Delta ASDA-B3 Series Servo Drive User Manual

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Smarter. Greener. Together.

Preface

Thank you for purchasing this product. This manual provides information about the ASDA-B3 series servo drives (B3) and the ECM-B3 and ECM-A3 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

ASDA-B3 product features:

- New control algorithm: overcomes the problems of a lack of stiffness or flexibility in the machine structure.
- Automatic 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.
- New generation of the ECM-B3 series servo motor: a compact size servo motor meets the need for reducing the size and weight of the equipment structures.

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

ASDA-B3 is a high resolution, open type servo drive. It should be installed in a shielded control box during operation. This product uses precise feedback control and a digital signal processor (DSP) with high-speed calculation functions to control the current output generated by IGBT to operate three-phase permanent magnet synchronous motors (PMSM) and to achieve precise positioning.

The ASDA-B3 series are used in industrial applications and should be installed in the control box. Servo drives, wires, and motors should all be installed in an environment which complies with the minimum requirement of UL50 Type 1.

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

The symbols of "DANGER", "WARNING", and "STOP" indicate:

DANGER	**Danger. May cause severe or fatal injuries to personnel if the instructions are not followed.**
WARNING	**Warning. May cause moderate injury to personnel, or lead to 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 B3 servo drive and servo motor, or it may cause fire or malfunction.

Installation

> **DANGER** Do not expose the product to an environment containing 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 class-3 ground system. Ground resistance should not exceed 100 Ω. Improper grounding may result in electric shock or fire.
> - Do not connect the three-phase source to the motor output terminals U, V, and W, or it may cause personnel injury or fire.
> - 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.

🛑 During the 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 equipment, it may damage the equipment 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 charging light 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, 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 (PG) feedback cables. The maximum length of the signal input cable is 3 meters (9.84 feet) and the maximum length of the PG 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 standards, the wires must comply with one of the following specifications to ensure proper grounding:
  1. Copper wire cross-sectional area is at least 10 mm^2.
  2. Aluminum wire cross-sectional area is at least 16 mm^2.
- Failure to comply with the specifications may result in personnel injury.
- Before applying power, inspect and ensure that the wiring is correct.

Note: this English manual is the language version for TUV certificate application. You can download manuals in multiple languages at http://www.deltaww.com.

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Product Overview

1

Before using the ASDA-B3 series servo drive, pay attention to the description of the inspection, nameplate, and model type. You can find a suitable servo motor for your ASDA-B3 servo drive in the table in Section 1.3.

1.1 Components of the servo set

A complete servo set includes:

(1) A servo drive and a servo motor.

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

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

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

(5) A 26-pin connector for CN1 (optional purchase for B3□-F/M/E models).

(6) A 44-pin connector for CN1 (optional purchase for B3□-L models).

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

(8) An RJ45 connector for CN3 or CN6, which is used for general (RS-485) and high-speed (CANopen, EtherCAT, DMCNET) communication (optional purchase).

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

(10) An STO connector for CN10 (only applicable on B3A models).

(11) Power supply for the servo drive:

Model	Control circuit	Main circuit	Regenerative resistor
All series	L_{1C}, L_{2C} terminal block	R, S, T terminal block	P⊕,D, C, ⊖ terminal block

(12) One metal piece for short-circuiting the terminal block.

(13) An installation instruction sheet.

1.2   Model overview

1.2.1   Nameplate information

ASDA-B3 series servo drive

■   **Nameplate information**

Model name ----•
Capacity specification ----•
Applicable power supply ----•
Rated power output ----•

Serial number and ----•
QR code

Firmware version ----•

■   **Serial number**

B30121M0   T   18   01   0001
_____   _   __   __   ____
   (1)   (2) (3) (4)   (5)

(1) Model name
(2) Manufacturing plant (T: Taoyuan; W: Wujiang)
(3) Year of production (18: year 2018)
(4) Week of production (from 1 to 52)
(5) Production sequence in a week (starting from 0001)

1

ECM series servo motor

■ **Nameplate information**

Model name ----- • MODEL : **ECM-A3H-CY0602RS0**

Applicable power supply ----- • INPUT: VAC 110 **A1.45 Ins.A**

Rated output ----- • OUTPUT: r/min 3000 N.m **0.64 kW 0.2**

         No.18, Xinglong Rd.,
         Taoyuan City 33068, Taiwan

QR code and serial number ----- • **ABCYB1JBW14230024**

ΔELTA AC SERVO MOTOR

Delta Electronics,Inc. MADE IN CHINA

■ **Serial number**

ABCYB1JB   W   14   23   0024   (1) Model name

  (1)   (2) (3) (4)   (5)   (2) Manufacturing plant (T: Taoyuan; W: Wujiang)

                                 (3) Year of production (14: year 2014)

                                 (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 for 220V series servo motor is 110V, and the applicable power supply for 400V series servo motor is 220V.

1.2.2   Model explanation

ASDA-B3 servo drive

$$\underline{ASD} - \underline{B3} - \underline{04}\ \underline{21} - \underline{M}$$
$$(1)\qquad(2)\qquad(3)\ (4)\qquad(5)$$

(1) Product name
AC Servo Drive

(2) Series
B3 series
B3A series

(3) Rated power output

Code	Specification	Code	Specification	Code	Specification
01	100 W	10	1.0 kW	45	4.5 kW
02	200 W	15	1.5 kW	55	5.5 kW
04	400 W	20	2.0 kW	75	7.5 kW
07	750 W	30	3.0 kW	-	-

(4) Input voltage and phase
21: 220V, single- / three-phase
23: 220V, three-phase
43: 400V, three-phase

(5) Model type
B3 series

Code	Pulse input	Analog voltage control	PR mode	RS-485	CANopen	DMCNET	EtherCAT	STO
L	Yes	Yes	Yes	Yes	No	No	No	No
M	No	Yes	Yes	No	Yes	No	No	No
F	No	Yes	Yes	No	No	Yes	No	No
E	No	Yes	Yes	No	No	No	Yes	No

B3A series[1]

Code	Pulse input	Analog voltage control	PR mode	RS-485	CANopen	DMCNET	EtherCAT	STO
L	Yes	Yes	Yes	Yes	No	No	No	Yes
M	Yes	Yes	Yes	Yes	Yes	No	No	Yes
F	Yes	Yes	Yes	No	No	Yes	No	Yes
E	Yes	Yes	Yes	No	No	No	Yes	Yes

Note:
1. The B3A series provide the dynamic brake function.
2. B3□ in this manual represents B3 or B3A.
3. The model codes listed here is only for demonstration of the naming convention, some combinations of the model codes are not available. Contact the distributors for the models available for purchase.

1

ECM-B3 series servo motor

$$\underset{(1)}{\underline{\text{ECM}}} - \underset{(2)}{\underline{\text{B}}} \; \underset{(3)}{\underline{3}} \; \underset{(4)}{\underline{\text{M}}} - \underset{(5)}{\underline{\text{C}}} \; \underset{(6)}{\underline{2}} \; \underset{(7)}{\underline{06}} \; \underset{(8)}{\underline{04}} \; \underset{(9)}{\underline{\text{R}}} \; \underset{(10)}{\underline{\text{S}}} \; \underset{(11)}{\underline{1}}$$

(1)   Product name
      ECM: Electronic Commutation Motor

(2)   Servo type
      B: general type servo motor

(3)   Series
      3: 3rd series

(4)   Inertia
      H: high 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
      J: 400V and 3,000 rpm
      K: 400V and 2,000 rpm
      L: 400V and 1,500 rpm

(6)   Encoder type
      A: 24-bit absolute optical encoder (resolution of single turn: 24-bit; number of revolutions: 16-bit)
      2: 24-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: number of revolutions means the maximum number of turns the encoder can record.

(7) Motor frame size

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

(8) Rated power output

Code	Specification	Code	Specification
01	100 W	15	1.5 kW
02	200 W	18	1.8 kW
04	400 W	20	2 kW
07	750 W	30	3 kW
08	850 W	45	4.5 kW
10	1.0 kW	55	5.5 kW
13	1.3 kW	75	7.5 kW

(9) Shaft type and oil seal

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

(10) Shaft diameter and connector type

    S: standard shaft diameter and standard connectors

    7: special shaft diameter (14 mm)* and standard connectors

    J: standard shaft diameter and IP67 waterproof connectors

    K: special shaft diameter (14 mm)* and IP67 waterproof connectors

    Note: the special shaft diameter is available for 220V F80 400 W servo motors.

(11) Special code

    1: standard products

Note: the model codes listed here is 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-A3 series servo motor

$$\underline{ECM} - \underline{A} \; \underline{3} \; \underline{L} - \underline{C} \; \underline{2} \; \underline{06} \; \underline{04} \; \underline{R} \; \underline{S} \; \underline{1}$$
$$(1) \quad\;\; (2) \; (3) \; (4) \quad (5) \; (6) \; (7) \; (8) \; (9) \,(10)\,(11)$$

(1) Product name
ECM: Electronic Commutation Motor

(2) Servo type
A: High-Precision Servo Motor

(3) Series
3: 3rd series

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

(5) Rated voltage and speed
C: 220V and 3,000 rpm

(6) Encoder type
Y: 24-bit absolute optical encoder (resolution of single turn: 24-bit; number of revolutions: 16-bit)
1: 24-bit incremental optical encoder (single-turn absolute)
A: 24-bit absolute optical encoder (resolution of single turn: 24-bit; number of revolutions: 16-bit)
2: 24-bit incremental optical encoder (single-turn absolute)
Note: number of revolutions means the maximum number of turns the encoder can record.

(7) Motor frame size

Code	Specification	Code	Specification
04	40 mm	08	80 mm
06	60 mm	-	-

(8) Rated power output

Code	Specification	Code	Specification
0F	50 W	04	400 W
01	100 W	07	750 W
02	200 W	-	-

(9) Shaft type and oil seal

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

Note: * indicates this model type is coming soon.

(10) Shaft diameter and connector type

S: standard shaft diameter and standard connectors

7: special shaft diameter (14 mm)* and standard connectors

J: standard shaft diameter and IP67 waterproof connectors

K: special shaft diameter (14 mm)* and IP67 waterproof connectors

Note: the special shaft diameter is available for 220V F80 400 W servo motors.

(11) Special code

1: standard products

Z: LS = 32 mm, LR = 35 mm. Refer to the note in Section A.3.5.

Note: the model codes listed here is only for demonstration of the naming conventions, some

combinations of the model codes are not available. Contact the distributors for the models

available for purchase.

1.3 ASDA-B3 servo drive and motor

1.3.1 220V models

A3 servo motor:

Servo motor							Servo drive
Inertia	Rated / Max. speed	Power	Output (W)	Model name	Rated torque (N-m)	Max. torque (N-m)	Model name
Low inertia	3000 / 6000 rpm	Single- / three-phase	50	ECM-A3L-C②040F③④⑤	0.159	0.557	ASD-B3①-0121-②
			100	ECM-A3L-C②0401③④⑤	0.32	1.12	
			200	ECM-A3L-C②0602③④⑤	0.64	2.24	ASD-B3①-0221-②
			400	ECM-A3L-C②0604③④⑤	1.27	4.45	ASD-B3①-0421-②
			400	ECM-A3L-C②0804③④⑤	1.27	4.44	
			750	ECM-A3L-C②0807③④⑤	2.39	6.45	ASD-B3①-0721-②
					2.39	8.36	ASD-B3①-1021-②
High inertia	3000 / 6000 rpm	Single- / three-phase	50	ECM-A3H-C②040F③④⑤	0.159	0.557	ASD-B3①-0121-②
			100	ECM-A3H-C②0401③④⑤	0.32	1.12	
			200	ECM-A3H-C②0602③④⑤	0.64	2.24	ASD-B3①-0221-②
			400	ECM-A3H-C②0604③④⑤	1.27	4.45	ASD-B3①-0421-②
			400	ECM-A3H-C②0804③④⑤	1.27	4.44	
			750	ECM-A3H-C②0807③④⑤	2.39	7.23	ASD-B3①-0721-②
					2.39	8.36	ASD-B3①-1021-②

Note:

1. In the servo motor model name, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector type, and ⑤ represents the special code.

2. In the servo drive model name, ① represents the product series and ② represents the model type.

3. B3 and B3A series support all the motors listed above.

B3 servo motor:

Servo motor							Servo drive
Inertia	Rated / Max. speed	Power	Output (W)	Model name	Rated torque (N-m)	Max. torque (N-m)	Model name
Low inertia	3000 / 6000 rpm	Single- / three-phase	100	ECM-B3L-C②0401③④⑤	0.32	1.12	ASD-B3①-0121-②
Medium inertia	3000 / 6000 rpm	Single- / three-phase	200	ECM-B3M-C②0602③④⑤	0.64	2.24	ASD-B3①-0221-②
			400	ECM-B3M-C②0604③④⑤	1.27	4.45	ASD-B3①-0421-②
			400	ECM-B3M-C②0804③④⑤	1.27	4.45	
			750	ECM-B3M-C②0807③④⑤	2.4	7.61	ASD-B3①-0721-②
			750	ECM-B3M-C②0807③④⑤	2.4	8.4	ASD-B3①-1021-②
			1000	ECM-B3M-C②0810③④⑤	3.18	11.13	ASD-B3①-1021-②
			1000	ECM-B3M-C②1010③④⑤	3.18	9.54	ASD-B3①-1021-②
			1500	ECM-B3M-C②1015③④⑤	4.77	14.31	ASD-B3①-1521-②
			2000	ECM-B3M-C②1020③④⑤	6.37	19.11	ASD-B3①-2023-②
	2000 / 3000 rpm		1000	ECM-B3M-E②1310③④⑤	4.77	14.3	ASD-B3①-1021-②
			1500	ECM-B3M-E②1315③④⑤	7.16	19.93	ASD-B3①-1521-②
			1500	ECM-B3M-E②1315③④⑤	7.16	21.48	ASD-B3①-2023-②
		Three-phase	2000	ECM-B3M-E②1320③④⑤	9.55	28.65	ASD-B3①-2023-②
			2000	ECM-B3M-E②1820③④⑤	9.55	28.65	
	1500 / 3000 rpm		3000	ECM-B3M-F②1830③④⑤	19.1	52.3	ASD-B3①-3023-②
High inertia	1500 / 4000 rpm	Single- / three-phase	850	ECM-B3H-F②1308③④⑤	5.39	16.17	ASD-B3①-1021-②
			1300	ECM-B3H-F②1313③④⑤	8.34	25.02	ASD-B3①-1521-②
		Three-phase	1800	ECM-B3H-F②1318③④⑤	11.5	34.5	ASD-B3①-2023-②

Note:

1. In the servo motor model name, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector type, and ⑤ represents the special code.

2. In the servo drive model name, ① represents the product series and ② represents the model type.

3. B3 and B3A series support all the motors listed above.

1

1.3.2 400V models

Servo motor							Servo drive
Inertia	Rated / Max. speed	Power	Output (W)	Model name	Rated torque (N-m)	Max. torque (N-m)	Model name
Medium inertia	3000 / 6000 rpm	Three-phase	750	ECM-B3M-J②0807③④⑤	2.4	7.61	ASD-B3①-1043-②
					2.4	8.4	ASD-B3①-1543-②
			1000	ECM-B3M-J②1010③④⑤	3.18	7.4	ASD-B3①-1043-②
					3.18	9.54	ASD-B3①-1543-②
			1500	ECM-B3M-J②1015③④⑤	4.77	13.08	ASD-B3①-1543-②
					4.77	14.31	ASD-B3①-2043-②
			2000	ECM-B3M-J②1020③④⑤	6.37	19.11	ASD-B3①-2043-②
	2000 / 3000 rpm		1000	ECM-B3M-K②1310③④⑤	4.77	11.08	ASD-B3①-1043-②
					4.77	14.3	ASD-B3①-1543-②
			1500	ECM-B3M-K②1315③④⑤	7.16	17.78	ASD-B3①-1543-②
					7.16	21.48	ASD-B3①-2043-②
			2000	ECM-B3M-K②1320③④⑤	9.55	28.65	ASD-B3①-2043-②
High inertia	1500 / 4000 rpm		850	ECM-B3H-L②1308③④⑤	5.39	11.55	ASD-B3①-1043-②
					5.39	16.17	ASD-B3①-1543-②
			1300	ECM-B3H-L②1313③④⑤	8.34	22.14	ASD-B3①-1543-②
					8.34	25.02	ASD-B3①-2043-②
			1800	ECM-B3H-L②1318③④⑤	11.5	34.5	ASD-B3①-2043-②
Medium inertia	2000 / 3000 rpm		2000	ECM-B3M-K②1820③④⑤	9.55	28.65	ASD-B3①-2043-②
	1500 / 3000 rpm		3000	ECM-B3M-L②1830③④⑤	19.1	53.9	ASD-B3①-3043-②
					19.1	57.29	ASD-B3①-4543-②
			4500	ECM-B3M-L②1845③④⑤	28.65	71.6	ASD-B3①-4543-②
			5500	ECM-B3M-L②1855③④⑤	35.01	105	ASD-B3①-5543-②
			7500	ECM-B3M-L②1875③④⑤	47.75	110.9	ASD-B3①-7543-②

Note:

1. In the servo motor model name, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector type, and ⑤ represents the special code.

2. In the servo drive model name, ① represents the product series and ② represents the model type.

3. B3 and B3A series support all the motors listed above.

1.4   Description of the drive interface

1.4.1   B3□-L models

No.	Name	Description
(1)	-	7-segment display.
(2)	CHARGE	Power indicator.
(3)	RST	Main circuit power. 220V models: connects to commercial power supply (200 - 230 V_{AC}, 50/60 Hz); 400V models: connects to commercial power supply (380 - 400 V_{AC}, 50/60 Hz).
(4)	L_{1C}, L_{2C}	Control circuit power. 220V models: connects to single-phase power supply (200 - 230 V_{AC}, 50/60 Hz); 400V models: connects to single-phase power supply (380 - 400 V_{AC}, 50/60 Hz).
(5)	Regenerative resistor	Connects to an external regenerative resistor, external regenerative braking unit, or the built-in regenerative resistor.
(6)	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.
(7)	Grounding screws	Connects to the ground wire for the power and servo motor.
(8)	CN4	Mini USB connector: connects to PC.
(9)	CN3	Modbus communication port.
(10)	CN1	I/O signal interface: connects to PLC or controls I/O.
(11)	CN10	STO connector: only supported by the B3A series.
(12)	CN2	Encoder connector: connects to the encoder.

1.4.2 B3☐-M / B3☐-F models

No.	Name	Description
(1)	-	7-segment display.
(2)	CHARGE	Power indicator.
(3)	RST	Main circuit power. 220V models: connects to commercial power supply (200 - 230 V_{AC}, 50/60 Hz); 400V models: connects to commercial power supply (380 - 400 V_{AC}, 50/60 Hz).
(4)	L_{1C}, L_{2C}	Control circuit power. 220V models: connects to single-phase power supply (200 - 230 V_{AC}, 50/60 Hz); 400V models: connects to single-phase power supply (380 - 400 V_{AC}, 50/60 Hz).
(5)	Regenerative resistor	Connects to an external regenerative resistor, external regenerative braking unit, or the built-in regenerative resistor.
(6)	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.
(7)	Grounding screws	Connects to the ground wire for the power and servo motor.
(8)	CN4	Mini USB connector: connects to PC.
(9)	CN3 / CN6	CANopen (CN3) or DMCNET (CN6) high-speed communication ports.
(10)	CN1	I/O signal interface: connects to PLC or controls I/O.
(11)	CN10	STO connector: only supported by the B3A series.
(12)	CN2	Encoder connector: connects to the encoder.

1.4.3 B3□-E models

No.	Name	Description
(1)	-	7-segment display.
(2)	CHARGE	Power indicator.
(3)	RST	Main circuit power. 220V models: connects to commercial power supply (200 - 230 V_{AC}, 50/60 Hz); 400V models: connects to commercial power supply (380 - 400 V_{AC}, 50/60 Hz).
(4)	L_{1C}, L_{2C}	Control circuit power. 220V models: connects to single-phase power supply (200 - 230 V_{AC}, 50/60 Hz); 400V models: connects to single-phase power supply (380 - 400 V_{AC}, 50/60 Hz).
(5)	Regenerative resistor	Connects to an external regenerative resistor, external regenerative braking unit, or the built-in regenerative resistor.
(6)	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.
(7)	Grounding screws	Connects to the ground wire for the power and servo motor.
(8)	CN4	Mini USB connector: connects to PC.
(9)	CN6	EtherCAT high-speed communication ports.
(10)	CN1	I/O signal interface: connects to PLC or controls I/O.
(11)	CN10	STO connector: only supported by the B3A series.
(12)	CN2	Encoder connector: connects to the encoder.

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1

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Installation

2

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

2

Precautions:

If the connection between the servo drive and servo motor is over 20 meters (65.61 feet), increase the gauge of the UVW connecting wire and the encoder cable. Refer to Section 3.1.6 for the wire specification.

2.1 Ambient storage conditions

Before installation, this product must be kept in the shipping carton. In order to retain the warranty coverage and for maintenance, 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% RH (non-condensing).

■ Avoid storing the product in an environment containing corrosive gas.

2.2 Ambient installation conditions

B3 servo drive: the environment should be free of devices that generate excessive heat; no 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 motor location should be between 0°C (32°F) and 40°C (104°F). The environment should be free of devices that generate excessive heat; no water, vapor, dust, and oily dust; no corrosive and inflammable gas or liquids; no airborne dust or metal particles.
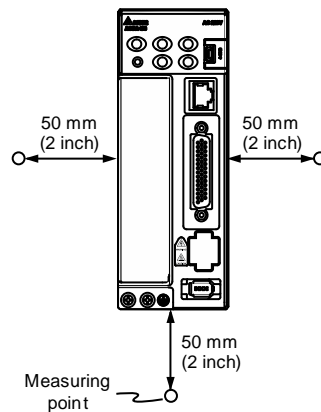
The ambient temperature of the operating environment for the servo drive is between 0°C (32°F) and 55°C (131°F). If the temperature is over 45°C (113°F), place the product in a well-ventilated environment. During long-term operation, the suggested temperature of the operating environment should be under 45°C (113°F) to ensure the servo drive's performance. Mount the product vertically in the distribution board (see the illustration of the correct mounting direction in Section 2.3) and install a fan on the board for heat dissipation. Ensure that the temperature for the clearance of 5 cm (1.97 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. Make sure the size of the distribution board and its ventilation condition can prevent the internal electrical devices from overheating. Also check if the vibration of the machine affects the electrical devices of the distribution board.

2.3 Mounting direction and space

Precautions:

■ Mount the servo drive in the correct direction according to the following illustrations with the base of the heat sink vertically 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 machine malfunction.

■ Do not block the ventilation holes of the servo drive, and do not mount it in the incorrect direction, or it may result in machine malfunction.

Correct

Air Flow

Air Flow   Base

Incorrect

Air Flow   Air Flow
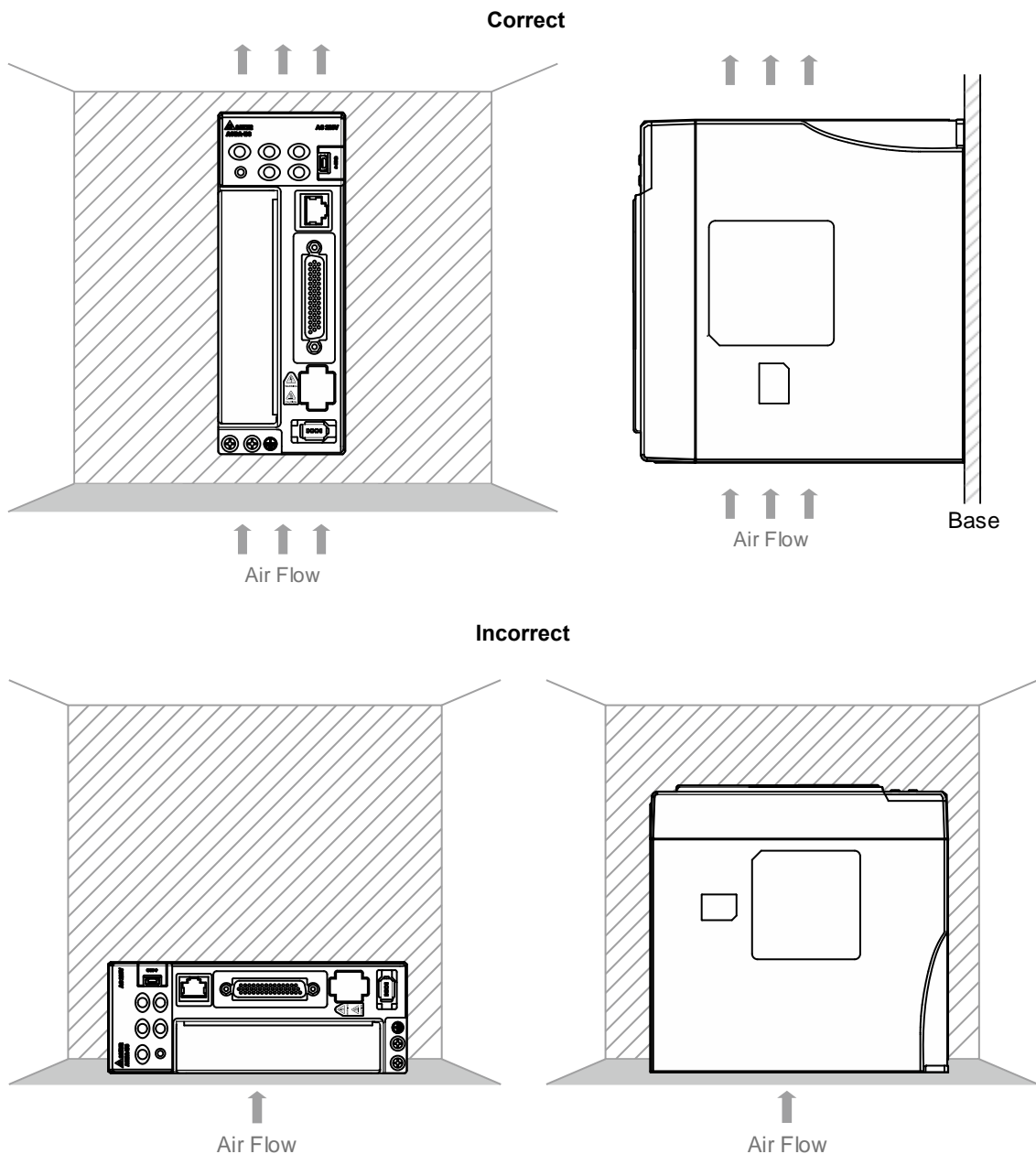
Heat dissipation requirements

■ To lower the wind resistance of the fan for better heat dissipation, follow these diagrams for the suggested clearance values when installing one or more 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.
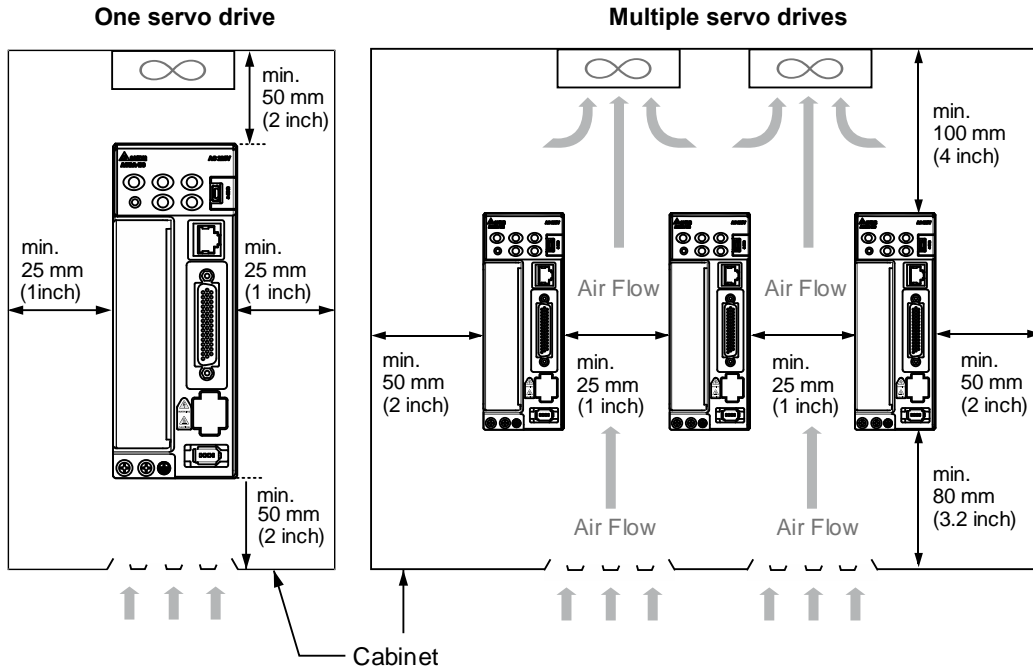
Note: the diagrams are not accurately scaled. Refer to the annotations on the diagrams.

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 operation manual. For your safety and correct use, read the manual, specifications, and precautions for the motor carefully before connecting the motor to any equipment.

The safety precautions are as follows:

Handling, mounting, and storage

■   When removing or installing a 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 shaft load 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 and apply rustproof oil every three months 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 steps to avoid electromagnetic interference, vibration, and abnormal temperature changes.

Wiring

■   If the current exceeds the maximum current in the specifications, the internal parts of the motor may lose their magnetism. Contact the distributor or local Delta sales representative if this problem occurs.

■   Check that 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 component test because it will damage the encoder.

■   When the motor or brake is undergoing high-voltage component tests, cut off the power supply for the controller. You should perform this kind of test only when necessary so as to maintain the product lifespan.

2

Operation

■ AC servo motor operation is controlled by the servo drive. Do not directly connect a commercial type 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's operation temperature 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 rather than stopping the motor. Caution: 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), which is caused by the structure of brake module, not a malfunction. It will not affect the motor's function.

■ When using a servo motor with a brake, do not use the 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.

Others

■ Delta 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 causes	Checking methods	Handling measures
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 / 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 is any abnormal noises (disk damage). 3. Visually inspect the encoder's rear cover for dust (encoder damage).	Replace the servo motor.
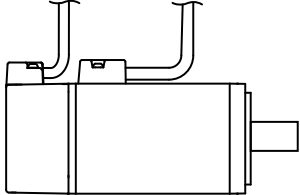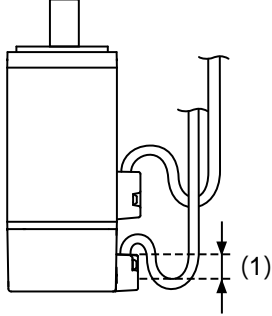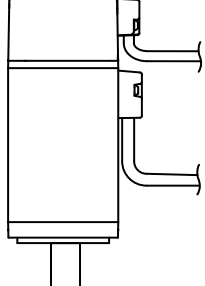
When the servo motor is overheating:

Possible causes	Checking methods	Handling measures
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 are other objects (such as paint or gasket) between the mounting surface and motor surface resulting in poor heat dissipation. Remove the object 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 	■ Do not operate the servo motor with oil seal in the vertical direction. ■ When wiring, install an oil trap (marked as (1) in the figure on the left) to prevent vapor from entering the motor. ■ When installing the servo motor in a machine (such as in a gearbox), 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 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 oil seal:

1. In the operating environment, keep the oil level lower than the oil seal lip.
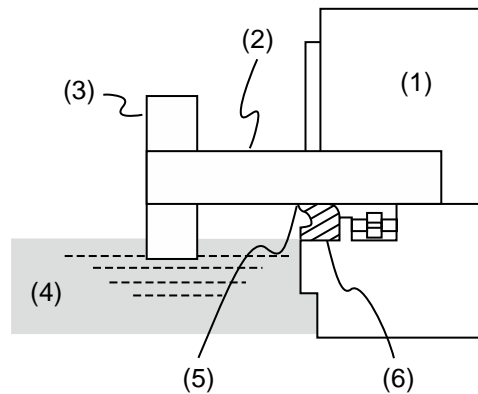
(1) Servo motor; (2) Motor shaft; (3) Gear; (4) Oil; (5) Oil seal lip; (6) Oil seal

2. Do not submerge the oil seal in liquid. The oil seal can only withstand splashes of oil.

3. Do not soak the oil seal lip in oil.

4. Keep the oil level lower than the oil seal lip. If the oil level is higher than the oil seal lip, oil may enter the servo motor and cause damage to the motor.

2.4.4 Precautions for using couplings

Caution:

It is suggested to use flexible couplings specifically designed for servo motors, especially double spring couplings, which provide some buffer tolerance during eccentric motion and deflection. Select couplings of appropriate size for the operating conditions. Improper use or connection may cause damage.

1. Wipe off the rustproof coating or oil on the motor shaft.

2. If you use a servo motor with a keyway, install the attached key or a key matching the specified dimensions on the motor shaft.

    Note: when you install the key on the motor, do not apply excessive impact force to the keyway or motor shaft.

3. Use dial gauge or other methods to ensure the centering precision is within the specifications. If you cannot use the dial gauge or other methods, slide the coupling along both axes and adjust it until it does not get stuck.

2
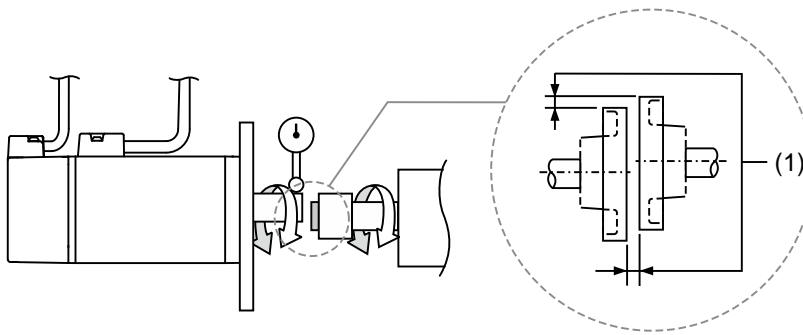
(1) The distance is measured at four different positions on the circumference for the centering precision. The difference between the maximum and minimum measurements should be 0.03 mm or less; even within this range, you can make adjustments to increase the centering precision.

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

4. Servo motor shaft installation safety precautions

   (1) 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.

   (2) When installing the coupling, do not apply excessive force to the shaft. Also, do not apply excessive force to the area around the encoder, as the impact may damage the encoder.
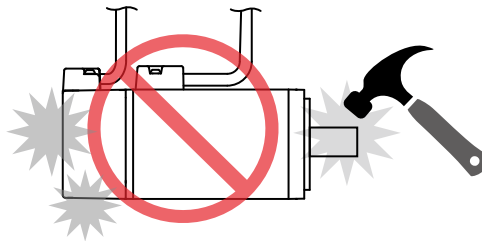
   (3) If the coupling makes any abnormal noise, realign the shaft until the noise disappears.

   (4) 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.

2.4.5 Oil and water prevention measures for the servo motor

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

1. Do not submerge the cable in oil or water.
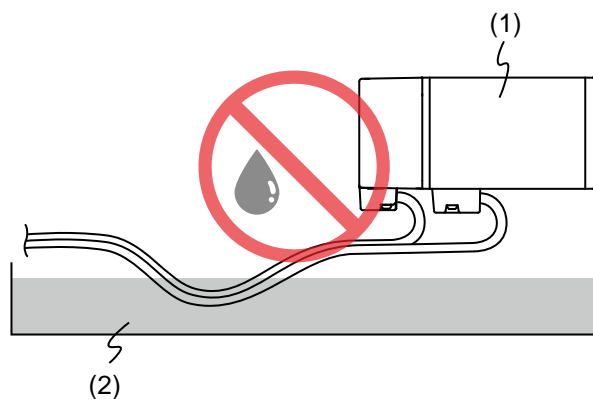
(1) Servo motor; (2) Oil

2. If oil or water is unavoidable, use oil-resistant cables. Delta does not provide oil-resistant cables.

2

3. 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.
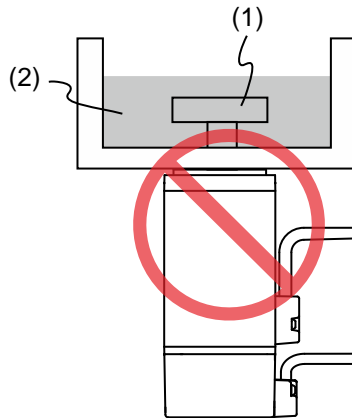
(1) Gear; (2) Oil

4. Do not use the servo motor in an environment with cutting fluids. Depending on the type of cutting fluids, sealing materials, coated colloids, cables, or other components may be affected or even deteriorated.

5. 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 above 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

1. 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.

2. The heat generated during the 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.

3. If it is difficult to apply large heat sinks in the operating environment or if the ambient air temperature or height 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, affect noise immunity, and result in malfunction.

2.5   Specifications for the circuit breaker and fuse

Servo drive model	Circuit breaker	Fuse (Class T)
ASD-B3①-0121-②	5A	10A
ASD-B3①-0221-②	5A	10A
ASD-B3①-0421-②	10A	10A
ASD-B3①-0721-②	10A	20A
ASD-B3①-1021-②	15A	30A
ASD-B3①-1521-②	20A	30A
ASD-B3①-2023-②	30A	50A
ASD-B3①-3023-②	30A	50A

Note:

1. In the servo drive model column, ① represents the product series and ② represents the model code. The above table includes the B3, B3A, and B3B series.

2. Operation mode: general.

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 Type B residual-current device (RCD) with time delay if 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 specifications of the EMC test. Refer to the following diagram for the standard installation.
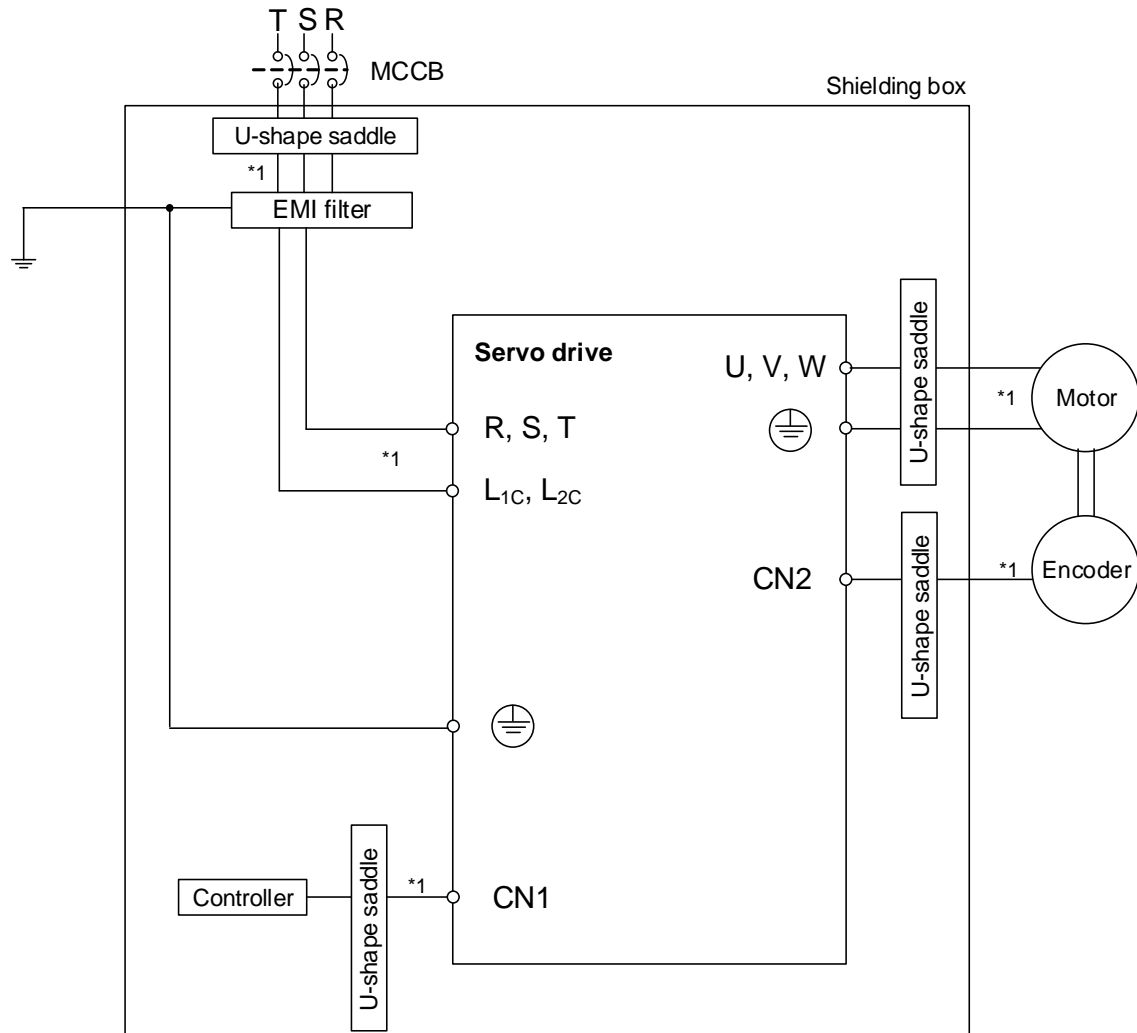
Note:

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, you can eliminate much of the interference. For better performance, it is recommended to use Delta's EMI filter for suppressing the interference.

Power	Servo drive model	Recommended EMI filter	
		1PH	3PH
100 W	ASD-B3①-0121-②	EMF023A21A	EMF10AM23A
200 W	ASD-B3①-0221-②	EMF023A21A	EMF10AM23A
400 W	ASD-B3①-0421-②	EMF023A21A	EMF10AM23A
750 W	ASD-B3①-0721-②	EMF023A21A	EMF10AM23A
1000 W	ASD-B3①-1021-②	EMF023A21A	EMF10AM23A
1500 W	ASD-B3①-1521-②	EMF023A21A	EMF10AM23A
2000 W	ASD-B3①-2023-②	-	EMF021A23A
3000 W	ASD-B3①-3023-②	-	EMF021A23A

Note: in the servo drive model column, ① represents the product series and ② represents the model code. The above table includes the B3, B3A, and B3B series.

General precautions for installation

To ensure the best performance of the EMI filter, apart from the instruction and wiring of the servo drive, 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 to install one servo drive with one EMI filter.

For more mounting specifications, refer to the following documents:

1. EN61000-6-4 (2001)

2. EN61800-3 (2004) PDS of category C2

3. EN55011+A2 (2007) Class A Group 1

Motor cable selection and installation precautions

The selection of motor cable (refer to Appendix B Accessories) 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 motor cable should be grounded with the shortest cable length and the largest contact area.

3. Remove the protective paint on the U-shape saddle and metal plate to ensure good contact. See the following figure.

4. Correctly connect the braided shielding of the motor cable and the metal plate: fix the braided shielding on both ends of the motor cable with the U-shape saddle and metal plate. See the following figure.
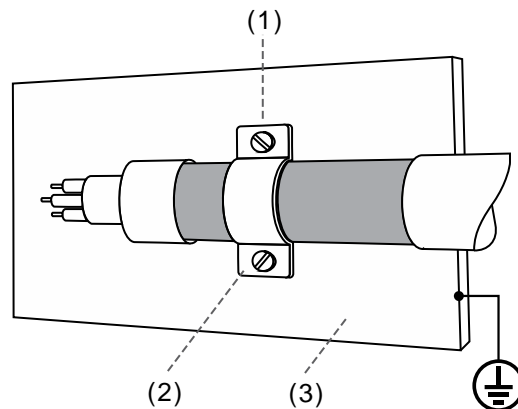
(1) Remove the protective paint on the U-shape saddle and metal plate to ensure good contact.

(2) U-shape saddle

(3) Well-grounded metal plate

2.7 Selecting the regenerative resistor

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 capacitance of the DC Bus and thus increases the voltage. When the voltage reaches a given value, it is consumed by a regenerative resistor. The servo drive has a built-in regenerative resistor; you can also use an external regenerative resistor if needed.
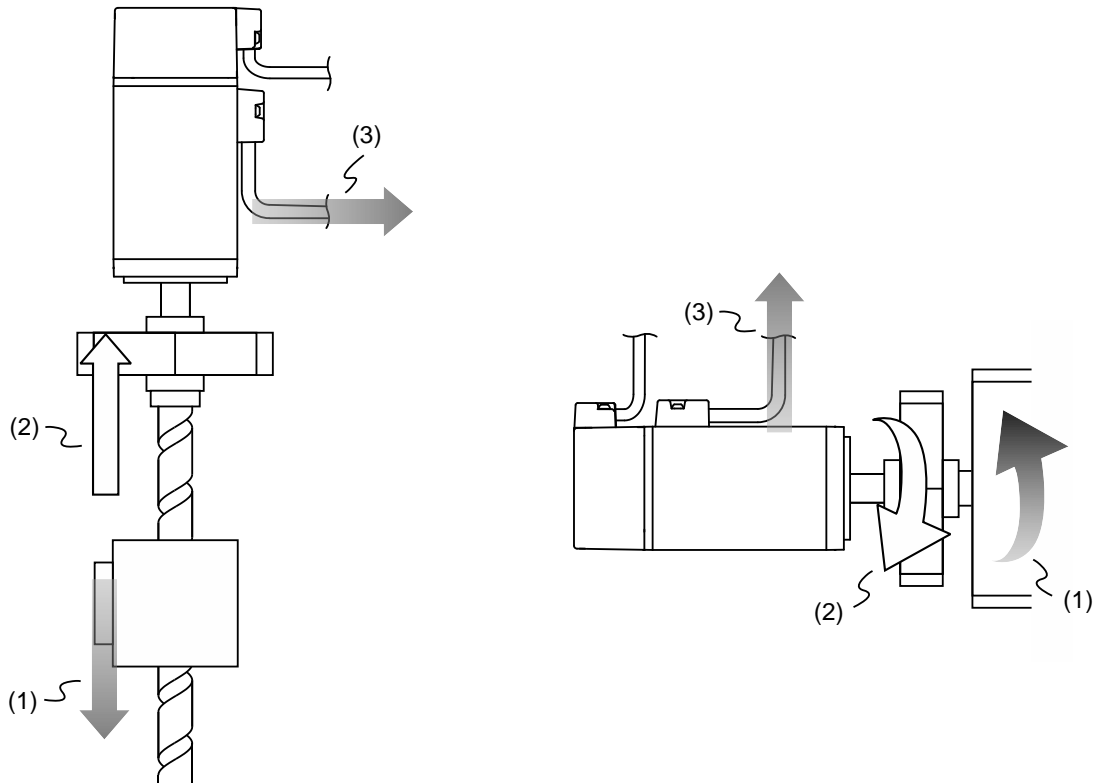
(1) Moving direction of the object; (2) Direction of torque; (3) Regenerative energy

Specifications of the built-in regenerative resistor in the ASDA-B3 are as follows:
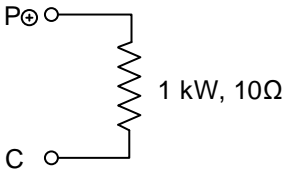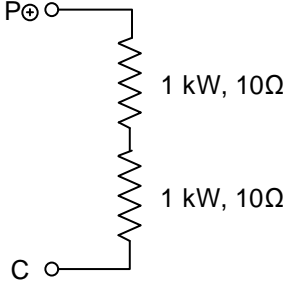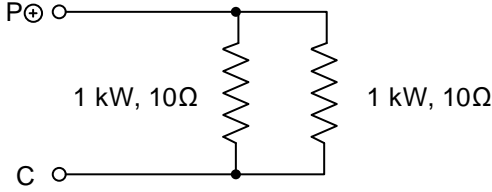
Servo drive (kW)	Specifications of the built-in regenerative resistor		Capacity of the built-in regenerative resistor (Watt)	Minimum allowable resistance value (reference for external resistors) (Ohm)
	Resistance (Ohm)	Capacity (Watt)		
0.1	-	-	-	60
0.2	-	-	-	60
0.4	100	40	20	60
0.75	100	40	20	60
1.0	100	40	20	30
1.5	100	40	20	30
2.0	20	80	40	15
3.0	20	80	40	15

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. Choose the correct 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. For general applications, you can connect more than one resistor in series. If the value from resistors connected in series exceeds the rated range, you can reduce the value by connecting the 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 parallel.

Connect to one external regenerative resistor	
P⊕○ ⌇ 1 kW, 10Ω C○	P1.052 = 10 (Ω) P1.053 = 1000 (W)
Connect to external regenerative resistors (serial connection)	
P⊕○ ⌇ 1 kW, 10Ω ⌇ 1 kW, 10Ω C○	P1.052 = 20 (Ω) P1.053 = 2000 (W)
Connect to external regenerative resistors (parallel connection)	
P⊕○ ⌇ 1 kW, 10Ω ⌇ 1 kW, 10Ω C○	P1.052 = 5 (Ω) P1.053 = 2000 (W)

3. Normally, if the capacity of the regenerative resistor (the average value) is within the rated capacity, the temperature 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 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$\oplus$ and C contacts, and P$\oplus$ and D contacts are left open. It is recommended that you choose external regenerative resistors of the resistance values specified in the table on page 16. Choose the external regenerative resistor according to the selected rotary motor (the setting value has included the factor of energy consumed by the IGBT).

Rotary motor:

Selecting the regenerative energy

(a) Calculation of the regenerative energy when there is no external torque.
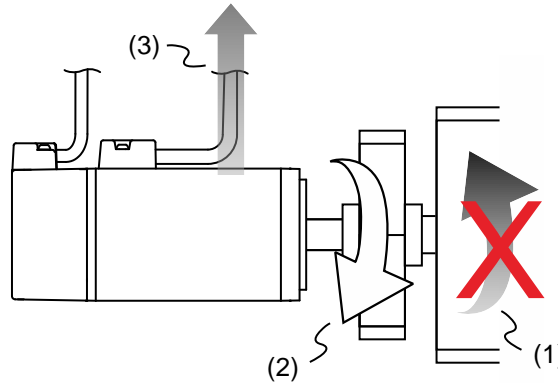
(1) Moving direction of the object; (2) Direction of torque;

(3) Regenerative energy generated when the motor decelerates

If the motor is making a reciprocating motion, the regenerative resistor consumes the excess return energy. Refer to the following table when calculating and selecting the required regenerative resistor.

Servo drive (kW)		Motor	Rotor inertia ($\times 10^{-4}$kg.m^2)	Regenerative energy generated when the motor decelerates from the rated speed to a stop without load Eo (joule)	Maximum regenerative energy of the capacitance Ec (joule)
Low inertia	0.1	ECM-A3L-C☑040F③④⑤	0.0229	0.11	4.21
	0.1	ECM-A3L-C☑0401③④⑤	0.04	0.20	4.21
	0.2	ECM-A3L-C☑0602③④⑤	0.09	0.45	5.62
	0.4	ECM-A3L-C☑0604③④⑤	0.15	0.74	8.42
	0.4	ECM-A3L-C☑0804③④⑤	0.352	1.74	8.42
	0.75	ECM-A3L-C☑0807③④⑤	0.559	2.76	18.25
	0.1	ECM-B3L-C☑0401③④⑤	0.299	1.48	4.21
Medium inertia	0.2	ECM-B3M-C☑0602③④⑤	0.141	0.70	5.62
	0.4	ECM-B3M-C☑0604③④⑤	0.254	1.26	8.42
	0.4	ECM-B3M-C☑0804③④⑤	0.648	3.20	8.42
	0.75	ECM-B3M-C☑0807③④⑤	1.07	5.29	18.25
	1.0	ECM-B3M-E☑1310③④⑤	7.79	17.12	26.21

2

Servo drive (kW)		Motor	Rotor inertia (× 10⁻⁴kg.m²)	Regenerative energy generated when the motor decelerates from the rated speed to a stop without load Eo (joule)	Maximum regenerative energy of the capacitance Ec (joule)
	1.5	ECM-B3M-E②1315③④⑤	11.22	24.66	34.94
	2.0	ECM-B3M-E②1320③④⑤	14.65	32.20	26.21
	2.0	ECM-B3M-E②1820③④⑤	29.11	63.98	26.21
	3.0	ECM-B3M-F②1830③④⑤	53.63	66.3	31.82
High inertia	0.1	ECM-A3H-C②040F③④⑤	0.0455	0.23	4.21
	0.1	ECM-A3H-C②0401③④⑤	0.0754	0.37	4.21
	0.2	ECM-A3H-C②0602③④⑤	0.25	1.24	5.62
	0.4	ECM-A3H-C②0604③④⑤	0.45	2.23	8.42
	0.4	ECM-A3H-C②0804③④⑤	0.92	4.55	8.42
	0.75	ECM-A3H-C②0807③④⑤	1.51	7.47	18.25

Note: in the servo motor model name, ② represents the encoder type; ③ represents the brake or keyway / oil seal type; ④ represents the shaft diameter and connector type; and ⑤ represents the special code.

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

Example:

For the motor ECM-A3L-CY0604RS1 (400 W), the reciprocating motion cycle is T = 0.4 sec.

Its rotation speed is 3,000 rpm and the load inertia is 15 times of the motor inertia.

Servo drive (kW)	Motor	Rotor inertia J (× 10⁻⁴kg.m²)	Regenerative energy generated when the motor decelerates from the rated speed to a stop without load Eo (joule)	Maximum regenerative energy of the capacitance Ec (joule)
0.4	ECM-A3L-CY0604RS1	0.15	0.74	8.42

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

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

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

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

(b) Calculation of the regenerative energy when there is external torque and the motor does the negative work.
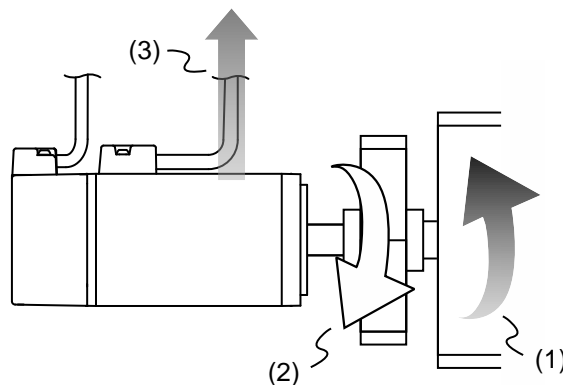
(1) Moving direction of the object; (2) Direction of torque; (3) Regenerative energy

Usually, the motor does positive work and the motor's torque direction is identical to the rotation direction. However, in some instances, the motor's torque direction is opposite to the rotation direction. This means the motor is doing negative work and the external 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 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, this energy is consumed by the regenerative resistor.

Example:

For the motor ECM-A3L-CY0604RS1 (400 W), when the torque of the external load is +70% of the rated torque (1.27 N-m) with 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. So, a regenerative resistor of 560 W and 40Ω is needed.

2.8   The use of braking

A brake is usually used for motions in the Z-axis direction because gravity causes the mechanism to fall. A brake can prevent the mechanism 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 only be enabled 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) to set the delay time.

Timing diagram of brake control:
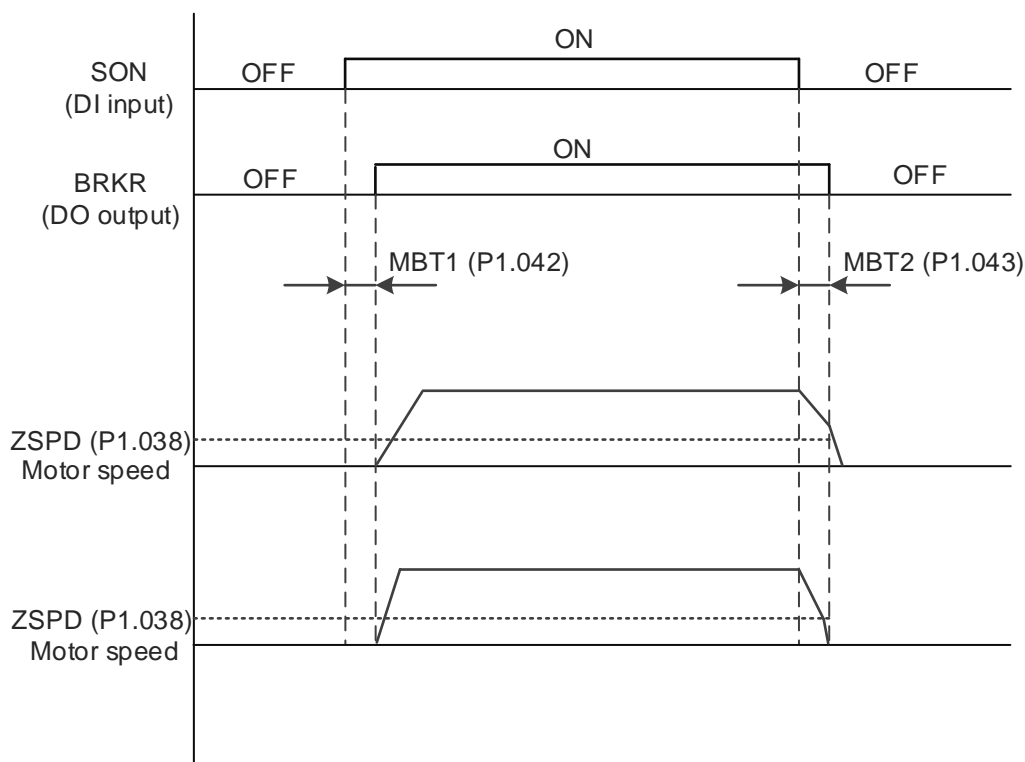
Output timing of the BRKR signal:

1.   When the servo drive is off and the time set for P1.043 is exceeded, but the motor speed is still faster than the speed set for P1.038, DO.BRKR is off (the motor is clamped).

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

Wiring of the brake:
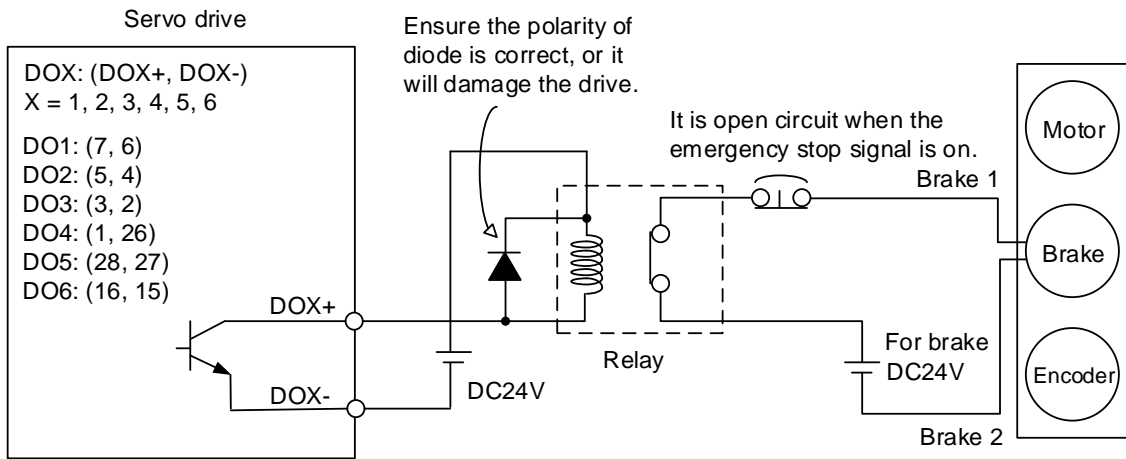
Note:

1.   The B3□-M, F, and E models have only DO1 and DO2. For more details, refer to Chapter 3 Wiring.

2.   The brake signal controls the solenoid valve, providing power to the brake and enabling the brake.

3.   Note that there is no polarity for the brake coil.

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

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

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

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2

Wiring

3

This chapter illustrates the power supply circuit, connectors, and wiring for each mode of the ASDA-B3.

3

3.1   System connection

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

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

No fuse breaker (NFB)
It could prevent the instantaneous excessive current caused by short-circuit or from damaging the servo drive when power is on / off.

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

Mini USB connector (CN4)
Connect to PC to operate the software. Use standard type USB mini connection cable to connect to ASDA-Soft.

Power input of the main circuit (RST)

Communication port connector (CN3/CN6)

Control circuit (L$_{1C}$ L$_{2C}$)

I/O connector (CN1)

Brake resistor connector (P⊕ D C)

STO (CN10)

Regenerative resistor
(optional purchase)

Encoder connector (CN2)

Servo drive output (UVW)

3

Installation precautions:

1. Make sure the power and wiring connections of the R, S, T, and L_{1C}, L_{2C} are correct. Refer to Appendix A Specifications 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 installing an external regenerative resistor, $P\oplus$ and D contacts are left open, and the external regenerative resistor is connected to $P\oplus$ and C contacts. When using the built-in regenerative resistor, $P\oplus$ and D contacts are short-circuited, and $P\oplus$ and C contacts are left open.

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

3.1.2   Connectors and terminal blocks

Symbol	Name	Description		
L$_{1C}$, L$_{2C}$	Power input for the control circuit	Connect to single-phase AC power. (Refer to the model specification for the proper input voltage.)		
R, S, T	Power input for the main circuit	Connect to three-phase AC power. (Refer to the model specification for the proper input voltage.)		
U, V, W, FG	Motor power connector	Connect to the servo motor.		
		Symbol	Wire color	Description
		U	Red	A three-phase main power cable for the motor.
		V	White	
		W	Black	
		FG	Green	Connect to the ground terminal $\oplus$ for the servo drive.
P$\oplus$, D, C, $\ominus$	Regenerative resistor terminal or braking unit	Use the built-in resistor	P$\oplus$ and D contacts are short-circuited, and P$\oplus$ and C contacts are left open.	
		Use an external resistor	The resistor is connected to P$\oplus$ and C contacts, and P$\oplus$ and D contacts are left open.	
		Use an external braking unit	Connect the external braking unit to P$\oplus$ and $\ominus$ of the servo drive. P$\oplus$ & D contacts and P$\oplus$ & C contacts are left open.	
$\oplus$	Ground terminal	Connect to the ground wire for the power and servo motor.		
CN1	I/O connector (optional purchase)	Connect to the controller. Refer to Section 3.3 for more information.		
CN2	Encoder connector (optional purchase)	Connect to the encoder. Refer to Section 3.4 for more information.		
CN3	RS-485 or CANopen connector (optional purchase)	For RS-485 or CANopen. Refer to Section 3.5 for more information.		
CN4	Mini USB connector (optional purchase)	Connect to PC or notebook. Refer to Section 3.6 for more information.		
CN6	DMCNET or EtherCAT connector (optional purchase)	For DMCNET or EtherCAT. Refer to Section 3.7 for more information.		
CN10	STO connector	Connect to STO (Safe Torque Off). Refer to Section 3.9 for more information.		

Pay special attention to the following when wiring:

1.   When the power is off, do not touch R, S, T, U, V, W, P$\oplus$, D, C, and $\ominus$ since the capacitance inside the servo drive can still contain a dangerously large amount of electric charge. Wait until the charging light is off.

2.   Separate R, S, T and U, V, W from other wires. The separation should be at least 30 cm (11.8 inches).

3.   When using RS-485, use the shielded twisted-pair cable to ensure the communication quality.

4.   When selecting the wires, refer to Section 3.1.6.

5.   Do not use any external capacitor, or it might damage the servo drive.

3.1.3 Wiring for power supply

There are two methods for wiring the power supply: single-phase and three-phase. In the following diagram, Power 1 is normally open, and Power 2 and ALRM_RY_B are normally closed. MC (magnetic contactor) is the power relay and the contact for the main power circuit.

