflow occurs.

  1: rotary axis position is not affected by overflow, but the absolute position is not retained (AL289 and AL062 do not function).

  2: when the DVP50MC series or AX series controller is used, rotary axis position is not affected by overflow, but the absolute position is not retained (AL289 and AL062 do not function).

- U: single-turn absolute function

  0: disable the single-turn absolute function.

  1: enable the single-turn absolute function and automatically set both P2.069.X and P2.069.Z to 1.

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:	-E		

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	Communication data unit setting	0: PUU 1: 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:	-E		

Settings:

Set P2.071 to 0x0001 to reset the current absolute position of the encoder. The clearing 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:	PT / PR
Unit:	rad/s	Setting range:	1 to 2000
Format:	DEC	Data size:	16-bit
Model:	-E		

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:	PT / PR
Unit:	0.001	Setting range:	500 to 1999
Format:	DEC	Data size:	16-bit
Model:	-E		

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:	PT / PR
Unit:	0.1%	Setting range:	0 to 3000
Format:	DEC	Data size:	16-bit
Model:	-E		

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:	PT / PR
Unit:	0.1%	Setting range:	0 to 3000
Format:	DEC	Data size:	16-bit
Model:	-E		

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:	PT / PR / S / Sz
Unit:	-	Setting range:	0x0000 to 0xF3F6
Format:	HEX	Data size:	16-bit
Model:	-E -L (does not support Bit 8, Bit 9, and Bit 12)		

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 (PT and 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:	-E, -L		

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:	-E, -L		

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:	-E, -L		

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:	-E, -L		

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:	-E, -L		

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:	-E, -L		

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:	-E, -L		

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:	-E, -L		

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:	-E, -L		

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:	PT / PR
Unit:	%	Setting range:	1 to 800
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

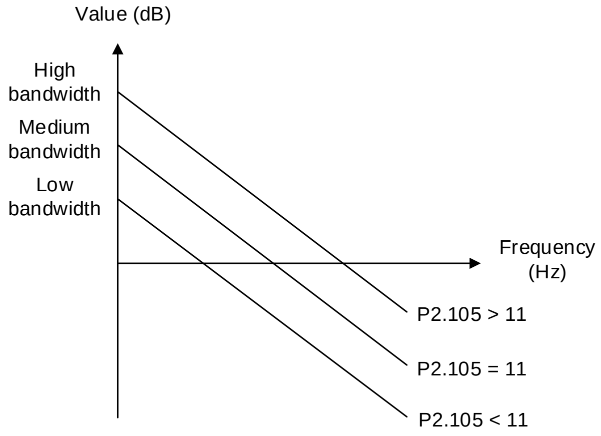
When the Torque command exceeds P2.104, the speed controller gain is switched from PI to P in order to reduce response overshoot.

P2.105	**Automatic gain adjustment level 1**		**Address: 02D2H 02D3H**
Default:	11	Control mode:	PT / PR
Unit:	-	Setting range:	1 to 21
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

Use this parameter to adjust the bandwidth when auto tuning. The higher the value, the higher the bandwidth after auto tuning. However, the bandwidth margin may be insufficient, causing machine jitter. The smaller the value, the lower the bandwidth after auto tuning. However, the response is slower.

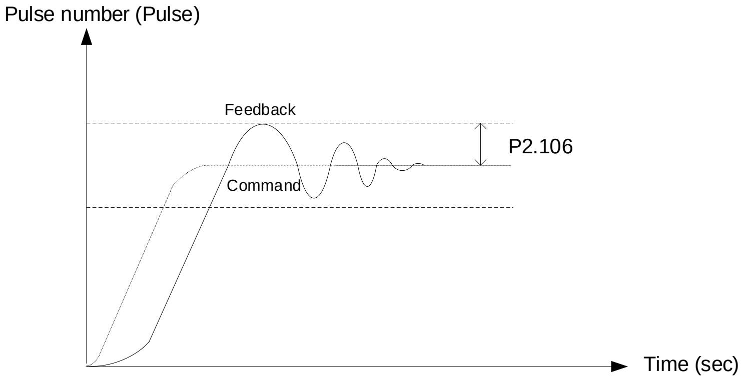
P2.105 setting value	Stiffness and response	Applicable mechanical parts
1 - 7	Low stiffness and low response	Belt, gear rack, reducer, cam
8 - 14	Medium stiffness and medium response	Screw
15 - 21	High stiffness and high response	Direct-coupled mechanical parts



P2.106	**Automatic gain adjustment level 2**		**Address: 02D4H 02D5H**
Default:	2000	Control mode:	PT / PR
Unit:	pulse	Setting range:	1 to 50331648
Format:	DEC	Data size:	32-bit
Model:	-E, -L		

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. The higher the value, the greater the maximum overshoot allowed by auto tuning. However, the response is faster. The smaller the value, the smaller the maximum overshoot allowed by auto tuning. However, the response is slower.



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:	-E, -L		

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 P2.017, the stronger the filtering effect.)

P2.108 - P2.111	**Reserved**

P2.112▲	**Special bit register 4**		**Address: 02E0H 02E1H**
Default:	0x2018	Control mode:	PT / PR / S / Sz
Unit:	-	Setting range:	0x0000 to 0x753F
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

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: 02E0H 02E1H**
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	0x00000000 - 0x000001FF
Format:	HEX	Data size:	32-bit
Model:	-E		

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 - 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:	-E -L (does not support Bit 3 and Bit 7)		

Settings:

Bit	7	6	5	4	3	2	1	0
Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0	Filter frequency for the motor speed of the monitoring variable (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:	PT / PR / S / Sz
Unit:	Hz	Setting range:	1 to 1000
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

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 A2 series models.

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:	-E, -L		

Settings:

UZ	Reserved	YX	Communication address setting

The address setting required for using RS-232 or RS-485 communication. Make sure there are no duplicate addresses in the same communication circuit, or it may cause communication failure.

■ RS-232 or RS-485

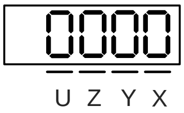
When the master station sets the communication address to 0xFF, the address is always 0xFF in the response message.

■ 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●	**Transmission speed**		**Address: 0302H 0303H**
Default:	0x0033	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0055
Format:	HEX	Data size:	16-bit
Model:	-L		

Settings:



X	RS-232 transmission speed	Z	Reserved
Y	RS-485 transmission speed	U	Reserved

■ X: RS-232 transmission speed

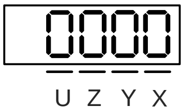
0: 4800 bps	1: 9600 bps	2: 19200 bps
3: 38400 bps	4: 57600 bps	5: 115200 bps

■ Y: RS-485 transmission speed

0: 4800 bps	1: 9600 bps	2: 19200 bps
3: 38400 bps	4: 57600 bps	5: 115200 bps

P3.002	**Modbus communication protocol**		**Address: 0304H 0305H**
Default:	0x0006	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0008
Format:	HEX	Data size:	16-bit
Model:	-L		

Settings:



X	RS-232 communication protocol	Z	Reserved
Y	RS-485 communication protocol	U	Reserved

- X: RS-232 communication protocol

0: 7, N, 2 (Modbus, ASCII)	1: 7, E, 1 (Modbus, ASCII)	2: 7, O, 1 (Modbus, ASCII)
3: 8, N, 2 (Modbus, ASCII)	4: 8, E, 1 (Modbus, ASCII)	5: 8, O, 1 (Modbus, ASCII)
6: 8, N, 2 (Modbus, RTU)	7: 8, E, 1 (Modbus, RTU)	8: 8, O, 1 (Modbus, RTU)

- Y: RS-485 communication protocol

0: 7, N, 2 (Modbus, ASCII)	1: 7, E, 1 (Modbus, ASCII)	2: 7, O, 1 (Modbus, ASCII)
3: 8, N, 2 (Modbus, ASCII)	4: 8, E, 1 (Modbus, ASCII)	5: 8, O, 1 (Modbus, ASCII)
6: 8, N, 2 (Modbus, RTU)	7: 8, E, 1 (Modbus, RTU)	8: 8, O, 1 (Modbus, RTU)

P3.003	**Modbus communication error handling**		**Address: 0306H 0307H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0001
Format:	HEX	Data size:	16-bit
Model:	-L		

Settings:

0: display AL020 and let the motor continue operating.

1: display AL020 and let the motor decelerate to a stop. Deceleration time is set in P5.003.B.

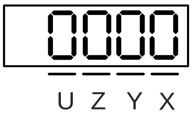
P3.004	**Modbus communication timeout**		**Address: 0308H 0309H**
Default:	0	Control mode:	All
Unit:	sec	Setting range:	0 to 20
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

If the value is not 0, communication timeout is enabled immediately. To disable this function, set the value to 0.

P3.005	**Modbus communication**		**Address: 030AH 030BH**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x0112
Format:	HEX	Data size:	16-bit
Model:	-L		

Settings:



X	Use RS-232 / RS-485 standard Modbus communication or connect to ASDA-Soft with RS-232	Z	Reserved
Y	Reserved	U	Reserved

- X: use RS-232 / RS-485 standard Modbus communication or connect to ASDA-Soft with RS-232

  0: use RS-232 / RS-485 standard Modbus communication.

  1: connect to ASDA-Soft with RS-232.

P3.006■	**Digital input (DI) control switch**		**Address: 030CH 030DH**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x1FFF (-E) 0x0000 to 0x01FF(-L)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

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	**Modbus communication response delay time**		**Address: 030EH 030FH**
Default:	1	Control mode:	All
Unit:	0.5 ms	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Model:	-L		

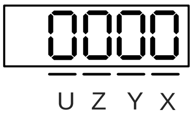
Settings:

Delays the time of communication response from servo drive to controller.

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:	-E		

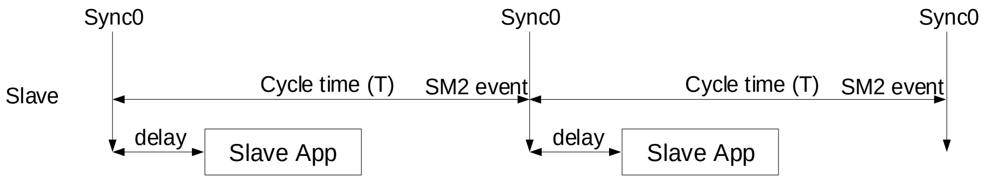
Settings:



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.

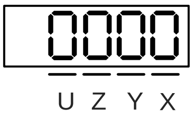
  The delay time shown in the following figure is (T/10) x Z (μs).



P3.010 - P3.011	**Reserved**

P3.012	**Communication support setting**		**Address: 0318H 0319H**
Default:	0x1000	Control mode:	EtherCAT
Unit:	-	Setting range:	0x0000 to 0x1111
Format:	HEX	Data size:	16-bit
Model:	-E		

Settings:



X	Reserved	Z	Load in the EtherCAT parameter values
Y	Reserved	U	Error clearing when the limit alarm 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	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 (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.

Note: when the function of OD 1010h (Store parameter) is enabled, the OD value is stored in non-volatile memory. When P3.012.Z = 0, the non-volatile value of OD is loaded as the initial content. Refer to the descriptions in CANopen Standard. When P3.012.Z = 1, the initial content refers to the preceding table.

- U: error clearing when the limit alarm occurs

0: when the limit alarm (AL014 or AL015) occurs, it needs to be cleared before the servo reverses to move away from the limit.

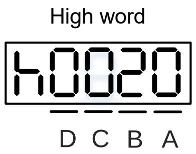
1: when the limit alarm (AL014 or AL015) occurs, it does not need to be cleared before the servo reverses to move away from the limit.

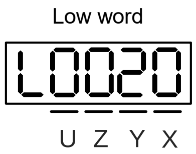
Note: determine whether the servo has reached the limit with the bit status of OD 6041h Statusword and OD 60FDh Digital inputs.
Positive limit: OD 6041h [Bit 14] is On & OD 60FDh [Bit 1] is On
Negative limit: OD 6041h [Bit 15] is On & OD 60FDh [Bit 0] is On
The status of other bits of OD 6041h (Fault / Warning / Quick stop) remains unchanged when the servo reaches the limit.

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:	-E		

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.

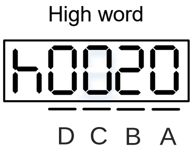
- C: unit selection for the maximum speed of OD 607Fh and OD 6080h

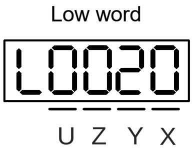
  0: 0.1 rpm for OD 607Fh and rpm for OD 6080h.

  1: pulse/sec for OD 607Fh and OD 6080h.

P3.019	**Statusword display content**		**Address: 0326H 0327H**
Default:	0x00000021	Control mode:	EtherCAT
Unit:	-	Setting range:	0x00000000 - 0x0001FFFF
Format:	HEX	Data size:	32-bit
Model:	-E		

Settings:





A	Reserved	X	Reserved
B	Reserved	Y	Reserved
C	Reserved	Z	Display content of OD 6041h [Bit 14]
D	Reserved	U	Reserved

- Z: display content of OD 6041h [Bit 14]

  0: display the positive limit status.

  1: display the current synchronization status between the servo drive and controller. When the status displays On, it indicates that the synchronization is complete (SYNC_OK).

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:	-E		

Settings:

When using the PDO to transmit data periodically, use this parameter to set the timeout setting. 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 alarm occurs, it means the allowable duration for packet loss exceeds the set range.

Digit	UZ	YX
Function	AL180 trigger condition	AL3E3 trigger condition
Range	0x00 (disabled) - 0xFF (default)	0x02 - 0x14

- YX: AL3E3 alarm 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 this parameter 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:	-E, -L		

Settings:

The last abnormal status 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 the last)**		**Address: 0402H 0403H**
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:

The second to last abnormal status record.

Refer to the description of high / low word in P4.000.

P4.002★	**Fault record (third to the last)**		**Address: 0404H 0405H**
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:

The third to last abnormal status record.

Refer to the description of high / low word in P4.000.

P4.003★	**Fault record (fourth to the last)**		**Address: 0406H 0407H**
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:

The fourth to last abnormal status record.

Refer to the description of high / low word in P4.000.

P4.004★	**Fault record (fifth to the last)**		**Address: 0408H 0409H**
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

Settings:

The fifth to last abnormal status 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:	-E, -L		

Settings:

The control methods are as follows:

1. Panel control:

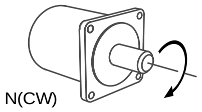
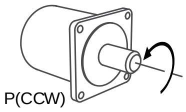
   Set the P4.005 JOG speed with the panel and it displays the JOG symbol. Pressing the UP key controls the JOG operation in the positive direction; pressing the DOWN key controls the JOG operation in the negative direction. Release the key to stop the JOG operation. If there is any error in this setting, 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:	-E, -L		

Settings:

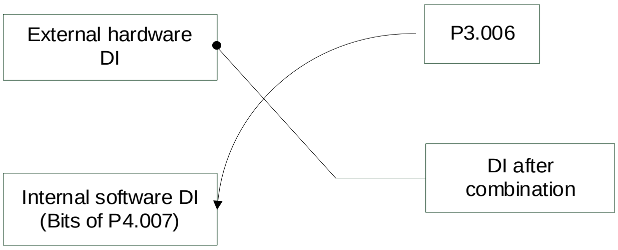
bit 00: corresponds to DO code = 0x30	bit 08: corresponds to DO code = 0x38
bit 01: corresponds to DO code = 0x31	bit 09: corresponds to DO code = 0x39
bit 02: corresponds to DO code = 0x32	bit 10: corresponds to DO code = 0x3A
bit 03: corresponds to DO code = 0x33	bit 11: corresponds to DO code = 0x3B
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■	**Multi-function for digital input**		**Address: 040EH 040FH**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x1FFF (-E) 0x0000 to 0x01FF (-L)
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

Settings:

The source of the DI input 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:



Read parameter: shows the DI status after combining external DI and software DI.

Write parameter: 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 - P2.014 for more information on DI1 - DI5 functional planning.

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:	-E, -L		

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 0x003F
Format:	HEX	Data size:	16-bit
Model:	-E, -L		

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 14
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

Settings:

0: reserved	4: calibrate the hardware offset of the current detector (W phase)
1: calibrate the hardware offset of the analog speed input	5: calibrate the hardware offset of options 1 - 4
2: calibrate the hardware offset of the analog torque input	6 - 14: reserved
3: calibrate the hardware offset of the current detector (V phase)	-

Note: the calibration function must be enabled by setting P2.008. When calibration, remove all external wirings for torque input and make sure the servo is in the Off state.

P4.011	**Analog speed input 1 - hardware offset calibration**		**Address: 0416H 0417H**
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	13926 to 18842
Format:	DEC	Data size:	16-bit
Model:	-L		

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.

P4.012	**Analog speed input 2 - hardware offset calibration**		**Address: 0418H 0419H**
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	13926 to 18842
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

Refer to the description of P4.011.

P4.013	**Analog torque input 1 - hardware offset calibration**		**Address: 041AH 041BH**
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	13926 to 18842
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

Refer to the description of P4.011.

P4.014	**Analog torque input 2 - hardware offset calibration**		**Address: 041CH 041DH**
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	13926 to 18842
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

Refer to the description of P4.011.

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:	-E, -L		

Settings:

Refer to the description of P4.011.

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:	-E, -L		

Settings:

Refer to the description of P4.011.

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:	-E, -L		

Settings:

Refer to the description of P4.011.

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:	-E, -L		

Settings:

Refer to the description of P4.011.

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:	-E, -L		

Settings:

Cool down the drive to 25°C (77°F) before calibration. The function must be enabled by setting P2.008.

P4.020	**Analog monitor output (Ch1) - offset compensation value**		**Address: 0428H 0429H**
Default:	0	Control mode:	All
Unit:	mV	Setting range:	-800 to +800
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

Manually adjust the compensation value for the offset (cannot reset). The function must be enabled by setting P2.008.

P4.021	**Analog monitor output (Ch2) - offset compensation value**		**Address: 042AH 042BH**
Default:	0	Control mode:	All
Unit:	mV	Setting range:	-800 to +800
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

Manually adjust the compensation value for the offset (cannot reset). The function must be enabled by setting P2.008.

P4.022	**Analog speed input - offset compensation value**		**Address: 042CH 042DH**
Default:	0	Control mode:	S
Unit:	mV	Setting range:	-5000 to +5000
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

Manually adjust the compensation value for the offset.

P4.023	**Analog torque input - offset compensation value**		**Address: 042EH 042FH**
Default:	0	Control mode:	T
Unit:	mV	Setting range:	-5000 to +5000
Format:	DEC	Data size:	16-bit
Model:	-L		

Settings:

Manually adjust the compensation value for the offset.

P4.024	**Level of undervoltage error**		**Address: 0430H 0431H**
Default:	160	Control mode:	All
Unit:	V (rms)	Setting range:	140 to 380
Format:	DEC	Data size:	16-bit
Model:	-E, -L		

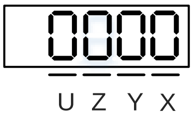
Settings:

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 0x0003
Format:	HEX	Data size:	16-bit
Model:	-E		

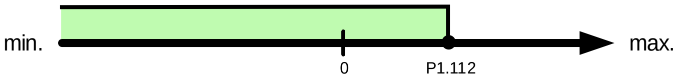
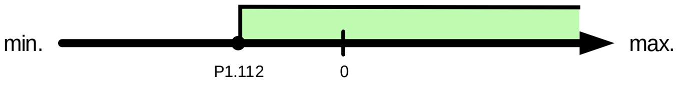
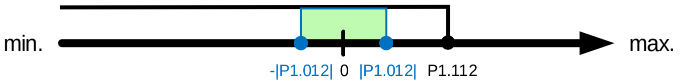
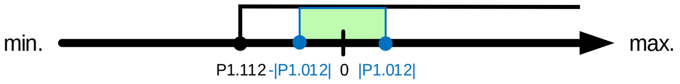
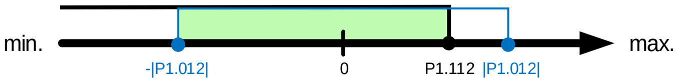
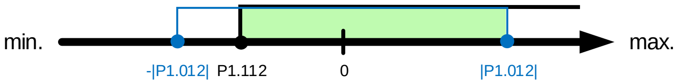
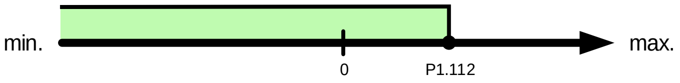
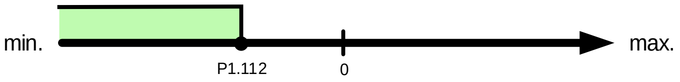
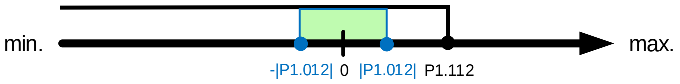
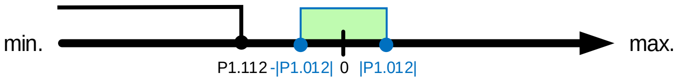
Settings:

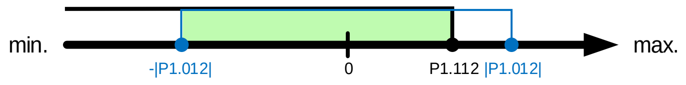
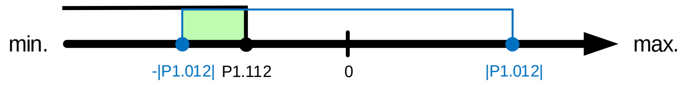
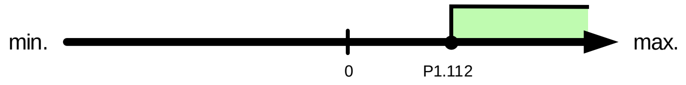
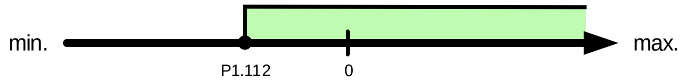
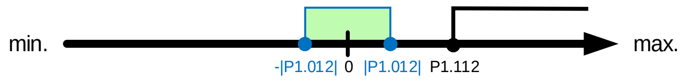
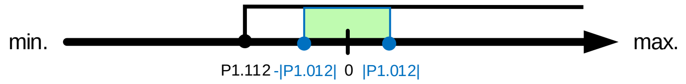
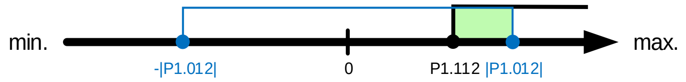
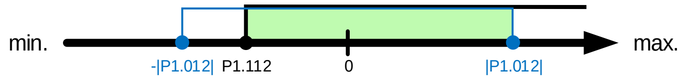
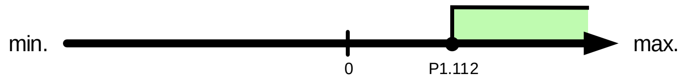
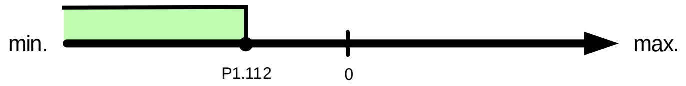
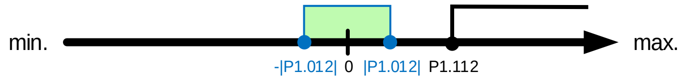
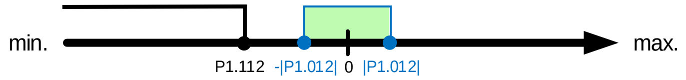
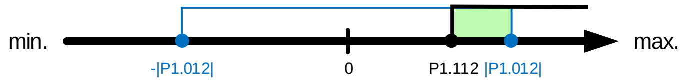
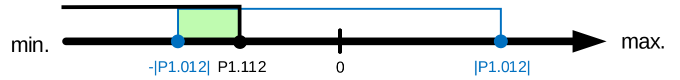


X	Single-direction torque limit setting	Z	Reserved
Y	Reserved	U	Reserved

- X: single-direction torque limit setting

  This setting limits the torque of the motor, and is applicable to external analog commands and 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	
1	Disable P1.012 (P1.002.Y = 0)	≥ 0	
		< 0	
	< |P1.112|	≥ 0	
		< 0	

P4.044.X	P1.012	P1.112	Operating range
1	> |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	

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:	-E, -L		

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:	Except PT
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit
Model:	-E, -L		

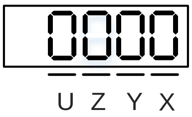
Settings:

Digit	D	C	B	A	W	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

1. OVF (DO: 0x12, Position command / feedback overflows), CTO (AL020 Serial communication timeout), SPL, SNL, PL, and NL are auto-protection functions.
2. STP is the stop function.
3. 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.

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:	-E		

Settings:



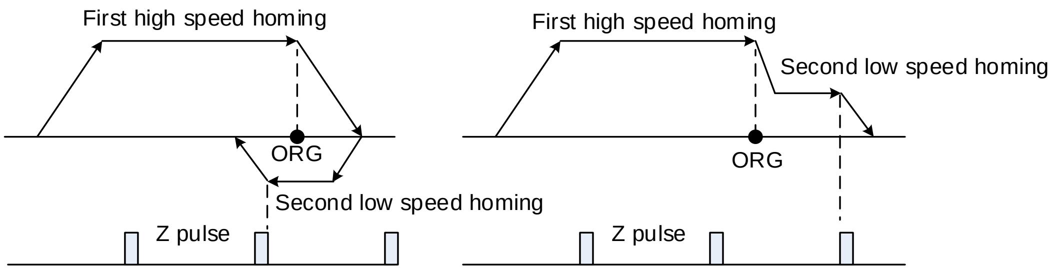
Definition of each setting value:

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 with ORG (when it switches from off to on state) as the homing origin
		-	X = 4: look for Z pulse in forward direction and define it as the homing origin
			X = 5: look for the Z pulse in reverse direction 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 with the ORG (when it switches from on to off state) as the homing origin
			X = 7: homing in reverse direction with ORG (when it switches from on to off state) 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

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:	-E			

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:	-E			

Settings:

The second speed setting for low speed homing.

P5.007■	**Trigger Position command (PR mode only)**		**Address: 050EH 050FH**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	0 to 1000
Format:	DEC	Data size:	16-bit
Model:	-E		

Settings:

- Set P5.007 to 0 to start homing.
- Set P5.007 to 1 - 99 to execute the specified PR procedure, which is the same as using DI.CTRG + POSn. You cannot set P5.007 to 100 - 999 as the value exceeds the valid range.

  Example: if you want to trigger PR#2

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 to 2 to start executing PR#2

- Set P5.007 to 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#3 is being executed and not yet complete.

  If the value read is 10003, it means PR#3 is complete, but the motor has not reached the target position yet.

  If the value read is 20003, it means PR#3 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:	-E		

Settings:

In PR mode, if the motor moves in the positive direction and its feedback position 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:	-E		

Settings:

In PR mode, if the motor moves in the negative direction and its feedback position 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:	-E		

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:	-E		

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:	-E		

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:	-E		

Settings:

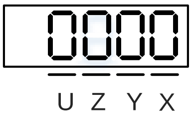
Window #2: when read with the panel or read and written through communication, the value set by P5.011 adds 1, but this parameter is not writable with the panel. Refer to Section 7.1.7 Data array for detailed instructions.

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:	-E		

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:	-E, -L		

Settings:

Read: feedback position of the main encoder, 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:	-E, -L		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E			

Settings:

Target speed #0 of 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:	-E			

Settings:

Target speed #1 of 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:	-E			

Settings:

Target speed #2 of 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:	-E			

Settings:

Target speed #3 of 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:	-E			

Settings:

Target speed #4 of 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:	-E			

Settings:

Target speed #5 of 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:	-E			

Settings:

Target speed #6 of 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:	-E			

Settings:

Target speed #7 of 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:	-E			

Settings:

Target speed #8 of 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:	-E			

Settings:

Target speed #9 of 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:	-E			

Settings:

Target speed #10 of 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:	-E			

Settings:

Target speed #11 of 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:	-E			

Settings:

Target speed #12 of 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:	-E			

Settings:

Target speed #13 of 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:	-E			

Settings:

Target speed #14 of 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:	-E			

Settings:

Target speed #15 of 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:	-E		

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:	-E		

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:	-E		

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:	-E		

Settings:

Refer to P5.093 for details.

P5.097■	Motion control macro command: issue command / read execution result		Address: 05C2H 05C3H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 to 0x099F
Format:	HEX	Data size:	16-bit
Model:	-E		

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.

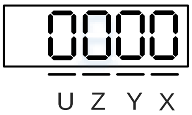
The command codes are listed in the following tables:

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 (only supported by E3-E) 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 number 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:	-E		

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

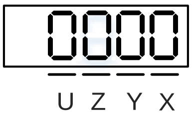
- U: the action when EV4 is on

  0: no action

  1 - D: execute PR#51 - 63

P5.099	**PR number 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:	-E		

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:	-E		

Settings:

Window #3: when read or written by any method, the value set by 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:	-E		

Settings:

Window #4: when read or written by any method, the value set by 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:	-E		

Settings:

Window #5: when read or written by any method, the value set by 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:	-E		

Settings:

Window #6: when read or written by any method, the value set by P5.011 does not add 1.

Refer to Section 7.1.7 Data array for detailed instructions.

P6.xxx PR parameters

The -L model does not support the PR mode and thus cannot use the P6.xxx or P7.xxx 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:	-E		

Settings:

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#1 – 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 may not be 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#1 after homing is complete.
   Set the route of PR#1 (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 to 0x01 - 0x63 and set ORG_DEF to P minus 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:	-E		

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:	-E		

Settings:

High word

Low word

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 3	Bit 2	Bit 1	Bit 0	
-	UNIT	AUTO	INS	1: SPEED, constant speed control.
CMD		OVLP	INS	2: SINGLE, positioning control. It stops when finished.
				3: AUTO, positioning control. It 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 (path type): when 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 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
10	10	P5.030	2500
11	11	P5.031	3000
12	12	P5.032	5000
13	13	P5.033	8000
14	14	P5.034	50
15	15	P5.035	30

- A: SPD, target speed

A	Corresponding parameter	Default value (ms)
0	P5.060	20
1	P5.061	50
2	P5.062	100
3	P5.063	200
4	P5.064	300
5	P5.065	500
6	P5.066	600
7	P5.067	800
8	P5.068	1000
9	P5.069	1300
10	P5.070	1500
11	P5.071	1800
12	P5.072	2000
13	P5.073	2300
14	P5.074	2500
15	P5.075	3000

- B: DLY, delay time

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
10	P5.050	3000
11	P5.051	3500
12	P5.052	4000
13	P5.053	4500
14	P5.054	5000
15	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 0 - Bit 1	Reserved	-
Bit 2	AUTO	0: disable auto function 1: once current PR path is finished, automatically load the next path

Note: the parameter format definition [C, A, U, Z] is different from the preceding table when P6.002.X = 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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

Settings:

Refer to the description of P6.003.

P6.070	**PATH 35 definition**		**Address: 068CH** **068CH**
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit
Model:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

Settings:

Refer to the description of P6.002.

P6.099	**PATH 49 data**		**Address: 0602H 0603H**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	-E		

Settings:

Refer to the description of P6.003.

P7.xxx PR parameters

⚠ **The -L model does not support the PR mode and thus cannot use the P6.xxx or P7.xxx 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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

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:	-E		

Settings:

Refer to the description of P6.002.

P7.097	PATH 98 data		Address: 07C3H 07C4H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit
Model:	-E		

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:	-E		

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:	-E		

Settings:

Refer to the description of P6.003.

Table 8.1 Digital input (DI) descriptions

⚠ **The -L model does not support PR mode and DI.ABSE (0x1D), DI.ABSC (0x1F), and DI.ABSQ.**

The -E model does not support PT mode and DI.VPL (0x0C), DI.VPRS (0x0D), DI.SPDKVC (0x0F), and DI.INHP (0x45).

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

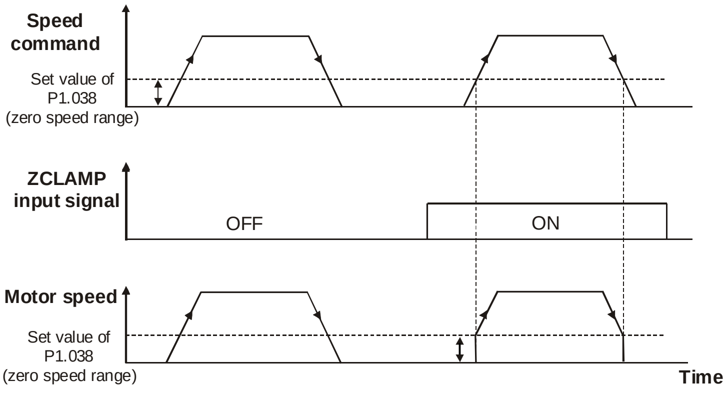
Value: 0x03

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	PT, PR, S

Value: 0x04

DI name	Description	Triggering method	Control mode
CCLR	Clear the pulse counter. Refer to P2.050 for the methods to clear the pulses. When this DI is on, the accumulative position pulse deviation of the drive (P0.002 = 33) is cleared to 0.	Rising-edge triggered, level triggered	PT, PR

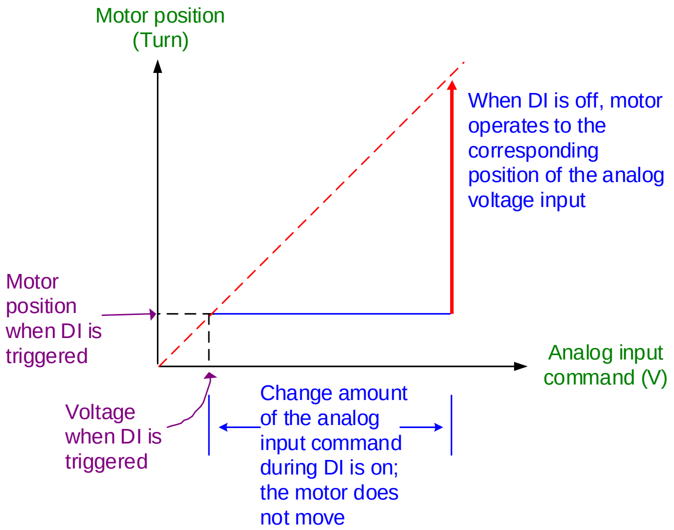
Value: 0x05

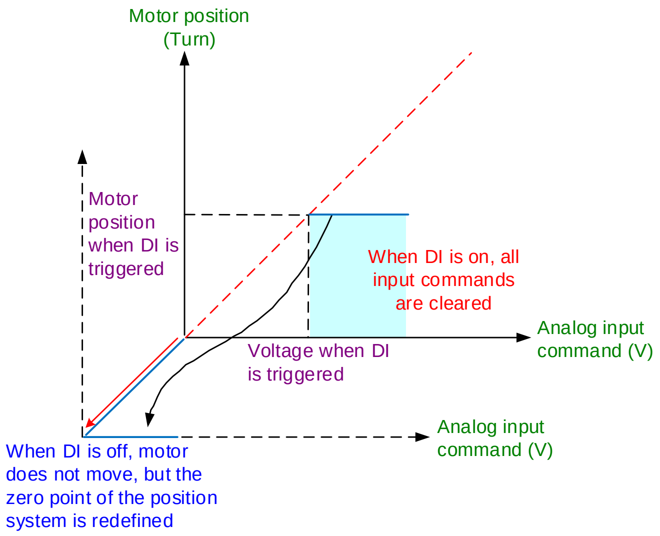
DI name	Description	Triggering method	Control mode
ZCLAMP	When the speed is slower than the setting of P1.038 (zero speed range), the motor stops operating when this DI is on.  	Level triggered	S

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 input method	Control mode
CTRG	In PR mode, after the PR 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 or analog voltage.	Level triggered	PT, PR, S

Value: 0x0C			
DI name	Description	Triggering method	Control mode
VPL	The -E model does not support this DI. Latch function of analog Position command. When this DI is on, the position of the motor is held at the current position when the DI is triggered. During this DI is on, the motor does not operate even when there is a change in the analog command. When this DI is off, the motor completes the command that was changed during the time DI was on. 	Level triggered	PT

<table>
<tr><th colspan="4">Value: 0x0D</th></tr>
<tr><th>DI name</th><th>Description</th><th>Triggering method</th><th>Control mode</th></tr>
<tr><td>VPRS</td><td>The -E model does not support this DI.
Clear function of analog Position command. When this DI is on, the position of the motor is held at the current position when DI is triggered. Despite the change in the analog command during DI is on, the motor remains at the current position even when the DI is off. However, the position that the motor remains at corresponds to the new analog command. Thus, the analog input command redefines the position system of the motor.
 </td><td>Level triggered</td><td>PT</td></tr>
</table>

Value: 0x0F			
DI name	Description	Triggering method	Control mode
SPDKVC	The -E model does not support this DI. Switch between P1.040 (Maximum motor speed for analog Speed command 1) and P1.081 (Maximum motor speed for analog Speed command 2).	Level triggered	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 or analog voltage.	Level triggered	T

<table>
<tr><th colspan="4">Value: 0x11, 0x12, 0x13, 0x1A, 0x1B, 0x1C, 0x1E</th></tr>
<tr><th>DI name</th><th>Description</th><th>Triggering method</th><th>Control mode</th></tr>
<tr><td>POS0
POS1
POS2
POS3
POS4
POS5
POS6</td><td>PR command selection (0 - 99)
<table>
<tr><th>Position command</th><th>POS 6</th><th>POS 5</th><th>POS 4</th><th>POS 3</th><th>POS 2</th><th>POS 1</th><th>POS 0</th><th>CT RG</th><th>Corres-ponding para-meter</th></tr>
<tr><td rowspan="2">Homing</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">↑</td><td>P6.000</td></tr>
<tr><td>P6.001</td></tr>
<tr><td rowspan="2">PR#1</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">1</td><td rowspan="2">↑</td><td>P6.002</td></tr>
<tr><td>P6.003</td></tr>
<tr><td>...</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>...</td></tr>
<tr><td rowspan="2">PR#50</td><td rowspan="2">0</td><td rowspan="2">1</td><td rowspan="2">1</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">1</td><td rowspan="2">0</td><td rowspan="2">↑</td><td>P6.098</td></tr>
<tr><td>P6.099</td></tr>
<tr><td rowspan="2">PR#51</td><td rowspan="2">0</td><td rowspan="2">1</td><td rowspan="2">1</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">1</td><td rowspan="2">1</td><td rowspan="2">↑</td><td>P7.000</td></tr>
<tr><td>P7.001</td></tr>
<tr><td>...</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>...</td></tr>
<tr><td rowspan="2">PR#99</td><td rowspan="2">1</td><td rowspan="2">1</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">1</td><td rowspan="2">1</td><td rowspan="2">↑</td><td>P7.098</td></tr>
<tr><td>P7.099</td></tr>
</table>
</td><td>Level triggered</td><td>PR</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>The -L model does not support this DI.
When DI.ABSE is on, the servo is in absolute mode and can enable the functions of DI.ABSQ, DI.ABSC, DO.ABSR, and DO.ABSD at the same time.
When DI.ABSE is on, the functions of DI4, DO2, and DO3 are no longer the ones assigned by the parameter. The DI4 function will be DI.ABSQ, DO2 will be DO.ABSR, and DO3 will be DO.ABSD. In addition, the DI point of DI.ABSC can be assigned by the parameter.</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>The -L model does not support this DI.
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 DI.ABSQ from DI4 replaces the DI4 function from P2.013</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>The -L model does not support this DI.
During I/O transmission, the controller sends the handshaking signal. When DI.ABSQ is off, the controller issues the request; when DI.ABSQ is on, the controller has processed the ABSD signal. This DI is only valid when DI.ABSE is on. Refer to Figure 10.3.5.1.1 in Chapter 10 for a detailed description.</td><td>Rising- and falling-edge triggered</td><td>All</td></tr>
</table>

<table>
<tr><th colspan="4">Value: 0x14, 0x15</th></tr>
<tr><th>DI name</th><th>Description</th><th>Triggering method</th><th>Control mode</th></tr>
<tr><td>SPD0
SPD1</td><td>Register Speed command selection (1 - 4)
<table>
<tr><th rowspan="2">Speed command number</th><th colspan="2">DI signal of CN1</th><th colspan="2" rowspan="2">Command source</th><th rowspan="2">Content</th><th rowspan="2">Range</th></tr>
<tr><th>SPD1</th><th>SPD0</th></tr>
<tr><td rowspan="2">S1</td><td rowspan="2">0</td><td rowspan="2">0</td><td>S</td><td>External analog signal</td><td>Voltage difference between V_REF and GND</td><td>-10V to +10V</td></tr>
<tr><td>Sz</td><td>N/A</td><td>Speed command is 0</td><td>0</td></tr>
<tr><td>S2</td><td>0</td><td>1</td><td colspan="2" rowspan="3">Internal register (parameter)</td><td>P1.009</td><td>+/- 7500 rpm</td></tr>
<tr><td>S3</td><td>1</td><td>0</td><td>P1.010</td><td>+/- 7500 rpm</td></tr>
<tr><td>S4</td><td>1</td><td>1</td><td>P1.011</td><td>+/- 7500 rpm</td></tr>
</table>
</td><td>Level triggered</td><td>S, Sz</td></tr>
</table>

<table>
<tr><th colspan="4">Value: 0x16, 0x17</th></tr>
<tr><th>DI name</th><th>Description</th><th>Triggering method</th><th>Control mode</th></tr>
<tr><td>TCM0
TCM1</td><td>Register Torque command selection (1 - 4)
<table>
<tr><th rowspan="2">Torque command number</th><th colspan="2">DI signal of CN1</th><th colspan="2" rowspan="2">Command source</th><th rowspan="2">Content</th><th rowspan="2">Range</th></tr>
<tr><th>TCM1</th><th>TCM0</th></tr>
<tr><td rowspan="2">T1</td><td rowspan="2">0</td><td rowspan="2">0</td><td>T</td><td>External analog signal</td><td>Voltage difference between T_REF and GND</td><td>-10V to +10V</td></tr>
<tr><td>Tz</td><td>N/A</td><td>Torque command is 0</td><td>0</td></tr>
<tr><td>T2</td><td>0</td><td>1</td><td colspan="2" rowspan="3">Internal register (parameter)</td><td>P1.012</td><td>+/- 500%</td></tr>
<tr><td>T3</td><td>1</td><td>0</td><td>P1.013</td><td>+/- 500%</td></tr>
<tr><td>T4</td><td>1</td><td>1</td><td>P1.014</td><td>+/- 500%</td></tr>
</table>
</td><td>Level triggered</td><td>T, Tz</td></tr>
</table>

Value: 0x18			
DI name	Description	Triggering method	Control mode
S-P	In S-P dual / multi-mode, when this DI is off, the drive is in Speed mode; when this DI is on, the drive is in Position mode. Select PT or PR with DI.PT-PR (0x2B).	Level triggered	Dual / multi-mode

Value: 0x19			
DI name	Description	Triggering method	Control mode
S-T	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.	Level triggered	Dual / multi-mode

Value: 0x20			
DI name	Description	Triggering method	Control mode
T-P	In T-P dual / multi-mode, when this DI is off, the drive is in Torque mode; when this DI is on, the drive is in Position mode. Select PT or PR with DI.PT-PR (0x2B).	Level triggered	Dual / multi-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: 0x2B

DI name	Description	Triggering method	Control mode
PT-PR	Use this DI to select the command source in PT-PR dual mode or PT-PR-S multi-mode. When this DI is off, the drive is in PT mode; when this DI is on, the drive is in PR mode.	Level triggered	Dual / multi-mode

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

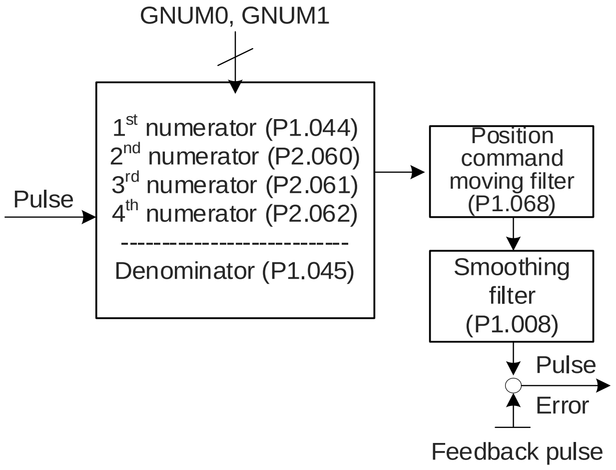
DI name	Description	Triggering method	Control mode
JOGD	When this DI is on, the motor jogs in the negative direction.	Level triggered	All

Value: 0x39			
DI name	Description	Triggering method	Control mode
EV1	Event trigger command 1. Refer to the setting of P5.098 and P5.099.	Rising- and falling-edge triggered	PR

Value: 0x3A			
DI name	Description	Triggering method	Control mode
EV2	Event trigger command 2. Refer to the setting of P5.098 and P5.099.	Rising- and falling-edge triggered	PR

Value: 0x3B			
DI name	Description	Triggering method	Control mode
EV3	Event trigger command 3. Refer to the setting of P5.098 and P5.099.	Rising- and falling-edge triggered	PR

Value: 0x3C			
DI name	Description	Triggering method	Control mode
EV4	Event trigger command 4. Refer to the setting of P5.098 and P5.099.	Rising- and falling-edge triggered	PR

Value: 0x43, 0x44			
DI name	Description	Triggering method	Control mode
GNUM0 GNUM1	E-Gear ratio (numerator) selection 0 E-Gear ratio (numerator) selection 1 	Level triggered	PT

Value: 0x45			
DI name	Description	Triggering method	Control mode
INHP	The -E model does not support this DI. In Position mode, the external pulse input command has no function when this DI is on. Important: this function has to be set to DI8 to ensure immediate pulse inhibition.	Level triggered	PT

Value: 0x46			
DI name	Description	Triggering method	Control mode
STP	Motor stops.	Rising-edge triggered	PR

Value: 0x47			
DI name	Description	Triggering method	Control mode
PFQS	Use this DI to set the emergency stop for 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	PT, PR, T, S

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

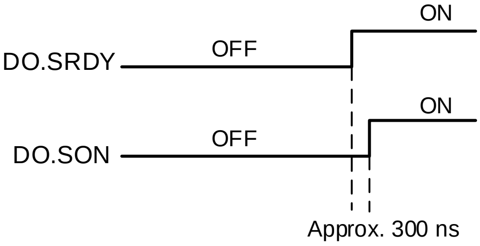
The -L model does not support PR mode and DO.ABSW (0x0D), DO.IDXD (0x0E), DO.Zon2 (0x2D), DO.Zon3 (0x2E), DO.Zon4 (0x2F), DO.ABSR, and DO.ABSD.