■ Wiring method for single-phase power supply (for models of 1.5 kW and 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_B: normally closed contact of the alarm relay

3
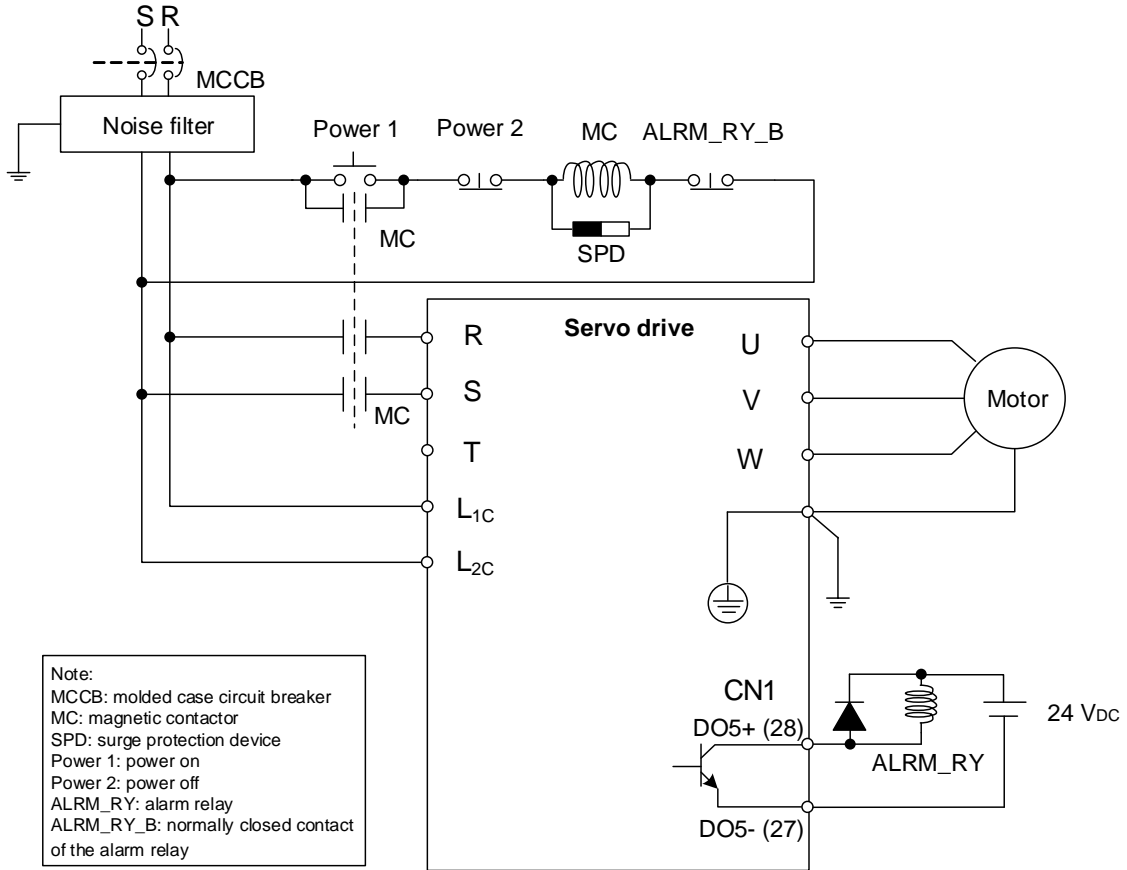
■ Wiring method for three-phase power supply (for all series)

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_B: normally closed contact
of the alarm relay
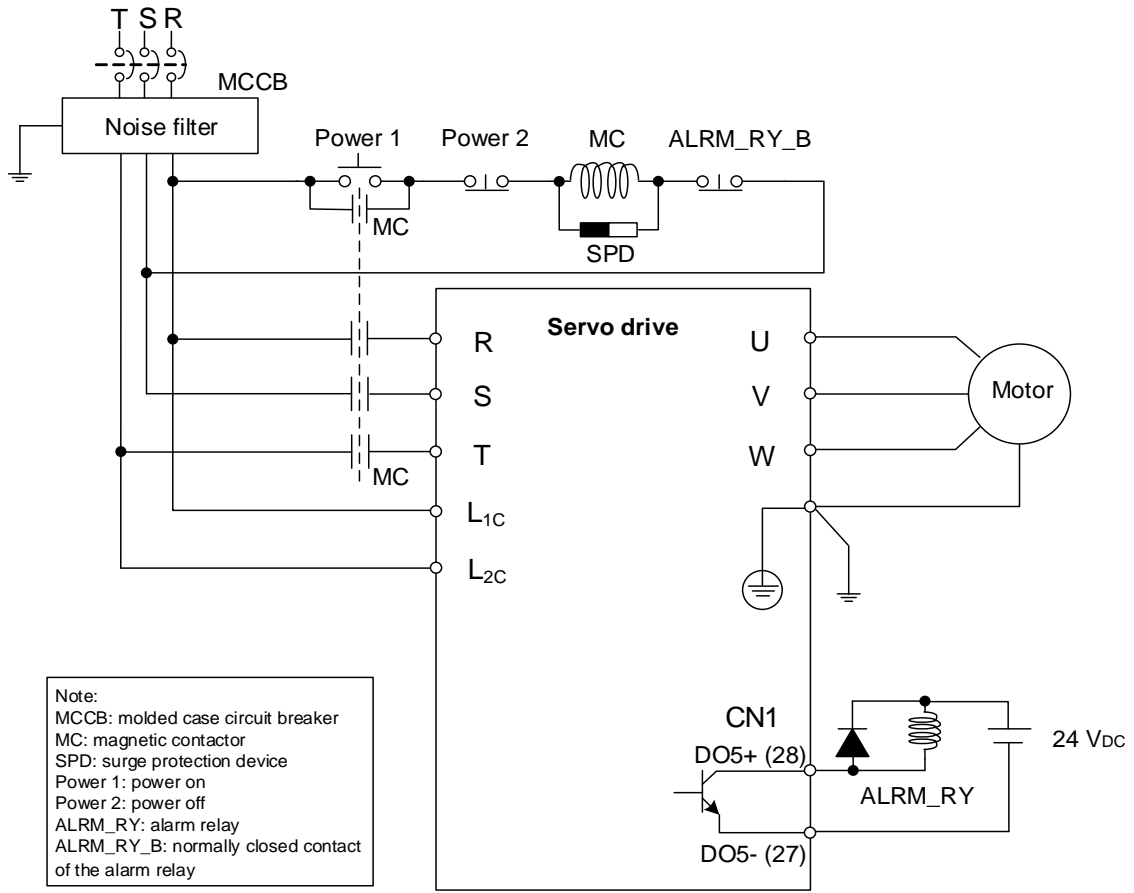
■ Connecting multiple servo drives (in series)

Using a common DC Bus can increase the efficiency of the regenerative energy.

For instance, while one of the axes is decelerating, the regenerative energy can supply other axes. If you need to connect servo drives of different power levels, only **models of similar power levels** can be connected.

Example (a servo system only allows servo drives of two different power levels)

1. If there is a 400 W servo drive in the system, you can connect a 200 W servo drive, and the regenerative resistor (or braking unit) should connect to the 400 W servo drive.

2. If there is a 400 W servo drive in the system, you can connect a 750 W servo drive, and the regenerative resistor (or braking unit) should connect to the 750 W servo drive.

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_B: normally closed contact
of the alarm relay
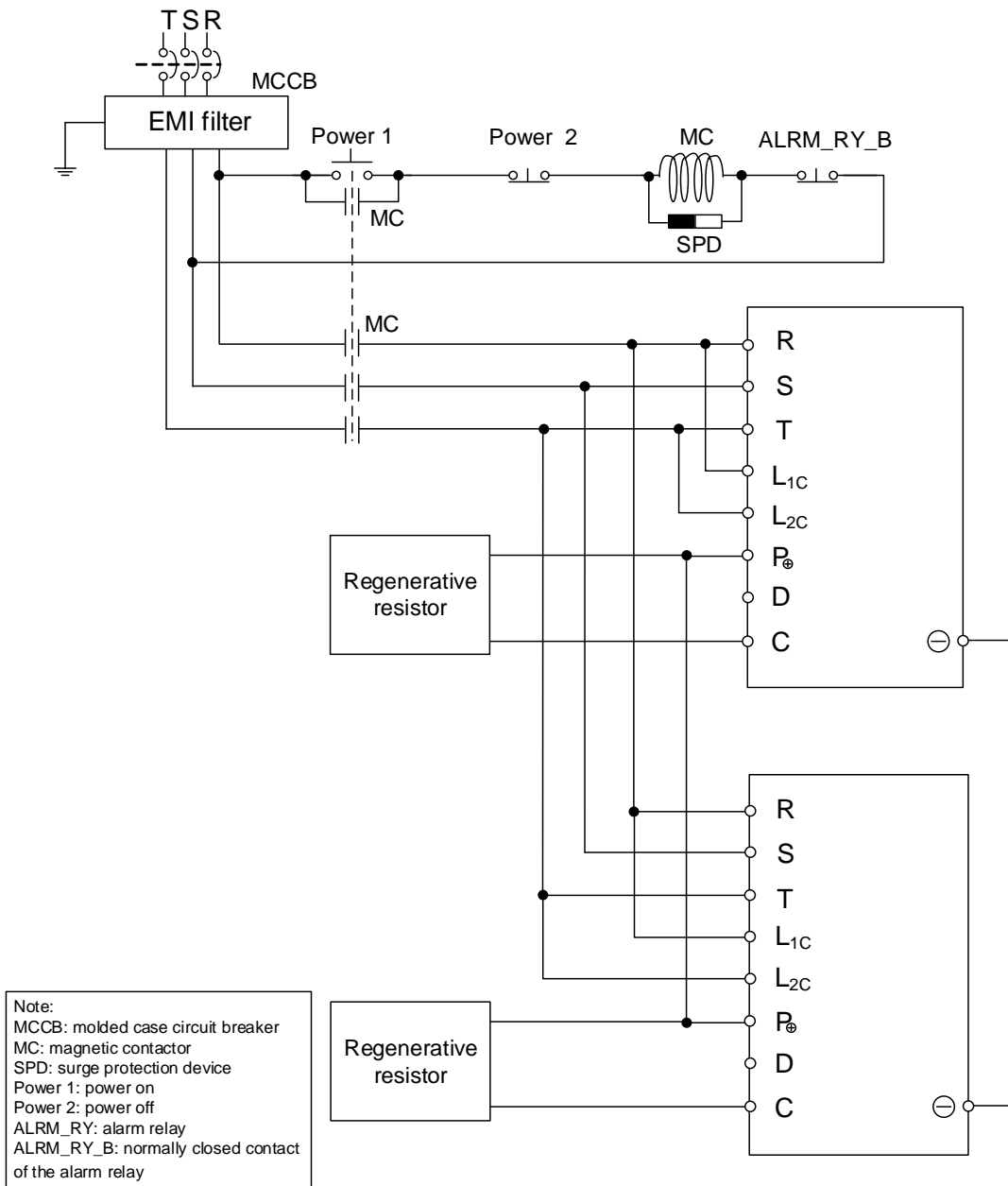
3.1.4   UVW connectors for the ASDA-B3 servo drive

In addition to the standard quick connectors, Delta also provides IP67 waterproof connectors for 50 W - 750 W motors.

Delta provides two types of power cables[1]: standard cables and flexible cables. If the power cable is connected to a moving machinery, it is suggested to use a flexible cable. Refer to the following table for flexible cable specifications.
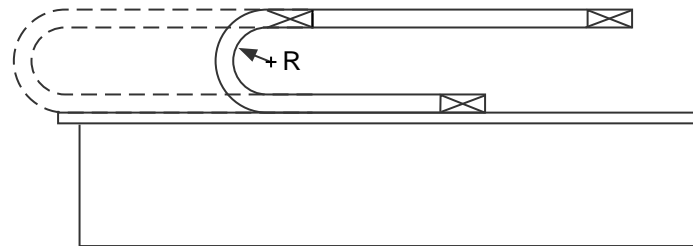
R = Bend radius of the encoder cable

Test item	Test specification
Bend radius	7.5 times of the cable outer diameter
Number of bending times	10 million[2]
Bending speed	5 m/s
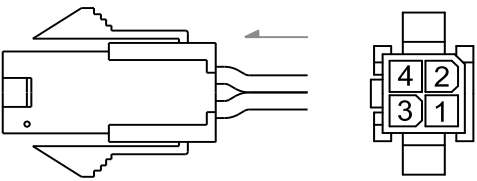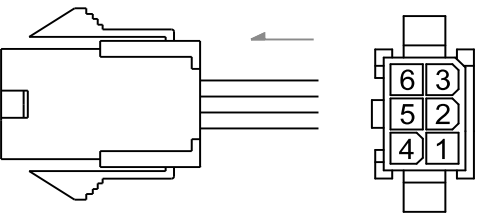
Note:

1.   Delta also provides standard and flexible 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

(1)
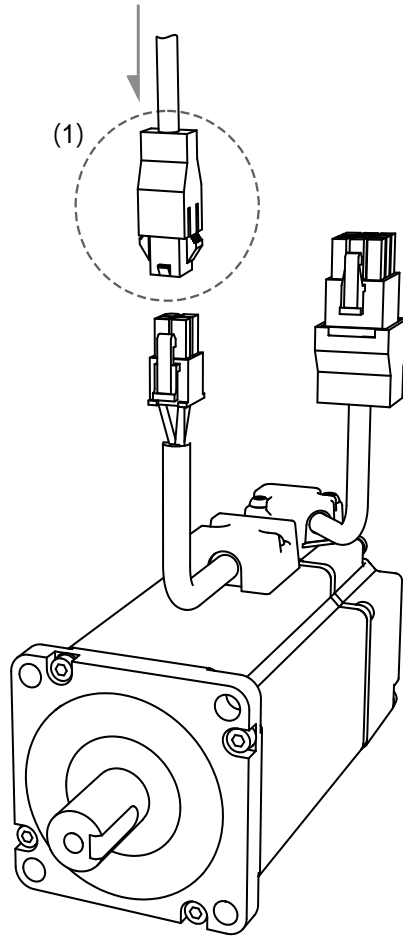
Note: pin assignments of the B3 and B2 models are the same. For easier wiring, the B3's connector

illustration (angle of viewing) is changed, which is different from that of B2.

Refer to the following table for UVW connector specifications.
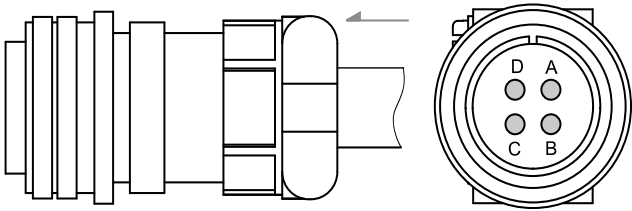
Motor model	UVW connector					

Recommended brand	Model number					
Molex	50-36-1735 (housing) 39-00-0040 (terminal)					
JWT	C4201H00-2*2PA (housing) C4201TOP-2 (terminal)					
Pin assignment						
U (Red)	V (White)	W (Black)	CASE GROUND (Green / Yellow)	BRAKE1*4	BRAKE2*4	
1	2	3	4	-	-	

The motor models listed in the first column:

ECM-B3①-C②0401③④⑤

ECM-B3①-C②0602③④⑤

ECM-B3①-C②0604③④⑤

ECM-B3①-C②0804③④⑤

ECM-B3①-C②0807③④⑤

ECM-A3①-C②040F③④⑤

ECM-A3①-C②0401③④⑤

ECM-A3①-C②0602③④⑤

ECM-A3①-C②0604③④⑤

ECM-A3①-C②0804③④⑤

ECM-A3①-C②0807③④⑤

Recommended brand	Model number					
Molex	50-36-1736 (housing) 39-00-0040 (terminal)					
JWT	C4201H00-2*3PA (housing) C4201TOP-2 (terminal)					
Pin assignment						
U (Red)	V (White)	W (Black)	CASE GROUND (Green / Yellow)	BRAKE1*4	BRAKE2*4
1	2	4	5	3	6

Wire selection: use a 600 V_{AC} PVC cable. Refer to Section 3.1.6 for more information.
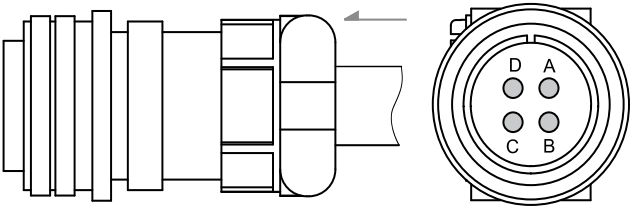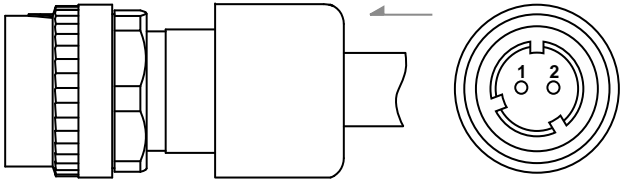
Note:

1. In the servo motor model name, ① represents the motor inertia, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector type, and ⑤ represents the special code.

2. Power supply for the brake is 24 V_{DC}. Do not share the same power supply with control signals.

3. The brake coil has no polarity. Its pin symbols are BRAKE1 and BRAKE2.

4. Color of brake cable for motors with the frame size of 40 - 86 mm: brown and blue.

3

Motor model	UVW connector
ECM-B3①-E②1310③④⑤ ECM-B3①-E②1315③④⑤ ECM-B3①-E②1320③④⑤	

Recommended brand	Model number
DDK	CE05-6A18-10SD-D-BSS(R1) (connector) CE3057-10A-1-D(R1) (cable clamp)
SUNCHU	CMS3106S18-10SBI
PLT	WPS3106A18-10S-R (connector) WPS3057-10A-R (cable clamp)

Pin assignment					
U (Red)	V (White)	W (Black)	CASE GROUND (Green / Yellow)	BRAKE1	BRAKE2
A	B	C	D	-	-

Wire selection: use a 600 V_{AC} PVC cable. Refer to Section 3.1.6 for more information.

Note: in the servo motor model name, ① represents the motor inertia, ② represents the encoder type,
③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector
type, and ⑤ represents the special code.

Motor model	UVW connector
ECM-B3①-E②1310③④⑤ ECM-B3①-E②1315③④⑤ ECM-B3①-E②1320③④⑤	

Recommended brand	Model number for UVW end
DDK	CE05-6A18-10SD-D-BSS(R1) (connector) CE3057-10A-1-D(R1) (cable clamp)
SUNCHU	CMS3106S18-10SBI
PLT	WPS3106A18-10S-R (connector) WPS3057-10A-R (cable clamp)

Recommended brand	Model number for brake end
DDK	CM10-SP2S-x-D or CMV1-SP2S-x-D
SUNCHU	SC-CMV1-SP02C

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

Wire selection: use a 600 V_{AC} PVC cable. Refer to Section 3.1.6 for more information.

Note:

1. In the servo motor model name, ① represents the motor inertia, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector type, and ⑤ represents the special code.

2. Power supply for the brake is 24 V_{DC}. Do not share the same power supply with control signals.

3. The brake coil has no polarity. Its pin symbols are BRAKE1 and BRAKE2.

4. Color of brake cable for motors with the frame size of 100 mm or above: red and black. The model number of UVW connector is MIL 18-10S and that of the brake connector is CMV1-2S.

3

Motor model	UVW connector				
ECM-B3①-E②1820③④⑤ ECM-B3①-F②1830③④⑤					

	Recommended brand		Model number		
	DDK		CE05-6A22-22SD-D-BSS(R1) (connector) CE3057-12A-1-D(R1) (cable clamp)		
	SUNCHU		CMS3106S22-22SBI		
	PLT		WPS3106A22-22S-R (connector) WPS3057-12A-R (cable clamp)		

Pin assignment					
U (Red)	V (White)	W (Black)	CASE GROUND (Green / Yellow)	BRAKE1	BRAKE2
A	B	C	D	-	-

Wire selection: use a 600 V_{AC} PVC cable. Refer to Section 3.1.6 for more information.

Note: in the servo motor model name, ① represents the motor inertia, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector type, and ⑤ represents the special code.

3

Motor model	UVW connector
ECM-B3①-E②1820③④⑤ ECM-B3①-F②1830③④⑤	

Recommended brand	Model number for UVW end
DDK	CE05-6A22-22SD-D-BSS(R1) (connector) CE3057-12A-1-D(R1) (cable clamp)
SUNCHU	CMS3106S22-22SBI
PLT	WPS3106A22-22S-R (connector) WPS3057-12A-R (cable clamp)

Recommended brand	Model number for brake end
DDK	CM10-SP2S-x-D or CMV1-SP2S-x-D
SUNCHU	SC-CMV1-SP02C

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

Wire selection: use a 600 V_{AC} PVC cable. Refer to Section 3.1.6 for more information.

Note:

1.   In the servo motor model name, ① represents the motor inertia, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector type, and ⑤ represents the special code.

2.   Power supply for the brake is 24 V_{DC}. Do not share the same power supply with control signals.

3.   The brake coil has no polarity. Its pin symbols are BRAKE1 and BRAKE2.

4.   Color of brake cable for motors with the frame size of 100 mm or above: red and black. The model number of UVW connector is MIL 22-22S and that of the brake connector is CMV1-2S.

3

Motor model	UVW connector				
	Recommended brand	Model number			
	CHOGORI	23004231-01 (wire diameter: Φ3.5 - 6.5 mm) 23004231-02 (wire diameter: Φ6.5 - 9.5 mm)			
	Pin assignment				
ECM-B3①-C②0401③④⑤ ECM-B3①-C②0602③④⑤ ECM-B3①-C②0604③④⑤ ECM-B3①-C②0804③④⑤ ECM-B3①-C②0807③④⑤ ECM-A3①-C②040F③④⑤ ECM-A3①-C②0401③④⑤ ECM-A3①-C②0602③④⑤ ECM-A3①-C②0604③④⑤ ECM-A3①-C②0804③④⑤ ECM-A3①-C②0807③④⑤	U (Red)	V (White)	W (Black)	CASE GROUND (Green / Yellow)	BRAKE1[*4] BRAKE2[*4]
	1	2	3	4	- -
	Recommended brand	Model number			
	CHOGORI	23006231-01 (wire diameter: Φ3.5 - 6.5 mm) 23006231-02 (wire diameter: Φ6.5 - 9.5 mm)			
	Pin assignment				
	U (Red)	V (White)	W (Black)	CASE GROUND (Green / Yellow)	BRAKE1[*4] BRAKE2[*4]
	1	2	3	4	5 6

Wire selection: use a 600 V_{AC} PVC cable. Refer to Section 3.1.6 for more information.

Note:

1. In the servo motor model name, ① represents the motor inertia, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector type, and ⑤ represents the special code.

2. Power supply for the brake is 24 V_{DC}. Do not share the same power supply with control signals.

3. The brake coil has no polarity. Its pin symbols are BRAKE1 and BRAKE2.

4. Color of brake cable for motors with the frame size of 40 - 86 mm: brown and blue; color of brake cable for motors with the frame size of 100 mm or above: red and black.

3.1.5   Specification for the encoder connector

Delta provides two types of encoder cables[1]: standard cables and flexible cables. If the encoder cable is connected to a moving machinery, it is suggested to use a flexible cable. Refer to the following table for flexible cable specifications.
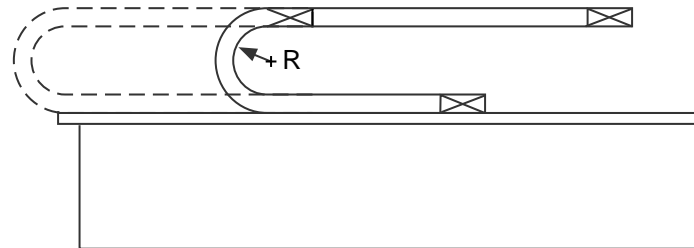
R = Bend radius of the encoder cable

Test item	Test specification
Bend radius	7.5 times of the cable outer diameter
Number of bending times	10 million[2]
Bending speed	5 m/s

Note:

1. Delta also provides standard and flexible power 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

Encoder connection (Diagram 1): Quick connector
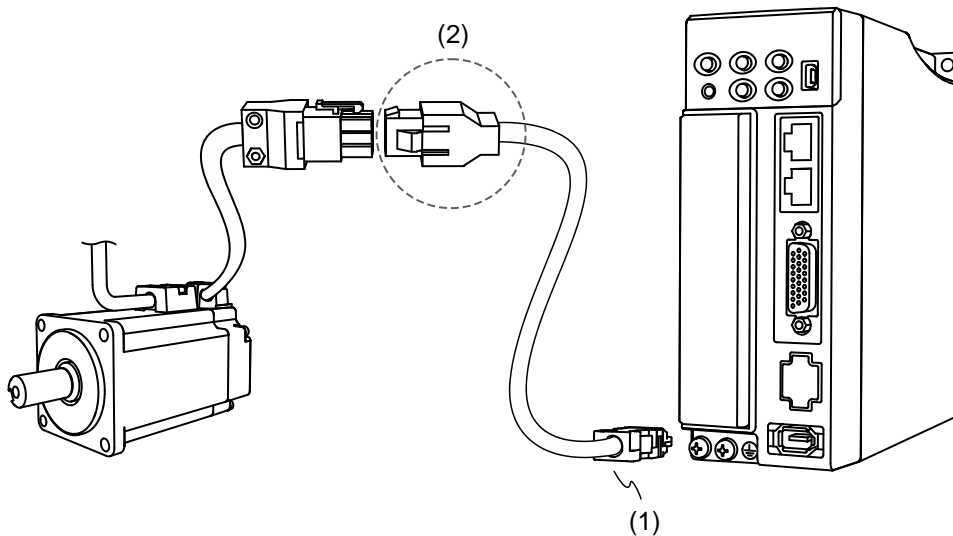
(1) CN2 connector; (2) Quick connector (Male)

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

Motor model	Quick connector (Male)	
ECM-B3①-C②0401③④⑤ ECM-B3①-C②0602③④⑤ ECM-B3①-C②0604③④⑤ ECM-B3①-C②0804③④⑤ ECM-B3①-C②0807③④⑤ ECM-A3①-C②040F③④⑤ ECM-A3①-C②0401③④⑤ ECM-A3①-C②0602③④⑤ ECM-A3①-C②0604③④⑤ ECM-A3①-C②0804③④⑤ ECM-A3①-C②0807③④⑤		
	Recommended brand	**Model number**
	TE Connectivity	1-172161-9 or 172161-1 (housing) 170359-1 (terminal) - tin-plated 170359-3 (terminal) - gold-plated

Note:

1. In the servo motor model name, ① represents the motor inertia, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector type, and ⑤ represents the special code.

2. It is suggested that the terminals of the servo motor and quick connector are plated with the same material. As the servo motor terminal is tin-plated, using the tin-plated connector is recommended.

Specifications and pin assignment for the quick connector of the incremental encoder
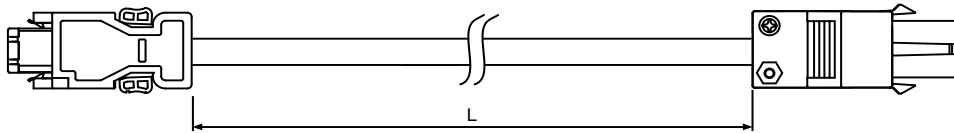
Model name	L	
	mm	inch
ACS3-CAE□1003	3000 ± 50	118 ± 2
ACS3-CAE□1005	5000 ± 50	197 ± 2
ACS3-CAE□1010	10000 ± 100	394 ± 4
ACS3-CAE□1020	20000 ± 100	788 ± 4

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

standard cables.

Quick connector for the encoder
(Female)   (Male)
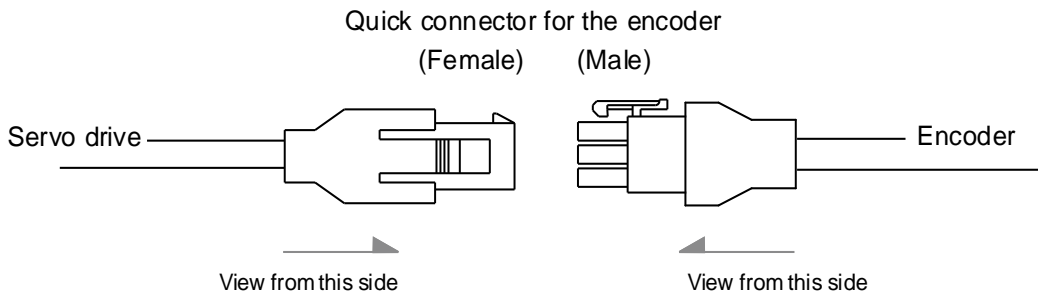
1 White T+	2 Reserved	3 Reserved
4 White/Red T-	5 Reserved	6 Reserved
7 Brown DC+5V	8 Blue GND	9 Shield

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 ASDA-B3 servo drive are for reference only. Refer to the actual servo drive.
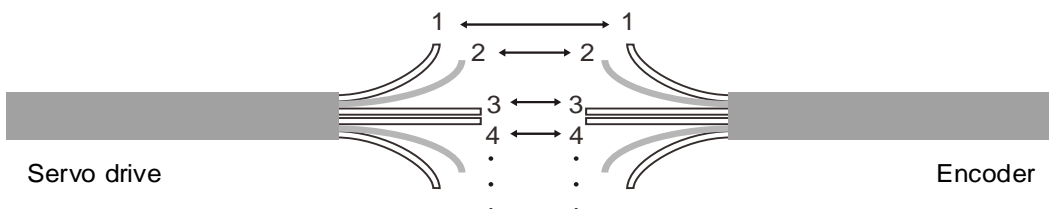
To directly connect the wires without using the connectors, wire them according to the

corresponding wire number (shown above). For example, connect wire No. 1 of the servo drive

to wire No. 1 of the motor encoder; connect wire No. 2 of the servo drive to wire No. 2 of the

motor encoder, and so on. Number the wires of the servo drive in sequence and then connect

them to the encoder.

Specification and pin assignment for the quick connector of the absolute encoder

Model name	L	
	mm	inch
ACS3-CAE□1003	3000 ± 50	118 ± 2
ACS3-CAE□1005	5000 ± 50	197 ± 2
ACS3-CAE□1010	10000 ± 100	394 ± 4
ACS3-CAE□1020	20000 ± 100	788 ± 4

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

Connection method:

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

Quick connector for the encoder

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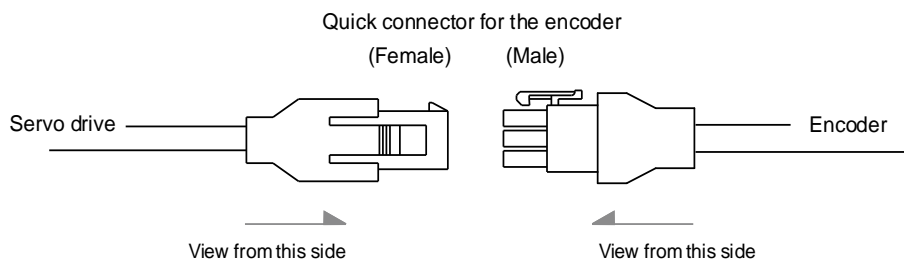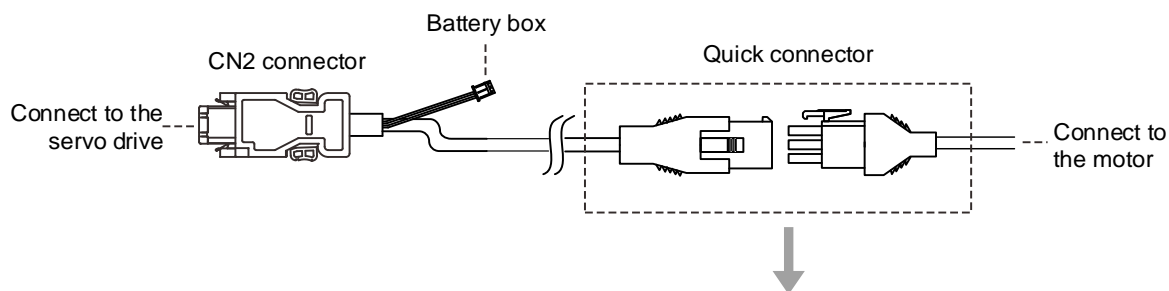
1 White T+	2 Red BAT+	3 Reserved
4 White/Red T-	5 Black BAT-	6 Reserved
7 Brown DC+5V	8 Blue GND	9 Shield

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 ASDA-B3 servo drive are for reference only. Refer to the actual servo drive.

3

Encoder connection (Diagram 2): Military connector
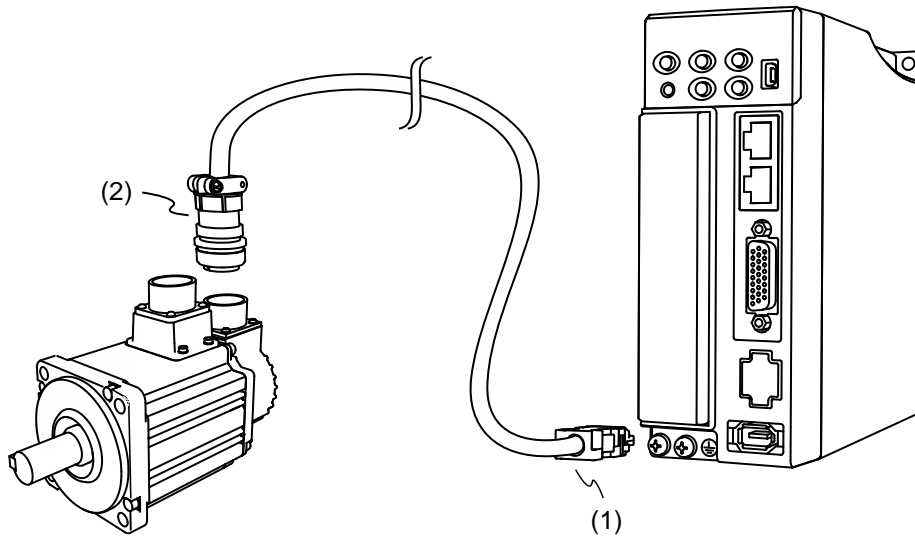
(1) CN2 connector; (2) Military encoder

Note: the diagram shows the connection between the servo drive and the encoder, and 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	
ECM-B3①-E②1310③④⑤ ECM-B3①-E②1315③④⑤ ECM-B3①-E②1320③④⑤ ECM-B3①-E②1820③④⑤ ECM-B3①-F②1830③④⑤		
	Recommended brand	**Model number**
	DDK	CM10-SP10S-x-D or CMV1-SP10S-x-D
	SUNCHU	SC-CMV1-SP10C

Note: in the servo motor model name, ① represents the motor inertia, ② represents the encoder type,

③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector

type, and ⑤ represents the special code.

3

Specifications and pin assignment for the military connector of the B3 incremental encoder

Model name	Straight	L	
		mm	inch
ACS3-CAE☐2703	CMV1-10S	3000 ± 50	118 ± 2
ACS3-CAE☐2705	CMV1-10S	5000 ± 50	197 ± 2
ACS3-CAE☐2710	CMV1-10S	10000 ± 100	394 ± 4
ACS3-CAE☐2720	CMV1-10S	20000 ± 100	788 ± 4

Note: select cables according to the ☐ in the model name. F represents flexible cables and N represents standard cables.
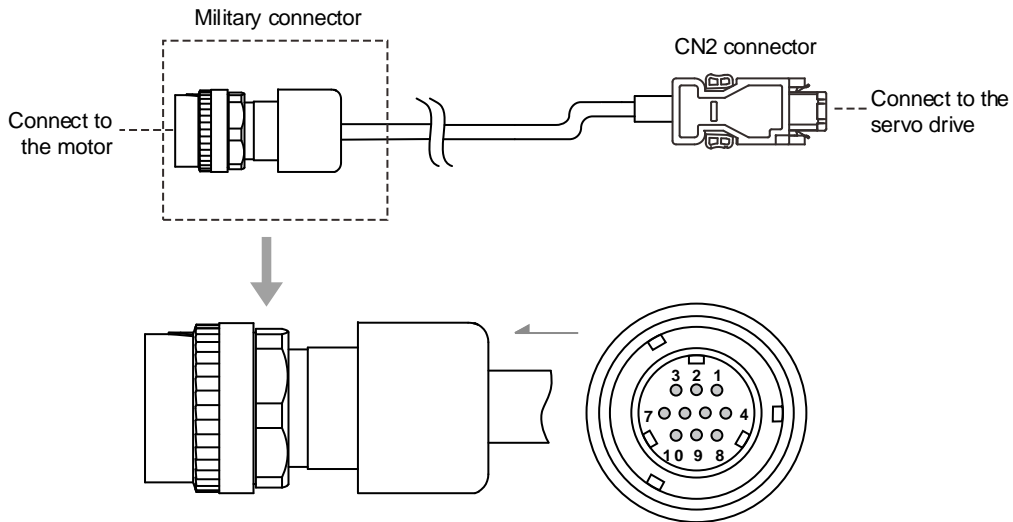
Pin No.	Terminal	Color
1	T+	White
2	T-	White/Red
3	-	-
4	DC+5V	Brown
5, 6, 7, 8	-	-
9	GND	Blue
10	Shield	-

Specifications and pin assignment for the military connector of the B3 absolute encoder

Model name	Straight	L	
		mm	inch
ACS3-CAE□2703	CMV1-10S	3000 ± 50	118 ± 2
ACS3-CAE□2705	CMV1-10S	5000 ± 50	197 ± 2
ACS3-CAE□2710	CMV1-10S	10000 ± 100	394 ± 4
ACS3-CAE□2720	CMV1-10S	20000 ± 100	788 ± 4

Note: select cables according to the □ in the model name. 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

Encoder connection (Diagram 3): IP67 waterproof connectors for ECM-A3 / B3 motors
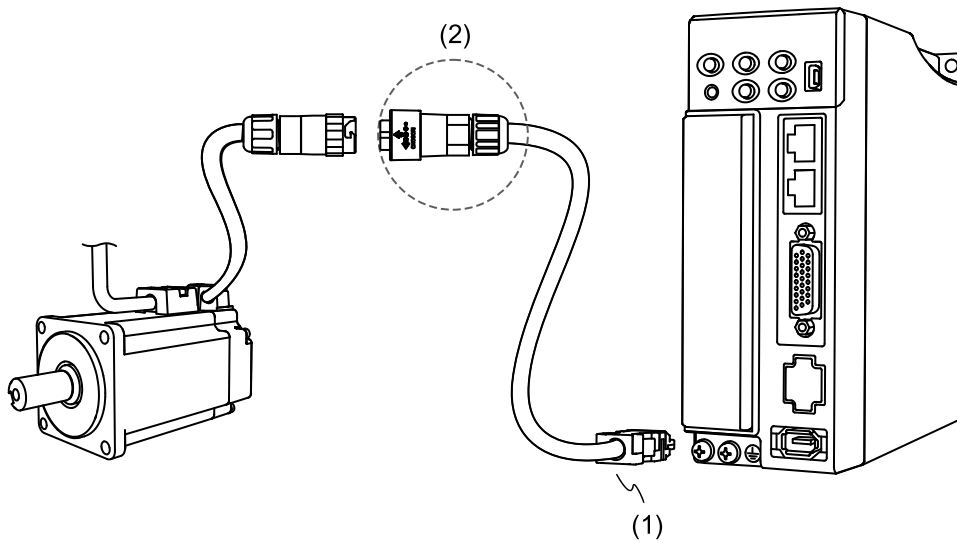
(1) CN2 connector; (2) IP67 waterproof connector

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	IP67 waterproof connector	
ECM-B3①-C②0401③④⑤ ECM-B3①-C②0602③④⑤ ECM-B3①-C②0604③④⑤ ECM-B3①-C②0804③④⑤ ECM-B3①-C②0807③④⑤ ECM-A3①-C②040F③④⑤ ECM-A3①-C②0401③④⑤ ECM-A3①-C②0602③④⑤ ECM-A3①-C②0604③④⑤ ECM-A3①-C②0804③④⑤ ECM-A3①-C②0807③④⑤		
	Recommended brand	**Model number**
	CHOGORI	22008231-01 (wire diameter: Φ3.5 - 6.5 mm)

Specifications and pin assignment for the IP67 waterproof connector of the A3 / B3 incremental encoder

Model name	Straight	L	
		mm	inch
ACS3-CAE☐2A03	22008231-01	3000 ± 50	118 ± 2
ACS3-CAE☐2A05	22008231-01	5000 ± 50	197 ± 2
ACS3-CAE☐2A10	22008231-01	10000 ± 100	394 ± 4
ACS3-CAE☐2A20	22008231-01	20000 ± 100	788 ± 4

Note: select cables according to the ☐ in the model name. F represents flexible cables and N represents standard cables.
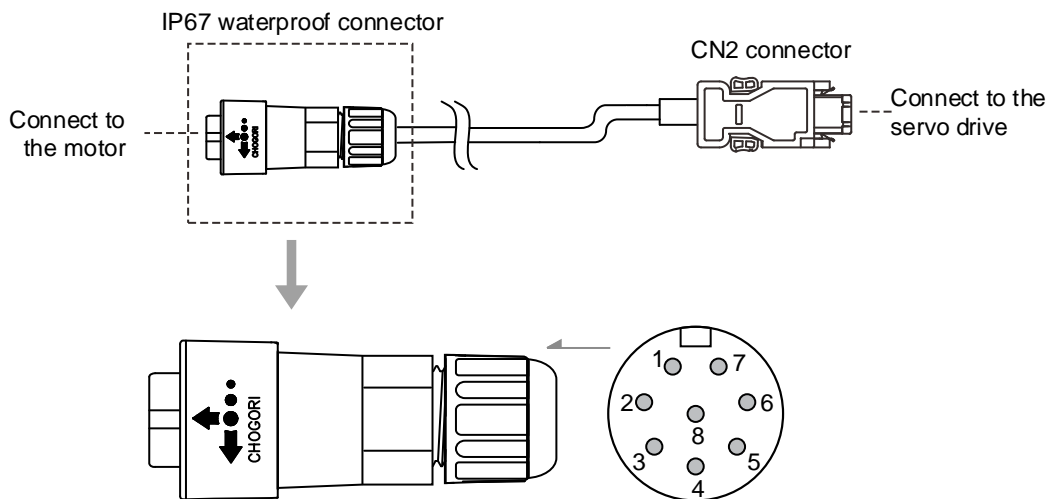
Pin No.	Terminal	Color
1	T+	White
2	T-	White/Red
3	GND	Blue
4	DC+5V	Brown
5, 6, 7	-	-
8	BRAID SHIELD	-

3

Specifications and pin assignment for the IP67 waterproof connector of the A3 / B3 absolute encoder

Model name	Straight	L	
		mm	inch
ACS3-CAE□2A03	22008231-01	3000 ± 50	118 ± 2
ACS3-CAE□2A05	22008231-01	5000 ± 50	197 ± 2
ACS3-CAE□2A10	22008231-01	10000 ± 100	394 ± 4
ACS3-CAE□2A20	22008231-01	20000 ± 100	788 ± 4

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

Connection method:

Caution Follow these instructions when wiring. Incorrect wiring may cause battery explosion.
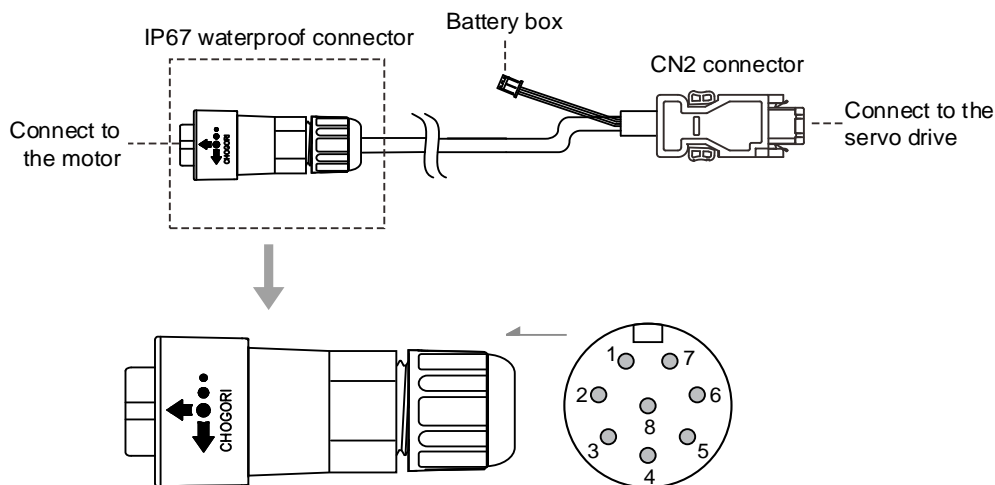
Pin No.	Terminal	Color
1	T+	White
2	T-	White/Red
3	GND	Blue
4	DC+5V	Brown
5	BAT-	Black
6	BAT+	Red
7	-	-
8	BRAID SHIELD	-

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

3.1.6　Wire selection

Refer to the requirements for doubling, and note the recommended wire for connectors and signal wiring for ASDA-B3 as listed in the following tables:

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

Servo drive model	Wire diameter	K. S. Terminals Inc.		Kise Terminal		Kss Terminal	
	U, V, W	Y type	O type	Y type	O type	Y type	O type
ASD-B3□-0121-□	18 AWG	SVBL1-3.7	RVBM1-3.7	SVS 1.25-3.5	RVS 1.25-3.5	YF1.25-3	RF1.25-3
ASD-B3□-0221-□							
ASD-B3□-0421-□							
ASD-B3□-0721-□							
ASD-B3□-1021-□	14 AWG	SVBL2-3.7	RVBM2-3.7	SV 3.5-3	RVS 2-3.5	YF3.5-3S	RF2-3
ASD-B3□-1521-□							
ASD-B3□-2023-□	12 AWG	SVBS5-4	RVBS5-4	SVS 5.5-4	RVL 5.5-4	YF5.5-4	RF5.5-4
ASD-B3□-3023-□							

Servo drive model	Wire diameter	K. S. Terminals Inc.		Kise Terminal		Kss Terminal	
	P⊕, C	Y type	O type	Y type	O type	Y type	O type
ASD-B3□-0121-□	14 AWG	SVBL2-3.7	RVBM2-3.2	SV 3.5-3	RV 2-3	YF3.5-3S	RF2-3
ASD-B3□-0221-□							
ASD-B3□-0421-□							
ASD-B3□-0721-□							
ASD-B3□-1021-□							
ASD-B3□-1521-□							
ASD-B3□-2023-□		SVBL2-4	RVBL2-4	SV 3.5-4	RV 3.5-4	YF2-4	RF2-4
ASD-B3□-3023-□							

Servo drive model	Wire diameter	K. S. Terminals Inc.		Kise Terminal		Kss Terminal	
	L₁C, L₂C	Y type	O type	Y type	O type	Y type	O type
ASD-B3□-0121-□	16 AWG	SVBL2-3.7	RVBM2-3.2	SV 1.25-3	RV 1.25-3	YF1.25-3	RF1.25-3
ASD-B3□-0221-□							
ASD-B3□-0421-□							
ASD-B3□-0721-□							
ASD-B3□-1021-□							
ASD-B3□-1521-□							
ASD-B3□-2023-□		SVBL2-4	RVBL2-4	SV 1.25-4	RVL 1.25-4	YF2-4	RF2-4
ASD-B3□-3023-□							

3

Servo drive model	Wire diameter	K. S. Terminals Inc.		Kise Terminal		Kss Terminal	
	R, S, T	Y type	O type	Y type	O type	Y type	O type
ASD-B3①-0121-②	22 AWG	SVBL1-3.7	RVBM1-3.7	SV 1.25-3	RV 1.25-3	YF1.25-3	RF1.25-3
ASD-B3①-0221-②	22 AWG						
ASD-B3①-0421-②	20 AWG						
ASD-B3①-0721-②	16 AWG						
ASD-B3①-1021-②	14 AWG	SVBL2-3.7	RVBM2-3.2	SV 3.5-3	RV 2-3	YF3.5-3S	RF2-3
ASD-B3①-1521-②	12 AWG	-	-		-		-
ASD-B3①-2023-②	12 AWG	SVBS5-4	RVBS5-4	SVS 5.5-4	RVS 5.5-4	YF5.5-4	RF5.5-4
ASD-B3①-3023-②	10 AWG						

If you choose other brands of terminals, refer to the terminal block width and screw specifications in the following table:

Servo drive model	Width	Screw
ASD-B3①-0121-②	7 mm	M3
ASD-B3①-0221-②		
ASD-B3①-0421-②		
ASD-B3①-0721-②		
ASD-B3①-1021-②		
ASD-B3①-1521-②		
ASD-B3①-2023-②	9.5 mm	M4
ASD-B3①-3023-②		

Note:

1. Select the correct O-type terminal or Y-type terminal corresponding to the servo drive and make sure the wire conforms to the specifications.

2. Use a crimping tool to properly crimp the terminal and wire.

3. Do not use bare wires for wiring, or the loose wires may cause accidents.

4. Use 600 V_{AC} PVC wire for the power cable with the wiring length of 20 meters (65.62 feet) or less.

5. In the servo drive model column, ① represents the product series and ② represents the model code.

Servo drive model	Encoder cable - wire diameter mm² (AWG)			
	Size	Number	Specification	Standard length
ASD-B3①-0121-②	Note*5	2C+2P	L = 3 - 20 m (UL2464)	L = 3 - 20 m (9.84 - 65.6 ft)
ASD-B3①-0221-②				
ASD-B3①-0421-②				
ASD-B3①-0721-②				
ASD-B3①-1021-②				
ASD-B3①-1521-②				
ASD-B3①-2023-②				
ASD-B3①-3023-②				

Note:

1. Use a shielded twisted-pair cable for wiring the encoder to reduce the noise interference.

2. The shield should connect to the ⏚ phase of the ground terminal.

3. When wiring, use the wires suggested in this section to avoid danger.

4. Specification of brake cable for motors with the frame size of 40 - 86 mm: 22 AWG; specification of brake cable for motors with the frame size of 100 mm or above: 20 AWG.

5. When the encoder cable length is 3 - 20 m (9.84 - 65.62 ft), 0.324 mm²-2C (22 AWG-2C) is +5V and grounded, and 0.205 mm²-2P (24 AWG-2P) is the signal cable.

6. In the servo drive model column, ① represents the product series and ② represents the model code.

3.1.7 IP67 connector wiring instructions

Follow these wiring instructions:
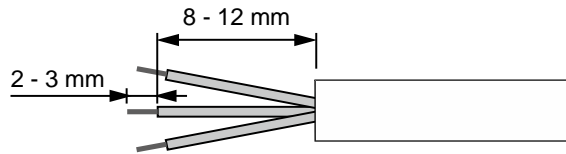
Step 1:

Cut through the cable and expose the shielding.

The exposed wire length should be 8 - 12 mm

(0.31 - 0.47 inches) and the tinned wire length

should be 2 - 3 mm (0.08 - 0.12 inches).
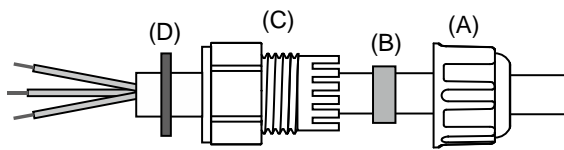
Step 2:

Place the (A) seals nut, (B) seals ring,

(C) clamp ring, and (D) gasket on the cable in

sequence.

Note: place the flat face of the gasket outwards and

the groove face towards the clamp ring for the

IP67 design.
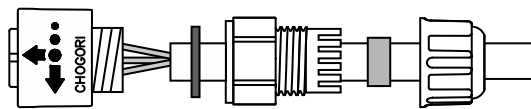
Step 3:

(1)   For the power connector, refer to

Section 3.1.4 for the pin assignment to

connect the pins.

(2)   For the encoder connector, refer to

Section 3.1.5 for the pin assignment to

connect the pins.
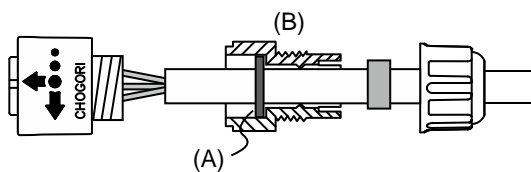
Step 4:

Place the groove face of the (A) gasket towards

the clamp ring and fit it into the (B) clamp ring.
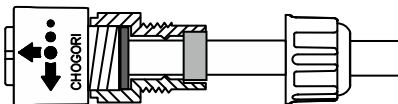
Step 5:

Use a wrench to lock the clamp ring to the

housing and **place** the seals ring **in** the

clamp ring.
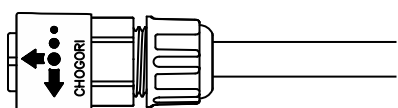
Step 6:

Use a wrench to lock the seals nut to the clamp

ring to complete the wiring.

Caution:

(B) ⟶ (A) ⟵ (B)

Connect to
the motor

Connect to the
servo drive
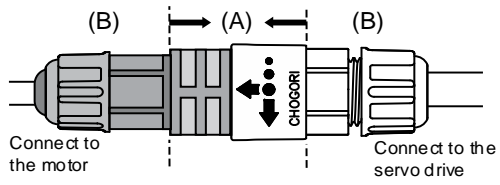
After wiring the IP67 connector, only fasten the
(A) location to lock the connector for connecting
the servo motor and drive. Do not pull or rotate
the (B) clamp ring and seals nut to avoid loose
connection and thus fail to meet the IP67
protection level.

3

3.2 Wiring diagram for the servo system

Models of 750 W and below
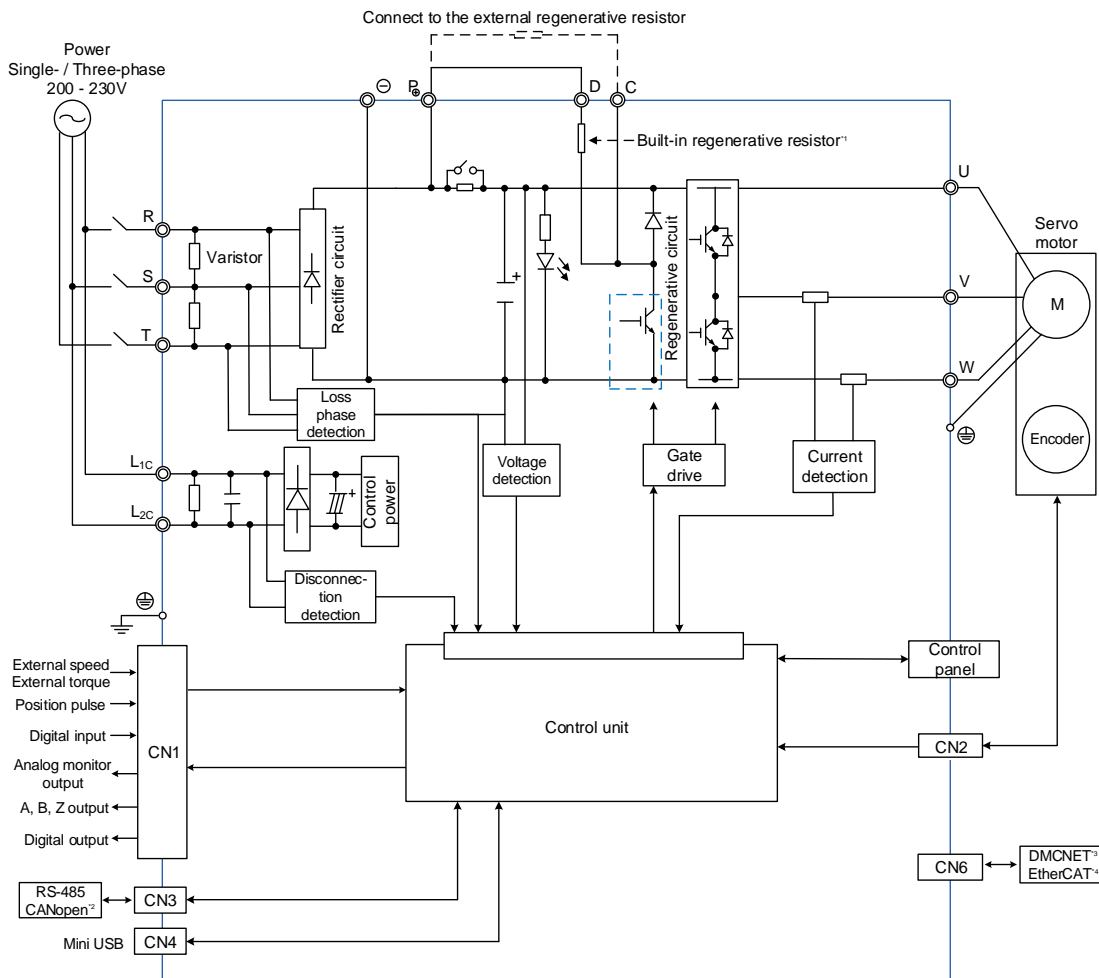
Note:

1. Models of 200 W and below do not have built-in regenerative resistor; models of 400 W and 750 W have built-in regenerative resistor.

2. CANopen is available on B3☐-M only.

3. DMCNET is available on B3☐-F only.

4. EtherCAT is available on B3☐-E only.

Models of 1 kW − 3 kW (with built-in regenerative resistor and fan)
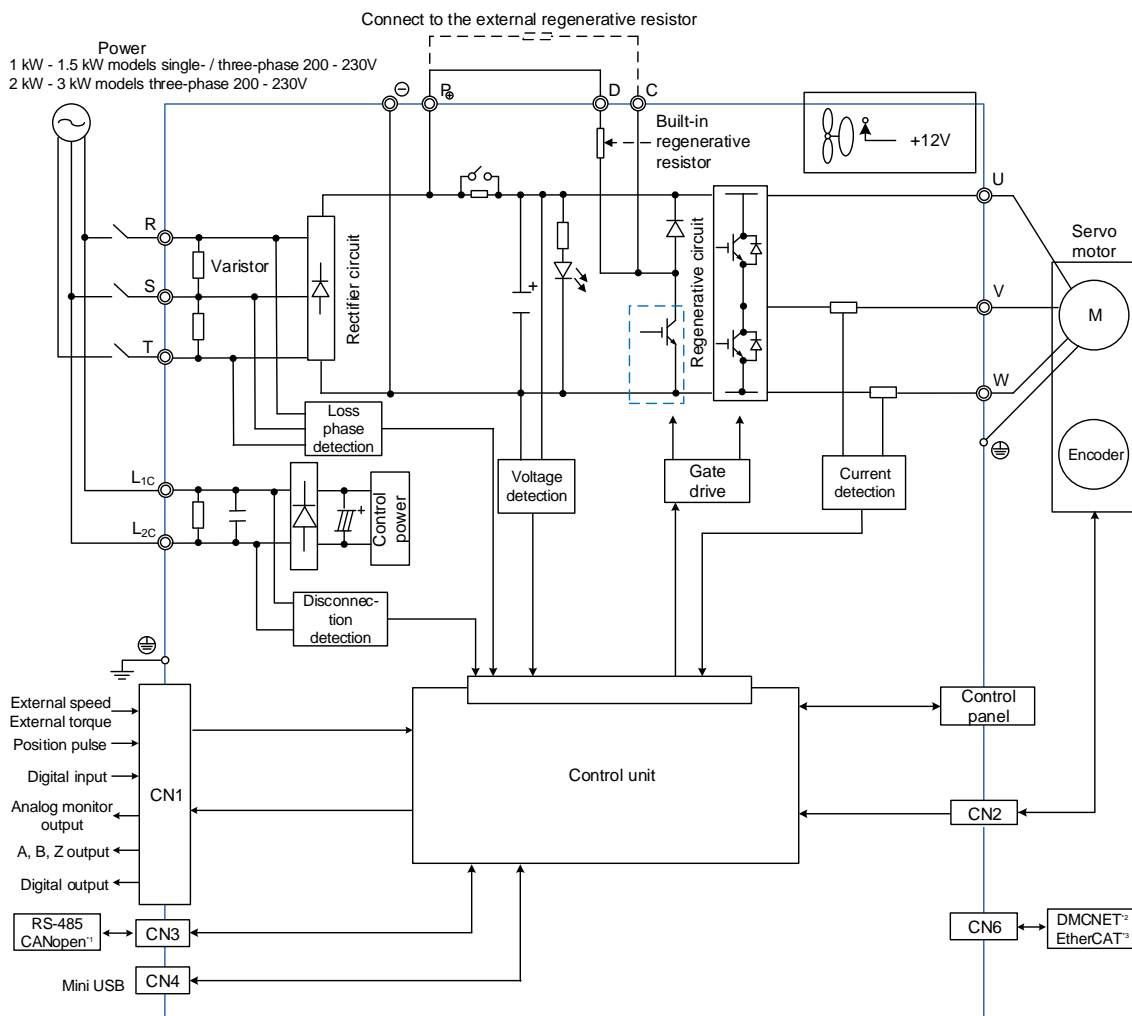
Note:

1.   CANopen is available on B3□-M only.

2.   DMCNET is available on B3□-F only.

3.   EtherCAT is available on B3□-E only.

3.3   Wiring for CN1 I/O connector
3.3.1   CN1 I/O connector (for M, F, and E models)

You can define 4 digital input (DI) points and 2 digital output (DO) points to provide highly flexible communication between the servo drive and the controller. In addition, differential type output signals, A+, A-, B+, B-, Z+, and Z-, for the encoder are provided. The pin assignments are shown as follows.
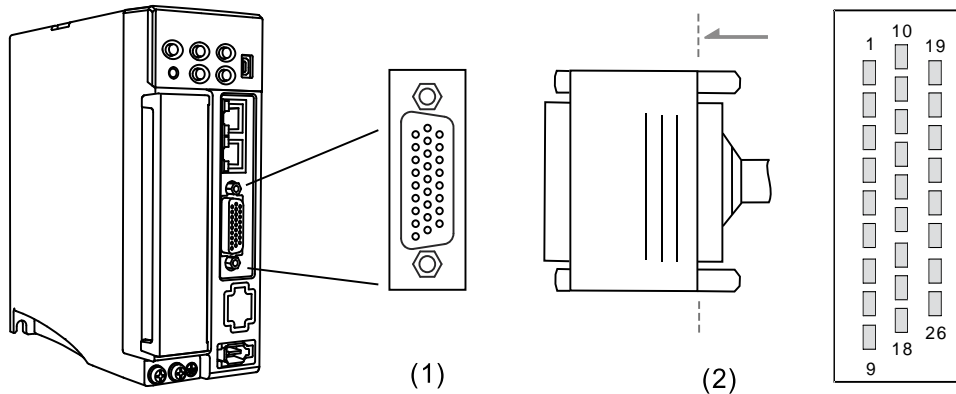
(1) CN1 connector (female); (2) CN1 connector (male)

Pin assignment:

Pin	Signal	Description	Pin	Signal	Description
1	OA	Encoder A pulse output	14	PULL HI_P (Pulse)	External power input of pulse
2	/OA	Encoder /A pulse output	15	DO1+	Digital output
3	OZ	Encoder Z pulse output	16	DO1-	Digital output
4	/OZ	Encoder /Z pulse output	17	DO2+	Digital output
5	COM+	Power input (24V ± 10%)	18	DO2-	Digital output
6	DI1-	Digital input	19	V_REF	Analog speed / position input (+)
7	DI2-	Digital input	20	T_REF	Analog torque input
8	DI3-	Digital input	21	MON1	Analog monitor output 1
9	DI4-	Digital input	22	MON2	Analog monitor output 2
10	GND	Ground for analog / differential output signal	23	SIGN+	Position sign (+)
11	OB	Encoder B pulse output	24	SIGN-	Position sign (-)
12	/OB	Encoder /B pulse output	25	PULSE+	Position pulse (+)
13	PULL HI_S (Sign)	External power input of Sign pulse	26	PULSE-	Position pulse (-)

Note:

1.   The pulse input function is supported by the B3A series only.

2.   **Do not directly input the 24V power supply to the SIGN+, SIGN-, PULSE+, and PULSE- pins, or the circuit elements will be damaged.**

3.3.2   Signal explanation for CN1 I/O connector (for M, F, and E models)

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

General signals:

Signal		Pin No.	Description	Wiring method (refer to Section 3.3.7)
Analog command (input)	V_REF	19	(1) When the motor speed command is set to -10V to +10V, it means the rotation speed is -3000 to +3000 rpm (default). You can set the corresponding range with parameters. (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	20	When the motor torque command is set to -10V to +10V, it means the rated torque is -100% to +100%.	C1
Analog monitor (output)	MON1 MON2	21 22	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.	C2
Position pulse* (input)	PULSE+ PULSE-	25 26	Position pulse can be sent by the line driver (single-phase max. frequency 4 MHz) or open collector (single-phase max. frequency 200 kHz). Three command types can be selected with P1.000, CW/CCW pulse, pulse and direction, and A/B pulse. If open collector type is used when sending position pulses, CN1 should be connected to an external power supply for pull high.	C3/C4
	SIGN+ SIGN-	23 24		
	PULL HI_P PULL HI_S	14 13		
Position pulse (output)	OA	1	Encoder signal A, B, and Z output (line driver).	C9/C10
	/OA	2		
	OB	11		
	/OB	12		
	OZ	3		
	/OZ	4		
Power	COM+	5	NPN: COM+ is for DI voltage input and requires an external power supply (24V ± 10%). PNP: COM+ is for DI voltage input (negative end) and requires an external power supply (24V ± 10%).	-
	GND	10	GND for analog signal and differential output signal.	

Note: the pulse input function is supported by the B3A series only.

3

These servo drive models provide user-defined I/O for you to set functions according to the application requirements. See Section 8.3 and refer to Table 8.1 Digital input (DI) descriptions and Table 8.2 Digital output (DO) descriptions. The default DI/DO signal configuration for each operation mode includes the most commonly used functions and meets the requirements for general applications. Set P1.001.U to 1 and cycle the power to the servo drive, then you can reset the signals to the default values corresponding to each mode.

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

DI	Control mode						
	PT	PR	S/Sz	T/Tz	PT-S	PT-T	PR-S
	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal
1	0x01	0x01	0x01	0x01	0x01	0x01	0x01
	SON	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

DI	Control mode					
	PR-T	S-T	Communication	PT-PR	PT-PR-S	PT-PR-T
	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal
1	0x01	0x01	0x00	0x01	0x01	0x01
	SON	SON	-	SON	SON	SON
2	0x22	0x22	0x22	0x22	0x22	0x22
	NL	NL	NL	NL	NL	NL
3	0x23	0x23	0x23	0x23	0x23	0x23
	PL	PL	PL	PL	PL	PL
4	0x21	0x21	0x21	0x21	0x21	0x21
	EMGS	EMGS	EMGS	EMGS	EMGS	EMGS

Note:

1.   Description of each DI signal:

Signal	Description	Signal	Description
SON	Servo is activated	NL	Negative limit
EMGS	Emergency stop	PL	Positive limit

2.   Refer to the C7 and C8 figures in Section 3.3.7 for wiring.

See the following table for the default DO signal of each control mode:

DO	Control mode						
	PT	PR	S/Sz	T/Tz	PT-S	PT-T	PR-S
	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal
1	0x01	0x01	0x01	0x01	0x01	0x01	0x01
	SRDY	SRDY	SRDY	SRDY	SRDY	SRDY	SRDY
2	0x07	0x07	0x07	0x07	0x07	0x07	0x07
	ALRM	ALRM	ALRM	ALRM	ALRM	ALRM	ALRM

DO	Control mode					
	PR-T	S-T	Communication	PT-PR	PT-PR-S	PT-PR-T
	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal
1	0x01	0x01	0x01	0x01	0x01	0x01
	SRDY	SRDY	SRDY	SRDY	SRDY	SRDY
2	0x07	0x07	0x07	0x07	0x07	0x07
	ALRM	ALRM	ALRM	ALRM	ALRM	ALRM

Note:

1. Description of each DO signal:

Signal	Description	Signal	Description
SRDY	Servo ready	ALRM	Servo alarm

2. Refer to the C5 and C6 figures in Section 3.3.7 for wiring.

If the default DI/DO function cannot meet the application requirement, specify the DI/DO functions by setting DI or DO code to the corresponding parameters. The signal functions are set with the parameters listed in the following table.

Signal		Pin No.	Corresponding parameter	Signal		Pin No.	Corresponding parameter
Standard DI	DI1-	6	P2.010	Standard DO	DO1+	15	P2.018
	DI2-	7	P2.011		DO1-	16	
	DI3-	8	P2.012		DO2+	17	P2.019
	DI4-	9	P2.013		DO2-	18	

3

3.3.3 Application: using the CN1 quick connector for wiring (for M, F, and E models)

The CN1 quick connector* is designed for easy wiring, which can be applied to the ASDA-B3 series servo drive. It is a good choice if you do not want to solder the wires. Its spring terminal blocks prevent the wire from loosening due to vibration.

Note: coming soon.

3.3.4 CN1 I/O connector (for L model)

You can define 9 digital input (DI) points and 6 digital output (DO) points to provide highly flexible communication between the servo drive and the controller. In addition, differential type output signals, A+, A-, B+, B-, Z+, and Z-, for the encoder are provided. Analog torque command input, analog speed / position command input, and pulse position command input are also available. The pin assignments are shown as follows:

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

Pin assignment:

Pin	Signal	Description	Pin	Signal	Description
1	DO4+	Digital output	23	/OB	Encoder /B pulse output
2	DO3-	Digital output	24	/OZ	Encoder /Z pulse output
3	DO3+	Digital output	25	OB	Encoder B pulse output
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	GND for analog signal and differential output signal
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	Encoder Z pulse line-driver output	35	PULL HI_S (Sign)	External power input of Sign pulse
14	MON2	Analog monitor output 2	36	PULL HI_P (Pulse)	External power input of pulse
15	DO6-	Digital output	37	SIGN-	Position sign (-)
16	DO6+	Digital output	38	NC	-
17	MON1	Analog monitor output 1	39	SIGN+	Position sign (+)
18	T_REF	Analog torque input	40	GND	GND for analog signal and differential output signal
19	GND	GND for analog signal and differential output signal	41	PULSE-	Position pulse (-)
20	V_REF	Analog command input speed / position (+)	42	NC	-
21	OA	Encoder A pulse output	43	PULSE+	Position pulse (+)
22	/OA	Encoder /A pulse output	44	OCZ	Encoder Z pulse open-collector output

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. The analog voltage control function is not supported by the B3B series.

3. **Do not directly input the 24V power supply to the SIGN+, SIGN-, PULSE+, and PULSE- pins, or the circuit elements will be damaged.**

3.3.5   Signal explanation for CN1 I/O connector (for L model)

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

General signals:

Signal		Pin No.	Description	Wiring method (refer to Section 3.3.7)
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 to +3000 rpm (default). You can set the corresponding range with parameters. (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%.	C1
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.	C2
Position pulse (input)	PULSE+ PULSE-	43 41	Position pulse can be sent by the line driver (single-phase max. frequency 4 MHz) or open collector (single-phase max. frequency 200 kHz). Three command types can be selected with P1.000, CW/CCW pulse, pulse and direction, and A/B pulse. If open collector type is used when sending position pulses, CN1 should be connected to an external power supply for pull high.	C3/C4
	SIGN+ SIGN-	39 37		
	PULL HI_P PULL HI_S	36 35		
Position pulse (output)	OA /OA	21 22	Encoder signal A, B, and Z output (line driver).	C9/C10
	OB /OB	25 23		
	OZ /OZ	13 24		
	OCZ	44	Encoder Z pulse output (open collector).	C11
Power	COM+	11	NPN: COM+ is for DI voltage input and requires an external power supply (24V ± 10%). PNP: COM+ is for DI voltage input (negative end) and requires an external power supply (24V ± 10%).	-
	GND	19, 29, 40	GND for analog signal and differential output signal.	
Other	NC	38, 42	No connection. This is for internal use only. Do not connect to NC, or it may damage the servo drive.	

Note: the analog voltage control function is not supported by the B3B series.

There are various operation modes available (refer to Section 6.1) and the I/O configuration differs for each mode. This servo drive model provides user-defined I/O for you to set functions according to the application requirements. See Section 8.3 and refer to Table 8.1 Digital input (DI) descriptions and Table 8.2 Digital output (DO) descriptions. The default DI/DO signal configuration for each operation mode includes the most commonly used functions and meets the requirements for general applications. Set P1.001.U to 1 and cycle the power to the servo drive, then you can reset the signals to the default values corresponding to each mode.

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

DI	Control mode					
	PT	PR	S/Sz	T/Tz	PT-S	PT-T
	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal
1	0x01	0x01	0x01	0x01	0x01	0x01
	SON	SON	SON	SON	SON	SON
2	0x04	0x08	0x09	0x10	0x04	0x04
	CCLR	CTRG	TRQLM	SPDLM	CCLR	CCLR
3	0x16	0x11	0x14	0x16	0x14	0x16
	TCM0	POS0	SPD0	TCM0	SPD0	TCM0
4	0x17	0x12	0x15	0x17	0x15	0x17
	TCM1	POS1	SPD1	TCM1	SPD1	TCM1
5	0x02	0x02	0x02	0x02	0x00	0x00
	ARST	ARST	ARST	ARST	-	-
6	0x22	0x22	0x22	0x22	0x00	0x00
	NL	NL	NL	NL	-	-
7	0x23	0x23	0x23	0x23	0x18	0x20
	PL	PL	PL	PL	S-P	T-P
8	0x21	0x21	0x21	0x21	0x21	0x21
	EMGS	EMGS	EMGS	EMGS	EMGS	EMGS
9	0x00	0x00	0x00	0x00	0x00	0x00
	-	-	-	-	-	-

DI	Control mode					
	PR-S	PR-T	S-T	PT-PR	PT-PR-S	PT-PR-T
	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal
1	0x01	0x01	0x01	0x01	0x01	0x01
	SON	SON	SON	SON	SON	SON
2	0x08	0x08	0x00	0x04	0x04	0x04
	CTRG	CTRG	-	CCLR	CCLR	CCLR
3	0x11	0x11	0x14	0x08	0x08	0x08
	POS0	POS0	SPD0	CTRG	CTRG	CTRG
4	0x12	0x12	0x15	0x11	0x11	0x11
	POS1	POS1	SPD1	POS0	POS0	POS0
5	0x14	0x16	0x16	0x12	0x12	0x12
	SPD0	TCM0	TCM0	POS1	POS1	POS1
6	0x15	0x17	0x17	0x13	0x24	0x24
	SPD1	TCM1	TCM1	POS2	ORGP	ORGP
7	0x18	0x20	0x19	0x24	0x18	0x20
	S-P	T-P	S-T	ORGP	S-P	T-P
8	0x21	0x21	0x21	0x2B	0x2B	0x2B
	EMGS	EMGS	EMGS	PT-PR	PT-PR	PT-PR
9	0x00	0x00	0x00	0x02	0x02	0x02
	-	-	-	ARST	ARST	ARST

Note:

1. Description of each DI signal:

Signal	Description	Signal	Description	Signal	Description
SON	Servo is activated	NL	Negative limit	PL	Positive limit
CCLR	Pulse clear	ARST	Alarm reset	EMGS	Emergency stop
CTRG	Internal position command triggered	TCM0	Torque command 0	TCM1	Torque command 1
TRQLM	Torque limit	SPD0	Speed selection 0	SPD1	Speed selection 1
SPDLM	Speed limit	POS0	Internal position selection 0	POS1	Internal position selection 1
S-P	Switch between S and P modes	T-P	Switch between T and P modes	S-T	Switch between S and T modes
PT-PR	Switch between PT and PR modes	POS2	Internal position selection 2	ORGP	ORG signal

2. Refer to the C7 and C8 figures in Section 3.3.7 for wiring.

See the following table for the default DO signal of each control mode:

DO	Control mode					
	PT	PR	S/Sz	T/Tz	PT-S	PT-T
	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal
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	0x09	0x04	0x04	0x04	0x04
	HOME	HOME	TSPD	TSPD	TSPD	TSPD
4	0x05	0x05	0x08	0x08	0x05	0x05
	TPOS	TPOS	BRKR	BRKR	TPOS	TPOS
5	0x07	0x07	0x07	0x07	0x07	0x07
	ALRM	ALRM	ALRM	ALRM	ALRM	ALRM

DO	Control mode					
	PR-S	PR-T	S-T	PT-PR	PT-PR-S	PT-PR-T
	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal	Default Signal
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	0x04	0x04	0x04	0x09	0x09	0x09
	TSPD	TSPD	TSPD	HOME	HOME	HOME
4	0x05	0x05	0x00	0x05	0x05	0x05
	TPOS	TPOS	-	TPOS	TPOS	TPOS
5	0x07	0x07	0x07	0x07	0x07	0x07
	ALRM	ALRM	ALRM	ALRM	ALRM	ALRM

Note:

Description of each DO signal:

Signal	Description	Signal	Description	Signal	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	-	-	-	-

If the default DI/DO function cannot meet the application requirement, specify the DI/DO functions by setting DI or DO code to the corresponding parameters. The signal functions are set with the parameters listed in the following table.

Signal		Pin No.	Corresponding parameter	Signal		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		Pin No.	Corresponding parameter	Signal		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	

3.3.6 Application: using the CN1 quick connector for wiring (for L model)

The CN1 quick connector (ACS3-IFSC4444) is designed for easy wiring, which can be applied to the ASDA-B3 series servo drive. It is a good choice if you do not want to solder the wires. Its spring terminal blocks prevent the wire from loosening due to vibration.

3
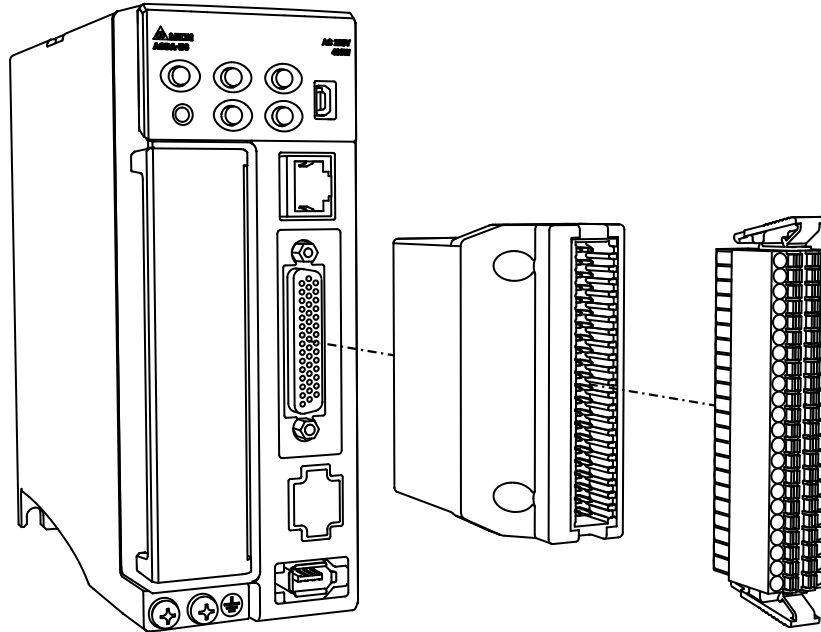
Pin assignment for the CN1 quick connector:

OCZ	44		43	PULSE
NC	42		41	/PULSE
GND	40		39	SIGN
NC	38		37	/SIGN
PULL HI_P	36		35	PULL HI_S
DI3-	34		33	DI5-
DI6-	32		31	DI7-
DI8-	30		29	GND
DO5+	28		27	DO5-
DO4-	26		25	OB
/OZ	24		23	/OB
/OA	22		21	OA
V_REF	20		19	GND
T_REF	18		17	MON1
DO6+	16		15	DO6-
MON2	14		13	OZ
DI9-	12		11	COM+
DI2-	10		9	DI1-
DI4-	8		7	DO1+
DO1-	6		5	DO2+
DO2-	4		3	DO3+
DO3-	2		1	DO4+

Note: NC represents "No connection".

Wiring and installation for the CN1 quick connector:

Installation
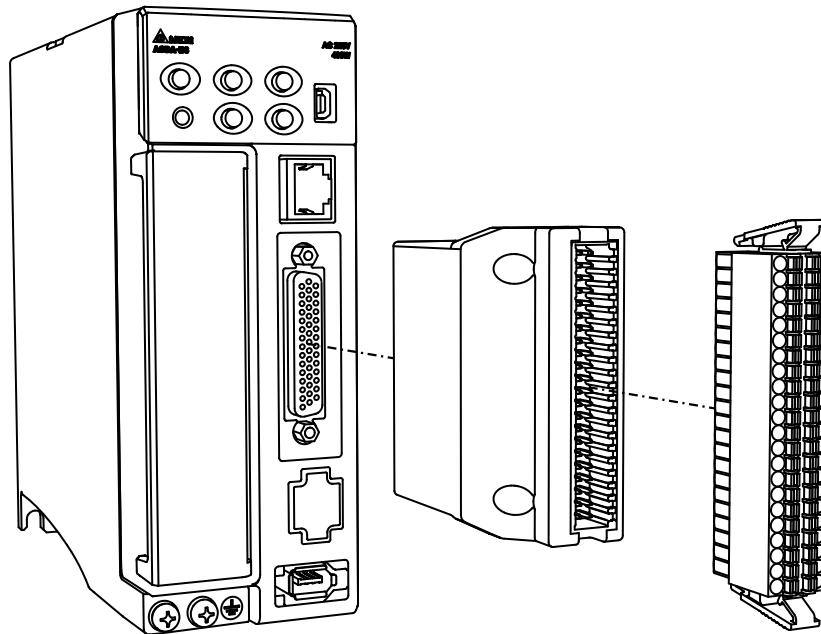
Wiring
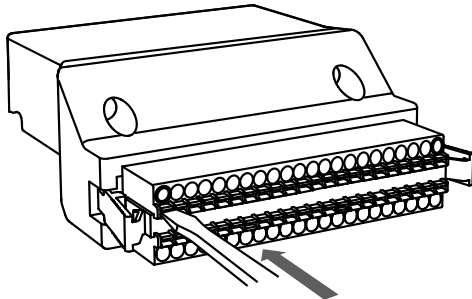
(1) The CN1 quick connector has multiple spring terminals. Determine which terminal is to be wired in advance. Use a flathead screwdriver to press the spring down to open the pin.
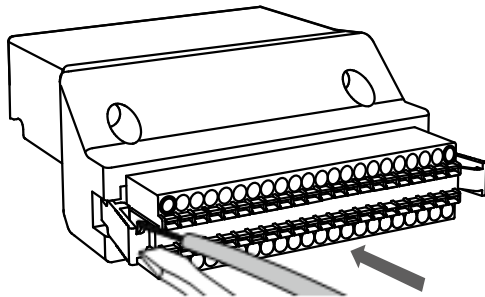
(2) Insert the stripped wire into the pin and withdraw the screwdriver to complete the wiring.

3

3.3.7   CN1 wiring diagrams

The wiring diagrams in this chapter are based on the B3-L model. Refer to the notes for the pin definition of other models. For the functions supported by each model, refer to Chapter 1.

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

C1: input for speed / torque (force) analog command
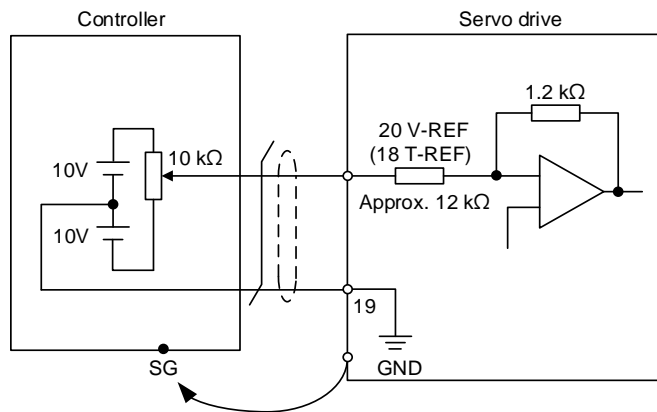
Note: the pin definition of the communication type models is different from that of the L model.

Communication type model pins: V-REF (19), T-REF (20), and GND (10).

C2: output for analog monitoring command (MON1 and MON2)
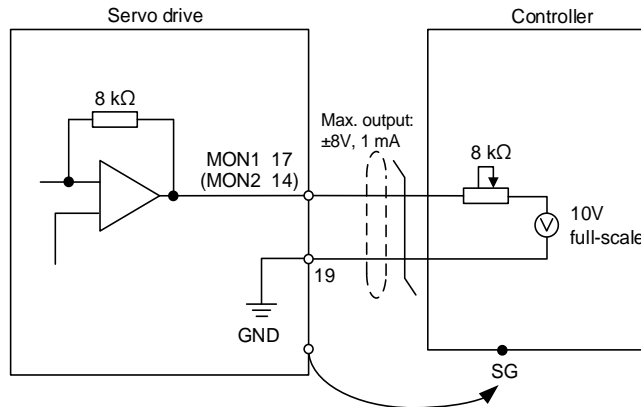
Note: the pin definition of the communication type models is different from that of the L model.

Communication type model pins: MON1 (21), MON2 (22), and GND (10).

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

Caution: do not directly input the 24V power supply to the SIGN+, SIGN-, PULSE+, and PULSE- pins, 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.
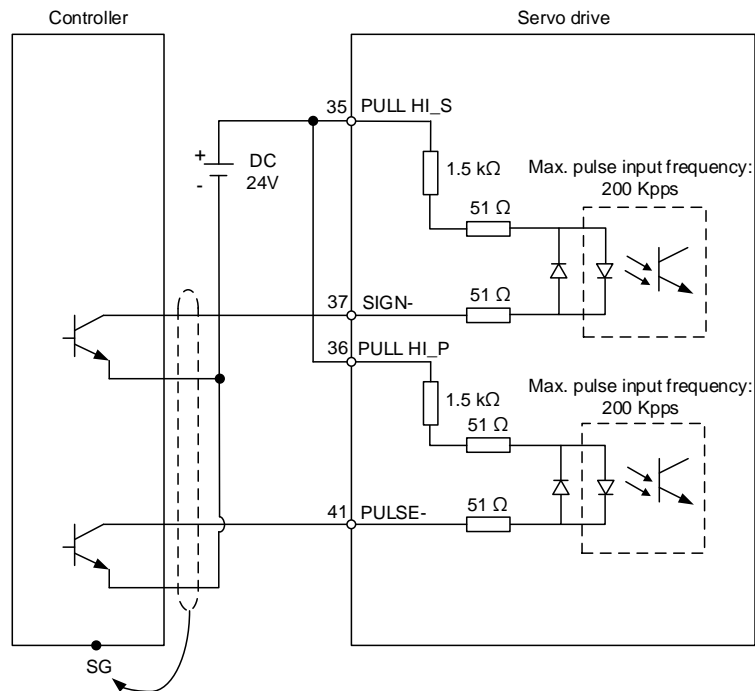
Note:

1. This is supported by the B3-L model and the B3A series only.

2. The pin definition of the communication type models is different from that of the L model.

    Communication type model pins: PULL HI_S (13), PULL HI_P (14), SIGN- (24), and PULSE- (26).

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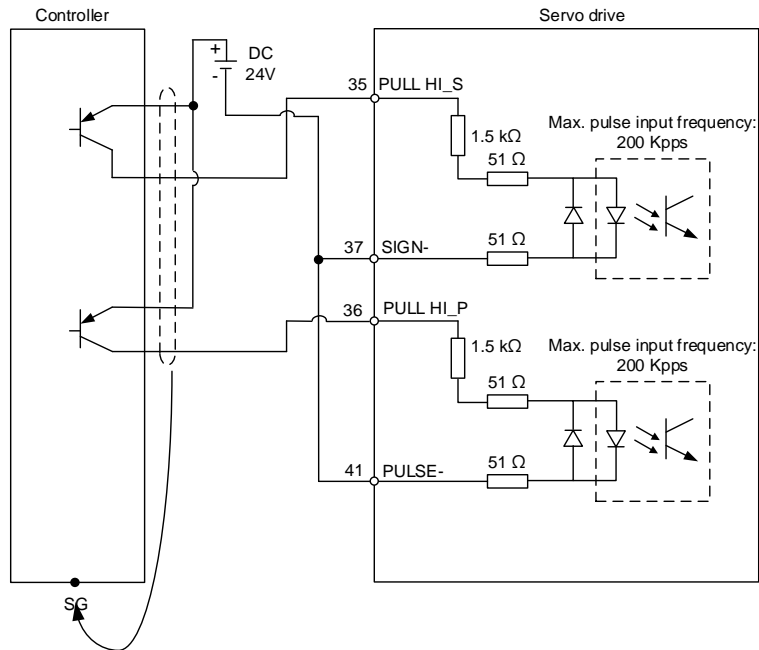
Note:

1. This is supported by the B3-L model and the B3A series only.

2. The pin definition of the communication type models is different from that of the L model.

    Communication type model pins: PULL HI_S (13), PULL HI_P (14), SIGN- (24), and PULSE- (26).

C4: pulse input (line driver) can only be used with 2.8V - 3.6V power systems.

Do not use it with 24V power.

Pulse	Type		Maximum input frequency (single-phase)
High speed pulse	Differential signal	Pulse train + sign	4 Mpps
		Forward and reverse pulse trains	
		AB phase pulse train	2 Mpps
Low speed pulse	Differential signal		200 Kpps
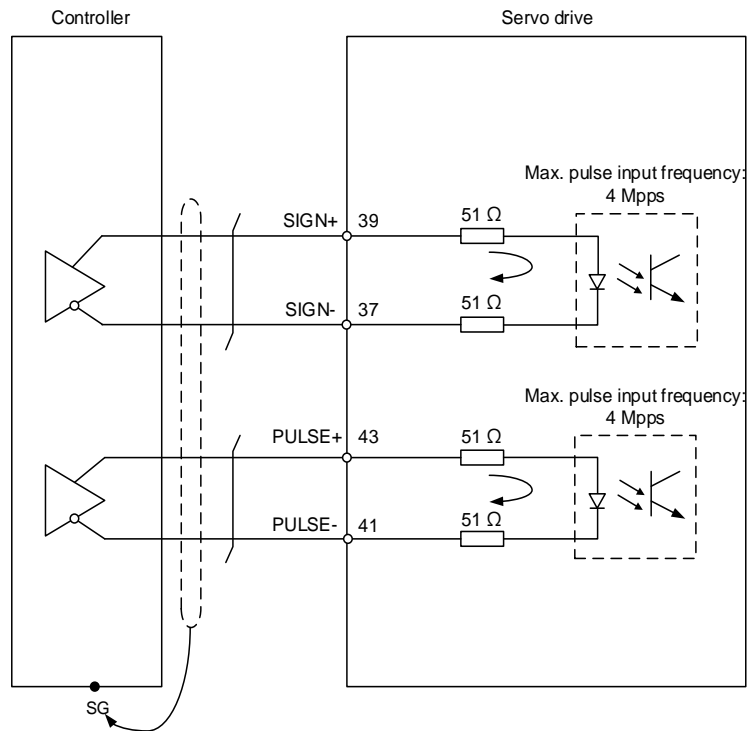
Note:

1.   This is supported by the B3-L model and the B3A series only.

2.   The pin definition of the communication type models is different from that of the L model.

     Communication type model pins: SIGN+ (23), SIGN- (24), PULSE+ (25), and PULSE- (26).

3

Important: 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 1N4005 diode)

C5: DO wiring - the servo drive uses an external power supply and the resistor is for general load.
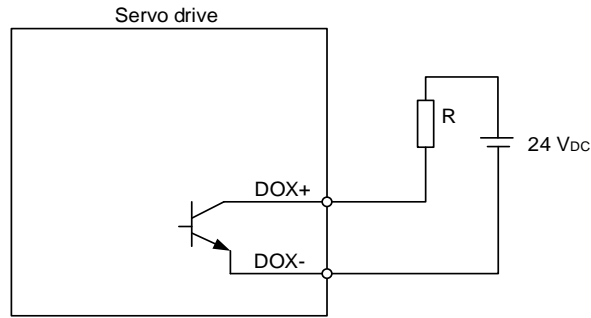
C6: DO wiring - the servo drive uses an external power supply and the resistor is for inductive
load.

3
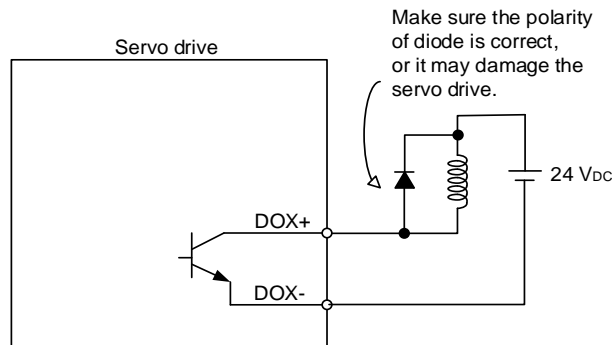
DI wiring - input signals by relay or open collector transistor.

Conditions of DI On / Off:

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

OFF: below 5V; condition: input current $\leq$ 0.5 mA.

C7: NPN transistor (SINK mode)
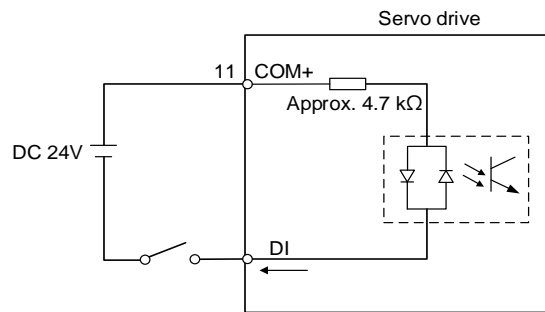
C8: PNP transistor (SOURCE mode)
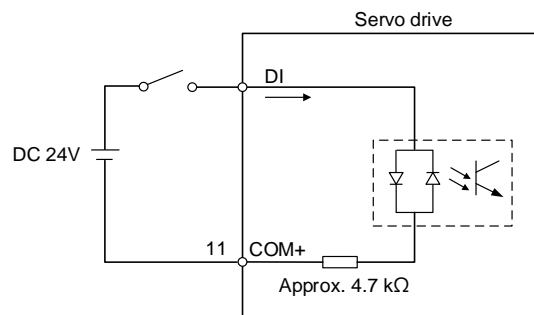
C9: output for encoder position signal (line driver)
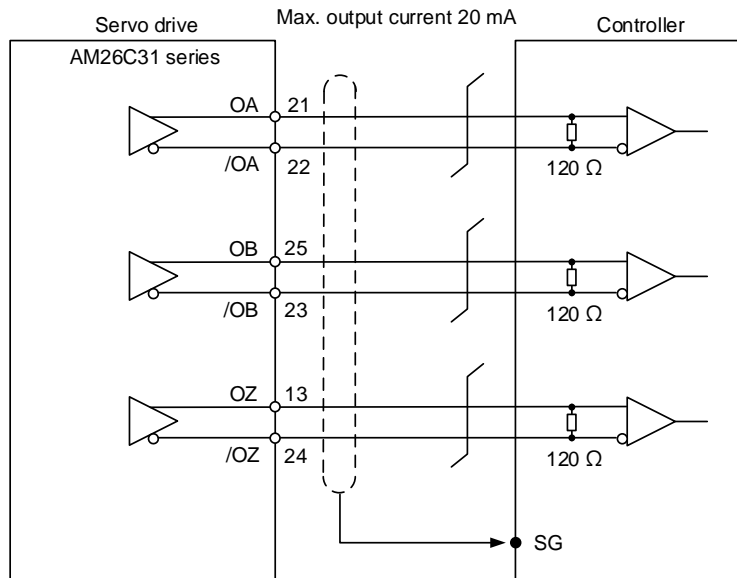
Note:

1. It is suggested that you connect the two GND for the controller and servo drive in parallel when the voltage deviation between the controller and the servo drive is too great.

2. The pin definition of the communication type models is different from that of the L model.

    Communication type model pins: OA (1), /OA (2), OB (11), /OB (12), OZ (3), and /OZ (4).

C10: output for encoder position signal (opto-isolator)
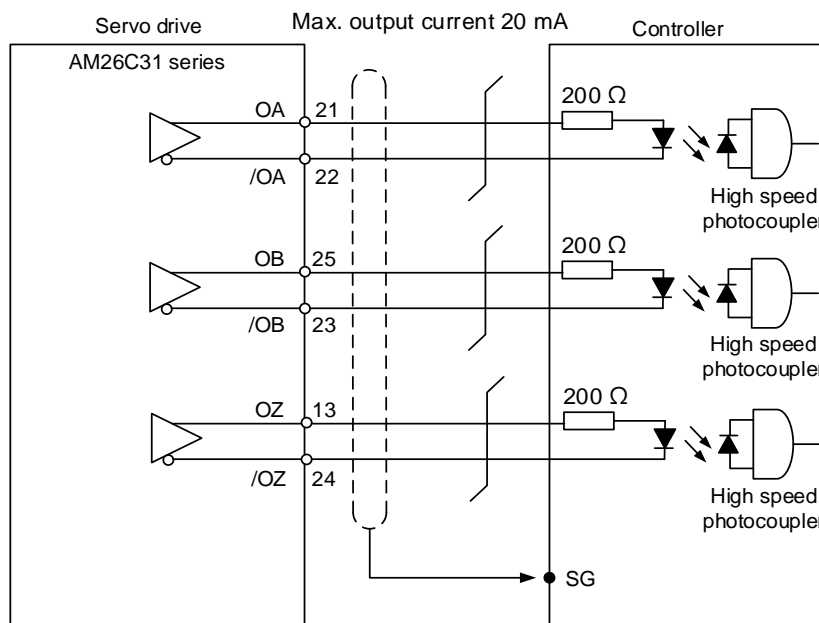
Note: the pin definition of the communication type models is different from that of the L model.

Communication type model pins: OA (1), /OA (2), OB (11), /OB (12), OZ (3), and /OZ (4).

C11: encoder OCZ output (open collector Z pulse output)
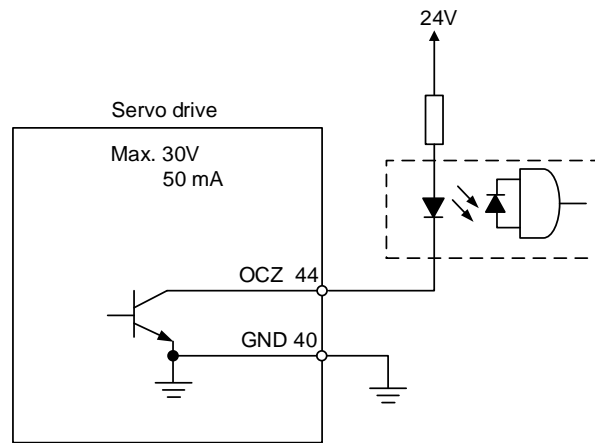
Note: this is not supported by the communication type models.

3

3.4 Wiring for the CN2 encoder connector

The CN2 encoder signal connector is shown as follows:
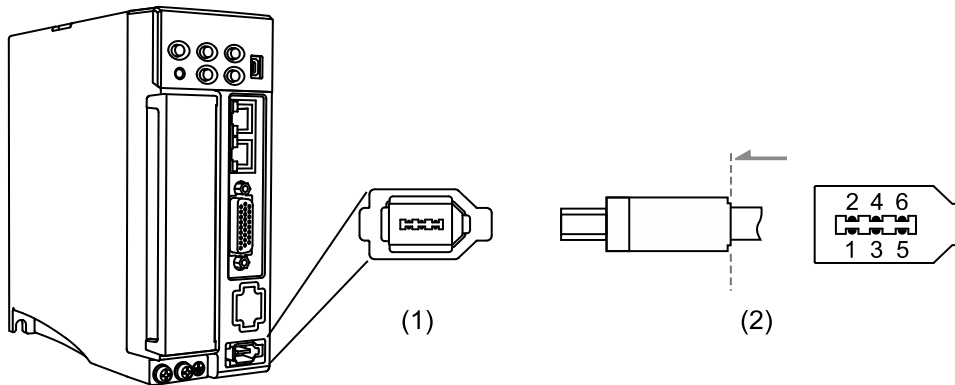
(1) CN2 connector (female); (2) CN2 connector (male)

> **WARNING**
> ■ DO NOT wire Pin 3 and Pin 4 of the servo drive CN2 connector. They are for internal use only; wiring them will cause damage to the internal circuit.
>
> ■ When using an absolute encoder, the battery supplies power directly to the encoder, so wiring to the CN2 connector of the servo drive is not required.

Quick connector ends:

View from this side   View from this side

Military connector ends:

View from this side   View from this side

IP67 waterproof connector ends:

View from this side   View from this side

Pin assignment of CN2 connector:

The end that connects to the encoder				The end that connects to the servo drive		
Military connector	Quick connector	IP67 connector	Color	Pin No.	Signal	Description
4	7	4	Brown	1	DC+5V	+5V power supply
9	8	3	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	1	White	5	T+	Serial communication signal (+)
2	4	2	White / Red	6	T-	Serial communication signal (-)
10	9	8	-	Case	Shield	Shielding
6	2	6	Red	-	-	Battery +3.6V
5	5	5	Black	-	-	Battery ground

Note: for the absolute battery wiring, refer to Section 3.1.5 Specification for the encoder connector.

Connecting shielded wire to the CN2 encoder connector is shown as follows:
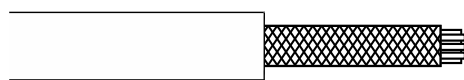
Step 1:

Cut through the cable and expose the shielding.

The exposed wire length should be 20 - 30 mm

(0.79 - 1.18 inches).
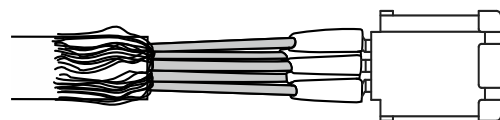
Step 2:

Spread the metal shielding and fold it back.

Refer to the CN2 pin assignment (see the table

above) to connect the pins.

3
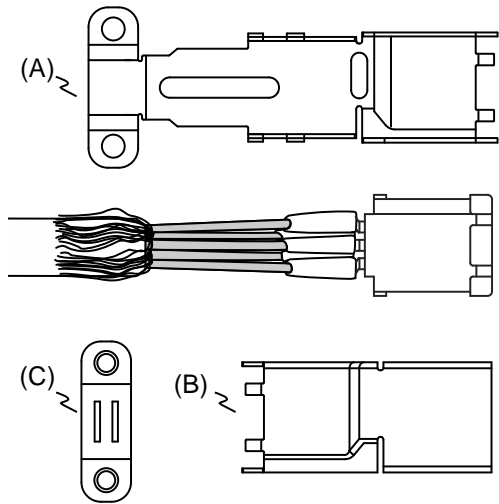
Step 3:

You need the following items to assemble the

connector:

(A) Big metal case

(B) Small metal case

(C) Metal ring
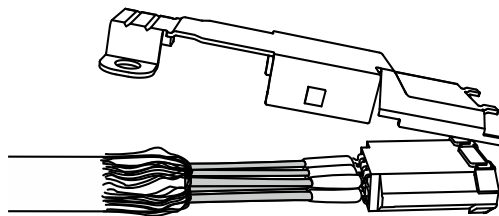
Step 4:

Place the big metal case to cover the exposed

wire shielding. Make sure the shielding is

completely covered to maintain the integrity of

the shielding.
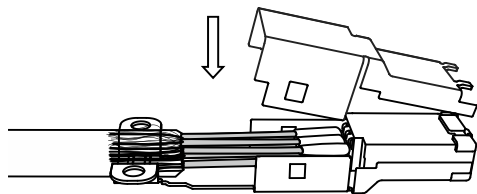
Step 5:

Fasten the small metal case on the other side.
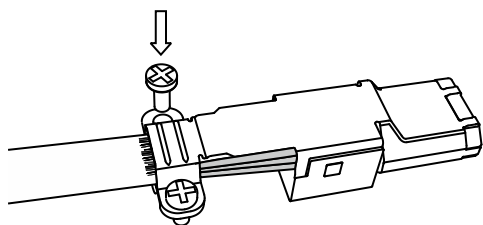
Step 6:

Tighten the metal ring to the big metal case.
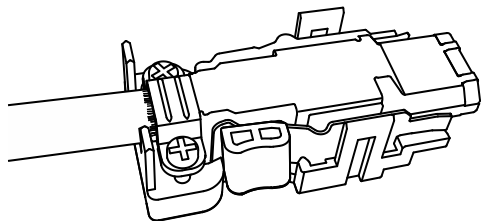
Step 7:

Fit one side of the plastic case over the

connector.
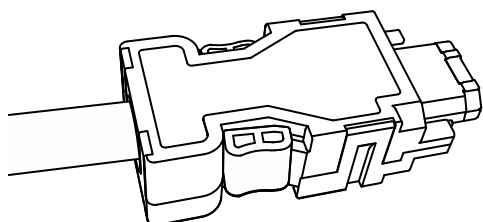
Step 8:

Place and fasten the other side of the case to

complete the connector.

3.5 Wiring for the CN3 communication connector
3.5.1 Wiring for the MODBUS communication connector

When the servo drive is connected to the PC via CN3, you can operate the servo drive, PLC, or HMI through MODBUS using the assembly language. The CN3 connector supports the RS-485 communication interface which enables you to connect multiple servo drives simultaneously.

Note: B3□-L model: single port (Pin 1 - Pin 8); supports RS-485 only.
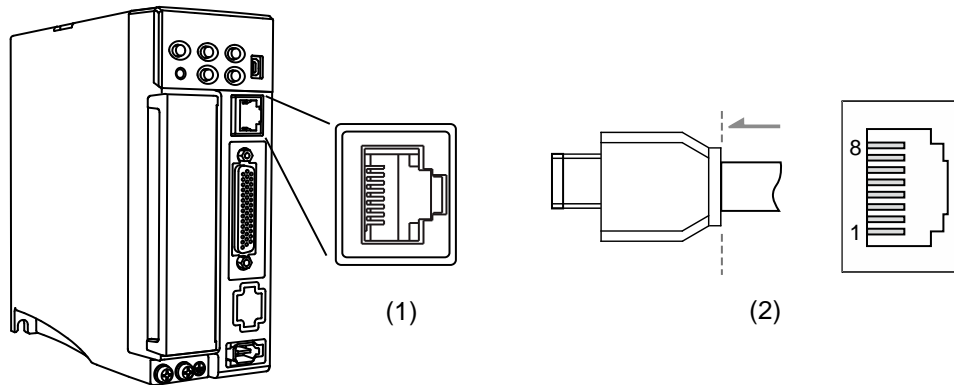
(1) CN3 connector (female); (2) CN3 connector (male)

Pin assignment:

Pin No.	Signal	Description
1	-	-
2	-	-
3, 7	GND_ISO	Signal GND
4	RS-485-	The servo drive transmits the data to differential terminal (-).
5	RS-485+	The servo drive transmits the data to differential terminal (+).
6, 8	-	-

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

Connecting multiple servo drives:
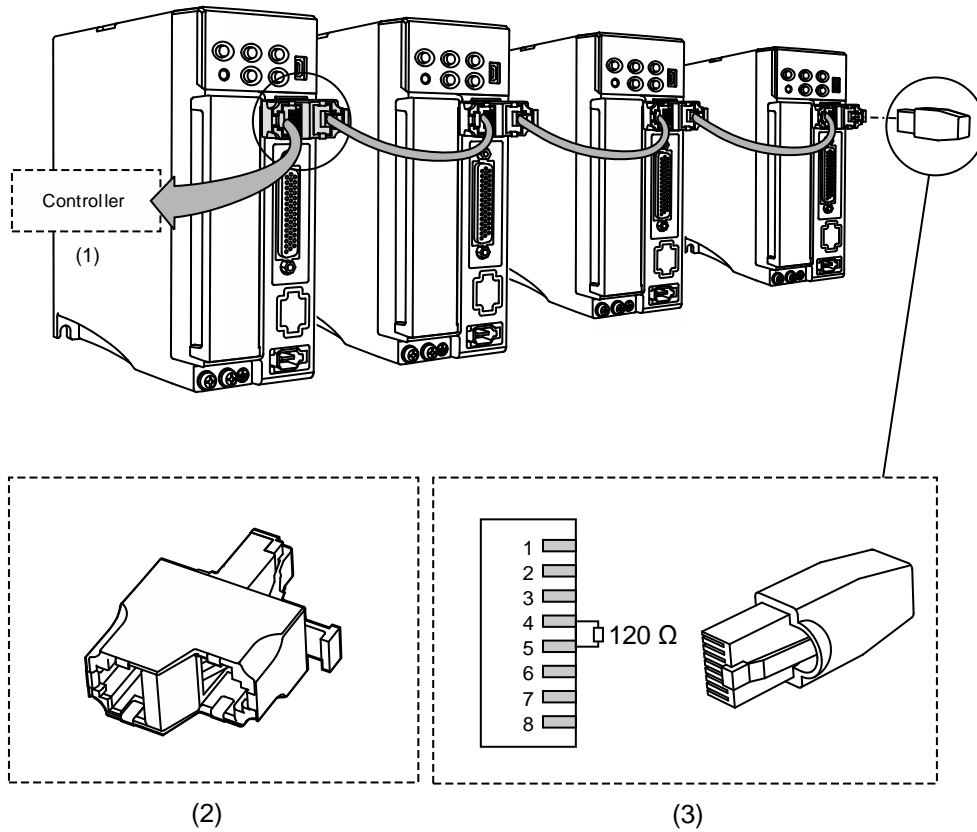
(1) Connect to the controller / PLC; (2) Modbus connector; (3) Wiring for RS-485 terminal resistor

Note:

1. This supports up to 32 axes via RS-485. The communication quality and the number of connectable 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 to use a terminal resistor of 120 Ω (Ohm) and 0.5 W (or above).

3. To connect multiple servo drives in parallel, use a Modbus connector as shown above, and put the terminal resistor in the last servo drive.

3.5.2   Wiring for the CANopen communication connector

The CN3 connector conforms to the CANopen DS301 and DS402 standards. You can use it for controlling position, torque, and speed, as well as accessing or monitoring the servo status with the standard CAN interface. The CN3 connector supports the CANopen communication interface which enables you to connect multiple servo drives simultaneously.

Note:

1.   B3A-M model: dual ports; supports RS-485 and high-speed communication (CANopen).

2.   B3-M model: supports high-speed communication (CANopen) but not RS-485.
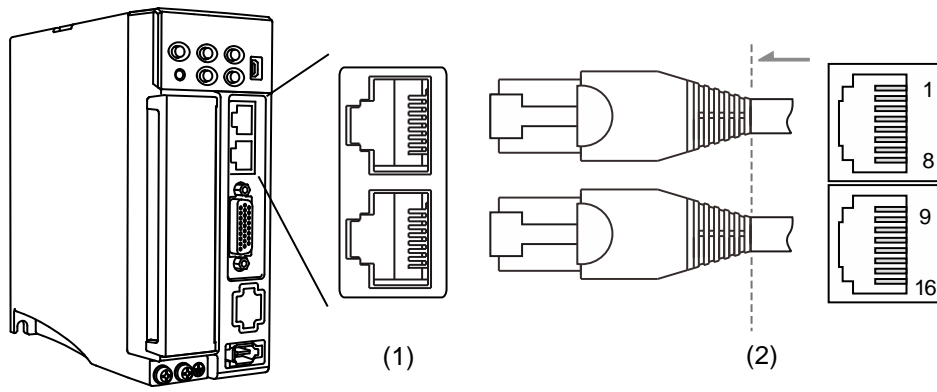
(1) CN3 connector (female); (2) CN3 connector (male)

Pin assignment:

Pin No.	Signal	Description
1, 9	CAN_H	CAN_H bus line (dominant high)
2, 10	CAN_L	CAN_L bus line (dominant low)
3, 11	GND_ISO	Signal GND
4, 12	RS-485-	For the servo drive to transmit data to the differential terminal (-)
5, 13	RS-485+	For the servo drive to transmit data to the differential terminal (+)
6, 14	-	-
7, 15	GND_ISO	Signal GND
8, 16	-	-

3

Connecting multiple servo drives:

Install the terminal resistor based on the communication mode.
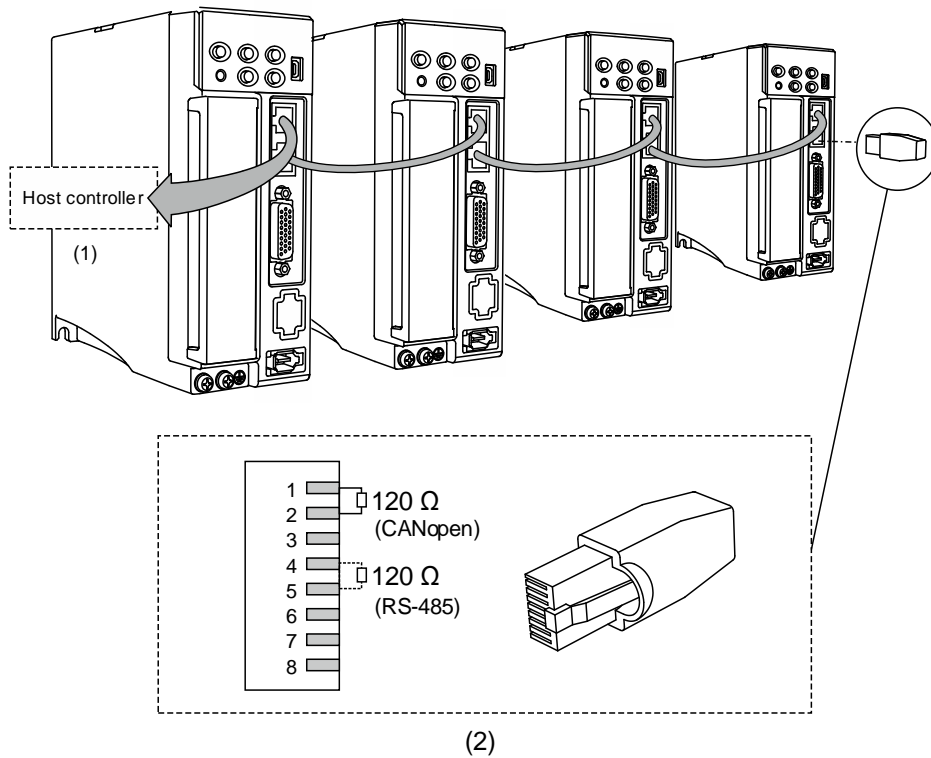
(1) Connect to the controller / PLC; (2) Wiring for CAN terminal resistor

Note:

1. The CANopen cable length can be up to 30 m (98.43 ft). You can connect a maximum of 32 axes using RS-485. The communication quality and the number of connectable 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 to use a terminal resistor of 120 Ω (Ohm) and 0.5 W (or above).

3. To connect multiple servo drives in parallel, use two sets of CAN ports as shown above, and put the terminal resistor in the last servo drive.

3.6   CN4 serial connector (Mini USB)

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

Note: when there is high interference during operation, it is suggested that you install a USB isolator.

    (Delta part number: UC-ADP01-A)
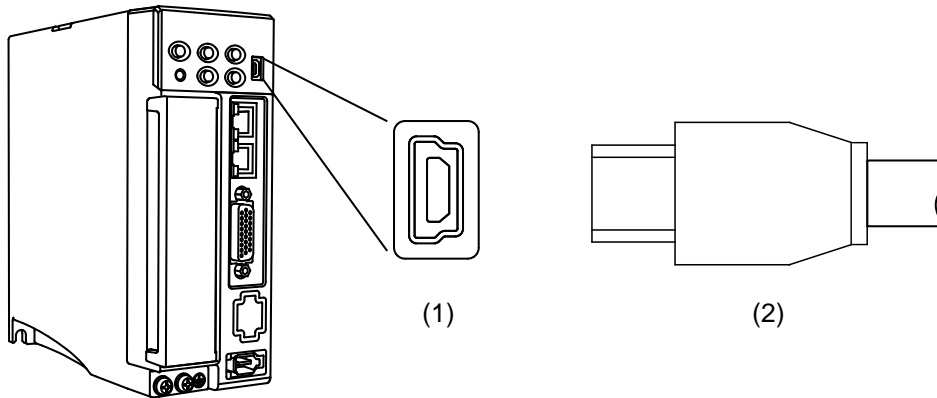
(1) USB connector (female); (2) USB connector (male)

3.7 Wiring for the CN6 communication connector
3.7.1 Wiring for the DMCNET communication connector

The servo drive uses a standard RJ45 connector with a shielded cable to connect to the controller or motion control card for controlling position, torque, and speed, as well as accessing or monitoring the servo status with Delta's DMCNET system.

You can set the station number of DMCNET with P3.000. Its maximum transmission rate is 20 Mbps. Two ports are provided for connecting multiple servo drives, with one way in and the other way out. Remember to put the terminal resistor (120 Ω) in the last servo drive.
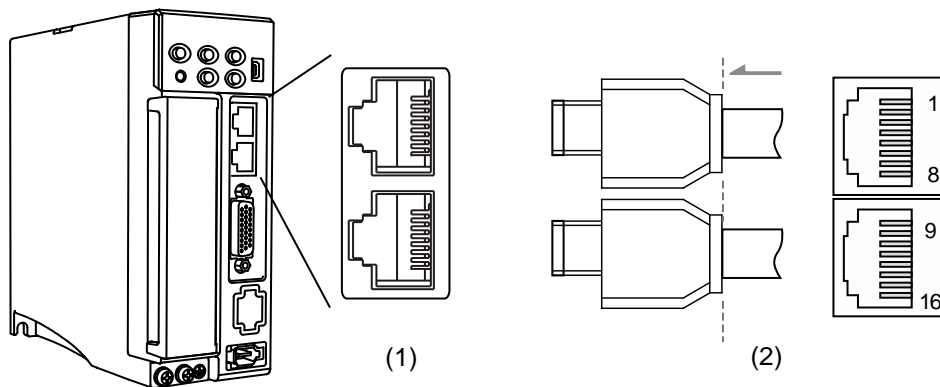
(1) CN6 connector (female); (2) CN6 connector (male)

Pin assignment (same for both connectors):

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

Connecting multiple servo drives:

(2)
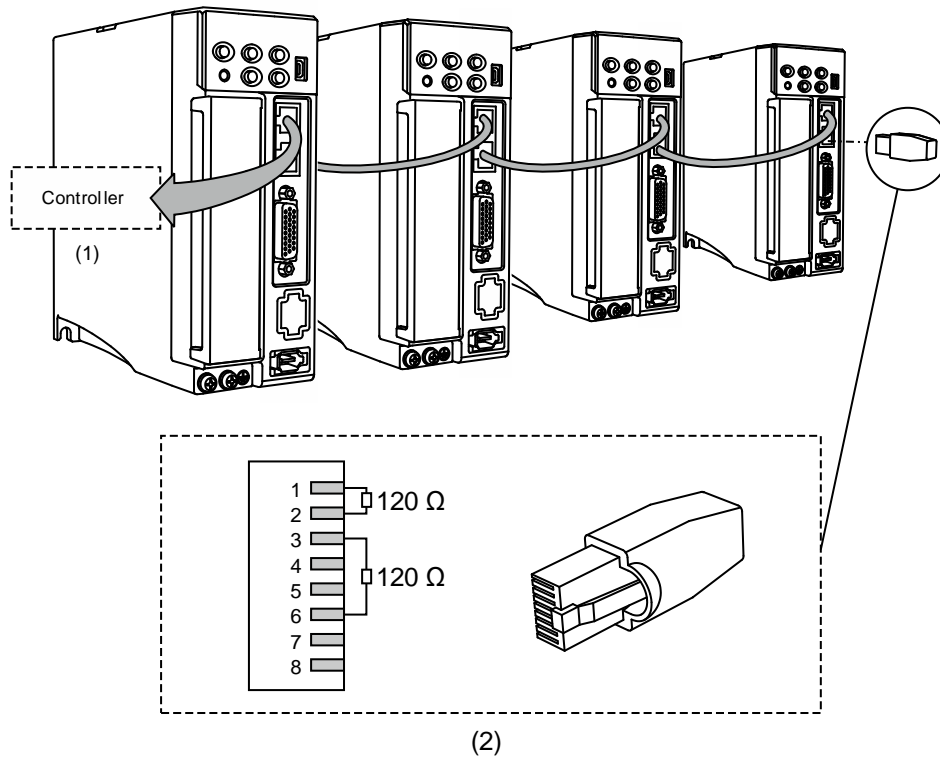
(1)   Connection to the controller / motion control card

(2)   DMCNET terminal resistor (Delta part number: ASD-TR-DM0008)

Note:

1.   This supports up to 12 axes with the cable length up to 30 m (98.43 ft).

2.   It is suggested to use a terminal resistor of 120 Ω (Ohm) and 0.5 W (or above).

3.   To connect multiple servo drives in serial, use two sets of DMCNET ports as shown above, and put the terminal resistor in the last servo drive.

3

3.7.2 Wiring for the EtherCAT communication connector

Two ports are provided for connecting multiple servo drives, with one way in and the other way out.
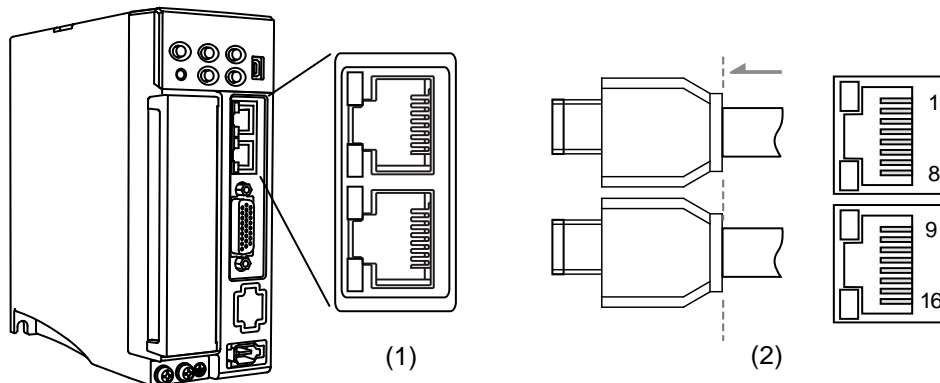
(1) CN6 connector (female); (2) CN6 connector (male)

Pin assignment (same for both connectors):

Pin No.	Terminal	Signal	Description
1, 9	TX+	TX+	Transmit +
2, 10	TX-	TX-	Transmit -
3, 11	RX+	RX+	Receive +
4, 12	-	-	-
5, 13	-	-	-
6, 14	RX-	RX-	Receive -
7, 15	-	-	-
8, 16	-	-	-

Description of each indicator for the CN6 connector:

■ Network status indicator

Indicator	Status	Description
On	Network is connected.	Connection is established but no data transmission.
Blinking	Connection is established and in data transmission.	Data in transmission.
Off	No connection.	Connection is not established.

■ EtherCAT connection status indicator (RUN)

Indicator	Status	Description
Off	Initial	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.
On	Operational	SDO, TxPDO, and RxPDO data packets can be transmitted.
Blinking	Pre-operational	The controller can exchange data through the mailbox.
Single flash	Safe-operational	The servo drive can use the SDO and TxPDO data packets to exchange data with the controller.

■   EtherCAT error indicator (ERR)

Indicator	Status	Description
Off	No error	No error has occurred.
On	PDI Watchdog timeout	Servo drive malfunction. Contact the distributor for assistance.
Blinking	State change error	Parameter setting error causes the system unable to switch states. Refer to the following diagram.
Single flash	Synchronization error / SyncManager error	The synchronization between the controller and the servo drive failed or the data was lost during data reception.
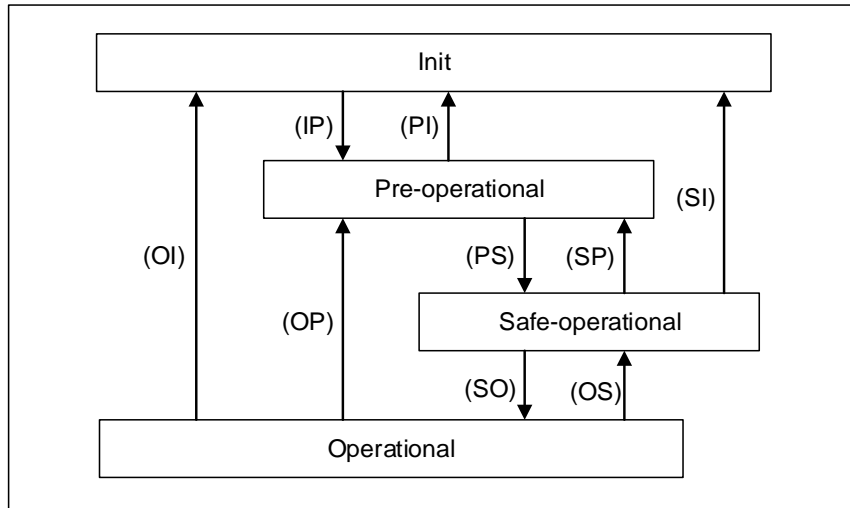
State switching diagram

Connecting multiple servo drives:
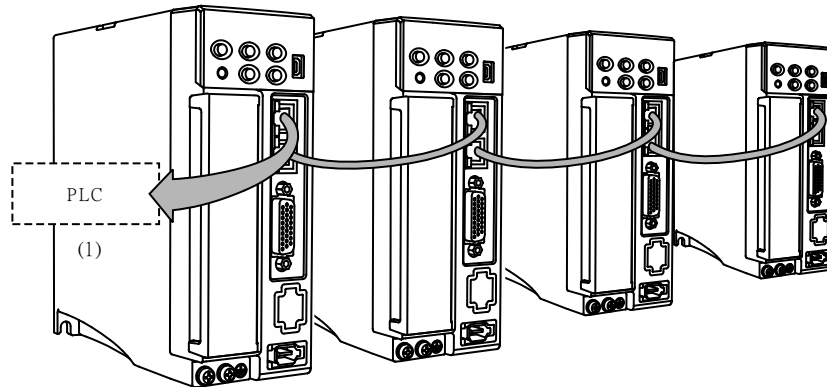
Note:

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 to use a Beckhoff cable (model number: ZB9020).

3.8   CN10 STO connector (Safe torque off)

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

Note: the STO function is supported by the B3A series only.
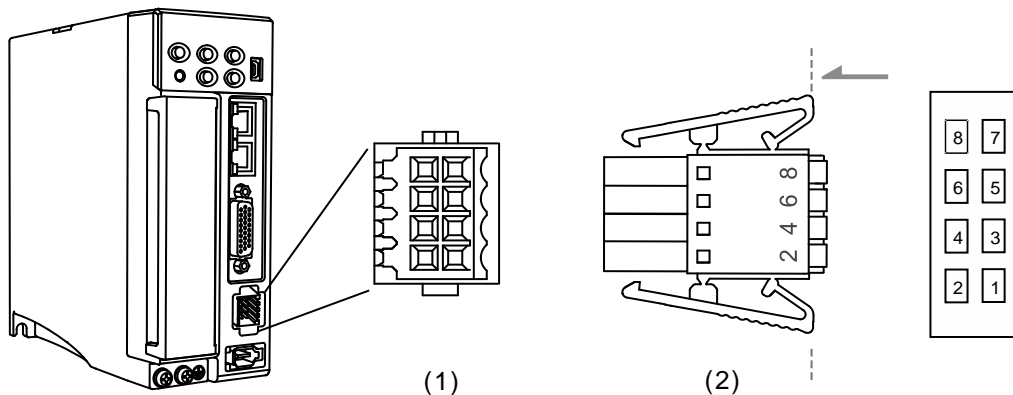
(1) CN10 STO connector (female); (2) CN10 quick connector (male)

Pin assignment:

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

If you do not need the STO function, plug in the STO connector that comes with the servo drive. The wiring has been done as shown in the figure on the right. If this connector has been disassembled, refer to Section 3.9 STO function (Safe Torque Off) for wiring information.
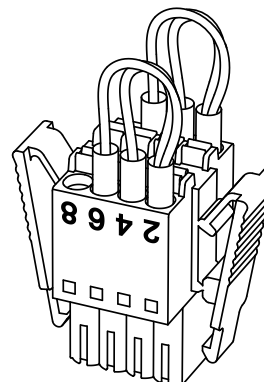
3.9 STO function (Safe Torque Off)

3.9.1 Introduction to STO

Once the STO function is enabled, the servo drive stops supplying current to the motor, cutting off the power supply and torque force. Do not repeatedly use this function for it does not stop the motor with active force.

Note: the STO function is supported by the B3A series only.

3.9.2 The potential danger of STO

After the STO function is enabled, the motor is no longer controlled by the servo motor. Thus, take all the potential danger resulted from enabling the STO function into consideration. Delta is not liable for mechanical damage and personnel injury if you fail to observe the following instructions:

1. For a safety circuit design, make sure the selected components conform to the safety specifications.
2. Before installation, read the safety instructions in the STO-related user manual for the components you use.
3. Do not touch the servo drive when the STO function is enabled. Although the power to the motor is cut off, there is residual electricity since the power supply is not completely removed from the servo drive. When maintaining the servo drive, use the molded case circuit breaker (MCCB) or magnetic contactor (MC) to cut off the power.
4. When the STO function is enabled, the servo drive can no longer control, stop, or decelerate the motor.
5. After the STO function is enabled, the servo drive no longer controls the motor, but the motor can still be moved by other external forces.
6. The feedback monitoring output signal (FDBK) is only for inspecting the STO function status rather than for safety output.
7. The STO function must be powered by the safety extra-low voltage (SELV) power source with reinforced insulation.
8. Power the STO signals with single power supply, or the leakage current will result in STO malfunction.

3.9.3 Specifications of STO

The ASDA-B3 series servo drive conforms to the following safety specifications:

Item	Description	Standard	Safety data
SFF	Safe failure fraction	IEC61508	Channel1: 80.08% Channel2: 68.91%
HFT (Type A subsystem)	Hardware fault tolerance	IEC61508	1
SIL	Safety integrity level	IEC61508	SIL2
		IEC62061	SILCL2
PFH	Probability of dangerous failure per hour [h^{-1}]	IEC61508	9.56×10^{-10}
PFD$_{av}$	Average probability of failure on demand	IEC61508	4.18×10^{-6}
Category	Category	EN954-1	Category 3
PL	Performance level	ISO13849-1	d
MTTF$_d$	Mean time to dangerous failure	ISO13849-1	High
DC	Diagnostic coverage	ISO13849-1	Low

3.9.4   How does the STO function work?

The STO function controls the motor current by two individual circuits. It cuts off the power supply to the motor when needed, after which the motor is free from torque force. When an STO alarm occurs, determine the alarm type according to the pin status of the feedback monitor signal (FDBK). The following table details how this function works.

Description of action and feedback status:

Signal	Safety signal source	Status of opto-isolator			
STO	STO_A ~ / STO_A	ON	ON	OFF	OFF
	STO_B ~ / STO_B	ON	OFF	ON	OFF
Servo drive output status		Ready	Torque off (STO_B lost)	Torque off (STO_A lost)	Torque off (STO mode)
Feedback monitor signal (FDBK status)		Open	Close	Open	Open
Alarm		N/A	AL500	AL501	AL502

Note:

1.   ON = 24V; OFF = 0V.

2.   Open = open circuit; Close = short circuit.

3.   The status of the feedback monitor signal switches immediately based on the safety signal source changes.

4.   Contact the distributor if AL503 occurs. Refer to Chapter 12 Troubleshooting for more details.

3.9.4.1   Activation status

STO reaction time:

When one of the safety signal source is low, the circuit cuts off the motor current within 20 ms.
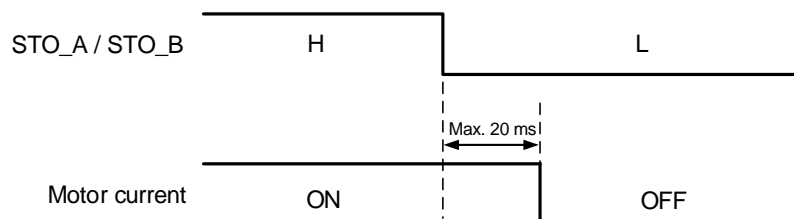
AL500: see the following diagram. When the motor runs normally, but both STO_A and STO_B signals are low for 10 ms at the same time, the firmware disables the drive (Servo Off) and triggers AL500.
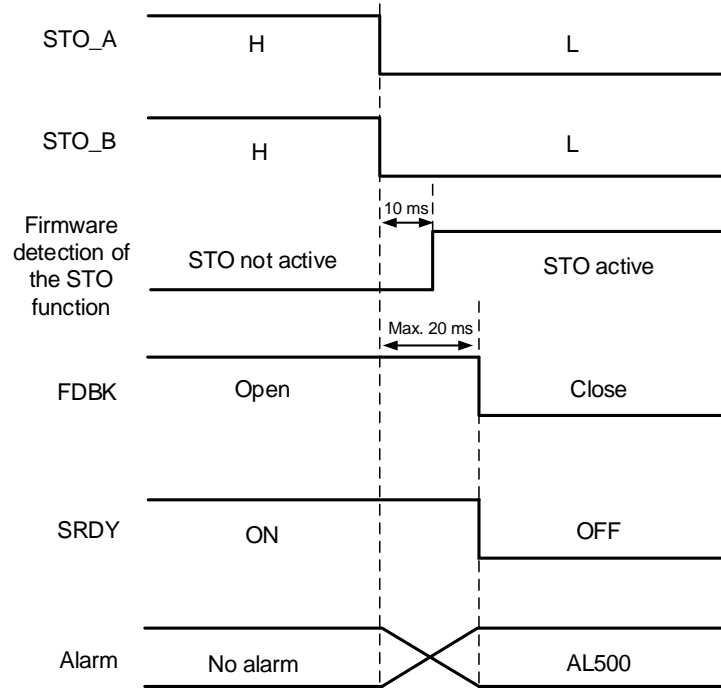
AL501 / AL502: see the following diagram. When the motor runs normally, but one of the safety signal source is low for 1 s, the firmware disables the drive (Servo Off) and triggers AL501 or AL502. The following diagram illustrates AL501.
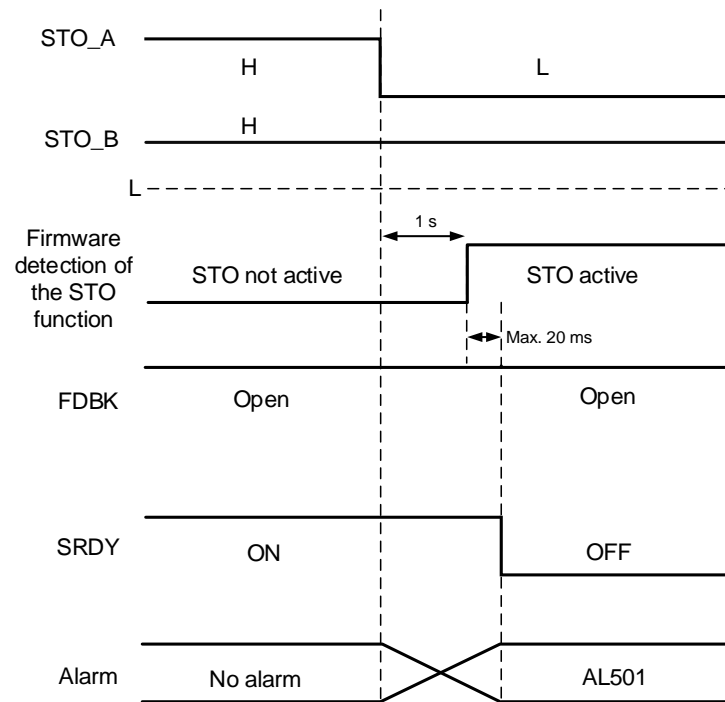
Note:

1. When the STO_A signal is low, AL501 occurs; when the STO_B signal is low, AL502 occurs.

2. Contact the distributor if AL503 occurs.

3. Refer to Section 3.9.4 for the FDBK signal.

3.9.4.2   Deactivation status

When both safety signal sources switch back to high, the alarm will not be cleared automatically.