The -E model does not support PT mode.

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. The time difference between DO.SRDY and DO.SON being on when the servo is on as soon as power is applied  	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	PT, PR

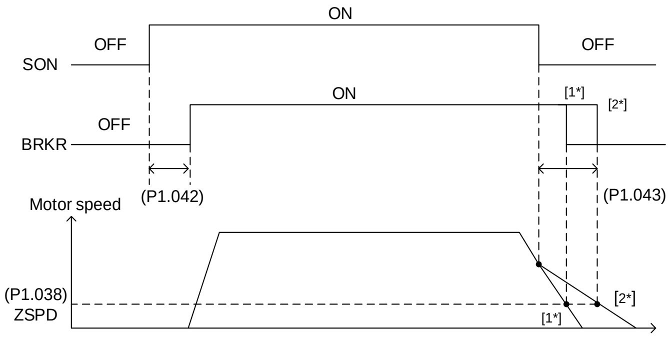
Value: 0x06

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

Value: 0x08

DO name	Description	Triggering method	Control mode
BRKR	Output signal of the magnetic brake control. Set P1.042 and P1.043 to adjust the delay time before and after the magnetic 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	The -L model does not support this DO. When an absolute encoder alarm occurs, this DO is on.	-	All

Value: 0x0E

DO name	Description	Triggering method	Control mode
IDXD	The -L model does not support this DO. When this DI 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 overload accumulative time exceeds **t_{OL}**. However, if the overload accumulative time exceeds the overload allowable time of the servo, the servo sends the overload alarms AL006 and AL023. **t_{OL}**= Overload allowable 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 (DO code: 0x10) is on. If the duration exceeds 8 seconds, the servo drive sends AL006 (overload) and AL023 (early overload warning).	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	PT, 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

Value: 0x17			
DO name	Description	Triggering method	Control mode
MC_OK	When DO.Cmd_OK and DO.TPOS are both on, then this DO is on; 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 mode, 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	The -L model does not support this DO. 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	The -L model does not support this DO. 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	The -L model does not support this DO. 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, DO.ABSR triggered by DO2 will replace the DO2 assigned by P2.019			
DO name	Description	Triggering method	Control mode
ABSR (always output by DO2)	The -L model does not support this DO. 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 DO is only valid when DI.ABSE is on. Refer to Figure 10.3.5.1.1 in Chapter 10 for a detailed description.	Level triggered	All

Value: when DI.ABSE is on, DO.ABSD triggered by DO3 will replace the DO3 assigned by P2.020			
DO name	Description	Triggering method	Control mode
ABSD (always output by DO3)	The -L model does not support this DO. The DO for ABS data. This DO is only valid when DI.ABSE and DO.ABSR are both on. Refer to Figure 10.3.5.1.1 in Chapter 10 for a detailed description.	Level triggered	All

Note: the digital output function is disabled when P2.018 - P2.022 and P2.041 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 use P0.002 to set the code for monitoring the variable.
Format	Each monitoring variable is stored in the 32-bit format (long integer) in the servo drive.
Category	Basic variables / extension variables: 1. Basic variables: the variables displayed on the panel within the loop of pressing the UP / DOWN keys 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 8.3 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 with 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:

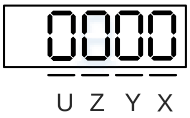
Property	Description
B	BASE: basic variables. Select the variables with the UP / DOWN keys on the panel.
D1 D2	Decimal place displayed on the panel. D1 indicates 1 decimal place and D2 indicates 2 decimal places.
Dec	Only decimal display is available on the panel, and you cannot switch to hexadecimal 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.

The monitoring variables are described in the following table by the code sequence:

Code	Variable name / property	Description
000 (00h)	Feedback position (PUU) B	Current feedback position of the motor encoder. Unit: Pulse of User Unit (PUU).
001 (01h)	Position command (PUU) B	Current position of the Position command. Unit: Pulse of User Unit (PUU). PT mode: number of pulse commands received by the servo drive. PR mode: absolute position of the Position command.
002 (02h)	Following error (PUU) B	Difference between the Position command before filtered and the feedback position. Unit: Pulse of User Unit (PUU).
003 (03h)	Feedback position (pulse) B	Current feedback position of the motor encoder. Unit: encoder unit (pulse).
004 (04h)	Position command (pulse) B	Current position of the Position command. Unit: encoder unit (pulse).
005 (05h)	Following error (pulse) B	Difference between the Position command before filtered and the feedback position. Unit: encoder unit (pulse).
006 (06h)	Pulse command frequency B	Frequency of the pulse command received by the drive. Unit: Kpps. Applicable to PT and PR modes.
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.
008 (08h)	Speed command (analog) B D2 Dec	Speed command from the analog channel. Unit: 0.01 Volt.
009 (09h)	Speed command (integrated) B	Integrated Speed command. Unit: 0.1 rpm. Source includes analog, register, or position loop.
010 (0Ah)	Torque command (analog) B D2 Dec	Torque command from the analog channel. Unit: 0.01 Volt.
011 (0Bh)	Torque command (integrated) B	Integrated Torque command. Unit: percentage (%). Source includes analog, register, or speed loop.
012 (0Ch)	Average load rate B	Average load rate (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.

Code	Variable name / property	Description
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 by communication (mapping parameter): Low word returns frequency F2. High word returns frequency F1.
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). The value being converted to the hexadecimal notation is identical to the alarm code displayed in P0.001 and the error code of communication model.
032 (20h)	Position error (PUU)	Difference between the Position command after filtered and the feedback position. Unit: Pulse of User Unit (PUU).
033 (21h)	Position error (pulse)	Difference between the Position command after filtered and the feedback position. 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).

Code	Variable name / property	Description
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)	PR number in execution	Displays the number of the PR command being executed.
049 (31h)	Pulse command CNT	Pulse counts from the pulse command (CN1).
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 analog, 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).
072 (48h)	Speed command (analog) B D1 Dec	Speed command from the analog channel. Unit: 0.1 rpm.
082 (52h)	PR number in execution	Provides the number of the PR command 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. (Not available on -L models)

<table>
<tr><th>Code</th><th>Variable name / property</th><th>Description</th></tr>
<tr><td>123 (7Bh)</td><td>Value returned when monitoring by panel</td><td>Monitoring value displayed when returned to the monitoring panel.</td></tr>
<tr><td>124 (7Ch)</td><td>EtherCAT network and connection status</td><td>Panel display:

<table>
<tr><td>X</td><td>network status for OUT port</td><td>Z</td><td>EtherCAT error status</td></tr>
<tr><td>Y</td><td>network status for IN port</td><td>U</td><td>EtherCAT connection status</td></tr>
</table>
■ 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)</td></tr>
<tr><td>-80</td><td>Encoder communication error rate</td><td>When this value continues to increase, it indicates that there is communication interference. In an interference-free environment, this value should not change.</td></tr>
<tr><td>-91</td><td>Overload (AL006) protection counter</td><td>Displays the motor load during operation. When the value reaches 100%, AL006 occurs.</td></tr>
<tr><td>-111</td><td>Regeneration error (AL005) protection counter</td><td>When the value of the regeneration counter reaches 100%, AL005 occurs.</td></tr>
<tr><td>-124</td><td>Encoder temperature</td><td>Monitor the encoder temperature.</td></tr>
<tr><td>-169</td><td>Regenerative resistor overload (AL086) protection counter</td><td>This variable monitors the average power consumed by the regenerative resistor (unit: %) when the energy of the servo drive capacitor is released to the regenerative resistor.
When the value reaches 100%, AL086 occurs.</td></tr>
<tr><td>-202</td><td>Motor electrical angle</td><td>The current electrical angle multiplied by 4.</td></tr>
<tr><td>-207</td><td>Regenerative resistor power consumption</td><td>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.</td></tr>
</table>

Modbus Communication

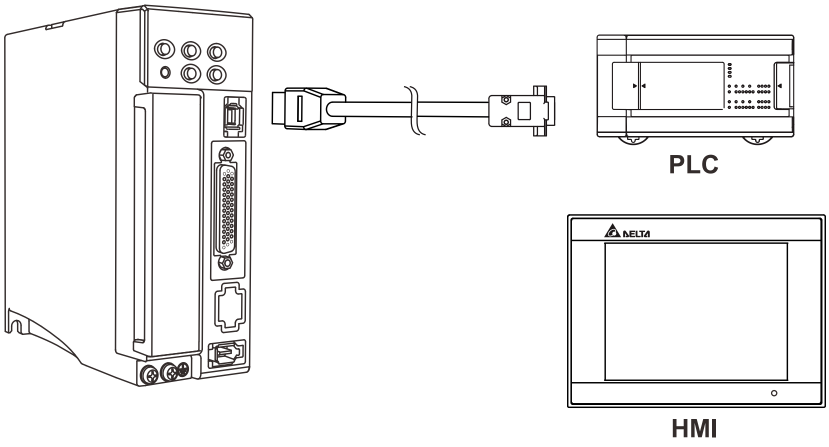
9

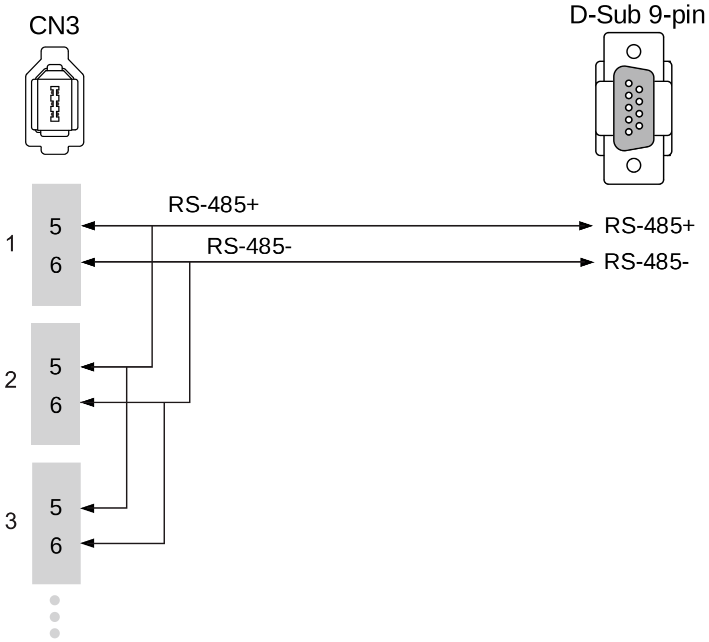
This chapter describes the Modbus communication which you use for reading and writing general parameters. For fieldbus control, refer to the related EtherCAT documentation. The details of ASCII and RTU modes are also provided in this chapter.

9.1 Modbus communication interface (hardware)

The servo drive supports RS-485 and RS-232 serial communication that you can use to access and change the parameters of the servo system.

Wiring for RS-485

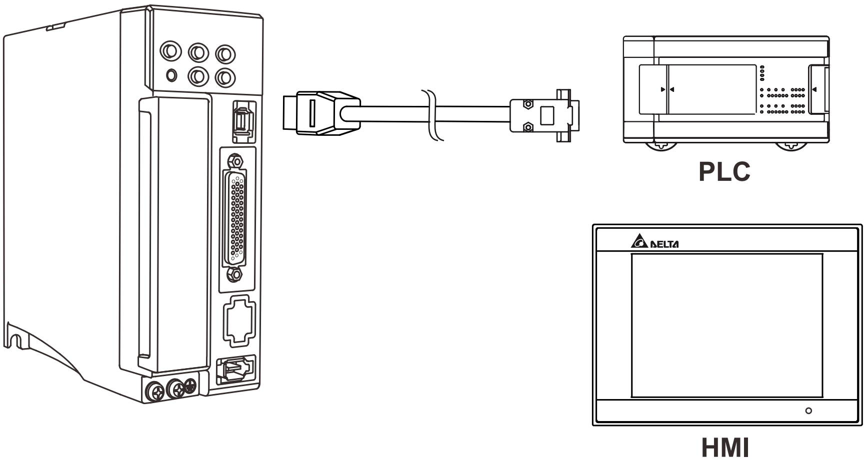


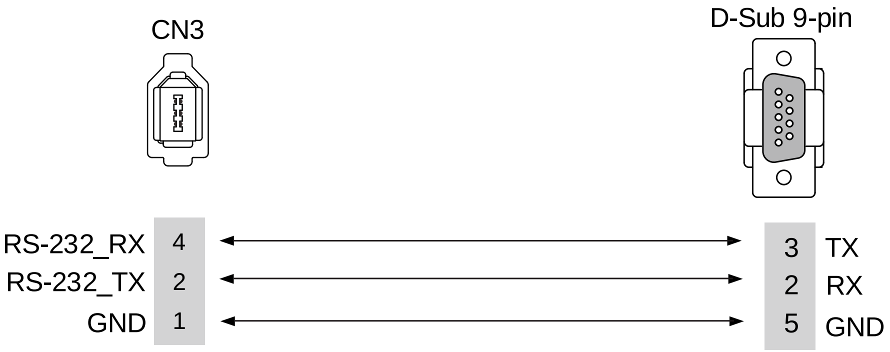


Note:

1. The cable length can be up to 100 meters when the servo drive is installed in a quiet environment. If the required transmission speed is over 38,400 bps, a cable with the length of 15 meters or less is recommended to ensure data transmission accuracy.
2. The gray-shaded numbers in the preceding figure represent the pin number of the connectors.
3. Supply 12 V_{DC} (or higher) power for the controller.
4. When using RS-485, you may connect up to 32 servo drives. Install a repeater to connect more servo drives (the maximum is 127 stations).
5. When using RS-485 Modbus communication to connect two or more servo drives in series, the interval between each communication command should be at least 160 ms.
6. Refer to Wiring for the CN3 connector in Chapter 3.

Wiring for RS-232





Note:

1. The cable length can be up to 15 meters when the servo drive is installed in a quiet environment. If the required transmission speed is over 38,400 bps, a cable with the length of 3 meters or less is recommended to ensure data transmission accuracy.
2. The gray-shaded numbers in the preceding figure represent the pin number of the connectors.
3. When using RS-232, it only supports connecting one device to one servo drive at a time.

9.2 Modbus communication parameters

The servo drive requires setting these parameters for using Modbus communication: P3.000 (Address), P3.001 (Transmission speed), P3.002 (Modbus communication protocol), and P3.005 (Modbus communication). On the other hand, P3.003 (Modbus communication error handling), P3.004 (Modbus communication timeout), P3.006 (Digital input (DI) control switch), and P3.007 (Modbus communication response delay time) are optional parameters. Refer to Chapter 8 for detailed descriptions of the relevant parameters.

9.3 Modbus communication protocol

There are two modes of Modbus network communication: ASCII (American Standard Code for Information Interchange) and RTU (Remote Terminal Unit). You can set the communication protocol (ASCII or RTU) with P3.002 according to your requirements. The servo drive also supports these functions: reading multiple words (03H), writing single word (06H), and writing multiple words (10H). Refer to the following descriptions.

Code description

ASCII mode:

In ASCII mode, data is transmitted in ASCII (American Standard Code for Information Interchange) format. For instance, to transmit “64H” between the master and slave, the ASCII codes “36H” and “34H” are sent to represent “6” and “4” respectively.

The corresponding ASCII codes for the numbers 0 to 9 and the characters A to F are as follows:

Symbol	‘0’	‘1’	‘2’	‘3’	‘4’	‘5’	‘6’	‘7’
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H
Symbol	‘8’	‘9’	‘A’	‘B’	‘C’	‘D’	‘E’	‘F’
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

RTU mode:

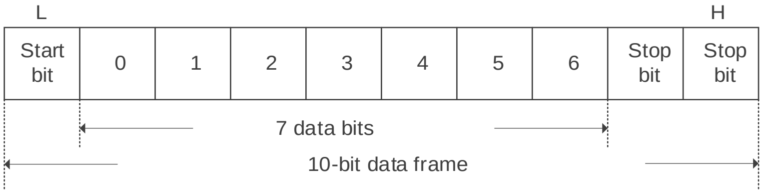
In RTU mode, each data frame consists of an 8-bit character (hexadecimal), which is more efficient than ASCII mode for data transmission because it can be done without code interchange. For instance, when transmitting “64H” between the master and slave, simply send “64H”.

Characters are encoded into the following frames and transmitted in series. The methods for checking each type of frame are as follows.

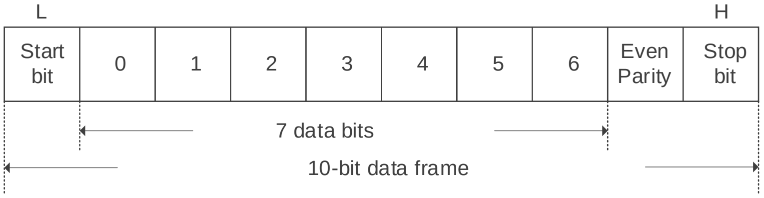
ASCII mode:

10-bit data frame (for 7-bit character)

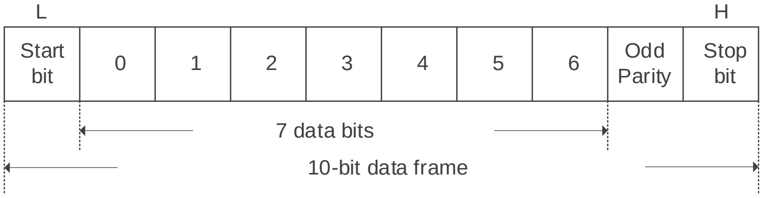
7N2



7E1



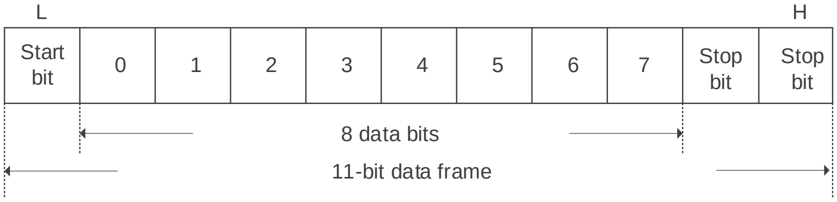
7O1



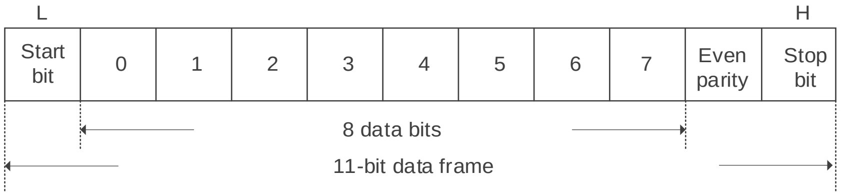
RTU mode:

11-bit data frame (for 8-bit character)

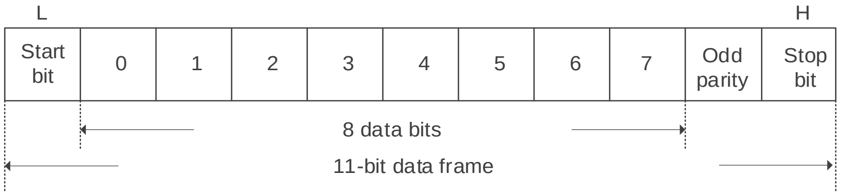
8N2



8E1



8O1



Communication data structure

Definitions for the data frames in the two modes are as follows:

ASCII mode:

Start	Start character ‘:’ (3AH)
Slave Address	Communication address: 1 byte, consists of 2 ASCII codes (ADR)
Function	Function code: 1 byte, consists of 2 ASCII codes (CMD)
Data (n-1)	Data content: n word(s) = 2n bytes (consists of 4n ASCII codes), n ≤ 10
…….	
Data (0)	
LRC	Error checking: 1 byte, consists of 2 ASCII codes
End 1	End code 1: (0DH)(CR)
End 0	End code 0: (0AH)(LF)

RTU mode:

Start	A silent interval of more than 10 ms
Slave Address	Communication address: 1 byte
Function	Function code: 1 byte
Data (n-1)	Data content: n word(s) = 2n bytes, n ≤ 10
…….	
Data (0)	
CRC	Error checking: 2 bytes
End 1	A silent interval of more than 10 ms

Example 1: function code 03H, reading multiple words

In the following example, the master issues a read command to the first slave.
The slave reads two continuous words starting from the start data address 0200H. In the response message from the slave, the content of the start data address 0200H is 00B1H and the content of the second data address 0201H is 1F40H. The maximum allowable number of data for one single read action is 10 words.

ASCII mode:

Command Message (Master):

Start	‘:’
Slave Address	‘0’
	‘1’
Function	‘0’
	‘3’
Start Data Address	‘0’
	‘2’
	‘0’
	‘0’
Data Quantity (in words)	‘0’
	‘0’
	‘0’
	‘2’
LRC	‘F’
	‘8’
End 1	(0DH)(CR)
End 0	(0AH)(LF)

Response Message (Slave):

Start	‘:’
Slave Address	‘0’
	‘1’
Function	‘0’
	‘3’
Data Quantity (in bytes)	‘0’
	‘4'
Content of Start Data Address 0200H	‘0’
	‘0’
	‘B’
	‘1’
Content of the 2nd Data Address 0201H	‘1’
	‘F’
	‘4’
	‘0’
LRC	‘E’
	‘8’
End 1	(0DH)(CR)
End 0	(0AH)(LF)

RTU mode:

Command Message (Master):

Slave Address	01H
Function	03H
Start Data Address	02H (High)
	00H (Low)
Data Quantity (in words)	00H
	02H
CRC (Check Low)	C5H (Low)
CRC (Check High)	B3H (High)

Response Message (Slave):

Slave Address	01H
Function	03H
Data Quantity (in bytes)	04H
Content of Start Data Address 0200H	00H (High)
	B1H (Low)
Content of the 2nd Data Address 0201H	1FH (High)
	40H (Low)
CRC (Check Low)	A3H (Low)
CRC (Check High)	D4H (High)

Note: a silent interval of 10 ms is required before and after each transmission in RTU mode.

Example 2: function code 06H, writing single word

In the following example, the master issues a write command to the first slave.
The slave writes data 0064H to the start data address 0200H and sends a response message to the master after the writing is complete.

ASCII mode:

Command Message (Master):

Start	‘:’
Slave Address	‘0’
	‘1’
Function	‘0’
	‘6’
Start Data Address	‘0’
	‘2’
	‘0’
	‘0’
Data Content	‘0’
	‘0’
	‘6’
	‘4’
LRC	‘9’
	‘3’
End 1	(0DH)(CR)
End 0	(0AH)(LF)

Response Message (Slave):

Start	‘:’
Slave Address	‘0’
	‘1’
Function	‘0’
	‘6’
Start Data Address	‘0’
	‘2'
	‘0’
	‘0’
Data Content	‘0’
	‘0’
	‘6’
	‘4’
LRC	‘9’
	‘3’
End 1	(0DH)(CR)
End 0	(0AH)(LF)

RTU mode:

Command Message (Master):

Slave Address	01H
Function	06H
Start Data Address	02H (High)
	00H (Low)
Data Content	00H (High)
	64H (Low)
CRC (Check Low)	89H (Low)
CRC (Check High)	99H (High)

Response Message (Slave):

Slave Address	01H
Function	06H
Start Data Address	02H (High)
	00H (Low)
Data Content	00H (High)
	64H (Low)
CRC (Check Low)	89H (Low)
CRC (Check High)	99H (High)

Note: a silent interval of 10 ms is required before and after each transmission in RTU mode.

Example 3: function code 10H, writing multiple words

In the following example, the master issues a write command to the first slave.
The slave writes two words 0BB8H and 0000H starting from the start data address 0112H. In other words, 0BB8H is written into 0112H and 0000H is written into 0113H. The maximum allowable number of data for one single write action is 8 words. The slave sends a response message to the master after the writing is complete.

ASCII mode:

Command Message (Master):

Start	‘:’
Slave Address	‘0’
	‘1’
Function	‘1’
	‘0’
Start Data Address	‘0’
	‘1’
	‘1’
	‘2’
Data Quantity (in words)	‘0’
	‘0’
	‘0’
	‘2’
Data Quantity (in bytes)	‘0’
	‘4’
Content of the 1st Data Frame	‘0’
	‘B’
	‘B’
	‘8’
Content of the 2nd Data Frame	‘0’
	‘0’
	‘0’
	‘0’
LRC	‘1’
	‘3’
End 1	(0DH)(CR)
End 0	(0AH)(LF)

Response Message (Slave):

Start	‘:’
Slave Address	‘0’
	‘1’
Function	‘1’
	‘0’
Start Data Address	‘0’
	‘1’
	‘1’
	‘2’
Data Quantity (in words)	‘0’
	‘0’
	‘0’
	‘2’
LRC	‘D’
	‘A’
End 1	(0DH)(CR)
End 0	(0AH)(LF)

RTU mode:

Command Message (Master):

Slave Address	01H
Function	10H
Start Data Address	01H (High)
	12H (Low)
Data Quantity (in words)	00H (High)
	02H (Low)
Data Quantity (in bytes)	04H
Content of the 1st Data Frame	0BH (High)
	B8H (Low)
Content of the 2nd Data Frame	00H (High)
	00H (Low)
CRC (Check Low)	FCH (Low)
CRC (Check High)	EBH (High)

Response Message (Slave):

Slave Address	01H
Function	10H
Start Data Address	01H (High)
	12H (Low)
Data Quantity (in words)	00H (High)
	02H (Low)
CRC (Check Low)	E0H (Low)
CRC (Check High)	31H (High)

Note: a silent interval of 10 ms is required before and after each transmission in RTU mode.

LRC and CRC transmission error checking

In ASCII mode, the error checking method is LRC (Longitudinal Redundancy Check). In RTU mode, the error checking method is CRC (Cyclic Redundancy Check). See the following details.

LRC (ASCII mode):

Start	‘:’
Slave Address	‘7’
	‘F’
Function	‘0’
	‘3’
Start Data Address	‘0’
	‘5’
	‘C’
	‘4’
Data Quantity (in words)	‘0’
	‘0’
	‘0’
	‘1’
LRC	‘B’
	‘4’
End 1	(0DH)(CR)
End 0	(0AH)(LF)

The LRC value is calculated by adding all the bytes, rounding down the carry, and taking the two’s complement.

In the preceding example:

7FH + 03H + 05H + C4H + 00H + 01H = 14CH, round down the carry 1 and take 4CH.

The two’s complement of 4CH is B4H.

CRC (RTU mode):

To calculate the CRC value:

Step 1: load a 16-bit register with the content of FFFFH, which is called the CRC register.

Step 2: perform (The low byte of the CRC register) XOR (The first byte of the command), and save the result in the CRC register.

Step 3: check the least significant bit (LSB) of the CRC register. If the bit is 0, shift the register one bit to the right. If the bit is 1, shift the register one bit to the right and perform (CRC register) XOR (A001H). Repeat this step 8 times.

Step 4: repeat Steps 2 and 3 until all bytes have been processed. The content of the CRC register is the CRC value.

After calculating the CRC value, fill in the low byte of the CRC value in the command message, and then the high byte. For example, if the result of CRC calculation is 3794H, put 94H in the message and then 37H as shown in the following table.

ADR	01H
CMD	03H
Start Data Address	01H (High)
	01H (Low)
Data Quantity (in words)	00H (High)
	02H (Low)
CRC (Check Low)	94H (Low)
CRC (Check High)	37H (High)

CRC example code:

This function calculates the CRC value in the C language. It needs two parameters:

```
unsigned char* data;
unsigned char length
//The function returns the CRC value in unsigned integer.
unsigned int crc_chk(unsigned char* data, unsigned char length) {
     int j;
     unsigned int reg_crc=0xFFFF;

     while( length-- ) {
          reg_crc^= *data++;
          for (j=0; j<8; j++ ) {
               if( reg_crc & 0x01 ) { /*LSB(bit 0 ) = 1 */
                    reg_crc = (reg_crc >> 1)^0xA001;
               } else {
                    reg_crc = (reg_crc>>1);
               }
          }
     }
     return reg_crc;
}
```

Example of a PC communication program:

```
#include<stdio.h>
#include<dos.h>
#include<conio.h>
#include<process.h>
#define PORT 0x03F8   /*  the address of COM 1  */
#define THR 0x0000
#define RDR 0x0000
#define BRDL 0x0000
#define IER 0x0001
#define BRDH 0x0001
#define LCR 0x0003
#define MCR 0x0004
#define LSR 0x0005
#define MSR 0x0006
unsigned char rdat[60];
/* read 2 data from address 0200H of ASD with address 1 */
unsigned char
tdat[60]={‘:’,’0’,’1’,’0’,’3’,’0’,’2’,’0’,’0’,’0’,’0’,’0’,’2’,’F’,’8’,’\r’,’\
n’};
void main() {
int I;
outportb(PORT+MCR,0x08);      /*  Interruption enable  */
outportb(PORT+IER,0x01);           /* Interruption as data in  */
outportb(PORT+LCR,( inportb(PORT+LCR) | 0x80 ) );
/*  the BRDL/BRDH can be access as LCR.b7 == 1  */
outportb(PORT+BRDL,12);
outportb(PORT+BRDH,0x00);
outportb(PORT+LCR,0x06);      /* set protocol
                                   <7,E,1> = 1AH,       <7,O,1> = 0AH
                                   <8,N,2> = 07H        <8,E,1> = 1BH
                                   <8,O,1> = 0BH                     */

for( I = 0; I<=16; I++ ) {
    while( !(inportb(PORT+LSR) & 0x20) );  /*  wait until THR empty  */
    outportb(PORT+THR,tdat[I]);            /*  send data to THR  */
}
I = 0;
while( !kbhit() ) {
    if( inportb(PORT+LSR)&0x01 ) {  /*  b0==1, data is read  */
        rdat[I++] = inportb(PORT+RDR); /*   read data from RDR  */
    }
}
}
```

9.4 Writing and reading communication parameters

Refer to Chapter 8 for the descriptions of the parameters. The parameters that you can write or read through communication are described as follows.

The servo drive parameters are divided into eight groups: Group 0 (Monitoring parameters), Group 1 (Basic parameters), Group 2 (Extension parameters), Group 3 (Communication parameters), Group 4 (Diagnosis parameters), Group 5 (Motion control parameters), and Group 6 and Group 7 (PR parameters). Except for the read-only parameters, all parameters can be set through communication. And you can read the values of all Group 0 to Group 7 parameters through communication.

Note the following additional details:

P3.001: when a new transmission speed is set, the next data is written at the new transmission speed.

P3.002: when a new communication protocol is set, the next data is written with the new communication protocol.

P4.005: servo motor JOG control. Refer to Chapter 8 for detailed descriptions.

P4.006: force digital output (DO) contact control. You can use this parameter to test the DO contacts. First set P2.008 to 406, and then set P4.006 to 0x0001, 0x0002, 0x0004, 0x0008, 0x0010, and 0x0020 to test DO1, DO2, DO3, DO4, DO5, and DO6 respectively. Afterwards, set P4.006 to 0x0000 to complete the test.

P4.010: hardware calibration options. First set P2.008 to 20 (14H in hexadecimal format) to enable this function.

P4.011 - P4.021: hardware offset calibration. The parameters were adjusted before delivery, so changing the parameter settings is not recommended. If you need to modify these parameters, first set P2.008 to 22 (16H in hexadecimal format) to enable this function.

9.5 RS-485 communication specification

Compared with RS-232, the RS-485 communication can carry out one-to-many transmission and has better anti-interference ability. RS-485 uses a balanced transmission line for signal reception and transmission. The transmitter converts the TTL signal into a differential signal and then sends it to the receiver. The receiver receives the differential signal and then converts it back to the TTL signal. Since the transmission process uses the differential signal, it has better anti-interference ability. However, there are still restrictions on the use of RS-485 communication, so note the following when wiring.

- Number of stations

  CN3 supports up to 32 servo drives. Install a repeater to connect more servo drives (the current maximum is 127 stations).

- Transmission distance

  The longer the transmission distance, the slower the transmission speed. The cable length can be up to 100 meters when the servo drive is installed in a quiet environment. If the required transmission speed is over 38,400 bps, a cable with the length of 15 meters or less is recommended to ensure data transmission accuracy.

- Transmission line

  The quality of the transmission line affects the signal transmission process. If there is interference during the transmission process, it may result in data loss. It is suggested that you use a shielded twisted-pair cable as it has metal shield and a grounding wire, which ensures better anti-interference ability.

- Topology

  For topology, the closer to the master station, the more stable the transmitted signal. RS-485 supports bus topology. The transmission line must connect from the first station to the second station, and then from the second station to the third station, and so on until the last station. RS-485 does not support star and ring topologies.

- Terminal resistor

  In the communication transmission process, if the impedance is not continuous, it causes signal reflection and signal distortion. This usually happens to the device that is configured at the end of the transmission line. If the impedance is small or even 0 Ω, the signal will be reflected. To solve this problem, add a resistor of the same characteristic impedance as the cable at the end of the transmission line, which is called a terminal resistor. In general, the transmission line used in the RS-485 signal transmission circuit is a twisted-pair cable, and its characteristic impedance is about 120 Ω, so the impedance of the terminal resistor is also 120 Ω.

- Anti-interference measures

  In the signal transmission process, if there is interference, it may result in signal distortion. Therefore, it is important to eliminate interference. The elimination methods are as follows:

  1. Add a terminal resistor.
  2. Check if the servo drive is installed in a high magnetic field environment. If so, keep it as far away as possible.
  3. Use a shielded twisted-pair cable for the transmission line.
  4. When wiring, isolate the high voltage power cable from the signal line.
  5. Use a ferrite ring at the power input.
  6. Add IEC 60384-14 certified X capacitor and Y capacitor at the power input.

Absolute System

10

This chapter introduces the absolute servo system, including the wiring and installation of the absolute encoder, the steps to set up the system, and the procedures for initializing and operating the system for the first time.

Important

An absolute servo system includes a servo drive, an absolute motor, and a battery box. The backup 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 the servo is set up 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 shown in the following:

ECM-E3 series servo motor

ECM－E3 □－□ □ □ □ □ □ □ □ □

A / P: absolute motor

Install the battery correctly to the encoder. One servo drive uses one single battery box; two servo drives can share one dual battery box. Use Delta's encoder cable to connect to the battery box. See the following sections for the specifications of the battery box and accessories.

10.1 Battery box and absolute encoder cable

10.1.1 Battery specifications

Precautions

Carefully read and follow these safety precautions. Use batteries in accordance with the specifications to avoid damage or dangerous conditions.

WARNING

- Make sure the installation location is free of water vapor and corrosive and inflammable gas.
- Do not scatter the batteries as this may result in short-circuiting.
- Do not short-circuit the positive and negative electrodes of the battery, and do not install the batteries in reverse direction.
- Do not mix new and used batteries to avoid losing power or shortening the life of the new batteries. Replacing all batteries with new ones is recommended.
- Follow the instructions in the manual when installing and wiring the battery box to avoid dangerous conditions.

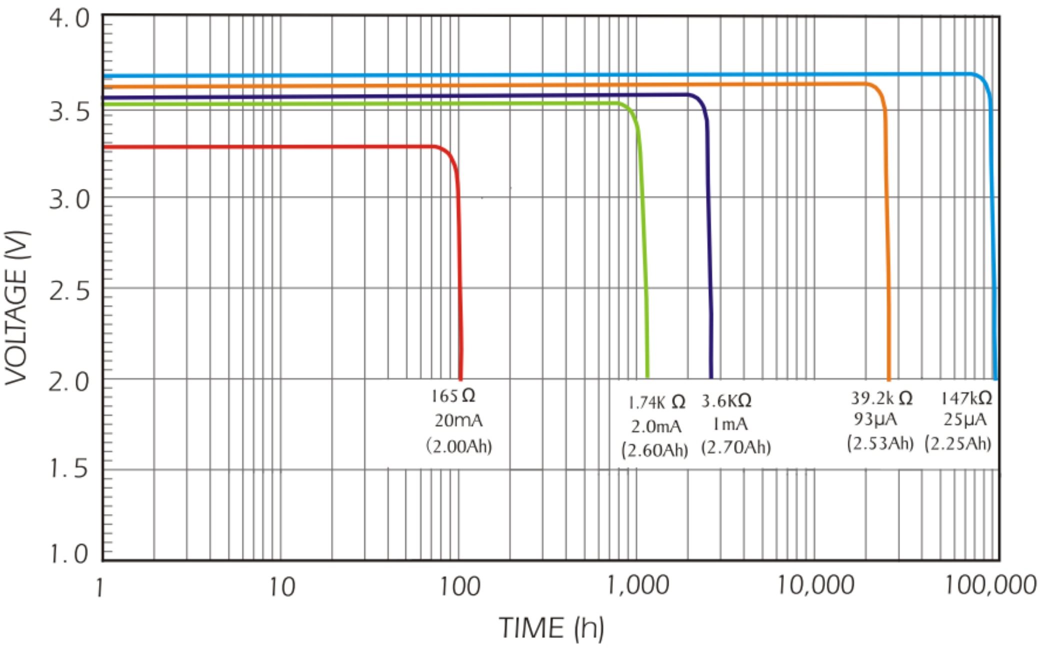
STOP

- Do not place the battery in a high-temperature environment over 100°C (212°F) or in the fire, as this may cause a fire or an explosion.
- The batteries are non-rechargeable. Do not charge the batteries as this may result in an explosion.
- Do not directly weld on the surface of the battery.

Battery specifications

Item	Li/SOCl2 Cylindrical Battery
Mode numberl	ER14505
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)
Supplier	EVE Energy Co., Ltd
Part number for the battery with wires	0991023281

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 expected battery life is as shown in the following table. Therefore, 3.1V is defined as low battery voltage for an absolute encoder.

Motor	Current consumption^{*2} (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 above 3.6V up to 5 years when the battery is stored in a dry place at room temperature.

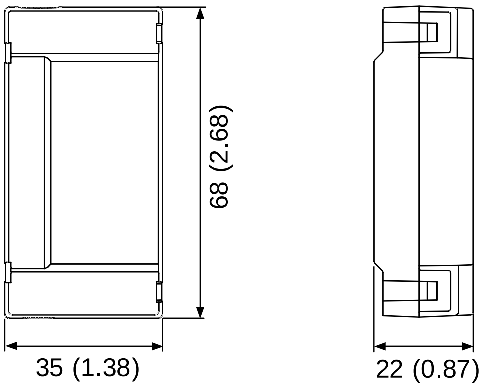
Note:

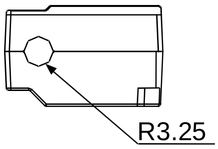
1. The battery life expectancy is measured with a test using a servo drive, a motor, and a single battery.
2. The current consumption is close to 0 before the absolute origin position is established. Once the absolute origin position is established, the battery starts draining. To avoid battery power consumption when the machine is in transport, it is recommended that you disconnect the battery from the servo drive or do not establish the absolute origin position.

10.1.2 Battery box dimensions

Single battery box

Delta model number: ASD-MDBT0100

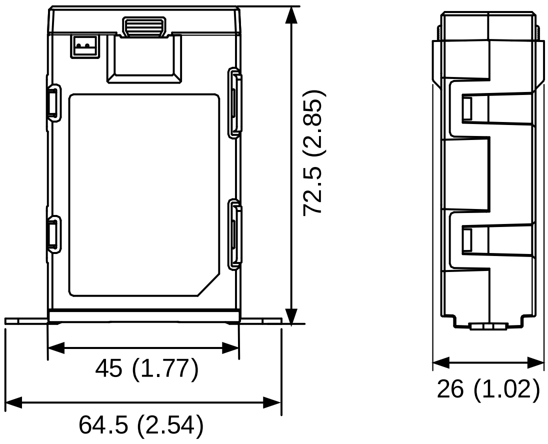


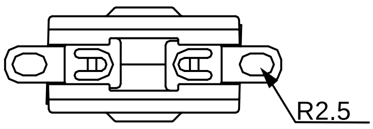


Unit: mm (inch)
Weight: 44 g

Dual battery box

Delta model number: ASD-MDBT0200

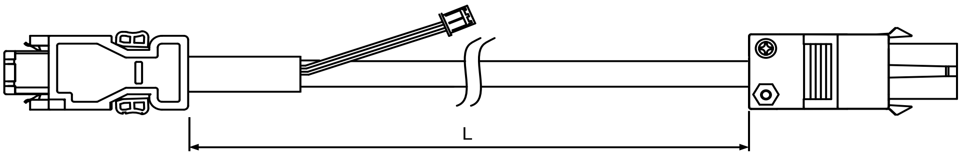




Unit: mm (inch)
Weight: 79.23 g

10.1.3 Connection cable for the absolute encoder

A. Quick connector

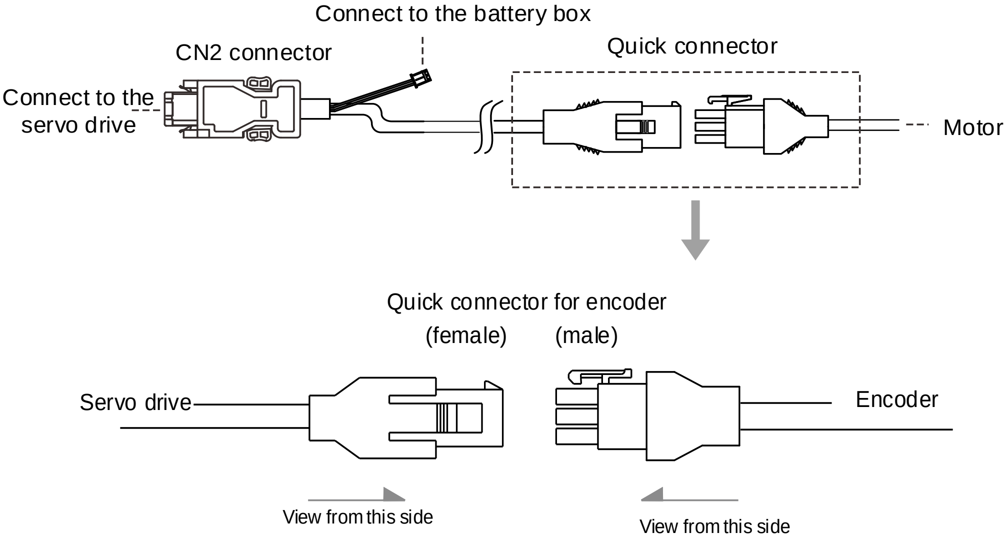


Model number of absolute encoder cable	L	
	mm	inch
ACS3-CAE☐0103	3000 ± 50	118 ± 2
ACS3-CAE☐0105	5000 ± 50	197 ± 2
ACS3-CAE☐0110	10000 ± 100	394 ± 4
ACS3-CAE☐0120	20000 ± 100	787 ± 4

Note: select cables according to the ☐ in the model number. B represents flexible cables and A represents standard cables.