Of all the STO alarms, only AL500 can be cleared with DI.ARST.
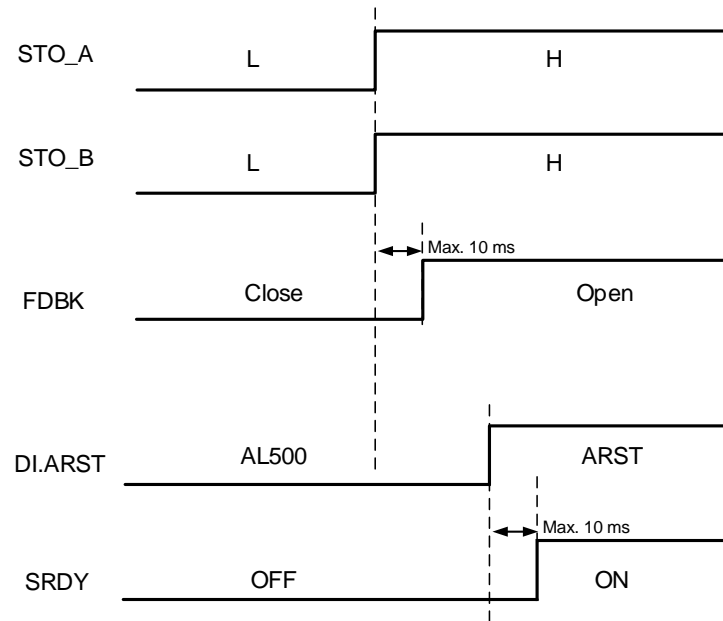
Note: refer to Section 3.9.4 for the FDBK signal.

3.9.5 Wiring for STO

3.9.5.1 Wiring without the STO function

You can short-circuit the connector or plug in the short-circuit connector that comes with the servo drive. Refer to the following wiring diagram:
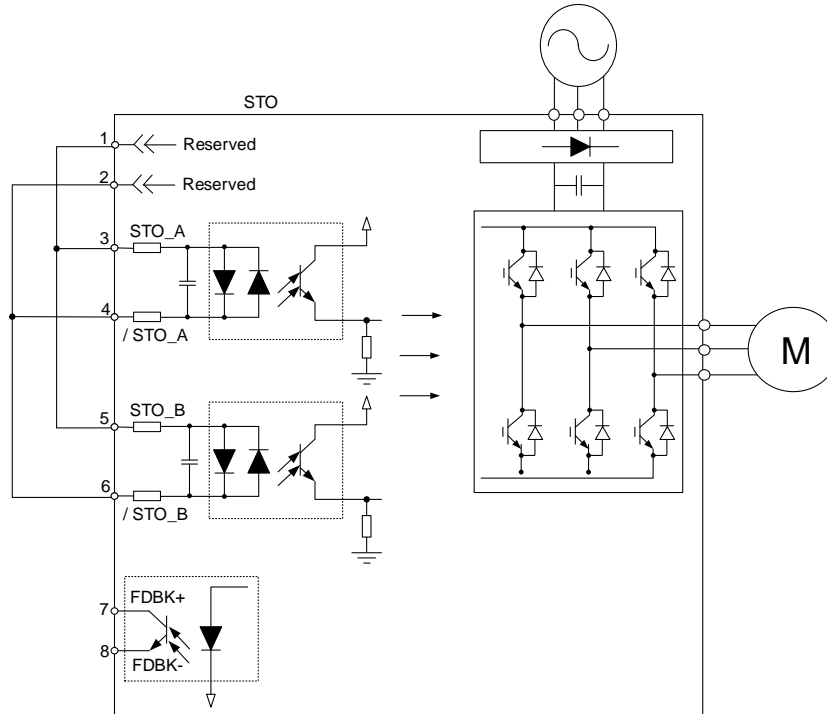
3.9.5.2 Wiring for single drive module with the STO function

To use a safety relay to trigger the STO function, connect the wiring as shown in the following diagram:
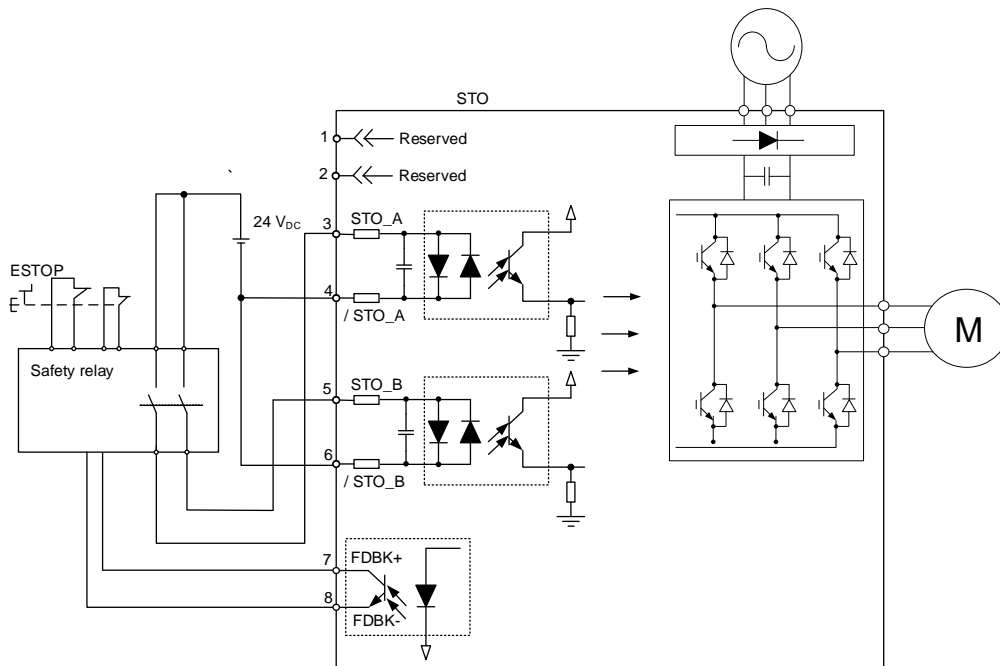
3.9.5.3 Wiring for multiple drive modules with the STO function

In the multiple drive modules system, the value of multiplying PFD and PFH by the number of drives must not exceed the specified safety value.
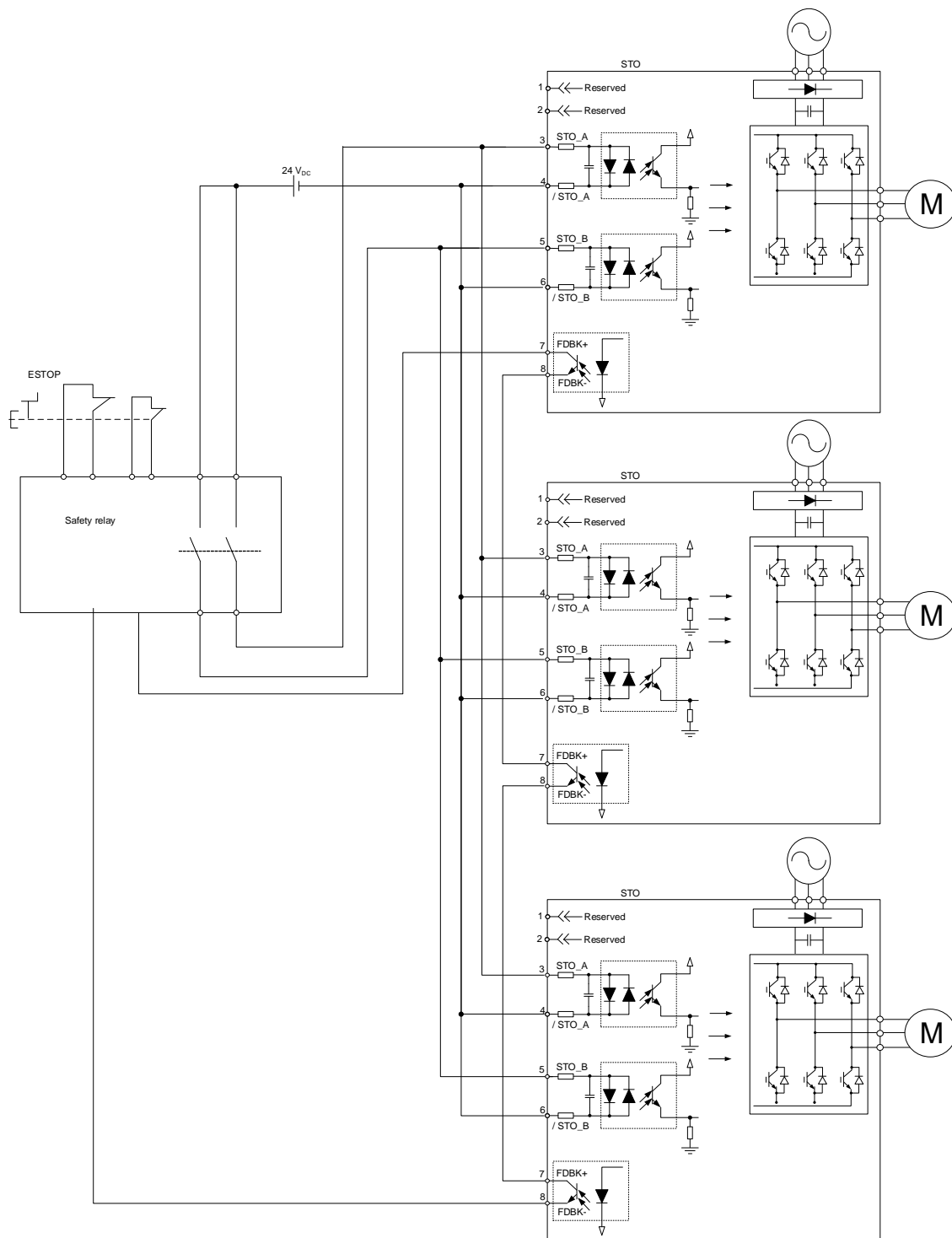
3.10 Standard wiring example

3.10.1 Position (PT) control mode - differential pulse signal

Servo drive
ASDA -B3 Series

MCCB MC

AC 200 / 230V
Three-phase* 5
50 / 60 Hz

R
S
T
L₁C
L₂C

P
D
C
U
V
W

* 2
Regenerative resistor

Red
White
Black
Green

Power supply

24V EMGS BRKR Brake
* 3

Encoder

This is for systems of 2.8 – 3.6V.
Do not input 24V power.

Differential pulse* 1
command input

CN1

SIGN+	39
SIGN-	37
PULSE+	43
PULSE-	41
T-REF	18
GND	19
MON1	17
GND	19
MON2	14
COM+	11

1.2 kΩ
12 kΩ

±10V 10 kΩ

Twisted-pair or twisted-shielded cable
10 kΩ
10 kΩ

* 2

SON	DI1	9
CCLR	DI2	10
TCM0	DI3	34
TCM1	DI4	8
ARST	DI5	33
NL	DI6	32
PL	DI7	31
EMGS	DI8	30
	DI9	12

4.7 KΩ

1.5 kΩ

SRDY	DO1+	7
	DO1-	6
ZSPD	DO2+	5
	DO2-	4
HOME	DO3+	3
	DO3-	2
TPOS	DO4+	1
	DO4-	26
ALRM	DO5+	28
	DO5-	27
	DO6+	16
	DO6-	15

24V

1.5 kΩ (×6)

CN2

1	+5V
2	GND
3	Do not connect this pin
4	Do not connect this pin
5	T+
6	T-
Case	Shield

SG Twisted-pair or twisted-shielded cable

CN3

6,8	-
5	RS485+
4	RS485-
3,7	GND_ISO
2	-
1	-

CN4

| Mini USB | * 4 |

Encoder pulse output

A-phase differential signal	OA	21
	/OA	22
B-phase differential signal	OB	25
	/OB	23
Z-phase differential signal	OZ	13
	/OZ	24
Z-phase open collector signal	OCZ	44
	GND	40

Max. output current: 50 mA
voltage: 30V

Note:

1. This is the wiring for differential pulse signal input. For the wiring for open-collector signal input, refer to Section 3.3.7.

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

3. The brake coil has no polarity.

4. Connects to Mini USB (for PC communication).

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

3.10.2 Position (PT) control mode - open-collector pulse signal
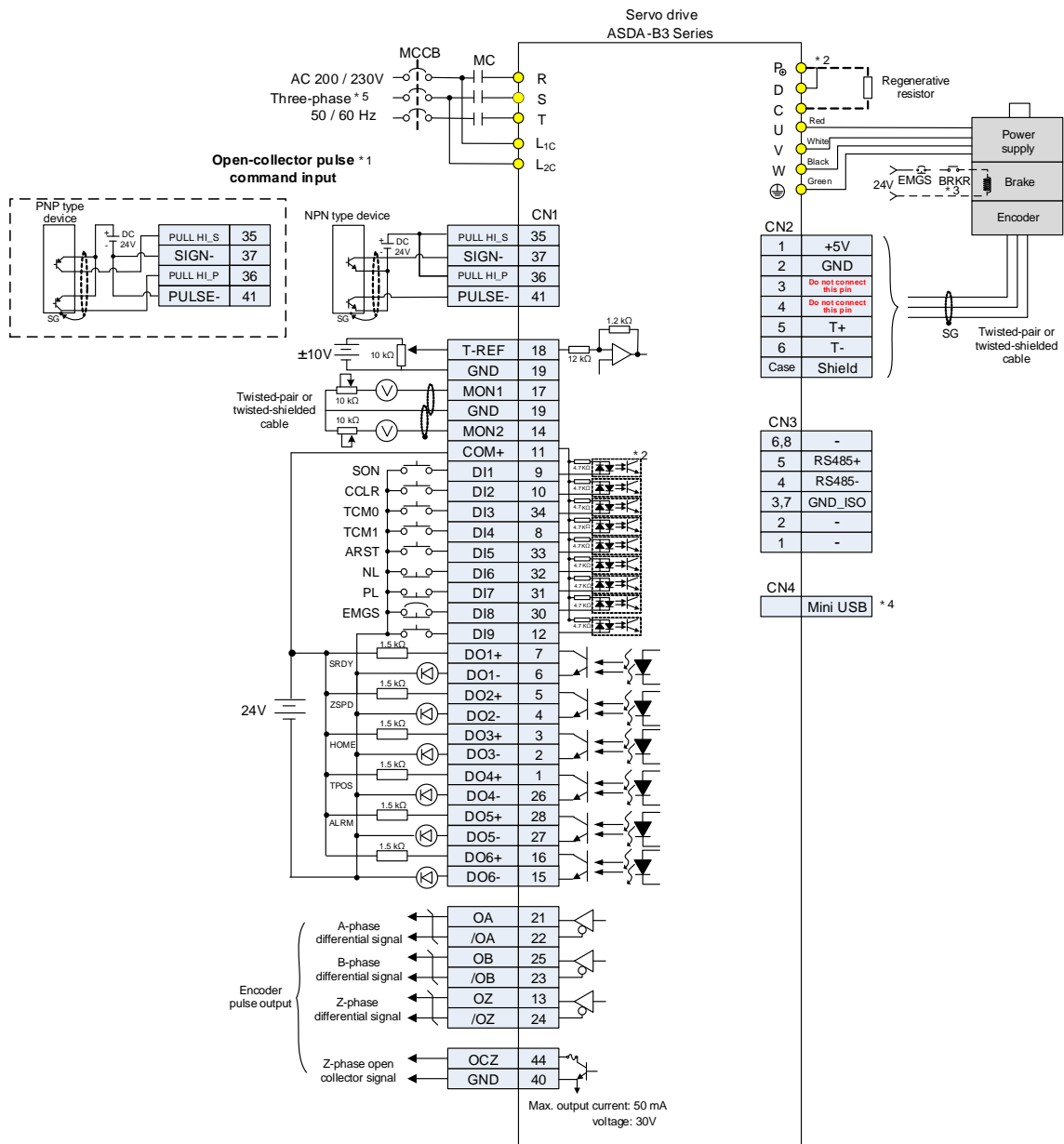
Note:

1. This is the wiring for open-collector signal input. For the wiring for differential pulse signal input, refer to Section 3.3.7.

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

3. The brake coil has no polarity.

4. Connects to Mini USB (for PC communication).

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

3.10.3 Position (PR) control mode - internal position command

Servo drive
ASDA-B3 series

MCCB   MC
AC 200 / 230V
Three-phase* 5
50 / 60 Hz

R
S
T
L₁C
L₂C

P
D
C
U
V
W

* 2   Regenerative resistor

Red
White
Black
Green

Power supply

24V   EMGS   BRKR   Brake
* 3

Encoder

CN2

1	+5V
2	GND
3	Do not connect this pin
4	Do not connect this pin
5	T+
6	T-
Case	Shield

SG   Twisted-pair or twisted-shielded cable

CN1

±10V   10 kΩ   1.2 kΩ

T-REF	18
GND	19
MON1	17
GND	19
MON2	14
COM+	11

12 kΩ

Twisted-pair or twisted-shielded cable
10 kΩ
10 kΩ

* 1

SON	DI1	9
CTRG	DI2	10
POS0	DI3	34
POS1	DI4	8
ARST	DI5	33
NL	DI6	32
PL	DI7	31
EMGS	DI8	30
	DI9	12

4.7 kΩ

SRDY	DO1+	7
	DO1-	6
ZSPD	DO2+	5
	DO2-	4
HOME	DO3+	3
	DO3-	2
TPOS	DO4+	1
	DO4-	26
ALRM	DO5+	28
	DO5-	27
	DO6+	16
	DO6-	15

1.5 kΩ

24V

CN3

6,8	-
5	RS485+
4	RS485-
3,7	GND_ISO
2	-
1	-

CN4

Mini USB	* 4

Encoder pulse output

A-phase differential signal	OA	21
	/OA	22
B-phase differential signal	OB	25
	/OB	23
Z-phase differential signal	OZ	13
	/OZ	24

Z-phase open collector signal	OCZ	44
	GND	40

Max. output current: 50 mA
voltage: 30V

Note:

1. Refer to Section 3.3.7 for CN1 wiring.

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

3. The brake coil has no polarity.

4. Connects to Mini USB (for PC communication).

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

3.10.4 Speed (S) control mode

Note:

1.   Refer to Section 3.3.7 for CN1 wiring.

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

3.   The brake coil has no polarity.

4.   Connects to Mini USB (for PC communication).

5   Models of 1.5 kW and below can use single-phase power supply.
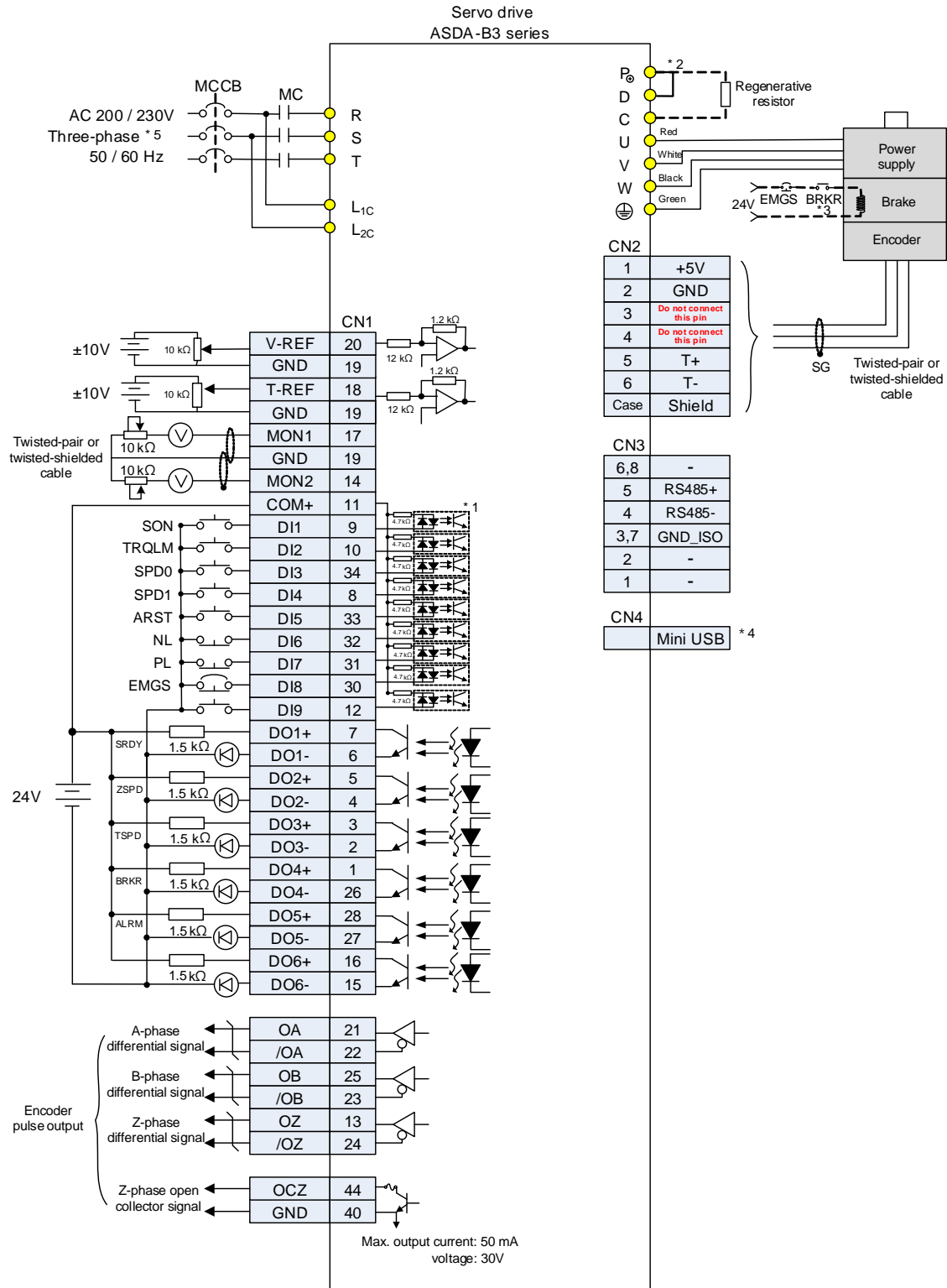
3.10.5 Torque (T) control mode
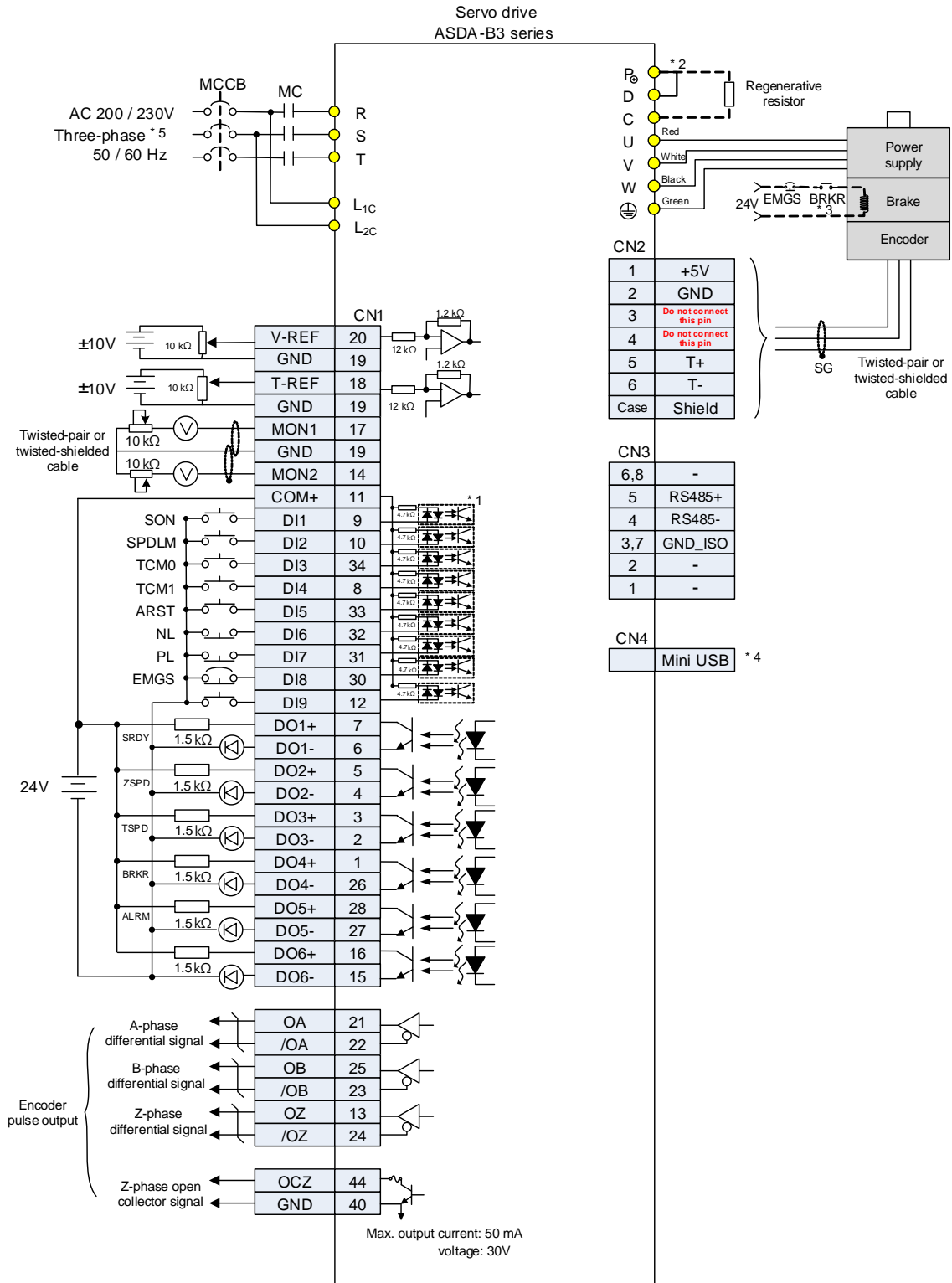
Note:

1. Refer to Section 3.3.7 for CN1 wiring.

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

3. The brake coil has no polarity.

4. Connects to Mini USB (for PC communication).

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

3.10.6 CANopen communication mode
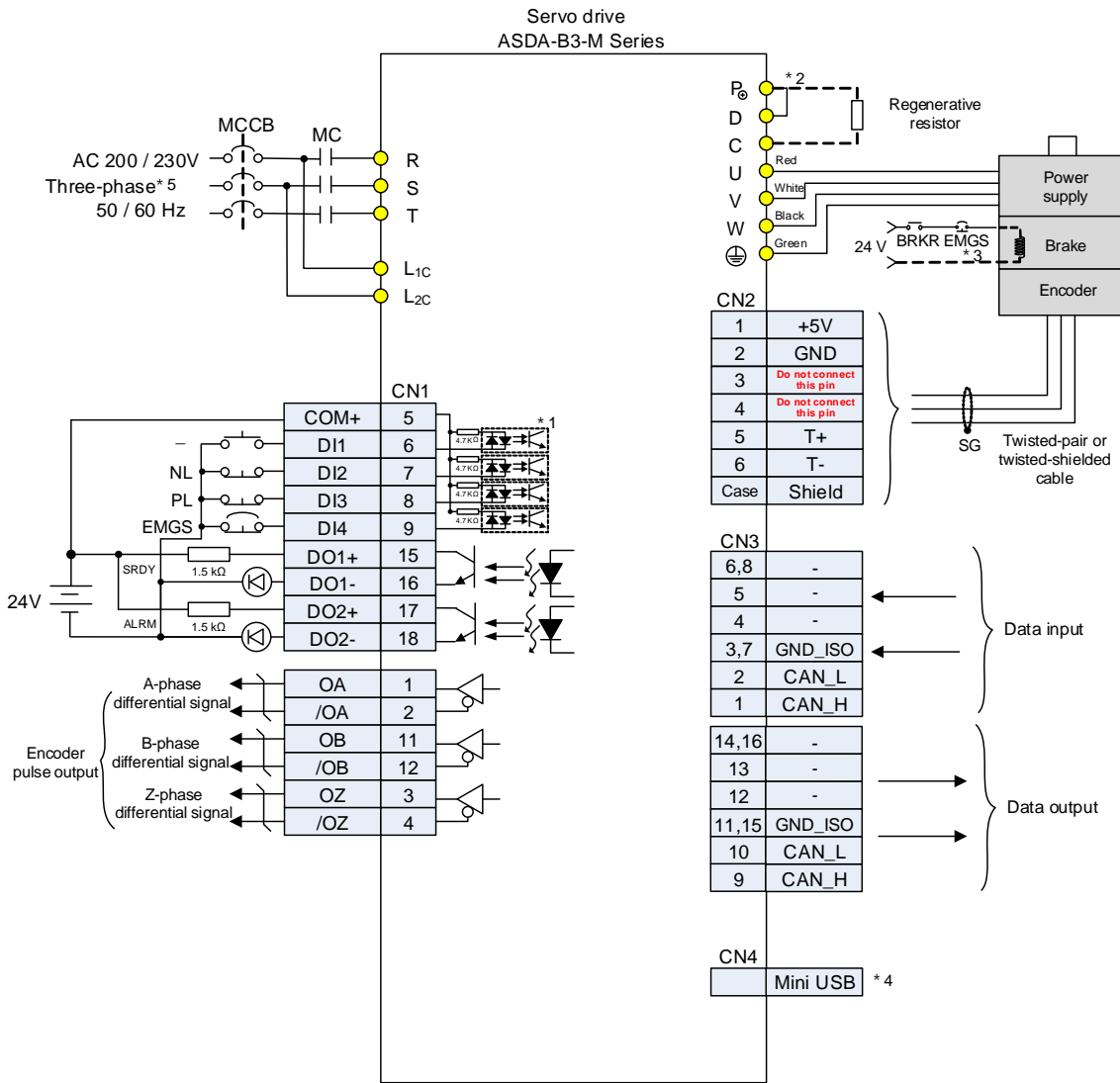
Note:

1. Refer to Section 3.3.7 for CN1 wiring.

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

3. The brake coil has no polarity.

4. Connects to Mini USB (for PC communication).

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

3.10.7 DMCNET communication mode
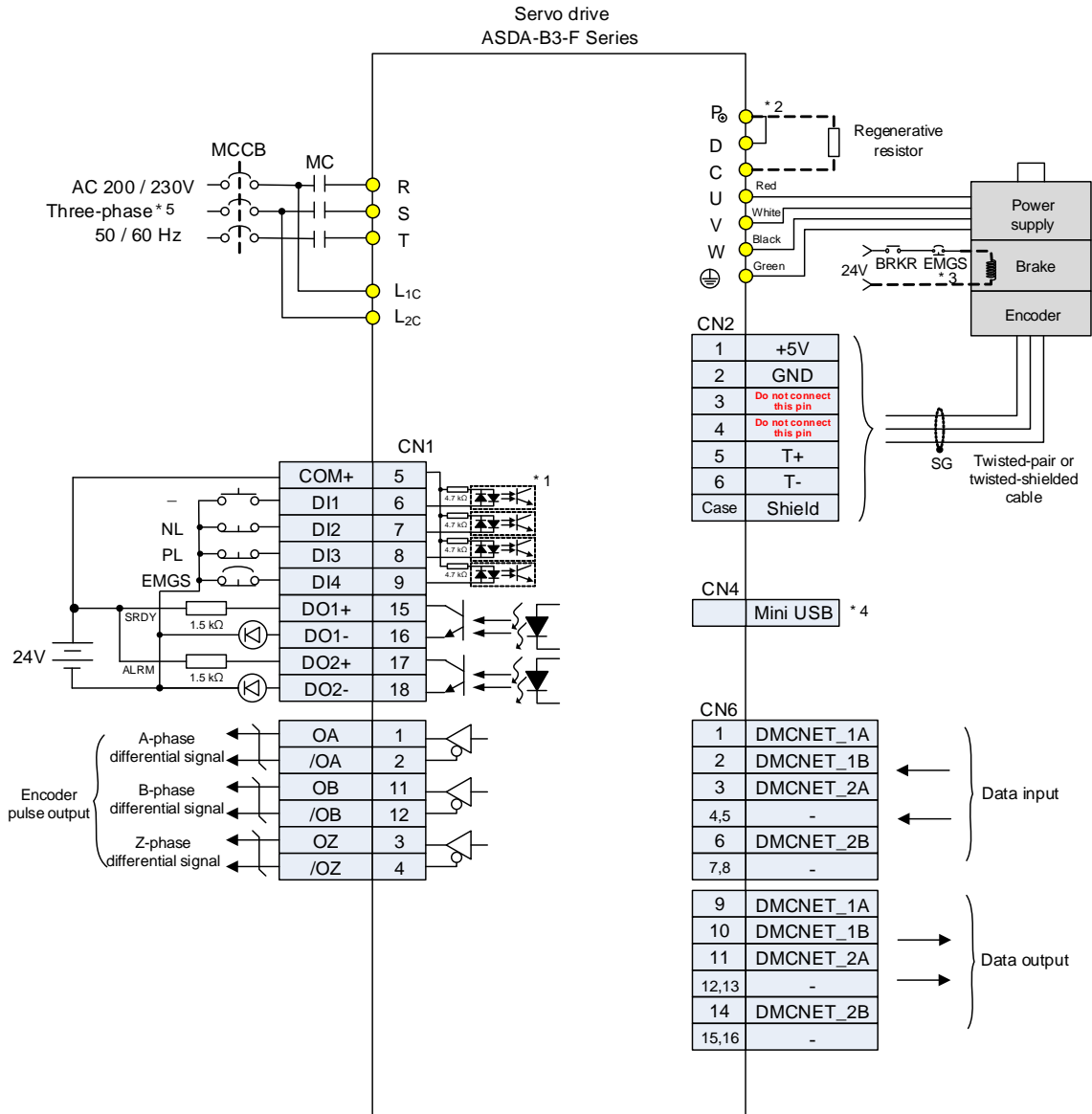
Note:

1.   Refer to Section 3.3.7 for CN1 wiring.

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

3.   The brake coil has no polarity.

4.   Connects to Mini USB (for PC communication).

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

3.10.8 EtherCAT communication mode
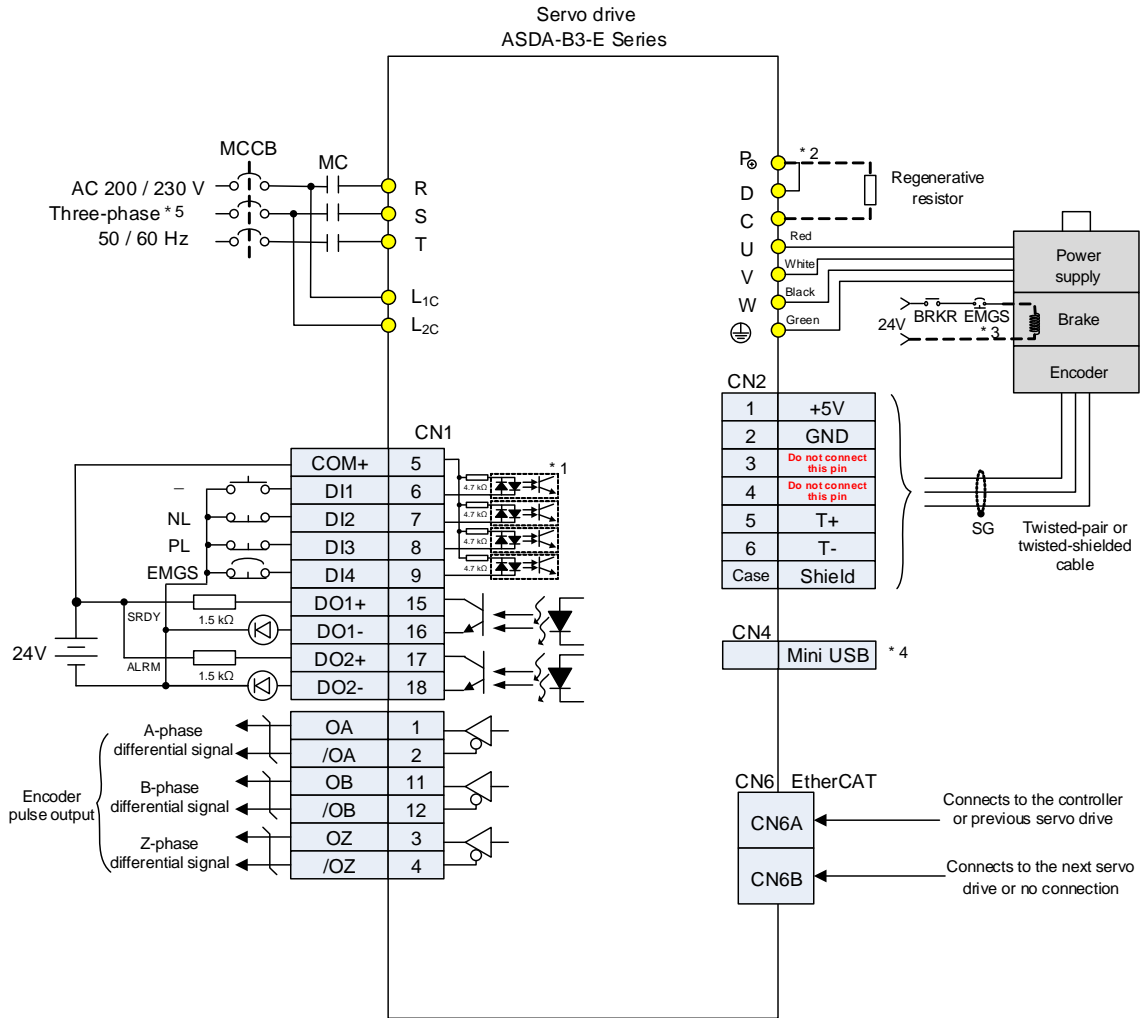
Note:

1. Refer to Section 3.3.7 for CN1 wiring.

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

3. The brake coil has no polarity.

4. Connects to Mini USB (for PC communication).

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

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3

Test Operation and Panel Display

<div style="text-align: right; font-size: 3em; font-weight: bold;">4</div>

This chapter describes the panel display of ASDA-B3 series servo drive, as well as its operation and testing.

4.1   Panel description

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

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

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

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

(5)   DOWN (▼) key: changes the monitoring code, parameter number, and value.

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

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

4.2 Parameter setting procedure

Switching modes:

Power On

Monitoring mode

⟶ Refer to Chapter 8.

MODE

Parameter mode

⟶ Refer to Chapter 8.

MODE

Alarm mode

MODE

1. If no alarm occurs, Alarm mode is skipped.
2. When a new alarm occurs, it switches to Alarm mode from any other mode.
3. When switching to a different mode, if you do not press a key within 20 seconds, it returns to Alarm mode. See Chapter 12 for detailed alarm information.
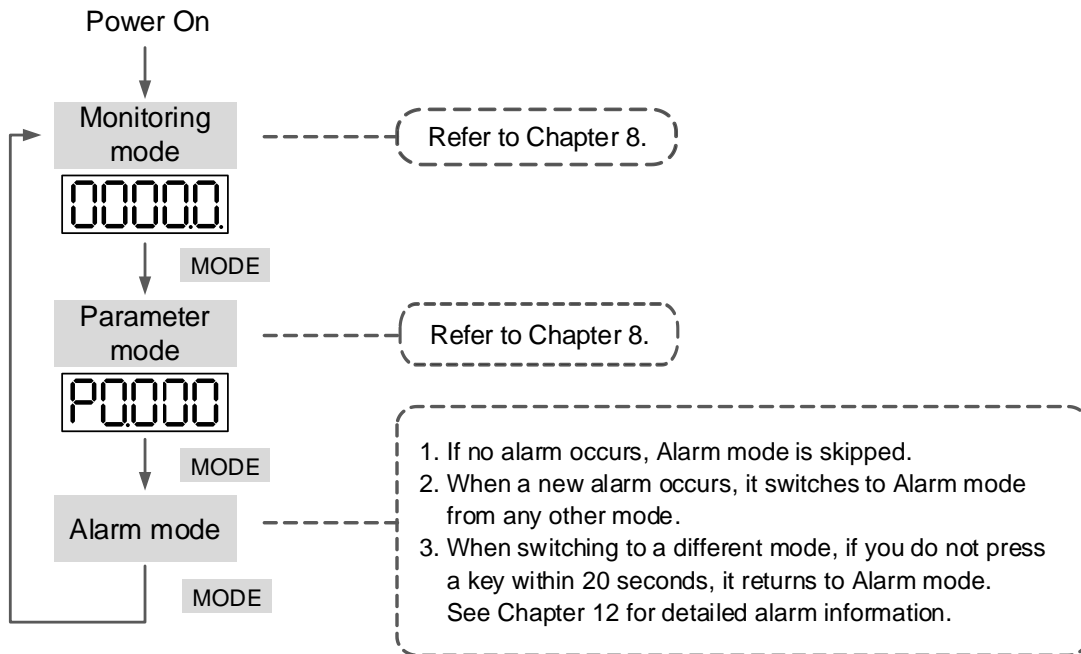
Operating in each mode:

Monitoring mode

Monitoring mode

C-PLS

Er.PLS

CP-Fr

FbPLS

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 / low digits of monitoring variables.

Parameter mode

4

Editing mode

Parameter mode

MODE ↑ ↓ SET

Editing mode

10000
Display parameter setting value

▲▼

10001 ...

SET

SAVEd
After saving the parameter setting value, it automatically returns to Parameter mode.

SHIFT

10000

▲▼

10010 ...

SET

SAVEd
After saving the parameter setting value, it automatically returns to Parameter mode.

SHIFT

10000

▲▼

10100 ...

SET

SAVEd
After saving the parameter setting value, it automatically returns to Parameter mode.

⋮

MODE

Monitoring / Alarm mode   If no alarm occurs, Alarm mode is skipped.

4.3   Status display

4.3.1   Save the setting display

When you complete the parameter setting, press the SET key to save the parameters.

The panel displays the status for one second.

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

4.3.2   Display the decimal point

Displayed symbol		Description
00000. ↓ Low byte	0000.0 ↓ High byte	High byte / low byte indication: this indicates the current high byte or low byte when the data is displayed in decimal format (32 bits).
0.0.000 ↓ Negative sign	000.0.0 ↓ No function	Negative sign: the two decimal points on the left represent the negative sign when the data is displayed in decimal format (16 or 32 bits). In hexadecimal format, it only shows positive values.

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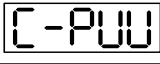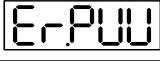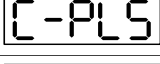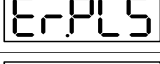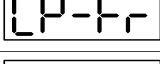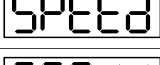
Displayed symbol	Description
AL.nnn	When an alarm occurs, the servo drive shows 'AL' as the alarm symbol and 'nnn' as the alarm code. Refer to Chapter 8 Parameters for a detailed description of P0.001 or Chapter 12 Troubleshooting for alarm details.

4.3.4   Positive and negative sign 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 value (the selected value is flashing).
2.4680	Press the SHIFT key for two seconds to switch between the positive (+) and negative (-) signs. If the parameter value is out of range after switching the positive or negative sign, then the servo drive automatically resets it to the original value.

4.3.5   Monitoring display
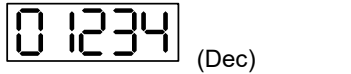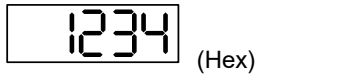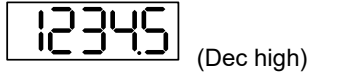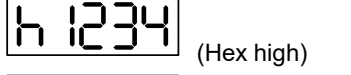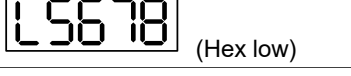
When you apply power to the drive, the display shows the monitoring displayed symbol for one second, and then enters Monitoring mode. In Monitoring mode, press the UP (▲) and DOWN (▼) keys to change the monitoring variables. Or you can directly change the setting value of P0.002 to specify the monitoring code. When powered, the default monitoring code is determined by the value of P0.002. For example, the value of P0.002 is 4. When the drive is powered, it displays the monitoring symbol C-PLS first, and then shows the input number of pulse commands. Refer to the following table for more information.

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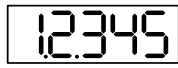
4

P0.002 setting value	Monitoring displayed symbol	Description	Unit
10	C-t91	Torque command	[Volt]
11	C-t92	Torque command	[%]
12	AUG-L	Average torque	[%]
13	PE-L	Peak torque	[%]
14	U bu5	Main circuit voltage	[Volt]
15	J-L	Load / motor inertia ratio Note: if it shows 13.0, it means the load inertia ratio is 13.	[1 times]
16	IGbtt	IGBT temperature	[°C]
17	rSn.Fr	Resonance frequency (low byte is the first resonance and high byte is the second one)	[Hz]
18	d1FF.2 0 +5000 0 +5000 0 Z Z Z	The absolute pulse number of encoder Z phase equals the homing value, 0. It is +5000 or -4999 pulses when the motor rotates in the positive or negative direction.	-
19	NNAP1	Mapping parameter #1: shows the content of parameter P0.025 (P0.035 specifies the mapping target)	-
20	NNAP2	Mapping parameter #2: shows the content of parameter P0.026 (P0.036 specifies the mapping target)	-
21	NNAP3	Mapping parameter #3: shows the content of parameter P0.027 (P0.037 specifies the mapping target)	-
22	NNAP4	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	
01234 (Dec)	16 bits	If the value is 1234, it displays 01234 (in decimal format).
1234 (Hex)		If the value is 0x1234, it displays 1234 (in hexadecimal format; the first digit does not show).
1234.5 (Dec high) 67890. (Dec low)	32 bits	If the value is 1234567890, the display of the high byte is 1234.5 and displays 67890 as the low byte (in decimal format).
h1234 (Hex high) L5678 (Hex low)		If the value is 0x12345678, the display of the high byte is h1234 and displays L5678 as the low byte (in hexadecimal format).

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

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

Note:

1. Dec means the value is displayed in decimal format; Hex represents hexadecimal format.

2. The display shown above is applicable in both Monitoring mode and Editing mode.

3. When all monitoring variables are 32 bits, you can switch the high / low bit and the display method (Dec / Hex). As described in Chapter 8, each parameter only supports one display method and cannot be switched.

4.4 General functions

4.4.1 Operation of fault record display

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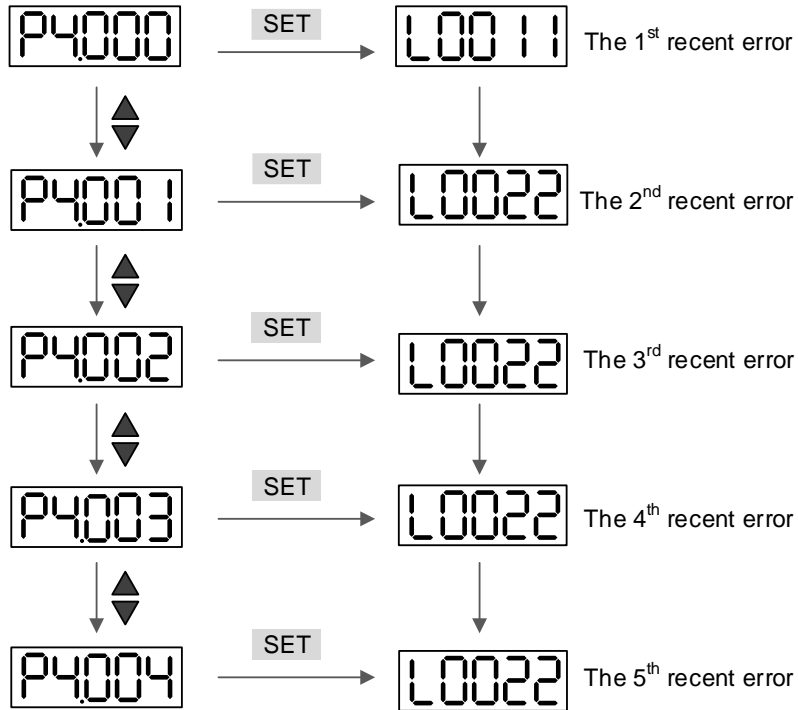
4.4.2   Force DO on

You can switch to the Diagnosis mode by the following steps. Set P2.008 to 406 and enable the function to force DO on. Then, set the DO by binary method with P4.006. When the parameter value is 2, it forces DO2 on. When the value is 5, it forces DO1 and DO3 on. No data is retained in this mode. The mode returns to the normal DO mode after cycling the power. You can also set P2.008 to 400 to switch to the normal DO mode.
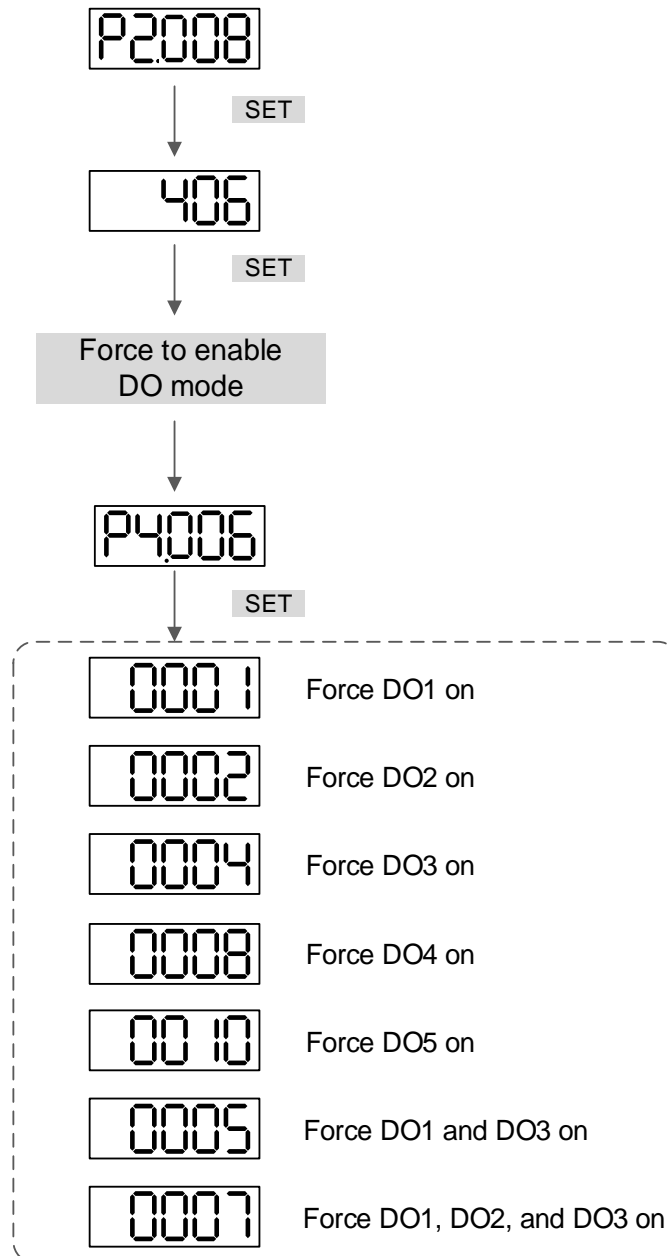
Note: P4.006 is displayed in hexadecimal format. Therefore, it does not show the fifth 0.

4.4.3   Digital input diagnosis operation

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

For example, if it shows 1FE1, E is in hexadecimal format; it will be 1110 when it transfers to binary format. Then, DI6 - DI8 are on.

(Display in hexadecimal format)
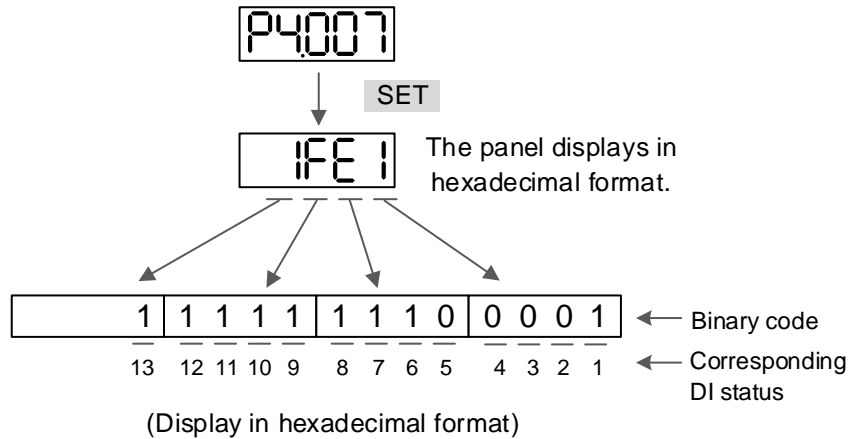
4.4.4   Digital output diagnosis operation

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

For example, if it shows 1F, F is in hexadecimal format; it will be 1111 when it transfers to binary format. Then, DO1 - DO4 are on.

(Display in hexadecimal format)
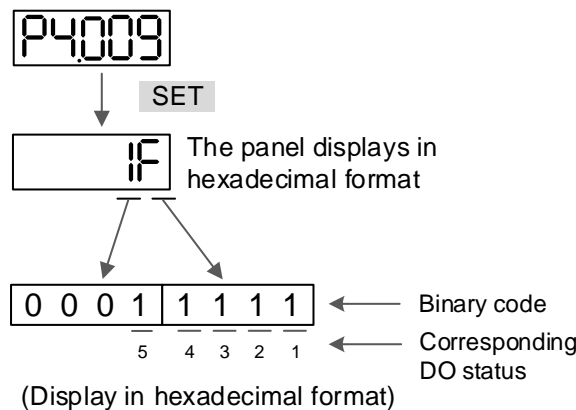
4.5 Testing

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

4.5.1 Testing without load

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

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

Check the following items carefully before operation.

Inspection before operation (without power)	■ Check for any obvious visible damage. ■ The wires at the wiring terminal should be isolated. ■ Make sure the wiring is correct to avoid damage or any abnormal operation. ■ Check for and remove any electrically conductive objects, including metal (such as screws) or inflammable objects inside or near the servo drive. ■ Check that the control switch is in the Off state. ■ Do not place the servo drive or external regenerative resistor on inflammable objects. ■ Make sure the circuits for the emergency stop and circuit breaker function normally. These functions need to be activated once the electromagnetic brake malfunctions.. ■ Reduce the electromagnetic interference if there is electronic interference with the peripheral devices. ■ Make sure the external voltage level of the servo drive is correct.
Inspection during operation (power is applied)	■ Protect the encoder cable from excessive stress. When the motor is running, make sure the cable is not worn or stretched. ■ Contact Delta if the servo motor vibrates or makes unusual noise during operation. ■ Make sure the settings for the parameters are correct. Different 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 there is no contact noise or other abnormal noise when the relay is operating, please contact Delta. ■ Check if the power indicator and LED display work properly.

4.5.2   Apply power to B3 servo drive

Follow these instructions.

1. Make sure the wiring between the motor and servo drive is correct:

    (1) U, V, W, and FG have to connect to the red, white, black, and green wires respectively. If the wiring is incorrect, the motor cannot work properly. The motor ground cable 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 power (R, S, T) to the output terminal (U, V, W) of B3 servo drive, or it may damage the servo drive.

2. Connect the power circuit for the servo drive:

    200V servo drive: connect the power to the servo drive. Refer to Chapter 3 for power wiring.

3. Turn on the power:

    220V servo drive supply: apply power, including to the control circuit (L_{1C}, L_{2C}) and main circuit (R, S, T).

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

$$\boxed{\mathsf{AL0\,13}}$$

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

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

$$\boxed{\mathsf{SPEEd}}$$
$$\downarrow$$
$$\boxed{\mathsf{00000}}$$
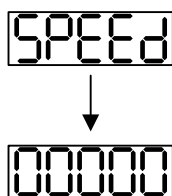
When the panel displays no text, check if the control circuit power is undervoltage.

■ When the screen displays:

```
SPEEd
  ↓
AL002
```
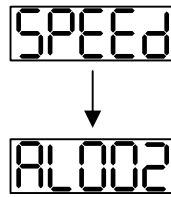
Overvoltage warning:

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

Corrective action:

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

■ When the screen displays:

```
SPEEd
  ↓
AL011
```
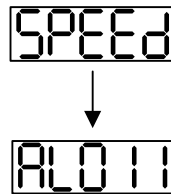
Encoder error warning:

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

Corrective action:

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

4

4

■   When the screen displays:

```
SPEEd
  ↓
ALO13
```
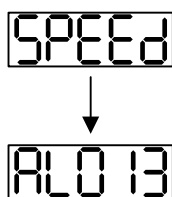
Emergency stop warning:

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 this 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 screen displays:

```
SPEEd
  ↓
ALO14
```
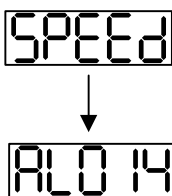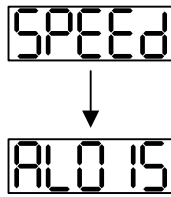
Negative limit error warning:

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 this 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 screen displays:

```
SPEEd
  ↓
RL0 15
```

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 this 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 screen displays:

```
RL00 1
```

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 prevent any metal conductors from being exposed.

■   When the screen displays:

```
RL003
```

Undervoltage warning:

Corrective action:

1. Check if the main circuit wiring is correct.

2. Use a voltmeter to check the main circuit voltage.

3. Use a voltmeter to measure if the power system complies with the specifications.

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

4

4.5.3   JOG trial run without load

It is easy to test the motor and servo drive using a JOG trial run without load since no extra wiring is needed. For safety reasons, it is recommended to set JOG at low speed. Follow 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 host controller. (JOG trial run with panel operation is not available in the Communication mode.)

Step 2: set 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 display JOG and enter JOG mode.

Step 5: press the MODE key after completing the trial run to exit JOG mode.
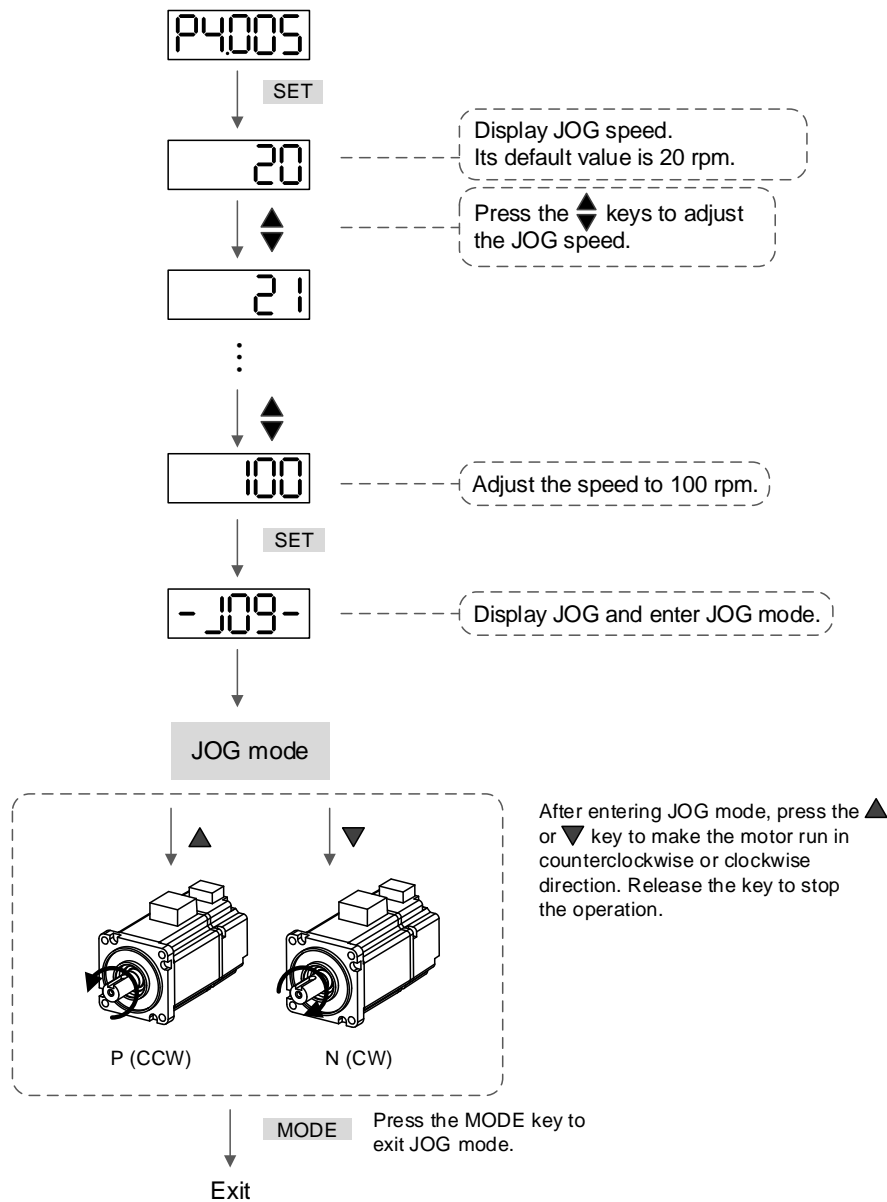
The following shows the JOG timing diagram:
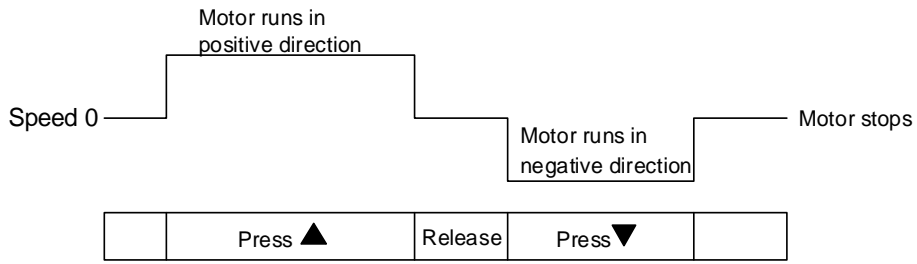
If the motor does not run, check if the wiring between U, V, W and encoder cable is correct.

If the motor runs abnormally, check if the U, V, W phase sequence is correct.

4

4.5.4   Trial run without load (Speed mode)

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

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

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

Digital input	Parameter setting value	Symbol	Function description	CN1 Pin No.
DI1	P2.010 = 101	SON	Servo activated	DI1- = 9
DI2	P2.011 = 109	TRQLM	Torque limit	DI2- = 10
DI3	P2.012 = 114	SPD0	Speed selection	DI3- = 34
DI4	P2.013 = 115	SPD1	Speed selection	DI4- = 8
DI5	P2.014 = 102	ARST	Alarm reset	DI5- = 33
DI6	P2.015 = 0	-	DI disabled	-
DI7	P2.016 = 0	-	DI disabled	-
DI8	P2.017 = 0	-	DI disabled	-
DI9	P2.036 = 0	-	DI disabled	-
DI10	P2.037 = 0	-	DI disabled	-
DI11	P2.038 = 0	-	DI disabled	-
DI12	P2.039 = 0	-	DI disabled	-
DI13	P2.040 = 0	-	DI disabled	-

This table shows the settings that disable the negative limit (DI6), positive limit (DI7), and emergency stop (DI8) functions. Thus, parameters P2.015 - P2.017 and P2.036 - P2.040 are set to 0 (disabled). You can program the digital inputs of Delta's servo drive. When programming the digital inputs for the servo drive, refer 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 settings, cycle the power to the servo drive or set DI5 to On to clear the error. Refer to Section 4.5.2.