Connection method:

Caution Follow these instructions when wiring. Incorrect wiring may cause battery explosion.

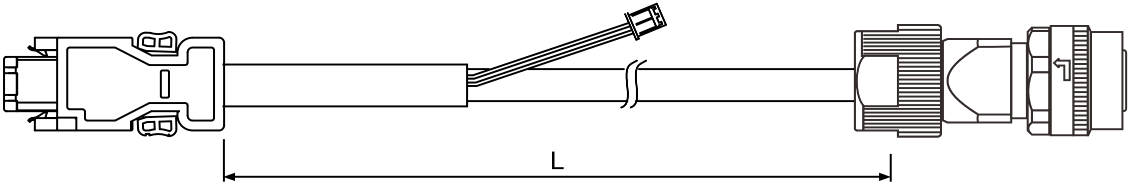


1 White T+	2 Red BAT+	3 Reserved
4 White/Red T-	5 Black BAT-	6 Reserved
7 Brown DC+5V	8 Blue GND	9 Shielding

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

Note: the wire colors of the encoder cable for the servo drive are for reference only. Refer to the actual product.

B. Military connector (IP67 waterproof)

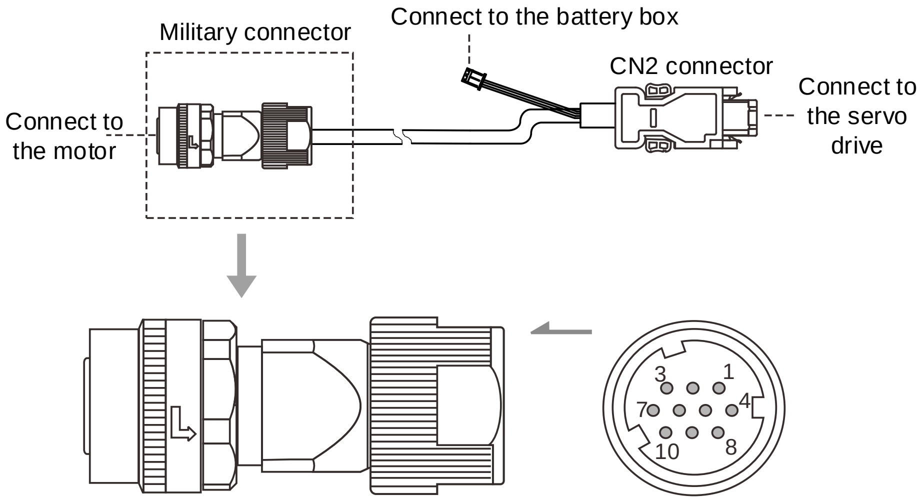


Model number of absolute encoder cable	Model number of connector	L	
		mm	inch
ACS3-CAE☐A103	CMV1-SP10S	3000 ± 50	118 ± 2
ACS3-CAE☐A105	CMV1-SP10S	5000 ± 50	197 ± 2
ACS3-CAE☐A110	CMV1-SP10S	10000 ± 100	394 ± 4
ACS3-CAE☐A120	CMV1-SP10S	20000 ± 100	787 ± 4

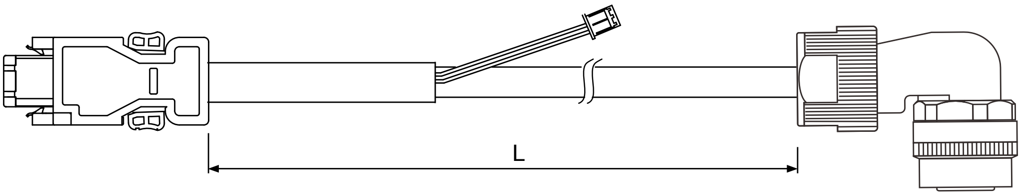
Note: select cables according to the ☐ in the model number. B represents flexible cables and A represents standard cables.

Connection method:

Caution Follow these instructions when wiring. Incorrect wiring may cause battery explosion.



Pin No.	Terminal	Wire color
1	T+	White
2	T-	White/Red
3	-	-
4	DC+5V	Brown
5	BAT-	Black
6	BAT+	Red
7, 8	-	-
9	GND	Blue
10	Shielding	-

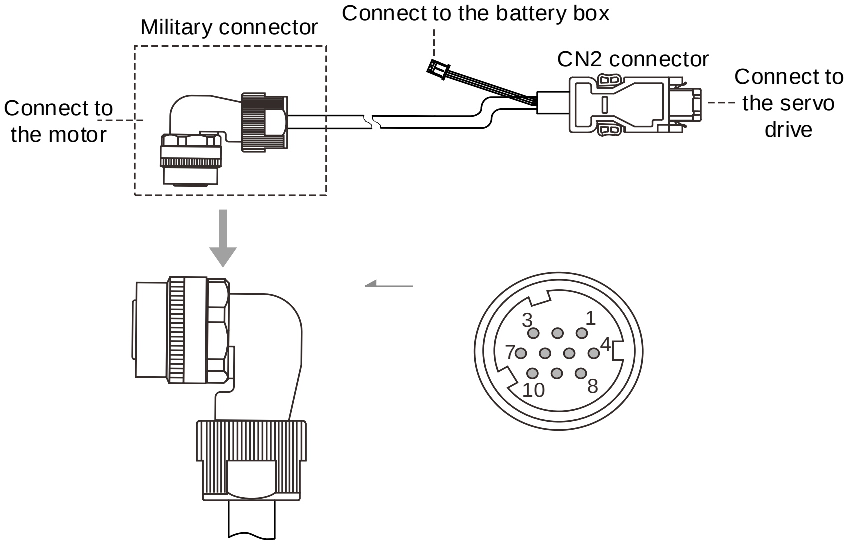


Model number of absolute encoder cable	Model number of connector	L	
		mm	inch
ACS3-CRE☐A103	CMV1-AP10S	3000 ± 50	118 ± 2
ACS3-CRE☐A105	CMV1-AP10S	5000 ± 50	197 ± 2
ACS3-CRE☐A110	CMV1-AP10S	10000 ± 100	394 ± 4
ACS3-CRE☐A120	CMV1-AP10S	20000 ± 100	787 ± 4

Note: select cables according to the ☐ in the model number. B represents flexible cables and A represents standard cables.

Connection method:

Caution Follow these instructions when wiring. Incorrect wiring may cause battery explosion.

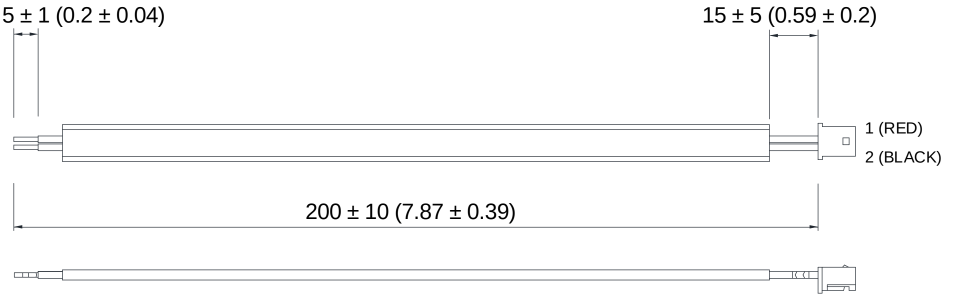


Pin No.	Terminal	Wire color
1	T+	White
2	T-	White/Red
3	-	-
4	DC+5V	Brown
5	BAT-	Black
6	BAT+	Red
7, 8	-	-
9	GND	Blue
10	Shielding	-

10.1.4 Battery box cable

Battery box cable for customized wiring

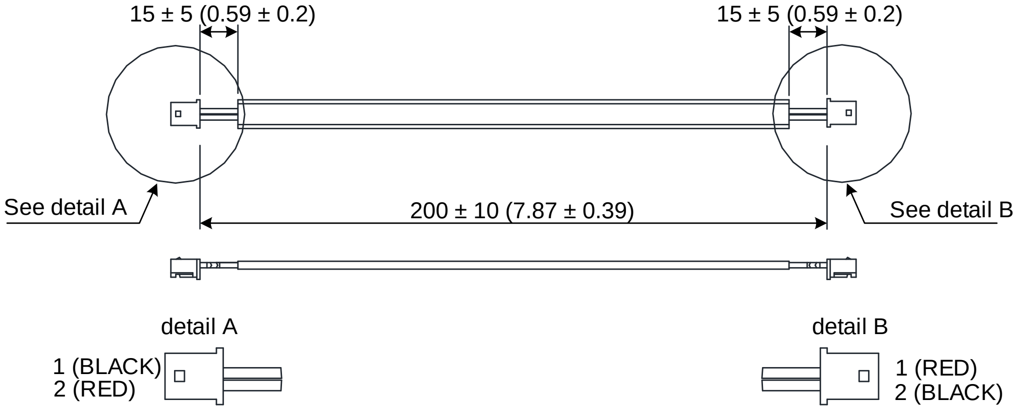
Delta part number: 3864850600



Unit: mm (inch)

Battery box cable that connects to the encoder cable (male to male)

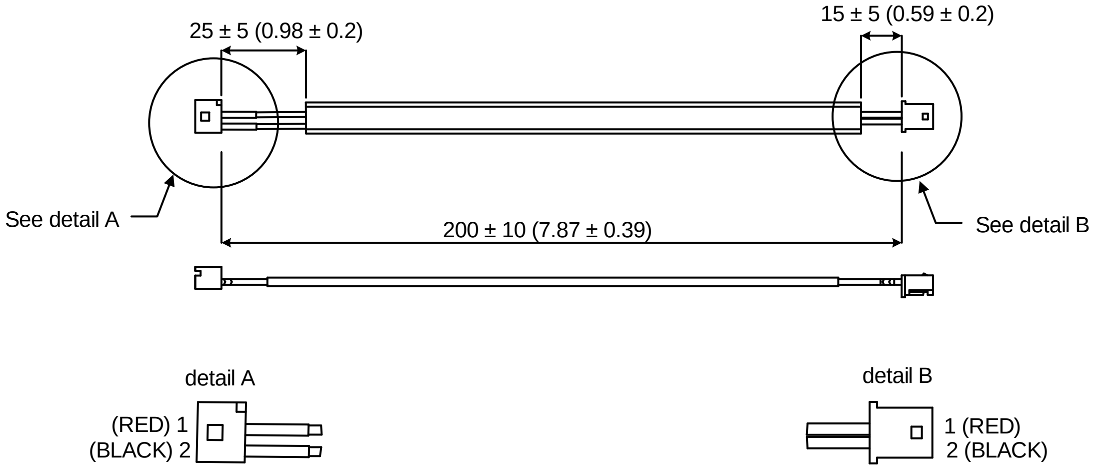
Delta part number: 3864811901



Unit: mm (inch)

Battery box cable that connects to the encoder cable (male to female)

Delta part number: 3864573700



Unit: mm (inch)

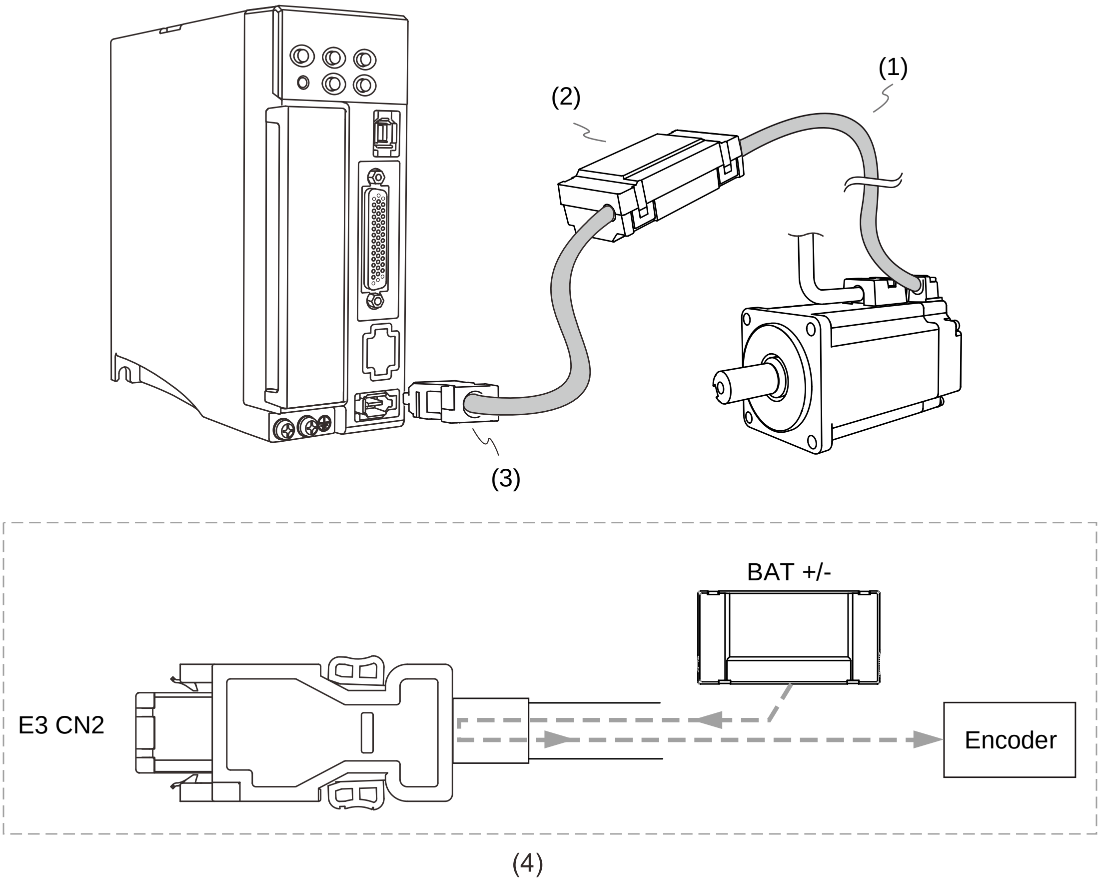
10.2 Installation

10.2.1 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 CN2 connector of the servo drive is not required.

Wiring example: single battery box (standard wiring)



(1) Encoder cable from the motor side; (2) Single battery box;

(3) CN2 connector; (4) Battery box wiring

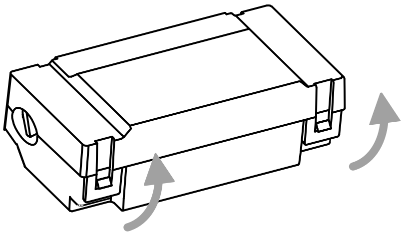
Pin assignment of CN2 connector:

Encoder cable connector (female)			CN2 of servo drive		
Quick connector	B3 military connector	Color	Pin No.	Signal	Description
7	4	Brown	1	DC+5V	+5V power supply
8	9	Blue	2	GND	Power ground
-	-	-	3	-	**Do not connect this pin. For internal use only.**
-	-	-	4	-	**Do not connect this pin. For internal use only.**
1	1	White	5	T+	Serial communication signal (+)
4	2	White/Red	6	T-	Serial communication signal (-)
9	10	-	Case	Shielding	Shielding
2	6	Red	-	-	+3.6V battery
5	5	Black	-	-	Battery ground

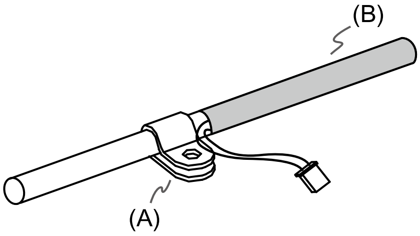
Note: for the wiring details of the absolute encoder connector, refer to Section 3.1.5 Specification for the encoder cable and connector.

10.2.2 Installing and replacing a battery

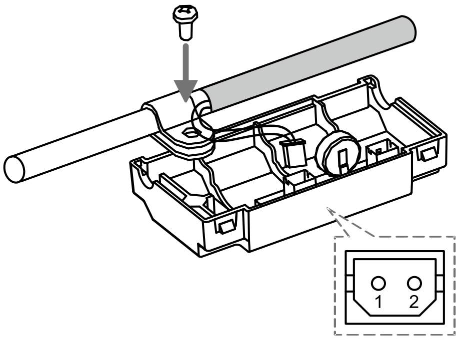
Single battery box



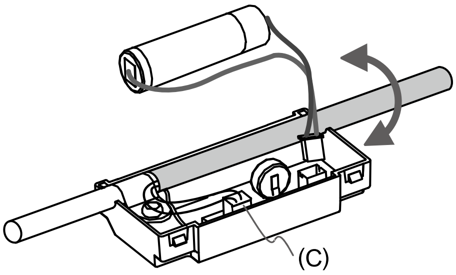
Step 1:
Release the snap-fit tabs on both sides and remove the battery box cover.



Step 2:
Position the (A) cable clamp to the encoder cable. Note that the cable clamp should be placed close to the (B) heat shrink.

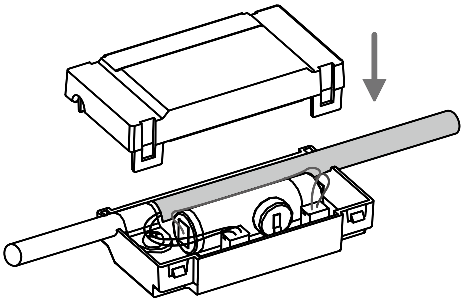


Step 3:
Plug in the battery box cable and secure the cable clamp to the battery box with a screw.



Step 4:
Install a new battery and plug in the battery connection wire.
(C) Replace the battery only when the main power from the servo drive is still on. Do not remove the battery box cable which connects to the servo drive, or else the system may lose data.

(continued)



Step 5:
Place the battery connection wire into the box and fit the cover.

Note:

To avoid data loss, replace the battery when any of the following circumstances occurs:

1. The servo drive shows AL061 which means the voltage is too low. Refer to Chapter 12 for more information.
2. The battery voltage is displayed as 31 when read with P0.002 (monitoring variable 26h), meaning the voltage is below 3.1V.

Important

When the encoder operates under battery power and the battery voltage is below 2.7V, the motor’s position record may be lost, and you need to re-establish the absolute origin position after installing new batteries. It is suggested that you replace the batteries when the main power from the servo drive is on to avoid loss of absolute position data.

10.3 System initialization and operating procedures

10.3.1 System initialization

When the servo system resumes operation after power cycling, the controller can acquire the motor's current absolute position with either communication or DI/DO. Delta's absolute system provides the position value in pulse and in PUU.

AL06A occurs when you initialize the absolute system for the first time because the position system has not been established. Clear the alarm by setting up the position system.
AL060 occurs when 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.

AL062 and AL289 are enabled by default. You can use P2.070 [Bit 2] to set whether to show these two alarms when the absolute position system overflows (the number of revolutions or the PUU number exceeds the range specified in the preceding paragraph). 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 with either DI/DO or communication. Based on the setting of P2.070, the controller can read the number of revolutions plus the pulse number within single turn (refer to Section 10.3.2) or the position value in PUU (refer to Section 10.3.3).

10.3.2 Pulse number

When the motor is running in the clockwise direction, the number of revolutions is defined as a negative value. When the motor is running in the counterclockwise direction, the number of revolutions is defined as a positive value. The range of 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.

When the motor is running in the counterclockwise direction and the number of revolutions reaches +32,767, the value jumps to -32,768 once the motor reaches the target position in the next turn, and the value keeps increasing from -32,768 to +32,767 if the motor keeps running. The value changes the other way when the motor is running in the clockwise direction.

There are 16,777,216 pulses in one motor revolution. That is, the pulse number within single turn ranges from 0 to 16,777,215. Pay attention to the motor's running direction and read the number of revolutions plus the pulse number within single turn with either communication or DI/DO.

Total pulse number = m (number of revolutions) x 16,777,216 + pulse number within 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 $\frac{\text{P1.045}}{\text{P1.044}}$ + P6.001.

When P1.001.Z = 1: the PUU number when power on = (-1) x pulse number x $\frac{\text{P1.045}}{\text{P1.044}}$ + P6.001.

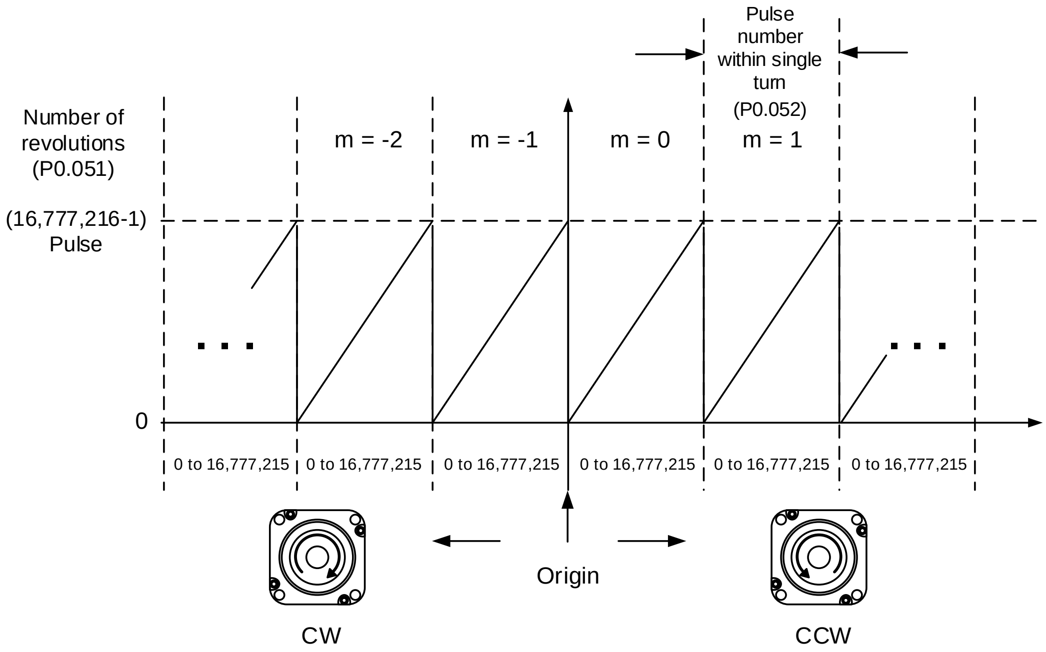


Figure 10.3.2.1 Absolute position in pulse number

10.3.3 PUU number

The PUU number is a 32-bit absolute position data with a positive or negative sign. When the motor is running in the positive direction, the PUU number increases; when the motor is running in the negative direction, the PUU number decreases. The motor operation direction (positive / negative) is defined by P1.001.Z; operation in the clockwise direction does not necessarily mean the motor is operating in the positive direction.

If the motor keeps running in the same direction and the number of revolutions exceeds the range of -32,768 to +32,767, the servo drive generates AL062 (Number of revolutions of the absolute encoder overflows (issued by encoder)). If the motor's PUU number exceeds the range of -2,147,483,648 to +2,147,483,647, the servo drive generates AL289 (Position counter overflows). When an overflow issue of the absolute encoder (AL062 or AL289) occurs, re-establish the absolute origin position to clear the alarm. Set P2.070 [Bit 2] to determine whether the servo drive generates the alarms AL062 and AL289 when an overflow occurs.

When the motor is running in the positive direction and the PUU number reaches +2,147,483,647, the next PUU number jumps to -2,147,483,648 and keeps increasing from -2147483648 to 2,147,483,647 if the motor keeps running. The value changes the other way when the motor is running in the negative direction.

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 ≒ 214,748.4, so once the motor runs over 32,767 (< 214,748.4) revolutions in the positive direction, AL062 occurs.

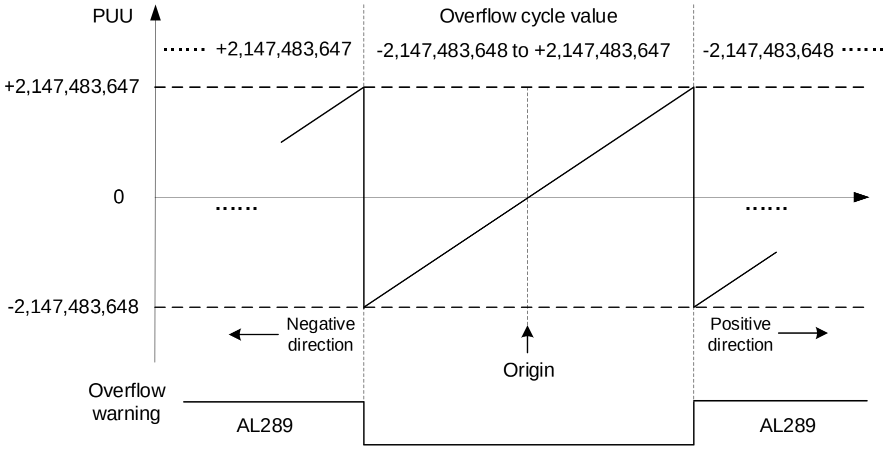


Figure 10.3.3.1 Absolute position in PUU number

Note: after the absolute origin position is established, any modification to P1.001.Z or E-Gear ratio (P1.044 and P1.045) changes the original setting of the absolute origin position. If these parameters are modified, re-establish the absolute origin position.

10.3.4 Establish the absolute origin position

When the absolute position is lost, the servo drive provides three methods to establish the absolute origin position: DI/DO, parameter setting, or the PR homing function. The following provides more details for each method.

10.3.4.1 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.

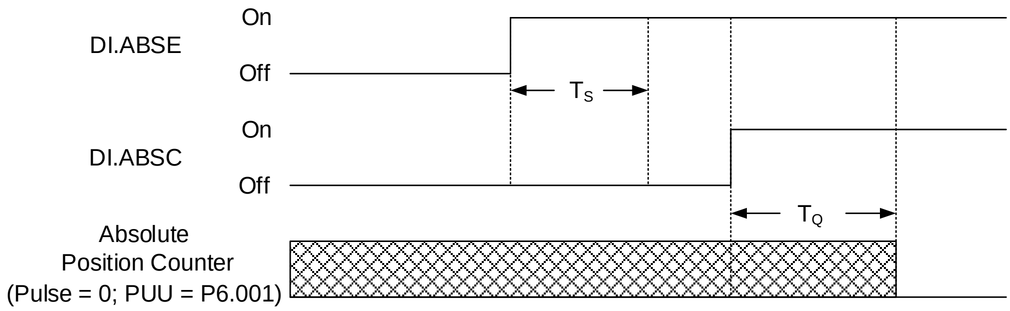


Figure 10.3.4.1.1 Timing diagram for establishing the absolute origin position with DI/DO

The following table describes the T_S and T_Q delay time after DI.ABSE and DI.ABSC are switched to On.

	T_S (ms)	T_Q (ms)
Min.	P2.009 + 2	
Max.	P2.009 + 10	

10.3.4.2 Establishing the absolute origin position with parameters

Set P2.071 to 0x0001 through the panel or with 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. As soon as P2.071 is set to 0x0001, the absolute position system resets.

10.3.4.3 Establishing the absolute origin position with the PR homing function

You can use the 11 homing modes in the PR mode to establish the absolute origin position. For more details, refer to Section 7.1.3.1 Homing methods.

10.3.5 Read the absolute position

10.3.5.1 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.

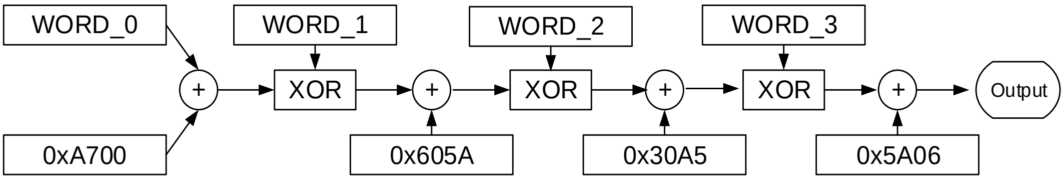
Bit 79 - Bit 64	Bit 63 - Bit 32		Bit 31 - Bit 16	Bit 15 - Bit 0
-	WORD_3	WORD_2	WORD_1	WORD_0
Check Sum	Encoder PUU -2,147,483,648 to +2,147,483,647		0	Encoder status (P0.050)

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 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.

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.

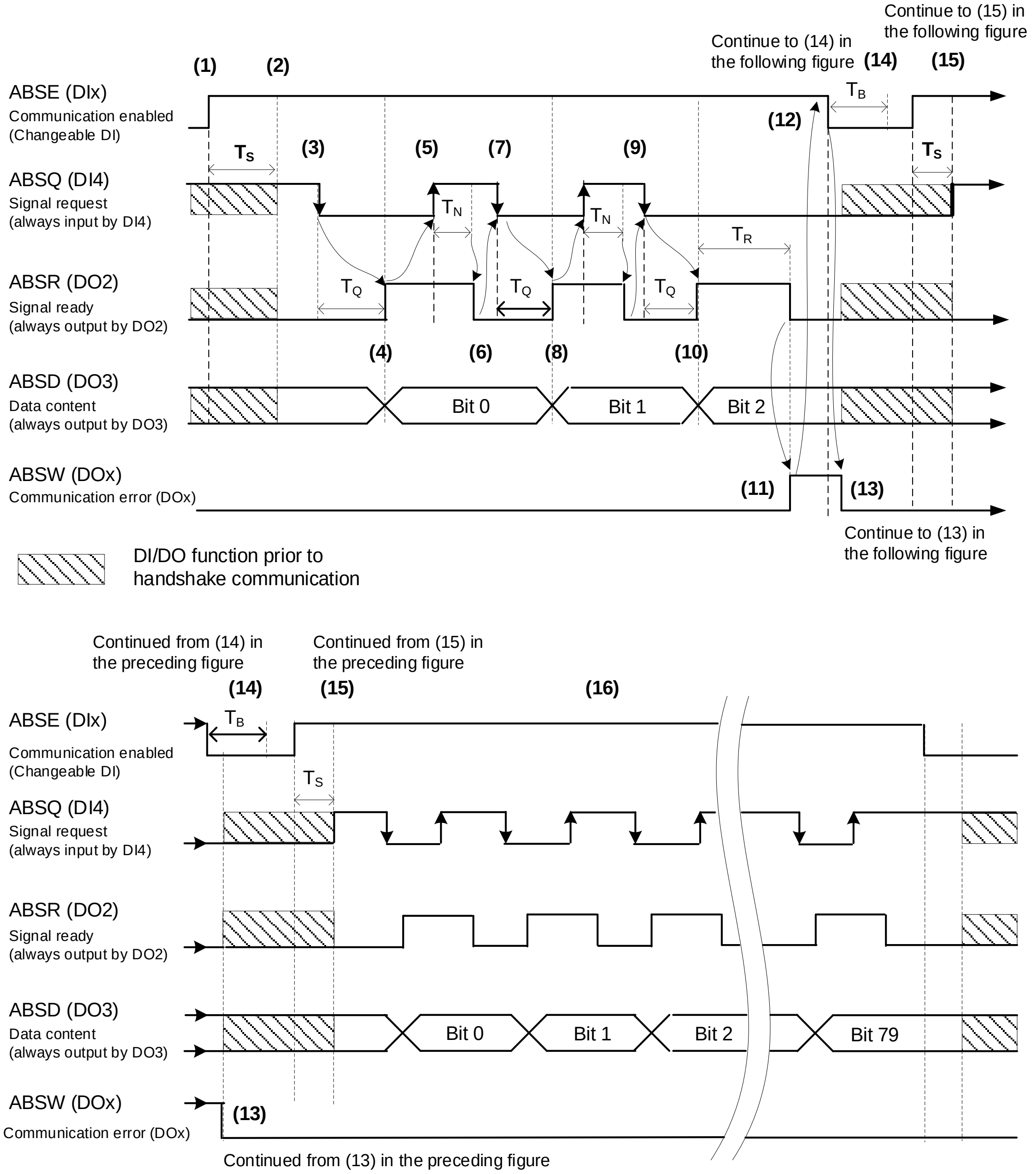


Figure 10.3.5.1.1 Timing diagram for reading the absolute position with DI/DO

The following table describes the delay time 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 not read the data and 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.

10.3.5.2 Reading the absolute position with communication

You can access the data of the absolute encoder with two communication methods: instant access or register access.

Instant access

Instant access refers to reading the motor's feedback position as soon as power is supplied to the servo. Setting P0.017 to 0 means to access the motor's feedback position through P0.009 (Status monitoring register 1).

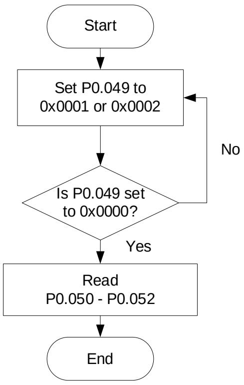
Register access

Register access means the motor's position is temporarily stored in the register and the read value does not change with the motor's movement. Once you set P0.049 through communication, the encoder status and motor absolute position (number of revolutions, pulse number within single turn or PUU) are stored in P0.050, P0.051, and P0.052 respectively. Set to read the value of P0.052 in units of pulse or PUU with P2.070 [Bit 1].

- When P0.049 is set to 0x0001, the drive does not clear the position error when reading the position value.
- When P0.049 is set to 0x0002, the drive clears the position error at the same time when reading the position value.

  After the motor is enabled, it moves slightly forward and backward to correct its position even when it is stopped. To avoid the difference between the actual and read motor positions, set P0.049 to 0x0002 to have the motor's actual position updated to the servo drive, which clears the position error.

  For example, when the read motor position is 20000, the actual position can be between 19999 and 20001. If you send a command to read the motor's position when it stops at 20001, the read value is 20001. Meanwhile, 20001 is updated to the servo drive, meaning the position error is cleared. If the servo drive does not update the read position, a command error occurs.
- After all positions are updated to P0.050 - P0.052, P0.049 is automatically reset to 0x0000. At this point, the controller can access the values of P0.050 - P0.052.
- P0.050 shows the status of the absolute encoder. When P0.050 [Bit 0] = 1 (absolute position lost) or P0.050 [Bit 2] = 1 (absolute number of revolutions overflows), it means the read absolute position is invalid, and you must re-establish the absolute origin position.



10.4 Parameters, DI/DO, and alarms related to absolute function

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

Parameter	Function
P0.002	Drive status
P0.049	Update encoder absolute position
P0.050	Absolute position system status
P0.051	Encoder absolute position - number of revolutions
P0.052	Encoder absolute position - pulse number within single turn or PUU
P2.069	Absolute encoder
P2.070	Read data selection
P2.071	Absolute position homing

Relevant DI/DOs (refer to Table 8.1 and Table 8.2 in Chapter 8 for detailed information):

DI name	Setting value
ABSE	0x1D
ABSC	0x1F
ABSQ (always input by DI4)	When DI.ABSE is on, the DI.ABSQ from DI4 replaces the DI4 function from P2.013

DO name	Setting value
ABSW	0x0D
ABSR (always output by DO2)	When DI.ABSE is on, DO.ABSR triggered by DO2 will replace the DO2 assigned by P2.019
ABSD (always output by DO3)	When DI.ABSE is on, DO.ABSD triggered by DO3 will replace the DO3 assigned by P2.020

Relevant alarms (refer to Chapter 12 for detailed information):

Display	Alarm name
AL060	Absolute position is lost
AL061	Encoder undervoltage
AL062	Number of revolutions of the absolute encoder overflows (issued by encoder)
AL069	Wrong motor type
AL06A	Absolute position is lost
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
AL289	Position counter overflows

EtherCAT Mode

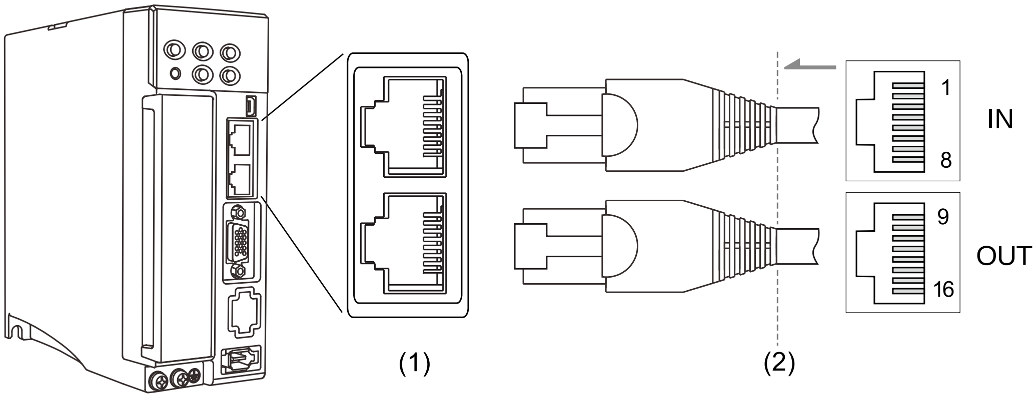
11

This chapter provides details for the required parameter settings when the servo communicates with the controller through the EtherCAT communication function.

11.1 Basic configuration

11.1.1 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 other devices. Incorrect wiring will lead to communication error.

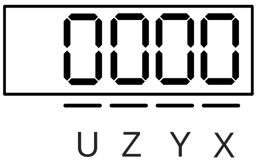


(1) CN6 connector (female); (2) CN6 connector (male)

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

Set P0.002 to 124 for monitoring the EtherCAT network and connection status with 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 power cycling and the initialization of the servo drive is complete, the communication has not yet started, but the controller can access the servo drive's register.
1	Operational	SDO, TxPDO, and RxPDO data packets can be transmitted.
2	Pre-Operational	The controller can exchange data through the mailbox.
3	Safe-Operational	The servo drive can use the SDO and TxPDO data packets to exchange data with the controller.

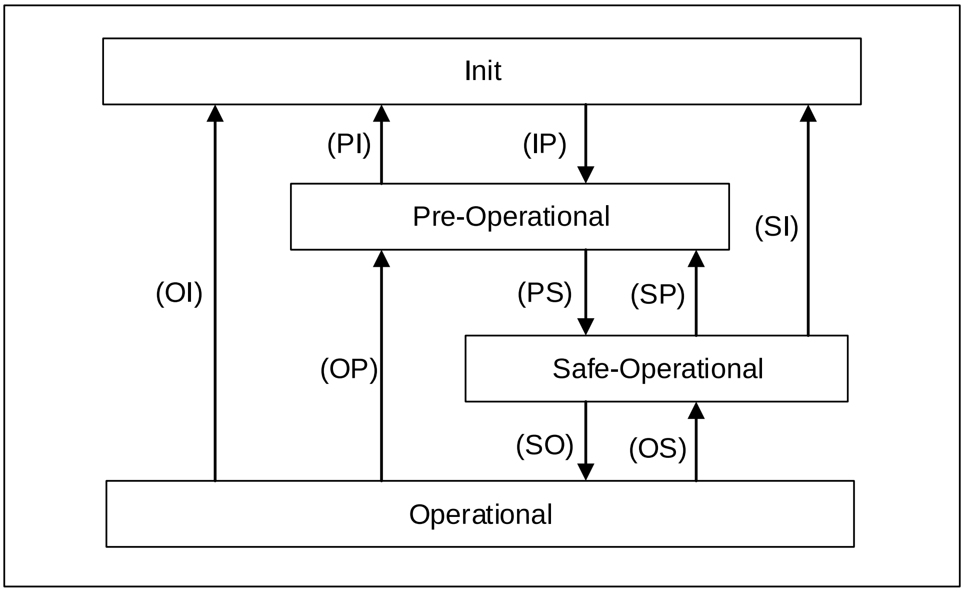
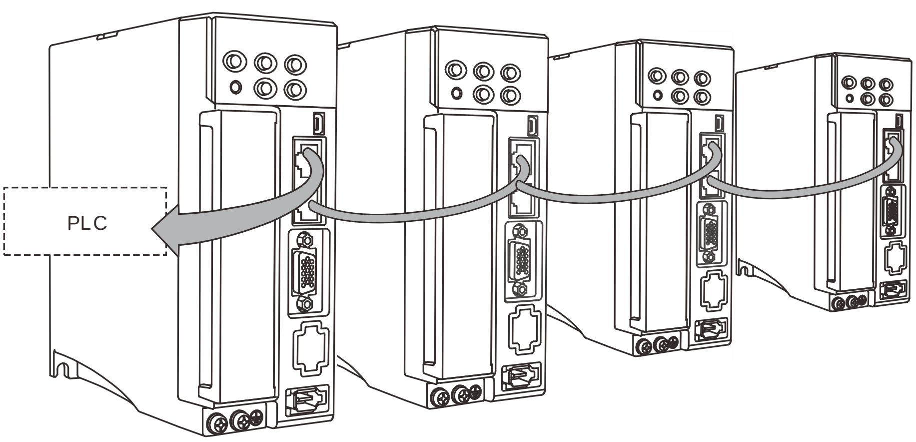


Figure 11.1.1.1 EtherCAT State Machine

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 cable.
3. It is suggested that you use a Beckhoff cable (model number: ZB9020).
4. 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.

11.1.2 ESI file import

EtherCAT is an open motion control bus 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 and E3-E servo drives share the same ESI file. To import ESI files to non-Delta controllers, refer to the manufacturer’s instruction manual.

Download the dedicated ESI file for the A3-E, B3-E and E3-E servo drives from the Download Center of Delta’s website.

The storage paths of ESI files for the non-Delta controllers are as follows:

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.

11.1.3 Parameter settings of EtherCAT mode

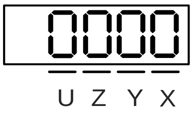
Follow these instructions to connect the EtherCAT controller and the servo drive:

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 parameter. 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

P3.009	**Communication synchronization**		**Address: 0312H 0313H**
Default:	0x5055	Control mode:	EtherCAT
Unit:	-	Setting range:	0x0000 - 0x9AFF
Format:	HEX	Data size:	16-bit

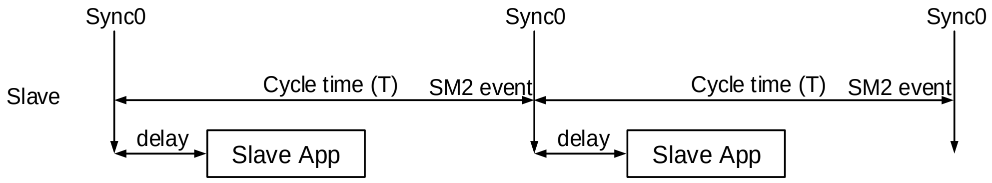
Settings:



The slave synchronizes with the master via SYNC. The definition is as follows:

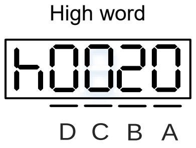
- Z: when the servo is operating in the DC-Synchronous mode, you can adjust the timing of the servo accessing the EtherCAT packets to ensure this timing is not in conflict with the timing of the controller sending the packets.

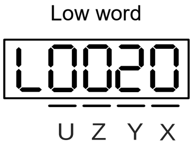
  The delay time shown in the following figure is (T/10) x Z (μs).



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

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

Settings:

When using the PDO to transmit data periodically, use this parameter to set the timeout setting. 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 alarm occurs, it means the allowable duration for packet loss exceeds the set 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 this parameter 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.

P0.002	**Drive status**		**Address: 0004H 0005H**
Default:	1	Control mode:	All
Unit:	-	Setting range:	-300 to +127
Format:	DEC	Data size:	16-bit

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.

Monitoring variables related to EtherCAT communication are as follows.

<table>
<tr><th>Code</th><th>Variable name</th><th>Description</th></tr>
<tr><td>119 (77h)</td><td>EtherCAT State Machine</td><td>1: Init
2: Pre-Operational (Pre-OP)
4: Safe-Operational (Safe-OP)
8: Operational (OP)</td></tr>
<tr><td>120 (78h)</td><td>Communication error rate</td><td>When this value continues to increase, it indicates that there is communication interference. In an interference-free environment, this value should not increase. (Not available on -L models)</td></tr>
<tr><td>124 (7Ch)</td><td>EtherCAT network and connection status</td><td>Panel display:

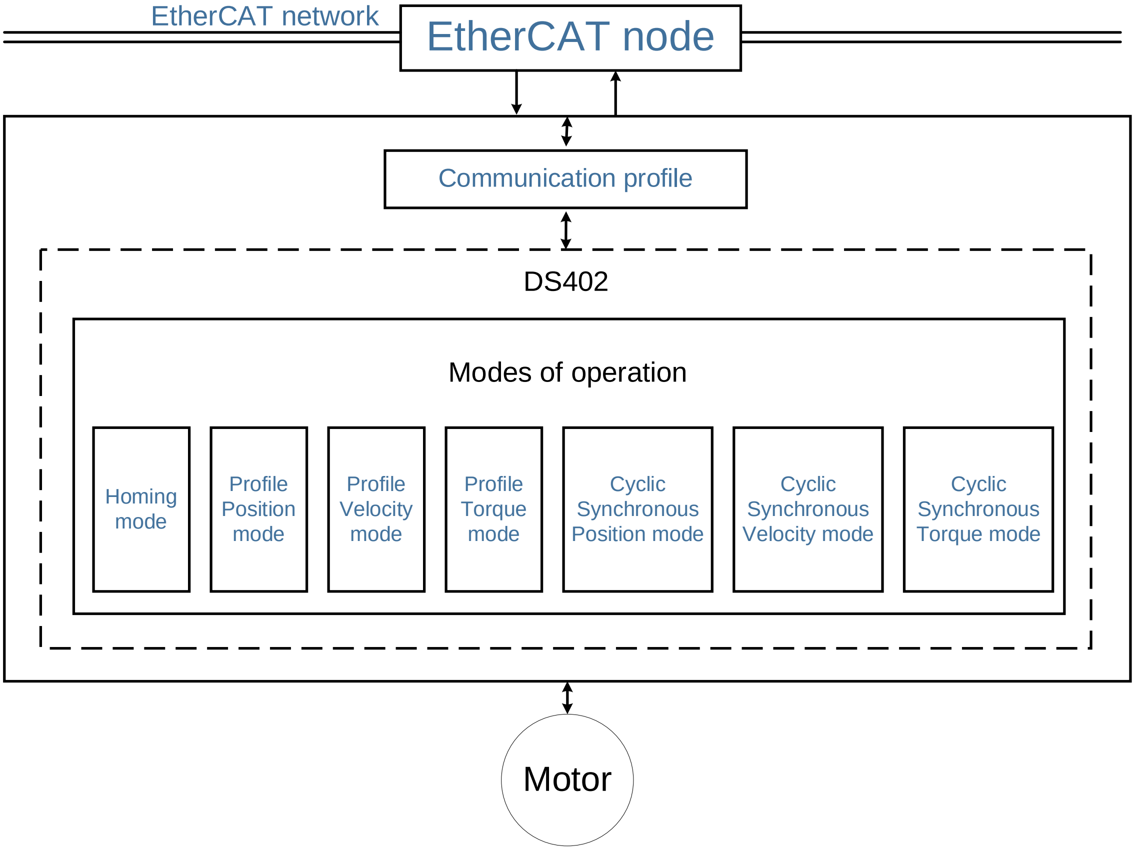

<table>
<tr><td>X</td><td>network status for OUT port</td><td>Z</td><td>EtherCAT error status</td></tr>
<tr><td>Y</td><td>network status for IN port</td><td>U</td><td>EtherCAT connection status</td></tr>
</table>
■ X: network status for OUT port
0: connection is not established
1: connection is established
■ 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)</td></tr>
</table>

11.2 Communication function

11.2.1 Specifications

EtherCAT communication functions	Physical layer	100BASE-TX
	Communication connector	RJ45 × 2
	Network topology	Line 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 EMCY: Emergency object
	LED indicator	No LED indicators. Refer to Section 11.1.1 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 Emergency object) 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 index settings for execution.

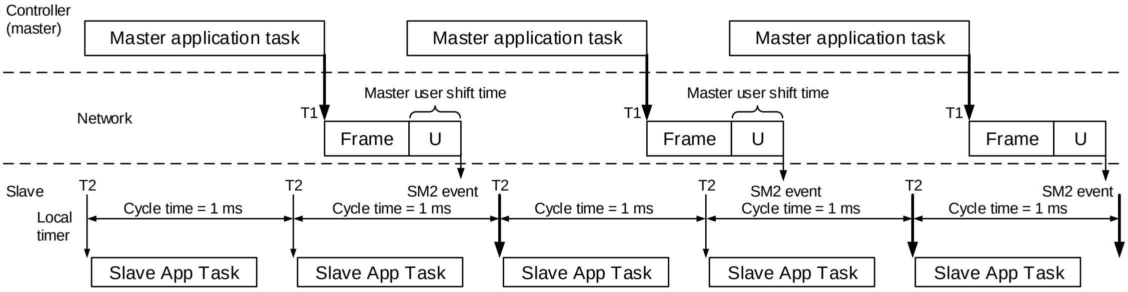
11.2.2 Synchronization mode

11.2.2.1 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).

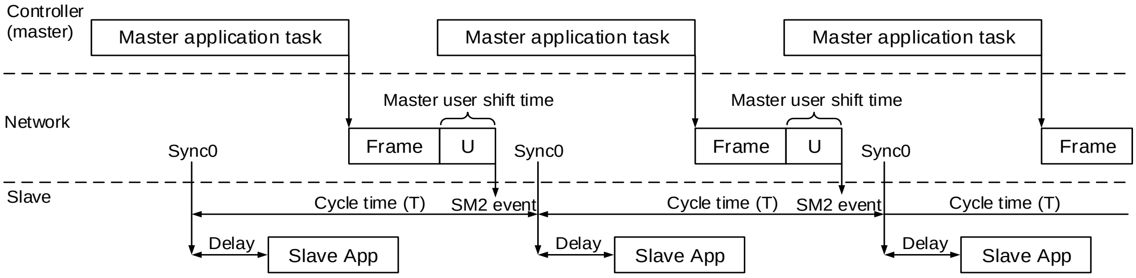
Free Run mode (Asynchronous)

Actually, the master and slave stations run asynchronously in the Free Run mode. The clock of the slave runs independently of the clock of the master. In other words, the clocks are not synchronized. The command and feedback transmissions between the master and slave 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 receives the PDO at the time T2 after the SM2 event.



DC-Synchronous mode (SYNC0 synchronization)

There is precise time synchronization between the master and slave stations in the DC-Synchronous mode. The master periodically executes the control program and sends PDO packets to transmit the command to the slave at a fixed time according to the distributed clocks (DC), and then receives the feedback from the slave. The slave receives and updates the PDO data at a fixed time according to the distributed clocks.



Note: Delay = P3.009.Z * (T/10) (μs)

11.2.2.2 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. Under the **DC** tab in the right column, select **DC-Synchronous** or **Free Run** as the Operation Mode.

11.2.2.3 Distributed clocks setting

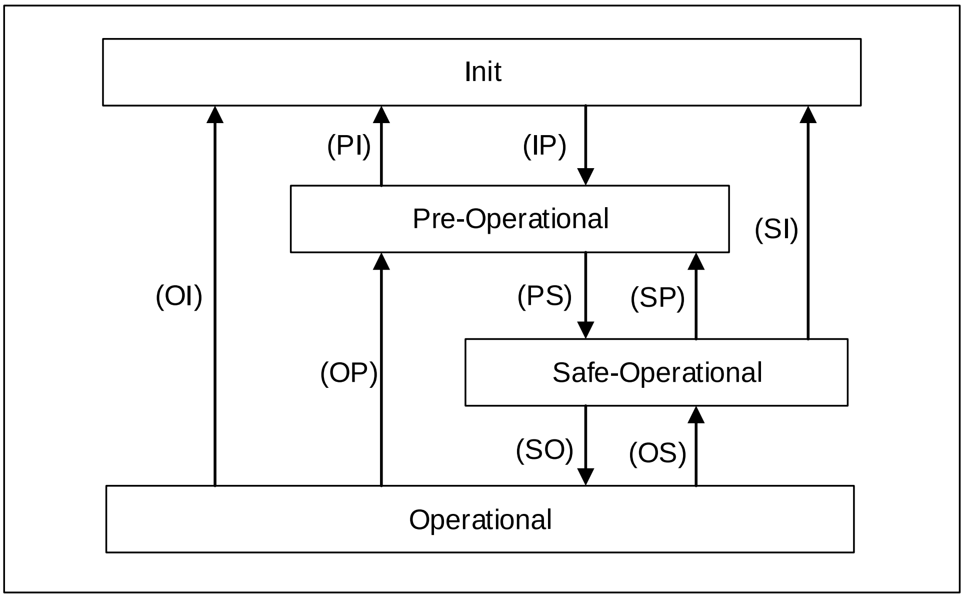
Follow these steps to set the data exchange cycle.

1. Select **NC-Task 1 SAF** in the left column.
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 and E3-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).

11.2.3 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 (slave) 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 initialization after being powered on without errors occurring. 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.

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.

11.2.4 PDO mapping configuration

The PDO mapping objects are allocated from OD 1600h to OD 1603h for RxPDOs and OD 1A00h to OD 1A03h for TxPDOs in the object dictionary. Each group of RxPDO and TxPDO supports updating the PDO data for up to 8 sets of 32-bit objects.

11.2.4.1 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 XML file of the EtherCAT slave. You can modify the PDO mapping configuration according to the requirements. The fourth group of RxPDO and TxPDO is the suggested configuration for Omron controllers.

In Delta ASDA-x3-E rev0.04.xml, the first to fourth groups of PDO configuration are shown as follows:

First group of RxPDO mapping

RxPDO (OD 1600h)	Controlword (OD 6040h)	Target position (OD 607Ah)	Target velocity (OD 60FFh)	Touch probe function (OD 60B8h)

First group of TxPDO mapping

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 RxPDO 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)			

Second group of TxPDO mapping (default)

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 RxPDO 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)		

Third group of TxPDO mapping

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 RxPDO 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)

Fourth group of TxPDO mapping (for Omron controllers)

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)

11.2.4.2 Set PDO mapping

Take the second group of 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).

11.2.4.3 PDO mapping object

Real-time data transmission can be achieved with the 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

11.2.4.4 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 (storage or restore in the wrong state).
08000022h	Object is in use.

11.3 EtherCAT operation modes

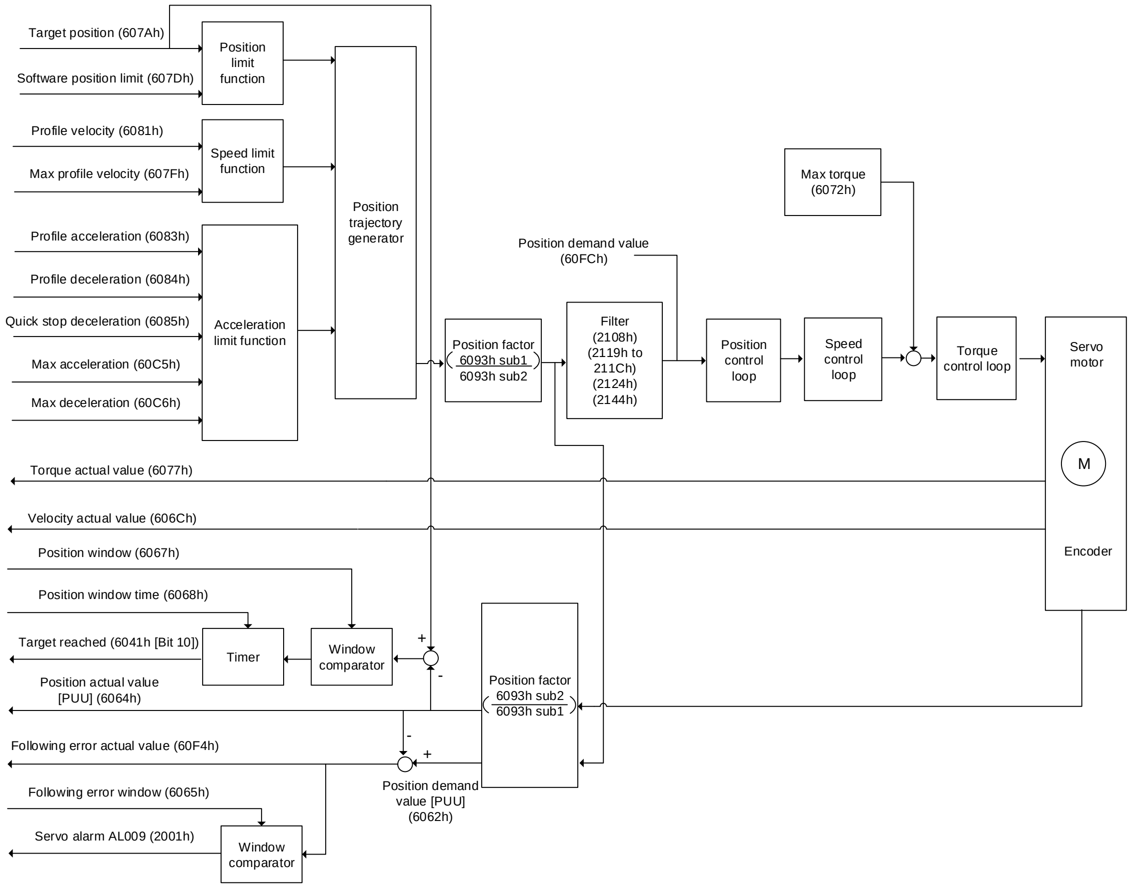
This section describes the modes of operation specified by CiA DS402 when the servo is in the EtherCAT mode. The content includes basic operation settings and related object descriptions.

11.3.1 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 11.4.3.3.

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 completing 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:

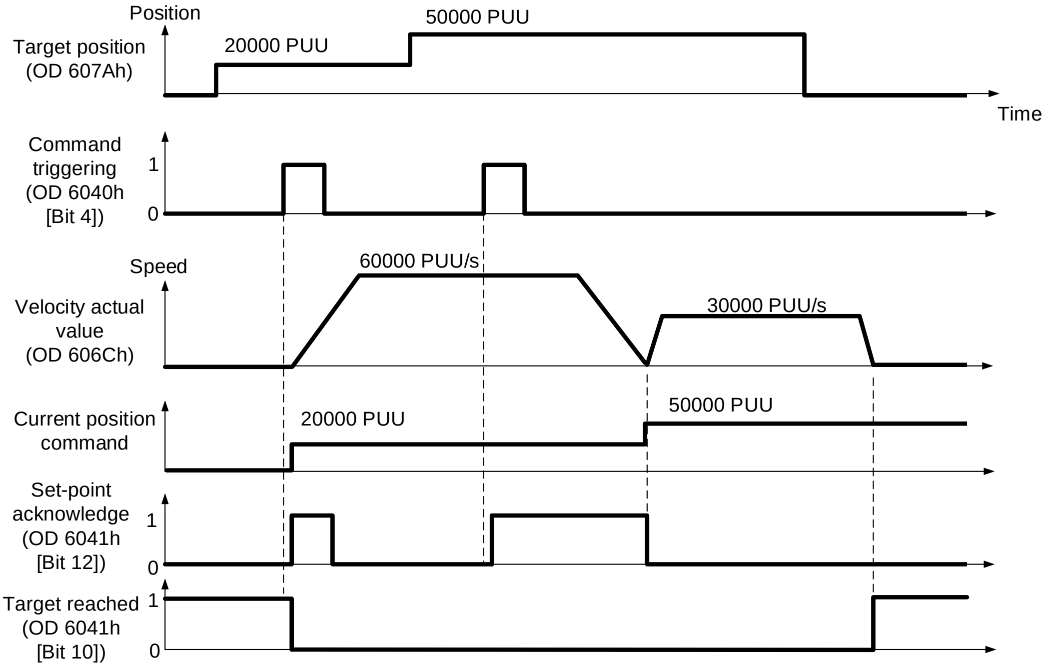
1. Read OD 6064h to obtain the actual value of the motor position at present.
2. Read OD 6041h to obtain the servo drive status, including the following error and notifications for set-point acknowledge and target reached.

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].

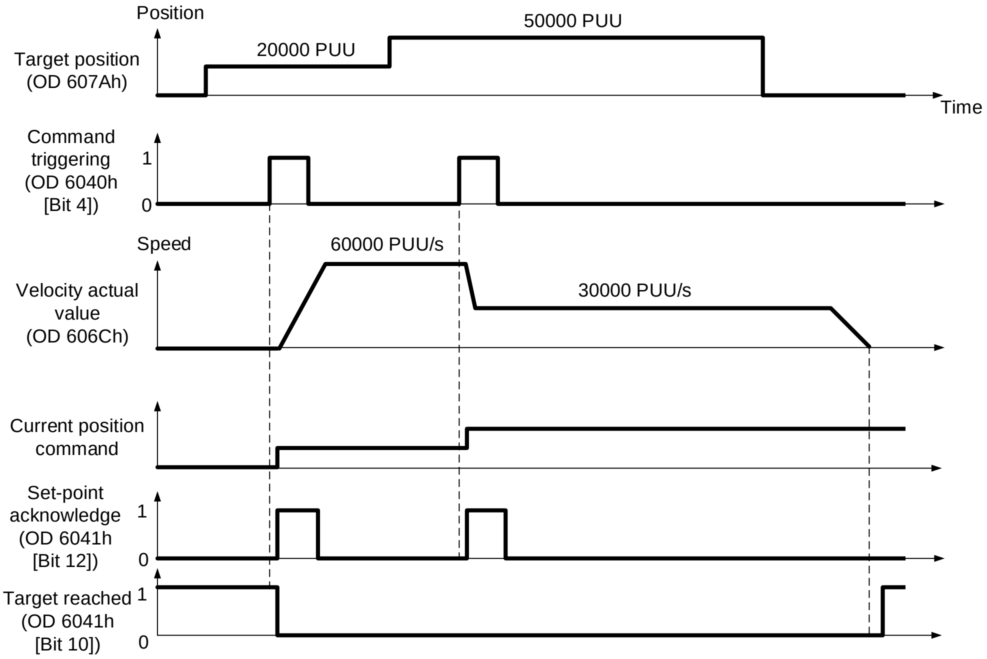
- OD 6040h [Bit 5] = 0: the command does not take immediate effect

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.



- OD 6040h [Bit 5] = 1: the command takes immediate effect (only valid in Profile Position mode).

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

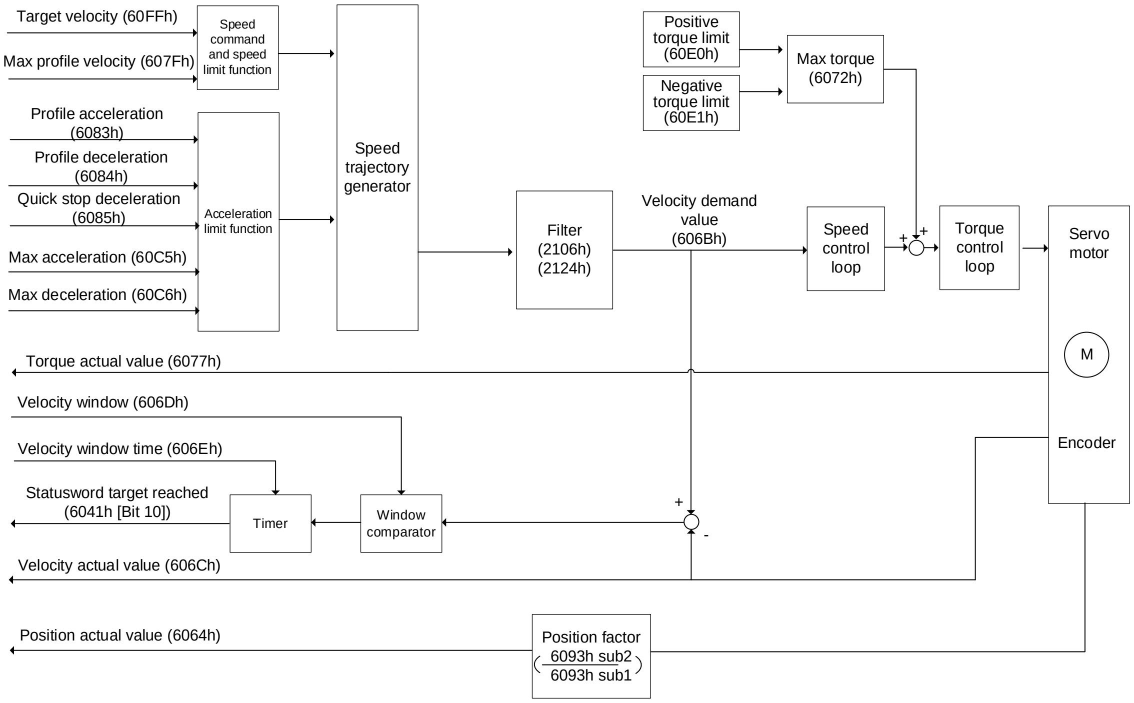
Index	Name	Data type	Access
6040h	Controlword	UNSIGNED16	RW
6041h	Statusword	UNSIGNED16	RO
6060h	Modes of operation	INTEGER8	RW
6061h	Modes of operation display	INTEGER8	RO
6062h	Position demand value [PUU]	INTEGER32	RO
6063h	Position actual internal value [Pulse]	INTEGER32	RO
6064h	Position actual value [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

Index	Name	Data type	Access
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 11.4.3 Details of objects.

11.3.2 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 is to ensure that the motor maintains 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 11.4.3.3.

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.

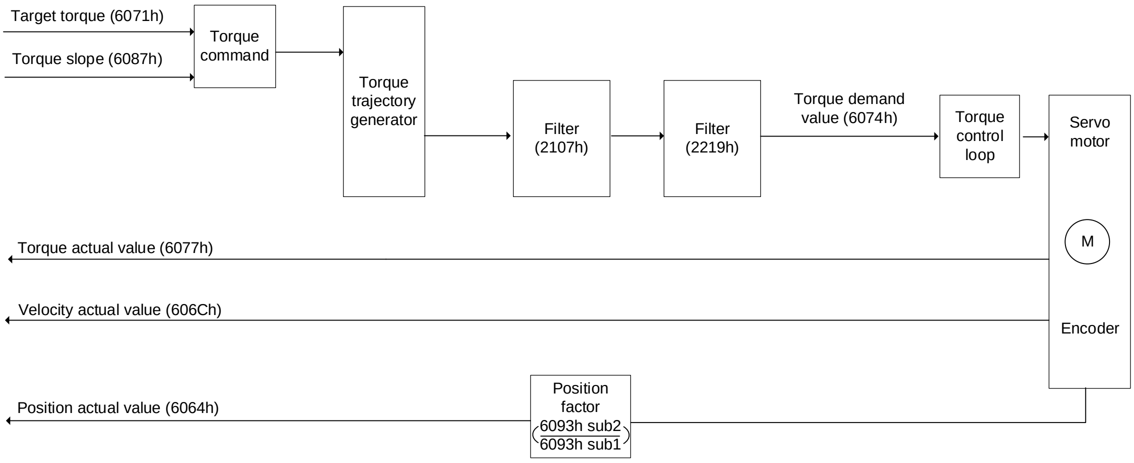
Relevant object list

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 11.4.3 Details of objects.

11.3.3 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 11.4.3.3.

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.

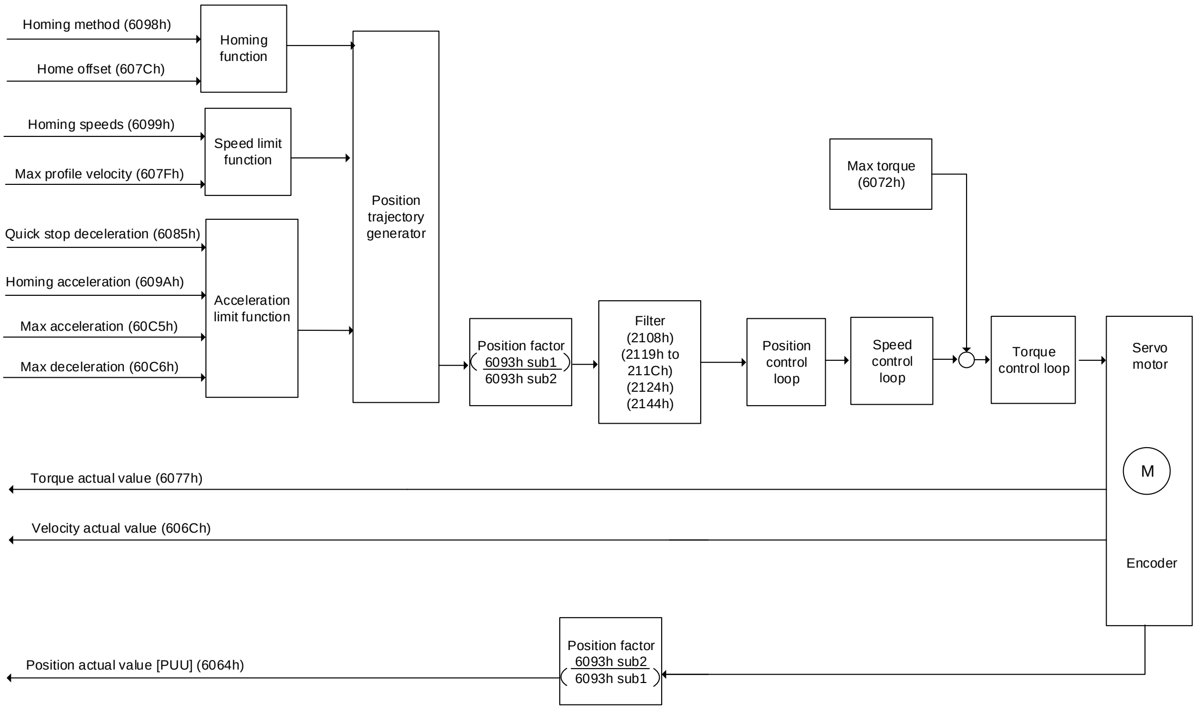
Relevant object list

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 11.4.3 Details of objects.

11.3.4 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 39 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 when searching for the home switch.
5. Set OD 6099h sub2 for the speed when searching 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 11.4.3.3.

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.

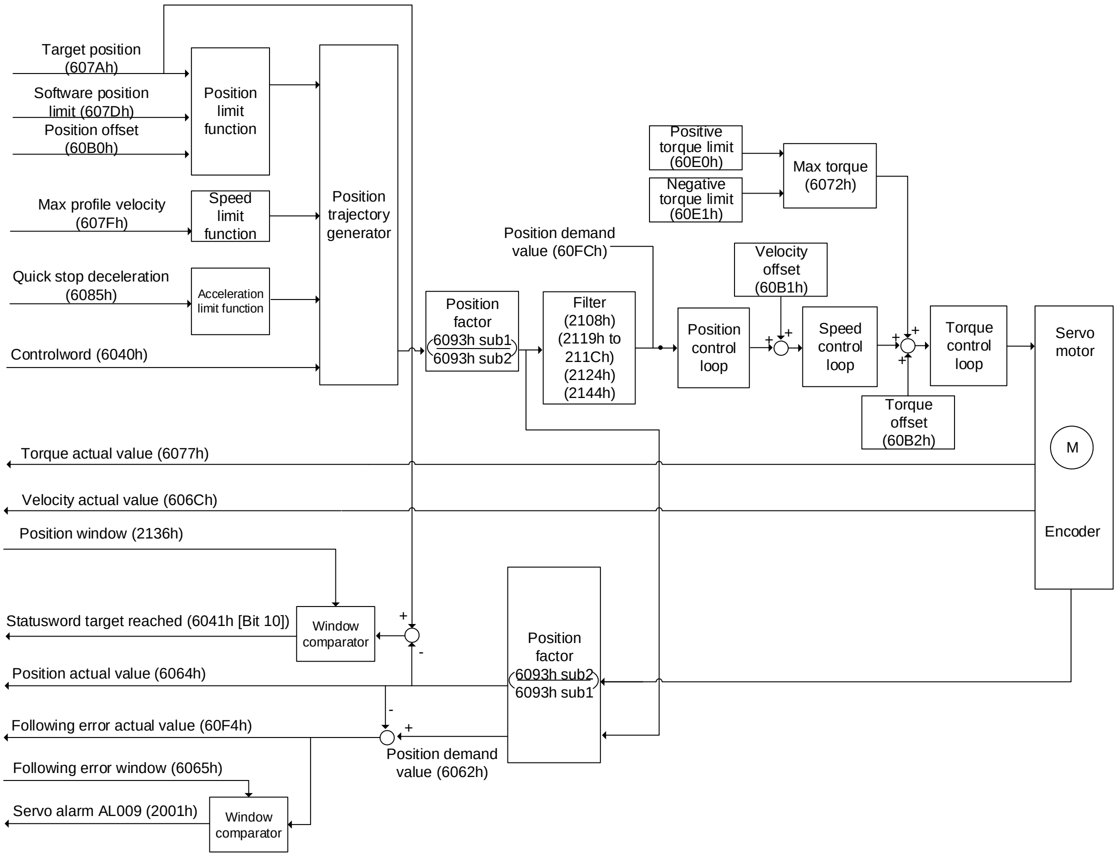
Relevant object list

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 11.4.3 Details of objects.

11.3.5 Cyclic Synchronous Position mode

The controller plans the path and transmits PDOs to the servo drive periodically in Cyclic Synchronous Position (CSP) mode. In this mode, when the controller transmits each PDO, it simultaneously transmits the target position and Controlword data to the servo drive. 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 11.4.3.3.

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).

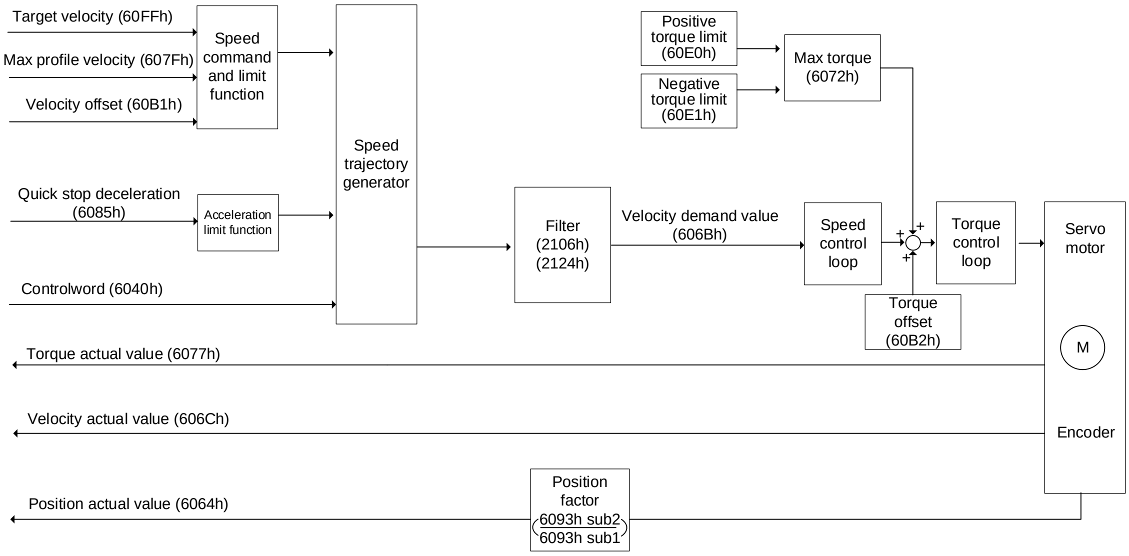
Relevant object list

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 11.4.3 Details of objects.

11.3.6 Cyclic Synchronous Velocity mode

The controller plans the speed and transmits PDOs to the servo drive periodically in Cyclic Synchronous Velocity (CSV) mode. In this mode, when the controller transmits each PDO, it simultaneously transmits the target velocity and Controlword data to the servo drive. 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 is to ensure that the motor maintains 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 11.4.3.3.

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.

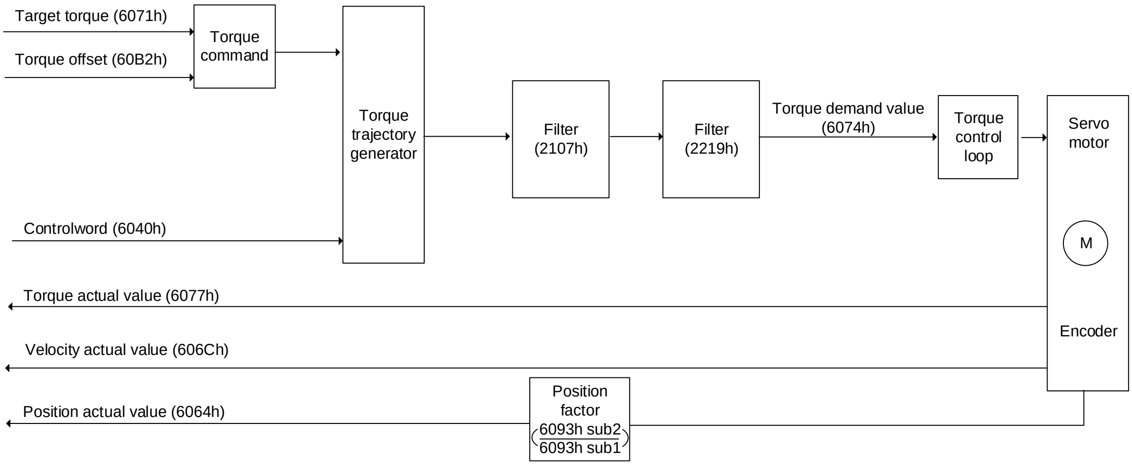
Relevant object list

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 11.4.3 Details of objects.

11.3.7 Cyclic Synchronous Torque mode

The controller plans the torque transmits PDOs to the servo drive periodically in Cyclic Synchronous Torque (CST) mode. In this mode, when the controller transmits each PDO, it simultaneously transmits the target torque and Controlword data to the servo drive. 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 setting of servo target torque is effective 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 11.4.3.3.

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 11.4.3 Details of objects.

11.3.8 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 both rising-edge and falling-edge triggered, 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 both rising-edge and falling-edge triggered, 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.

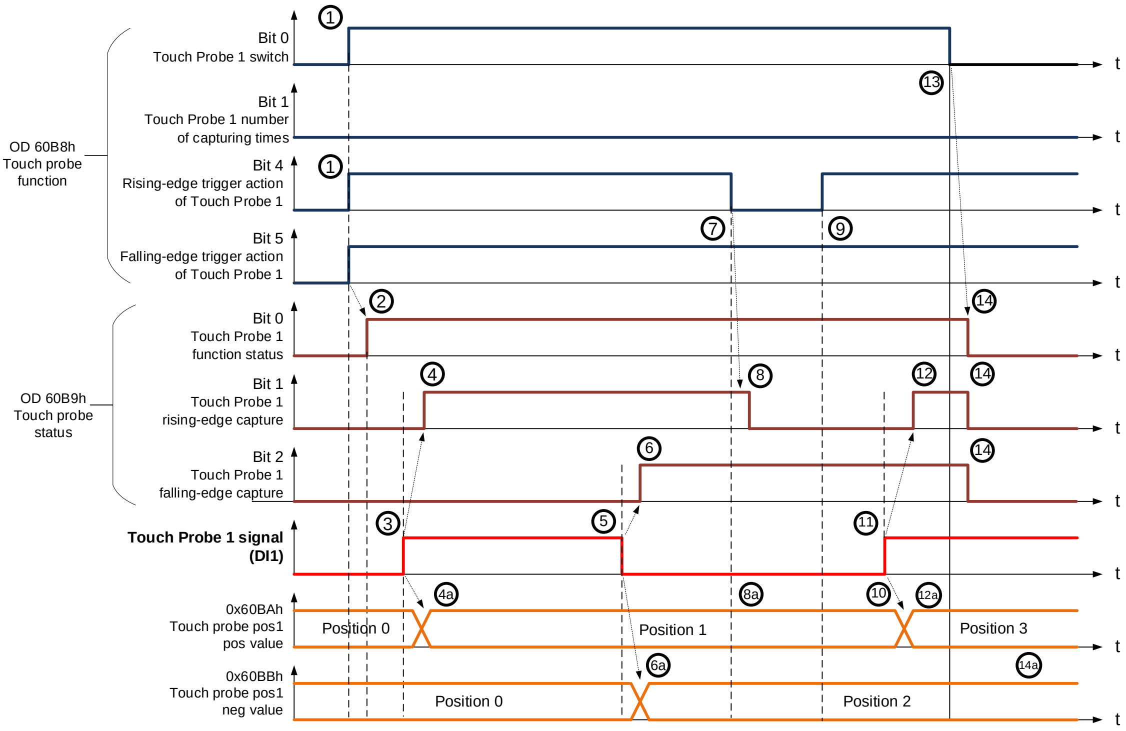
Bit	Function	Description
Bit 13	Falling-edge trigger action of Touch Probe 2	0: N/A 1: start capturing when the Touch Probe 2 signal is falling-edge triggered and store the data in OD 60BDh.
Bit 14 - Bit 15	Reserved	-

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.

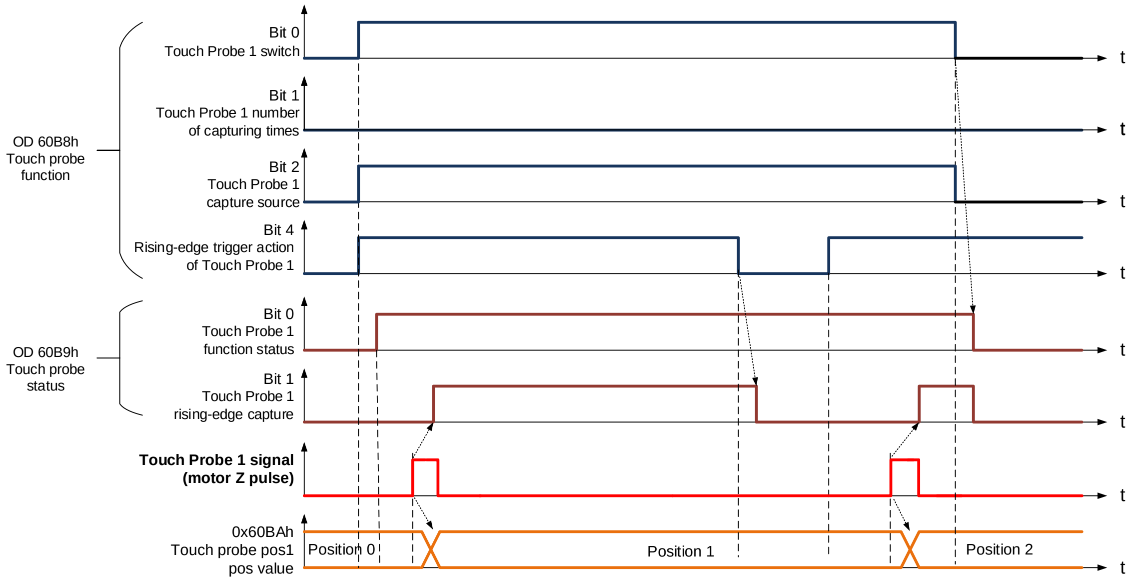
Example 1: the following is the timing diagram for the Touch Probe 1 function. In this example, the Touch Probe 1 function is triggered by the external DI. When OD 60B8h [Bit 1] is set to 0 and OD 60B8h [Bit 4] & [Bit 5] are set to 1, the Touch Probe 1 signal is triggered on both rising and falling edges, and the data is captured once for each triggering.



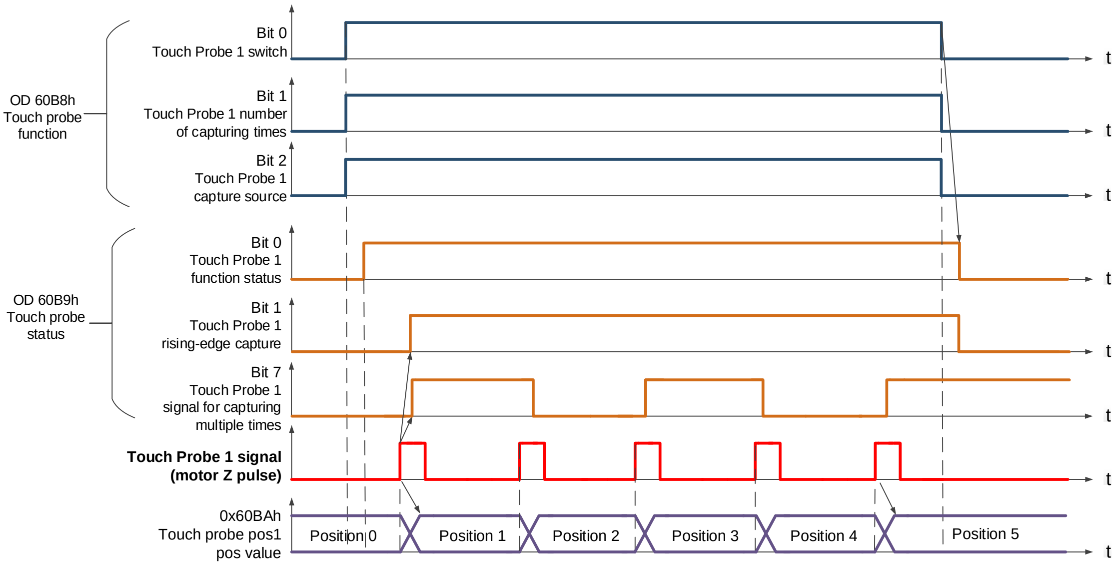
Status	Function	Description
(1)	OD 60B8h [Bit 0] = 1	Enable Touch Probe 1.
	OD 60B8h [Bit 1] = 0	Capture one time.
	OD 60B8h [Bit 4] = 1	Start capturing when the Touch Probe 1 signal is rising-edge triggered.
	OD 60B8h [Bit 5] = 1	Start capturing when the Touch Probe 1 signal is falling-edge triggered.
(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	Store the captured data in OD 60BAh when the Touch Probe 1 signal is rising-edge triggered.
(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	Store the captured data in OD 60BBh when the Touch Probe 1 signal is falling-edge triggered.
(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.

Status	Function	Description
(10)	OD 60BAh	Data at the rising-edge remains the same.
(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	Store the captured data in OD 60BAh when the Touch Probe 1 signal is rising-edge triggered.
(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 11.4.3 Details of objects.

11.4 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).

11.4.1 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 0 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 0 data type is UNSIGNED8, so it is not a RECORD data.

Data type

Refer to CANopen DS301.

11.4.2 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

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

11.4.3 Details of objects

11.4.3.1 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
0402	A2
0602	M
0702	A3
0B02	B3
1002	E3

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

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	0
Description	Number of errors
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	0 - 5
Default	0

Sub-index	1 - 5
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 12 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	0
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	1 - 8
Description	Specify the 1st to 8th objects and the contents 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

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 sub0	3			Set 3 PDO mappings.
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
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	0
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	1 - 8
Description	Specify the 1st to 8th objects and the contents 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

Object 1C12h: RxPDO assign

Index	1C12h
Name	RxPDO assign
Object code	ARRAY
Data type	UNSIGNED16
Access	RW
PDO mapping	No

Sub-index	0
Description	Number of sub-index
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	0 - 1
Default	1

Sub-index	0
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	0
Description	Number of sub-index
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	0 - 1
Default	1

Sub-index	0
Description	Specify the TxPDO index to be used
Data type	UNSIGNED16
Access	RW
PDO mapping	No
Setting range	0x1A00, 0x1A01, 0x1A02, 0x1A03
Default	0x1A01

11.4.3.2 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	7F

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

11.4.3.3 OD 6XXXh communication object group

Object 603Fh: Error code (CANopen defined)

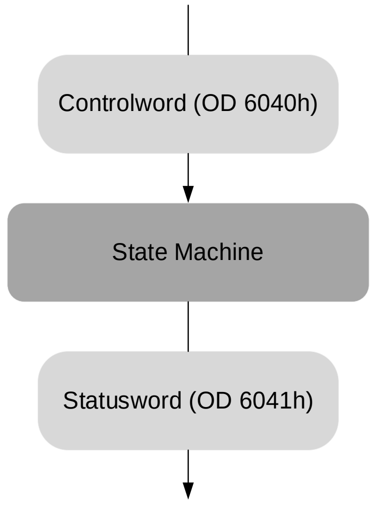
Index	603Fh
Name	Error code
Object code	VAR
Data type	UNSIGNED16
Access	RO
PDO mapping	Yes
Setting range	UNSIGNED16
Default	0

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.