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

Speed command number	CN1 DI signal		Command source		Content	Range
	SPD1	SPD0				
S1	0	0	Mode	S	Voltage difference between V-REF and GND	-10V to +10V
				Sz	Speed command is 0	0
S2	0	1	Internal register parameter		P1.009	-60000 to +60000
S3	1	0			P1.010	-60000 to +60000
S4	1	1			P1.011	-60000 to +60000

0: the switch is open (off).

1: the switch is closed (on).

The parameter setting range of the internal register is from -60000 to +60000. Speed setting = setting value x 0.1 rpm. For example, P1.009 = +30000, speed setting = +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 (positive direction)
-	CW (negative direction)

Step 3:

1. Switch on DI1 and the drive is in the Servo On state.

2. When both Speed commands of DI3 (SPD0) and DI4 (SPD1) are off, that means it executes the S1 command. The motor rotates according to the analog voltage command.

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

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

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

6. You can repeat steps 3 - 5.

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

4.5.5 Trial run without load (Position mode)

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

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

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

Digital input	Parameter setting value	Symbol	Function description	CN1 Pin No.
DI1	P2.010 = 101	SON	Servo activated	DI1- = 9
DI2	P2.011 = 108	CTRG	Command triggered	DI2- = 10
DI3	P2.012 = 111	POS0	Position selection	DI3- = 34
DI4	P2.013 = 112	POS1	Position selection	DI4- = 8
DI5	P2.014 = 102	ARST	Alarm reset	DI5- = 33
DI6	P2.015 = 0	-	DI disabled	-
DI7	P2.016 = 0	-	DI disabled	-
DI8	P2.017 = 0	-	DI disabled	-
DI9	P2.036 = 0	-	DI disabled	-
DI10	P2.037 = 0	-	DI disabled	-
DI11	P2.038 = 0	-	DI disabled	-
DI12	P2.039 = 0	-	DI disabled	-
DI13	P2.040 = 0	-	DI disabled	-

This table shows the settings that disable the negative limit (DI6), positive limit (DI7), and emergency stop (DI8) functions. Thus, parameters P2.015 - P2.017 and P2.036 - P2.040 are set to 0 (disabled). You can program the digital inputs of Delta's servo drive. When programming the digital inputs for the servo drive, refer 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 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 3.10.2 for the wiring for Position (PR) control mode. See the following table for the 100 sets of PR and the Position commands (POS0 - POS6).

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

0: the switch is open (off).

1: the switch is closed (on).

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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4

Tuning

5

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

5.1 Tuning procedure and the applied mode

5.1.1 Flowchart of the tuning procedure

You can tune the servo drive by following this flowchart. First, start from the Auto Tuning mode. If you are not satisfied with the system's performance, then use Gain adjustment modes 1, 2, 3, or Manual mode for tuning the servo system.
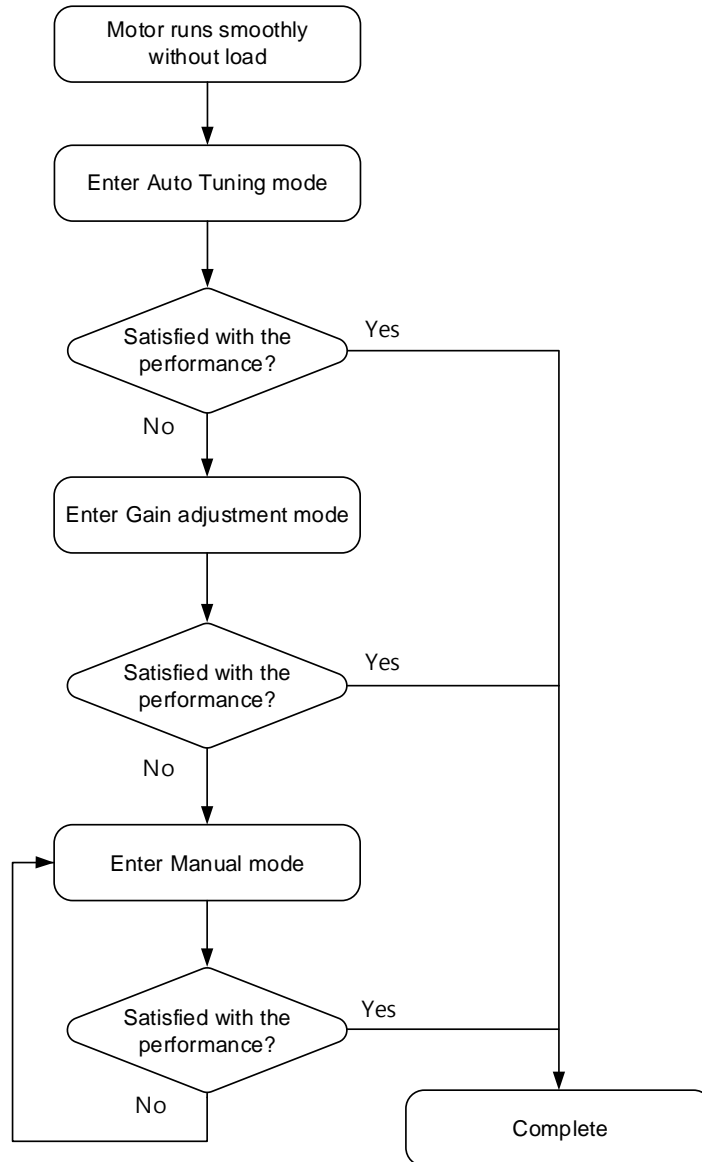
5.1.2   Differences between gain adjustment modes

P2.032 setting value	Adjustment mode	Inertia estimation	Parameter	
			Manual	Auto
0	Manual	Fixed set value of P1.037	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102	N/A
1	Gain adjustment mode 1	Real-time estimation	P2.031	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102
2	Gain adjustment mode 2	Fixed set value of P1.037	P1.037, P2.031	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102
3	Gain adjustment mode 3 (only when the two-degrees-of-freedom control function is enabled)	Fixed set value of P1.037	P1.037, P2.031, P2.089	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.098, P2.099, P2.101, P2.102
4	Gain adjustment mode 4	Reset to gain default value	-	-

Note:

1. For more information on the parameter functions, refer to Section 5.3 Gain adjustment modes.

2. When the two-degrees-of-freedom control function is disabled (set P2.094 [Bit 12] to 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.

5.2   Auto tuning

The auto tuning function provided by the ASDA-B3 enables the system to perform real-time machine inertia estimation and upload the tuned parameters to the servo drive. You can use the ASDA-Soft software or the drive panel to start auto tuning. The following table lists the parameters that change with the results of auto tuning.

Gain parameters		Filter and resonance suppression parameters	
Parameter No.	Function	Parameter No.	Function
P1.037	Load inertia ratio	P1.025	Low-frequency vibration suppression frequency (1)
P2.000	Position control gain	P1.026	Low-frequency vibration suppression gain (1)
P2.004	Speed control gain	P1.027	Low-frequency vibration suppression frequency (2)
P2.006	Speed integral compensation	P1.028	Low-frequency vibration suppression gain (2)
P2.031	Bandwidth response level	P2.023	Notch filter frequency (1)
P2.032	Gain adjustment mode	P2.024	Notch filter attenuation level (1)
P2.089	Command response gain (enabling the two-degrees-of-freedom control function (set P2.094 [Bit12] to 1) is required)	P2.025	Resonance suppression low-pass filter
		P2.043	Notch filter frequency (2)
		P2.044	Notch filter attenuation level (2)
		P2.045	Notch filter frequency (3)
		P2.046	Notch filter attenuation level (3)
		P2.049	Speed detection filter and jitter suppression
		P2.098	Notch filter frequency (4)
		P2.099	Notch filter attenuation level (4)
		P2.101	Notch filter frequency (5)
		P2.102	Notch filter attenuation level (5)

5.2.1 Flowchart of auto tuning

You can use the drive panel or ASDA-Soft to complete auto tuning. The auto tuning function in the B3 servo drive helps you to find the most suitable parameters for your system according to the machine characteristics.

```
                          ┌──────────────┐
                          │  Auto Tuning │
                          └──────┬───────┘
              ┌──────────────────┴──────────────────┐
              ▼                                      ▼
  ┌────────────────────────┐          ┌────────────────────────┐
  │  With the controller:  │          │  Without the controller:│
  │ the path is configured │          │ the back and forth path │
  │    by the controller.  │          │ is set by the servo drive│
  └───────────┬────────────┘          └────────────┬───────────┘
              └──────────────────┬──────────────────┘
                                 ▼
                    ┌────────────────────────┐
                    │ The drive automatically│
                    │ estimates the inertia  │
                    │ and starts to tune the │
                    │        system.         │
                    └───────────┬────────────┘
                                ▼
                          ┌──────────┐
                          │ Complete │
                          └──────────┘
```
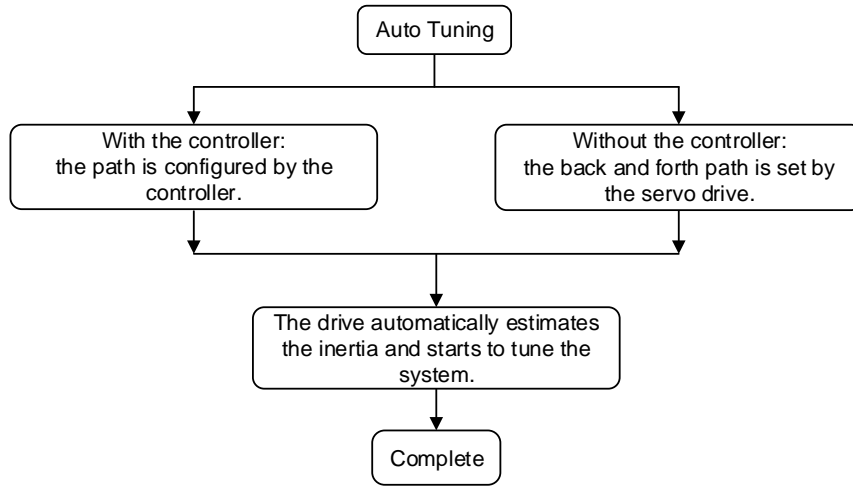
Note: when the path is configured by the controller, make sure the dwell time is added to the operation cycle. Otherwise, AL08B occurs and the servo drive cannot complete auto tuning.

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

```
                    ┌──────────┐
                    │  Start   │
                    └────┬─────┘
                         ▼
              ┌─────────────────────┐
              │ Use the drive panel │◄──────────────┐
              │ or ASDA-Soft to     │               │
              │ enter Auto Tuning   │               │
              │ mode                │               │
              └──────────┬──────────┘               │
                         ▼                          │
                   ◇─────────────◇     No   ┌──────────────────┐
                  ◇  Satisfied    ◇────────►│ Change the setting│
                  ◇ with the       ◇        │   of P2.105       │
                   ◇  stiffness?  ◇         └──────────────────┘
                    ◇───────────◇
                         │ Yes
                         ▼
                   ◇─────────────◇     No   ┌──────────────────┐
                  ◇  Satisfied    ◇────────►│ Change the setting│
                  ◇ with the       ◇        │   of P2.106       │
                   ◇  response?   ◇         └──────────────────┘
                    ◇───────────◇
                         │ Yes
                         ▼
                   ┌──────────┐
                   │ Complete │
                   └──────────┘
```
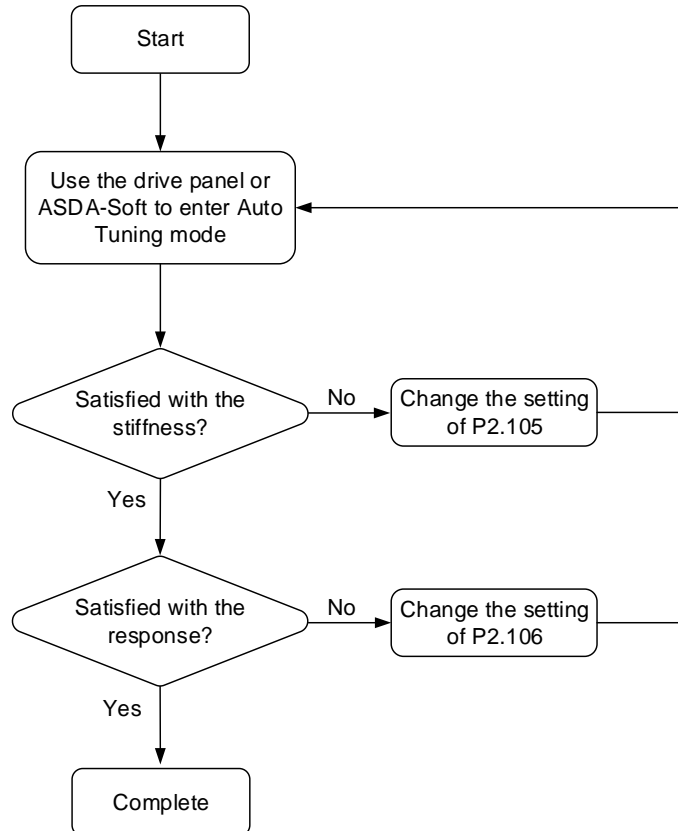
5.2.2 Auto tuning with the drive panel

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

Flowchart of auto tuning
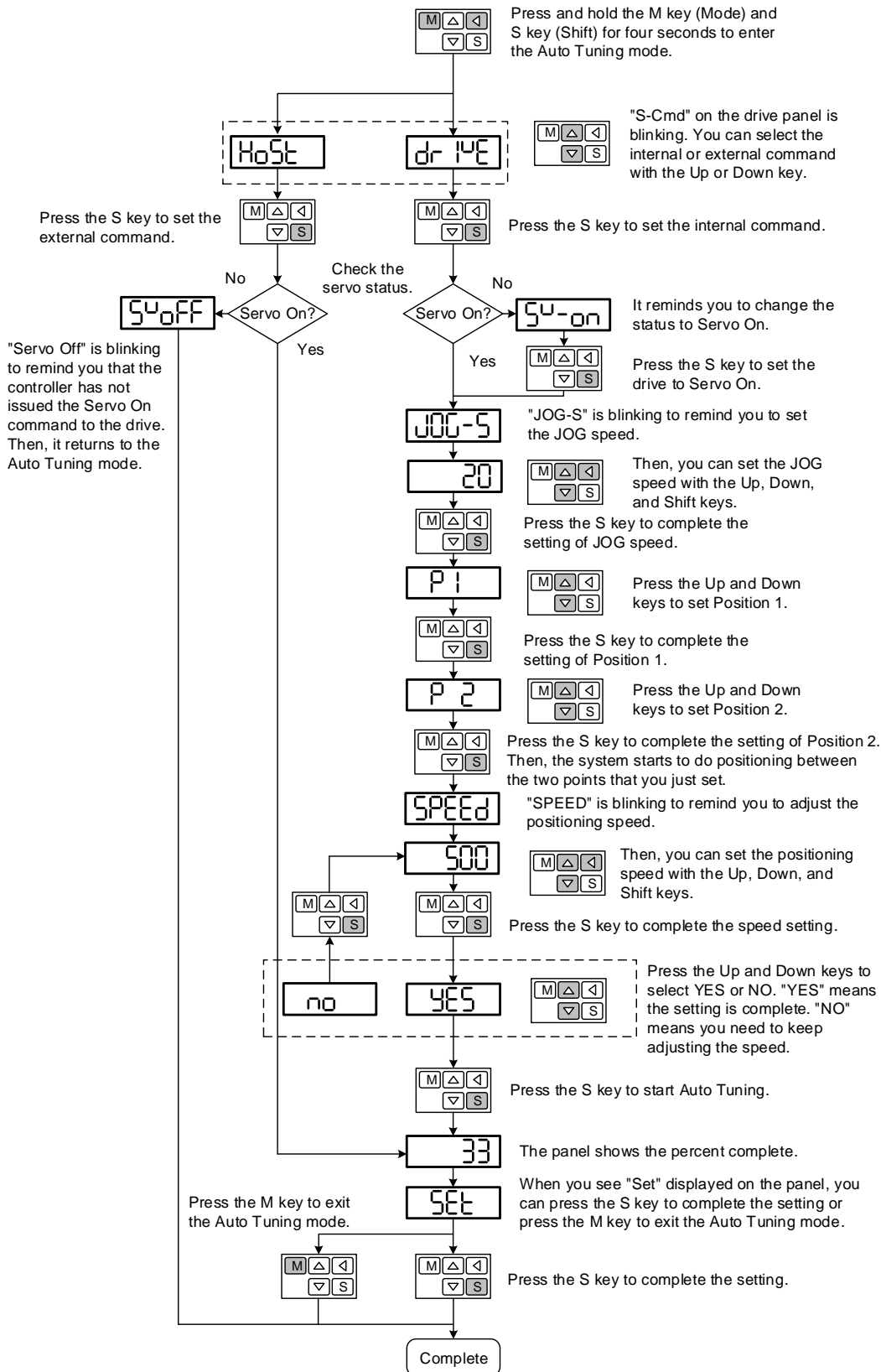
5.2.3 Auto tuning with ASDA-Soft (software)

Instead of using the drive panel, you can use ASDA-Soft to complete auto tuning. Go to Delta's website (http://www.deltaww.com/) to download ADSA-Soft for free. Install the software and open the executable file (.exe), then you can see the following screen.
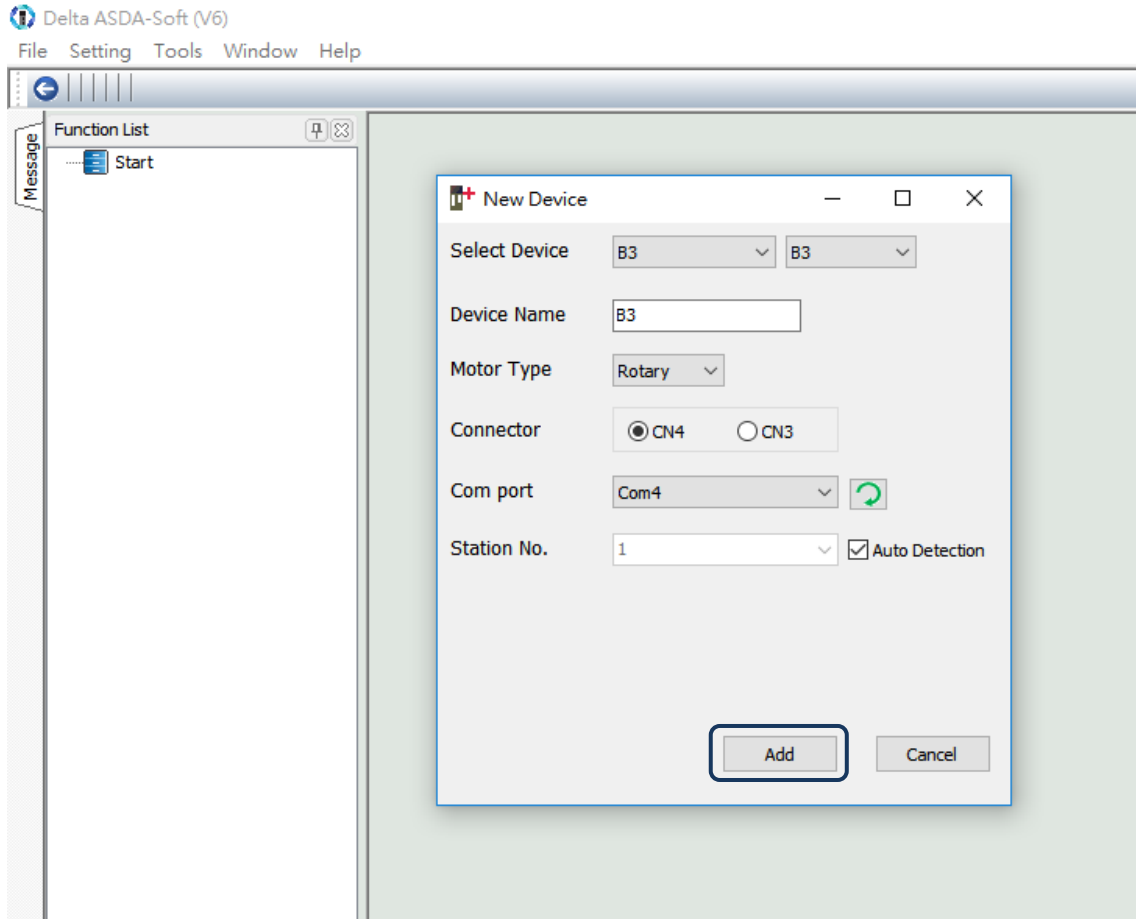
Make sure your ASDA-B3 servo drive, servo motor, and power are all properly connected.

Then click **Add** for the ASDA-Soft to be in online mode.

5

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

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

Step 1:

When the software is in online mode, the program window appears as follows. Click **Auto Tuning** in the Function List tree view.
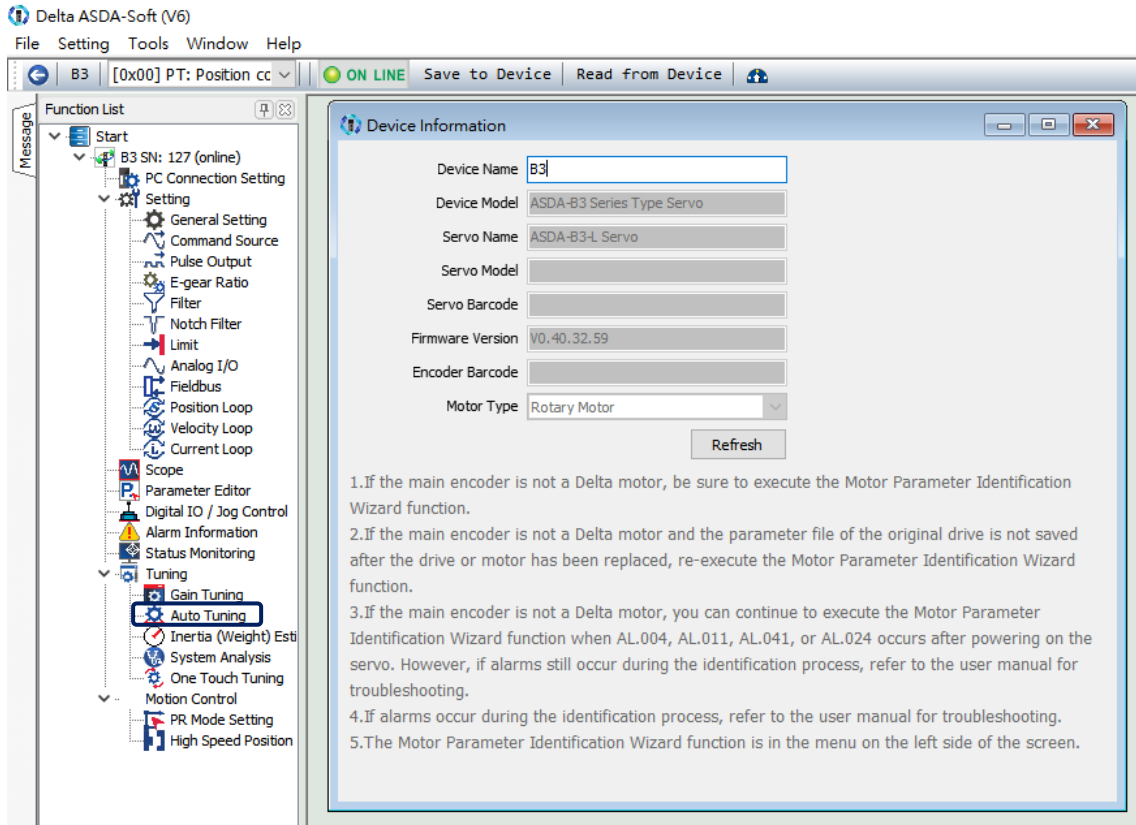
Step 2:

Click **Controller: Motion Command from Controller** and make sure the motion / machining path is set correctly.
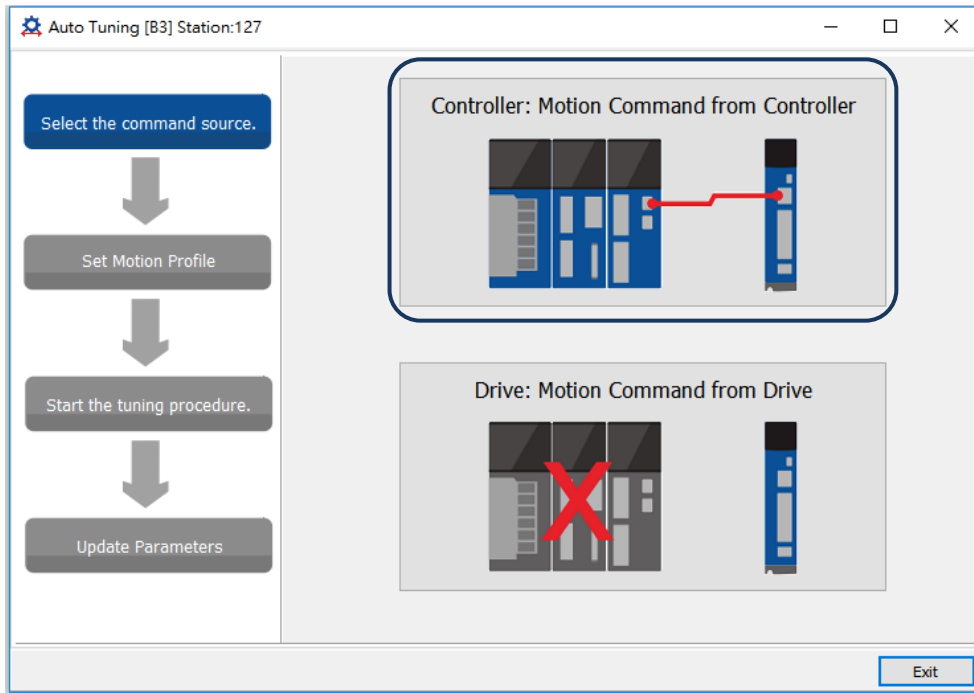
Suggestions: set the motor to operate at least one cycle in both positive and negative directions. The delay time for reaching the positions in both positive and negative directions should not be less than 1,000 ms with the running speed no less than 500 rpm.

Step 3:

Repeatedly run the motor with the path you just set. Before running the motor, make sure no one is standing close to the machinery. Then, click **Next**.

5

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

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

Click **Update** to complete auto tuning.

5
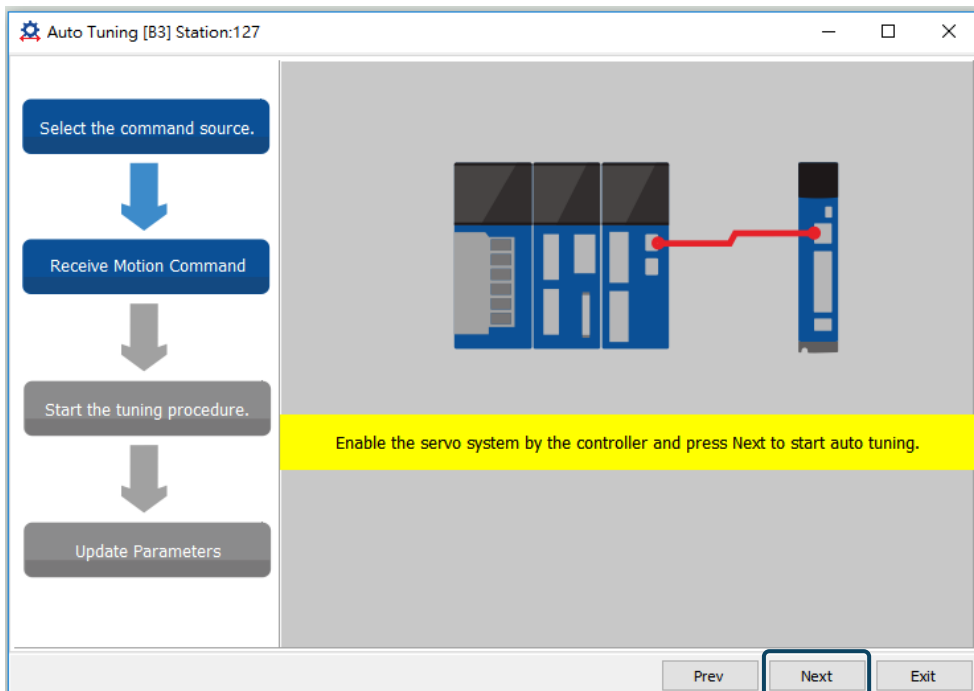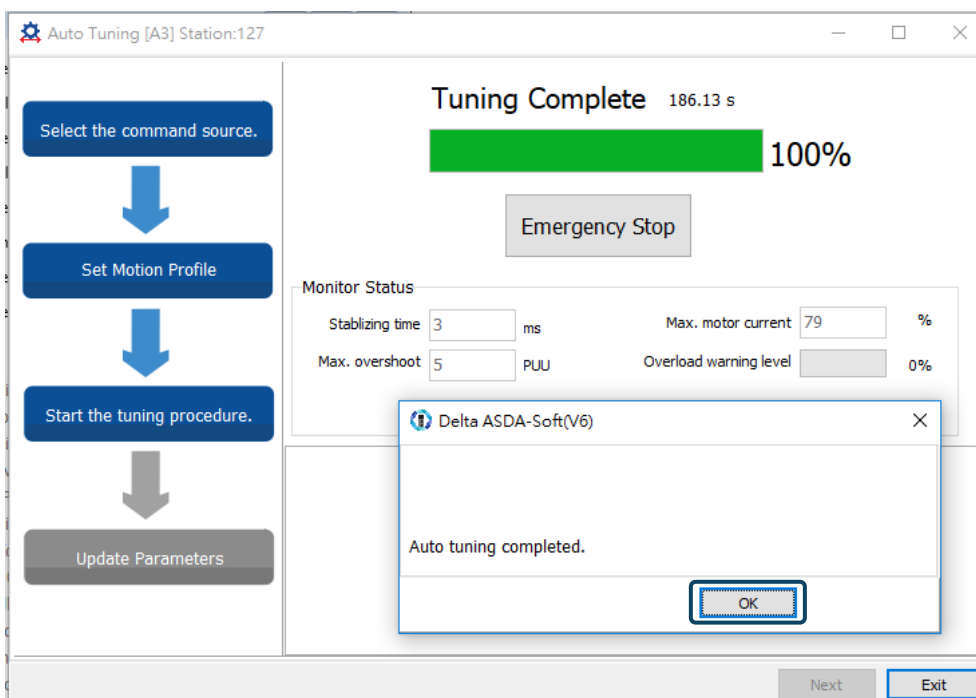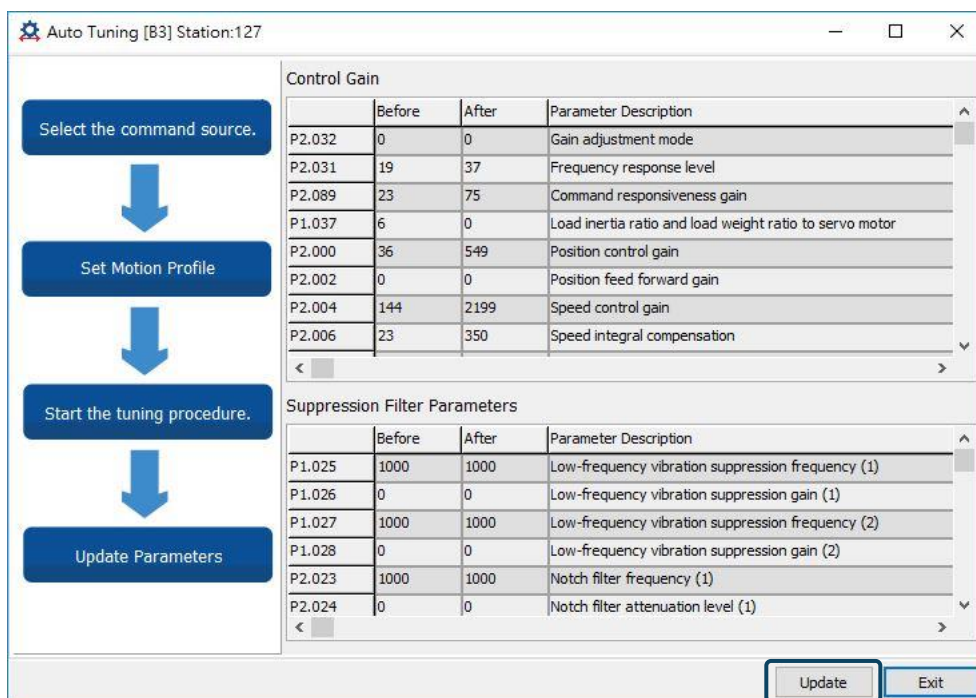
■   Auto tuning with the servo drive: the servo drive sends the commands to drive the motor.

Step 1:

When the software is in online mode, the program window appears as follows.

Click **Auto Tuning** in the Function List tree view.
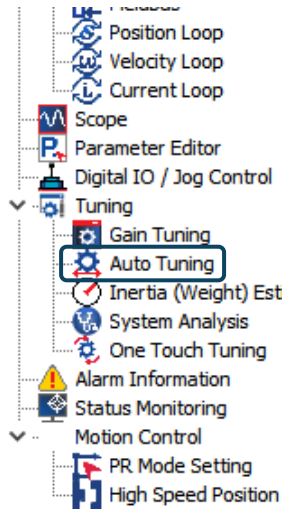
Step 2:

Click **Drive: Motion Command from Drive** to enter the path setting window.
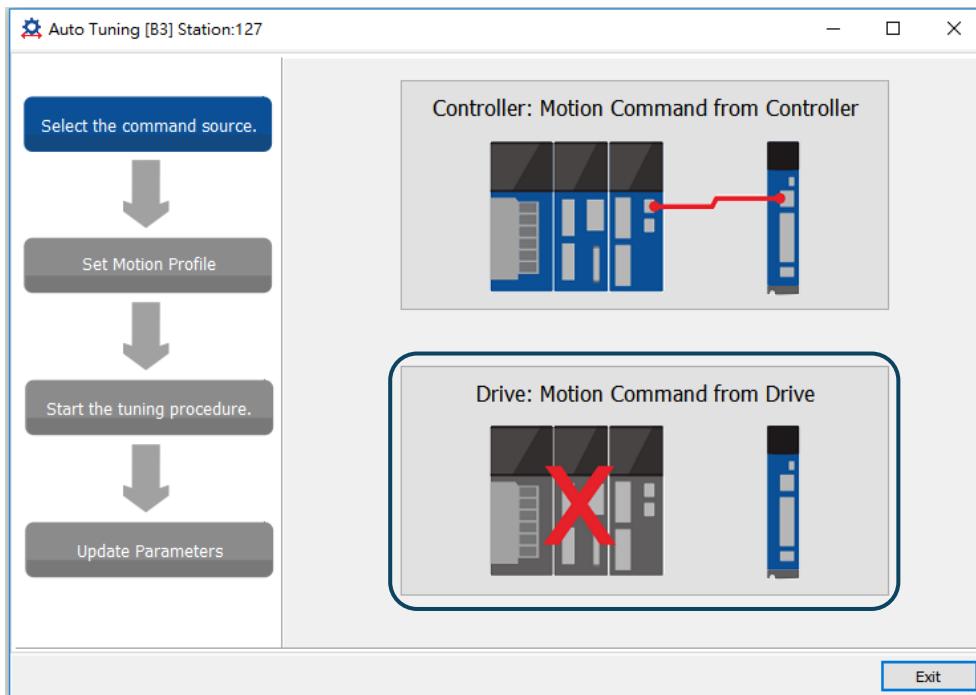
Follow these steps to set the motor running path:

1. Set the system to the Servo ON state.

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

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

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

Then, click **Next**.
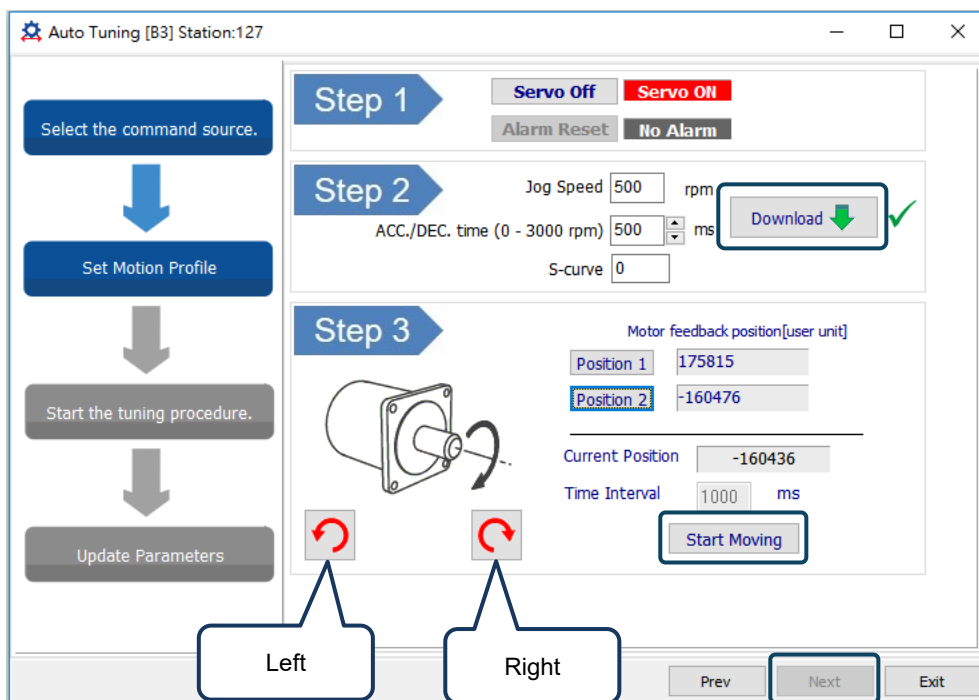
Step 3:

Wait until the tuning progress bar reaches 100%, after which a window with "Auto tuning completed." appears. Click **OK** to continue.
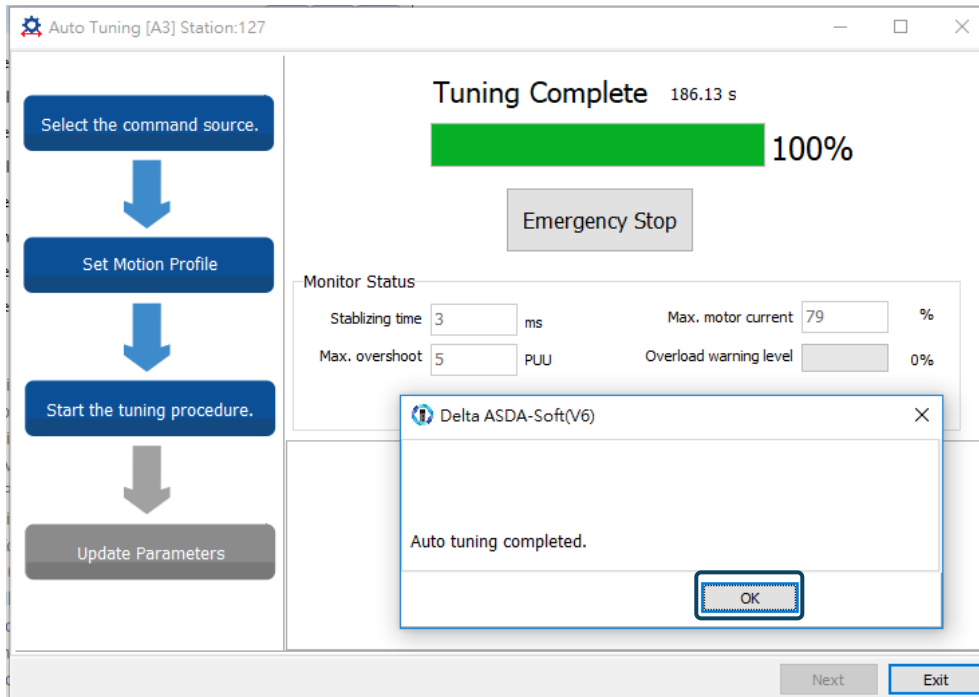
The screen shows a table comparing the parameters before and after being changed by auto tuning.
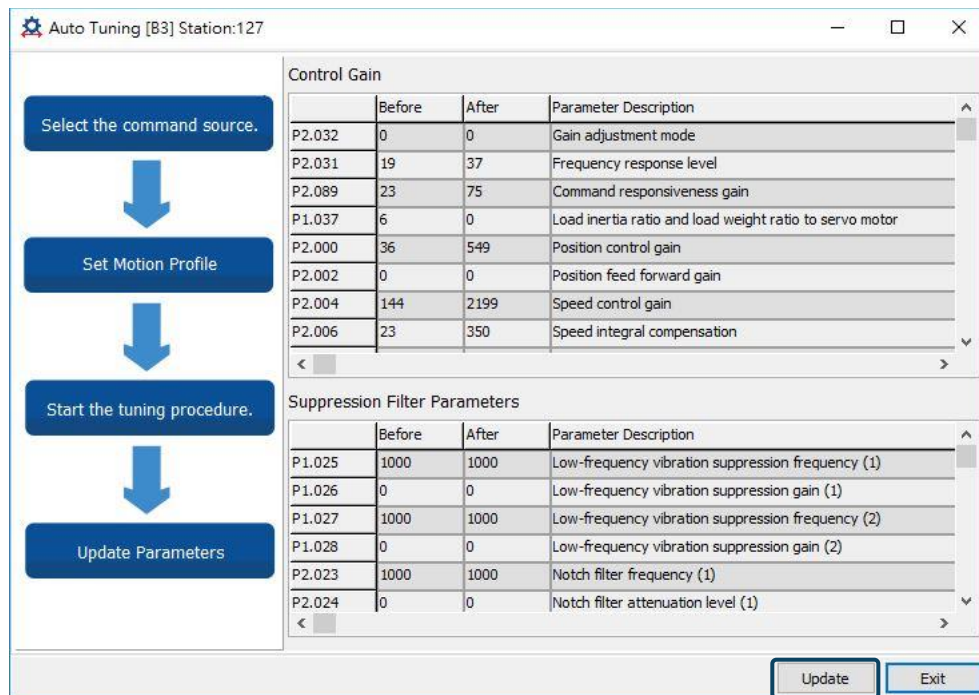
Click **Update** to complete auto tuning.

5.2.4 Alarms related to auto tuning

In Auto Tuning mode, it is vital that you program the command path, including the operation cycle (such as acceleration, constant speed, and deceleration) and dwell time. See the following figure. When any of the settings is incorrect, the servo drive stops tuning and displays an alarm. Please check the alarm causes and take corrective actions.
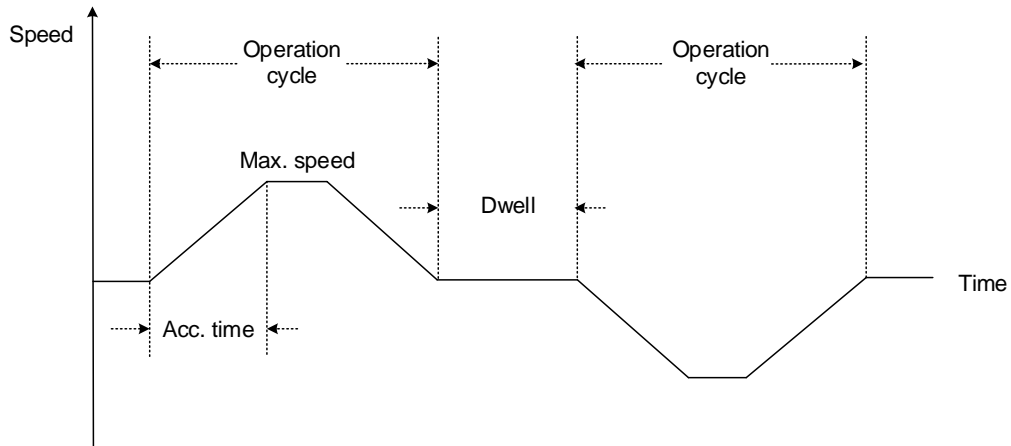
Display	Alarm name
AL08A	Auto-tuning function - Command error
AL08B	Auto-tuning function - Pause time is too short
AL08C	Auto-tuning function - Inertia estimation error

5.3   Gain adjustment modes

Apart from the auto tuning function described above, there are three other gain adjustment modes you can use to fine tune the system. You can then easily complete tuning by increasing or decreasing the bandwidth response level (P2.031). Follow the tuning procedure in Section 5.1.

5.3.1   Flowchart of Gain adjustment mode
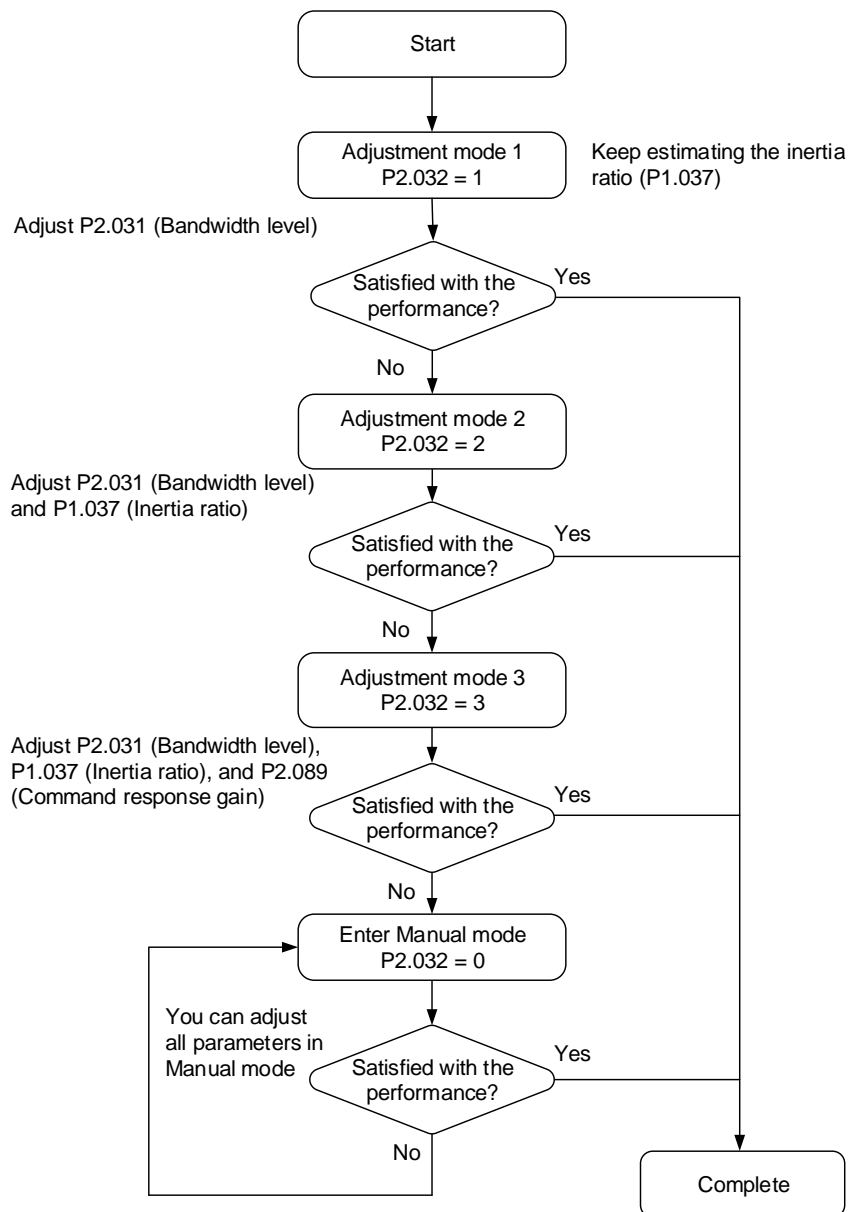
5.3.2 Gain adjustment mode 1

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

P2.032 setting 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 motor accelerates from 0 rpm to 3,000 rpm within 1.5 seconds.

2. It is suggested to set the motor speed to 500 rpm or higher. The lowest speed should be no less than 200 rpm.

3. The load inertia 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 your need, try Gain adjustment mode 2 to tune the servo system. In Gain adjustment mode 2, the system does not automatically estimate the inertia. You must set the correct machine inertia in P1.037.

P2.032 setting 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 applicable to most applications. However, when the machine does not comply with the requirements for inertia estimation, you have to set the correct inertia ratio in P1.037.

5.3.4 Gain adjustment mode 3

When Gain adjustment modes 1 and 2 cannot meet your need, try Gain adjustment mode 3 to tune the servo system. P2.089 (Command response gain) is available in this mode. You can increase the gain value to shorten the response and settling time for the position command. However, if you set the parameter value too high, it might cause position overshoot and machinery vibration. This function is only available for changing commands, such as the acceleration / deceleration application, which improves the response. However, when the two-degrees-of-freedom control function is disabled (set P2.094 [Bit 12] to 0), the effect of Gain adjustment mode 3 is the same as that of Gain adjustment mode 2, so setting P2.089 is invalid in that scenario.

P2.032 setting 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   Setting the bandwidth response level (stiffness)

When the inertia is fixed and you increase the bandwidth response level (P2.031), the servo's bandwidth increases as well. If resonance occurs, lower the parameter value 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 reduce the bandwidth response level to 28. When you adjust the value of this parameter, the servo drive automatically adjusts the corresponding parameters, such as P2.000 and P2.004.
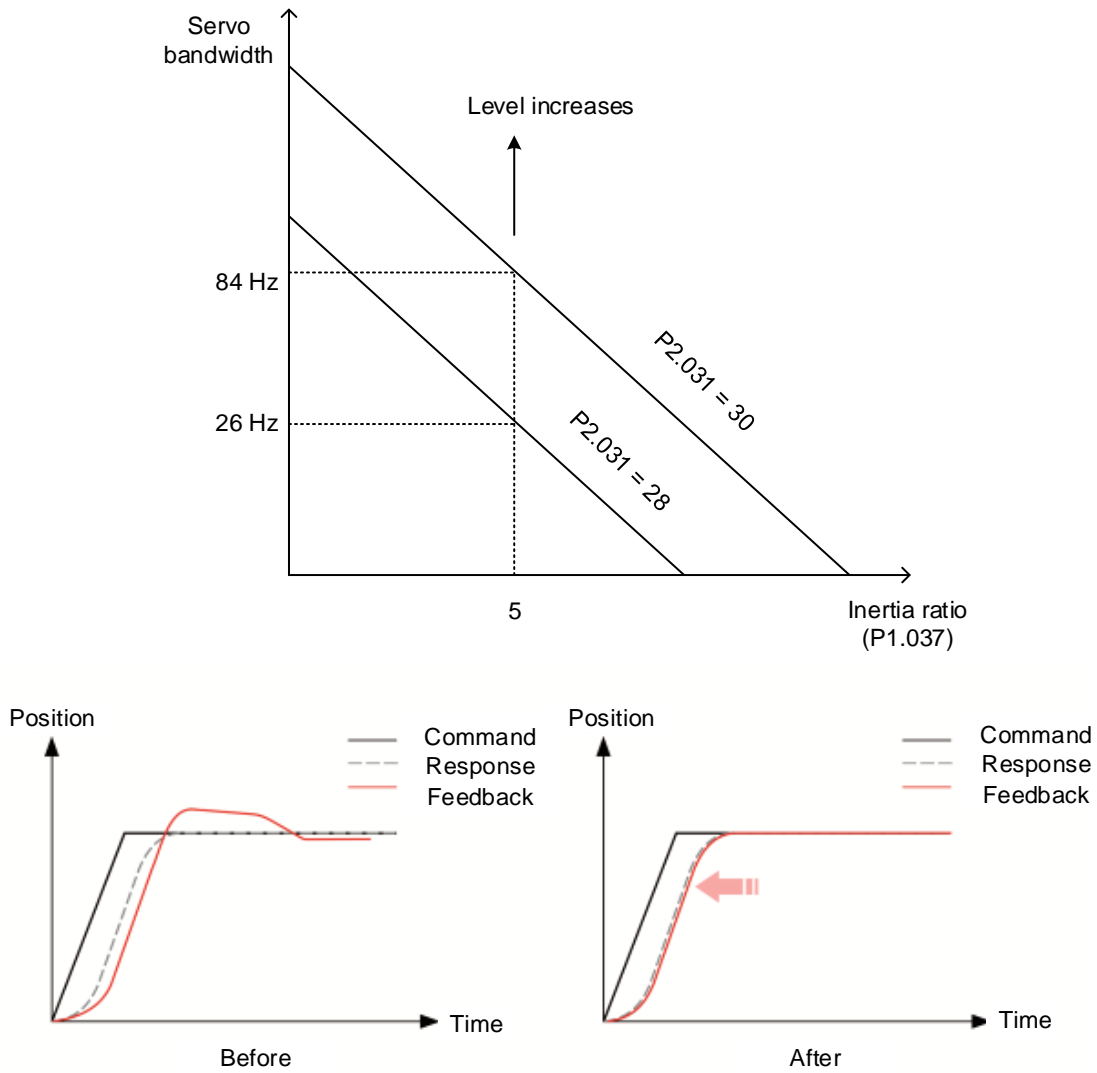
Figure 5.3.5.1 Adjust the bandwidth response level

5.3.6   Setting the command response gain (response)

Use P2.089 to adjust the command response gain. Increasing the gain can minimize the
deviation between the position command and command response in the intermittent duty zone.
This function is only available for changing commands. Before adjusting the value of P2.089,
first enable the two-degrees-of-freedom control function (set P2.094 [Bit 12] to 1).
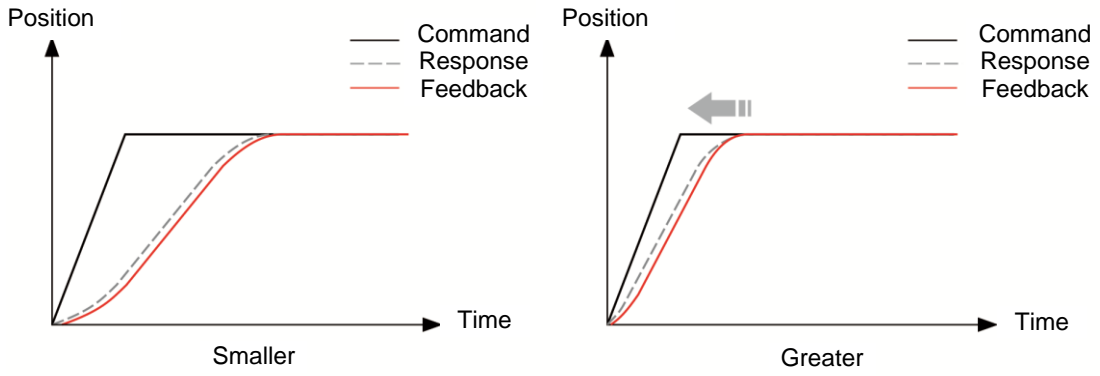
Figure 5.3.6.1 Adjust the command response gain

5.4   Tuning in manual mode

The selection of the position or speed response bandwidth should be determined by the machine 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 might cause mechanical resonance. Thus, machinery with higher stiffness is used to solve this problem. When the response bandwidth 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 control loop. The bigger the KPP value, the higher the response bandwidth of the position loop. This lowers the following error and position error, and shortens the settling time. However, if you set the value too high, it can cause the machinery to vibrate or cause overshoot when positioning. The calculation of the position loop response bandwidth is as follows:

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

■   Speed control gain (KVP, P2.004)

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

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

JM: motor inertia; JL: load inertia; P1.037: 0.1 (times)

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

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

■   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 the machinery to vibrate. It is suggested that you set the value as follows:

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

5

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

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

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

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

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

Note: to use this parameter, disable the two-degrees-of-freedom control function (set P2.094 [Bit 12] to 0).

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

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

Note: to use this parameter, disable the two-degrees-of-freedom control function (set P2.094 [Bit 12] to 0).

5.5 Mechanical resonance suppression

Five sets of notch filters are provided to suppress mechanical resonances. You can set all five to auto resonance suppression with P2.047 or manually set the resonance suppression with ASDA-Soft. See the following flowchart of manual adjustment.

```
┌─────────────────────────────────┐
│ Use the analytic tool provided  │
│ by ASDA-Soft to display the     │
│ point of resonance.             │
└─────────────────────────────────┘
                │
                ▼
┌─────────────────────────────────┐
│ The drive issues the command    │
│ to accelerate and decelerate    │
│ the motor alternatively.        │
└─────────────────────────────────┘
                │
                ▼
         ╱ High-frequency ╲    No    ┌──────────┐
        ╲  resonance?     ╱  ──────▶ │ Complete │
                │                     └──────────┘
               Yes
                │
                ▼
┌─────────────────────────────────┐
│ Set the value of resonance      │
│ frequency to P2.023 and set     │
│ P2.024 to 4.                    │
└─────────────────────────────────┘
                │
                ▼
         ╱ Resonance  ╲     No    ┌──────────────────┐
        ╲ eliminated? ╱   ──────▶ │ Increase the     │
                │                  │ value of P2.024  │
               Yes                 └──────────────────┘
                │
                ▼
         ┌──────────┐
         │ Complete │
         └──────────┘
```

Operation Mode

6
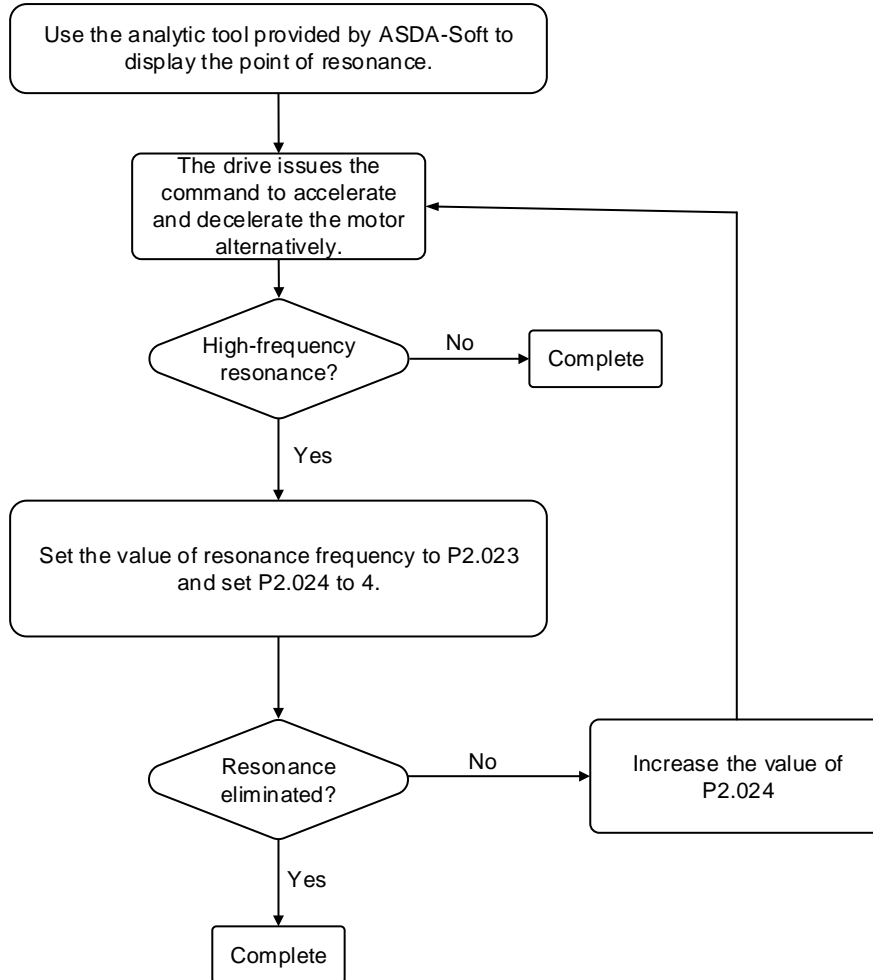
This chapter describes the operation of each control mode, including gain adjustment and filters. For Position mode, you use the external pulse and commands from the internal registers. For Speed mode and Torque mode, apart from the commands from the internal registers, you can also control the servo drive by the analog voltage input. In addition to Single mode, Dual mode is also available for meeting the application requirements.

6

6.1   Selecting the operation mode

This servo drive provides three basic operation modes: Position, Speed, and Torque.

The available communication modes are CANopen, DMCNET, and EtherCAT. For the basic operation mode, you can choose from Single mode, Dual mode, and Multi-mode. The following table lists all the available modes.

Mode		Short name	Code	Description
Single mode	Position mode (Terminal block input)	PT	00	The servo drive receives the Position command and commands the motor to run to the target position. The Position commands are communicated through the terminal block and the signal type is pulse.
	Position mode (Register input)	PR	01	The servo drive receives the Position command and commands the motor to run to the target position. 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 analog voltage (-10V to +10V) which is communicated through the 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 analog voltage (-10V to +10V) which is communicated through the 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 PT and S modes with DI signals.
		PT-T	07	Switch PT and T modes with DI signals.
		PR-S	08	Switch PR and S modes with DI signals.
		PR-T	09	Switch PR and T modes with DI signals.
		S-T	0A	Switch S and T modes with DI signals.
		PT-PR	0D	Switch PT and PR modes with DI signals.
Communication mode			0B	DMCNET mode Operates with the communication mode for PLC.
			0C	CANopen mode EtherCAT mode
Multi-mode		PT-PR-S	0E	Switch PT, PR, and S modes with DI signals.
		PT-PR-T	0F	Switch PT, PR, and T modes with DI signals.

6

Here are the steps to switch the operation mode:

1. Switch the servo drive to Servo Off status. You can do this by setting DI.SON to off.

2. Set P1.001 and refer to the code listed above for the mode selection.

3. After setting the parameter, cycle power to the servo drive.

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

6.2   Position mode

Two input modes for position control are available on the ASDA-B3: external pulse (PT mode) and internal register (PR mode). In PT mode, the ASDA-B3 servo drive receives the pulse command for direction (motor runs forward or reverse). You can control the rotation angle of the motor with the input pulse. The ASDA-B3 can receive pulse commands of up to 4 Mpps.

You can also accomplish position control using the internal register (PR mode) without the external pulse command. The ASDA-B3 provides 100 command registers with two input modes. You can set the 100 registers first before switching the drive to Servo On status and then set DI.POS0 - DI.POS6 of CN1 for the switch. Or, directly set the register values through communication.

6.2.1   Position command in PT mode

The PT Position command is the pulse input from the terminal block. There are three pulse types and each type has positive and negative logic that you can set in 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 built-in command registers, (P6.000, P6.001) - (P7.098, P7.099). Use DI (0x11) - (0x1E) (POS0 - POS6 of CN1) to select one of the 100 sets as the Position command and 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 that DI is off (the circuit is open); 1 means that DI is on (the circuit is closed).

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

6

There are many applications for both absolute type and incremental type registers. You can easily complete a periodic motor operation according to the table above. For example, assume the Position command PR#1 is 10 turns and PR#2 is 20 turns. PR#1 is issued first and PR#2 comes second. The following diagrams show the difference between absolute and incremental positioning.
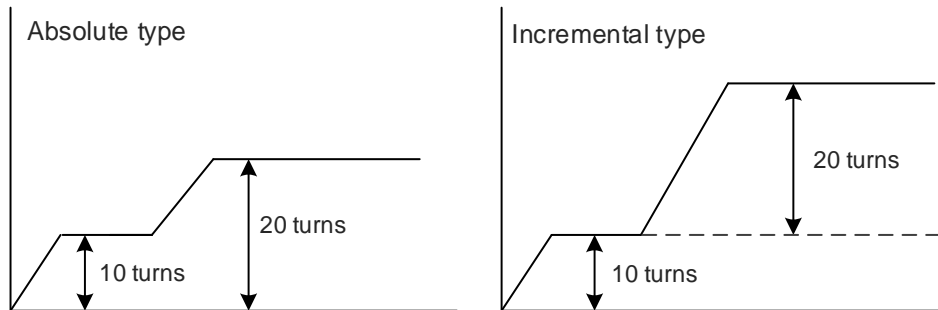
6.2.3 Control structure of Position mode

The basic control structure is shown in the following flowchart.
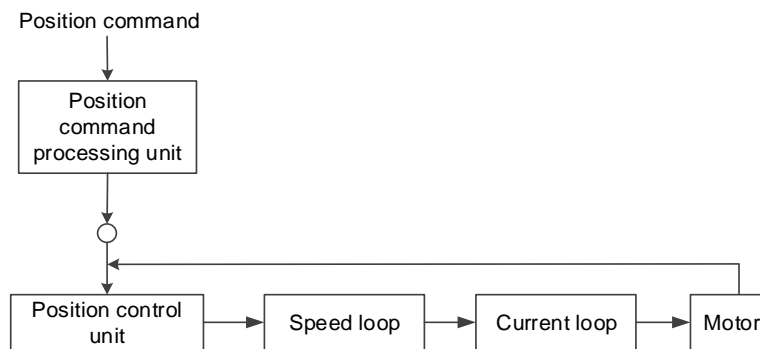
For better control, the pulse signals are processed by the Position command processing unit. The structure is shown in the following diagram.
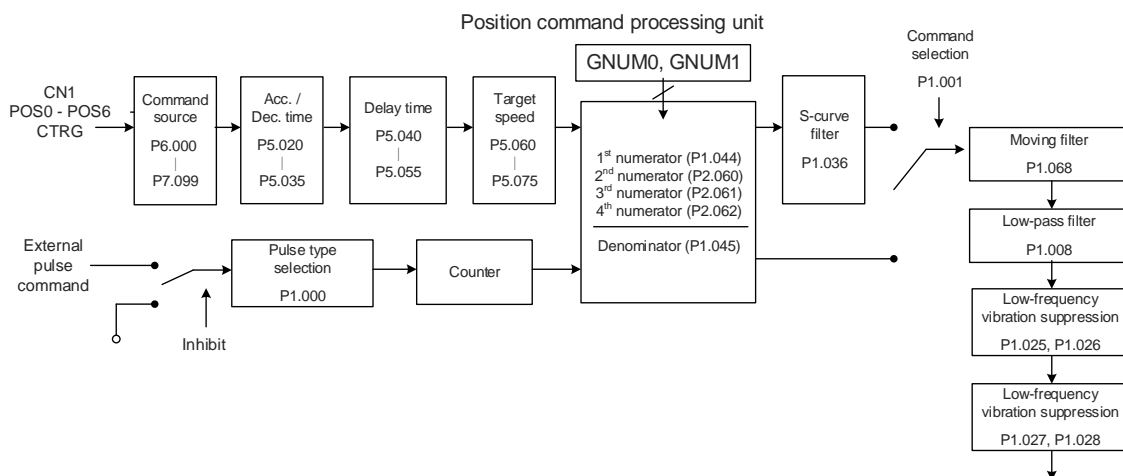
The upper path of the above diagram is the PR mode and the lower one is the PT mode that you can select with P1.001. You can set the E-Gear ratio in both modes to adjust the positioning resolution. In addition, you can use either a moving filter or low-pass filter to smooth the command (described as follows).

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 DI4, setting P2.017 (DI4) to 0x45 (DI.INHP) is required.
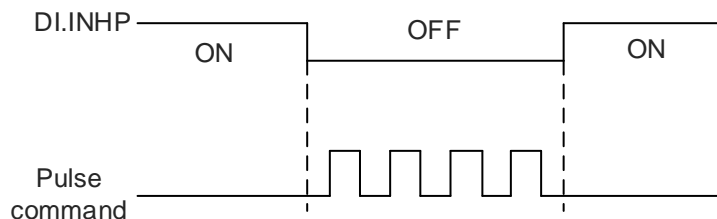
6.2.4 S-curve filter for Position commands

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 influenced by friction and inertia when the motor starts or stops rotating. Setting a larger acceleration / deceleration 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 pulse, the speed and angular acceleration are continuous, so the S-curve command filter is not necessary.
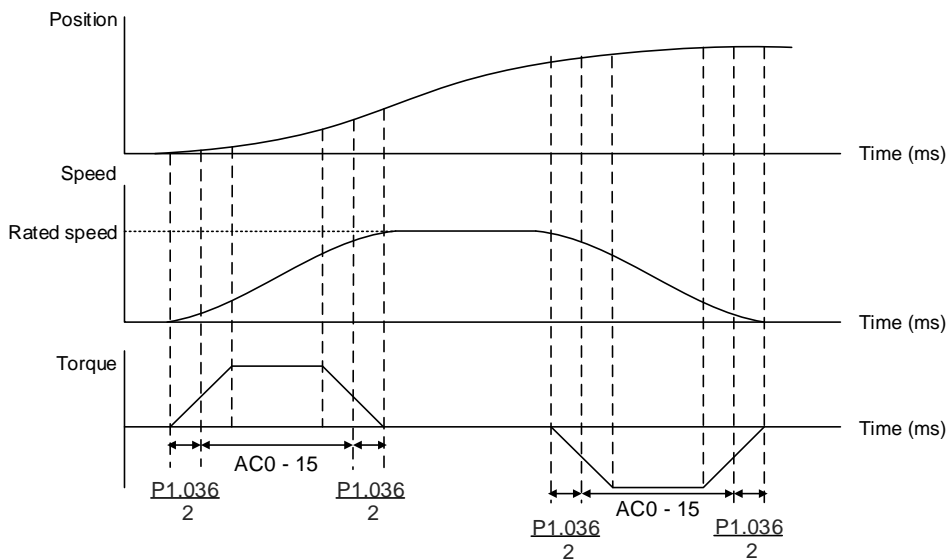
Position and S-curve speed and time setting (incremental position command)
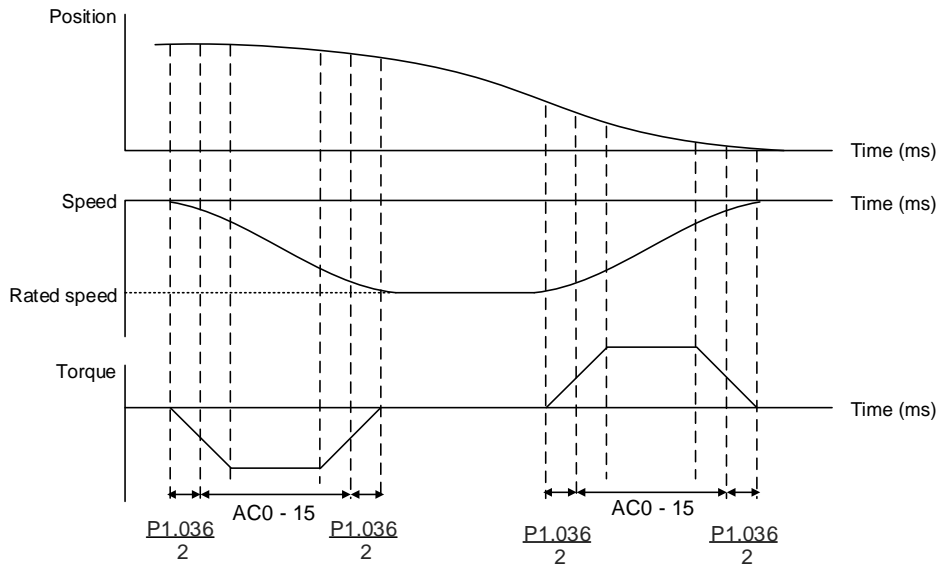
Position and S-curve speed and time setting (decremental position command)

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

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

6.2.5   Electronic gear ratio (E-Gear ratio)

The electronic gear provides easy settings for the resolution. The resolution of ASDA-B3 is 24-bit, which means that it generates 16,777,216 pulses per motor rotation. Regardless of the encoder resolution (17-bit, 20-bit, or 22-bit), the E-Gear ratio is set according to the 24-bit resolution of ASDA-B3 servo drive.

When the E-Gear ratio is 1, it generates 16,777,216 pulses per motor rotation. When you set the ratio to 0.5, then every two pulses from the command (controller) corresponds to one pulse for the motor. However, larger E-Gear ratio might create a sharp corner in the profile and lead to a high jerk. To solve this problem, apply an S-curve command filter or a low-pass filter to reduce the jerk.

For example, if you set the E-Gear ratio so that the workpiece is moved at the speed of 1 μm/pulse, then it means the workpiece moves 1 μm per pulse.
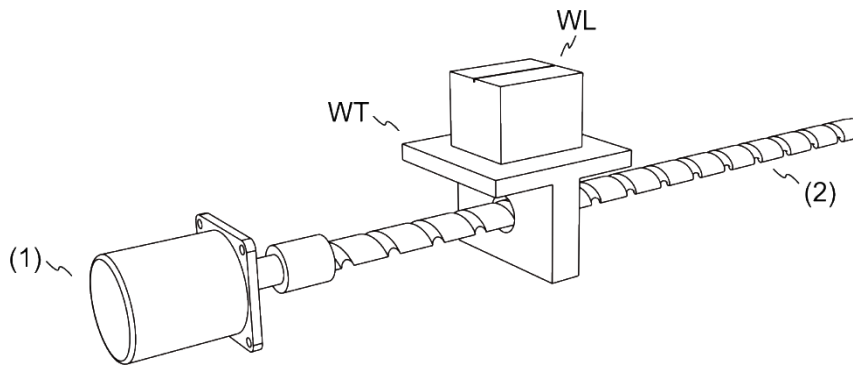
(1)   Motor; (2) Ball screw pitch: 3 mm (equals 3,000 μm); WL: workpiece; WT: platform

	Gear ratio	Moving distance per 1 pulse command
E-Gear is not applied	$= \dfrac{1}{1}$	$= \dfrac{3000\frac{\mu m}{rev}}{16777216\frac{pulse}{rev}} \times \dfrac{1}{1} = \dfrac{3000}{16777216}$ (Unit: $\dfrac{\mu m}{pulse}$)
E-Gear is applied	$= \dfrac{16777216}{3000}$	$= \dfrac{3000\frac{\mu m}{rev}}{16777216\frac{pulse}{rev}} \times \dfrac{16777216}{3000} = 1$ (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
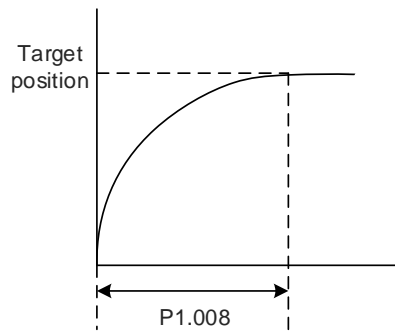
Refer to Chapter 8 for detailed descriptions of the relevant parameter.

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 issued with the DI signals (POS0 - POS6 and CTRG) of CN1. Refer to Section 6.2.2 for information about the DI signal and its selected register. The timing diagrams are shown as follows.
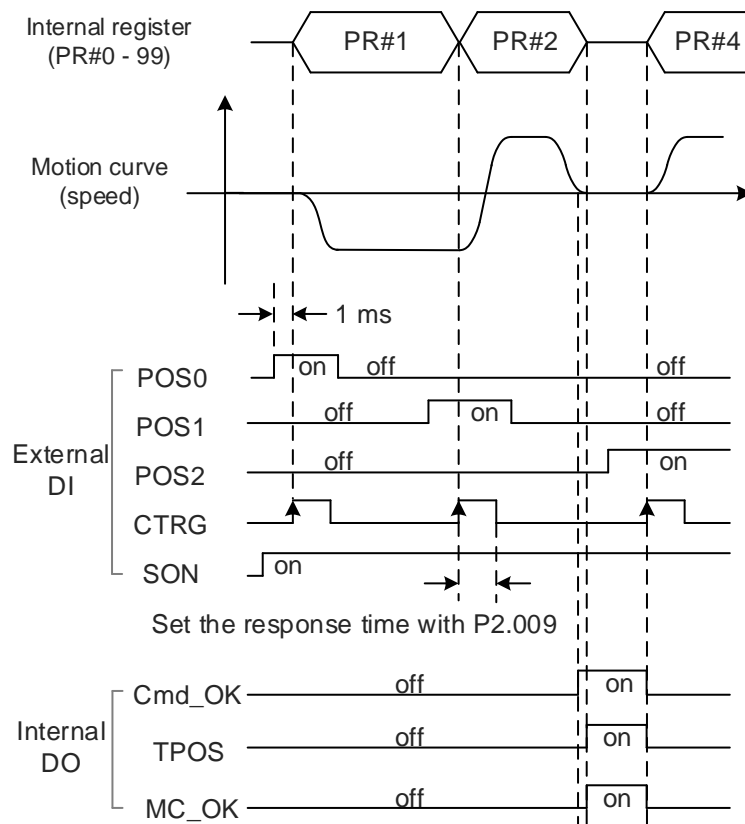
Note: Cmd_OK is on when the PR command is complete; TPOS is on when the error is smaller than the value set by P1.054; MC_OK is on when Cmd_OK and TPOS are both on.

6.2.8 Gain adjustment of the position loop

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

■ Auto

The ASDA-B3 servo drive provides an Auto Tuning function that allows you to easily complete the gain adjustment. 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 (P2.004 and P2.006) since a speed loop is included in the position loop. Then set the position control gain (P2.000) and position feed forward gain (P2.002).

Description of the position control gain and position feed forward gain:

1. Position control gain: the higher the gain, the larger bandwidth for the position loop response.

2. Position feed forward gain: reduces the deviation of phase delay.

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

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

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

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

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

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

Position control unit
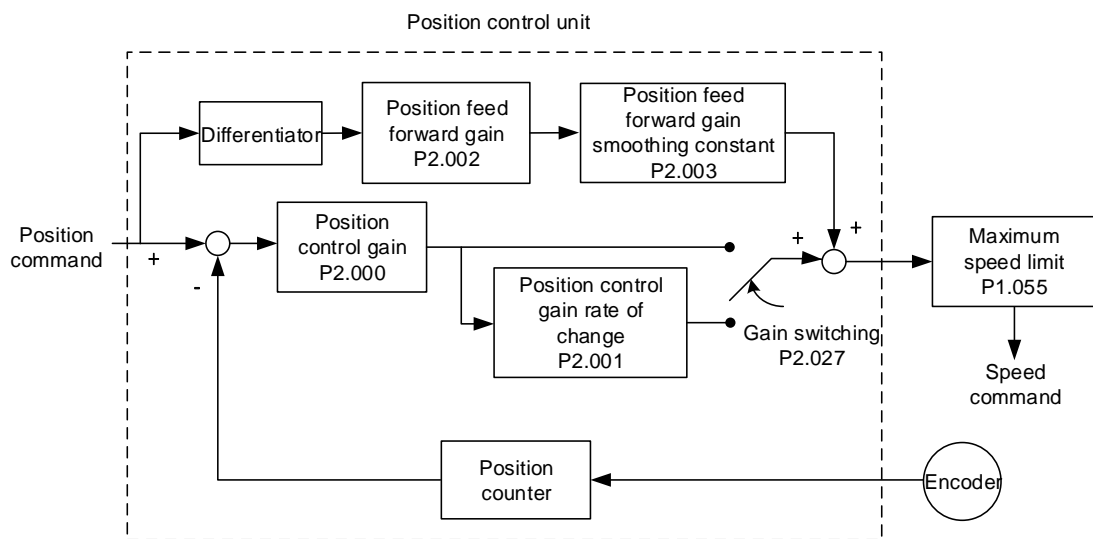
When you set the value of KPP (P2.000) too high, the bandwidth for the position loop is increased and the phase margin is reduced. Meanwhile, the rotor rotates and vibrates in the forward and reverse directions. In this case, decrease the KPP value until the rotor stops vibrating. When the external torque is too high, the low value for KPP cannot meet the demand of reducing the position following error. In this case, increasing the position feed forward gain, PFG (P2.002), can effectively reduce the position following error.
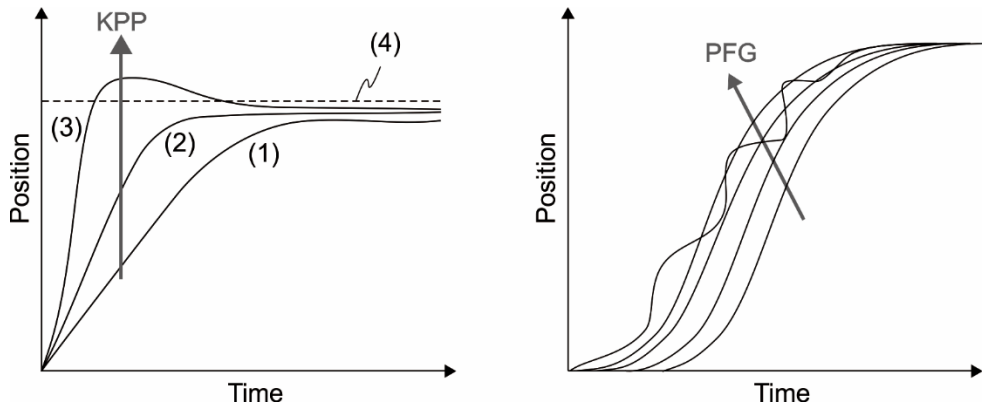
The actual position curve changes from (1) to (3) with the increase in the KPP value.

(4) stands for the Position command.

6.2.9 Low-frequency vibration suppression in Position mode

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

Auto setting

If you have difficulty finding the resonance at low frequency, enable the auto low-frequency vibration suppression function, which automatically searches for the specific resonance at low frequency. If you set P1.029 to 1, the system automatically disables the auto low-frequency vibration suppression function and starts to search the resonance at low frequency. When the detected resonance frequency remains at the same level, the system automatically changes the settings as follows.

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.

If P1.029 is automatically reset to 0, but the low-frequency vibration persists, check if P1.026 or P1.028 is enabled. If the values of P1.026 and P1.028 are both 0, it means no resonance frequency is detected. Lower the value of P1.030 and set P1.029 to 1 to search the vibration frequency again. Note that when you set the detection level too low, it might detect noise as resonance at low frequency.

The process of automatically searching for the resonance frequency is shown in the following flowchart.

6
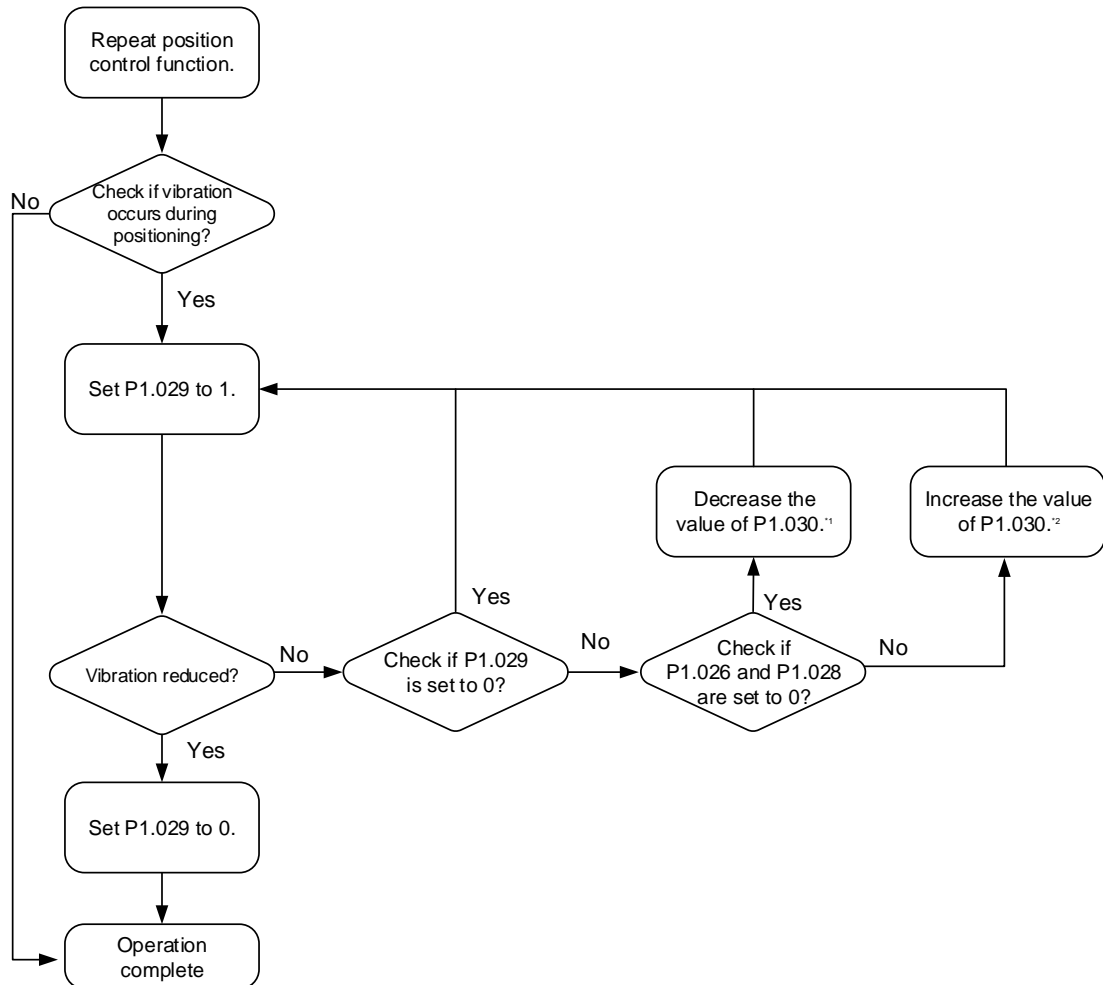
Note:

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 not being able to be detected.

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.

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

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

Manual setting

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

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

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

6.3 Speed mode

There are two kinds of command sources: analog input and internal register (parameters). The analog command controls the motor speed by scaled external voltage input. The command register input controls the speed in two ways. Before operation, respectively set the speed values in three registers. You can switch among the three sets of speed either by using DI.SPD0 / DI.SPD1 of CN1 or change 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 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	Register parameter		P1.009	-60000 to 60000
S3	1	0			P1.010	-60000 to 60000
S4	1	1			P1.011	-60000 to 60000

■   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 it is in Sz mode, the command is 0. Thus, if the Speed command using analog voltage is not required, you can use Sz mode to address the problem of zero drift in the voltage. If it is in S mode, the command is the voltage difference between V_REF and GND. The range of the input voltage is between -10V and +10V, and you can adjust the corresponding speed (P1.040).

■   When either one of SPD0 and SPD1 is not 0, the Speed command comes from the internal register. The command is activated once the status of SPD0 and SPD1 are switched. There is no need to use DI.CTRG for triggering.

■   The parameter setting range (internal register) is -60000 to 60000.
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

Use the Speed command in Speed mode (S or Sz) and in Torque mode (T or Tz) to set the speed limit.

6.3.2 Control structure of Speed mode

The basic control structure is shown in the following flowchart.
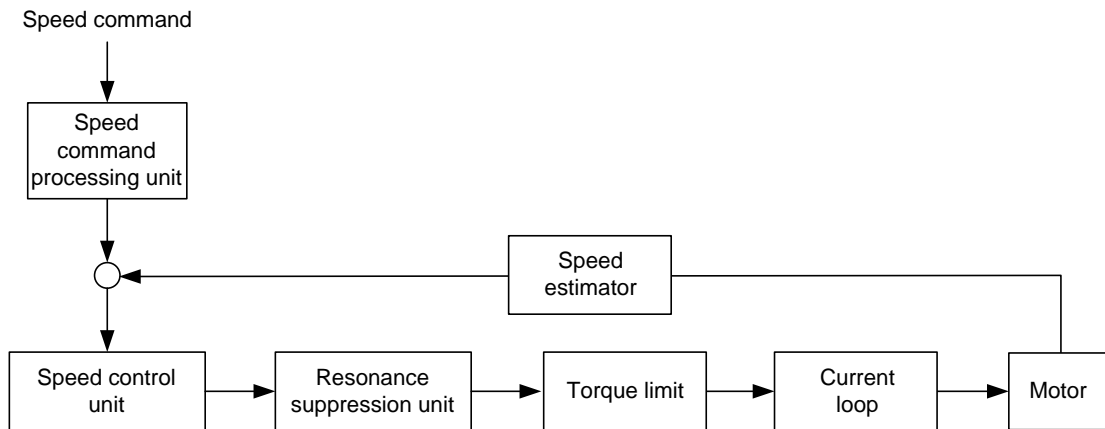
The Speed command processing unit selects the command source (see Section 6.3.1), including the scaling parameter (P1.040) for maximum rotation speed corresponding to the analog voltage and the S-curve parameter for smoothing the speed. The Speed control unit manages the gain parameters for the servo drive and calculates the current command for servo motor in real-time. The Resonance suppression unit suppresses the resonance of the machine.

The following diagram introduces the function of Speed command processing unit. Its structure is shown as follows.
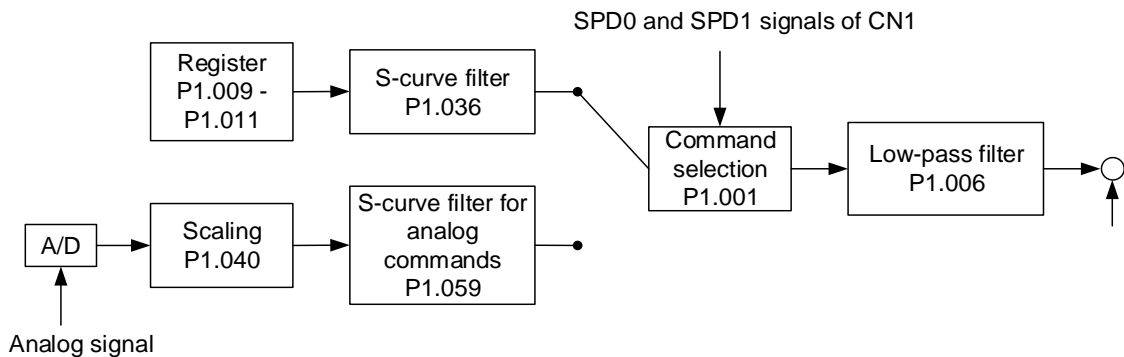
The upper path is the command from the register and the lower one is the command from the external analog voltage that you can select with the status of SPD0 and SPD1, and P1.001 (S or Sz). In this condition, the S-curve and low-pass filters are applied to achieve a smoother response.

6.3.3   Smooth Speed command

S-curve filter

During the process of acceleration or deceleration, the S-curve filter uses the three-stage acceleration curve and creates a smoother motion trajectory. It avoids jerk (rapid change of acceleration), resonance, and noise caused by abrupt speed variation. You can use the 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 status of motor activating and stopping. The servo drive can also calculate the total time for executing the command. T (ms) indicates the operation time and S (rpm) indicates the absolute Speed command, which is the absolute value of the initial speed minus the end speed.
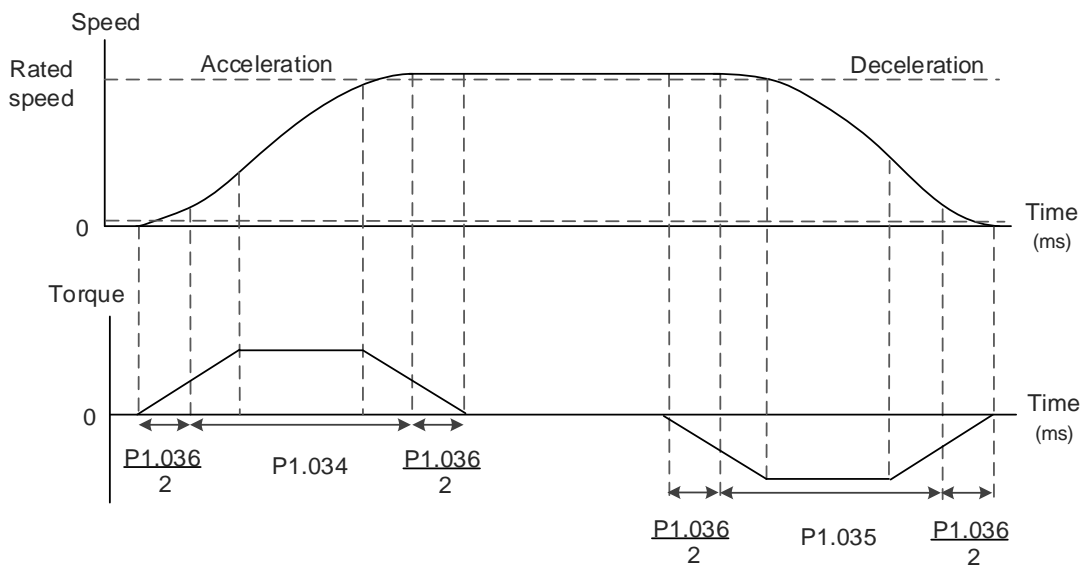
Figure 6.3.3.1 S-curve and time setting

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 constant

S-curve filter for analog commands

The S-curve filter for analog commands helps to stabilize the motor operation when the analog input signal (speed) changes rapidly.
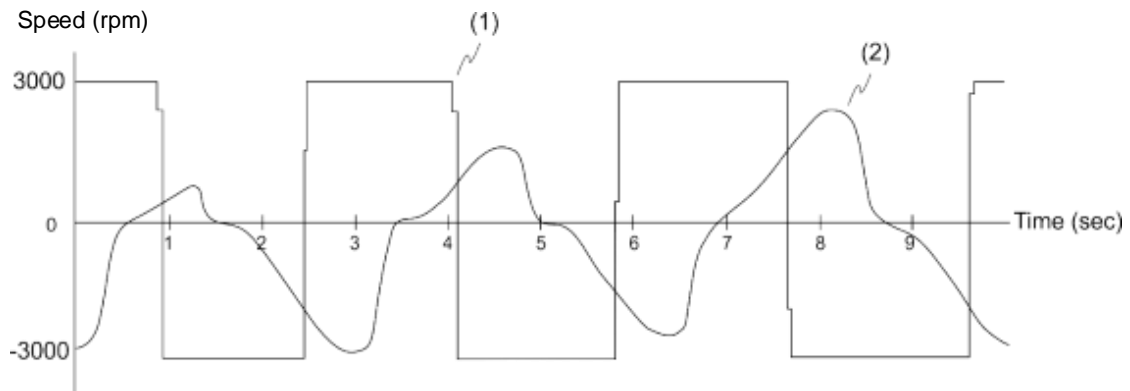
(1)   Analog Speed command; (2) Motor speed

The S-curve filter for analog commands smoothes the analog input signal. Its time program is the same as the S-curve filter mentioned in the above paragraph. Also, the speed and acceleration curves are both continuous. The above graph shows the S-curve and the motor speed when you apply the S-curve filter for analog commands. 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

You usually use the low-pass filter 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)
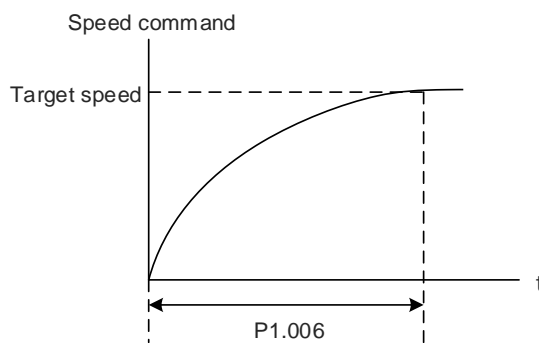
6.3.4   Scaling of the analog command

In the analog mode, control the motor's Speed command by the analog voltage difference between V_REF and GND. Use P1.040 and P1.081 (maximum rotation speed for analog Speed command) to adjust the slope of the speed change and its range. P1.082 can change the filter switching time between P1.040 and P1.081.
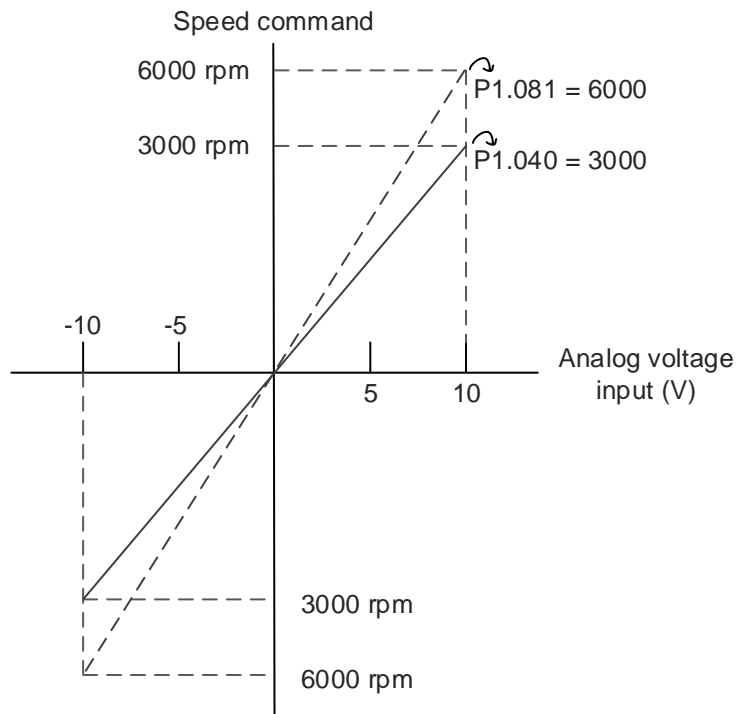
Refer to Chapter 8 for detailed descriptions of the relevant parameters.

Parameter	Function
P1.040	First set of maximum rotation speed for analog Speed command
P1.081	Second set of maximum rotation speed for analog Speed command
P1.082	Filter switching time between P1.040 and P1.081

6.3.5   Timing diagram of Speed mode
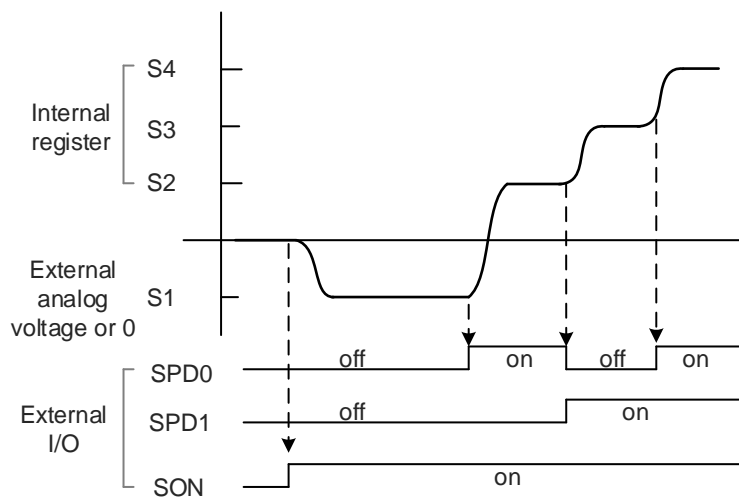
Note:

1. "off" means that DI is off (the circuit is open); "on" means that DI is on (the circuit is closed).

2. When it is in Sz mode, the Speed command S1 = 0; when it is in S mode, the Speed command S1 is 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.
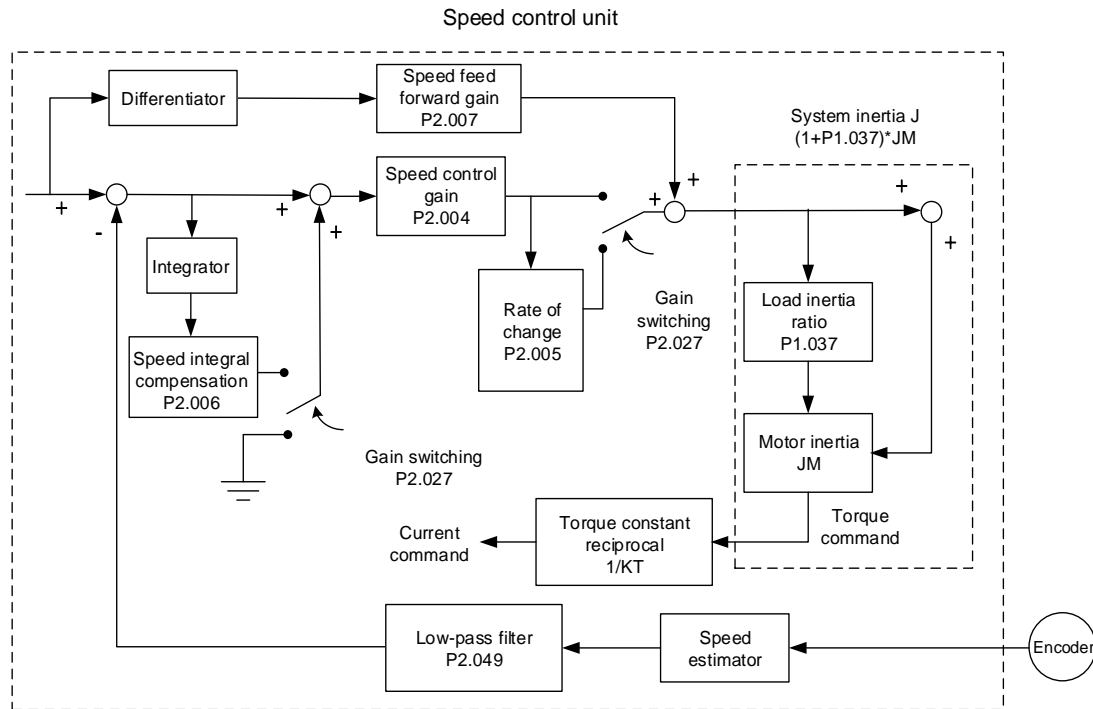
Speed control unit

In the speed control unit, you can adjust different types of gain. You can adjust the gain manually or use the two gain adjustment modes provided.

Manual: manually set the parameters, and all auto or auxiliary functions are disabled.

Gain adjustment mode: refer to Chapter 5 Tuning.

Manual mode

When you set P2.032 to 0, you also set the speed control gain (P2.004), speed integral compensation (P2.006), and speed feed forward gain (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, this sacrifices the phase margin. If you set this gain too high, it reduces the system stability.
Speed feed forward gain: reduces the deviation of phase delay.

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

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

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

Time domain
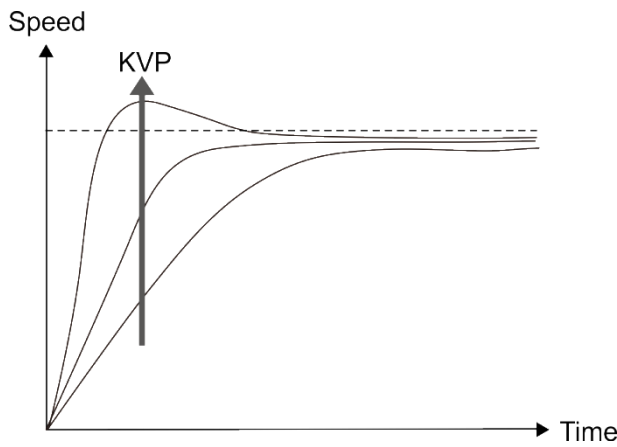
The higher the KVP value, the larger the bandwidth. The time of the speed increase will also be shorter. However, if the value is set too high, the phase margin is too small. The effect is not as good as KVI for the steady-state error but is better for the effect on following error.
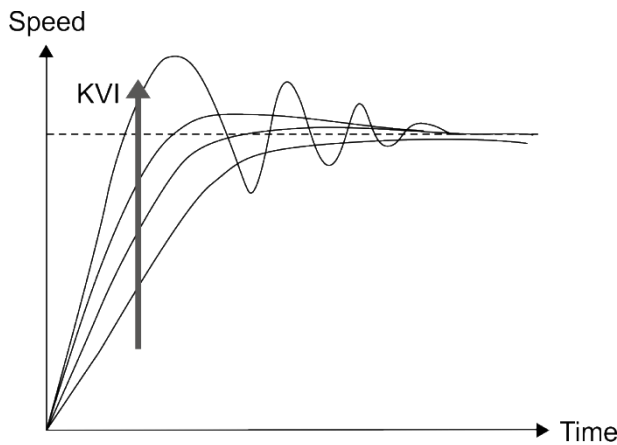
The higher the KVI value, the larger the low-frequency gain. It shortens the time for the steady-state error to reduce to zero. However, it does not significantly reduce the following error.
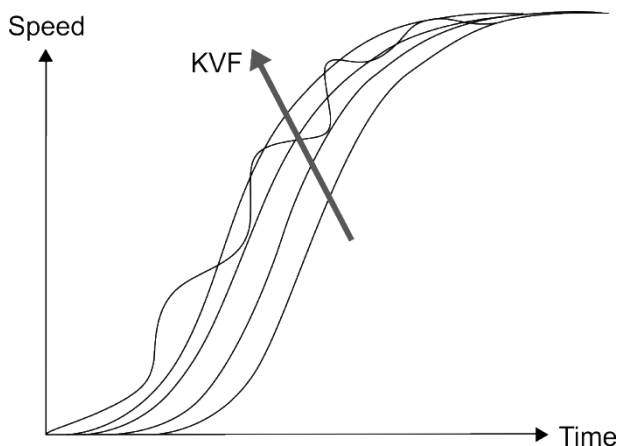
The closer the KVF value is to 1, the more complete the forward compensation. The following error becomes very small. However, a KVF value that is set too high also causes vibration.

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

Speed control unit
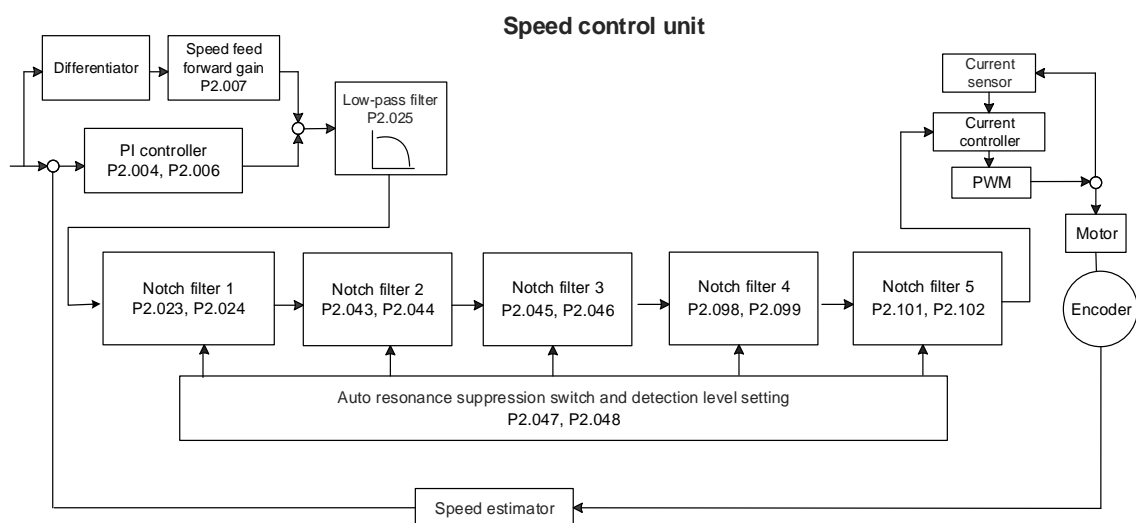
The ASDA-B3 provides two types of resonance suppression: one is the Notch filter and the other is the low-pass filter. See the following diagrams for the results of using these filters.

System open-loop gain with resonance:

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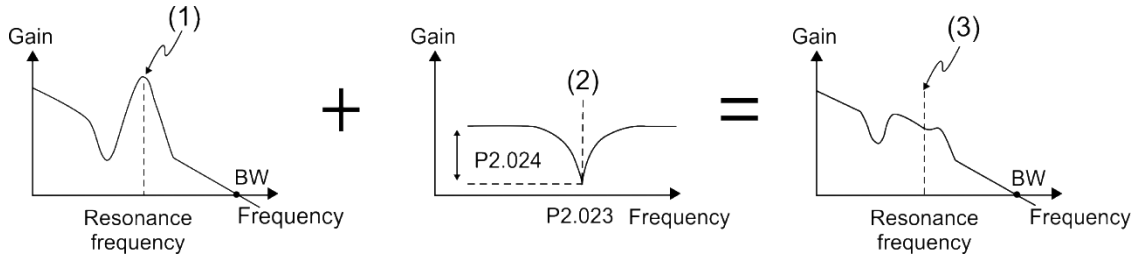
(1) Resonance point; (2) Notch filter; (3) Resonance point suppressed by the Notch filter

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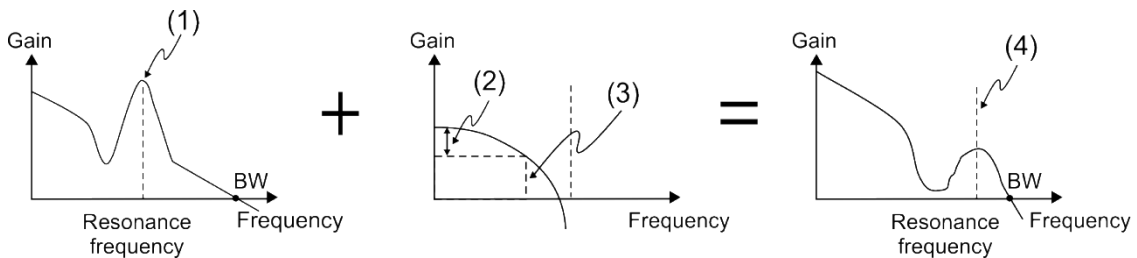
(1) Resonance point; (2) Attenuation rate (-3 dB); (3) Low-pass filter (Cutoff frequency of low-pass filter = 1000 / P2.025 Hz); (4) Resonance point suppressed by the low-pass filter

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

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

System open-loop gain with resonance:

Gain
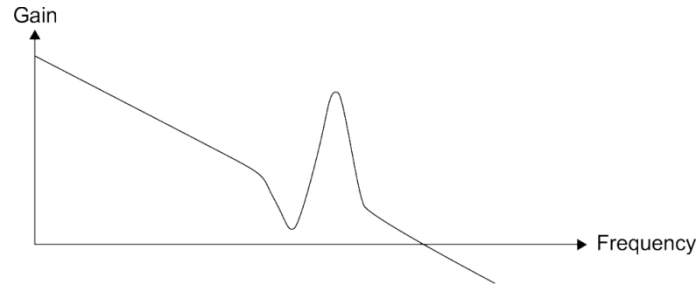
Frequency

When the value of P2.025 is increased from 0, BW becomes smaller, as shown in the following figure. Although it solves the problem of the resonance frequency, the response bandwidth and phase margin are reduced.
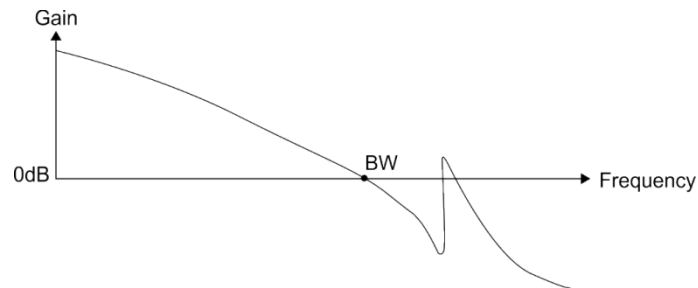
Gain

0dB   BW   Frequency

If you know the resonance frequency, you can suppress the resonance by using the Notch filter. The frequency range of the Notch filter is 50 - 5000 Hz and the suppression strength is 0 - 40 dB. If the frequency does not meet the Notch filter conditions, then using the low-pass filter to reduce the resonance is suggested.

6.4   Torque mode

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

6.4.1   Selecting the Torque command source

External analog voltage and internal parameters are the two Torque command sources.

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

Torque command number	CN1 DI signal		Command source			Content	Range
	TCM1	TCM0					
T1	0	0	Mode	T	External analog signal	Voltage difference between T_REF and GND	-10V to +10V
				Tz	N/A	Torque command is 0	0
T2	0	1	Register parameter			P1.012	-500% to 500%
T3	1	0				P1.013	-500% to 500%
T4	1	1				P1.014	-500% to 500%

■   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 it is in Tz mode, then the command is 0. If there is no need to use the analog voltage for the Torque command, then Tz mode is applicable and can avoid the problem of zero voltage drift. If it is in T mode, then the command is the voltage difference between T_REF and GND. Its input voltage range is -10V to +10V, which means you can adjust the corresponding torque (P1.041).

■   When either one of TCM0 or TCM1 is not 0, the internal parameters become the source for the Torque command. The command is executed after TCM0 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 it is in Speed mode, you can think of it as the command input for the torque limit.

6.4.2   Control structure of Torque mode

The following diagram shows the basic control structure of Torque mode.
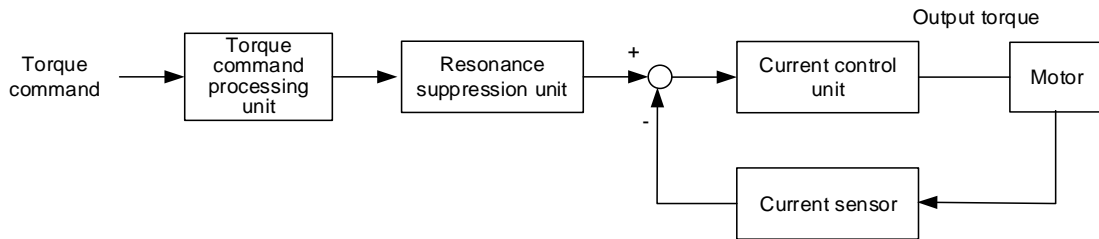
The Torque command processing unit selects the command source (see Section 6.4.1), including the scaling parameter (P1.041) for rotation speed and S-curve parameter for smoothing the torque. The current control unit manages the gain parameters for the servo drive and calculates the current for servo motor in real-time; you can only set this by commands.

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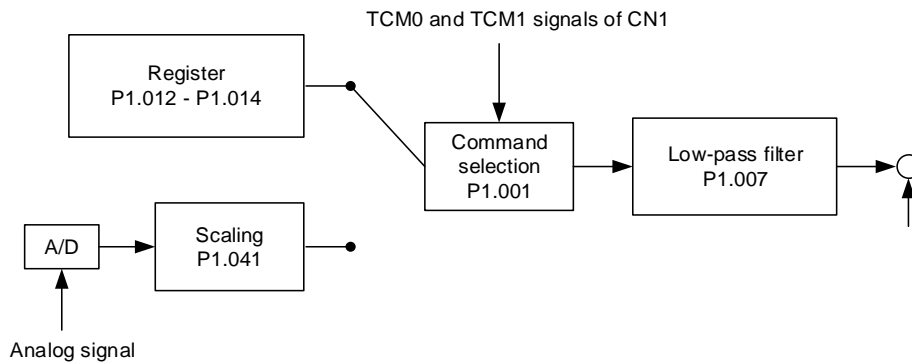
The upper path is the command from the register and the lower one is the command from the external analog voltage that you can select with the status of TCM0 and TCM1, and P1.001 (T or Tz). Adjust the torque with the analog voltage scaling (P1.041) and smooth the response with the low-pass filter (P1.007).

6.4.3 Smooth Torque command

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

Parameter	Function
P1.007	Torque command smoothing constant (low-pass filter)
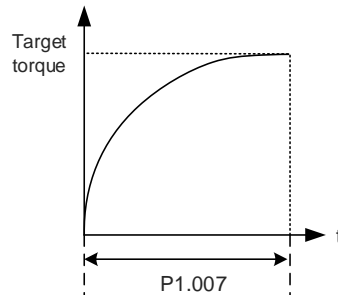
6.4.4 Scaling of the analog command

The Torque command is controlled by the analog voltage difference between T_REF and GND. Adjust the torque slope and its range 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.
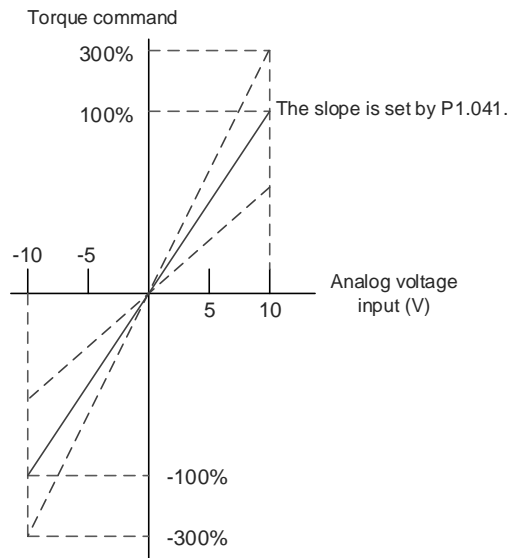
Refer to Chapter 8 for detailed descriptions of the relevant parameter.

Parameter	Function
P1.041	Maximum output for analog Torque command

6.4.5 Timing diagram of Torque mode
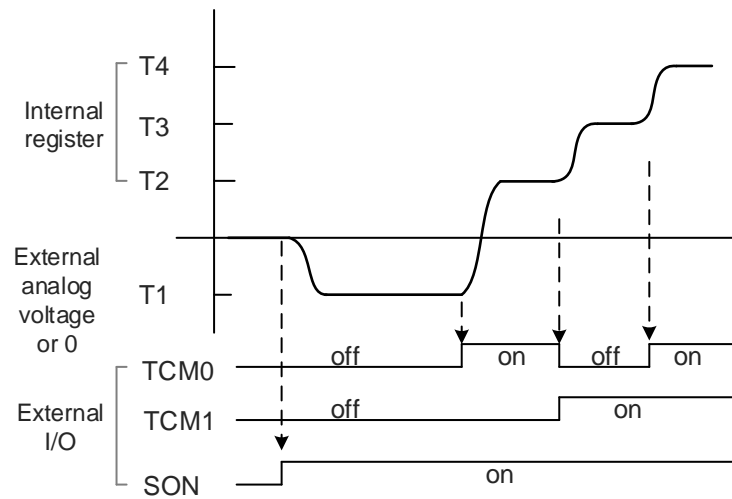
Note:

1. "off" means that DI is off (the circuit is open); "on" means that DI is on (the circuit is closed).

2. When in Tz mode, the Torque command T1 = 0; when in T mode, the Torque command T1 is the external analog voltage input.

3. In Servo On state, the command is selected according to the status of TCM0 and TCM1.

6.5 Dual mode

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

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

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

6.5.1   Speed / Position dual mode

Speed / Position dual mode includes PT-S and PR-S. The command source for PT-S comes
from the external pulse while the source for PR-S comes from the internal parameters (P6.000 -
P7.027). You can control the Speed command with the external analog voltage or the internal
parameters (P1.009 - P1.011). The switch between Speed and Position modes is controlled by
the DI.S-P (0x18) signal. The switch for PT and PR for Position mode is controlled by DI.PT-PR
(0x2B). Thus, you select both Position and Speed commands in PR-S mode with the DI signal.
The timing diagram is shown as follows.
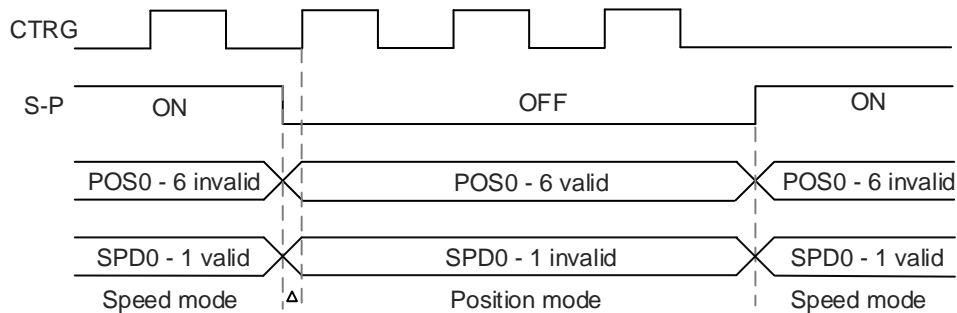
In Speed mode (DI.S-P is on), you select the Speed command with DI.SPD0 and DI.SPD1.
DI.CTRG is not applicable. When switching to Position mode (DI.S-P is off), since the Position
command has not been issued (it waits for the rising edge of DI.CTRG), the motor stops (indicated
by △ in the figure above). When the Position command is controlled by DI.POS0 - DI.POS6 and
triggered by the rising edge of DI.CTRG, the motor operates to the specified position. When
DI.S-P is on, it returns to the Speed mode. Refer to the introduction of single mode for the DI
signal and the selected commands for each mode.

6.5.2   Speed / Torque dual mode

Speed / Torque dual mode includes only S-T. You control the Speed command with the external
analog voltage and 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), and is selected by DI.TCM0 and DI.TCM1.
The switch between Speed and Torque modes is controlled by the DI.S-T (0x19) signal.
The timing diagram is shown as follows.
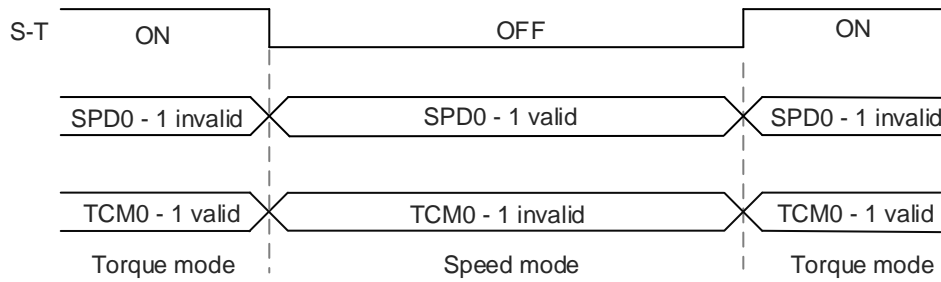
In Torque mode (DI.S-T is on), you select the Torque command with DI.TCM0 and DI.TCM1.
When switching to Speed mode (DI.S-T is off), you select the Speed command with DI.SPD0
and DI.SPD1. The motor operates according to the Speed command. When DI.S-T is on,
it returns to the Torque mode. Refer to the introduction of single mode for the DI signal and the
selected commands for each mode.

6.5.3 Torque / Position dual mode

Torque / Position dual mode includes PT-T and PR-T. The command source for PT-T comes from the external pulse while the source for PR-T comes from internal parameters (P6.000 - P7.027). You control the Torque command with the external analog voltage or the internal parameters (P1.012 - P1.014). The switch between Torque and Position modes is controlled by the DI.T-P (0x20) signal. The switch for PT and PR for Position mode is controlled by the DI.PT-PR (0x2B) signal. Thus, you select both Position and Torque commands in PR-T mode with the DI signal. The timing diagram is shown as follows.
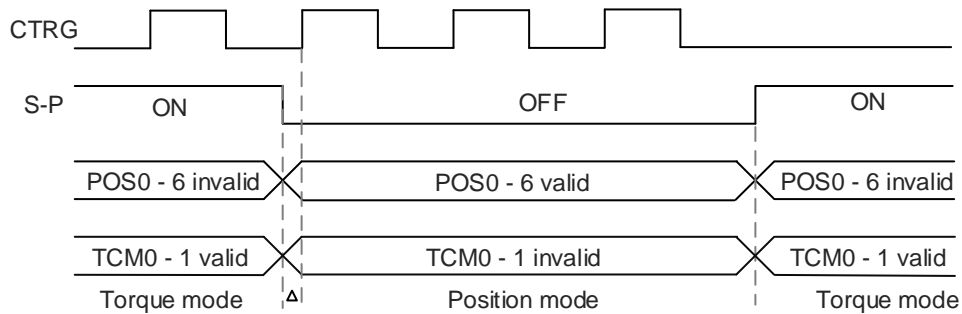
In Torque mode (DI.T-P is on), you select the Torque command with DI.TCM0 and DI.TCM1. DI.CTRG is not applicable. When switching to Position mode (DI.T-P is off), since the Position command has not been issued (it waits for the rising edge of DI.CTRG), the motor stops (indicated by △ in the figure above). When the Position command is controlled by DI.POS0 - DI.POS6 and triggered by the rising edge of DI.CTRG, the motor operates to the specified position. When DI.T-P is on, it returns to the Torque mode. Refer to the introduction of single mode for the DI signal and the selected commands for each mode.

6.6   Others

6.6.1   Applying the speed limit

The maximum speed in each mode (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 descriptions.

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

Speed limit function disabled (P1.002)	Speed limit function enabled (P1.002)
SPD0 - 1 invalid	SPD0 - 1 valid

Command source selection of speed limit
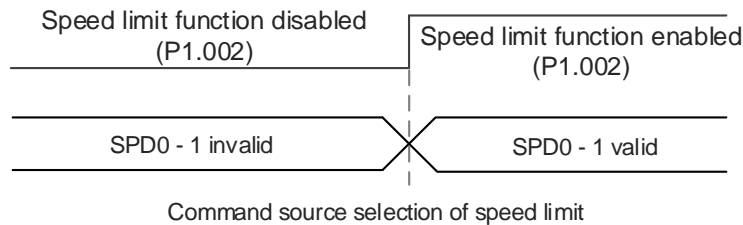
6.6.2   Applying the torque limit

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 descriptions.

You can use the torque limit in Position mode (PT and PR) or Speed mode (S) to limit the motor torque output. If you are using the external pulse in Position mode or using the external analog voltage in Speed mode, the DI signals are available and you can set TCM0 and TCM1 for the torque limit command (internal parameters). If not, use the analog voltage input for the Torque limit command. When you set P1.002 (disable / enable torque limit function) to 1, the Torque limit function is enabled. The timing diagram is shown as follows.

Torque limit function disabled (P1.002)	Torque limit function enabled (P1.002)
TCM0 - 1 invalid	TCM0 - 1 valid

Command source selection of torque limit
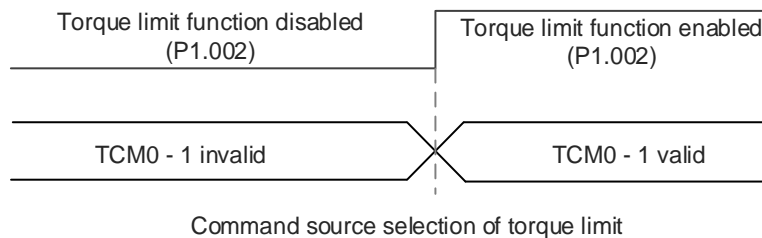
6.6.3 Analog monitoring

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.

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	Offset adjustment for analog monitor output (Ch1)
P4.021	Offset adjustment for analog monitor output (Ch2)

Example:

Specify a motor speed of 1,000 rpm, which corresponds to analog voltage output of 8V with the maximum speed of 5,000 rpm. The setting is as follows:

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

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

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

Voltage drift

When voltage drift occurs, the voltage level defined as zero voltage is different from the set zero point. To fix this problem, 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 approximately 10 bits, which is equivalent to 13 mV/LSB.

Motion Control

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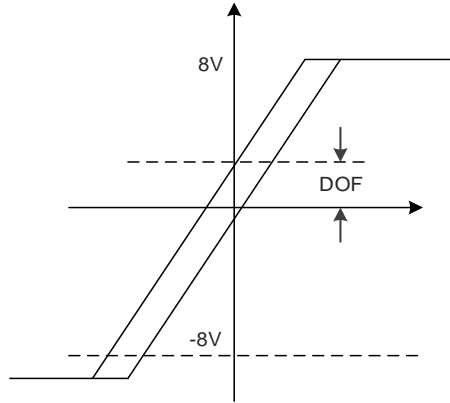
This chapter introduces internal motion commands in the ASDA-B3 in PR mode. In this mode, commands are generated based on the internal command of the servo drive. Various motion commands are available, including Homing, Speed, Position, Write, Jump, and high-speed position capture (Capture). This chapter contains detailed description of each command type.

7.1   PR mode description

In PR mode, the servo drive automatically generates the motion commands and saves all parameter settings in the servo drive parameter file. Thus changing parameter values simultaneously changes the PR commands. The ASDA-B3 provides 100 path setting sets, which include the homing method, Position command, Speed command, Jump command, Write command, and Index Position command.

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

PR path	Setting paramters	Path property	Path data
PR#0	→	P6.000	P6.001
PR#1	→	P6.002	P6.003
PR#2	→	P6.004	P6.005
⋮		⋮	⋮
PR#50	→	P7.000	P7.001
⋮		⋮	⋮
PR#99	→	P7.098	P7.099
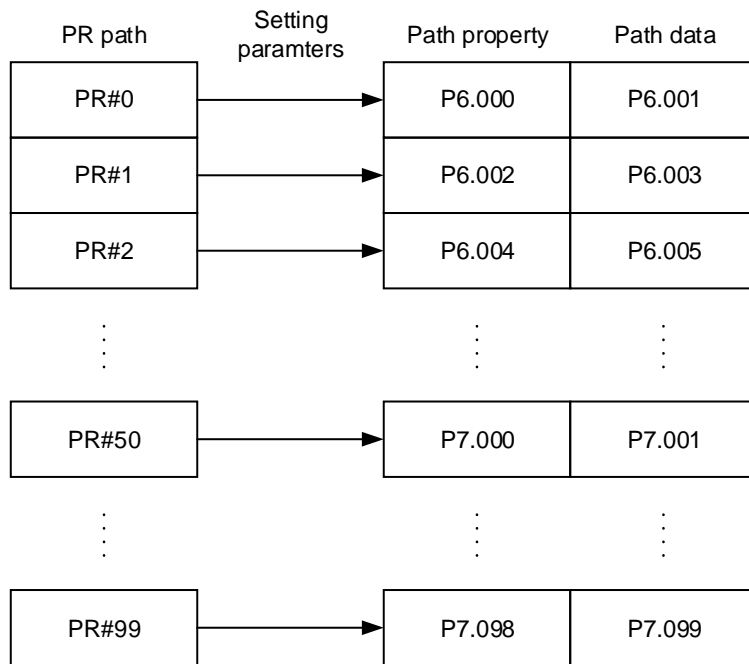
Figure 7.1.1 Setting parameters for each PR path

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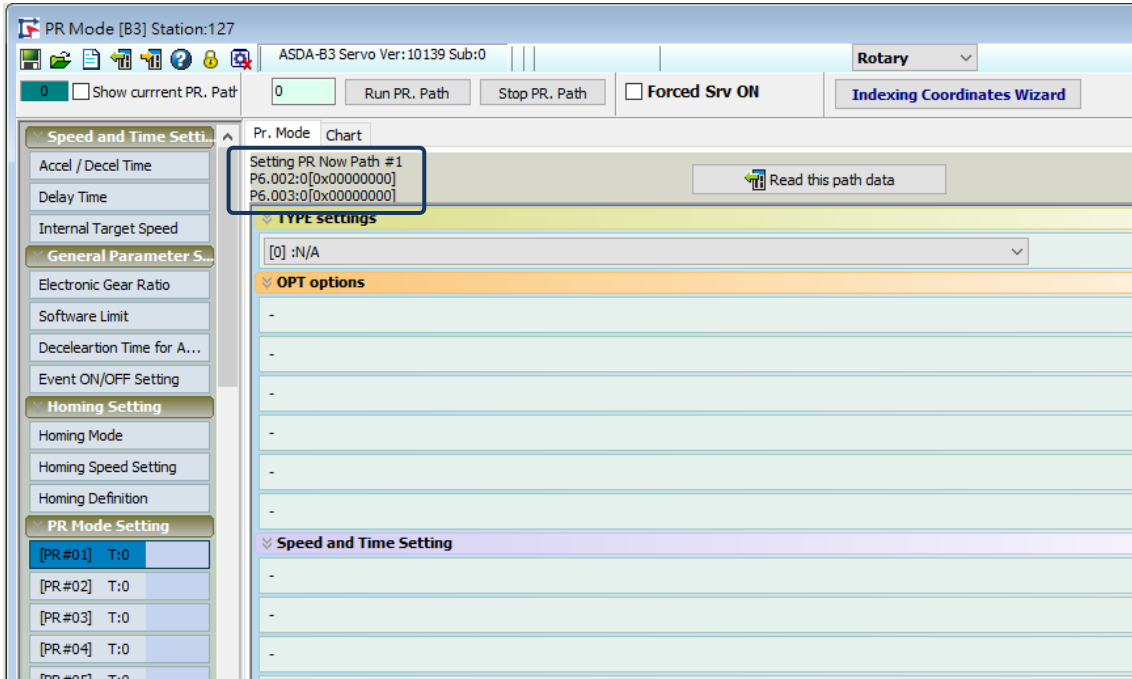
Figure 7.1.2 PR Mode interface in ASDA-Soft

Table 7.1.1 Example of PR#1 property and data content

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

Note: TYPE: Control command mode

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

ASDA-Soft version V6 provides an editing interface for PR diagrams. (see Figure 7.1.3).