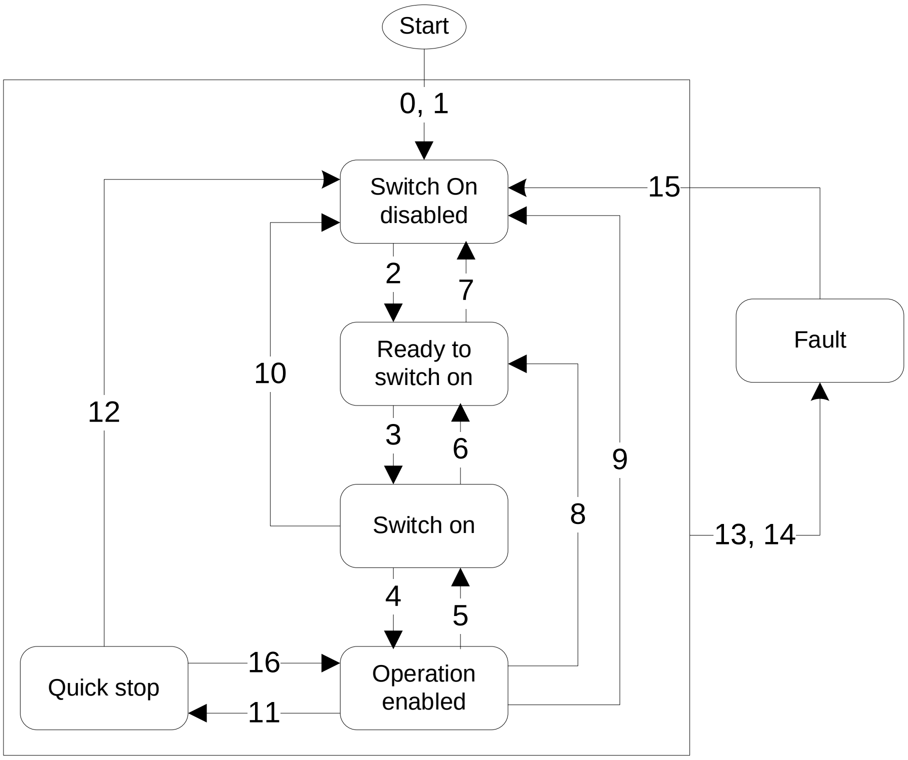
Bit	Function	Description
Bit 4 - Bit 6	Defined in each operation mode	These bits are individually defined according to the operation mode, as shown in the following table.
Bit 7	Fault reset	-
Bit 8	Halt	-
Bit 9 - Bit 15	Reserved	-

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	Homing	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	-	-	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.

Bit 12 - Bit 13 are individually defined according to the operation mode, as shown in the following table:

Bit	Definition in each operation mode						
	PP	PV	PT	Homing	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.

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) The ASDA-A2 servo drive generates 1,280,000 pulses per motor revolution. The ASDA-A3 / ASDA-B3 / ASDA-E3 servo drive generates 16,777,216 pulses per motor revolution.

Object 6064h: Position actual value (PUU)

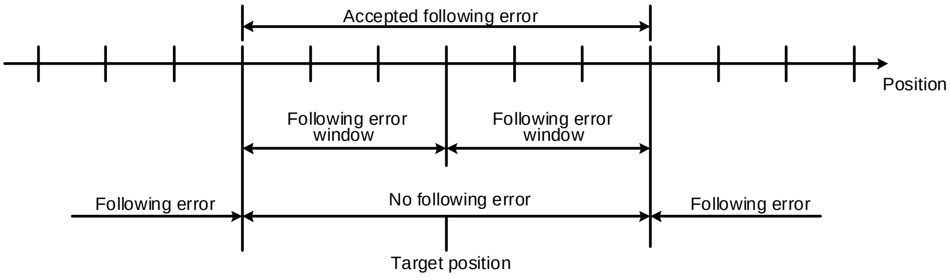
Index	6064h
Name	Position actual value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	PUU

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 this setting range, AL009 (Excessive deviation of Position command) is triggered.



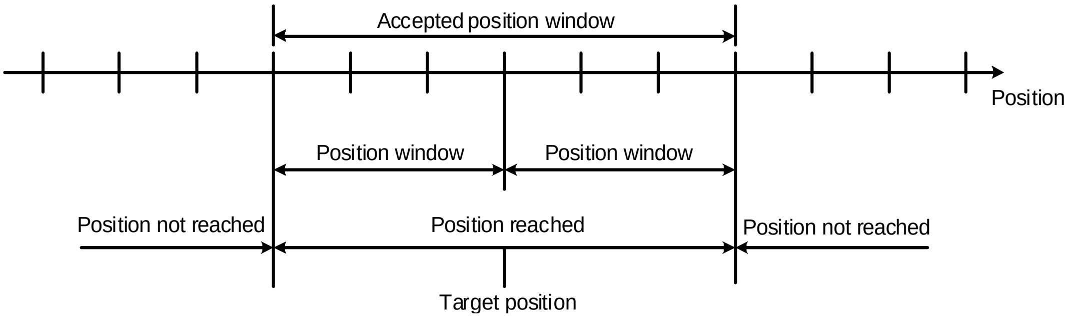
Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.

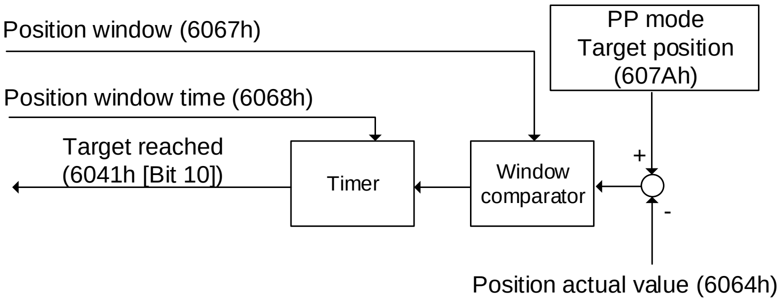
Object 6067h: Position window

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.



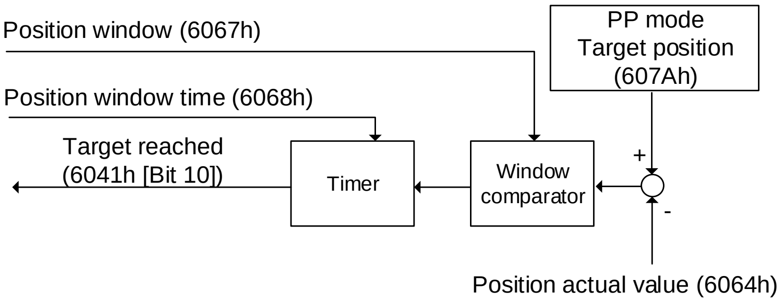


Object 6068h: Position window time

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 only works in Profile Velocity mode and Cyclic Synchronous Velocity mode.

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.

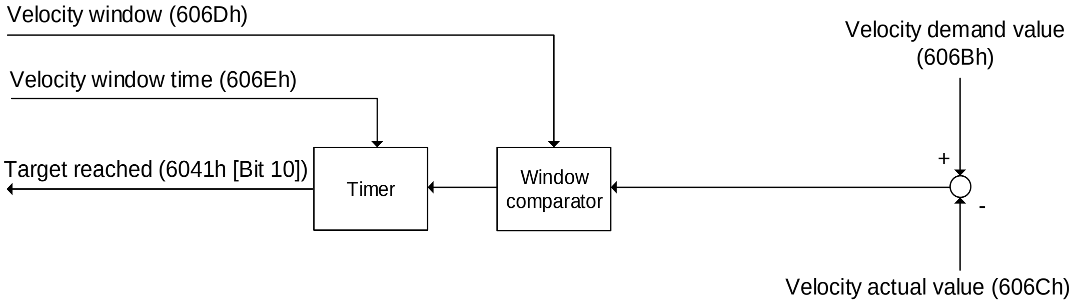
Object 606Dh: Velocity window

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 only works in Profile Velocity mode.

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 only works in Profile Torque mode and Cyclic Synchronous Torque mode.

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 only works in Profile Position mode and Cyclic Synchronous Position mode. For more details, refer to Sections 11.3.1 and 11.3.5.

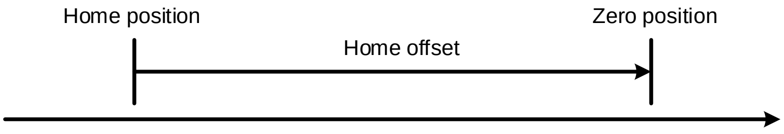
Object 607Ch: Home offset

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.



Object 607Dh: Software position limit

Index	607Dh
Name	Software position limit
Object code	ARRAY
Data type	INTEGER32
Access	RW

Sub-index	0
Description	Number of entries
Data type	UNSIGNED8
Access	RO
PDO mapping	Yes
Setting range	2
Default	2

Sub-index	1
Description	Min position limit
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	-2147483648 to +2147483647
Default	-2147483648
Unit	PUU

Sub-index	2
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 setting value of OD 607Fh (unit: 0.1 rpm) multiplied by 10 is equivalent to the setting value of P1.055 (Maximum speed limit; unit: 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 only works in Profile Position mode. For more details, refer to Section 11.3.1.

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 only works in Profile Position mode and Profile Velocity mode.

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 only works in Profile Position mode and Profile Velocity mode.

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 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	0
Description	Number of sub-index
Data type	UNSIGNED8
Access	RO
PDO mapping	No
Setting range	2
Default	2

Sub-index	1
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 6.2.5.

Sub-index	2
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 6.2.5.

Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.

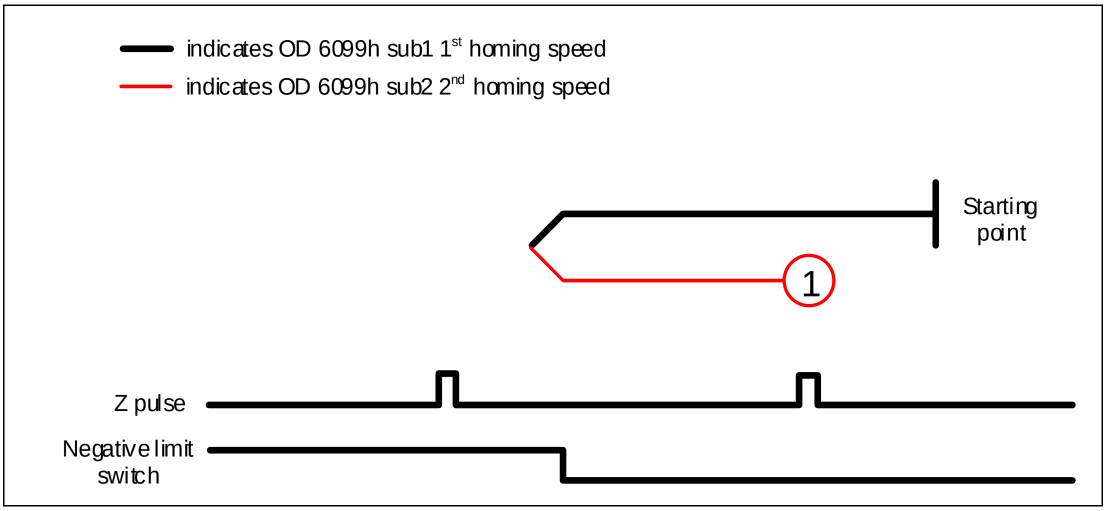
Object 6098h: Homing method

Index	6098h
Name	Homing method
Object code	VAR
Data type	INTEGER8
Access	RW
PDO mapping	Yes
Setting range	-4 to 35
Default	0

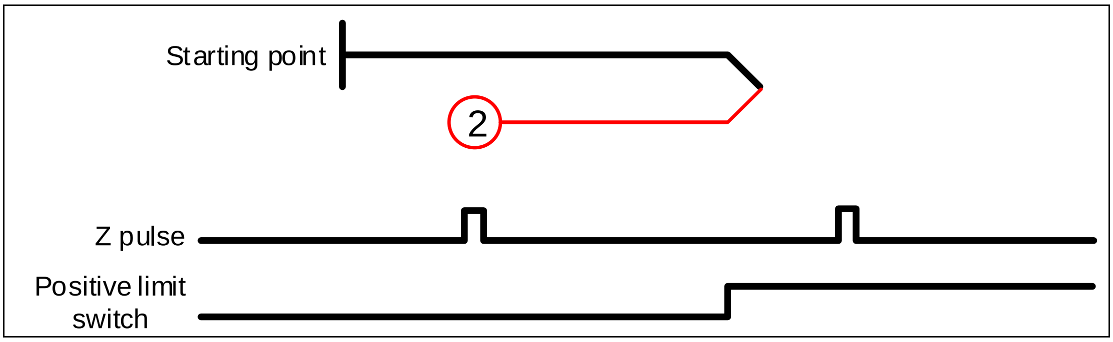
Object function:

The homing methods include looking for the Z pulse (Methods 1 - 14, 33, 34, 36, 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.

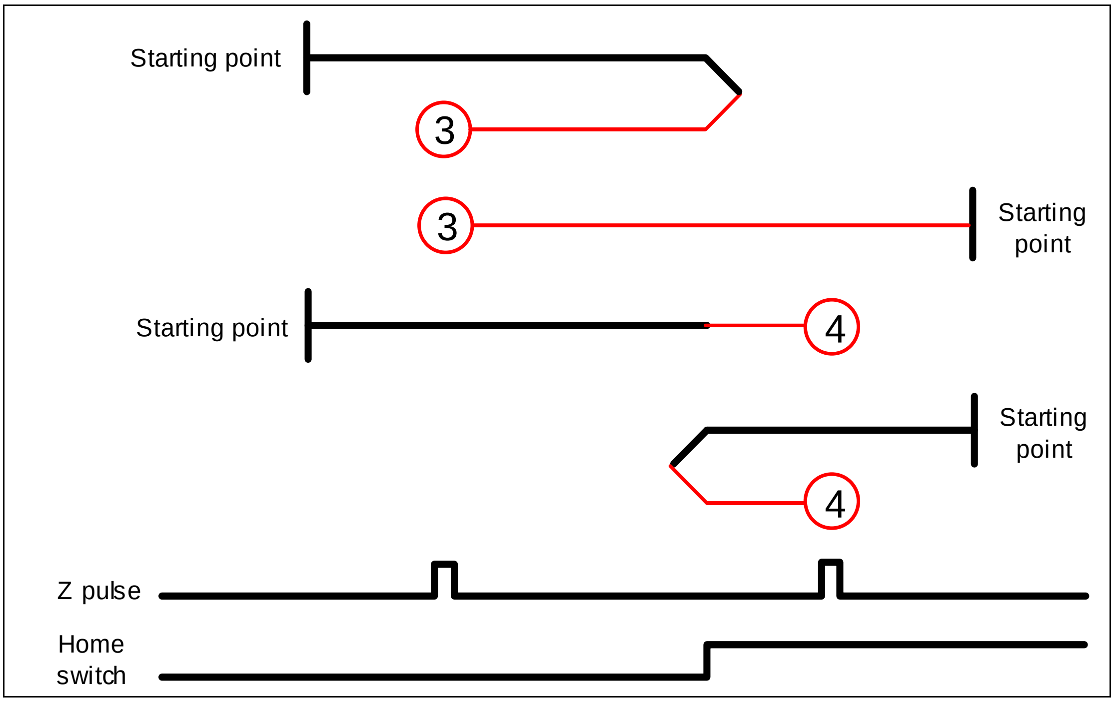
Method 1: homing on the negative limit switch and Z pulse



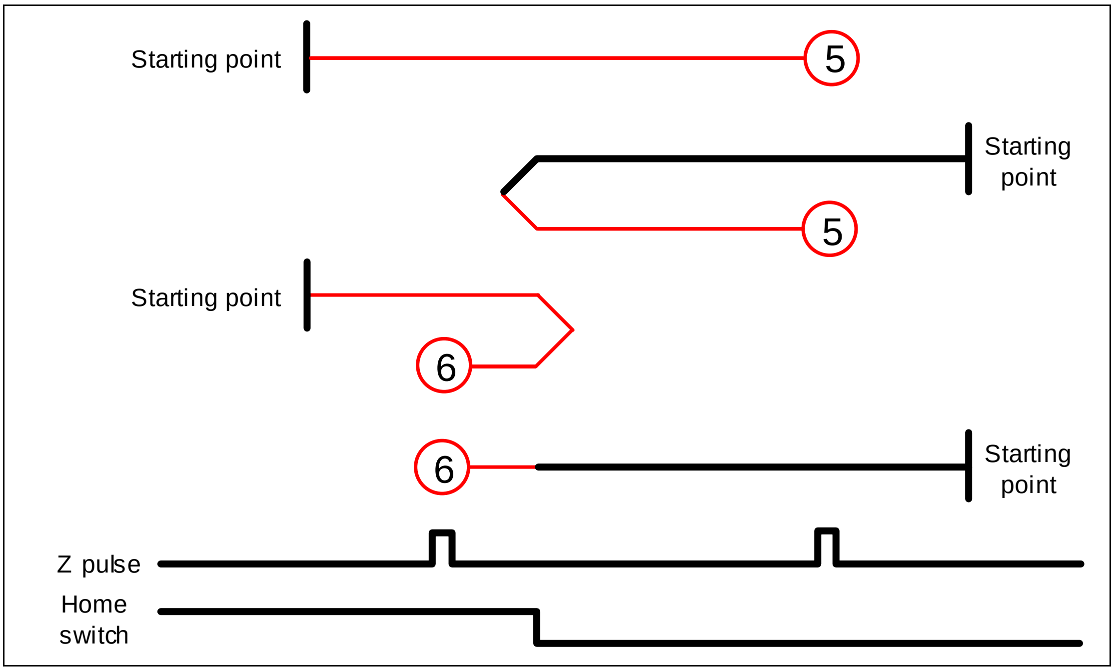
Method 2: homing on the positive limit switch and Z pulse



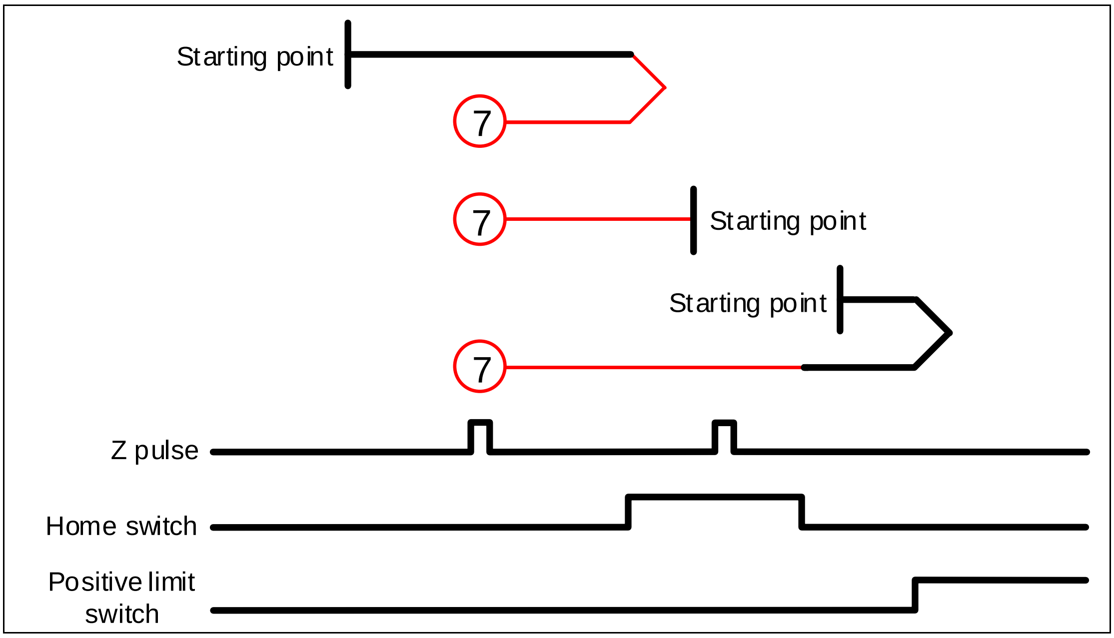
Methods 3 and 4: homing on the home switch and Z pulse



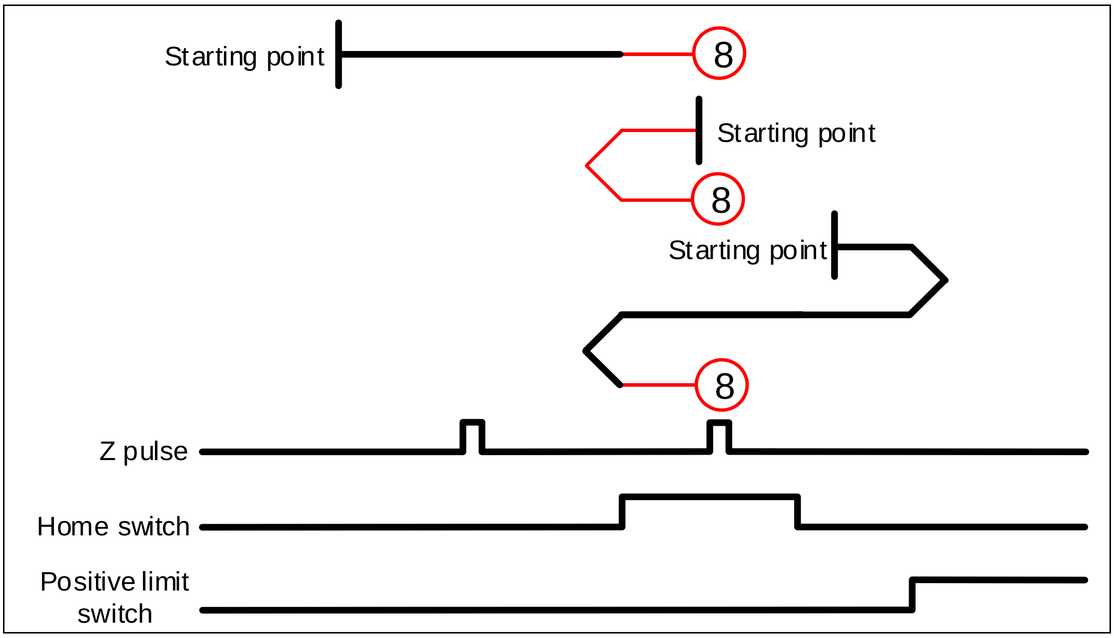
Methods 5 and 6: homing on the home switch and Z pulse



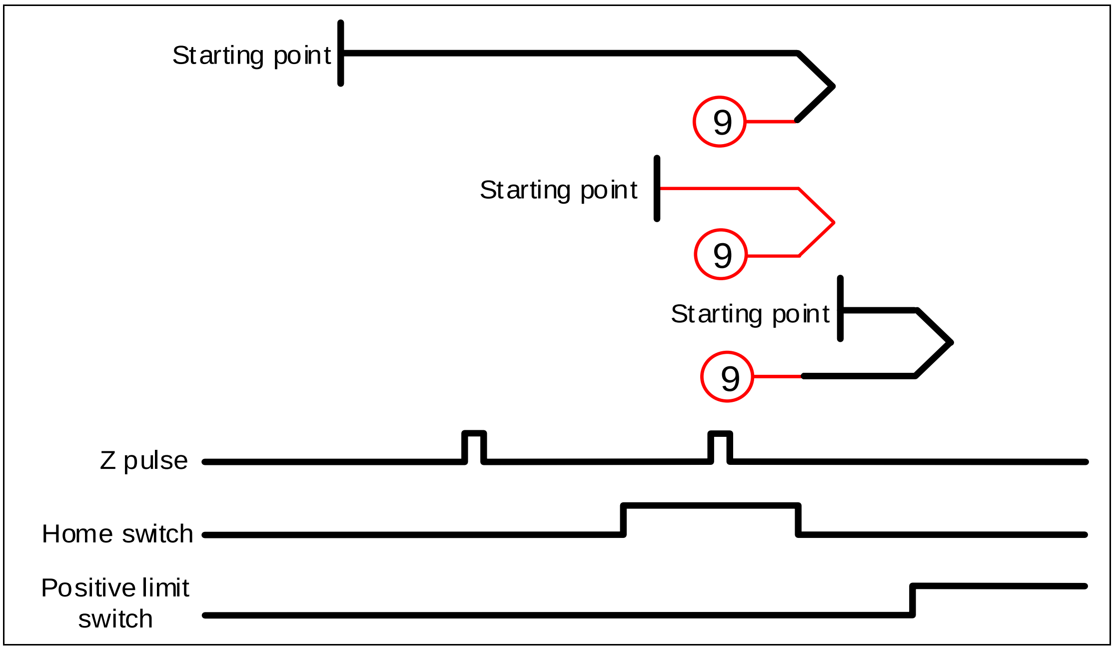
Method 7: homing on the positive limit switch, home switch, and Z pulse



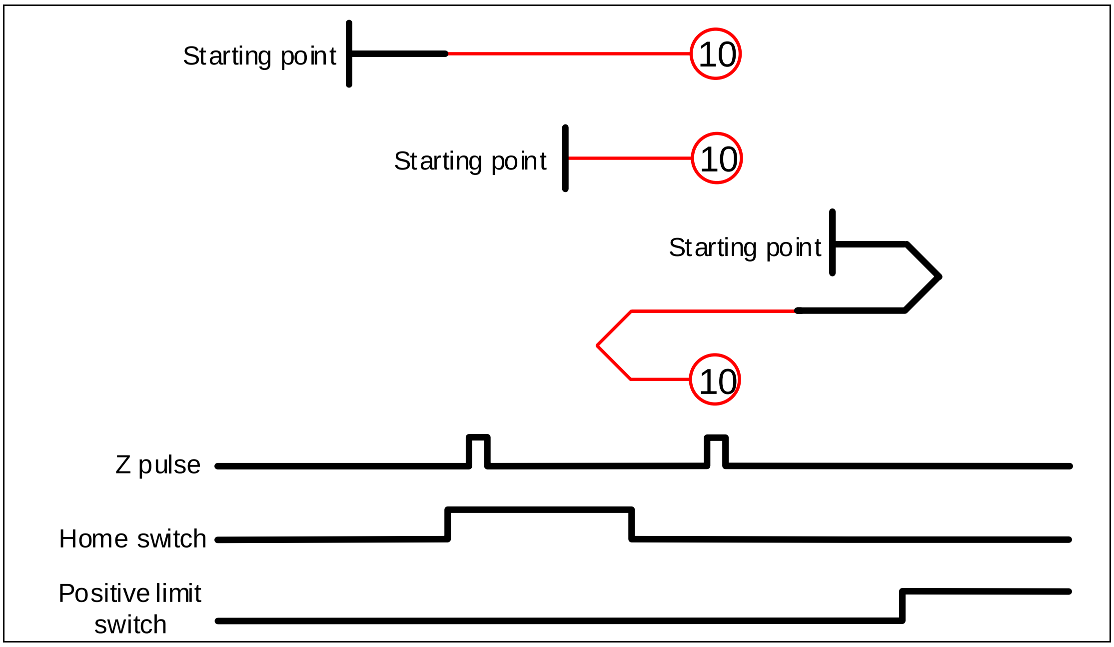
Method 8: homing on the positive limit switch, home switch, and Z pulse



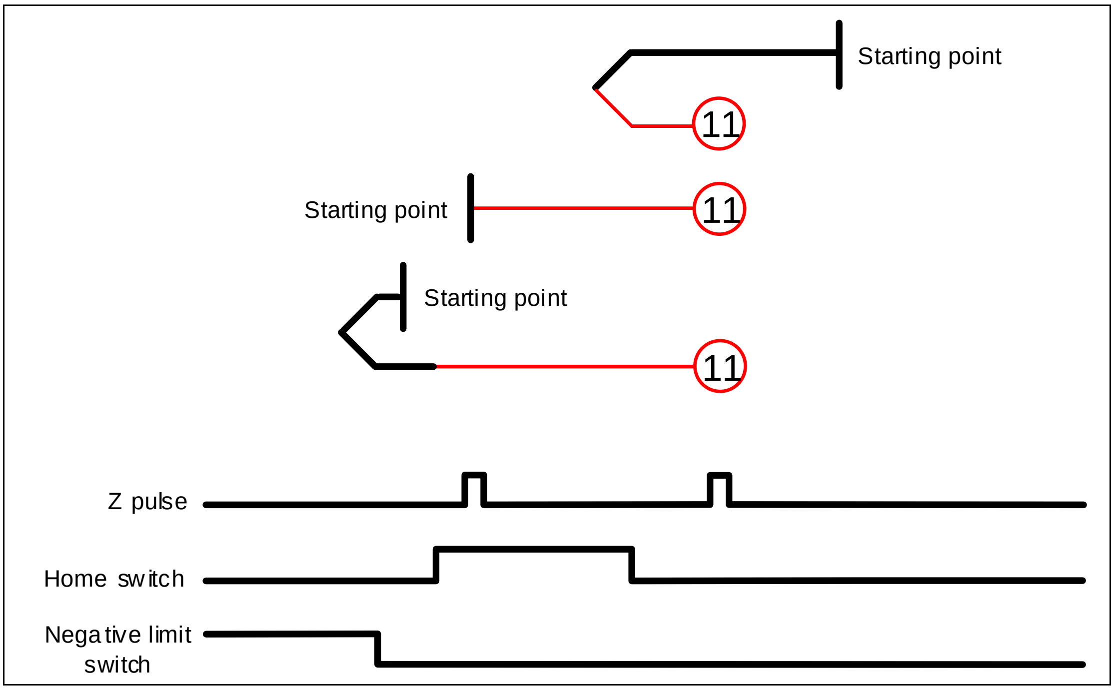
Method 9: homing on the positive limit switch, home switch, and Z pulse



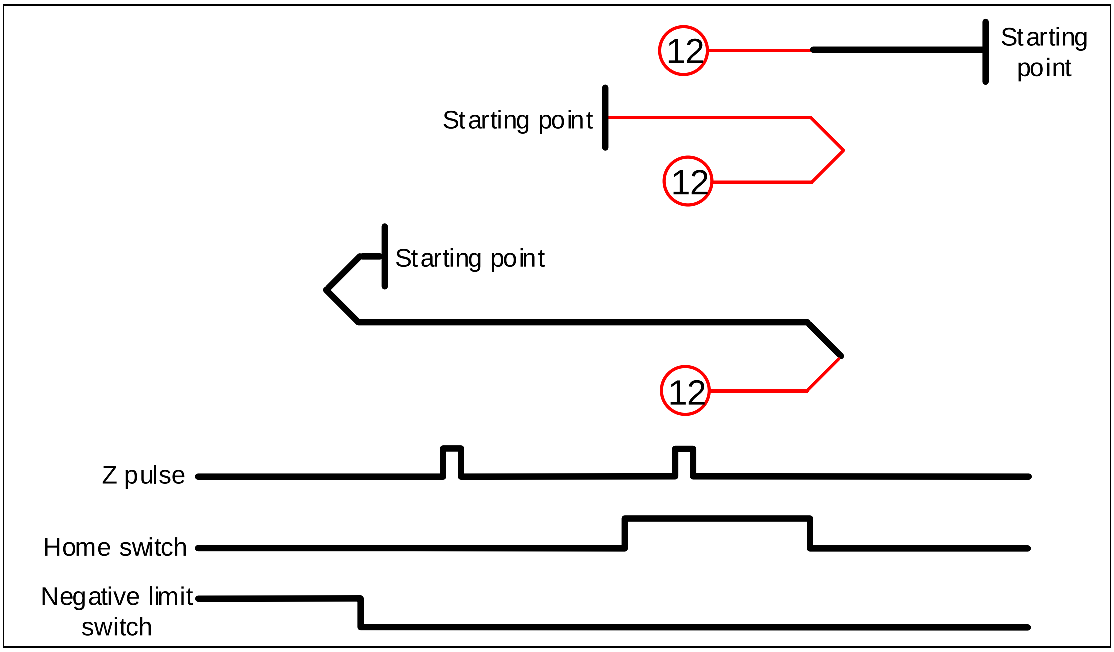
Method 10: homing on the positive limit switch, home switch, and Z pulse



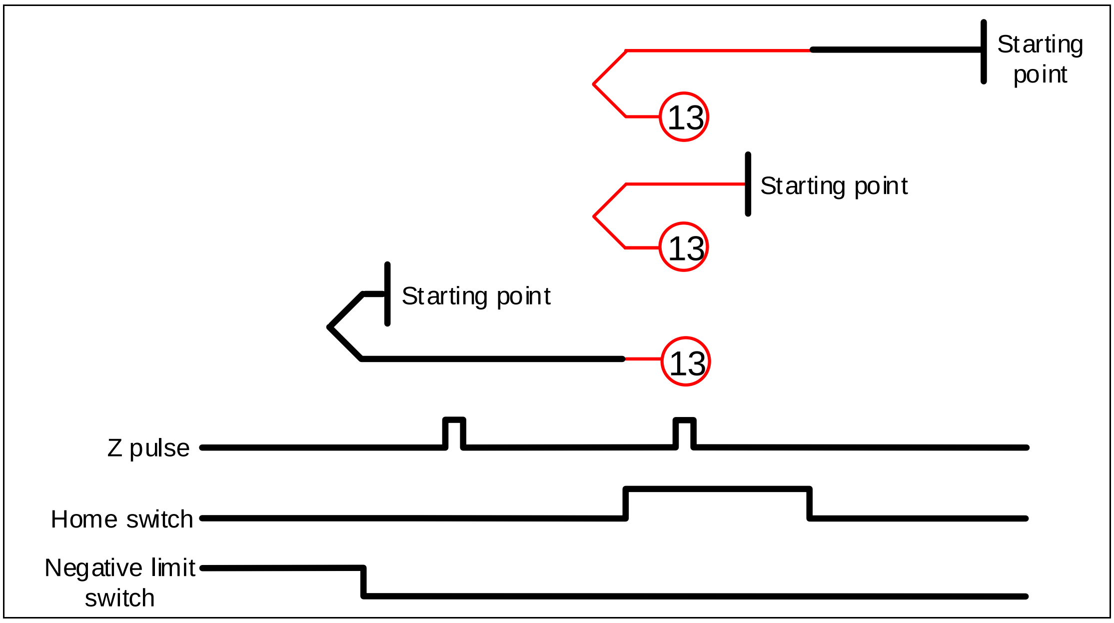
Method 11: homing on the negative limit switch, home switch, and Z pulse



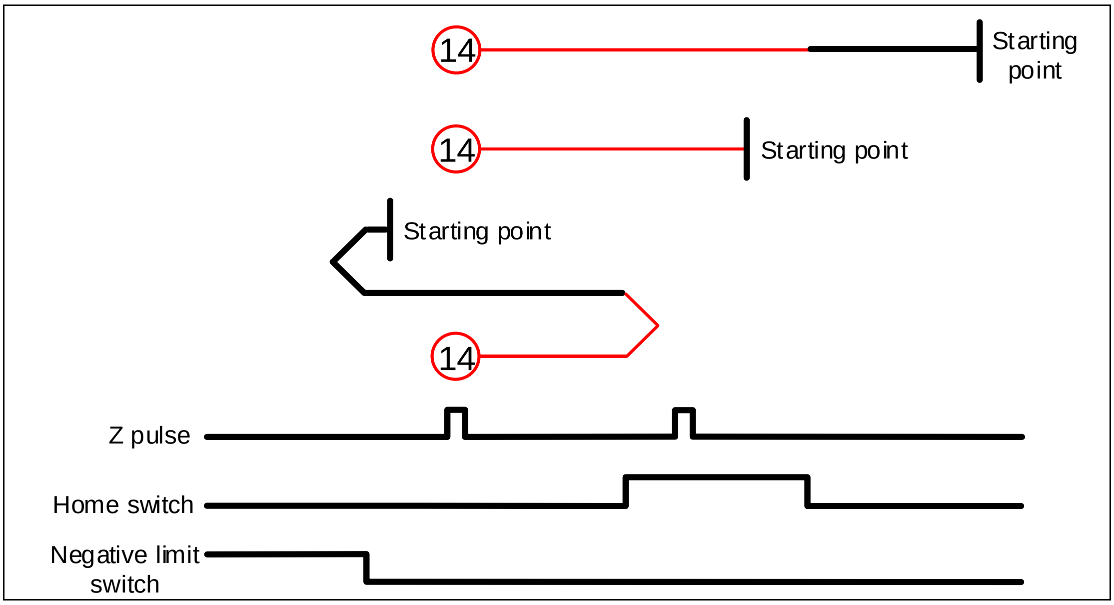
Method 12: homing on the negative limit switch, home switch, and Z pulse



Method 13: homing on the negative limit switch, home switch, and Z pulse

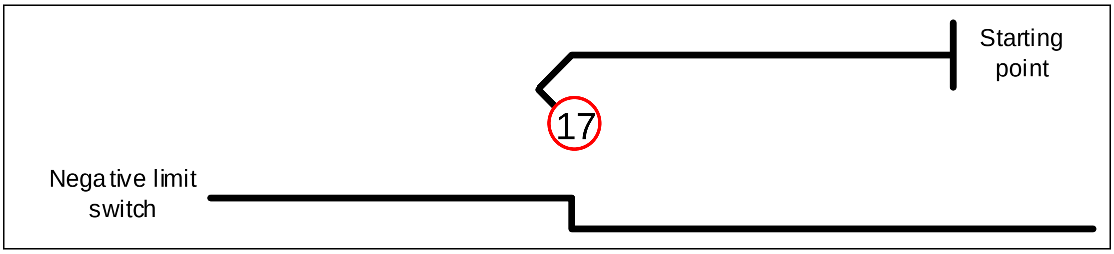


Method 14: homing on the negative limit switch, home switch, and Z pulse

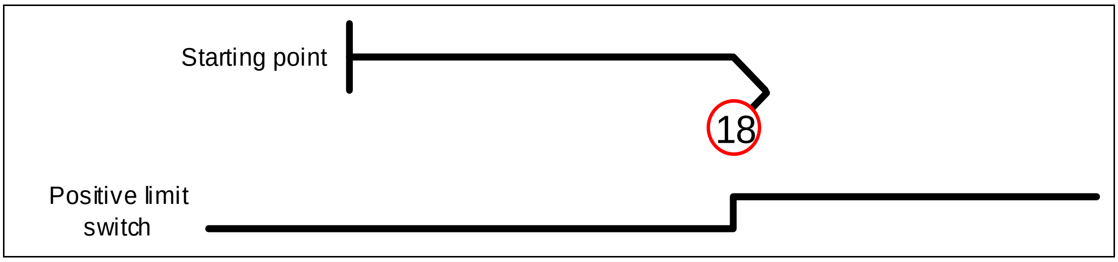


Methods 15 and 16: reserved

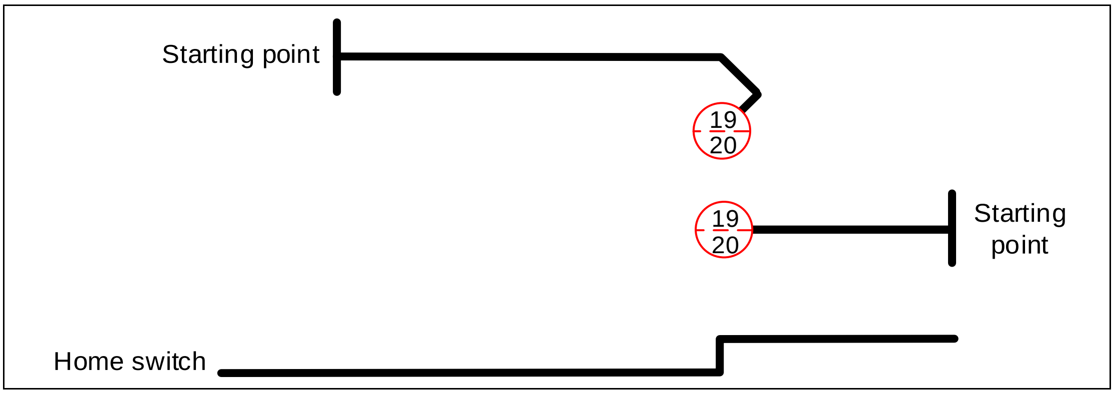
Method 17: homing on the negative limit switch



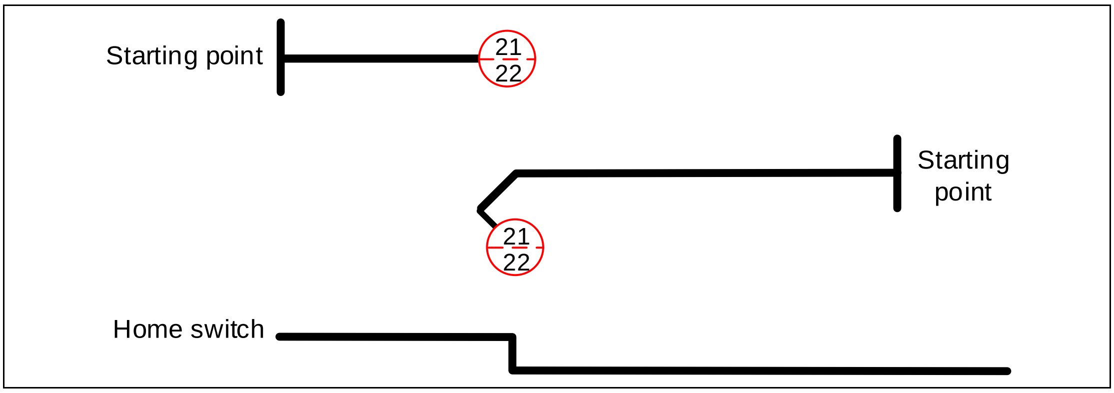
Method 18: homing on the positive limit switch



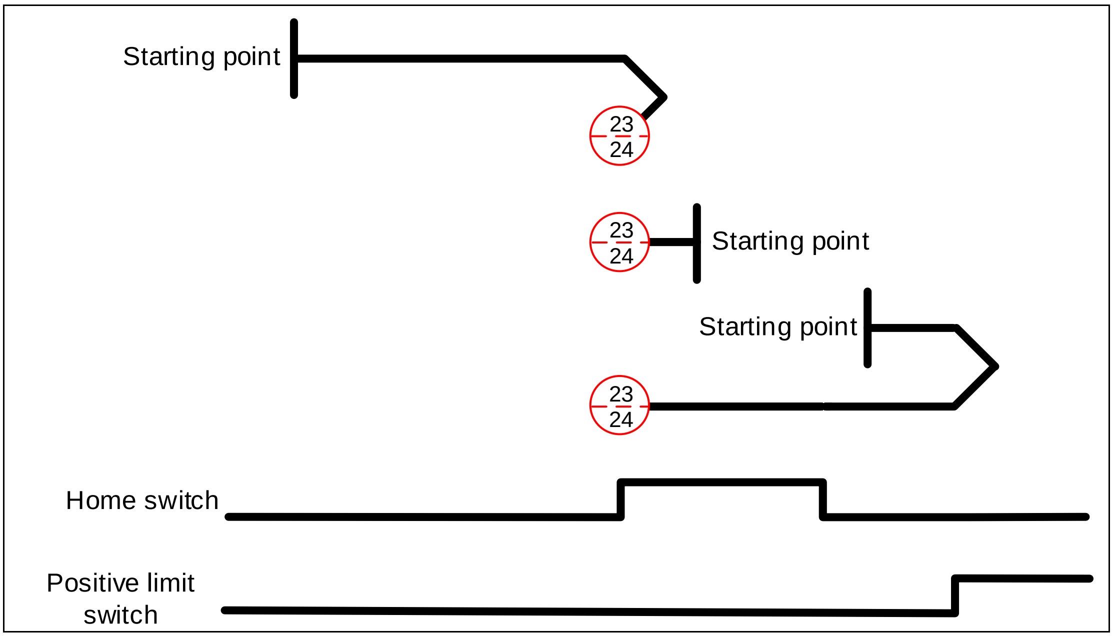
Methods 19 and 20: homing on the home switch



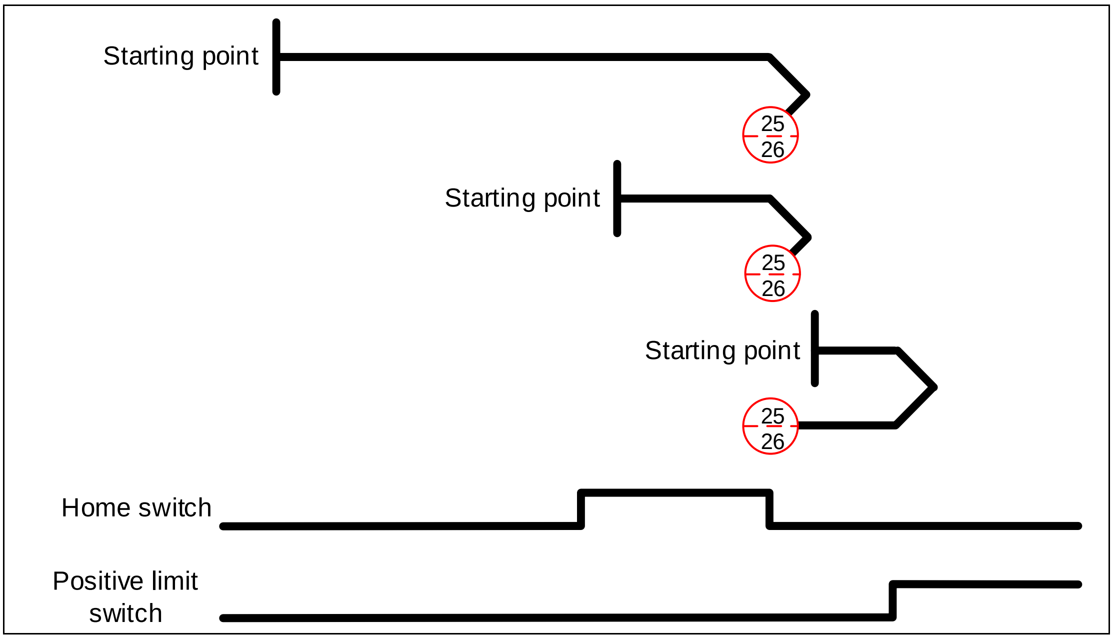
Methods 21 and 22: homing on the home switch