It is easier to set PR paths in ASDA-Soft, where you can set the options of command triggering, command types, and other properties.
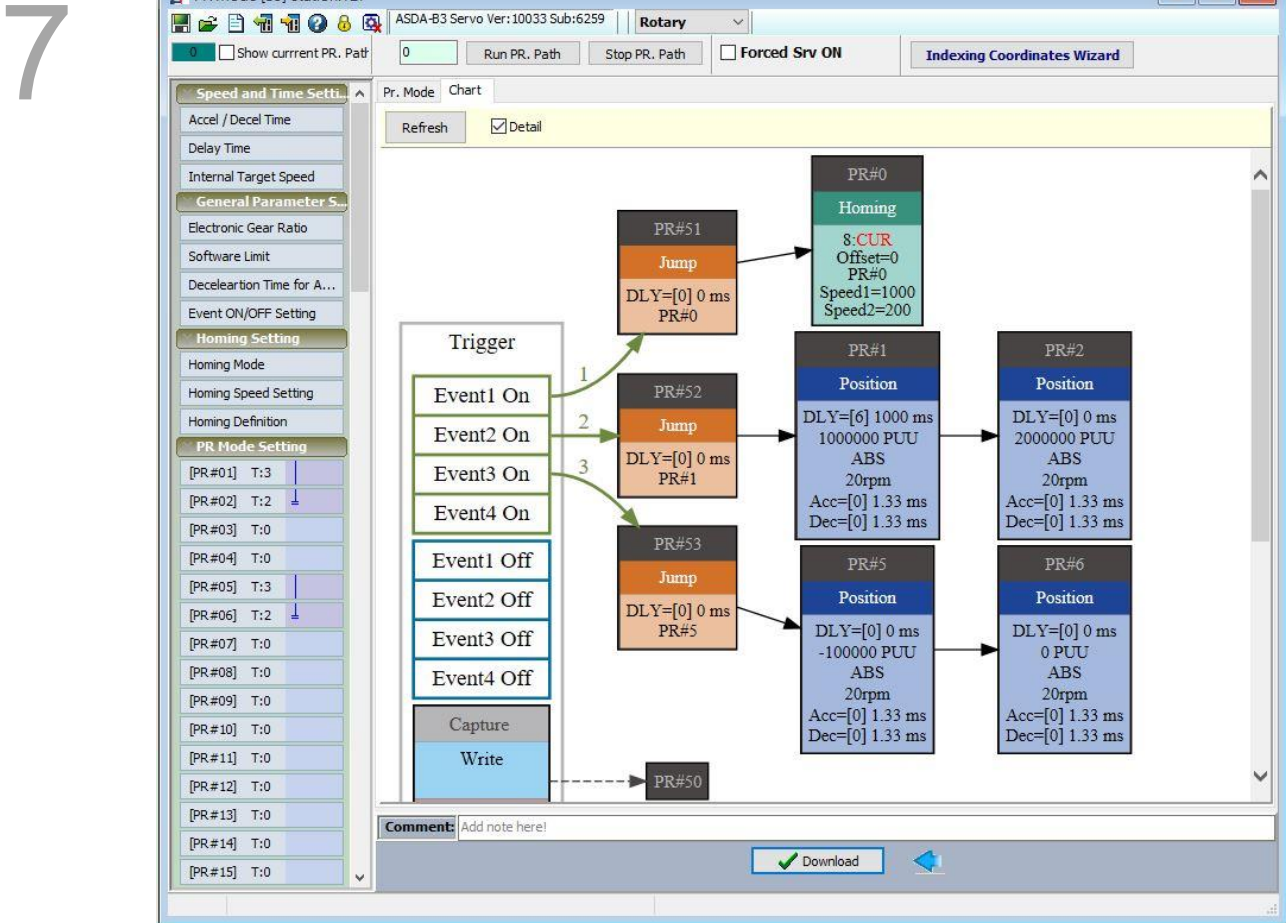
Figure 7.1.3 PR Diagram display in ASDA-Soft

7.1.1 Shared PR parameters

ASDA-B3 provides 16 acceleration and 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 target speed setting from P5.060, when you change the value of P5.060, those PR commands' target speed are also changed. Please be aware of this when setting PR paths so as to avoid any danger or damage to the machine.

ASDA-Soft also provides a user-friendly interface for this shared PR parameter function
(see Figure 7.1.1.2). In these data, the acceleration or deceleration time is set based on the
length of time for 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, when the target speed for the motion
command is 3000 rpm, then the required duration is 50 ms. If the target speed for the motion
command is 1500 rpm, then the acceleration time is 25 ms. The acceleration or deceleration
time is a fixed slope, so the slope does not change when you change parameter values.

Figure 7.1.1.1 Shared parameter data for PR paths
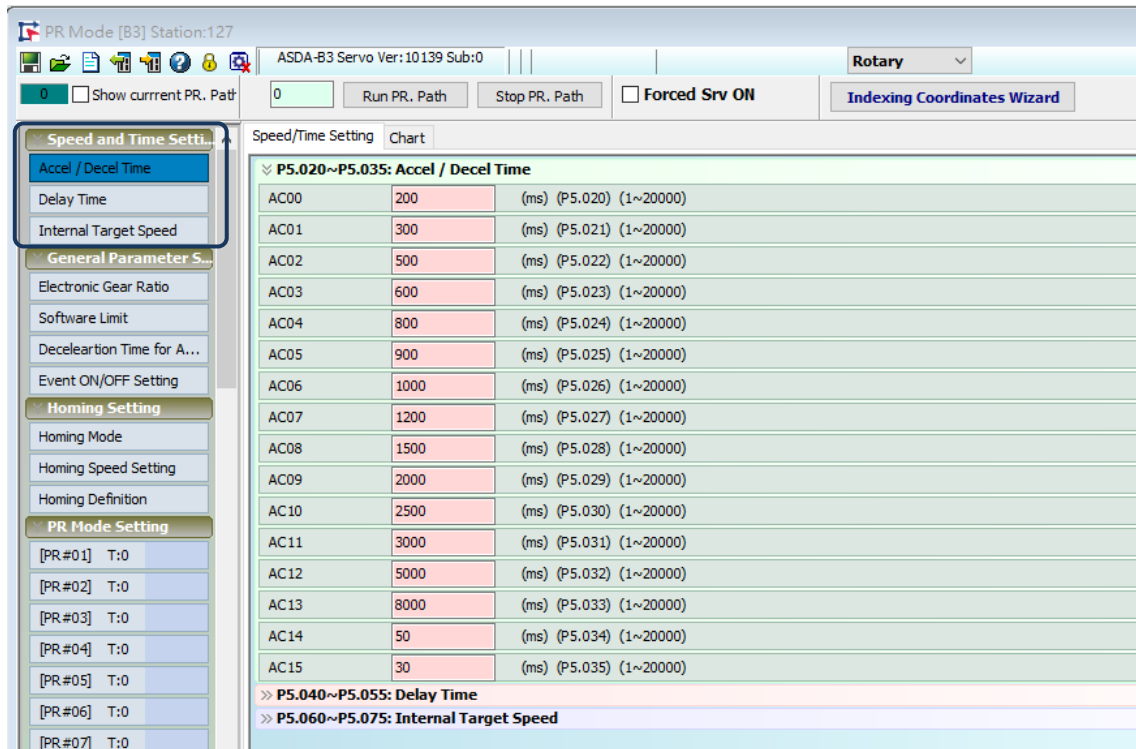
Figure 7.1.1.2 ASDA-Soft interface for shared PR parameter data

7.1.2   Monitoring variables of PR mode

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

1.   Command position (PUU): monitoring variable code 001, simplified as Cmd_O (Command Operation). The target position of the motion command generated per scan cycle during servo operation (updated every 1 ms).

2.   PR command end register: 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 to PR command end register.

3.   Feedback position (PUU): monitoring variable code 000, simplified as Fb_PUU (Feedback PUU). The feedback position (coordinates) for the motor.

4.   Position error (PUU): monitoring variable code 002, simplified as Err_PUU (Error PUU). The deviation between the command position (PUU) and the feedback position (PUU).

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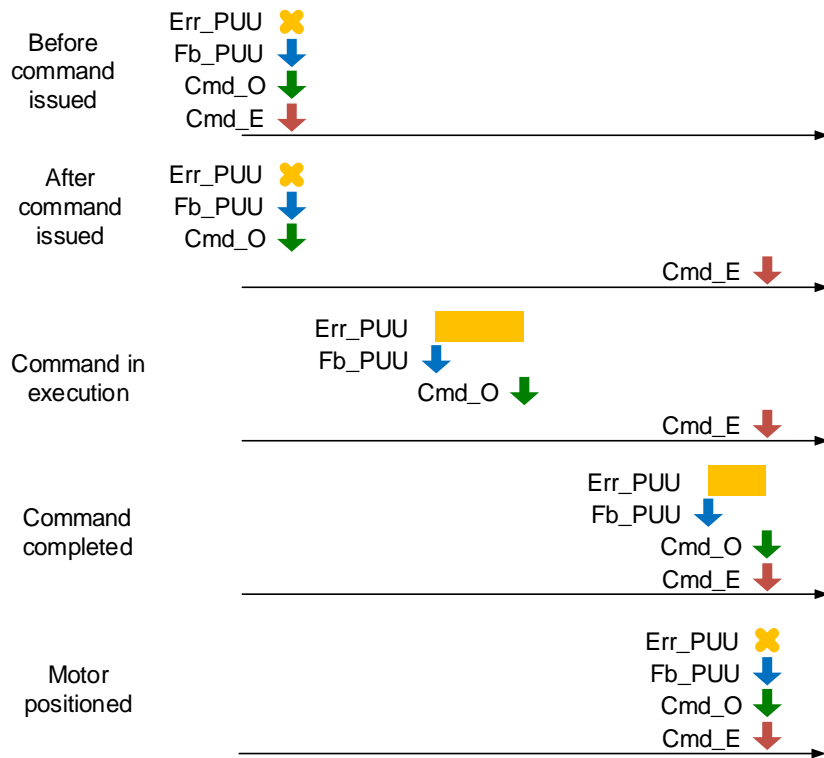
Figure 7.1.2.1 Timing diagram for PR mode monitoring variables

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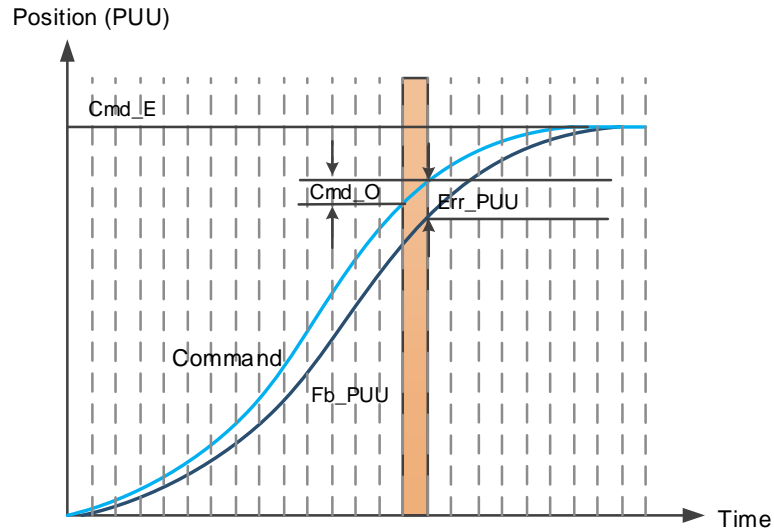
Figure 7.1.2.2 Monitoring variables status when a command is executed in PR mode

You can use digital input (DI) to call PR paths and digital output (DO) to monitor PR paths (refer to Table 8.1 and 8.2 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 execution is complete, DO.Cmd_OK [0x15] is set to on.

When the motor reaches its target position, DO.TPOS [0x05] is set to on. Then, after the PR Position command completes and motor reaches the target position, both DO signals are on and the servo outputs the MC_OK [0x17] signal to signify that it has completed this PR path. The operation is as shown in Figure 7.1.2.3. If you have set a delay time in this PR and the motor reaches the target position, then DO.TPOS [0x05] is set to on.

When the delay time is over, DO.Cmd_OK [0x15] (PR position command complete) is set to on. After both of the above mentioned DO signals are on, the servo outputs the MC_OK [0x17] signal to signify that it has completed this PR path, as shown in Figure 7.1.2.4.

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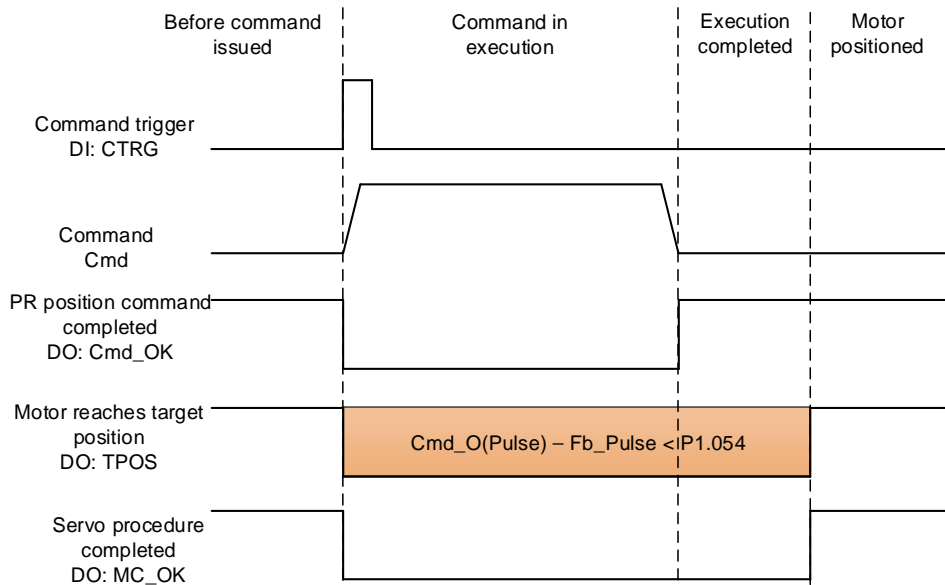
Figure 7.1.2.3 Operation of DI/DO signals in PR mode
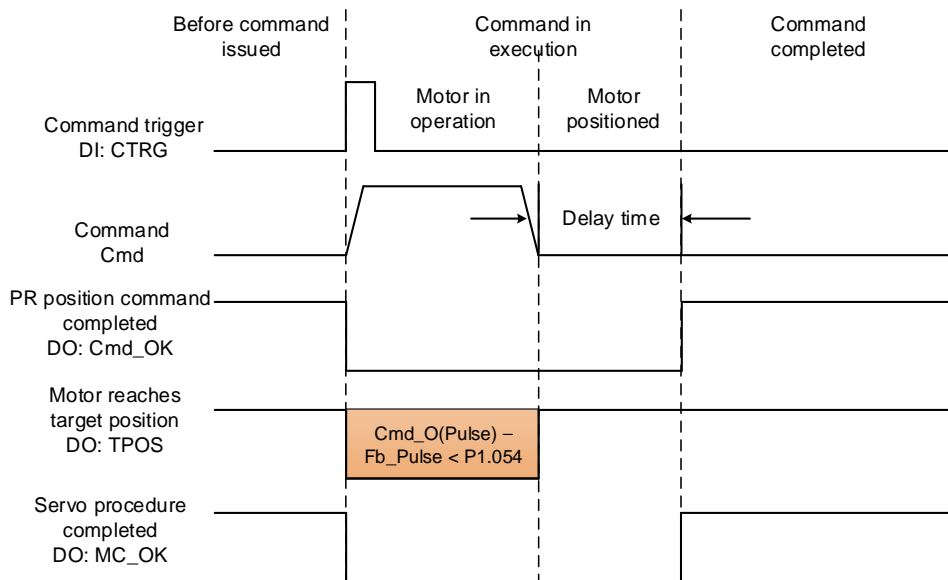
Figure 7.1.2.4 Operation of DI/DO signals in PR mode (including delay time)

7.1.3   Motion Control commands

The ASDA-B3 provides 100 path setting sets, which include the homing method, Speed command, Position command, Jump command, Write command, and Index Position command. The following sections detail each command type.

7.1.3.1   Homing methods

The ASDA-B3 provides 11 homing methods in the PR mode, including 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 limit signal as the trigger, with more than 30 combinations available. The homing method is specified by P5.004 and the homing definition is determined by P6.000. The following lists the function of each bit.

P5.004	Homing methods		Address: 0508H 0509H
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 - 0x012A
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

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

Definition of each setting value:

U	Z	Y	X
Reserved	Limit setting	Z pulse setting	Homing method
	0 - 1	0 - 2	0 - 8
-	-	Y = 0: return 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: return 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

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U	Z	Y	X
	-	-	X = 8: define current position as the origin
	When reaching the limit: Z = 0: show error Z = 1: reverse direction	Y = 0: return 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 - 0xFFFFFF6F
Format:	HEX	Data size:	32-bit

Settings:

Homing definition:

High bit

⌐0020

D C B A

Low bit

L052A

U Z YX

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

■ YX: PATH: Path type

0x00: Stop: homing complete and stop

0x01 - 0x63: Auto: homing complete and execute the specified path (Path#1 - Path#99)

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

0: do not execute homing

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

The PR Homing mode includes the function for setting the origin offset. You can define any point on the coordinate axis as the reference origin, which does not have to be 0. Once you define the reference origin, the system can create the coordinate system for the motion axis. See Figure 7.1.3.1.1. The coordinate for the reference origin is 2000 (P6.001 = 2000). The motor passes by the reference origin and then stops at coordinate 1477. From the coordinate system that it created, the system automatically calculates the position of 0 point. As soon as the PR motion command is issued, the motor moves to the specified position.
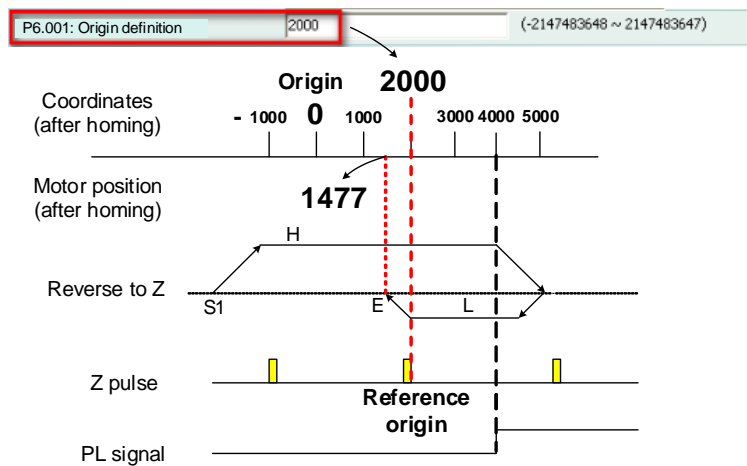
Figure 7.1.3.1.1 Origin definition

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

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 and 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.

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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 - 2000.0	1 - 20000	-	-
Format:	DEC	DEC	-	-
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-

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 - 500.0	1 - 5000	-	-
Format:	DEC	DEC	-	-
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-

Settings:

The second speed setting for low speed homing.

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

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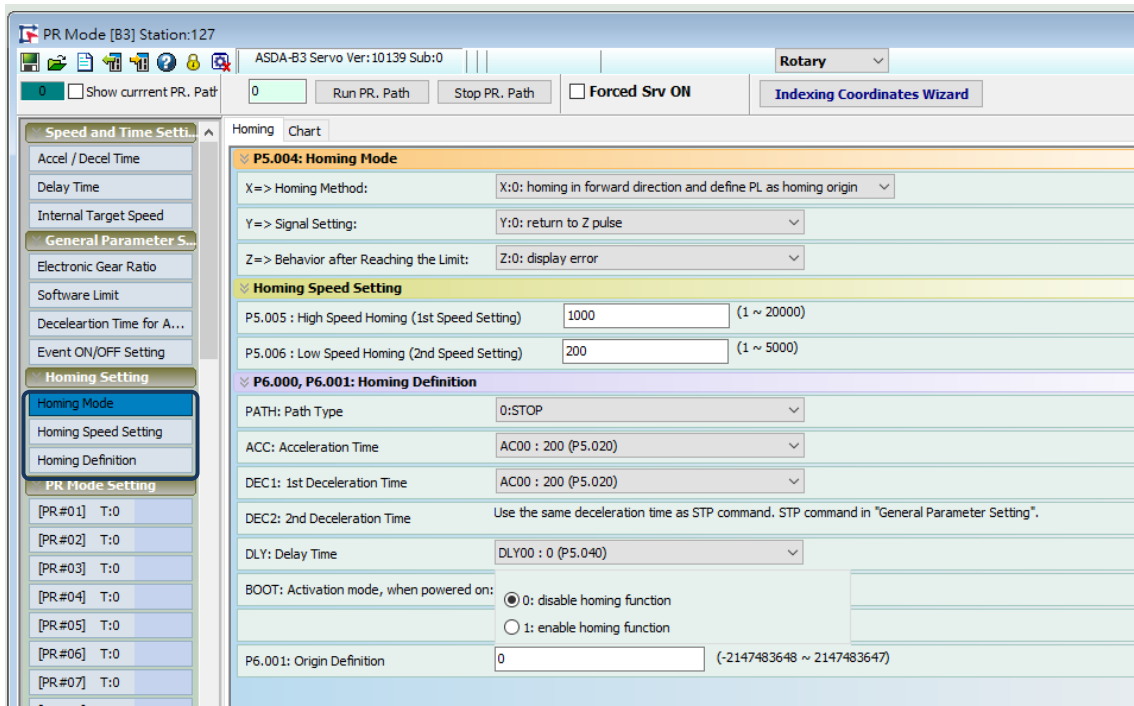
Figure 7.1.3.1.2 Homing screen in ASDA-Soft

The following describes the homing methods supported by the ASDA-B3. 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. When the limit is detected, you can choose whether or not to look for the Z pulse and use it as the reference origin. The searching result is the same regardless of where the start point is. The ASDA-B3 always looks for the set reference point to reset the coordinates.
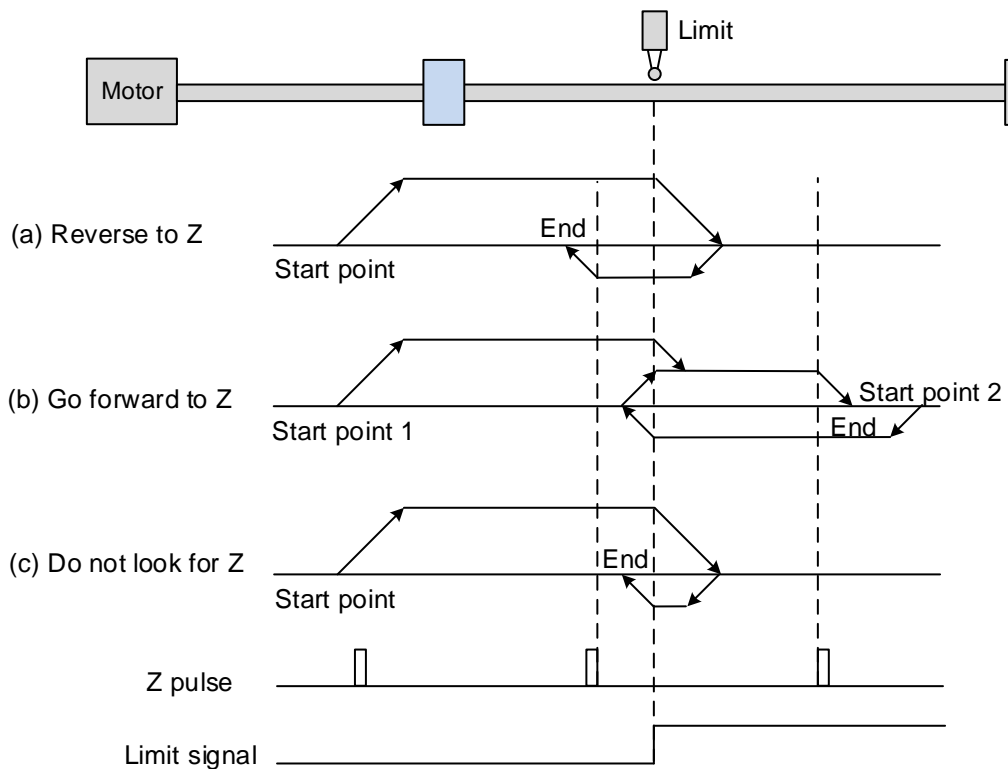
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(a) If you set the servo to look for the Z pulse in the reverse direction, the servo operates at high speed (first speed setting) and then decelerates once it reaches the limit (rising-edge triggered). Then the servo switches to low speed (second speed 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, it first operates at high speed (first speed setting) and then decelerates once reaching the rising-edge limit signal. Then the servo switches to low speed (second speed setting) and returns to look for the rising-edge signal. Once 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 signal as the reference origin.

    You can choose whether or not to use the Z pulse as the reference origin after the ORG signal is detected.
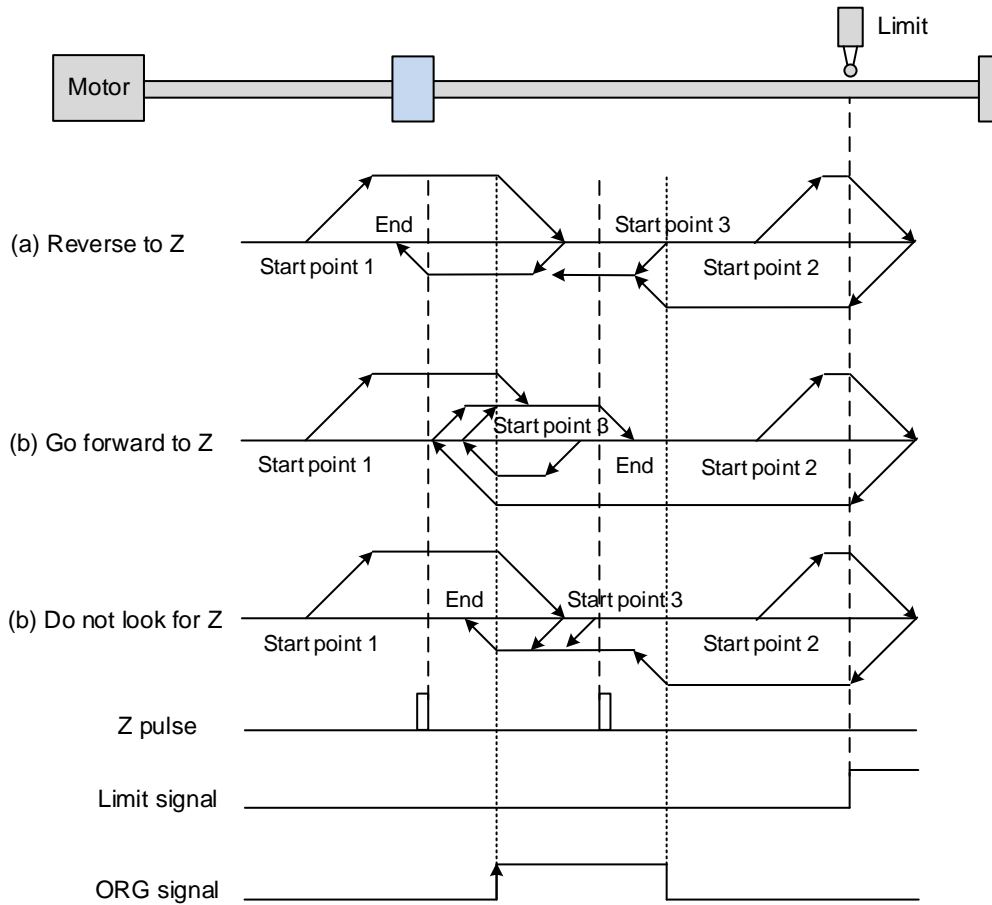
(a) If you set the servo to look for the Z pulse in the reverse direction, when the ORG signal at the start point is un-triggered (low, Start point 1), the servo operates at high speed (first speed setting) and then decelerates once it reaches the ORG signal (rising-edge triggered). Then it switches 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 it reaches the limit switch. If you set the servo to reverse direction, it operates in the reverse direction to reach the home sensor (ORG). Once reaching the home sensor (ORG), the servo 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.

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If the ORG signal at the start point is triggered (high, Start point 3), the servo reverses with low speed (second speed setting) and after the ORG signal switches to low, it continues to look for the Z pulse. Once 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) mentioned above), refer to the timing diagram above.

3. Referencing the Z pulse.

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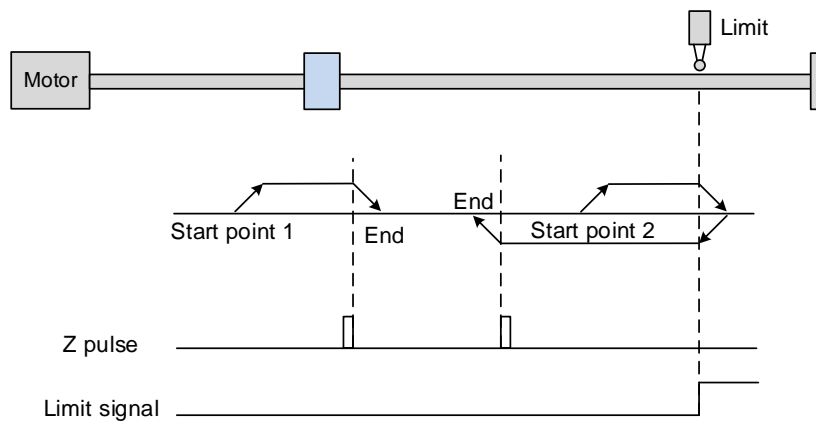
4.　Referencing the falling edge of the ORG signal.

This method uses the falling-edge signal of the home sensor as the reference origin.

You can choose whether or not to use the Z pulse as the reference origin after the ORG signal is detected.
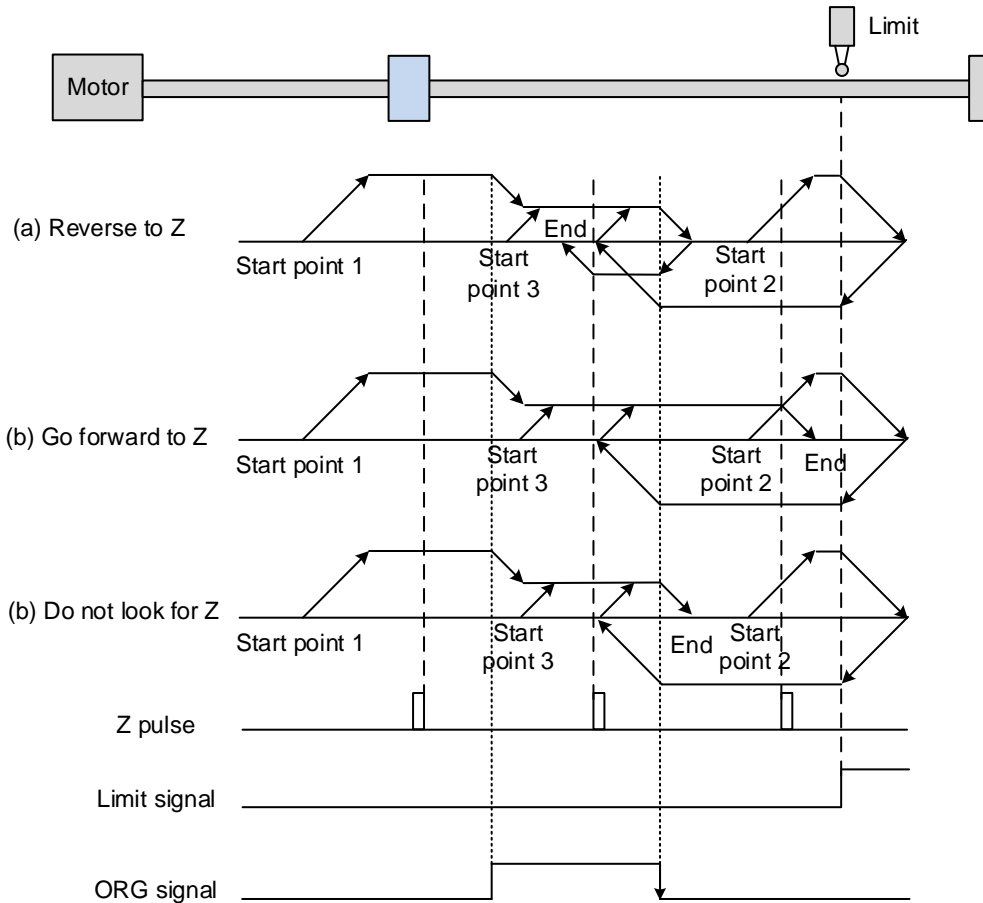
(a) If you set the servo to to look for the Z pulse in the reverse direction, when the ORG signal at the start point is un-triggered (low, Start point 1), the servo operates at high speed (first speed setting) until reaching the rising edge of the ORG signal. Then it decelerates and switches to low speed (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 it reaches the limit switch. If you set the servo to reverse direction, it operates in reverse direction to reach the home sensor (ORG). Once reaching the home sensor (ORG), the servo decelerates and operates at low speed (second speed setting) in the forward direction to reach the falling edge of the ORG signal. 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 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) mentioned above), refer to the timing diagram above.

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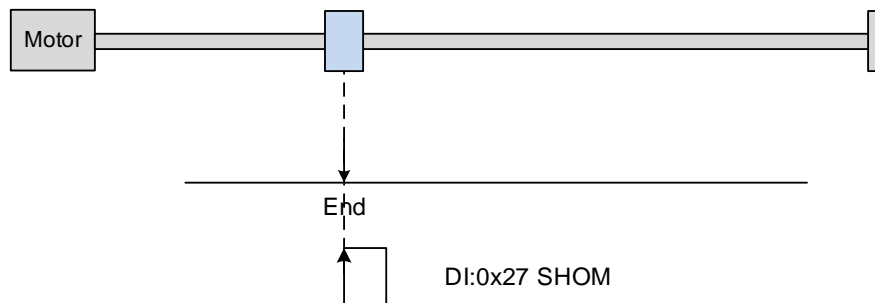
6.   Referencing the torque limit.

This method uses the motor's stop position as the origin by referring to: the limit on the mechanism, the torque level setting (P1.087), and the retaining time (P1.088). You can also choose whether to use the Z pulse as the reference origin.
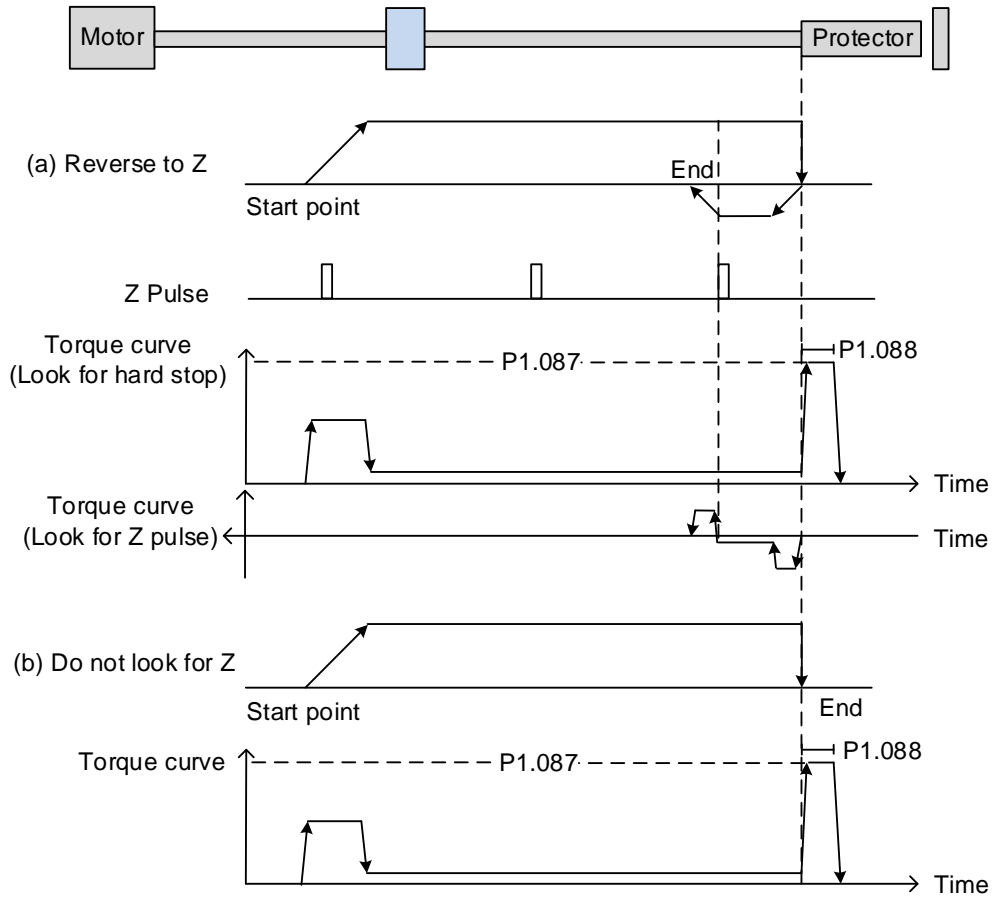
(a)   If you set the servo to look for the Z pulse in the reverse direction, the servo operates at high speed (first speed setting) and outputs a greater current to counter the external force once it touches the protector. When the motor torque reaches the torque detection level (P1.087) and the output duration is longer than the level reached timer setting (P1.088), the servo operates in the reverse direction to look for the Z pulse at low speed (second speed setting). Once 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, it operates at high speed (first speed setting) until touching the protector. Then the servo outputs a greater current to counter the external force. When the motor torque reaches the torque detection level (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 maximum torque limit setting (P1.087), the great impact may cause damage to the machine.

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The following tables list the parameters for the torque limit (P1.087) and the torque limit time (P1.088).

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

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 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 to return 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: set P1.087 to 50%, then 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 - 2000
Format:	DEC	Data size:	16-bit

Settings:

The setting of the level reached timer for the torque homing mode. Refer to P1.087 for the timing diagram of torque homing mode.

As mentioned in Section 7.1.2, the PR mode provides four monitoring variables for you to monitor the servo commands and feedback status. These are Command position PUU (Cmd_O), PR command end register (Cmd_E), Feedback position PUU (Fb_PUU), and Position error PUU (Err_PUU). Before homing completes, the command end register (Cmd_E) cannot be calculated because the coordinate system can only be created after homing is complete, and the target position remains unknown after the Homing command is issued. This is why the status of each monitoring variables is different during homing. In Homing command's default setting, the contents of Cmd_E and Cmd_O are identical. After the servo finds the reference origin and creates the coordinate system, it sets the content of Cmd_E to the coordinate of the reference origin. However, once the servo finds the reference origin, it still requires some distance for motor to decelerate to a stop. Meanwhile, Cmd_O continues to issue commands. If no other PR commands are issued after homing (other than the Position command), the contents of the final command position (Cmd_O) and command end position (Cmd_E) will be different. See Figure 7.1.3.1.3.
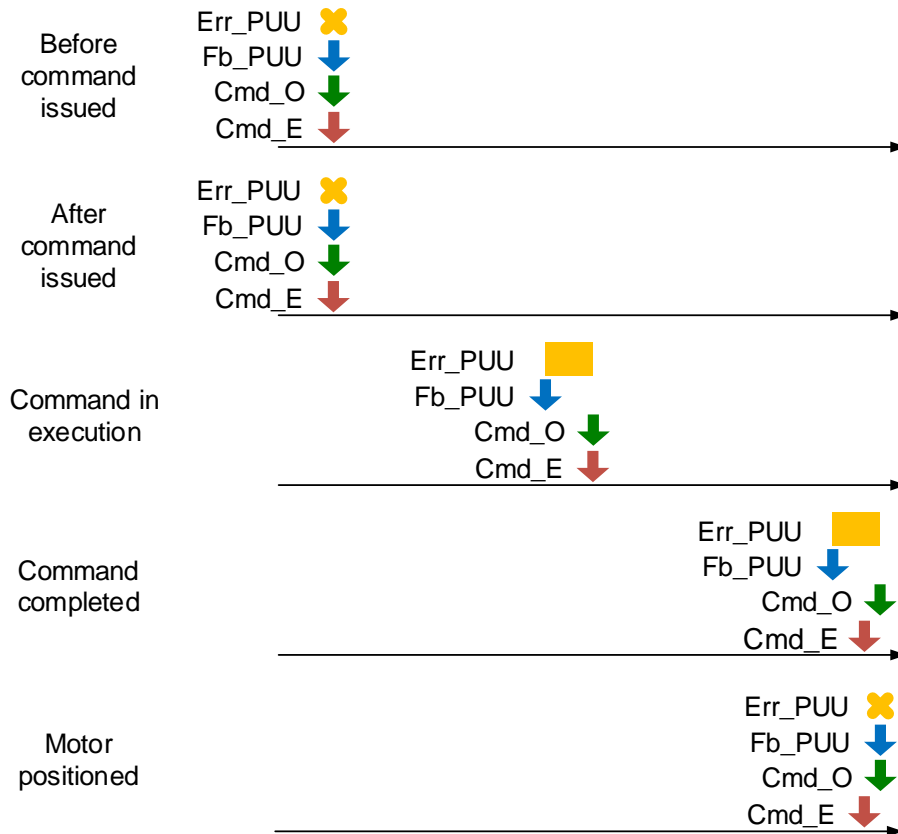
Figure 7.1.3.1.3 Homing mode and monitoring variables

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 in the PR mode screen in ASDA-Soft. See Figure 7.1.3.2.1.

■   INS is an interrupt command that interrupts the previous motion command. Refer to Section 7.1.6 for more details.

■   AUTO is a command that automatically loads and executes the next PR path when the current PR path completes. You can set the target speed with two unit options, 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 PR parameters. The software calculates and displays the required duration for accelerating from 0 to the target speed.

■   DLY is the delay time that is determined by the shared PR parameters. It delays the command; in other words, the delay time is the time to wait after the target speed command completes.

See Figure 7.1.3.2.2 for the effects of the parameters for the PR mode speed control. Table 7.1.3.2.1 shows the bit functions when speed control is in operation.
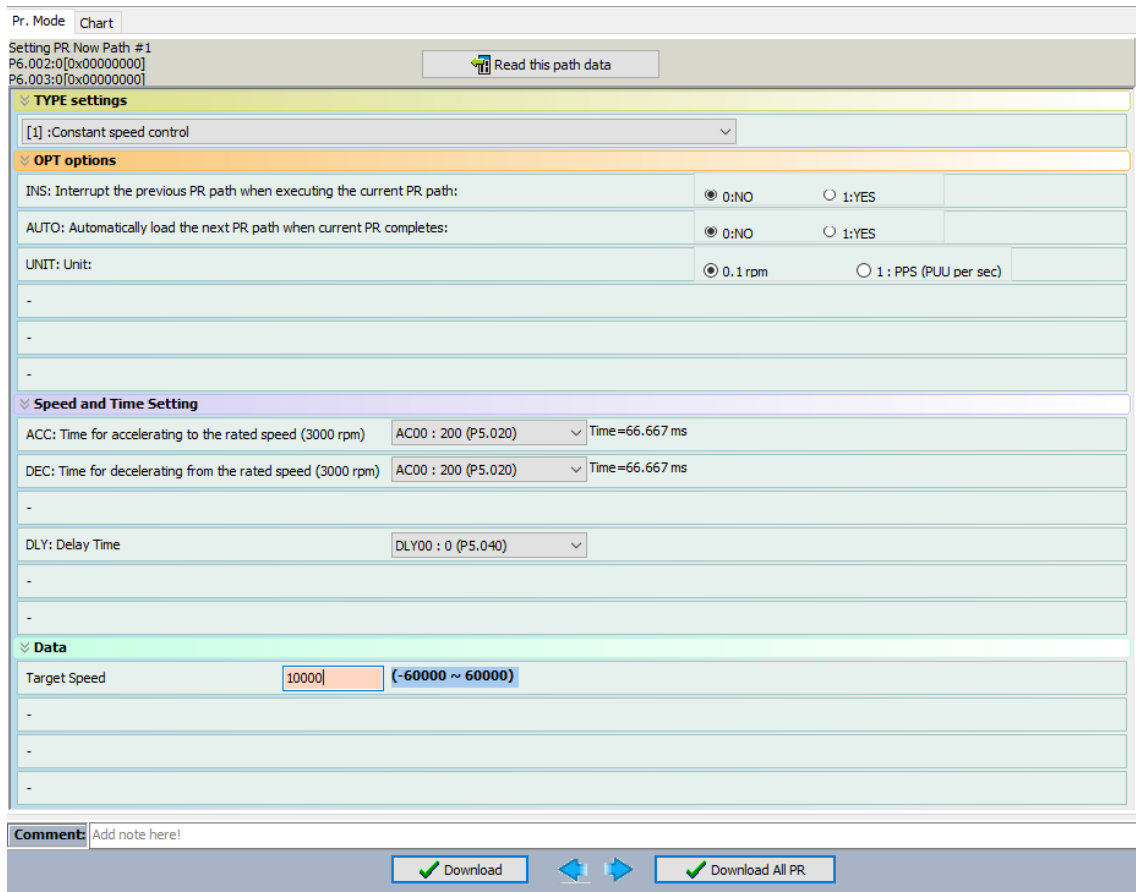
Figure 7.1.3.2.1 PR mode Speed control screen in ASDA-Soft

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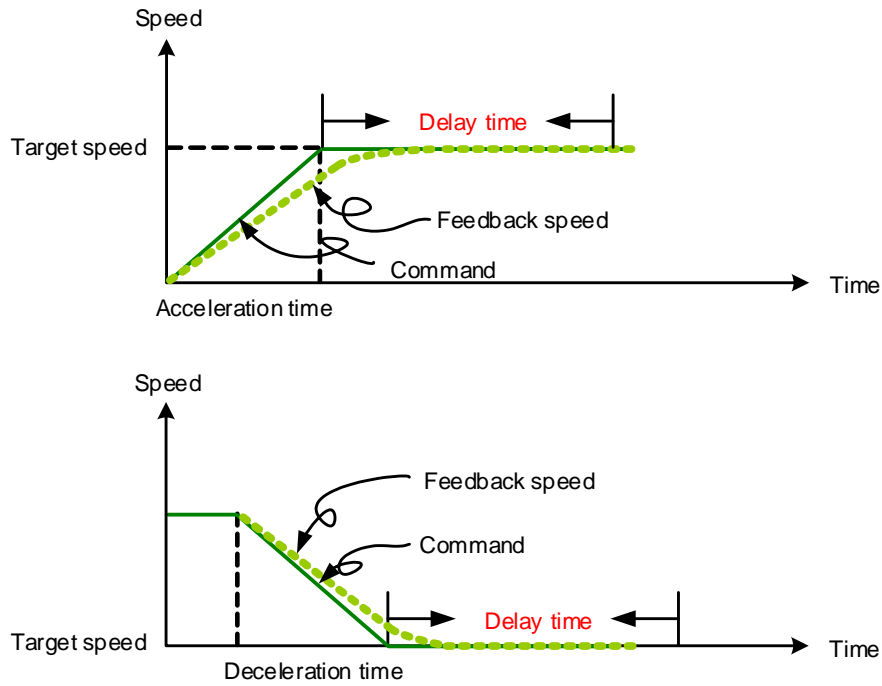
Figure 7.1.3.2.2 Parameters for PR mode speed control

Table 7.1.3.2.1 Bit functions of PR speed control

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

Note:

1. Y: OPT: option

BIT	3	2	1	0
Command type	-	UNIT	AUTO	INS

   INS: Interrupt command that interrupts the previous motion command.

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

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

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

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

7.1.3.3 Position command

The PR mode includes a position control function. There are two command types: Type 2 and Type 3. If you choose the Type 2 command, the execution stops once the command is complete. If you choose the Type 3 command, the next PR path is automatically executed. Use the same method to set the value for these types of commands in ASDA-Soft. See Figure 7.1.3.3.1.

■ INS is an interrupt command that interrupts the previous motion command. Refer to Section 7.1.6.

■ OVLP is an overlap command 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.

■ ACC / DEC is the acceleration / deceleration time determined by the shared PR parameters. The software calculates and displays the required duration for accelerating from 0 to the target speed.

■ SPD is the target speed determinedby the shared PR parameters. You can choose whether it is multiplied by 0.1.

■ DLY is the delay time determinedby the shared PR parameters and 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 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 control is in operation.

Pr. Mode | Chart

Setting PR Now Path #1
P6.002:1[0x00000001]
P6.003:10000[0x00002710]   🔲 Read this path data

⌄ 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

-   ○ 11: CAP High Speed Position Capturing, CMD = Captured + 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!

✔ Download   ⬅ ➡   ✔ Download All PR

Figure 7.1.3.3.1 PR mode Position control screen in ASDA-Soft
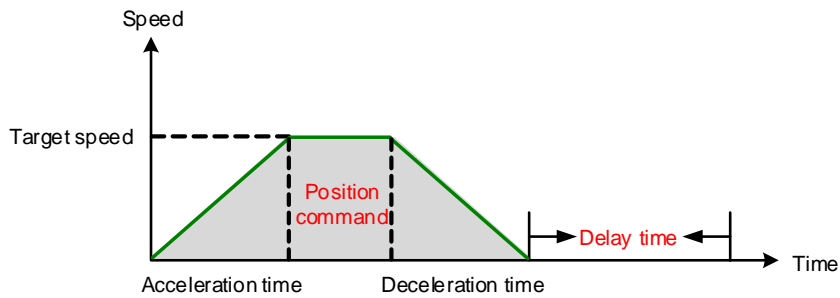
Figure 7.1.3.3.2 Parameters for PR mode position control

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

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

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

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

4. High-speed position capturing command (CAP): when executed, the target position is the last position acquired by the Capture function plus the position command value. Refer to Section 7.2.2 for more on the high-speed position capturing function. In the following example, a high-speed capturing command with the value of 60000 PUU is inserted in the previous PR path. The target position is the captured position value (10000 PUU) plus the relative position command (60000 PUU), which equals 70000 PUU on the coordinate axis. The target position specified by the original command is omitted.
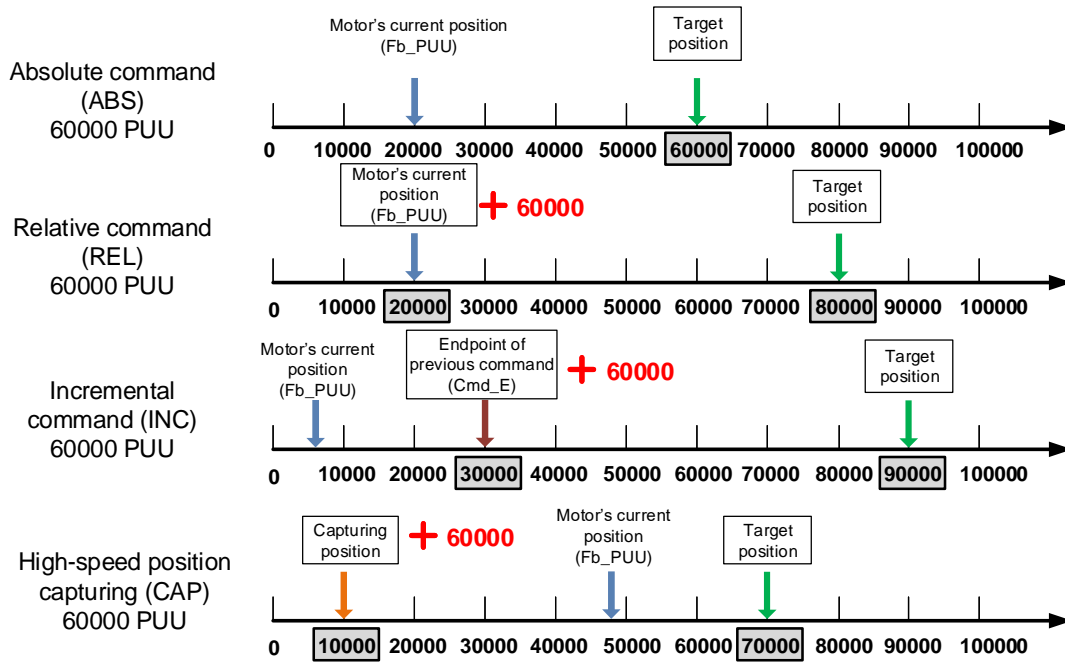
Figure 7.1.3.3.3 Four types of Position command

Table 7.1.3.3.1 Bit functions of PR position control

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

Note:

1. Y: OPT: option

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

   INS: Interrupt command that interrupts the previous motion command.

   OVLP: allow overlapping of the next command.

   CMD: Position command selection.

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

3. A: SPD: target speed, set by P5.060 - P5.075.

4. 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 PR path number to jump to in the PR mode screen in ASDA-Soft (see Figure 7.1.3.4.2).

■ INS is an interrupt command that interrupts the previous motion command. Refer to Section 7.1.6 for more details.

■ DLY is the delay time that is determined by the shared PR parameters. Once a Jump command is issued, the servo drive starts counting the delay time.

■ Available target PR numbers are PR#00 - PR#99.

Table 7.1.3.4.1 shows the bit functions when a Jump command is in operation.
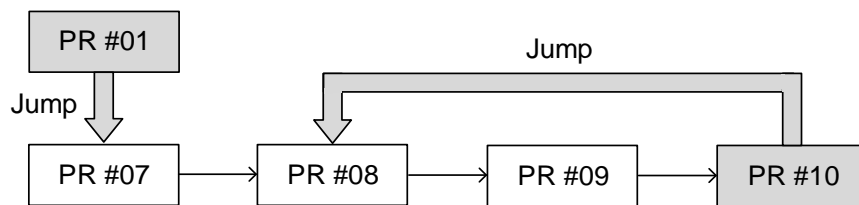
Figure 7.1.3.4.1 Jump command in PR mode
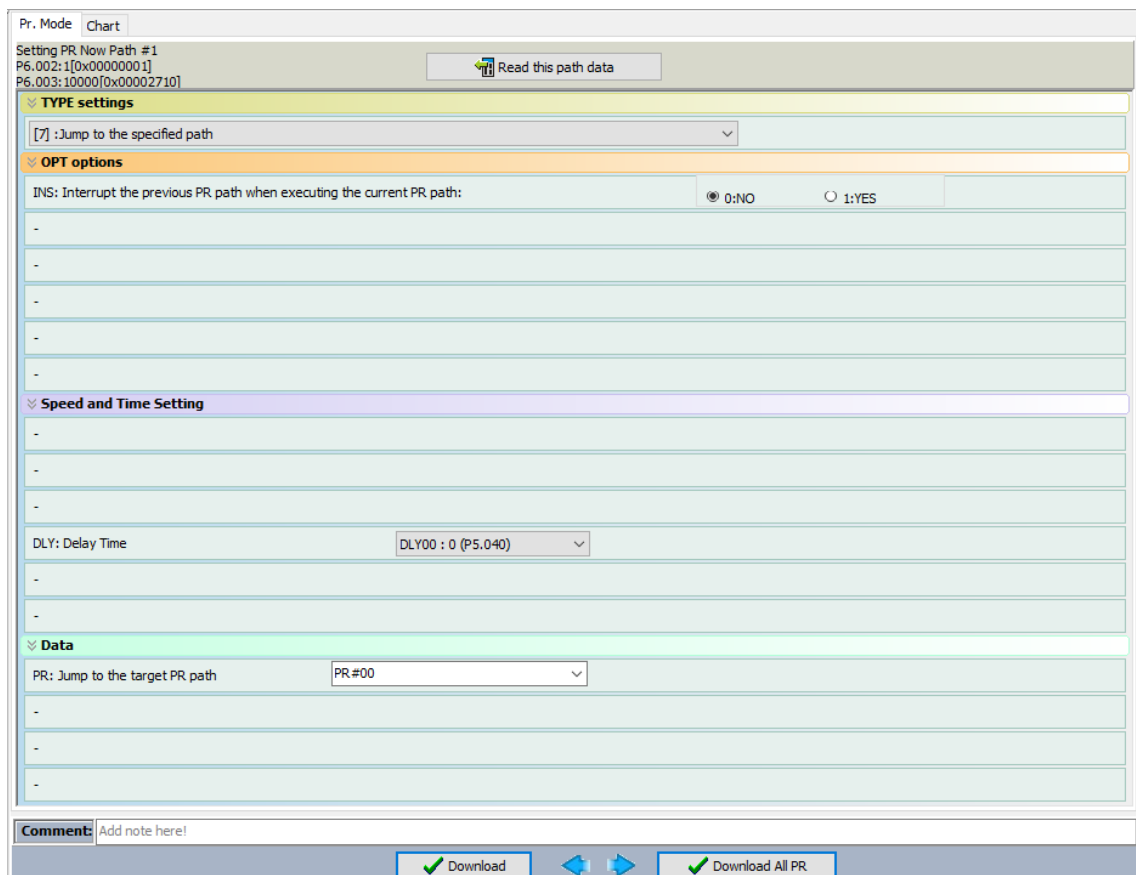
Figure 7.1.3.4.2 PR Mode Jump command screen in ASDA-Soft

Table 7.1.3.4.1 Bit functions of PR Jump command

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

Note:

1. Y: OPT: option

BIT	3	2	1	0
Command type	-	-	-	INS

    INS: Interrupt command that interrupts the previous motion command.

2. 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 write a parameter to a specified path in the PR mode screen in ASDA-Soft (see Figure 7.1.3.5.1).

■ INS is an interrupt command that interrupts the previous motion command. Refer to Section 7.1.6 for more details.

■ AUTO command automatically loads and executes the next PR once the current PR completes.

■ ROM command writes parameters to both RAM and EEPROM at the same time. Writing to non-volatile memory function is also available; however, frequent usage shortens the life of the EEPROM.

■ DLY is the delay time that is determined by the shared PR parameters. Once a Jump command is issued, the servo drive starts counting the delay time.

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

Writing Target	Data source
Parameter	Constant
Data array	Parameter
-	Data array
-	Monitoring variables
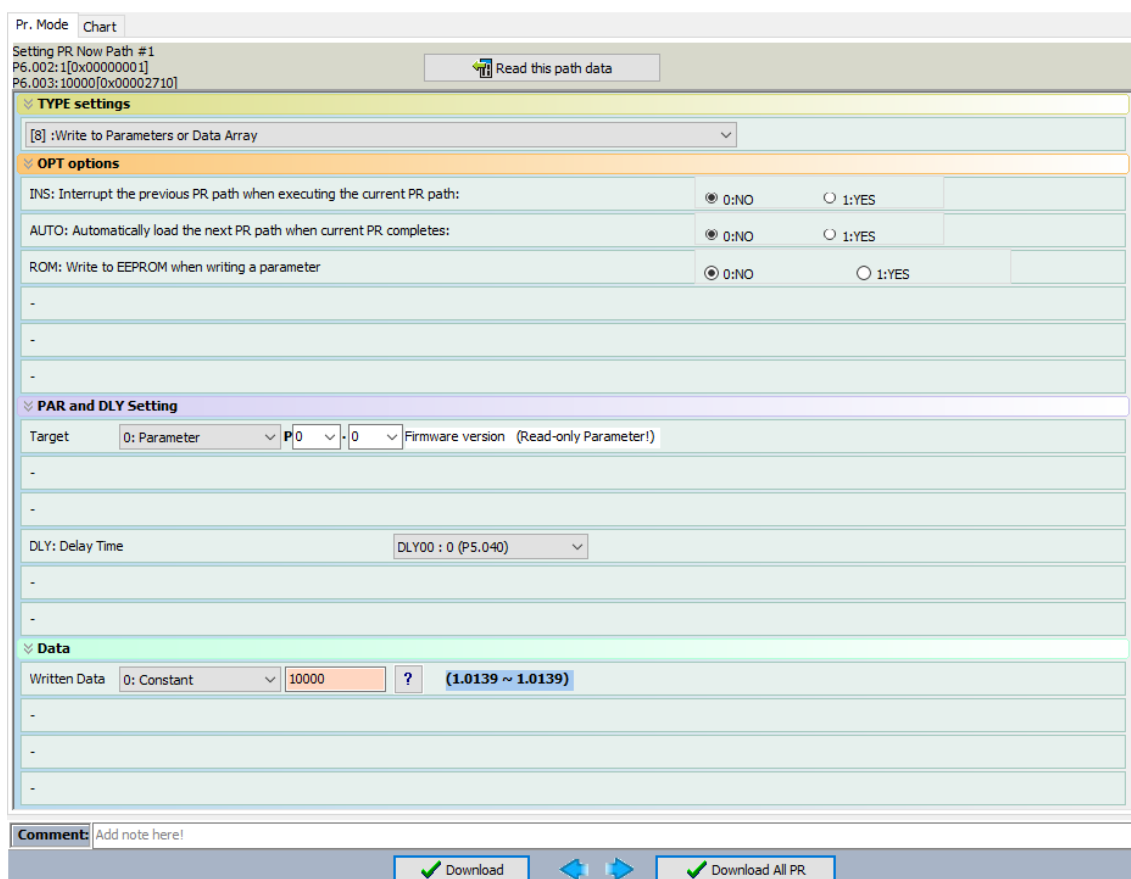
Figure 7.1.3.5.1 PR mode Write command screen in ASDA-Soft

Table 7.1.3.5.1 Bit functions of PR Write command

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

Note:

1. Y: OPT: option

BIT	3	2	1	0
Command type	-	ROM	AUTO	INS

   INS: Interrupt command that interrupts the previous motion command.

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

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

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

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

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

4. Z, U, A: DESTINATION: destination

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

5. SOURCE: Data source setting

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

7.1.3.6 Index Position command

The PR mode includes an Index Position command, which creates an indexing coordinate system. This command positions the motor within the indexing coordinates. Unlike other feedback positions in global coordinate system, the Index Position command is able to divide the total moving distance of one index into the number of paths required by the application (see Figure 7.1.3.6.1). When using the Index 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 start the index positioning in the Index Coordinates Setting Wizard in the PR mode screen in ASDA-Soft (see Figure 7.1.3.6.2). As shown in the example, the start PR path is set to 1, the path number is set to 10, and the total moving distance is 100000 PUU. When you click **OK**, the software automatically writes position command 0 PUU to PR#01, 10000 PUU to PR#02, 20000 PUU to PR#03, and so on up to PR#08. When the index position reaches 80000 PUU, it automatically returns to 0 PUU. In addition, you can modify the index position in each PR path as needed, as shown in Figure 7.1.3.6.3.

■   INS is an interrupt command that interrupts the previous motion command. Refer to Section 7.1.6.

■   OVLP is an overlap command 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.

■   DIR sets the rotation direction with options of forward rotation (always runs forward), reverse rotation (always runs backward), 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 a command that automatically loads and executes the next PR path when the current PR completes.

■   ACC / DEC is the acceleration / deceleration time determined by the shared PR parameters.

■   SPD is the target speed determined by the shared PR parameters.

■   DLY is the delay time determined by the shared PR parameters. It is defined by a command from the controller. The servo starts counting the delay time once reaching the target position.

■   Position command is the target position of each index segment. Note that the setting range must be smaller than the total index moving distance (P2.052).

Table 7.1.3.6.1 shows the bit functions when an Index Position command is in operation. If you use the index function, execute homing first in order to create the coordinate system so that the origin of the motor's feedback position and that of the motor's index position can be identical. If you do not execute homing, AL237 occurs.