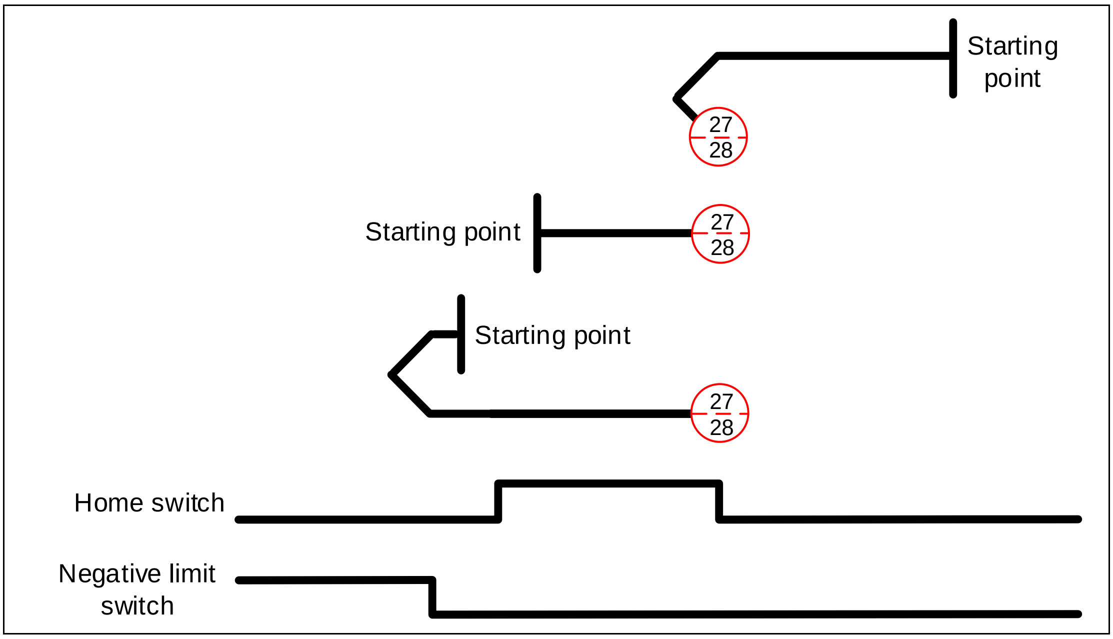
Methods 23 and 24: homing on the positive limit switch and home switch



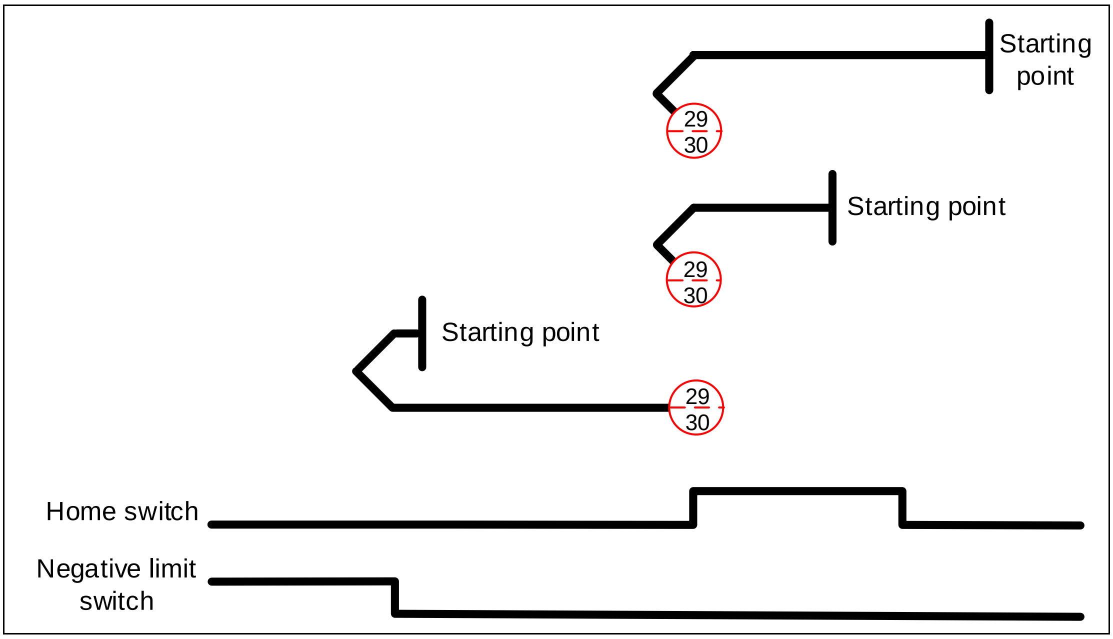
Methods 25 and 26: homing on the positive limit switch and home switch



Methods 27 and 28: homing on the negative limit switch and home switch

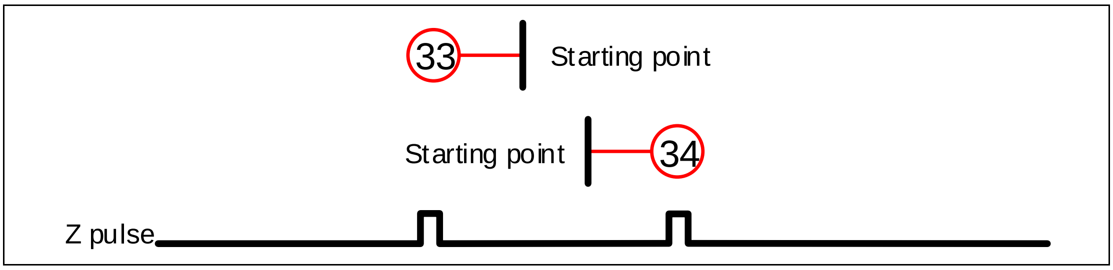


Methods 29 and 30: homing on the negative limit switch and home switch



Methods 31 and 32: reserved

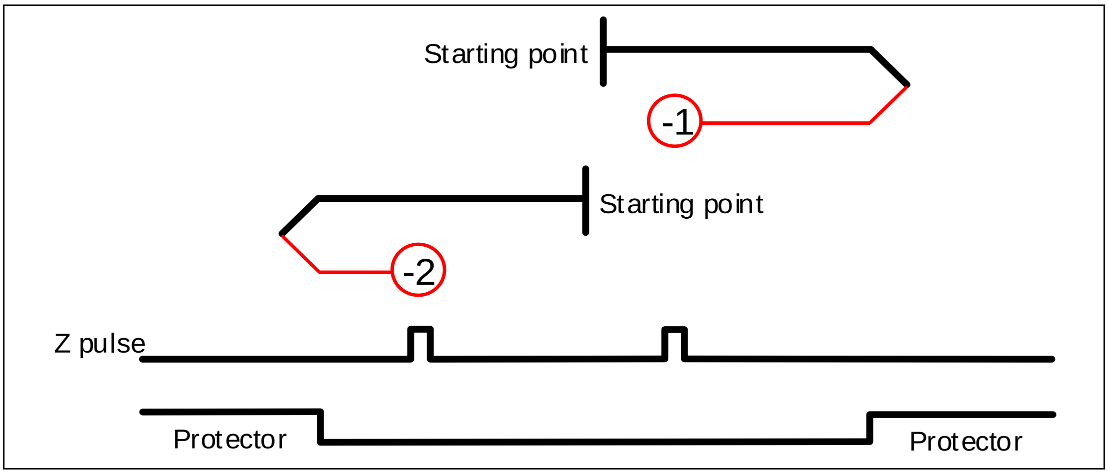
Methods 33 and 34: homing on the Z pulse



Method 35: defines the current feedback position as the origin

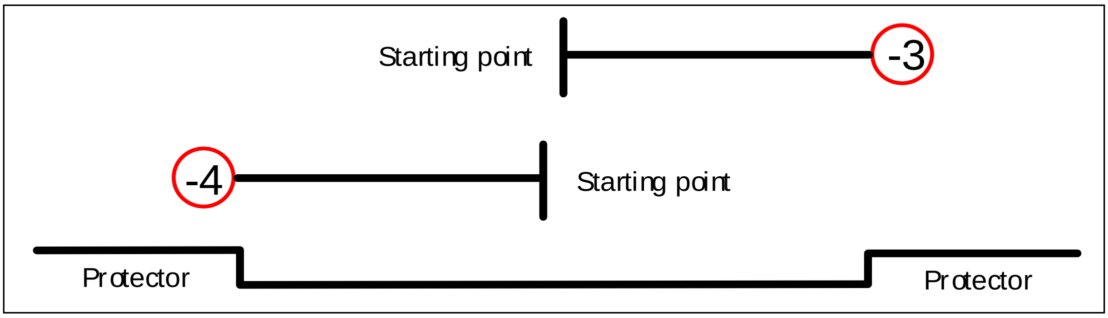
Methods 36 and 37:

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	0
Description	Number of sub-index
Data type	UNSIGNED8
Access	RO
PDO mapping	Yes
Setting range	2
Default	2

Sub-index	1
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	2
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 only works in Homing mode.

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. For more details, refer to Section 11.3.5 Cyclic Synchronous Position mode.

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. For more details, refer to Section 11.3.6 Cyclic Synchronous Velocity mode.

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. For more details, refer to Section 11.3.7 Cyclic Synchronous Torque mode.

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 Touch Probe related function settings. For the operation details, refer to Section 11.3.8 for the description of Touch Probe.

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 both rising-edge and falling-edge triggered, 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 both rising-edge and falling-edge triggered, 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 11.3.8 for the description of Touch Probe.

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	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 11.3.8 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 11.3.8 for the description of Touch Probe.

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 11.3.8 for the description of Touch Probe.

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 11.3.8 for the description of Touch Probe.

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 11.3.8 for the description of Touch Probe.

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.

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 position actual value (OD 6064h). For more details, refer to the architecture diagrams in Section 11.3.

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

Object function:

This command is generated after being processed by the servo drive filter. For more details, refer to the architecture diagrams in Section 11.3.

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:

31 16	15 3	2	1	0
Manufacturer-specific	Reserved	Home switch	Positive limit switch	Negative limit switch
MSB				LSB

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 - Bit 31	Reserved

Object 60FEh: Digital outputs

Index	60FEh
Name	Digital outputs
Object code	ARRAY
Data type	UNSIGNED32
Access	RW

Sub-Index	0
Description	Number of sub-index
Data type	UNSIGNED8
Access	RO
PDO mapping	Yes
Setting range	2
Default	2

Sub-Index	1
Description	Physical outputs
Data type	UNSIGNED32
Access	RW
PDO mapping	Yes
Setting range	0x00000000 to 0xFFFFFFFF
Default	0

Sub-Index	2
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
0 - 15	-	Reserved
16	DO1	0: off; 1: on
17	DO2	0: off; 1: on
18	DO3	0: off; 1: on
19	DO4	0: off; 1: on
20 - 31	-	Reserved

OD 60FEh sub2 (Bit mask)

Bit	DO	Description
0 - 15	-	Reserved
16	DO1	0: disable physical outputs; 1: enable
17	DO2	0: disable physical outputs; 1: enable
18	DO3	0: disable physical outputs; 1: enable
19	DO4	0: disable physical outputs; 1: enable
20 - 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.
  When P2.021 = 0x0133, the output of DO4 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 0x60FE 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 only works in Profile Velocity mode and Cyclic Synchronous Velocity mode.

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

11.5 Diagnostics and troubleshooting

This section provides diagnostics and troubleshooting information related to communication with the controller or interference elimination. For information about the servo drive alarms, refer to Chapter 12 Troubleshooting.

1. The SYNC communication cycle of the controller and servo drive is different

   Since the jitter of each controller is different, the time the servo drive receives the SYNC differs from the SYNC communication cycle time. When this happens, adjust the value of P3.009.U to increase the error range and let the servo drive automatically correct the internal timer so it is consistent with the communication cycle of the controller.

2. 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.

11.5.1 EtherCAT Diagnosis

The EtherCAT automatic error diagnostic function must be used with the ASDA-Soft software of version 6.1.2.0 or above. To use this function, activate **EtherCAT Diagnosis** in ASDA-Soft and press **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 the ASDA-Soft software for the updated functions of **EtherCAT Diagnosis**.

11.5.2 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
AL008	Abnormal pulse command	8600h
AL009	Excessive deviation of Position command	8611h
AL010	Voltage error during regeneration	3210h
AL011	CN2 communication failed	7305h
AL012	Calibration error	6320h
AL013	Emergency stop	5441h
AL014	Negative limit error	5443h
AL015	Positive limit error	5442h
AL016	Abnormal IGBT temperature	4210h
AL017	EEPROM error	5330h
AL018	OA, OB output error	7306h
AL020	Serial communication timeout	7520h
AL022	RST 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
AL02F	Blocked rotor protection	0000h
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
AL042	Voltage input for analog Speed command is too high	FF01h
AL044	Servo function operational warning	6100h
AL045	E-Gear ratio value error	6320h
AL048	OA and OB output error	7036h
AL053	Motor parameter error	0000h
AL056	Excessive motor speed	0000h
AL05C	Motor position feedback error	0000h
AL060	Absolute position is lost	7305h
AL061	Encoder undervoltage	7305h

Display	Alarm name	16-bit error code
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 error	-
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

Display	Alarm name	16-bit error code
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 Type [8] PR is out of range	0207h
AL209	Parameter number of 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
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
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
AL510	Internal parameter update program of the servo drive is abnormal	0000h
AL520	Calculation program timeout	0000h
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

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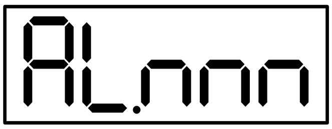
Troubleshooting

12

This chapter provides alarm descriptions and the corrective actions you can use for troubleshooting.

There are three types of alarms: General, Motion control, and Communication. The detailed information is as follows.

General type: alarms caused by hardware or encoder signal errors.
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 0 for clearing the alarm.

12.1 Alarm list

General type

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL001	Overcurrent	○			○
AL002	Overvoltage	○			○
AL003	Undervoltage		○		○
AL004	Motor combination error	○			○
AL005	Regeneration error	○			○
AL006	Overload	○			○
AL007	Excessive deviation of Speed command	○			○
AL008	Abnormal pulse command	○			○
AL009	Excessive deviation of Position command	○			○
AL010	Voltage error during regeneration	○			○
AL011	CN2 communication failed	○			○
AL012	Calibration error	○			○
AL013	Emergency stop		○		○
AL014	Negative limit error		○	○	
AL015	Positive limit error		○	○	
AL016	Abnormal IGBT temperature	○			○
AL017	EEPROM error	○			○
AL018	OA and OB output error	○			○
AL020	Serial communication timeout		○	○	
AL022	RST power error		○		○
AL023	Early overload warning		○	○	
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	○			○
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 protective range	○			○
AL036	Encoder alarm status error	○			○
AL042	Voltage input for analog Speed command is too high	○			○
AL044	Servo function operational warning		○	○	
AL045	E-Gear ratio value error	○			○
AL048	OA and OB output error	○			○
AL053	Motor parameter error	○			○
AL056	Excessive motor speed	○			○
AL05C	Motor position feedback error	○			○

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	Emergency stop during deceleration		○	○	
AL3CF	Emergency stop		○		○
AL422	Write-in failed caused by power supply cut-off	○			○
AL521	Vibration elimination parameter error	○			○

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
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.

Motion control type

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL207	Parameter group of Type [8] PR is out of range		○	○	
AL209	Parameter number of 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 by Type [8] PR is read-only		○	○	
AL217	Parameter written by Type [8] PR is write-protected when Servo On		○	○	
AL219	Parameter written by Type [8] PR is write-protected		○	○	
AL231	Monitoring variable code specified by 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	○			○
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.

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		○	○	
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.

12.2 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 is abnormal.
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 part of the wiring. Check if 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 value of the internal 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?	DI.ARST

AL002 Overvoltage	
Trigger condition and cause	Condition: main circuit voltage exceeds the rated value. Cause: 1. The input voltage of 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 of the main circuit is within the allowable range (refer to Appendix A Specifications) and if the power system complies with the specifications. Use the correct power source or connect the transformer and regulator in series to keep the voltage within the range. 2. If the alarm occurs when the input voltage of 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

AL003 Undervoltage	
Trigger condition and cause	Condition: 1. Main circuit voltage is below the rated value. The error type of AL003 is a warning by default. To set AL003 as an alarm, you can set P2.066 [Bit 9] to 1. 2. DC Bus voltage is below P4.024 × $\sqrt{2}$. Cause: 1. The input voltage of 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 power supply is correct and the wiring of input power supply for 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 source or connect the transformer in series.
How to clear the alarm?	Clear AL003 according to the setting of P2.066 [Bit 2]: 1. If P2.066 [Bit 2] is set to 0, use DI.ARST to clear the alarm after the voltage is back in the normal range. 2. If P2.066 [Bit 2] is set to 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?	DI.ARST

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 error. 4. Encoder error.
Checking method and corrective action	1. Set P0.002 to 12 for monitoring 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. 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?	DI.ARST

AL007 Excessive deviation of Speed command	
Trigger condition and cause	Condition: difference between the command speed and the feedback speed exceeds the allowable range set by P2.034. Cause: 1. A drastic change in the input Speed command. 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. Use the signal detector to check if the input analog voltage signal is normal. If not, adjust the rate of change for input signals or enable the filter function. 2. Check if the value of P2.034 (Excessive deviation warning condition of Speed command) 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

AL008 Abnormal pulse command	
Trigger condition and cause	Condition: the input frequency of the pulse command is over the allowable value for the hardware interface. Cause: the pulse command frequency is higher than the rated input frequency.
Checking method and corrective action	Use the scope to check if the input frequency is higher than the rated input frequency and input the pulse with the correct frequency.
How to clear the alarm?	DI.ARST

AL009 Excessive deviation of Position command	
Trigger condition and cause	Condition: difference between the command position and the feedback position exceeds the allowable range set by P2.035. Cause: 1. The maximum allowable position deviation 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.

AL009 Excessive deviation of Position command	
Checking method and corrective action	1. Check the set value of P2.035 (Excessive deviation of Position command warning). If the value 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 using an incorrect regenerative resistor or not connecting an external regenerative resistor to the servo drive. 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

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. The motor is not supported by this servo drive series.
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 if the CN2 connector is properly connected to the CN2 port on the servo drive. If the connector is loose, reconnect it to the servo drive. 3. Check for the cable and connector which connect the motor and CN2 of the servo drive to see if there is any poor wiring or damaged wires. If so, replace the connector and cable. 4. Check the communication error rate by setting P0.002 to -80. If the error rate 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 grounded to the servo drive heat sink. (b) Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. (c) Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 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 encoders.
How to clear the alarm?	Cycle power on the servo drive.

AL012 Calibration error	
Trigger condition and cause	Condition: the calibration value exceeds the allowable value during electrical calibration. Cause: 1. The analog input contact is not correctly returned to zero. 2. The detection device is damaged.
Checking method and corrective action	1. Check if the voltage level at the analog input contact is the same as the ground potential. 2. Cycle power and execute the calibration again. If the issue persists after power cycling, send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Remove the connection cable for CN1 and then execute auto calibration.

AL013 Emergency stop	
Trigger condition and 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 to clear the alarm.

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's capacity or reducing the load. 2. Check if the wiring of servo drive output is correct.
How to clear the alarm?	DI.ARST

AL017 EEPROM error	
Trigger condition and cause	Condition: 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 “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 a 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. Use DI.ARST 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 when power is supplied to the drive, reset the parameters and then cycle the power. If the alarm occurs during operation, set DI.ARST to on.

AL018 OA and OB output error	
Trigger condition and cause	Condition: the output frequency of the OA and OB pulses is higher than the maximum output frequency of the hardware. Cause: 1. The resolution of the OA and OB pulses is set too high. 2. There is interference or damage to the encoder signal cable, causing communication error. 3. Encoder error.
Checking method and corrective action	1. Correctly set the parameters. The settings of P1.076 and P1.046 should follow these requirements: P1.076 > motor speed and $\frac{\text{Motor speed}}{60} \times \text{P1.046} \times 4 < 19.8 \times 10^6$ 2. Check the communication error rate by setting P0.002 to -80. If the error rate 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 grounded to the servo drive heat sink. (b) Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. (c) Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 3. Check the fault record (P4.000 - P4.004) and see if an alarm has occurred (AL011, AL024, AL025, or AL026). Use the corresponding checking methods and corrective actions to clear the alarm if any of them occurs. 4. If you do not need to use the OA and OB pulses, set P2.065 [Bit 13] to 1 to disable the detection function for OA and OB output error (AL018 / AL048).
How to clear the alarm?	1. DI.ARST 2. Contact the distributor.

AL020 Serial communication timeout	
Trigger condition and cause	Condition: RS-485 communication error. Cause: 1. Improper setting for P3.004 (Modbus 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 RST power error	
Trigger condition and cause	Condition: RST power cable is loose or there is no power. The error type of AL022 is a warning by default. To set AL022 as an alarm, you can set P2.066 [Bit 12] to 1. Cause: RST power error.
Checking method and corrective action	Check if the RST power cable is loose or there is no power. For 1.5 kW (or below) servo drives, this alarm occurs when all three phases are not connected to the power supply. For 2 kW (or above) servo drives, this alarm occurs when one single phase is not connected to the power supply. Correctly connect the power to the servo drive. If the issue persists, send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	DI.ARST

AL023 Early overload warning	
Trigger condition and cause	Early overload warning.
Checking method and corrective action	1. Check if the motor is overloaded and refer to the corrective actions of AL006 for troubleshooting. 2. Check if the value of P1.056 (Motor output overload warning level) is set too low. If so, set the value higher, or set the value greater than 100 to disable the warning function.
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 grounded to the servo drive heat sink. 2. Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 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.

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 the inertia of the mechanical parts 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 grounded to the servo drive heat sink. (b) Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. (c) Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 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 grounded to the servo drive heat sink. 2. Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 4. Check the communication error rate by setting P0.002 to -80. If the error rate is greater than 0 and increases continuously, check the previous three items again. If the error rate 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 connection for the encoder signal cable. 2. Check if the power supply for the encoder is stable and make sure to use shielded cable. 3. Check if the operating temperature is over 95°C (203°F). Identify the cause for 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 correctly installed. (voltage > 3.8V) 3. Check if the motor is properly grounded. Make sure the ground end (yellow / green) of the power cable is grounded to the servo drive heat sink. 4. Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. 5. Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 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.

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 to 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	Accessing the internal data of the motor is in error.
Checking method and corrective action	Send your servo motor back to Delta.
How to clear the alarm?	N/A

AL02F Blocked rotor protection	
Trigger condition and cause	Condition: the servo drive is overloaded, and the motor speed keeps at 10 rpm (or below) or the rotor is blocked. Cause: 1. The motor or the connected mechanical part is locked, causing the motor not to rotate. 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 duration of the occurrence of blocked rotor. 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?	DI.ARST

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. 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. If P1.057 is set too low, it may lead to malfunction; if P1.057 is set too high, it may lose the protection function.
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 switch for wiring error detection 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 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.

AL033 Motor is in error	
Trigger condition and cause	The encoder signal 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. 3. Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply 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. Other types of encoder internal error. 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 protective range	
Trigger condition and cause	Condition: encoder temperature is over the upper lmit of 100°C (212°F). Cause: encoder temperature is over 100°C.
Checking method and corrective action	Set P0.002 to -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 (86°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.

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 power cable (yellow / green end) is grounded to the servo drive heat sink. 2. Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 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.

AL042 Voltage input for analog Speed command is too high	
Trigger condition and cause	Voltage input for the analog Speed command is higher than the level specified by P1.083.
Checking method and corrective action	Check and make sure the voltage source for the analog Speed command is correct. Check the value of P1.083, and if this function not required, set it to 0.
How to clear the alarm?	DI.ARST

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 this filter is necessary. 2. Set P2.066 [Bit 4] to 1 to disable this alarm.
How to clear the alarm?	1. Disable the filter if it is not required, such as the low-pass filter (P1.006 - P1.008), moving filter (P1.068), low-frequency vibration suppression (P1.025 - P1.028), vibration elimination (P1.089 - P1.094), Notch filter (1st to 5th 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 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.

AL048 OA and OB output error	
Trigger condition and cause	Condition: the output frequency of the OA and OB pulses is higher than the maximum output frequency of the hardware. Cause: 1. The resolution of the OA and OB pulses is set too high. 2. There is interference or damage to the encoder signal cable, causing communication error. 3. Encoder error.

AL048 OA and OB output error	
Checking method and corrective action	1. Correctly set the parameters. The settings of P1.076 and P1.046 should follow these requirements: $P1.076 > \text{motor speed}$ and $\frac{\text{Motor speed}}{60} \times P1.046 \times 4 < 19.8 \times 10^6$ 2. Check the communication error rate by setting P0.002 to -80. If the error rate 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 grounded to the servo drive heat sink. (b) Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. (c) Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 3. Check the fault record (P4.000 - P4.004) and see if an alarm has occurred (AL011, AL024, AL025, or AL026). Use the corresponding checking methods and corrective actions to clear the alarm if any of them occurs. 4. If you do not need to use the OA and OB pulses, set P2.065 [Bit 13] to 1 to disable the detection function for OA and OB output error (AL018 / AL048).
How to clear the alarm?	1. DI.ARST 2. Contact the distributor.

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 the 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 the user 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.

AL056 Excessive motor speed	
	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: losing 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 of the servo drive is off. 3. The battery is not installed when the absolute function is enabled. 4. Poor connection or disconnection of the battery power circuit.

AL060 Absolute position is lost	
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 of 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?	Connect or reconnect 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 10.3.4 for more details.

AL061 Encoder undervoltage	
Trigger condition and cause	Condition: battery voltage of the absolute encoder is lower than the rated value (3.1V). Cause: voltage level of the battery is too low.
Checking method and corrective action	1. Check if the battery voltage is below 3.1V with the monitoring variable 26h. 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: motor’s rotation cycle exceeds the allowable range.
Checking method and corrective action	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.
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 you 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 resolution. 2. The number of revolutions of a Delta motor is -32768 to +32767. Cause: motor’s rotation cycle 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 for preventing rotary axis position loss when an overflow occurs. If it is disabled, set P2.069.Z to 1 to enable the function.
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 to -124 to read 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 (86°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. In the first condition, the absolute position is not established. Thus, the origin is lost. In the other condition, an error occurred. After the absolute origin position is established, AL06A still occurs after power cycling of the servo drive. ■ Absolute position is not established. Condition: 1. The servo drive is used for the first time. 2. The battery is drained and the power of 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 supply of 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. ■ An error occurred. 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 supply is unstable due to damage of the encoder cable. 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.

AL06A Absolute position is lost

Checking method and corrective action	1. Check if the absolute origin position is established (refer to Section 10.3.1 for more information). 2. Avoid replacing the battery when the servo drive is powered off. It is suggested that you replace the battery 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 cross-testing. 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?	This 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 half 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.

AL06F The absolute position is not established	
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 grounded to the servo drive heat sink. 2. Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 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 grounded to the servo drive heat sink. 2. Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 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 grounded to the servo drive heat sink. 2. Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 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 grounded to the servo drive heat sink. 2. Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 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 grounded to the servo drive heat sink. 2. Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 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 cycled after the encoder parameter is written to the encoder, so the parameter value is not updated.
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.

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 grounded to the servo drive heat sink. 2. Check if the connection for the encoder signal cable is normal. Make sure the encoder signal cable is separated from the power supply or any high-current cables to avoid interference. 3. Use shielded cable for the encoder cable. Pull out the wire mesh and have it correctly grounded. 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 to 200 rpm or lower, 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	Use DI.ARST 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 to -80 to check the communication quality of the encoder. If the communication is normal, use DI.ARST 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 because of the high current. Cause: 1. UVW of the servo drive is short-circuited. 2. Motor wiring is in error. 3. The GND for analog signal of the servo drive is interfered.
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.

AL083 Servo drive outputs excessive current	
	3. Check if the GND for analog signal is mistakenly connected to another ground signal (incorrect connection can cause interference). Do not share the GND for analog signal with other signal source. Follow the wiring instructions in Chapter 3.
How to clear the alarm?	DI.ARST

AL085 Regeneration setting error	
Trigger condition and cause	Condition: regeneration control error. Cause: regenerative resistor is not operating, but the regenerative voltage remains at 400V 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?	DI.ARST

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. Re-assess whether the regenerative energy exceeds the value of P1.053. If so, replace the regenerative resistor with one that has a 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 displayed DC Bus voltage when you set 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

AL086 Regenerative resistor overload	
	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 source or connect the regulator in series.
How to clear the alarm?	DI.ARST

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 this 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] to 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.

AL08A Auto tuning function - command error	
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?	DI.ARST

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 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 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 cycle power on the servo drive.

AL0A6 Absolute positions of the servo drive and motor do not match	
Trigger condition and cause	Condition: suppose there are servo drive A, servo motor A, servo drive B, and servo motor B. Servo drive A and servo drive B have established the absolute origin positions with servo motor A and servo motor B respectively. In this case, if you operate servo drive A with servo motor B, AL0A6 will be triggered. Cause: replace the servo drive or servo motor.
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 (more than two 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 (more than two 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.

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 the 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.

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 cable. 3. For communication type models, 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 an excessive number of 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 to 10 to reset the parameters.
How to clear the alarm?	OD 6040h [Bit 7] (Fault reset), DI.ARST, or OD 1011h.

AL207 Parameter group of Type [8] PR is out of range	
Trigger condition and cause	Condition: when Type [8] PR command specifies parameter as the data source, the parameter group is out of range. Cause: parameter group exceeds the range.
Checking method and corrective action	Write parameter using PR procedure: when the data source is parameter and the group setting exceeds the range, check the setting range of the group for the written parameters.
How to clear the alarm?	DI.ARST

AL209 Parameter number of Type [8] PR is out of range	
Trigger condition and cause	Condition: when Type [8] PR command specifies parameter as the data source, the parameter number is out of range. Cause: parameter number exceeds the range.
Checking method and corrective action	Write parameter using PR procedure: when the data source is parameter and the parameter number setting exceeds the range, check the setting range of the number for the written parameters.
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 command 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 command to write the parameter, the parameter value is incorrect. Cause: an error occurs when you write the parameter with Type [8] PR command.
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 by Type [8] PR is read-only	
Trigger condition and cause	Condition: the read-only parameter is written by Type [8] PR command. Cause: an error occurs when you write the parameter with Type [8] PR command.
Checking method and corrective action	The specified parameter is read-only.
How to clear the alarm?	DI.ARST

AL217 Parameter written by Type [8] PR is write-protected when Servo On	
Trigger condition and cause	Condition: when you use Type [8] PR command to write the 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 command.
Checking method and corrective action	Write the 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 command and the parameter.

AL219 Parameter written by Type [8] PR is write-protected	
Trigger condition and cause	Condition: the parameter written by Type [8] PR command 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 by Type [8] PR is out of range	
Trigger condition and cause	Condition: when Type [8] PR command specifies monitoring variable as the data source, the monitoring variable code is out of range. Cause: the monitoring variable code is out of range.
Checking method and corrective action	Write parameter using PR procedure: when the data source is 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 to check if the feedback position has overflowed and then execute the homing procedure. Absolute system: AL235 occurs when the absolute positioning command is issued in the following conditions: 1. Feedback position 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 to check if the feedback position 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 using DI.ARST to clear the alarm. 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 commands are not set or not triggered, causing the PR command incomplete.
How to clear the alarm?	DI.ARST or cycle power on the servo drive.

AL249 PR path number is out of range	
Trigger condition and cause	Condition: the number of the triggered PR path exceeds the maximum. Cause: the number of the triggered PR path exceeds 99.
Checking method and corrective action	1. Check if the PR command jumps to a path exceeding the range. 2. Check if the PR command 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 feedback position 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 feedback position. 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 feedback position 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 feedback position. 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.

AL289 Position counter overflows	
Trigger condition and cause	Position counter overflows.
Checking method and corrective action	1. Set the 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 is set to 1 (enabling the function of preventing the rotary axis position loss 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 Emergency stop during deceleration	
Trigger condition and cause	This alarm occurs when DI.PFQS (0x47) is rising-edge triggered. 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 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 goes off.
Checking method and corrective action	Refer to the description of P1.048. After DO.MC_OK is on, DO.MC_OK then goes off because DO.TPOS turns 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 Emergency 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 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).

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 not yet established, 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: if P2.069.Z is set to 1 (enabling the function of preventing the rotary axis position loss 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 from 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 to 12 for monitoring 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.

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 alarm persists, disable the vibration elimination function by setting [Bit 8] and [Bit 9] of P2.094 to 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 [Bit 8] and [Bit 9] of P2.094 to 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 P5.007 and P0.001 for the two channels and 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 switch for disconnection detection 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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Specifications Appendix A

A.1 ASDA-E3 series servo drive

A.1.1 Specifications of the ASDA-E3 servo drive

ASDA-E3			100 W	200 W	400 W	750 W	1 kW	1.5 kW	2 kW	3 kW
			01	02	04	07	10	15	20	30
Main circuit power	Phase / Voltage		Single- / Three-phase 220 V_{AC}						Three-phase 220 V_{AC}	
	Permissible voltage		Single- / Three-phase 200 - 230 V_{AC}, -15% to +10%						Three-phase 200 - 230 V_{AC}, -15% to +10%	
	Input current (3PH) Unit: Arms		0.82	1.26	2.0	3.33	5.25	5.8	8.1	10.9
	Input current (1PH) Unit: Arms		1.51	2.28	3.7	6.37	10.0	11.3	-	-
Continuous output current Unit: Arms			0.9	1.55	2.65	5.1	7.3	8.3	13.4	19.4
Max. instantaneous output current Unit: Arms			3.88	7.07	10.6	14.14	21.21	24.3	38.3	53.03
Regenerative resistor	Built-in	Resistance (Ohm)	-	-	-	100	100	100	20	20
		Capacity (Watt)	-	-	-	40	40	40	80	80
	Minimum allowable resistance value for external resistors (Ohm)		60	60	60	60	30	30	15	15
Cooling method			Air convection cooling				Fan cooling			

Note:

1. The input current is the actual value measured when the servo drive is under the rated output condition with an AC power supply at 220V.
2. When an electronic transformer is used, the output of the servo drive will be derated to 70%.

Specification table

Item			Specification
Servo drive resolution			24-bit (16777216 p/rev)
Main circuit control			SVPWM control
Tuning mode			Manual / Auto
Position control mode	Pulse type		Pulse + symbol, CCW pulse + CW pulse, A phase + B phase
	Max. input pulse frequency		Pulse + symbol: 4 Mpps CCW pulse + CW pulse: 4 Mpps A phase + B phase: single-phase 2 Mpps Open collector: 200 Kpps
	Command source		External pulse Register (not supported by E3-L)
	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	Analog command input	Voltage range	-10 to +10 V_{DC}
		Resolution	12-bit
		Input impedance	1 MΩ
		Time constant	25 μs
	Speed control range[*1]		1 : 6000
	Command source		External analog command / Register
	Smoothing method		Low-pass filter; S-curve filter; moving filter
	Torque limit		Parameter settings / Analog input
	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 operating temperature between 0°C to 45°C (32°F to 113°F)
Torque control mode	Analog command input	Voltage range	-10 to +10 V_{DC}
		Input impedance	1 MΩ
		Time constant	25 μs
	Command source		External analog command / Register
	Smoothing method		Low-pass filter
	Speed limit		Parameter settings / Analog input
Analog monitoring output			Monitoring signal can be set by parameters (voltage output range: ±8V); resolution: 10-bit
Digital input			-L models: 9 DI points; -E models: 6 DI points. Refer to Table 8.1 Digital input (DI) descriptions in Chapter 8 for the function settings.

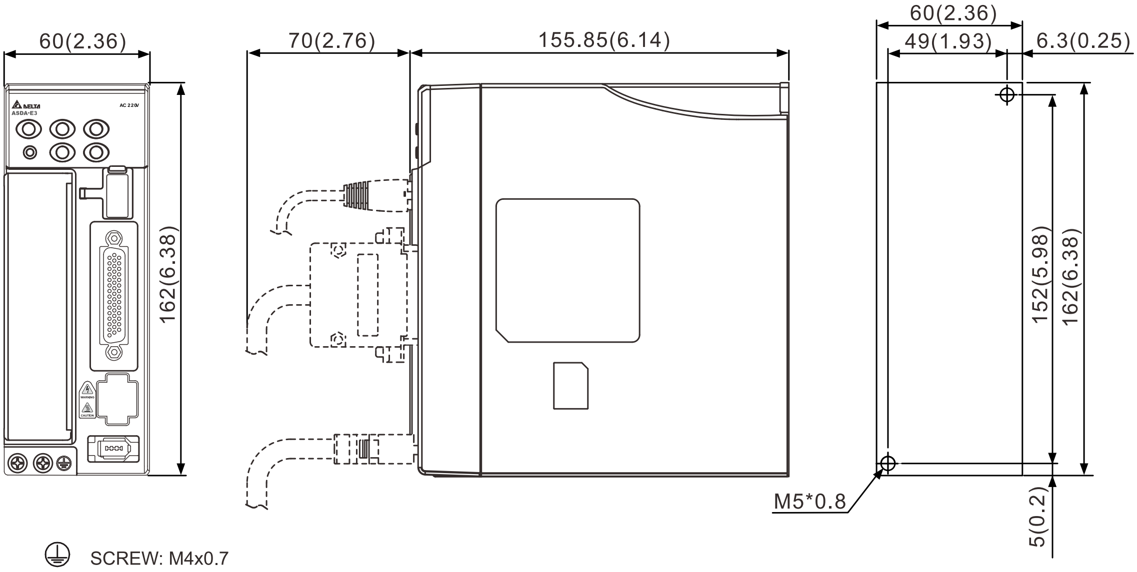
Item		Specification
Digital output		-L models: 6 DO points; -E models: 3 DO points. Refer to Table 8.2 Digital output (DO) descriptions in Chapter 8 for the function settings.
Protection function		Overcurrent, Overvoltage, Undervoltage, Abnormal temperature, Regeneration error, Overload, Excessive deviation of Speed command, Excessive deviation of Position command, CN2 communication failed, Calibration error, Emergency stop, Positive / negative limit error, Serial communication timeout, RST power error, Serial communication timeout, Short-circuit protection for terminals U, V, W, and so on.
Communication interface		-L models: RS-485 / RS-232 -E models: 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
	Operating temperature	0°C to 45°C (32°F to 113°F) If the operating temperature is above 45°C (113°F), derate 10% at every temperature increase of 5°C (41°F). Also, forced cooling is required).
	Storage temperature	-20°C to +65°C (-4°F to +149°F)
	Humidity	0 - 90% RH (non-condensing)
	Vibration	< 20 Hz: 9.80665 m/s^2 (1 G) 20 Hz to 50 Hz: 5.88 m/s^2 (0.6 G)
	IP rating	IP20
	Power system	TN system[*3*4]
	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. TN system: the neutral point of the power system connects directly to the ground. The exposed metal components connect to the ground through the protective ground conductor.
4. Use a single-phase three-wire power system for models using a single-phase power supply.
5. Scan the QR code or go to Delta's website for the CE certificate.

A.1.2 Dimensions of the servo drive

100 W / 200 W / 400 W

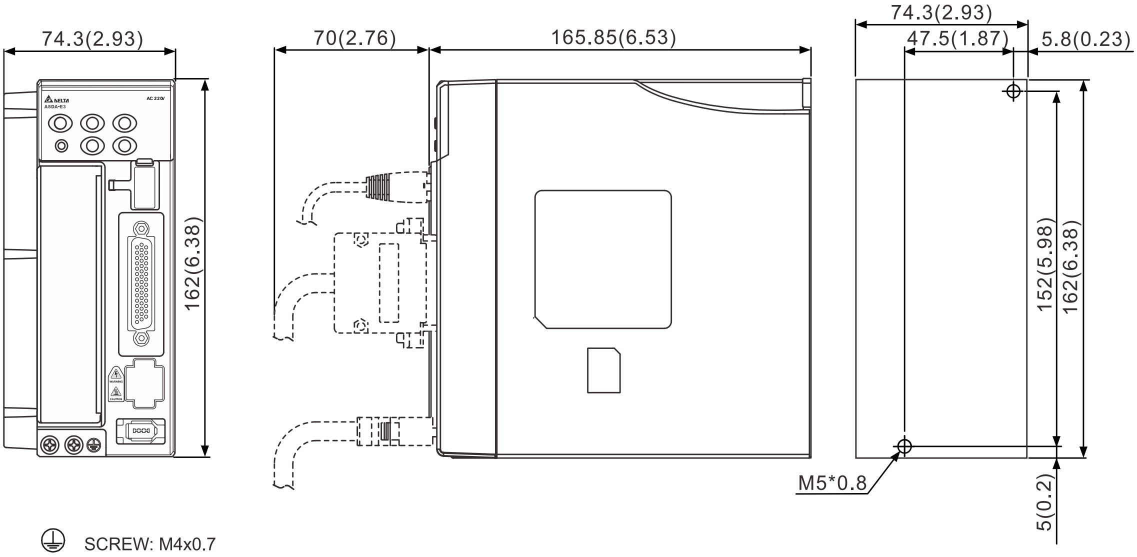


SCREW: M4x0.7
TIGHTENING TORQUE: 14 (kgf-cm)

Unit: mm(inch)

Weight	0.9 kg (1.98 lb)

750 W

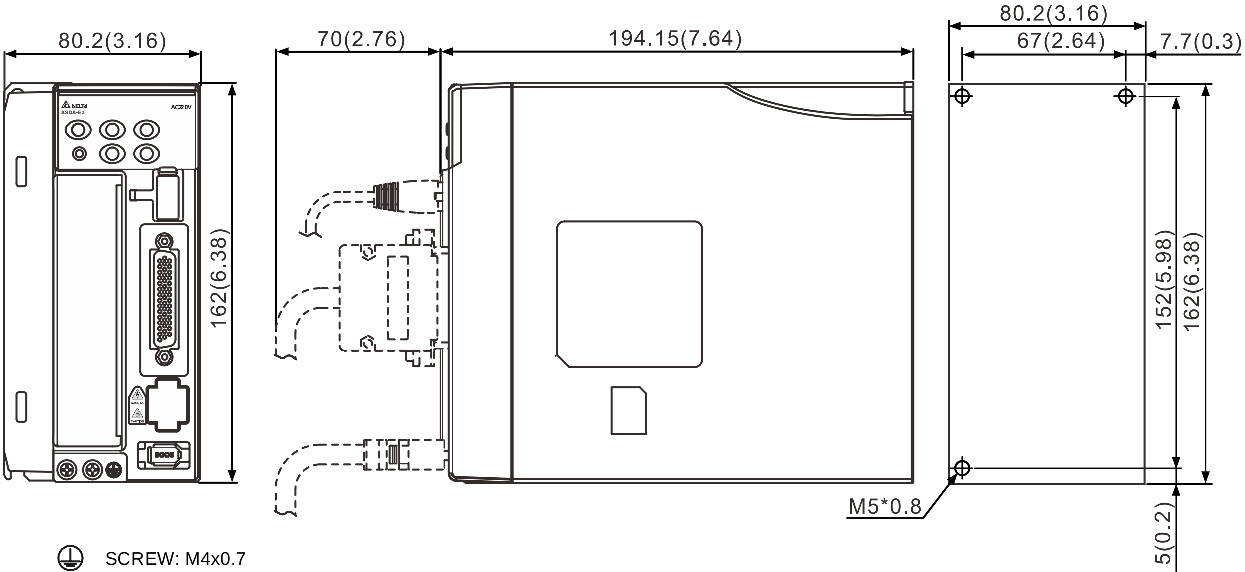


SCREW: M4x0.7
TIGHTENING TORQUE: 14 (kgf-cm)

Unit: mm(inch)

Weight	1.2 kg (2.65 lb)

1 kW / 1.5 kW

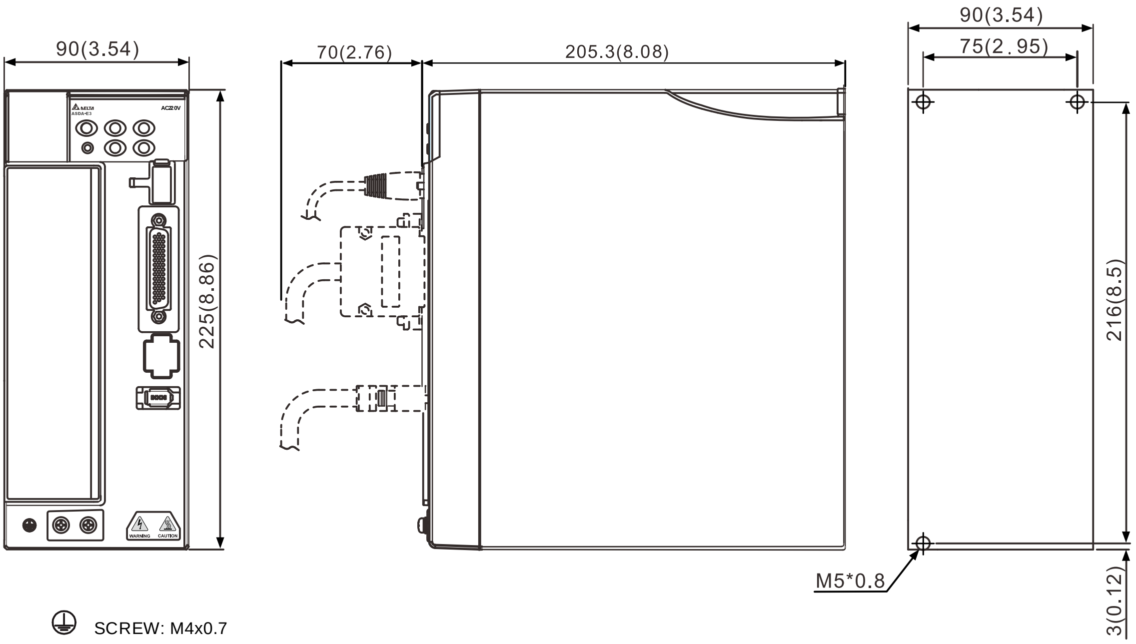


SCREW: M4x0.7
TIGHTENING TORQUE: 14 (kgf-cm)

Unit: mm(inch)

Weight	1.8 kg (3.97 lb)

2 kW / 3 kW



SCREW: M4x0.7
TIGHTENING TORQUE: 14 (kgf-cm)

Unit: mm(inch)

Weight	2.8 kg (6.17 lb)

Note:

1. Dimensions and weights of the servo drives may be updated without prior notice.
2. The values in imperial units in the preceding illustrations are for reference only. Refer to the values in metric units.

A.2 ECM-E3 series servo motor

ECM-E3 series servo motor

ECM	-	E	3	M	-	C	2	06	04	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

M: medium inertia

L: low inertia

(5) Rated voltage and speed

C: 220V and 3,000 rpm

E: 220V and 2,000 rpm

F: 220V and 1,500 rpm

(6) Encoder type

A: 22-bit absolute optical encoder

(resolution of single turn: 22-bit; number of revolutions: 16-bit)

2: 22-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)

Note:

1. The E3-L servo drive does not support the absolute function (including the single-turn absolute function). Therefore, the E3-L servo drive can only operate all motors as incremental type motors.
2. Number of revolutions means the maximum number of turns the encoder can record.

(7) Motor frame size

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

(8) Rated power output

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

(9) Shaft type and oil seal

	w/o brake with oil seal	with brake with oil seal
Keyway (with fixed screw holes)	R	S

(10) Shaft diameter and connector type

S: standard shaft diameter and standard 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 model numbers available for purchase.

A.2.1 ECM-E3 series servo motor

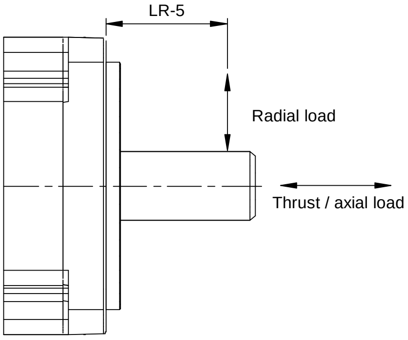
Motor frame size: 80 mm and below

ECM-	E3L-C②0401③④E	E3M-C②0602③④E	E3M-C②0604③④E	E3M-C②0807③④E
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)	34.25	29.05	63.50	53.83
Change of rated power (kW/s) (with brake)	32.51	27.13	61.09	50.97
Rotor inertia (× 10^{-4} kg·m^2)	0.0299	0.141	0.254	1.07
Rotor inertia (× 10^{-4} kg·m^2) (with brake)	0.0315	0.151	0.264	1.13
Mechanical time constant (ms)	0.50	0.91	0.52	0.54
Mechanical time constant (ms) (with brake)	0.53	0.97	0.54	0.57
Torque constant-KT (N-m/A)	0.374	0.45	0.53	0.56
Voltage constant-KE (mV/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 (w/o brake) (kg)	0.5	0.9	1.2	2.34
Weight (with brake) (kg)	0.7	1.3	1.6	3.15
Max. radial load (N)[*5]	78	245	245	392
Max. axial load (N)[*5]	54	74	74	147
Brake operating voltage	24 V$_{DC}$ ± 10%			
Brake holding torque [N-m (Min)][*2]	0.3	1.3	1.3	2.5
Brake power consumption (at 20°C (68°F))[W]	6.1	7.6	7.6	8
Brake release time [ms (Max)]	20	20	20	20
Brake pull-in time [ms (Max)]	35	50	50	60
Derating rate with oil seal (%)	10	10	5	5
Insulation class	Class B (CE)			
Insulation resistance	100 MΩ min. (at 500 V$_{DC}$)			
Insulation strength	1.8 kV$_{AC}$, 1 sec			
Vibration grade	V15			
Operating temperature	-20°C to +60°C (-4°F to +140°F)[*3]			
Storage temperature	-20°C to +80°C (-4°F to +176°F)			
Operating and storage humidity	20 - 90% RH (non-condensing)			

ECM-	E3L-C2⃞0401 3⃞4⃞E	E3M-C2⃞0602 3⃞4⃞E	E3M-C2⃞0604 3⃞4⃞E	E3M-C2⃞0807 3⃞4⃞E
Vibration capacity	2.5 G			
IP rating	IP65 (not including power cables and signal cables)			
Approvals	CE			

Note:

1. The rated torque is the continuous permissible torque when the servo 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 servo motor brake is only for keeping the object installed on the motor in a stopped state. Do not use it for deceleration or as a dynamic brake.
3. If the operating temperature is over 40°C (104°F), refer to Section A.2.3 Power derating curves of the E3 motors.
4. In the servo motor model number, 2⃞ represents the encoder type, 3⃞ represents the brake or keyway / oil seal type, and 4⃞ represents the shaft diameter and connector type.
5. Follow the load specification for the motor shaft during operation. The load for the motor shaft is defined as follows.

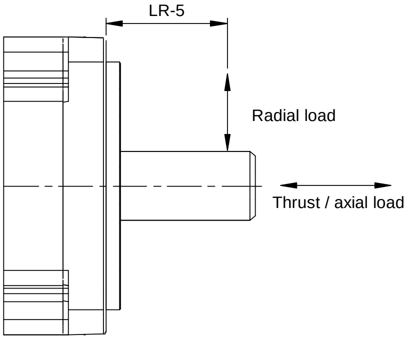


Motor frame size: 130 mm & 180 mm

ECM-	E3M-E$\boxed{2}$1310$\boxed{3}\boxed{4}$E	E3M-E$\boxed{2}$1315$\boxed{3}\boxed{4}$E	E3M-E$\boxed{2}$1320$\boxed{3}\boxed{4}$E	E3M-F$\boxed{2}$1830$\boxed{3}\boxed{4}$E
Rated power (kW)	1	1.5	2	3
Rated torque (N-m)[*1]	4.77	7.16	9.55	19.1
Max. torque (N-m)	14.3	21.48	28.65	57.29
Rated speed (rpm)	2000			1500
Max. speed (rpm)	3000			
Rated current (Arms)	5.96	8.17	10.59	18.21
Max. instantaneous current (Arms)	19.9	26.82	34.20	58.9
Change of rated power (kW/s)	29.21	45.69	62.25	68.02
Change of rated power (kW/s) (with brake)	28.66	45.09	61.62	66.45
Rotor inertia ($\times 10^{-4}$ kg·m^2)	7.79	11.22	14.65	53.63
Rotor inertia ($\times 10^{-4}$ kg·m^2) (with brake)	7.94	11.37	14.8	54.9
Mechanical time constant (ms)	1.46	1.10	1.03	1.21
Mechanical time constant (ms) (with brake)	1.49	1.12	1.04	1.24
Torque constant-KT (N-m/A)	0.80	0.88	0.90	1.05
Voltage constant-KE (mV/rpm)	29.30	31.69	32.70	37.9
Armature resistance (Ohm)	0.419	0.260	0.198	0.086
Armature inductance (mH)	4	2.81	2.18	1.52
Electrical time constant (ms)	9.55	10.81	11.01	17.67
Weight (w/o brake) (kg)	4.9	6.0	7.0	13.9
Weight (with brake) (kg)	6.3	7.4	8.5	17.6
Max. radial load (N)[*5]	490	686	980	1470
Max. axial load (N)[*5]	98	343	392	490
Brake operating voltage	24 V_{DC} ± 10%			
Brake holding torque [N-m (Min)][*2]	10	10	10	25
Brake power consumption (at 20°C (68°F))[W]	21.5	21.5	21.5	31
Brake release time [ms (Max)]	50	50	50	30
Brake pull-in time [ms (Max)]	110	110	110	120
Derating rate with oil seal (%)	5	5	5	5
Insulation class	Class B (CE)			
Insulation resistance	100 MΩ min. (at 500 V_{DC})			
Insulation strength	1.8 kV_{AC}, 1 sec			
Vibration grade	V15			
Operating temperature	-20°C to +60°C (-4°F to +140°F)[*3]			
Storage temperature	-20°C to +80°C (-4°F to +176°F)			
Operating 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			

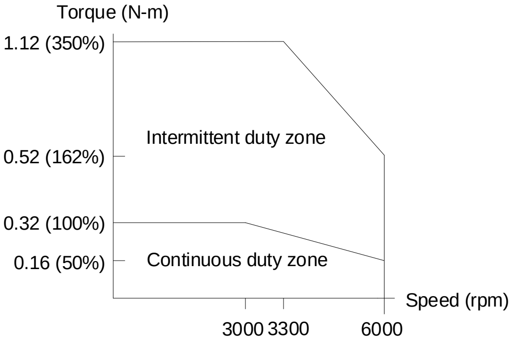
Note:

1. The rated torque is the continuous permissible torque when the servo 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
   F180: 550 mm x 550 mm x 30 mm
   Material: aluminum
2. The built-in servo motor brake is only for keeping the object in a stopped state. Do not use it for deceleration or as a dynamic brake.
3. If the operating temperature is over 40°C (104°F), refer to Section A.2.3 Power derating curves of the E3 motors.
4. In the servo motor model number, $\boxed{2}$ represents the encoder type, $\boxed{3}$ represents the brake or keyway / oil seal type, and $\boxed{4}$ represents the shaft diameter and connector type.
5. Follow the load specification for the motor shaft during operation. The load for the motor shaft is defined as follows.

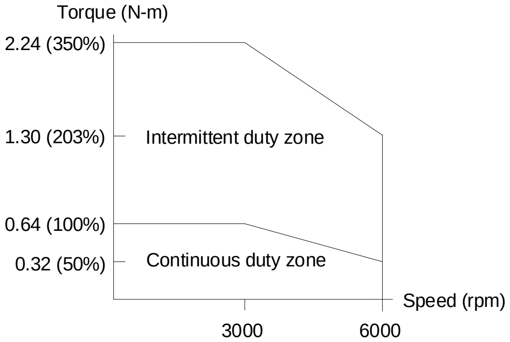


A.2.2 Torque features (T-N curves) of the E3 motors

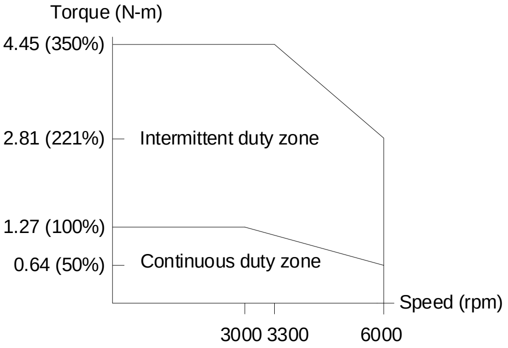
Motor frame size: 80 mm and below



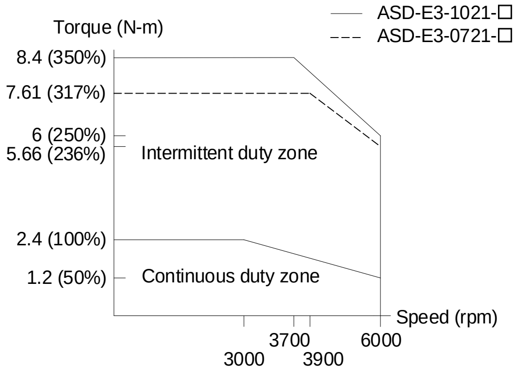
ECM-E3L-C2⃞04013⃞4⃞E



ECM-E3M-C2⃞06023⃞4⃞E



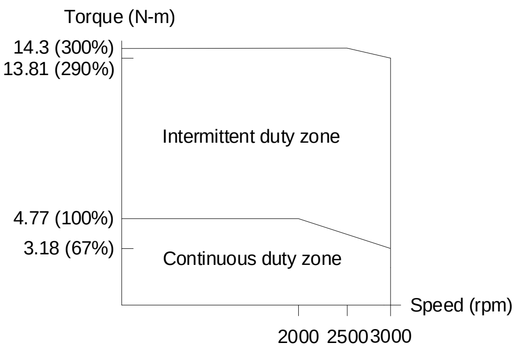
ECM-E3M-C2⃞06043⃞4⃞E



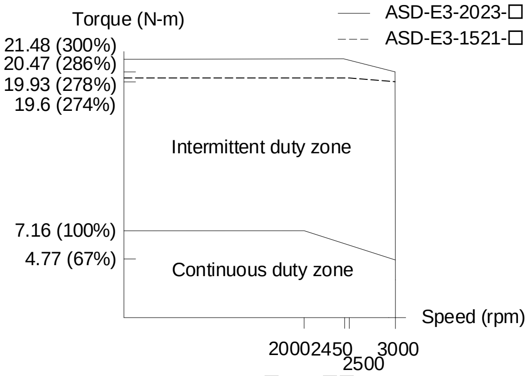
ECM-E3M-C2⃞08073⃞4⃞E

Note: in the servo motor model number, 2⃞ represents the encoder type, 3⃞ represents the brake or keyway / oil seal type, and 4⃞ represents the shaft diameter and connector type.

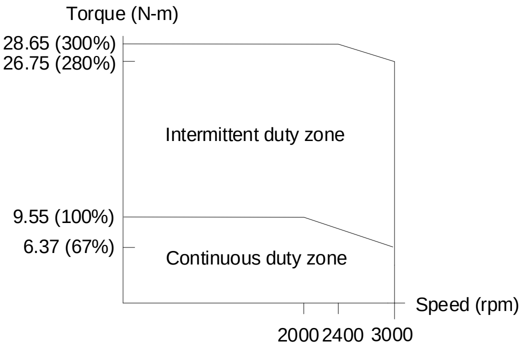
Motor frame size: 130 mm



ECM-E3M-E2⃞1310③④E



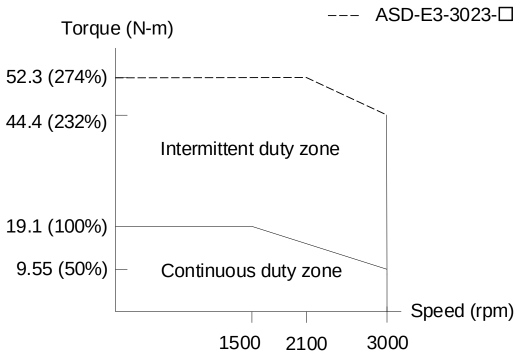
ECM-E3M-E2⃞1315③④E



ECM-E3M-E2⃞1320③④E

Note: in the servo motor model number, 2⃞ represents the encoder type, 3⃞ represents the brake or keyway / oil seal type, and 4⃞ represents the shaft diameter and connector type.

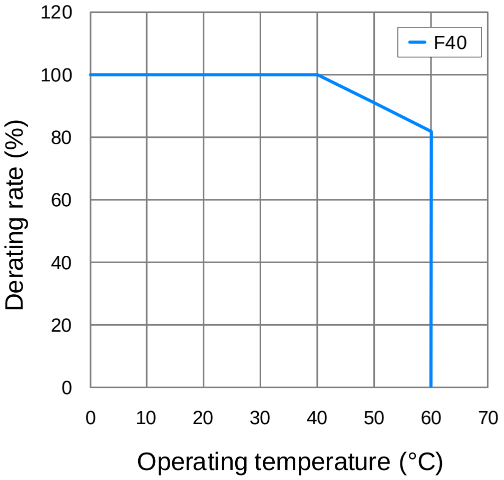
Motor frame size: 180 mm

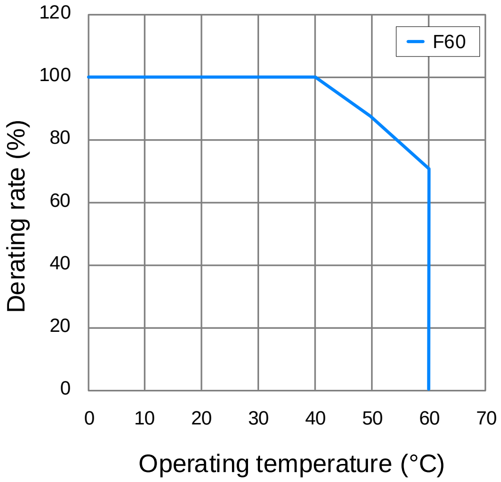


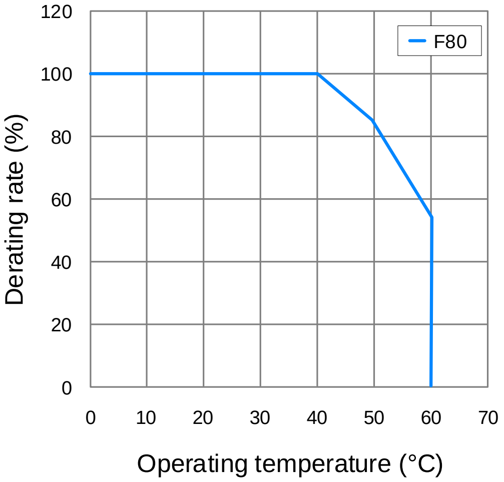
ECM-E3M-F2⃞1830③④E

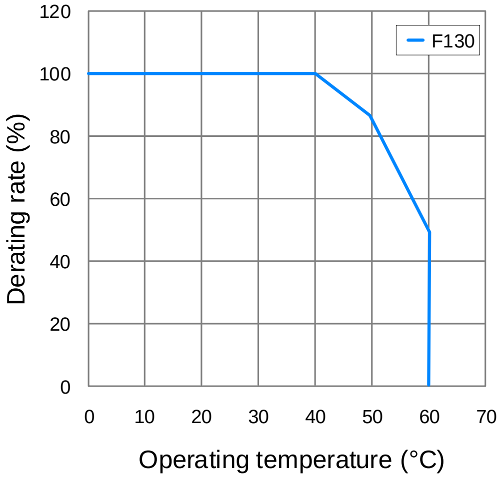
Note: in the servo motor model number, 2⃞ represents the encoder type, 3⃞ represents the brake or keyway / oil seal type, and 4⃞ represents the shaft diameter and connector type.

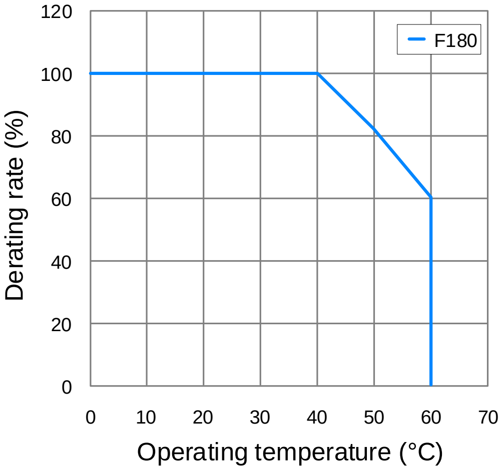
A.2.3 Power derating curves of the E3 motors











A.2.4 Overload features

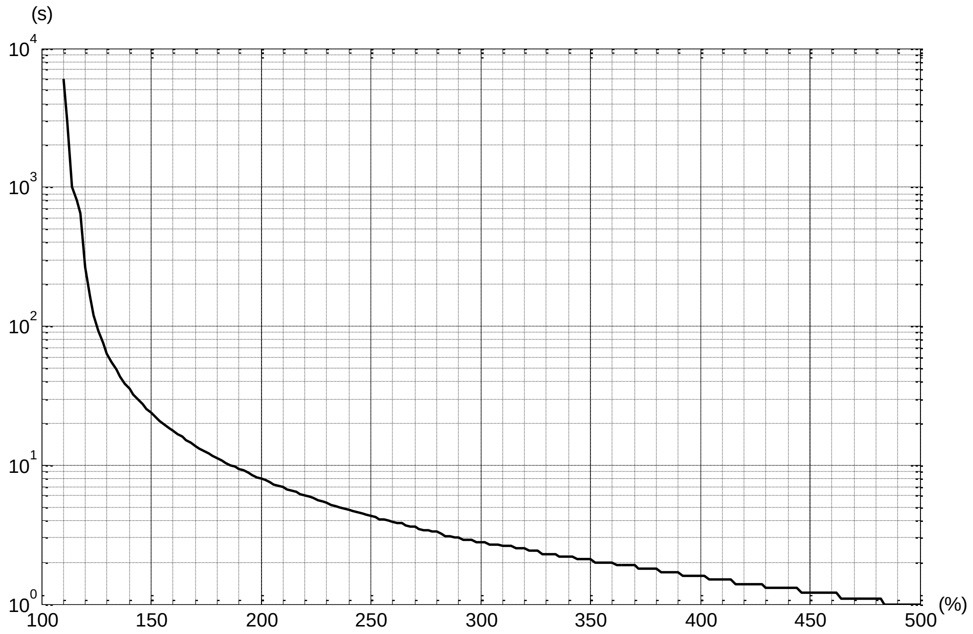
Definition of overload protection

The overload protection prevents the motor from overheating.

Causes of overload

1. The motor's operating torque exceeds the rated range and the operating time is too long.
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 resonance in the motor.
5. A motor with a built-in brake operates without the brake released.

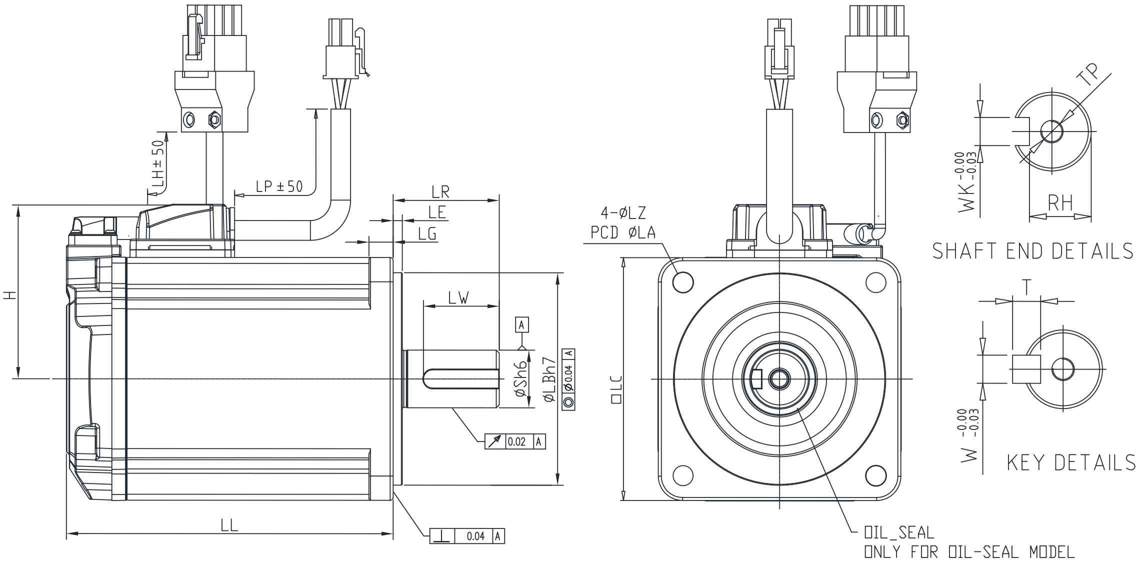
Graph of load ratio and operating time



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	1.0 s

A.2.5 Dimensions of ECM-E3 series servo motor

Motor frame size: 80 mm and below

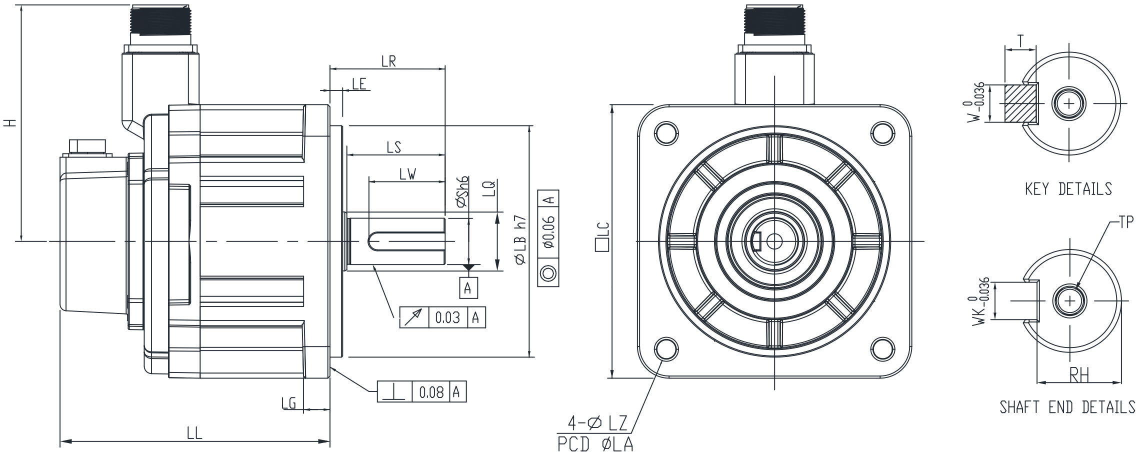


Unit: mm

ECM-	E3L-C②0401③④E	E3M-C②0602③④E	E3M-C②0604③④E	E3M-C②0807③④E
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 (w/o 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	37.5	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

Note: in the servo motor model number, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, and ④ represents the shaft diameter and connector type.

Motor frame size: 130 mm & 180 mm



Unit: mm

ECM-	E3M-E2⃞1310 3⃞4⃞E	E3M-E2⃞1315 3⃞4⃞E	E3M-E2⃞1320 3⃞4⃞E	E3M-F2⃞1830 3⃞4⃞E
LC	130	130	130	180
LZ	9	9	9	13.5
LA	145	145	145	200
S	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$35(^{+0}_{-0.016})$
LB	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$114.3(^{+0}_{-0.035})$
LL (w/o brake)	127.9	139.9	151.9	160.5
LL (with brake)	168.5	180.5	192.5	212.5
H	115	115	115	139
LS	47	47	47	73
LR	55	55	55	79
LQ	28	28	28	45
LE	6	6	6	4
LG	12.5	12.5	12.5	18
LW	36	36	36	63
RH	18	18	18	30
WK	8	8	8	10
W	8	8	8	10
T	7	7	7	8
TP	M6 Depth 12	M6 Depth 12	M6 Depth 12	M12 Depth 25

Note: in the servo motor model number, 2⃞ represents the encoder type, 3⃞ represents the brake or keyway / oil seal type, and 4⃞ represents the shaft diameter and connector type.

Accessories Appendix B

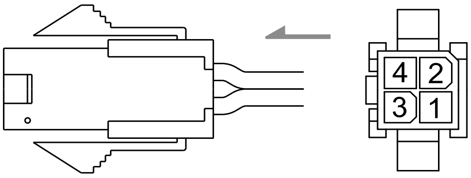
This chapter only provides model numbers or part numbers of the accessories, refer to the servo drive catalog for choosing the suitable models.

B.1 Power connector

B.1.1 F40 - F80 motors

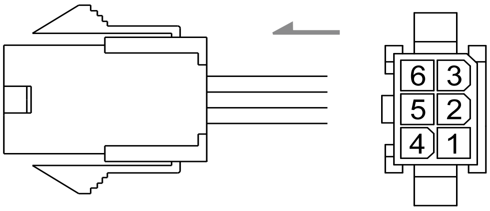
Standard connector for E3 non-brake motors

Delta model number: ACS3-CAPW1000



Standard connector for E3 brake motors

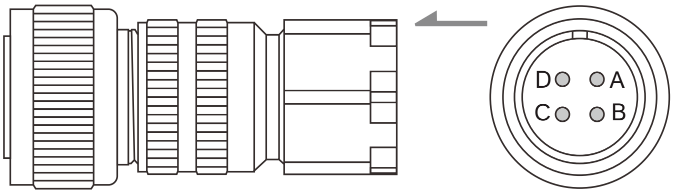
Delta model number: ACS3-CAPW2000



B.1.2 F100 - F130 motors

Straight military connector for E3 non-brake motors

Delta model number: ACS3-CAPWA000

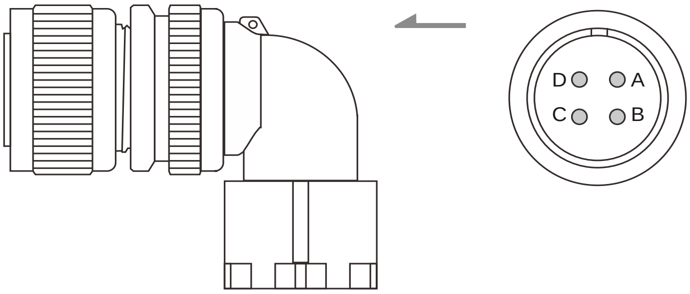


Note:

1. Refer to Section 3.1.7 Wiring for IP67 waterproof connectors for more information.
2. For the brake motors, you need to purchase this connector and the brake connector for F100 - F180 motors listed in Section B.1.4.

Right angle military connector for E3 non-brake motors

Delta model number: ACS3-CRPWA000



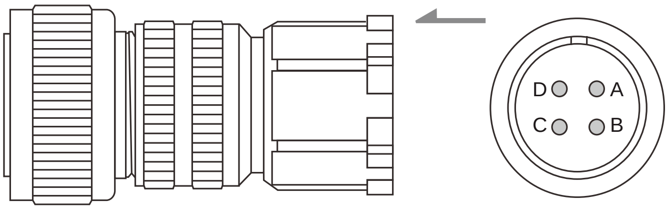
Note:

1. Refer to Section 3.1.7 Wiring for IP67 waterproof connectors for more information.
2. For the brake motors, you need to purchase this connector and the brake connector for F100 - F180 motors listed in Section B.1.4.

B.1.3 F180 motors

Straight military connector for E3 non-brake motors

Delta model number: ACS3-CAPWC000

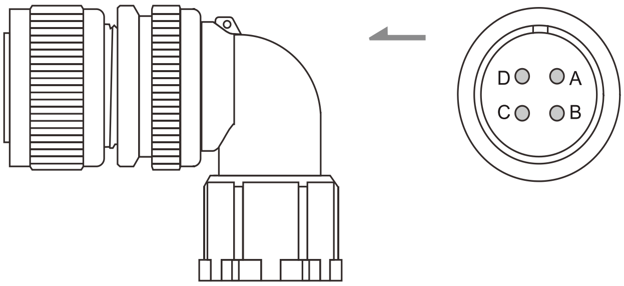


Note:

1. Refer to Section 3.1.7 Wiring for IP67 waterproof connectors for more information.
2. For the brake motors, you need to purchase this connector and the brake connector for F100 - F180 motors listed in Section B.1.4.

Right angle military connector for E3 non-brake motors

Delta model number: ACS3-CRPWC000



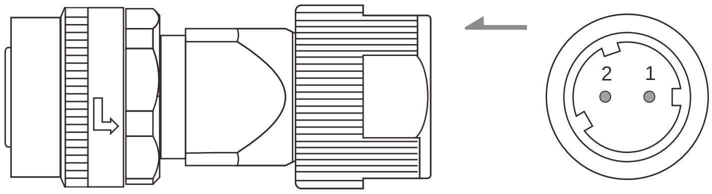
Note:

1. Refer to Section 3.1.7 Wiring for IP67 waterproof connectors for more information.
2. For the brake motors, you need to purchase this connector and the brake connector for F100 - F180 motors listed in Section B.1.4.

B.1.4 Brake connector for F100 - F180 motors

Straight military connector for E3 motors

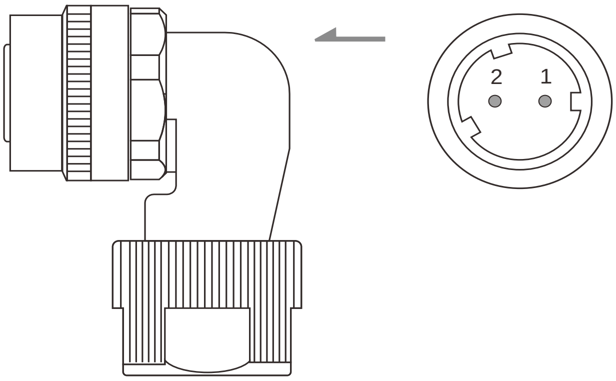
Delta model number: ACS3-CABRA000



Note: refer to Section 3.1.7 Wiring for IP67 waterproof connectors for more information.

Right angle military connector for E3 motors

Delta model number: ACS3-CRBRA000

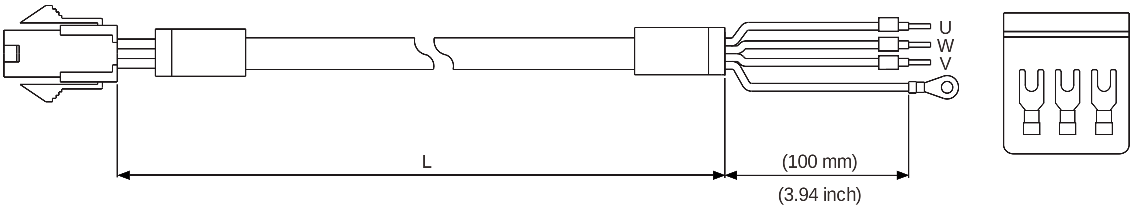


Note: refer to Section 3.1.7 Wiring for IP67 waterproof connectors for more information.

B.2 Power cable

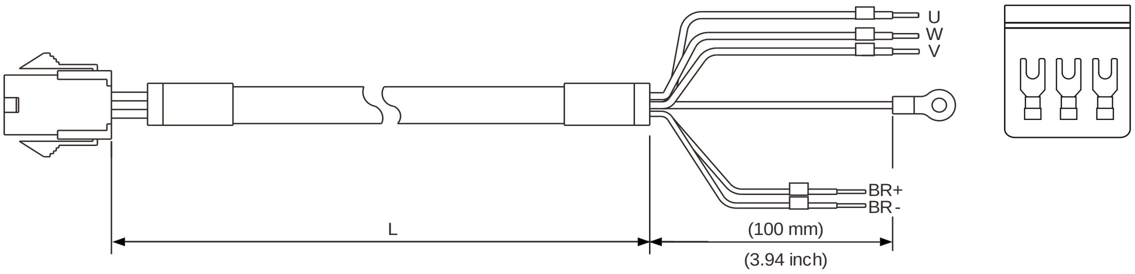
B.2.1 F40 - F80 motors

Cable with standard connector for or E3 non-brake motors



Cable type	Model number	UVW wire diameter	L	
		AWG (mm²)	mm	inch
Standard	ACS3-CAPW1103	18 (0.82)	3000 ± 50	118 ± 2
	ACS3-CAPW1105	18 (0.82)	5000 ± 50	197 ± 2
	ACS3-CAPW1110	18 (0.82)	10000 ± 100	394 ± 4
	ACS3-CAPW1120	18 (0.82)	20000 ± 100	787 ± 4
Flexible	ACS3-CAPF1103	18 (0.82)	3000 ± 50	118 ± 2
	ACS3-CAPF1105	18 (0.82)	5000 ± 50	197 ± 2
	ACS3-CAPF1110	18 (0.82)	10000 ± 100	394 ± 4
	ACS3-CAPF1120	18 (0.82)	20000 ± 100	787 ± 4

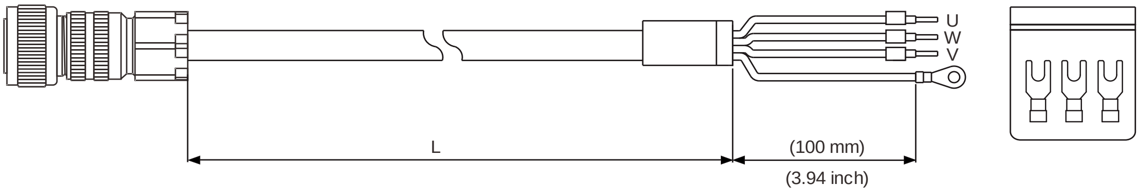
Cable with standard connector for E3 brake motors



Cable type	Model number	UVW wire diameter	Brake wire diameter	L	
		AWG (mm²)		mm	inch
Standard	ACS3-CAPW2103	18 (0.82)	22 (0.3)	3000 ± 50	118 ± 2
	ACS3-CAPW2105	18 (0.82)	22 (0.3)	5000 ± 50	197 ± 2
	ACS3-CAPW2110	18 (0.82)	22 (0.3)	10000 ± 100	394 ± 4
	ACS3-CAPW2120	18 (0.82)	22 (0.3)	20000 ± 100	787 ± 4
Flexible	ACS3-CAPF2103	18 (0.82)	22 (0.3)	3000 ± 50	118 ± 2
	ACS3-CAPF2105	18 (0.82)	22 (0.3)	5000 ± 50	197 ± 2
	ACS3-CAPF2110	18 (0.82)	22 (0.3)	10000 ± 100	394 ± 4
	ACS3-CAPF2120	18 (0.82)	22 (0.3)	20000 ± 100	787 ± 4

B.2.2 F100 - F130 motors

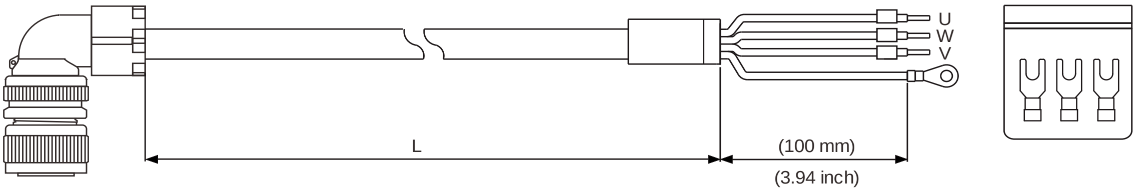
Cable with straight military connector for E3 non-brake motors



Cable type	Model number	Connector	Wire diameter	L	
			AWG (mm^2)	mm	inch
Standard	ACS3-CAPWA203	3106A-18-10S	16 (1.3)	3000 ± 50	118 ± 2
	ACS3-CAPWA205		16 (1.3)	5000 ± 50	197 ± 2
	ACS3-CAPWA210		16 (1.3)	10000 ± 100	394 ± 4
	ACS3-CAPWA220		16 (1.3)	20000 ± 100	787 ± 4
	ACS3-CAPWA303		14 (2.1)	3000 ± 50	118 ± 2
	ACS3-CAPWA305		14 (2.1)	5000 ± 50	197 ± 2
	ACS3-CAPWA310		14 (2.1)	10000 ± 100	394 ± 4
	ACS3-CAPWA320		14 (2.1)	20000 ± 100	787 ± 4
Flexible	ACS3-CAPFA203		16 (1.3)	3000 ± 50	118 ± 2
	ACS3-CAPFA205		16 (1.3)	5000 ± 50	197 ± 2
	ACS3-CAPFA210		16 (1.3)	10000 ± 100	394 ± 4
	ACS3-CAPFA220		16 (1.3)	20000 ± 100	787 ± 4
	ACS3-CAPFA303		14 (2.1)	3000 ± 50	118 ± 2
	ACS3-CAPFA305		14 (2.1)	5000 ± 50	197 ± 2
	ACS3-CAPFA310		14 (2.1)	10000 ± 100	394 ± 4
	ACS3-CAPFA320		14 (2.1)	20000 ± 100	787 ± 4

Note: brake cables are sold separately. Refer to Section B.2.4 for more information.

Cable with right angle military connector for E3 non-brake motors

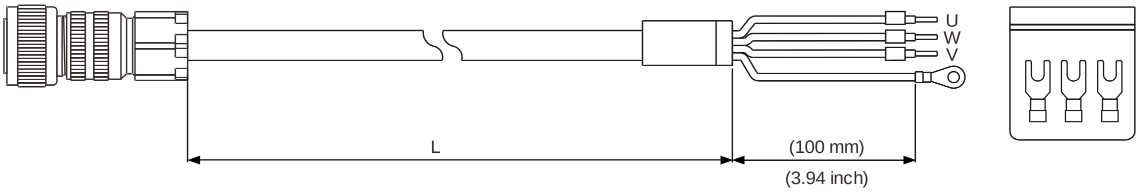


Cable type	Model number	Connector	Wire diameter	L	
			AWG (mm^2)	mm	inch
Standard	ACS3-CRPWA203	3108A-18-10S	16 (1.3)	3000 ± 50	118 ± 2
	ACS3-CRPWA205		16 (1.3)	5000 ± 50	197 ± 2
	ACS3-CRPWA210		16 (1.3)	10000 ± 100	394 ± 4
	ACS3-CRPWA220		16 (1.3)	20000 ± 100	787 ± 4
	ACS3-CRPWA303		14 (2.1)	3000 ± 50	118 ± 2
	ACS3-CRPWA305		14 (2.1)	5000 ± 50	197 ± 2
	ACS3-CRPWA310		14 (2.1)	10000 ± 100	394 ± 4
	ACS3-CRPWA320		14 (2.1)	20000 ± 100	787 ± 4
Flexible	ACS3-CRPFA203		16 (1.3)	3000 ± 50	118 ± 2
	ACS3-CRPFA205		16 (1.3)	5000 ± 50	197 ± 2
	ACS3-CRPFA210		16 (1.3)	10000 ± 100	394 ± 4
	ACS3-CRPFA220		16 (1.3)	20000 ± 100	787 ± 4
	ACS3-CRPFA303		14 (2.1)	3000 ± 50	118 ± 2
	ACS3-CRPFA305		14 (2.1)	5000 ± 50	197 ± 2
	ACS3-CRPFA310		14 (2.1)	10000 ± 100	394 ± 4
	ACS3-CRPFA320		14 (2.1)	20000 ± 100	787 ± 4

Note: brake cables are sold separately. Refer to Section B.2.4 for more information.

B.2.3 F180 motors

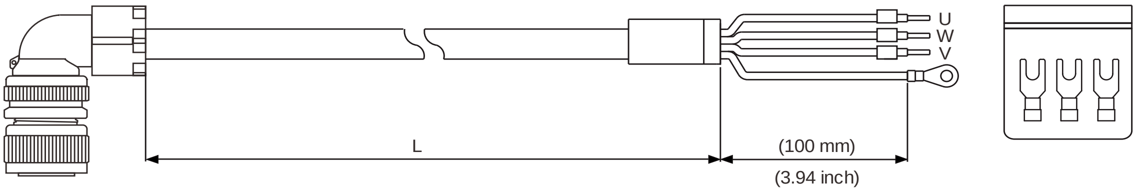
Cable with straight military connector for E3 non-brake motors



Cable type	Model number	Connector	Wire diameter	L	
			AWG (mm^2)	mm	inch
Standard	ACS3-CAPWC303	3106A-22-22S	14 (2.1)	3000 ± 50	118 ± 2
	ACS3-CAPWC305		14 (2.1)	5000 ± 50	197 ± 2
	ACS3-CAPWC310		14 (2.1)	10000 ± 100	394 ± 4
	ACS3-CAPWC320		14 (2.1)	20000 ± 100	787 ± 4
	ACS3-CAPWC403		12 (3.3)	3000 ± 50	118 ± 2
	ACS3-CAPWC405		12 (3.3)	5000 ± 50	197 ± 2
	ACS3-CAPWC410		12 (3.3)	10000 ± 100	394 ± 4
	ACS3-CAPWC420		12 (3.3)	20000 ± 100	787 ± 4
	ACS3-CAPWC503		10 (5.3)	3000 ± 50	118 ± 2
	ACS3-CAPWC505		10 (5.3)	5000 ± 50	197 ± 2
	ACS3-CAPWC510		10 (5.3)	10000 ± 100	394 ± 4
	ACS3-CAPWC520		10 (5.3)	20000 ± 100	787 ± 4
	ACS3-CAPWC603		8 (8.4)	3000 ± 50	118 ± 2
	ACS3-CAPWC605		8 (8.4)	5000 ± 50	197 ± 2
	ACS3-CAPWC610		8 (8.4)	10000 ± 100	394 ± 4
	ACS3-CAPWC620		8 (8.4)	20000 ± 100	787 ± 4
Flexible	ACS3-CAPFC303		14 (2.1)	3000 ± 50	118 ± 2
	ACS3-CAPFC305		14 (2.1)	5000 ± 50	197 ± 2
	ACS3-CAPFC310		14 (2.1)	10000 ± 100	394 ± 4
	ACS3-CAPFC320		14 (2.1)	20000 ± 100	787 ± 4
	ACS3-CAPFC403		12 (3.3)	3000 ± 50	118 ± 2
	ACS3-CAPFC405		12 (3.3)	5000 ± 50	197 ± 2
	ACS3-CAPFC410		12 (3.3)	10000 ± 100	394 ± 4
	ACS3-CAPFC420		12 (3.3)	20000 ± 100	787 ± 4
	ACS3-CAPFC503		10 (5.3)	3000 ± 50	118 ± 2
	ACS3-CAPFC505		10 (5.3)	5000 ± 50	197 ± 2
	ACS3-CAPFC510		10 (5.3)	10000 ± 100	394 ± 4
	ACS3-CAPFC520		10 (5.3)	20000 ± 100	787 ± 4
	ACS3-CAPFC603		8 (8.4)	3000 ± 50	118 ± 2
	ACS3-CAPFC605		8 (8.4)	5000 ± 50	197 ± 2
	ACS3-CAPFC610		8 (8.4)	10000 ± 100	394 ± 4
	ACS3-CAPFC620		8 (8.4)	20000 ± 100	787 ± 4

Note: brake cables are sold separately. Refer to Section B.2.4 for more information.

Cable with right angle military connector for E3 non-brake motors

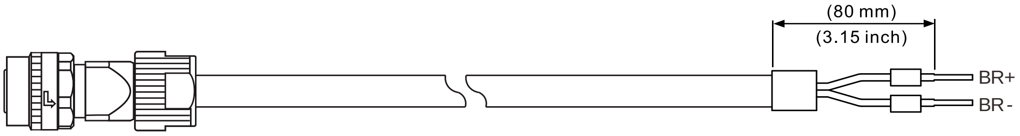


Cable type	Model number	Connector	Wire diameter	L	
			AWG (mm²)	mm	inch
Standard	ACS3-CRPWC303	3108A-22-22S	14 (2.1)	3000 ± 50	118 ± 2
	ACS3-CRPWC305		14 (2.1)	5000 ± 50	197 ± 2
	ACS3-CRPWC310		14 (2.1)	10000 ± 100	394 ± 4
	ACS3-CRPWC320		14 (2.1)	20000 ± 100	787 ± 4
	ACS3-CRPWC403		12 (3.3)	3000 ± 50	118 ± 2
	ACS3-CRPWC405		12 (3.3)	5000 ± 50	197 ± 2
	ACS3-CRPWC410		12 (3.3)	10000 ± 100	394 ± 4
	ACS3-CRPWC420		12 (3.3)	20000 ± 100	787 ± 4
	ACS3-CRPWC503		10 (5.3)	3000 ± 50	118 ± 2
	ACS3-CRPWC505		10 (5.3)	5000 ± 50	197 ± 2
	ACS3-CRPWC510		10 (5.3)	10000 ± 100	394 ± 4
	ACS3-CRPWC520		10 (5.3)	20000 ± 100	787 ± 4
	ACS3-CRPWC603		8 (8.4)	3000 ± 50	118 ± 2
	ACS3-CRPWC605		8 (8.4)	5000 ± 50	197 ± 2
	ACS3-CRPWC610		8 (8.4)	10000 ± 100	394 ± 4
	ACS3-CRPWC620		8 (8.4)	20000 ± 100	787 ± 4
Flexible	ACS3-CRPFC303		14 (2.1)	3000 ± 50	118 ± 2
	ACS3-CRPFC305		14 (2.1)	5000 ± 50	197 ± 2
	ACS3-CRPFC310		14 (2.1)	10000 ± 100	394 ± 4
	ACS3-CRPFC320		14 (2.1)	20000 ± 100	787 ± 4
	ACS3-CRPFC403		12 (3.3)	3000 ± 50	118 ± 2
	ACS3-CRPFC405		12 (3.3)	5000 ± 50	197 ± 2
	ACS3-CRPFC410		12 (3.3)	10000 ± 100	394 ± 4
	ACS3-CRPFC420		12 (3.3)	20000 ± 100	787 ± 4
	ACS3-CRPFC503		10 (5.3)	3000 ± 50	118 ± 2
	ACS3-CRPFC505		10 (5.3)	5000 ± 50	197 ± 2
	ACS3-CRPFC510		10 (5.3)	10000 ± 100	394 ± 4
	ACS3-CRPFC520		10 (5.3)	20000 ± 100	787 ± 4
	ACS3-CRPFC603		8 (8.4)	3000 ± 50	118 ± 2
	ACS3-CRPFC605		8 (8.4)	5000 ± 50	197 ± 2
	ACS3-CRPFC610		8 (8.4)	10000 ± 100	394 ± 4
	ACS3-CRPFC620		8 (8.4)	20000 ± 100	787 ± 4

Note: brake cables are sold separately. Refer to Section B.2.4 for more information.

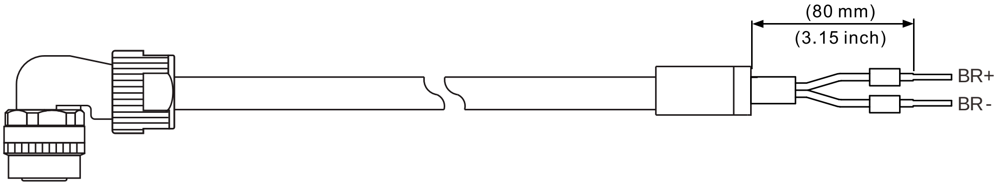
B.2.4 Brake cable for F100 - F180 motors

Cable with straight military connector for E3 motors



Cable type	Model number	Connector	Wire diameter	L	
			AWG (mm²)	mm	inch
Standard	ACS3-CABRA103	CMV1-SP2S	20 (0.5)	3000 ± 100	118 ± 4
	ACS3-CABRA105		20 (0.5)	5000 ± 100	197 ± 4
	ACS3-CABRA110		20 (0.5)	10000 ± 100	394 ± 4
	ACS3-CABRA120		20 (0.5)	20000 ± 100	787 ± 4
Flexible	ACS3-CABFA103		20 (0.5)	3000 ± 100	118 ± 4
	ACS3-CABFA105		20 (0.5)	5000 ± 100	197 ± 4
	ACS3-CABFA110		20 (0.5)	10000 ± 100	394 ± 4
	ACS3-CABFA120		20 (0.5)	20000 ± 100	787 ± 4

Cable with right angle military connector for E3 motors

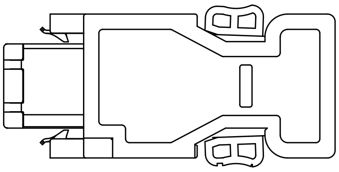


Cable type	Model number	Connector	Wire diameter	L	
			AWG (mm²)	mm	inch
Standard	ACS3-CRBRA103	CMV1-AP2S	20 (0.5)	3000 ± 100	118 ± 4
	ACS3-CRBRA105		20 (0.5)	5000 ± 100	197 ± 4
	ACS3-CRBRA110		20 (0.5)	10000 ± 100	394 ± 4
	ACS3-CRBRA120		20 (0.5)	20000 ± 100	787 ± 4
Flexible	ACS3-CRBFA103		20 (0.5)	3000 ± 100	118 ± 4
	ACS3-CRBFA105		20 (0.5)	5000 ± 100	197 ± 4
	ACS3-CRBFA110		20 (0.5)	10000 ± 100	394 ± 4
	ACS3-CRBFA120		20 (0.5)	20000 ± 100	787 ± 4

B.3 Encoder connector

Servo drive end

Delta model number: ACS3-CNENC200

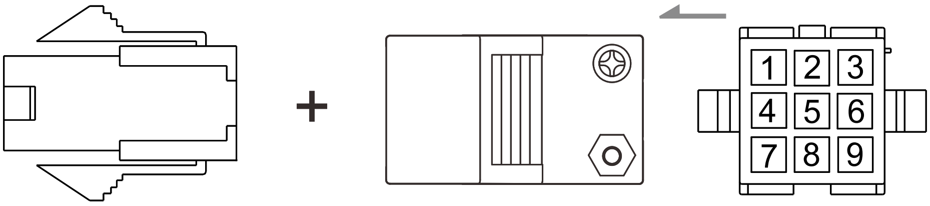


B.3.1 F40 - F80 motors

The following is the connector for the motor end, which need to be used with the connector (ACS3-CNENC200) for the servo drive end.

Standard connector for E3 motors

Delta model number: ACS3-CAEN0000

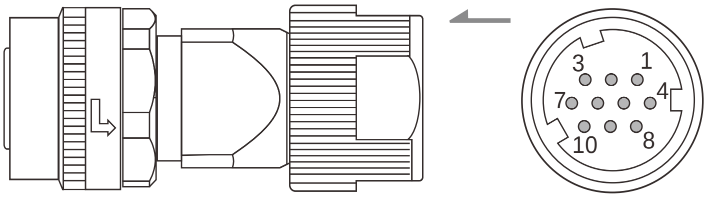


B.3.2 F100 - F180 motors

The following are connectors for the motor end, which need to be used with the connector (ACS3-CNENC200) for the servo drive end.

Straight military connector for E3 motors

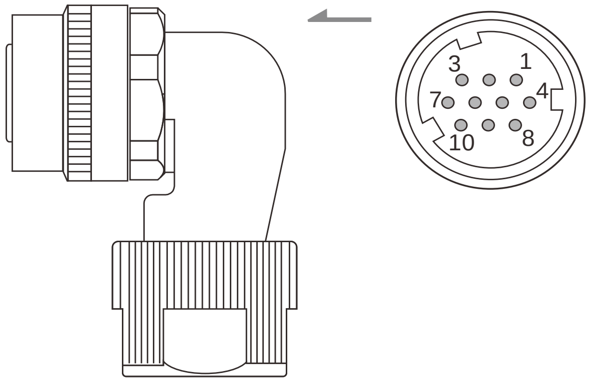
Delta model number: ACS3-CAENA000



Note: refer to Section 3.1.7 Wiring for IP67 waterproof connectors for more information.

Right angle military connector for E3 motors

Delta model number: ACS3-CRENA000

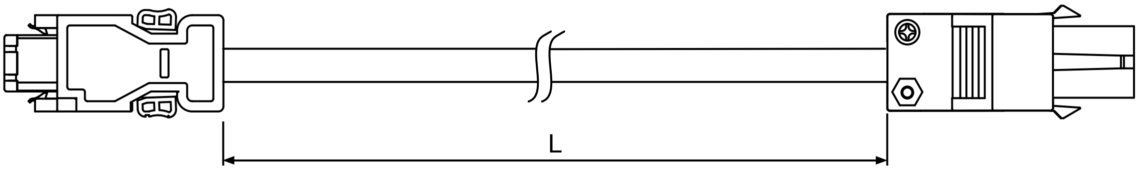


Note: refer to Section 3.1.7 Wiring for IP67 waterproof connectors for more information.

B.4 Encoder cable (incremental type)

B.4.1 F40 - F80 motors

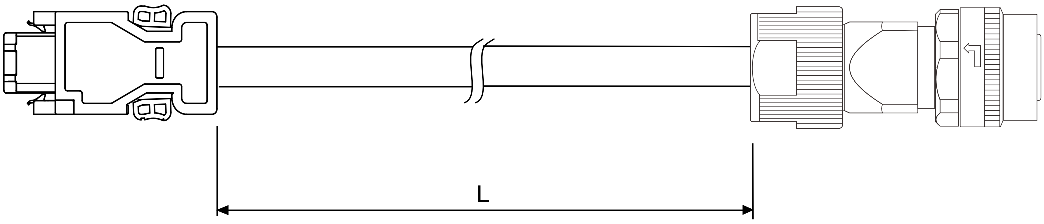
Cable with standard connector for E3 motors



Cable type	Model number	L	
		mm	inch
Standard	ACS3-CAEN0103	3000 ± 50	118 ± 2
	ACS3-CAEN0105	5000 ± 50	197 ± 2
	ACS3-CAEN0110	10000 ± 100	394 ± 4
	ACS3-CAEN0120	20000 ± 100	787 ± 4
Flexible	ACS3-CAEF0103	3000 ± 50	118 ± 2
	ACS3-CAEF0105	5000 ± 50	197 ± 2
	ACS3-CAEF0110	10000 ± 100	394 ± 4
	ACS3-CAEF0120	20000 ± 100	787 ± 4

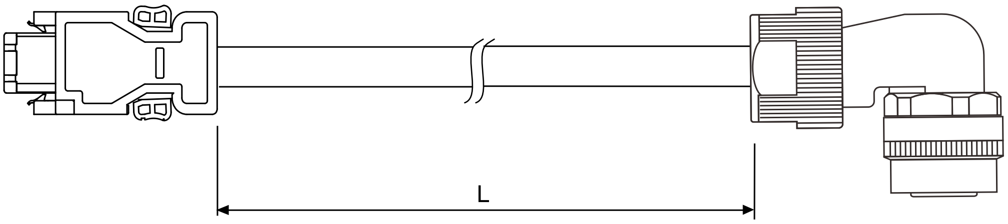
B.4.2 F100 - F180 motors

Cable with straight military connector for E3 motors



Cable type	Model number	Connector	L	
			mm	inch
Standard	ACS3-CAENA103	CMV1-SP10S	3000 ± 50	118 ± 2
	ACS3-CAENA105		5000 ± 50	197 ± 2
	ACS3-CAENA110		10000 ± 100	394 ± 4
	ACS3-CAENA120		20000 ± 100	787 ± 4
Flexible	ACS3-CAEFA103		3000 ± 50	118 ± 2
	ACS3-CAEFA105		5000 ± 50	197 ± 2
	ACS3-CAEFA110		10000 ± 100	394 ± 4
	ACS3-CAEFA120		20000 ± 100	787 ± 4

Cable with right angle military connector for E3 motors

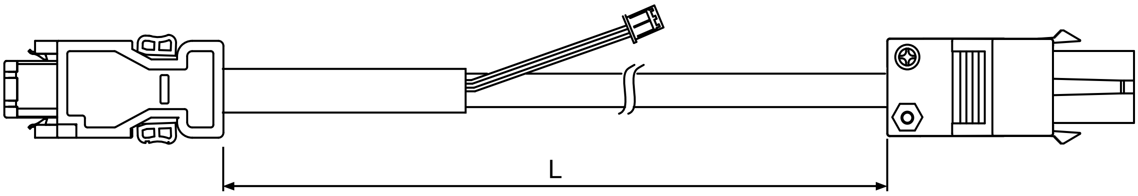


Cable type	Model number	Connector	L	
			mm	inch
Standard	ACS3-CRENA103	CMV1-AP10S	3000 ± 50	118 ± 2
	ACS3-CRENA105		5000 ± 50	197 ± 2
	ACS3-CRENA110		10000 ± 100	394 ± 4
	ACS3-CRENA120		20000 ± 100	787 ± 4
Flexible	ACS3-CREFA103		3000 ± 50	118 ± 2
	ACS3-CREFA105		5000 ± 50	197 ± 2
	ACS3-CREFA110		10000 ± 100	394 ± 4
	ACS3-CREFA120		20000 ± 100	787 ± 4

B.5 Encoder cable (absolute type)

B.5.1 F40 - F80 motors

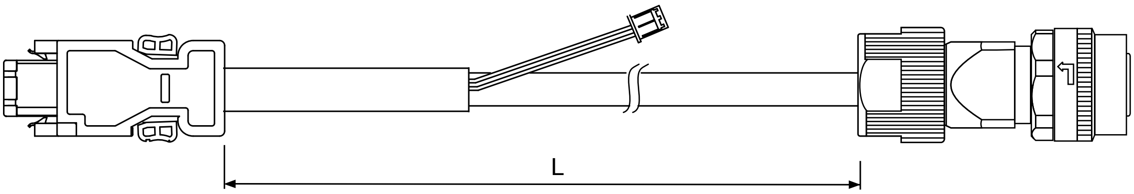
Cable with standard connector for E3 motors



Cable type	Model number	L	
		mm	inch
Standard	ACS3-CAEA0103	3000 ± 50	118 ± 2
	ACS3-CAEA0105	5000 ± 50	197 ± 2
	ACS3-CAEA0110	10000 ± 100	394 ± 4
	ACS3-CAEA0120	20000 ± 100	787 ± 4
Flexible	ACS3-CAEB0103	3000 ± 50	118 ± 2
	ACS3-CAEB0105	5000 ± 50	197 ± 2
	ACS3-CAEB0110	10000 ± 100	394 ± 4
	ACS3-CAEB0120	20000 ± 100	787 ± 4

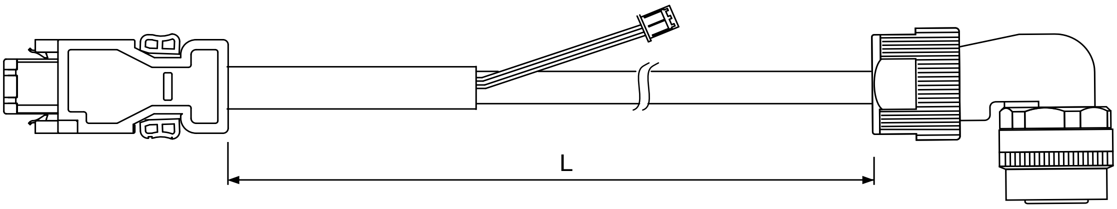
B.5.2 F100 - F180 motors

Cable with straight military connector for E3 motors



Cable type	Model number	Connector	L	
			mm	inch
Standard	ACS3-CAEAA103	CMV1-SP10S	3000 ± 50	118 ± 2
	ACS3-CAEAA105		5000 ± 50	197 ± 2
	ACS3-CAEAA110		10000 ± 100	394 ± 4
	ACS3-CAEAA120		20000 ± 100	787 ± 4
Flexible	ACS3-CAEBA103		3000 ± 50	118 ± 2
	ACS3-CAEBA105		5000 ± 50	197 ± 2
	ACS3-CAEBA110		10000 ± 100	394 ± 4
	ACS3-CAEBA120		20000 ± 100	787 ± 4

Cable with right angle military connector for E3 motors

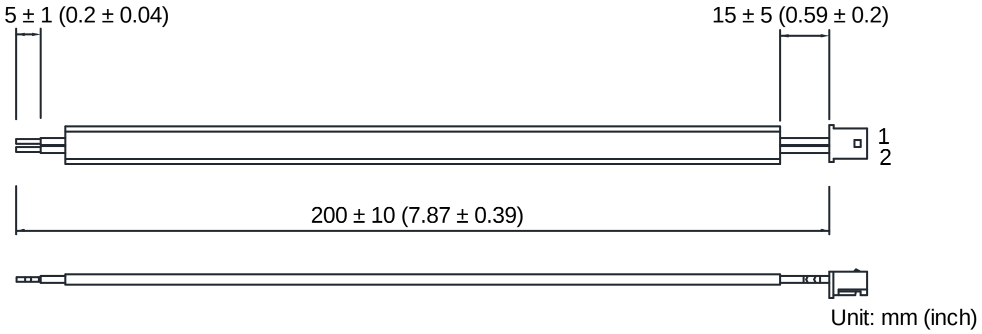


Cable type	Model number	Connector	L	
			mm	inch
Standard	ACS3-CREAA103	CMV1-AP10S	3000 ± 50	118 ± 2
	ACS3-CREAA105		5000 ± 50	197 ± 2
	ACS3-CREAA110		10000 ± 100	394 ± 4
	ACS3-CREAA120		20000 ± 100	787 ± 4
Flexible	ACS3-CREBA103		3000 ± 50	118 ± 2
	ACS3-CREBA105		5000 ± 50	197 ± 2
	ACS3-CREBA110		10000 ± 100	394 ± 4
	ACS3-CREBA120		20000 ± 100	787 ± 4

B.6 Battery box cable

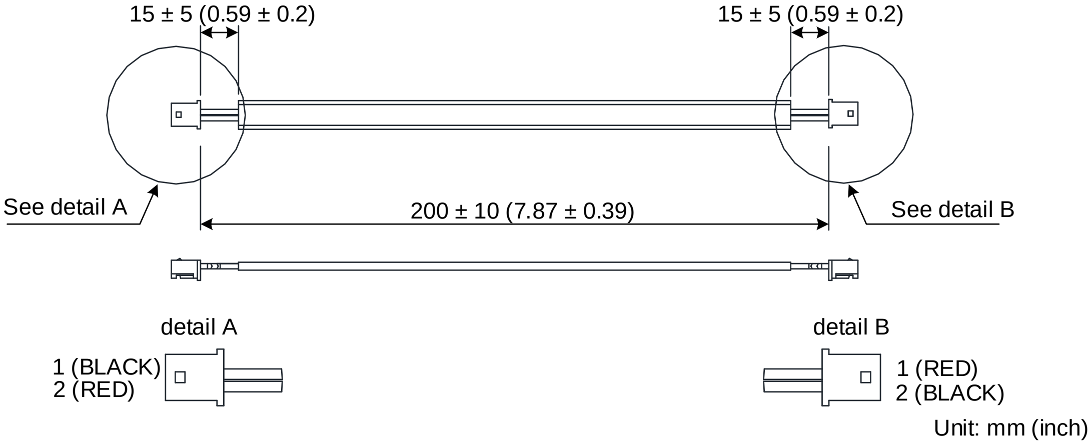
Battery box cable for customized wiring

Delta part number: 3864850600



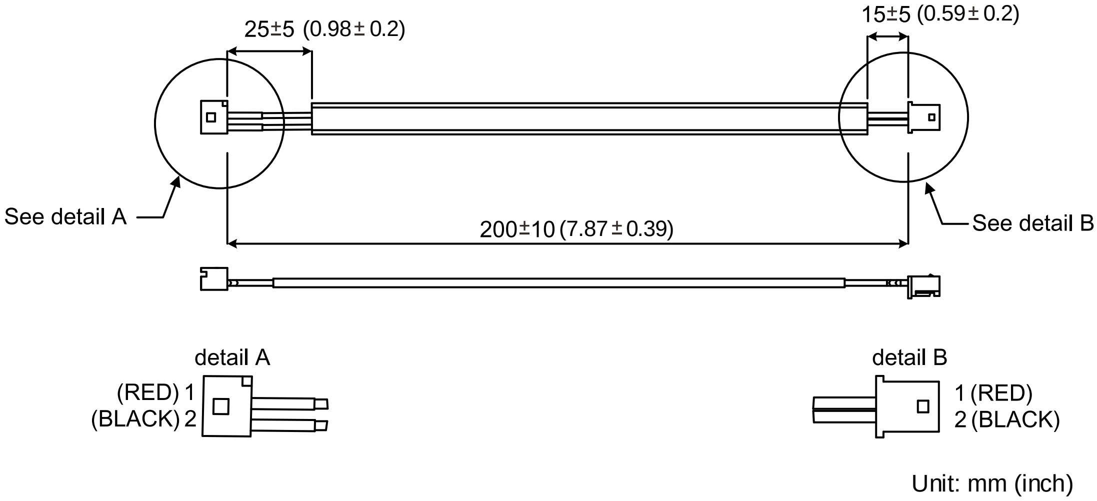
Battery box cable that connects to the encoder cable (male to male)

Delta part number: 3864811901



Battery box cable that connects to the encoder cable (male to female)

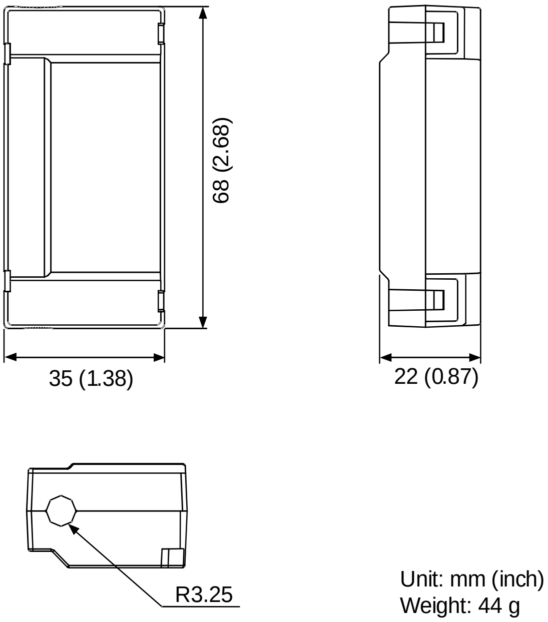
Delta part number: 3864573700



B.7 Battery box

Single battery box

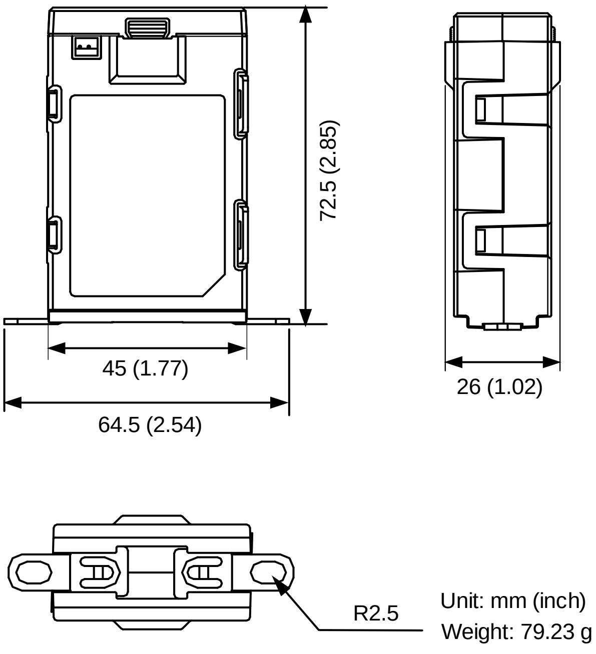
Delta model number: ASD-MDBT0100



Unit: mm (inch)
Weight: 44 g

Dual battery box

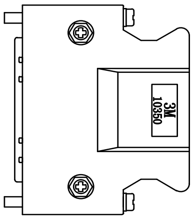
Delta model number: ASD-MDBT0200



Unit: mm (inch)
Weight: 79.23 g

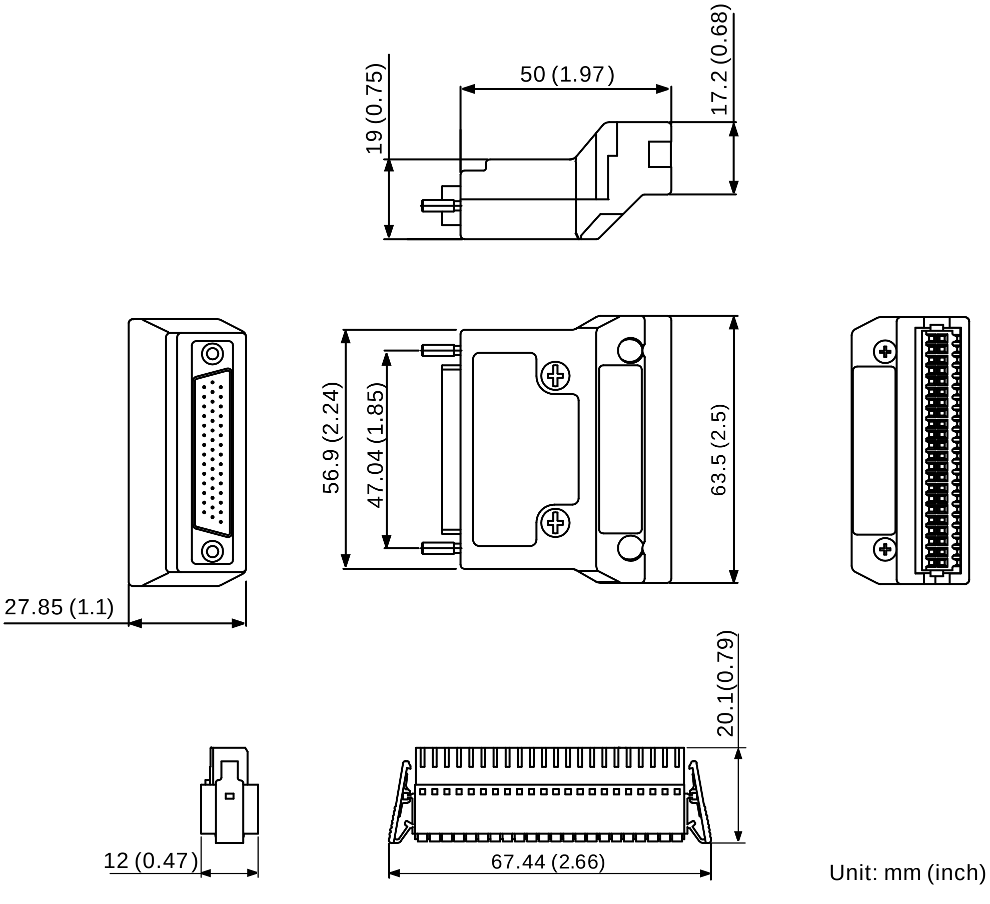
B.8 CN1 connector

Delta model number: ASDBCNDS0044 (for -L servo drives)



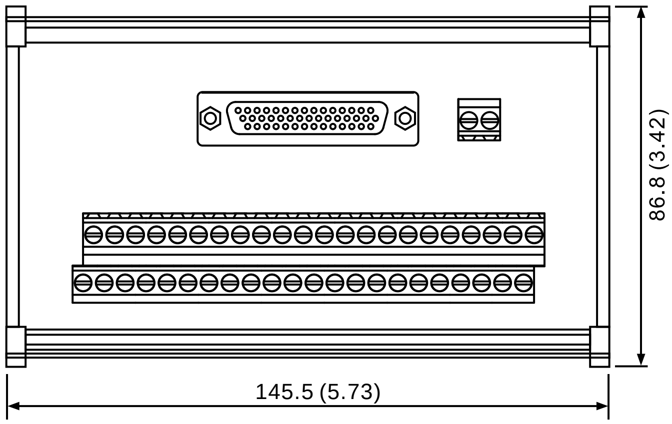
B.9 CN1 quick connector

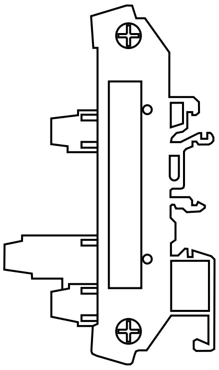
Delta model number: ACS3-IFSC4444 (for -L servo drives)

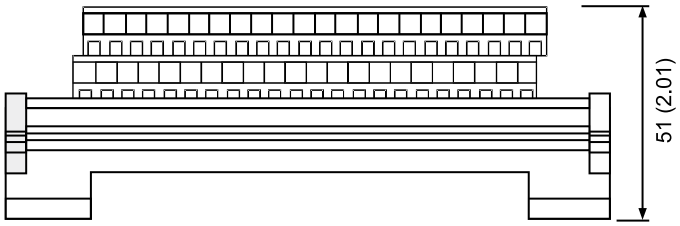


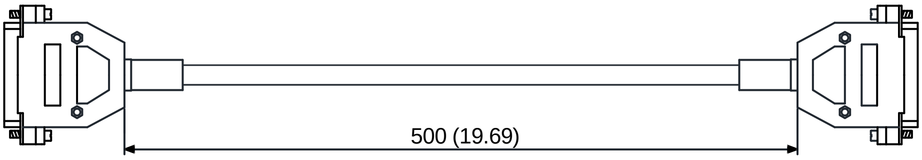
B.10 CN1 terminal block module

Delta model number: ACS3-MDTB4400 (for -L servo drives)





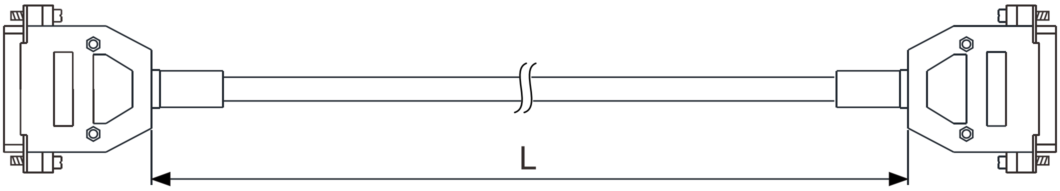




Unit: mm (inch)

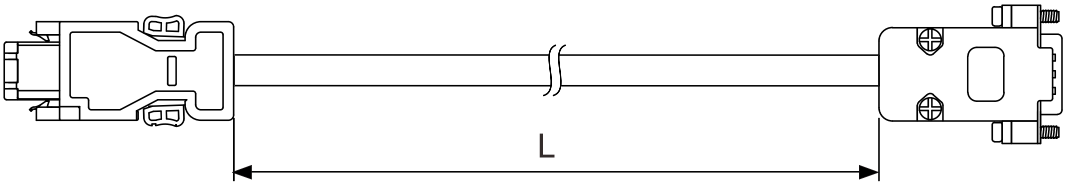
B.11 E3 / B2 conversion cable

CN1 conversion cable (for -L servo drives)



Model number	L	
	mm	inch
ACS3-CABDC1	500 ± 50	19.69 ± 1.97

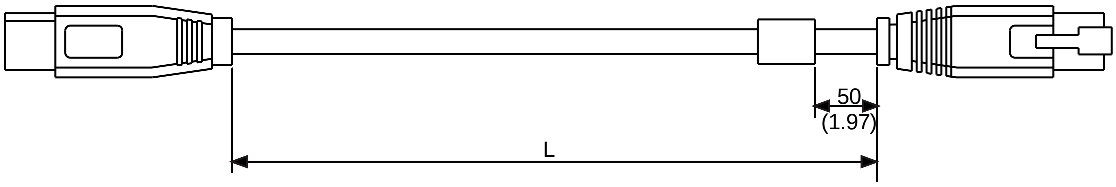
CN2 conversion cable

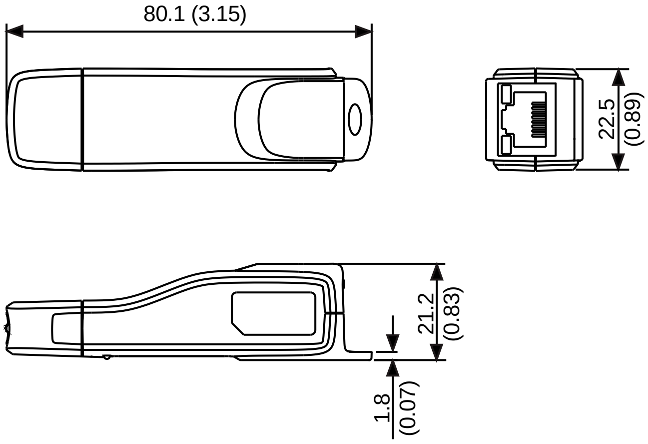


Model number	L	
	mm	inch
ACS3-CABDC2	150	5.91

B.12 CN3 Modbus communication cable

Delta model number: ACS3-CNUS0A08





Unit: mm (inch)

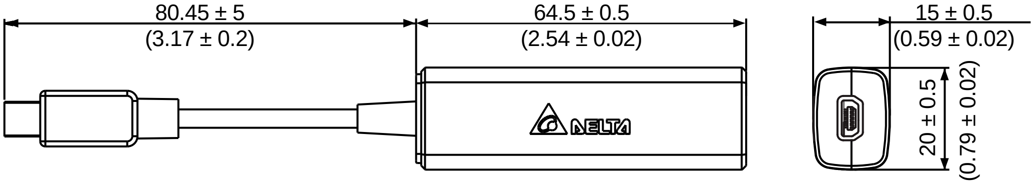
L	
mm	inch
3000 ± 100	118 ± 4

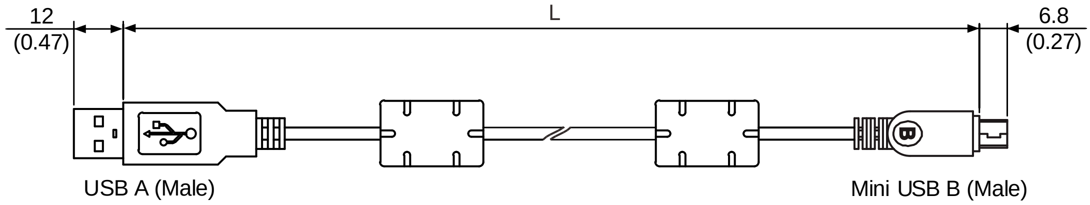
Adapter	
Type-A (USB 2.0) end	RJ-45 end
Connects to the USB port on PC	Connects to the Modbus communication cable

Note: ASD-CNUS0A08 and ACS3-CNUS0A08 are the same product; you only need to purchase either one of them.

B.13 CN4 Mini USB communication module

USB cable and isolator included



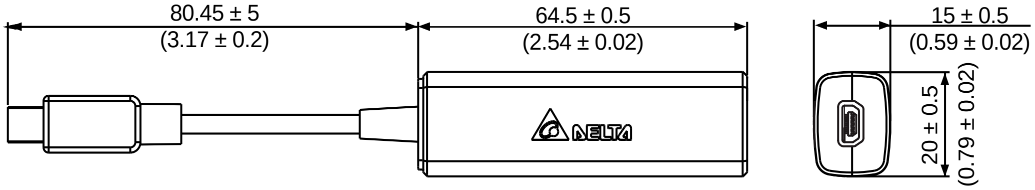


Unit: mm (inch)

Model number	L	
	mm	inch
UC-PRG015-01B	1500 ± 100	59 ± 4
UC-PRG030-01B	3000 ± 100	118 ± 4

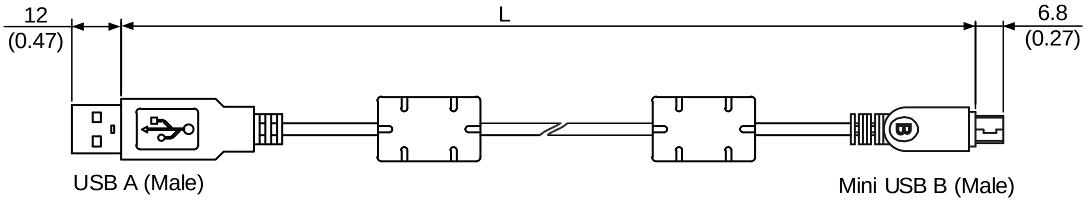
USB isolator

Delta model number: UC-ADP01-A



Unit: mm (inch)

USB cable



Unit: mm (inch)

Model number	L	
	mm	inch
UC-PRG015-01A	1500 ± 100	59 ± 4
UC-PRG030-01A	3000 ± 100	118 ± 4

B.14 Optional accessories

F40 - F80 motors

Cable type	Connector type		Servo drive	100 W	200 W	400 W	750 W	1 kW
			Servo motor (ECM-E3)	100 W	200 W	400 W	750 W	750 W
-	Non-waterproof	-	Encoder connector (servo drive end)	ACS3-CNENC200				
-	Non-waterproof	Standard	Power connector (without brake)	ACS3-CAPW1000				
			Power connector (with brake)	ACS3-CAPW2000				
			Encoder connector (motor end)	ACS3-CAEN0000				
Standard	Non-waterproof	Standard	Power cable (without brake)	ACS3-CAPW11XX				
			Power cable (with brake)	ACS3-CAPW21XX				
			Encoder cable (incremental type)	ACS3-CAEN01XX				
			Encoder cable (absolute type)	ACS3-CAEA01XX				
Flexible	Non-waterproof	Standard	Power cable (without brake)	ACS3-CAPF11XX				
			Power cable (with brake)	ACS3-CAPF21XX				
			Encoder cable (incremental type)	ACS3-CAEF01XX				
			Encoder cable (absolute type)	ACS3-CAEB01XX				

Note:

1. XX indicates the cable length. 03 = 3 m; 05 = 5 m; 10 = 10 m; 20 = 20 m.
2. E3-L model does not support the absolute function, so an absolute encoder cable is not required.

F100 - F130 motors

Cable type	Connector type			1 kW	1.5 kW	2 kW
			Servo drive	1 kW	1.5 kW	2 kW
			Servo motor (ECM-E3)	1 kW	1.5 kW	2 kW
-	Non-waterproof	-	Encoder connector (servo drive end)	ACS3-CNENC200		
-	Waterproof	Military connector - straight	Power connector (without brake)	ACS3-CAPWA000		
			Brake connector	ACS3-CABRA000		
			Encoder connector (motor end)	ACS3-CAENA000		
		Military connector - right angle	Power connector (without brake)	ACS3-CRPWA000		
			Brake connector	ACS3-CRBRA000		
			Encoder connector (motor end)	ACS3-CRENA000		
Standard	Waterproof	Military connector - straight	Power cable (without brake)	ACS3-CAPWA2XX		ACS3-CAPWA3XX
			Brake cable	ACS3-CABRA1XX		
			Encoder cable (incremental type)	ACS3-CAENA1XX		
			Encoder cable (absolute type)	ACS3-CAEAA1XX		
		Military connector - right angle	Power cable (without brake)	ACS3-CRPWA2XX		ACS3-CRPWA3XX
			Brake cable	ACS3-CRBRA1XX		
			Encoder cable (incremental type)	ACS3-CRENA1XX		
			Encoder cable (absolute type)	ACS3-CREAA1XX		
Flexible	Waterproof	Military connector - straight	Power cable (without brake)	ACS3-CAPFA2XX		ACS3-CAPFA3XX
			Brake cable	ACS3-CABFA1XX		
			Encoder cable (incremental type)	ACS3-CAEFA1XX		
			Encoder cable (absolute type)	ACS3-CAEBA1XX		
		Military connector - right angle	Power cable (without brake)	ACS3-CRPFA2XX		ACS3-CRPFA3XX
			Brake cable	ACS3-CRBFA1XX		
			Encoder cable (incremental type)	ACS3-CREFA1XX		
			Encoder cable (absolute type)	ACS3-CREBA1XX		

Note:

1. XX indicates the cable length. 03 = 3 m; 05 = 5 m; 10 = 10 m; 20 = 20 m.
2. E3-L model does not support the absolute function, so an absolute encoder cable is not required.

F180 motors

Cable type	Connector type		Servo drive	3 kW
			Servo motor (ECM-E3)	3 kW
-	Non-waterproof	-	Encoder connector (servo drive end)	ACS3-CNENC200
-	Waterproof	Military connector - straight	Power connector (without brake)	ACS3-CAPWC000
			Brake connector	ACS3-CABRA000
			Encoder connector (motor end)	ACS3-CAENA000
		Military connector - right angle	Power connector (without brake)	ACS3-CRPWC000
			Brake connector	ACS3-CRBRA000
			Encoder connector (motor end)	ACS3-CRENA000
Standard	Waterproof	Military connector - straight	Power cable (without brake)	ACS3-CAPWC4XX
			Brake cable	ACS3-CABRA1XX
			Encoder cable (incremental type)	ACS3-CAENA1XX
			Encoder cable (absolute type)	ACS3-CAEAA1XX
		Military connector - right angle	Power cable (without brake)	ACS3-CRPWC4XX
			Brake cable	ACS3-CRBRA1XX
			Encoder cable (incremental type)	ACS3-CRENA1XX
			Encoder cable (absolute type)	ACS3-CREAA1XX
Flexible	Waterproof	Military connector - straight	Power cable (without brake)	ACS3-CAPFC4XX
			Brake cable	ACS3-CABFA1XX
			Encoder cable (incremental type)	ACS3-CAEFA1XX
			Encoder cable (absolute type)	ACS3-CAEBA1XX
		Military connector - right angle	Power cable (without brake)	ACS3-CRPFC4XX
			Brake cable	ACS3-CRBFA1XX
			Encoder cable (incremental type)	ACS3-CREFA1XX
			Encoder cable (absolute type)	ACS3-CREBA1XX

Note:

1. XX indicates the cable length. 03 = 3 m; 05 = 5 m; 10 = 10 m; 20 = 20 m.
2. E3-L model does not support the absolute function, so an absolute encoder cable is not required.

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Revision History

Release date	Version	Chapter	Revision contents
June, 2023	V1.0 (First edition)	-	-

For relevant information about [ASDA-E3], please refer to:

(1) ASDA-B2 User Manual

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