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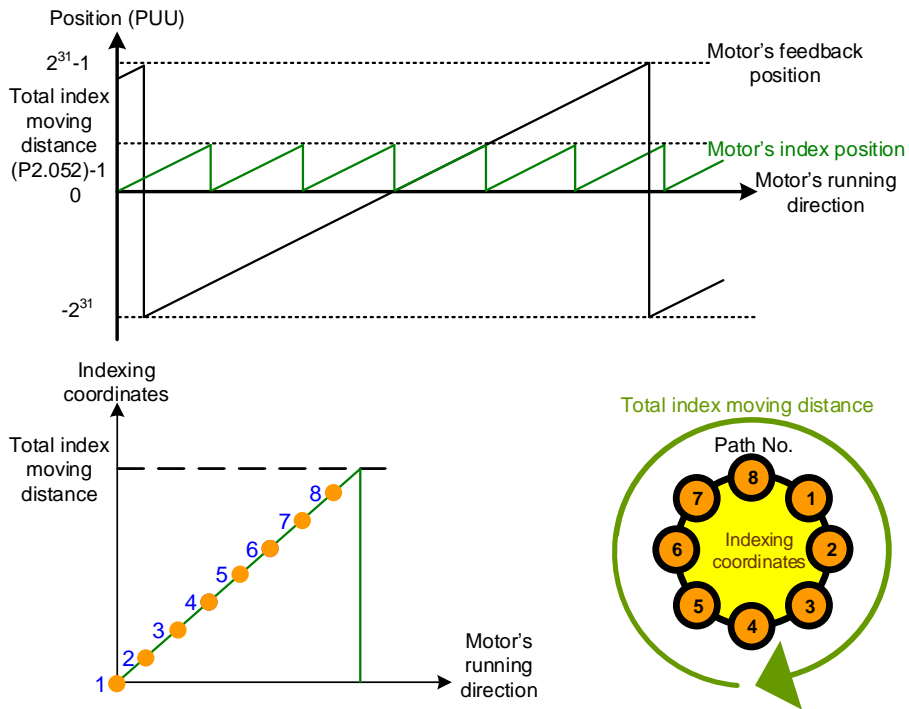
Figure 7.1.3.6.1 PR mode indexing coordinates
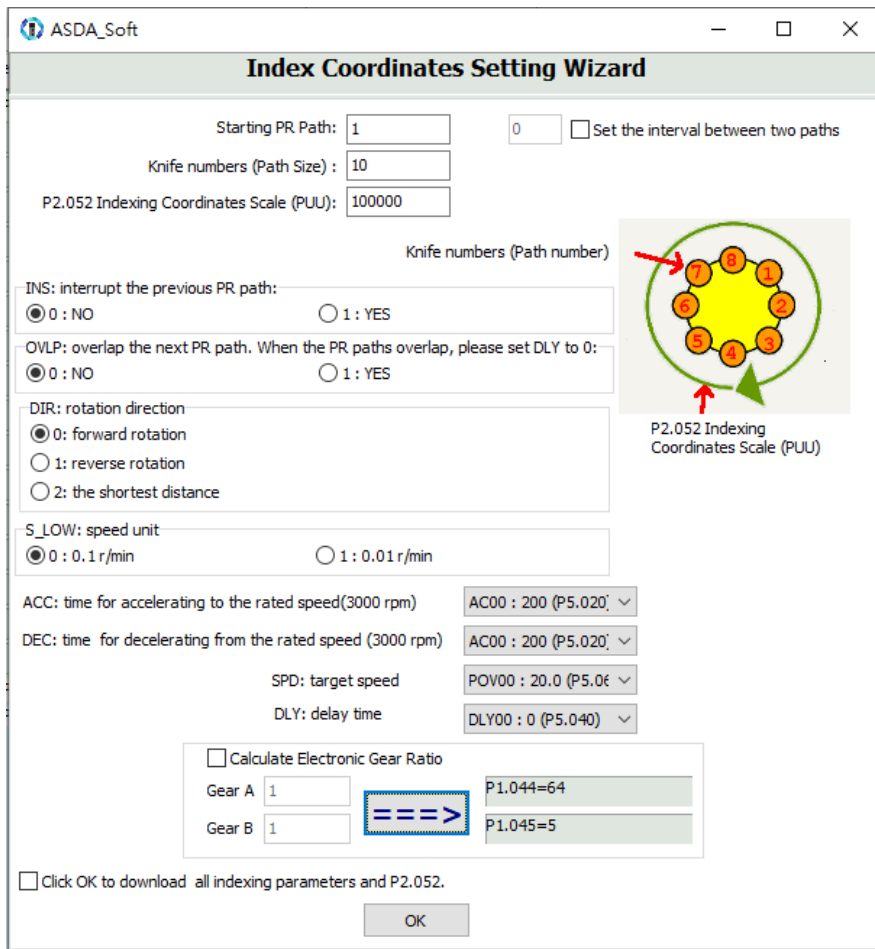
Figure 7.1.3.6.2 Index Coordinates Setting Wizard in PR mode
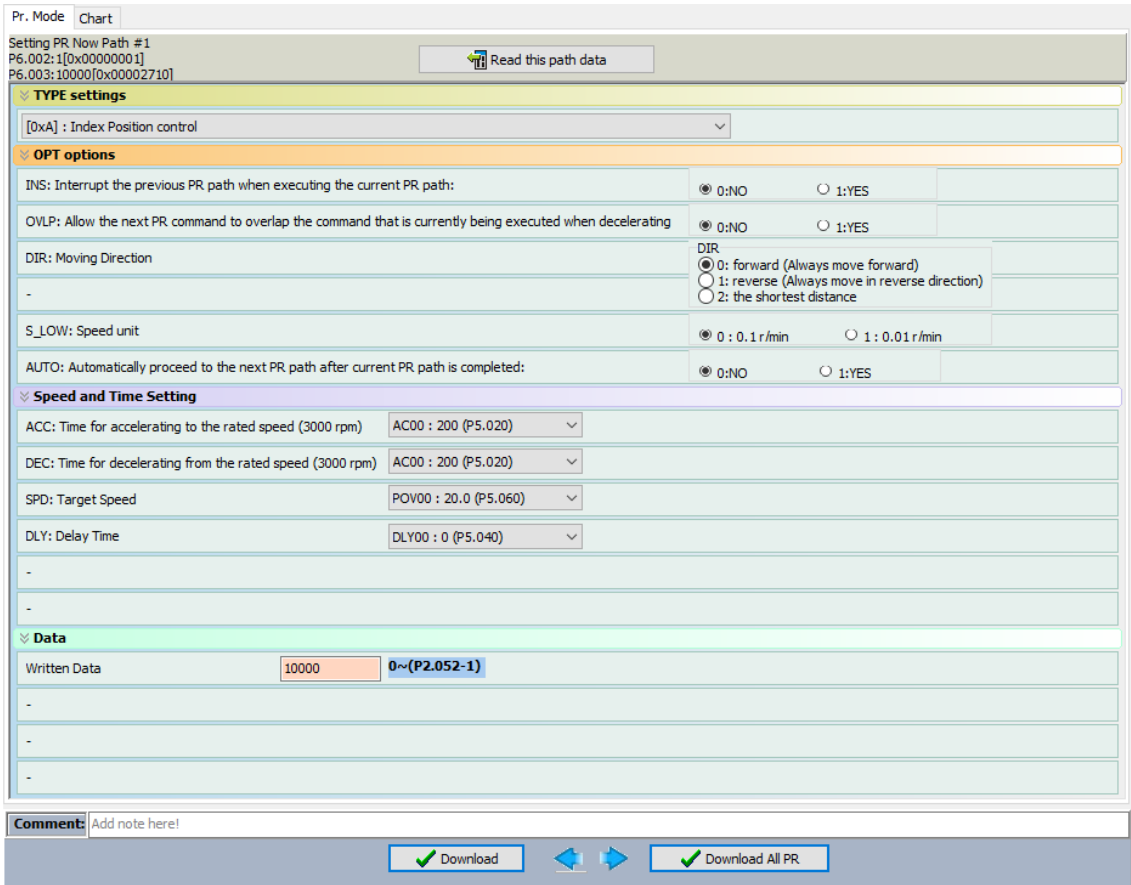
Figure 7.1.3.6.3 PR mode Index Position screen in ASDA-Soft
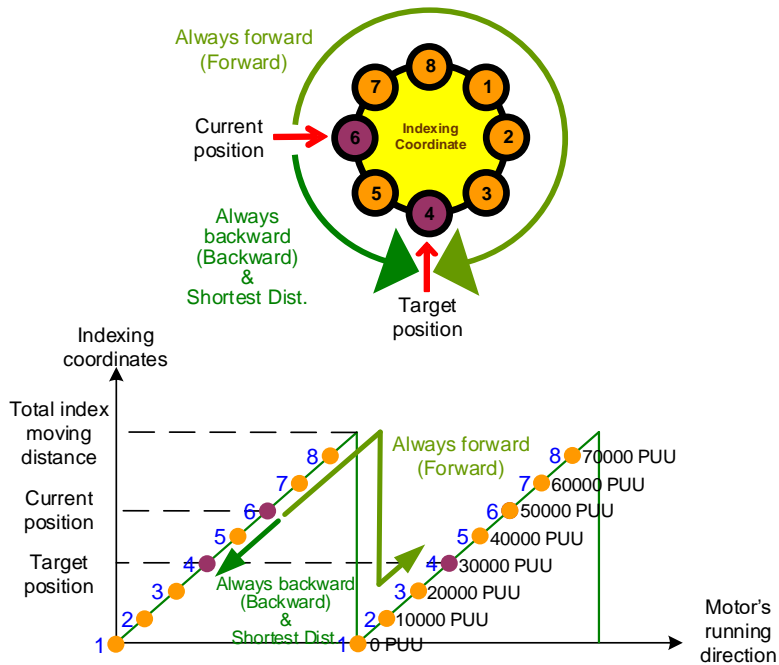
Figure 7.1.3.6.4 Motor's operation direction and indexing coordinates

Table 7.1.3.6.1 Bit functions of the PR Index Position command

BIT PR parameters	D	C	B	A	U	Z	Y	X
Command type	-	OPT2	DLY	SPD	DEC	ACC	OPT	0xA
Data content	Index Position command [PUU](0 - P2.052 minus1)							

Note:

1. Y: OPT: option

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

INS: Interrupt command that interrupts the previous motion command.

OVLP: allow overlapping of the next command.

2. C: OPT2: option 2

BIT	3	2	1	0
Command type	-	AUTO	-	S_LOW

S_LOW: speed unit options, 0 stands for 0.1 r/min and 1 for 0.01 r/min.

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

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.

7.1.4 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. This includes five parts: number, command execution type (property), command type, next procedure command, and command information. See Figure 7.1.4.1.
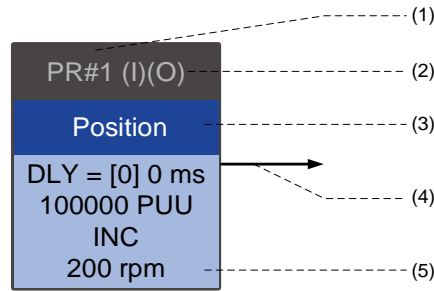
Figure 7.1.4.1 Overview of the PR procedure

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

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

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

(4)   Next procedure command: if 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 information type.

The following sections illustrate each command type and its representation.

Homing methods

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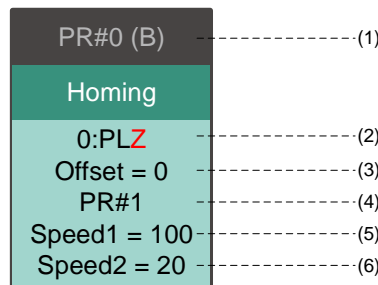
Figure 7.1.4.2 Homing methods display

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

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

Homing method	Y = 0: reverse to look for Z pulse Y = 1: go forward to look for Z pulse	Y = 2: do not look for Z pulse
X = 0: homing in forward direction and use PL as the homing origin	0: PLZ	0: PL
X = 1: homing in reverse direction with NL as the homing origin	1: NLZ	1: NL
X = 2: homing in forward direction with ORG (when it switches from off to on state) as the homing origin	2: F_ORGZ	2: F_ORG
X = 3: homing in reverse direction with ORG (when it switches from off to on state) as the homing origin	3: R_ORGZ	3: R_ORG
X = 4: look for the Z pulse in forward direction with it as the homing origin	4: F_Z	
X = 5: look for the Z pulse in reverse direction with it as the homing origin	5: R_Z	
X = 6: homing in forward direction with the ORG (when it switches from on to off state) as the homing origin	6: F_ORGZ	6: F_ORG
X = 7: homing in reverse direction with ORG (when it switches from on to off state) as the homing origin	7: R_ORGZ	7: R_ORG
X = 8: 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: next PR path to be executed after homing.

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

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

Speed command

You can use the Speed command in any PR paths (PR#1 - PR#99). It is marked as "Speed". See Figure 7.1.4.3.
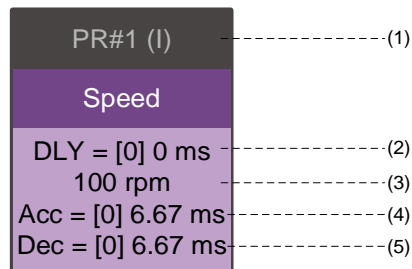
Figure 7.1.4.3 Speed command display

(1) Command execution type (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 PR parameters. It is defined by a command from the controller; the servo drive starts counting the delay time once it reaches the target speed.

(3) Target speed: the set target speed.

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

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

Position command

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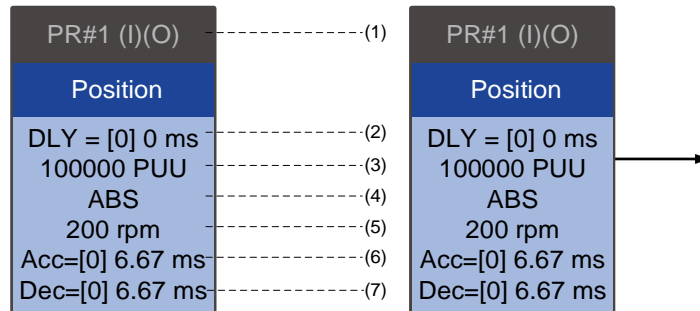
Figure 7.1.4.4 Position command display

(1) Command execution type (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. The Position command can overlap (OVLP) the next PR path. Set the delay time to 0 when using this function. If the Overlap function is enabled, it displays (O); if not, no information is displayed.

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

(3) Target position: the set target position.

(4) Position command type: "ABS" means absolute positioning; "REL" means relative positioning; "INC" means incremental positioning; "CAP" means high-speed position capturing.

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

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

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

Jump command

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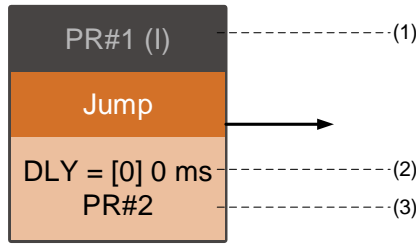
Figure 7.1.4.5 Jump command display

(1) Command execution type (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 PR parameters.

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

Write command

You can use the Write command in any PR paths (PR#1 - PR#99). It is marked as "Write". See Figure 7.1.4.6.
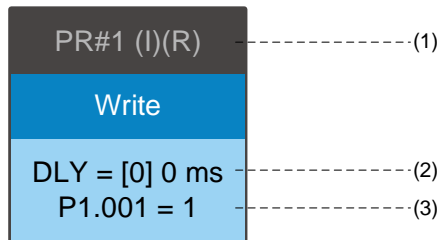
Figure 7.1.4.6 Write command display

(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 PR parameters.

(3) Writing target and data source: the corresponding target and data sources 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[#])

Index Position command

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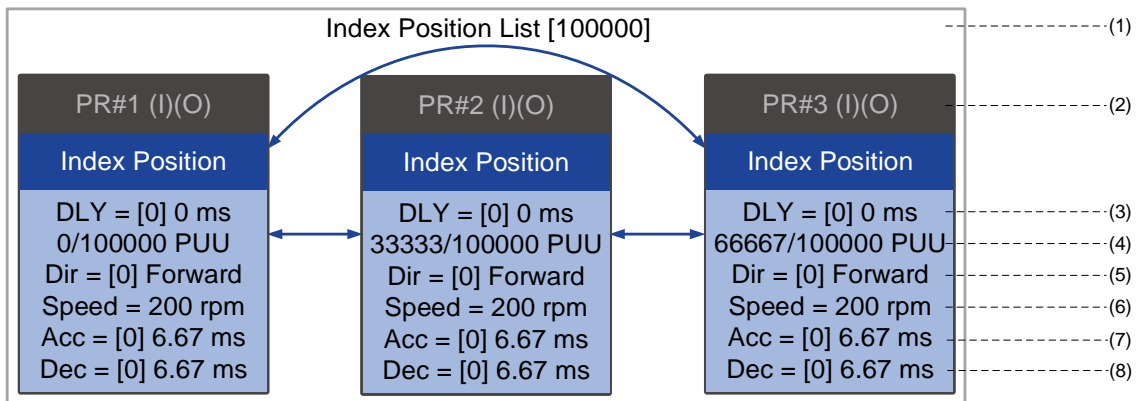
Figure 7.1.4.7 Index Position command display

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

(2)   Command execution type (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. The Index Position command can overlap (OVLP) the next PR path. Before using the Overlap function, set the delay time to 0. If the Overlap function is enabled, it displays (O); if not, no information is displayed.

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

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

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

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

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

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

7.1.5 Trigger methods for the PR command

There are four types of PR trigger methods. They are DI-triggered, Event-triggered, P5.007-triggered, and Capture-triggered (high-speed position capturing). Choose the most suitable trigger method according to the applications and requirements.

Digital input (DI) triggering

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

Digital Input (DI) : ASDA-B3-L Servo:Pt Mode	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 DI/O setting screen in ASDA-Soft

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

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

Position command	POS 6	POS 5	POS 4	POS 3	POS 2	POS 1	POS 0	CTRG	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 DI for special functions: [0x27] Enable homing and [0x46] Motor stops. 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 DI/O setting screen in ASDA-Soft to set these functions, as shown in Figure 7.1.5.2.
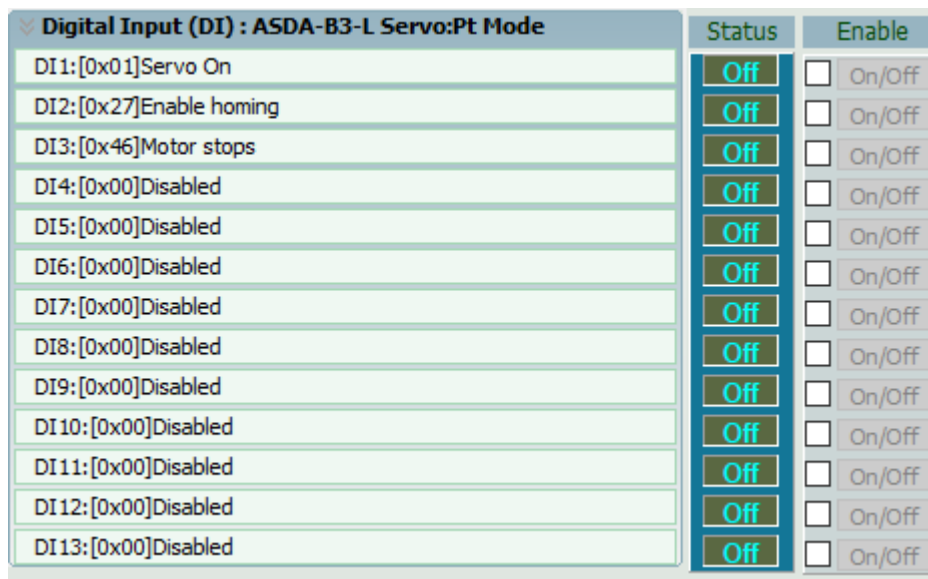
Figure 7.1.5.2 DI/O setting screen in ASDA-Soft

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Event triggering

For the event triggering method, you 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 range of PR path numbers that you can specify is from 51 - 63 (see the example in Figure 7.1.5.3). Before using the event triggering for PR commands, you must define the DI functions, which are [0x39] Event trigger command 1, [0x3A] Event trigger command 2, [0x3B] Event trigger command 3, and [0x3C] Event trigger command 4 (see Table 8.1). You can use the DI/O setting screen in ASDA-Soft to set these functions, as shown in Figure 7.1.5.4.

Figure 7.1.5.3 Example of event triggering timing diagram

Figure 7.1.5.4 DI/O setting screen in ASDA-Soft

You can use P5.098 to set the rising-edge trigger of the PR path and use P5.099 to set the falling-edge trigger. Refer to Chapter 8 for more details. Users can use ASDA-Soft to set the event trigger of PR paths. See Figure 7.1.5.5.
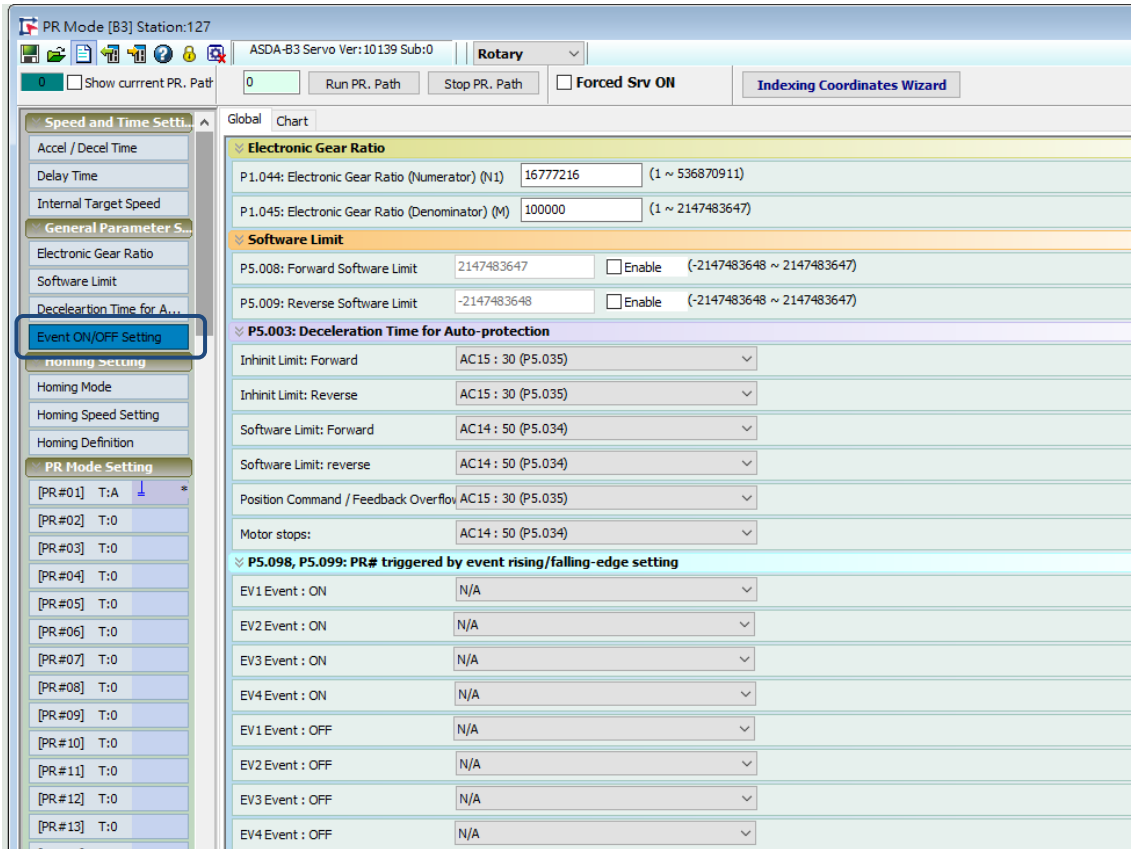
Figure 7.1.5.5 Event ON / OFF setting screen in ASDA-Soft

PR command trigger register (P5.007)

For the PR command trigger register, you write the PR number to be executed in P5.007 to have the servo drive execute the specified PR path. If you write 0 to the PR Command Trigger register, the servo drive executes homing. If you write 1 - 99 to the PR Command Trigger register, the servo drive executes the specified PR path. If you write 1000 to the PR command Trigger register, the servo drive stops executing PR commands. Refer to the setting descriptions of P5.007 in Chapter 8.

High-speed position capture (Capture) triggering

For the Capture triggering method, it uses high-speed position capture to trigger the specified PR path. When the capturing completes, you can set Bit 3 of P5.039.X to trigger or not trigger PR#50. For detailed settings, refer to Section 7.2.

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7.1.6 PR procedure execution flow

The ASDA-B3 updates the command status every 1 ms. Figure 7.1.6.1 illustrates the PR procedure execution flow and how the servo drive deals with PR commands. Once a PR procedure is triggered, it goes through three units, which are PR queue, PR executor, and motion command generator.
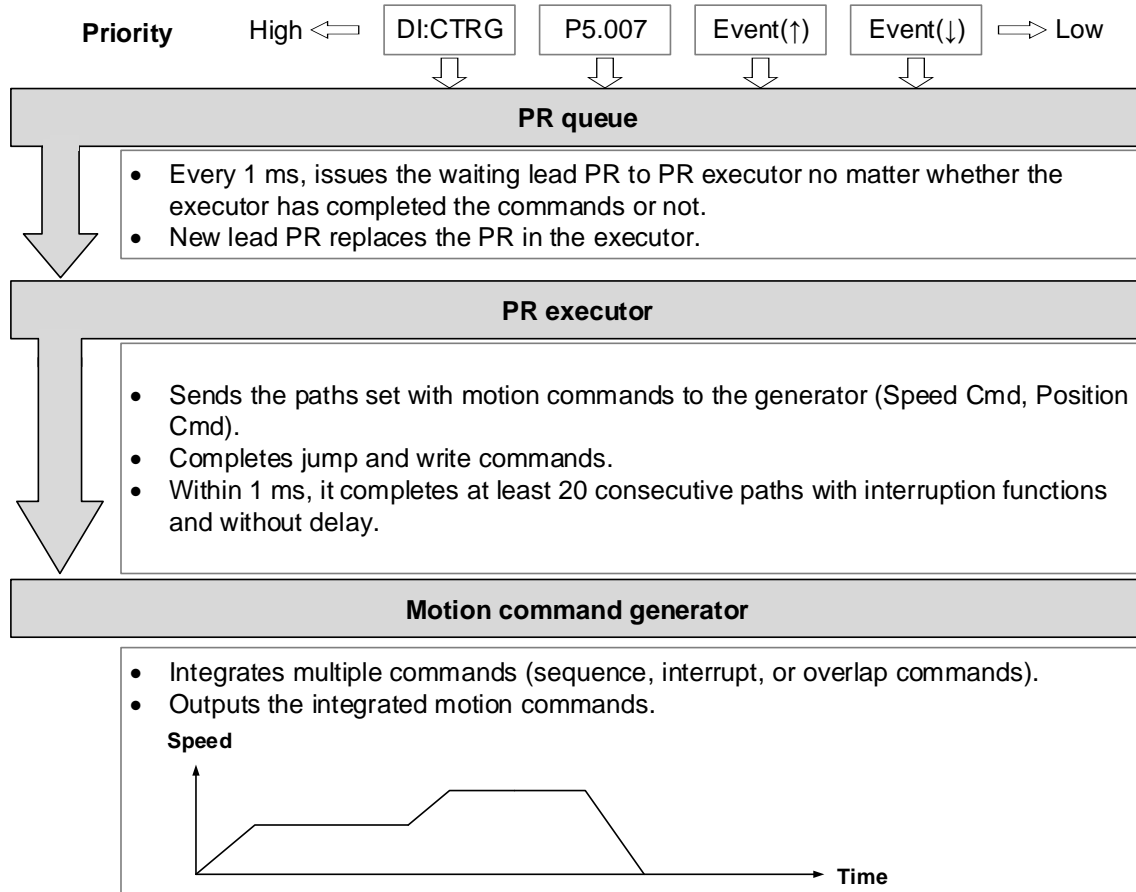
Figure 7.1.6.1 PR execution flow in the ASDA-B3

■ **Trigger mechanism**

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

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■ **PR queue**

The triggered PR path is the lead PR. The PR group it leads goes into the PR queue to wait for prioritization.

In each ms, the servo drive sends the lead PR and the PR group it leads to the PR executor with a first-in first-out method no matter whether a PR path is being executed. Therefore, as long as a PR path is triggered, the PR queue collects it and sends it to the executor.

■ **PR Executor**

Once the PR executor receives the lead PR and its PR group, the PR group that is being executed will be replaced immediately. If the received PR group includes motion commands, such as Speed commands and Position commands, then the PR executor sends them to the motion command generator. PR paths with Write or Jump commands are complete 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 commands (INS) (without delay times) within 1 ms. If there is a PR path that has not been completed within 1 ms, and a new PR group is sent to the executor by the queue, the new PR group then replaces the previous PR group. In other words, instead of executing the PR group that hasn't been completed, the executor starts executing the new PR group. If there is a PR path that has not been completed within 1 ms but no new PR group is sent to the executor, the executor continues to execute the unfinished PR path.

■ **Motion command generator**

Motion commands include the Speed and Position commands. The PR executor sends this type of 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 soon as they enter the generator. If another motion command (with interrupt setting) also enters the generator, it is integrated with the current command in the generator and the integration is based on the motion command settings. The settings include whether multiple motion commands are sequence commands and whether they are set with the Overlap or Interrupt function. All integration varies with each PR path setting.

Sequence command

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

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■   Position command followed by a Position command

When the PR executor receives two consecutive Position commands, if they do not have Interrupt or Overlap functions, the PR executor issues the first Position command to the motion command generator, and the generator starts the first part of position control. After the first Position command completes, if no delay time is set, the PR executor issues the second Position command for the generator to start the second part of position control (see Figure 7.1.6.2 (a)). If the first Position command includes a delay, the PR executor starts counting the delay time right after the motor reaches the target position. Then it issues the second Position command for the generator to start the second part of position control as shown in Figure 7.1.6.2 (b).
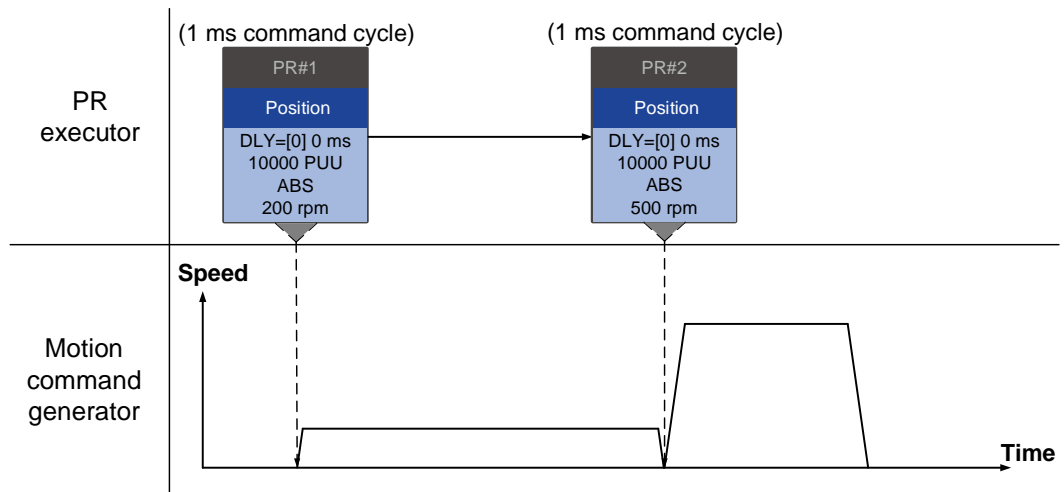
(a) Position command without delay
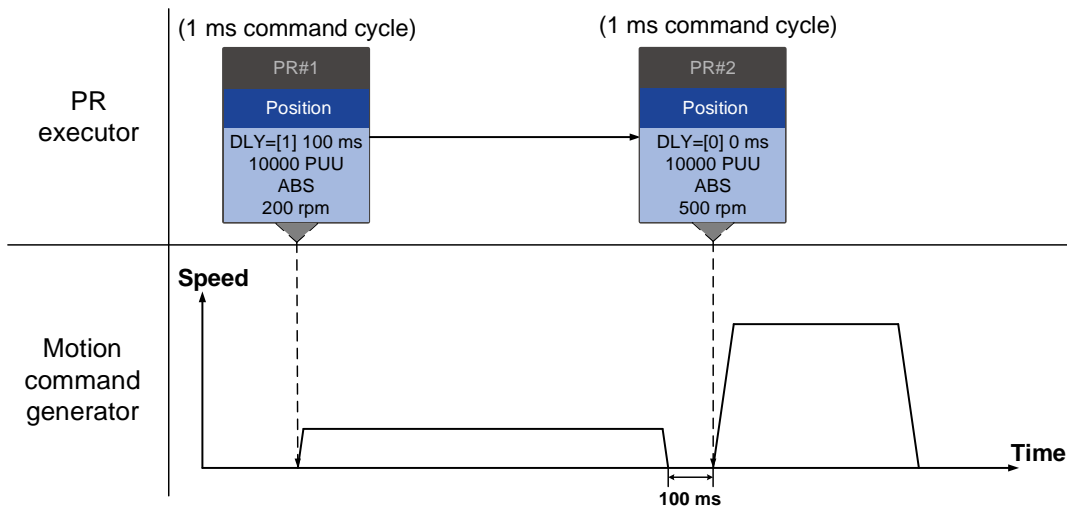
(b) Position command with delay

Figure 7.1.6.2 Position sequence command

■ Speed command followed by a Speed command

When the PR executor receives two consecutive Speed commands, if they do not have
Interrupt or Overlap functions, the PR executor issues the first Speed command to the motion
command generator, and the generator starts the first part of speed control. After the first Speed
command completes, if no delay time is set, the PR executor issues the second Speed
command for the generator to start the second part of speed control (see Figure 7.1.6.3 (a)).
If the first Speed command includes a delay, the PR executor starts counting the delay time
right after the motor reaches the target speed. Then it issues the second Speed command for
the generator to start the second part of speed control as shown in Figure 7.1.6.3 (b).

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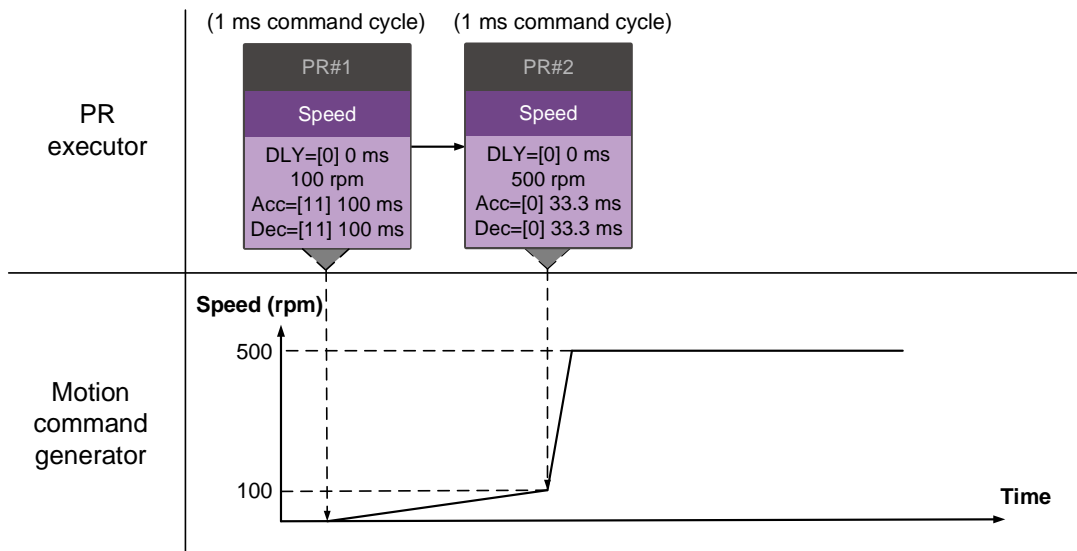
(a) Speed command without delay
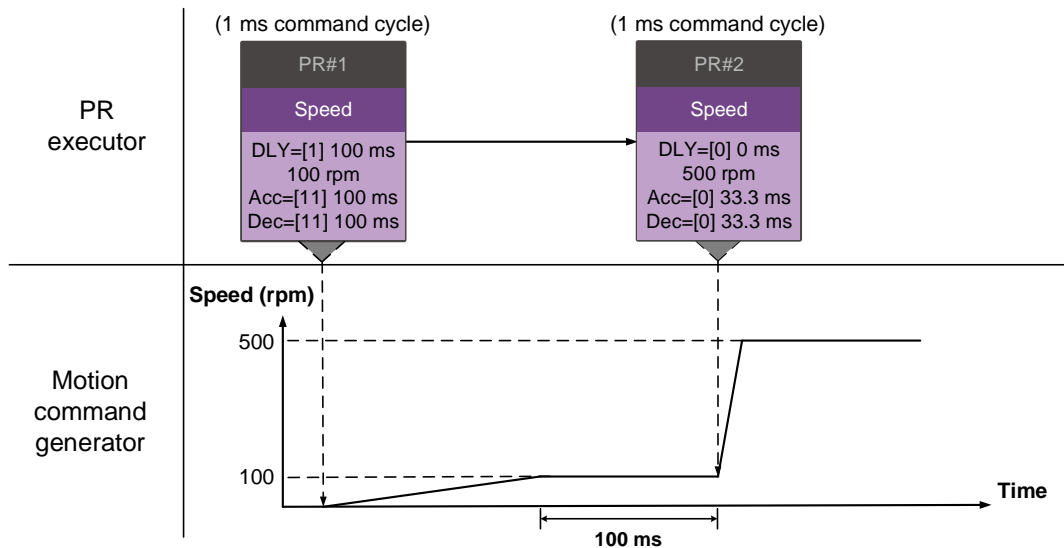
(b) Speed command with delay

Figure 7.1.6.3 Speed sequence command

■   Multiple commands

The PR queue updates commands every 1 ms. For a motion command, the PR queue sends the next command to the generator only after the previous command completes. Jump or Write commands are executed in the PR queue immediately. As shown in Figure 7.1.6.4, in the first ms, the PR queue receives a Position command and sends this command to the motion command generator, having the generator to execute the command. In the second ms, the PR queue receives a Write command and executes it immediately. In the third ms, the PR queue receives a Jump command and executes it immediately as well. These last two commands are not sent to the motion command generator since the PR queue and the generator can execute commands independently. In the fourth ms, the PR queue receives a Position command. Next, the PR executor sends this Position command to the generator for execution.
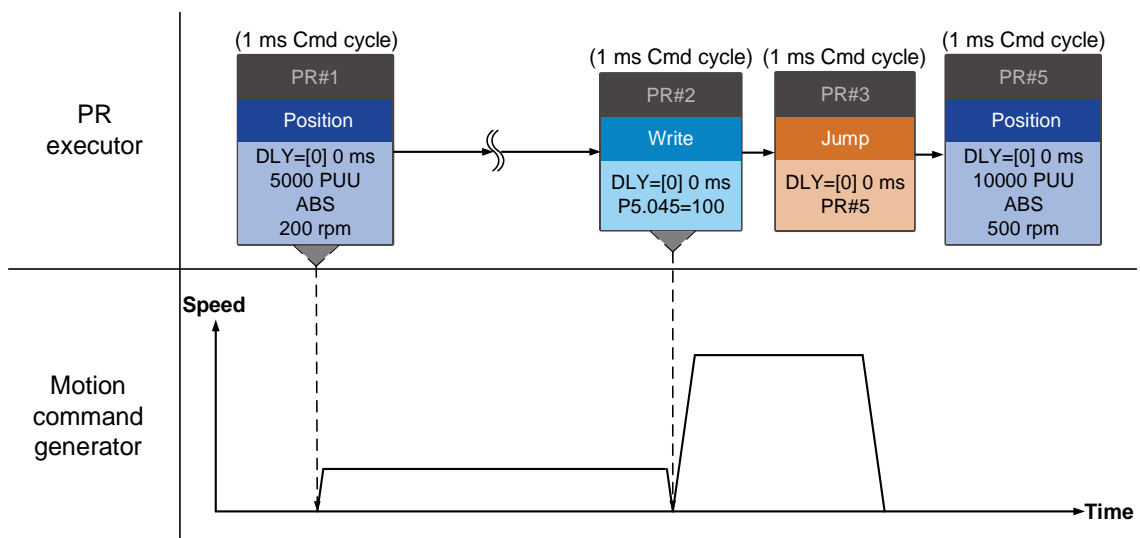
Figure 7.1.6.4 Multiple sequence commands

Command interruption

Interruption (INS) causes a command in execution to be replaced or integrated.

The results of the interruption differ based on the command types. The next command replaces or combines with the previous command. There are two types of interruption: internal and external, as shown in Figure 7.1.6.5.
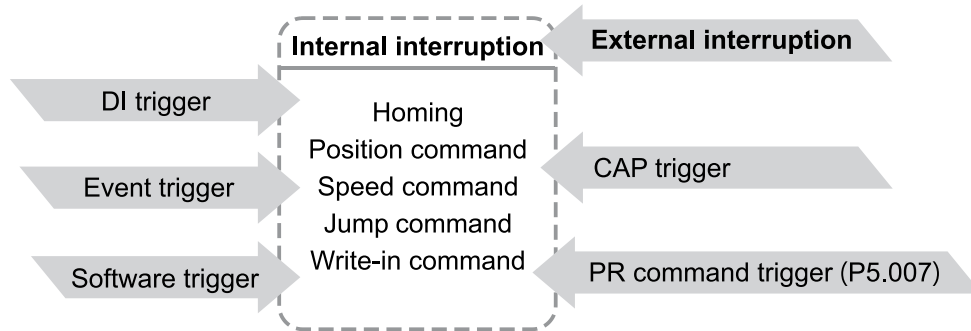
Figure 7.1.6.5 Internal and external interruption

1.   Internal Interruption

For a series of PR paths, if one PR path includes an AUTO function (auto-execute the next path), the system continues to read the next path after reading the current path. 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 interrupt command. It replaces the un-executed part in the previous path with the next or integrates the next with the commands of the previous path which are in execution.

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

When the PR executor receives three consecutive Position commands with an interrupt in the second command, the executor treats the first and the second Position commands as one PR group. Since the first Position command is not executed, the executor replaces the first command with the second and only sends the second command to the motion command generator for execution. After the second command is complete, the executor sends the third command to the generator (see Figure 7.1.6.6 (a)). If the first command includes a delay, then the PR executor sends the first command to the generator and then starts counting the delay time. After the delay is over, it then sends the second command and the generator starts the second part of speed control. While the first command is still being executed, it is integrated with the second command. Note that this integration differs from that described in Section 7.1.3. Refer to the following note. Once the second command is complete, the executor sends the third command to the generator for execution (see Figure 7.1.6.6 (b)).

(a) Position command without delay

(b) Position command with delay
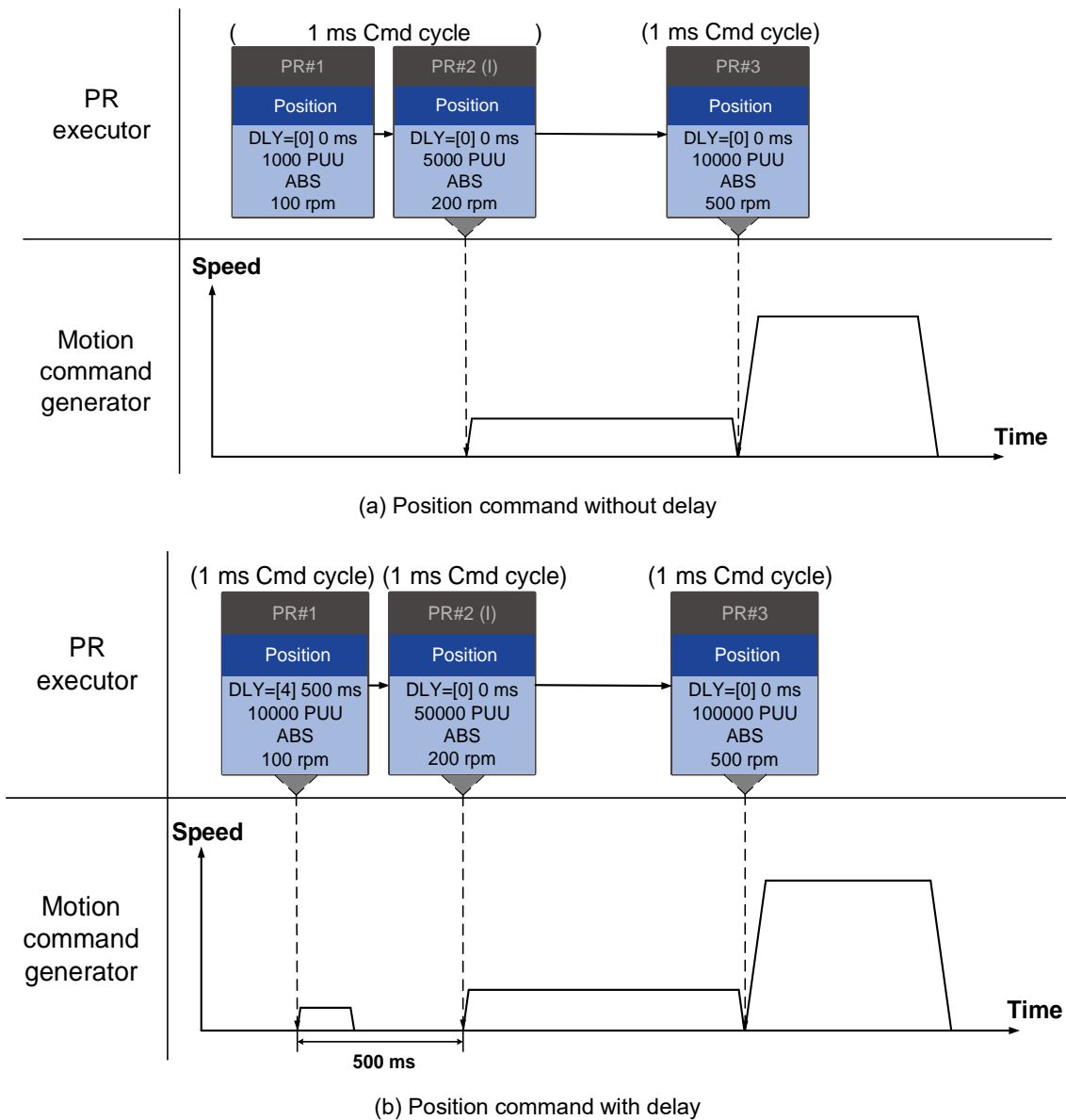
Figure 7.1.6.6 Internal interruption - Position command

Note: the integration for internal interrupt position command is slightly different from what is described in Section 7.1.3. The way REL and INC commands work is identical. The target position is the previous target position plus the current position. See the following example. The rest of the integration method is the same as mentioned in Section 7.1.3.
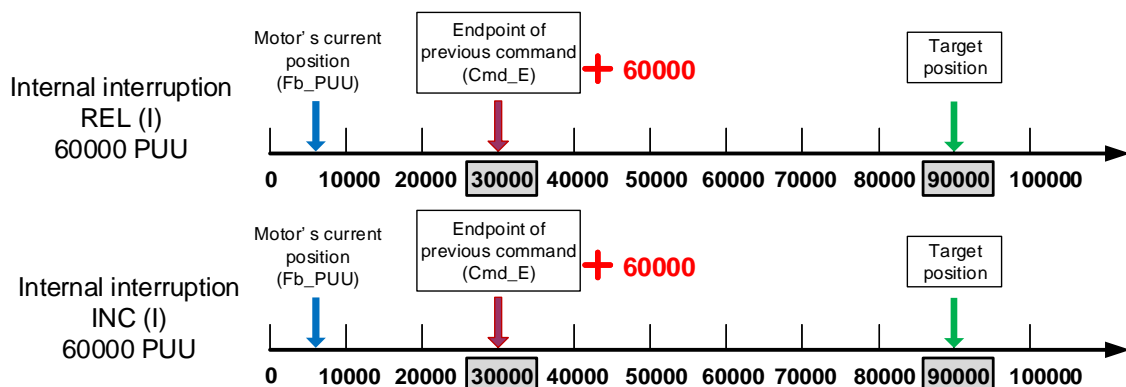
Figure 7.1.6.7 Example of relative and incremental position commands for internal interruption

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

When the PR executor receives three consecutive Speed commands with an interrupt in the second command, the executor treats the first and the second as one PR group. Since the first Speed command is not executed, the executor replaces the first command with the second and only sends the second command to the motion command generator for execution. After the second command is complete, the executor sends the third command to the generator (see Figure 7.1.6.8 (a)). If the first command includes a delay, then the PR executor sends the first command to the generator and then starts counting the delay time. After the delay is over, it then sends the second command and the generator starts the second part of speed control. While the first command is still being executed, it is integrated with the second command. Once the second command is complete, the executor sends the third to the generator for execution (see Figure 7.1.6.8 (b)).
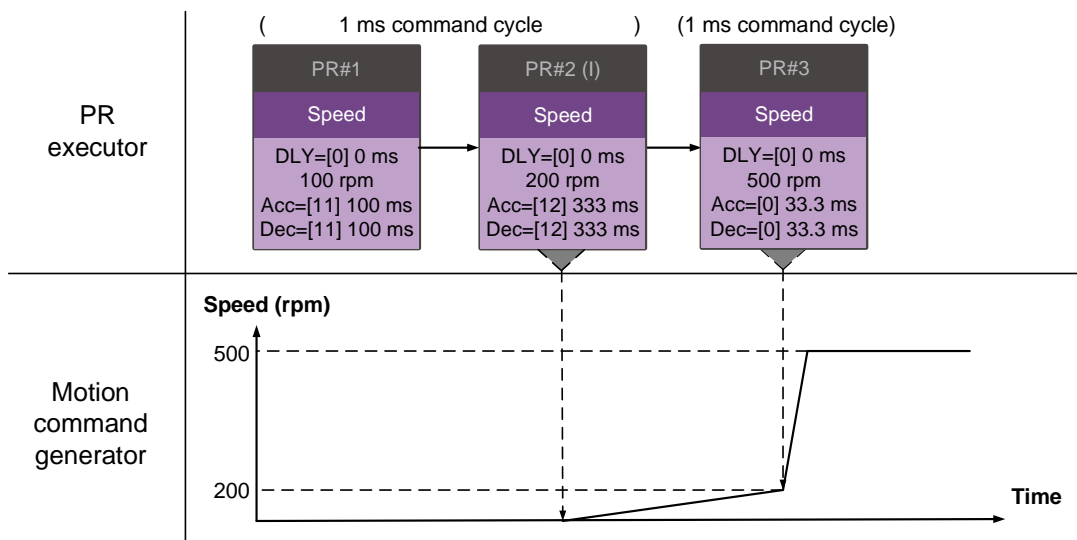
(a) Speed command without delay
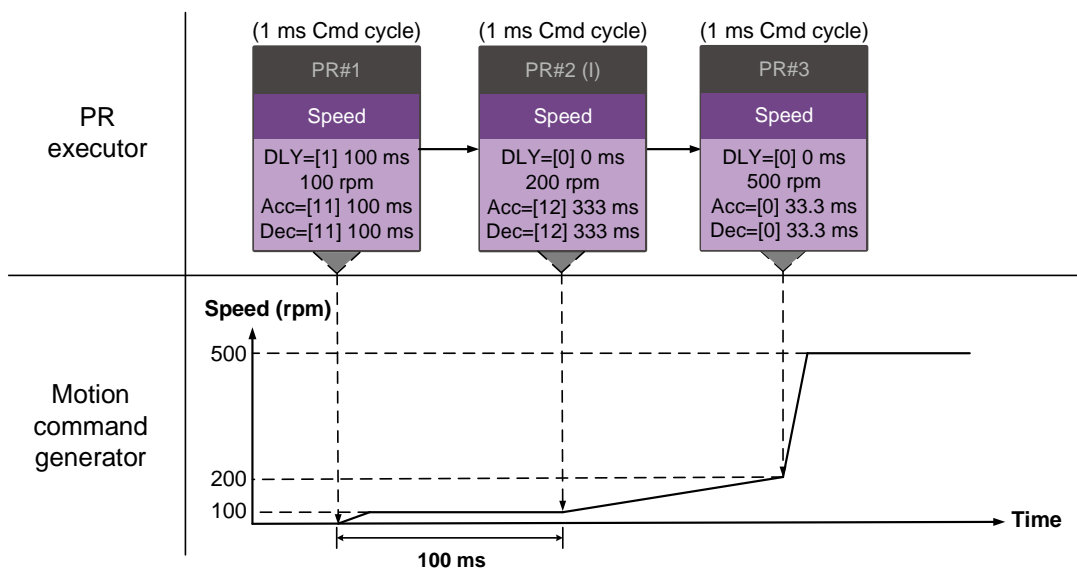
(b) Speed command with delay

Figure 7.1.6.8 Internal interruption - Speed command

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■ Multiple interrupt commands

The PR queue updates commands every 1 ms. If all PR paths include an Interrupt function, the queue can read at least 20 PR paths in 1 ms, and these paths are called a PR group. If this PR group has multiple motion commands, the PR queue only sends the last command it receives to the motion command generator for execution. Therefore, in a PR group, only one PR path with motion command is executed. The latter motion command directly replaces the former, whereas Jump and Write commands are executed as soon as they are received by the PR queue (see Figure 7.1.6.9 (a)). If one of the PR paths includes a delay, the PR queue schedules all paths on the basis of this PR path. The prior path(s) including a delay becomes the first PR group, and what follows is the second PR group. Thus, this PR procedure can execute up to two PR paths with motion commands, as shown in Figure 7.1.6.9 (b).

(a) Multiple commands without delay

(b) Multiple commands with delay
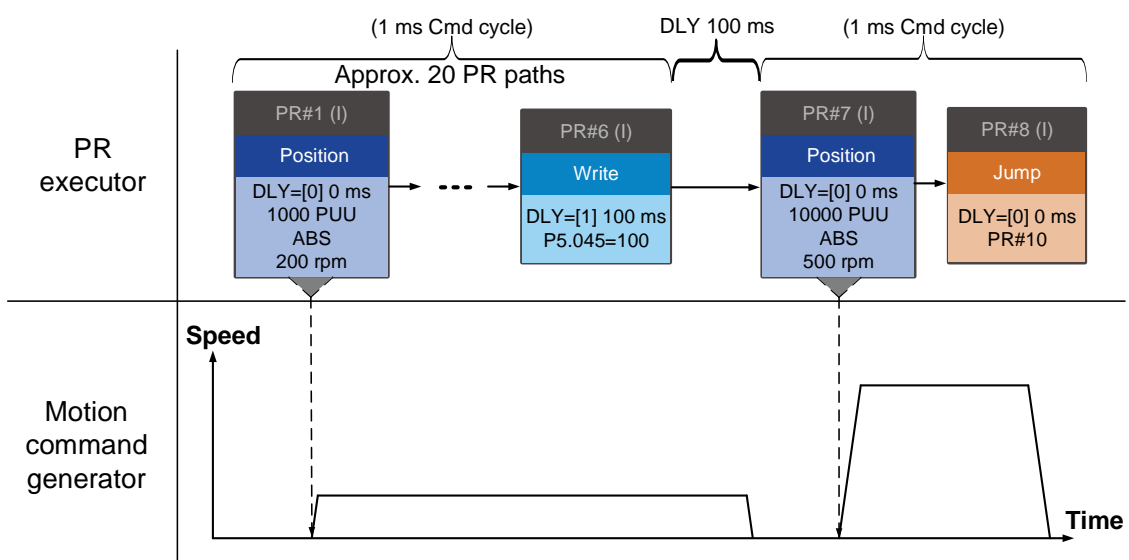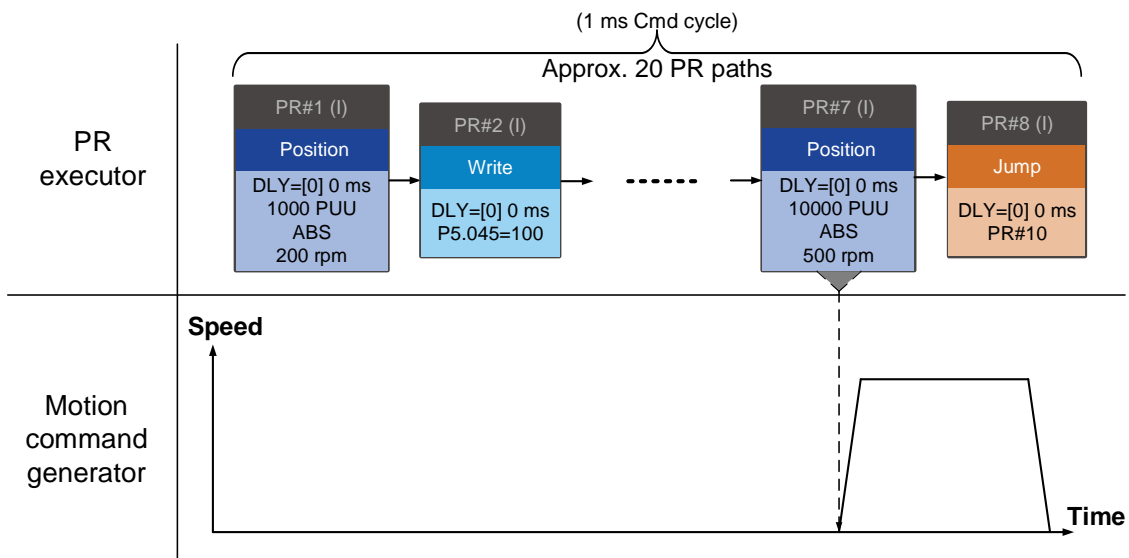
Figure 7.1.6.9 Internal interruption - Multiple commands

2.   External Interruption

If an external interruption is encountered, it uses the PR Command trigger method to execute another PR path (refer to Section 7.1.5 for PR trigger methods). When the PR queue receives a PR path with an Interrupt function, it sends this path to the motion command generator immediately and changes the path in execution. Note that a delay does not change the result of an external interruption. That is, once the PR queue receives an external interrupt command, the motion commands in the latter part are executed by the generator and integrated with the previous commands.

The external interruption is as shown in Figure 7.1.6.10 (a). If a PR path with an Interrupt function enters the PR executor as an external interruption, the executor sends this Position command immediately to the generator so that the motor can run in accordance with the interruption. The motor uses the settings that integrate with the former motion commands when running. The methods of integration are described in Section 7.1.3. Similarly, an external interruption affects Speed and Position commands the same way and the same is true for multiple commands. See Figure 7.1.6.10 (b) for an example.
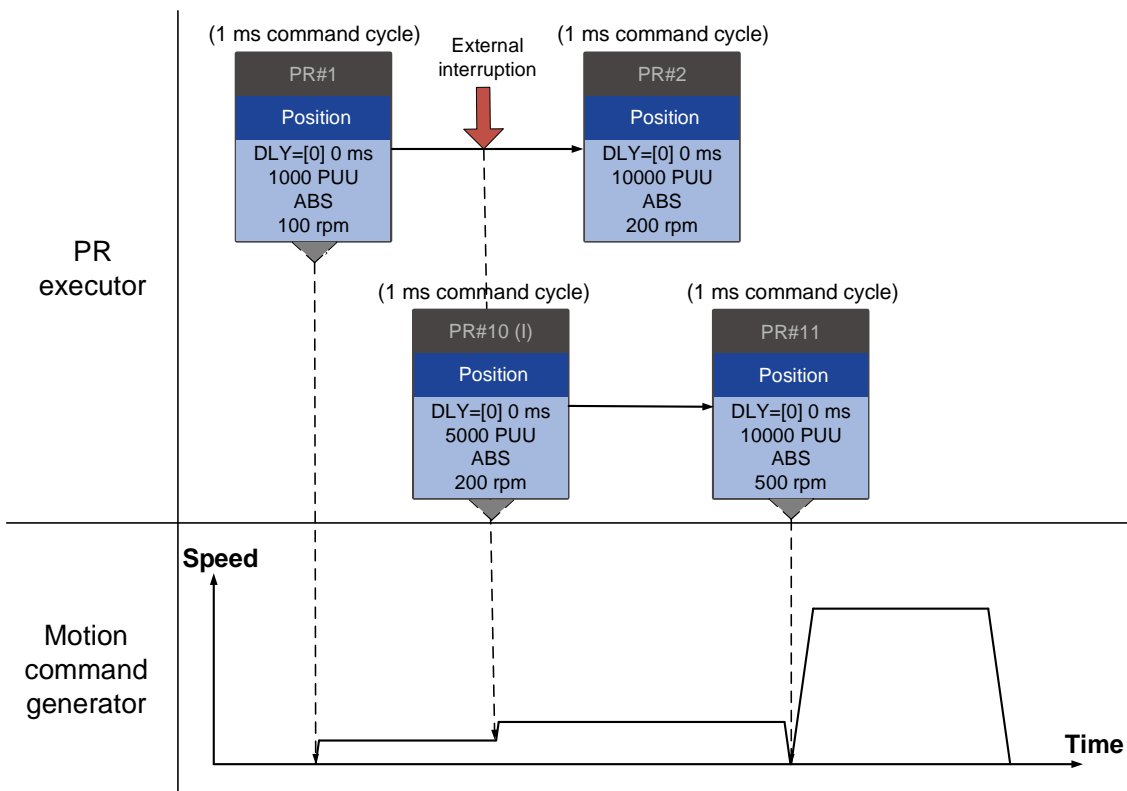
(a) External interruption - Position command

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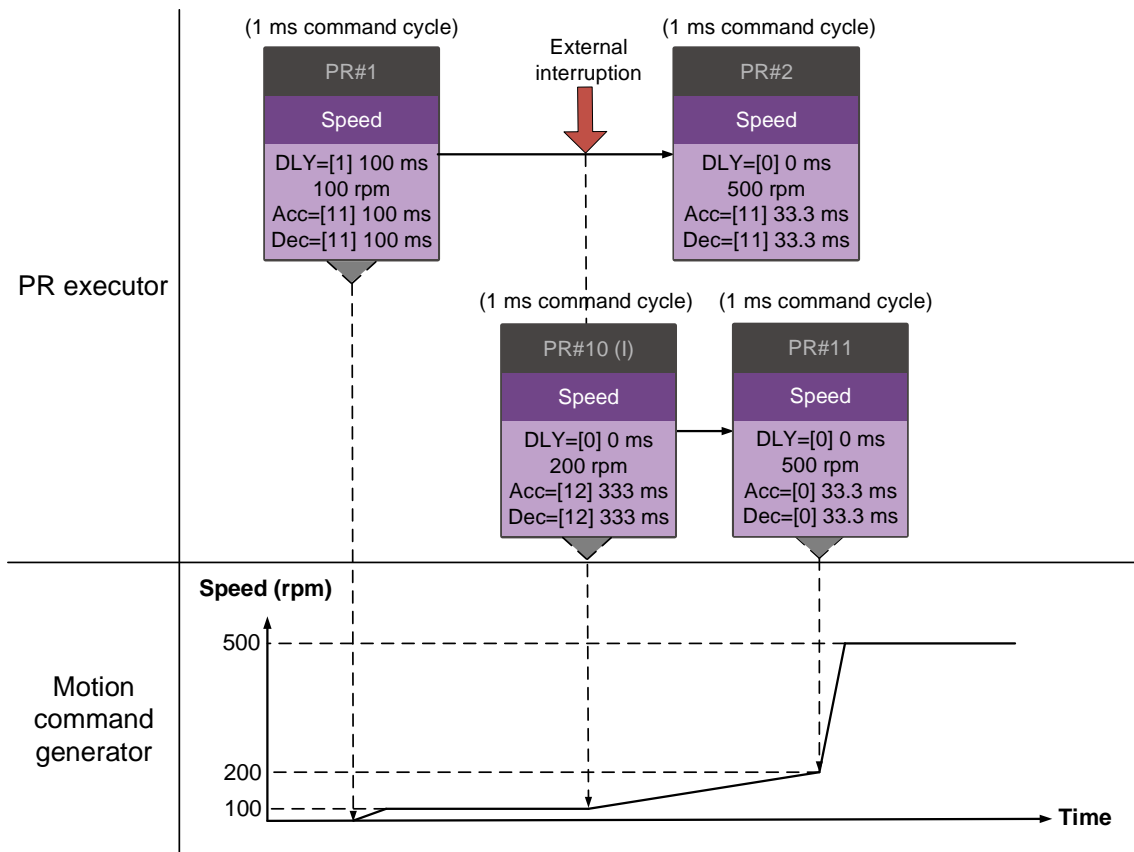
(b) External interruption - Speed command

Figure 7.1.6.10 External interruption

Overlap command

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

$$\frac{\text{1st target speed } (Spd1)}{3000} \times \text{Deceleration time } (Dec)$$

$$= \frac{\text{2nd target speed } (Spd2)}{3000} \times \text{Acceleration time } (Acc)$$

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

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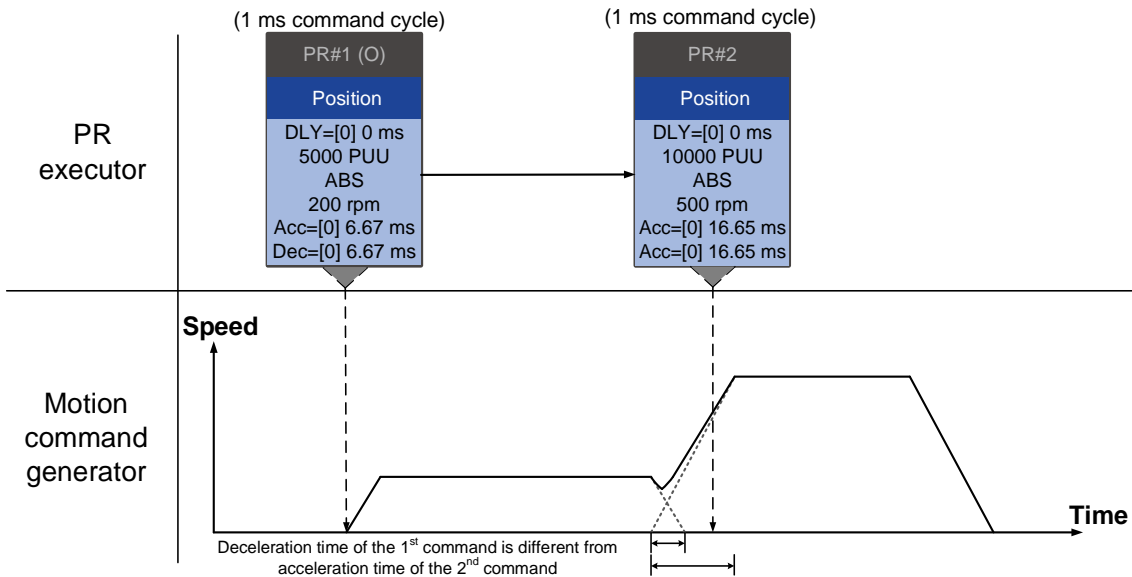
(a) Overlap command - Acceleration and deceleration time are different
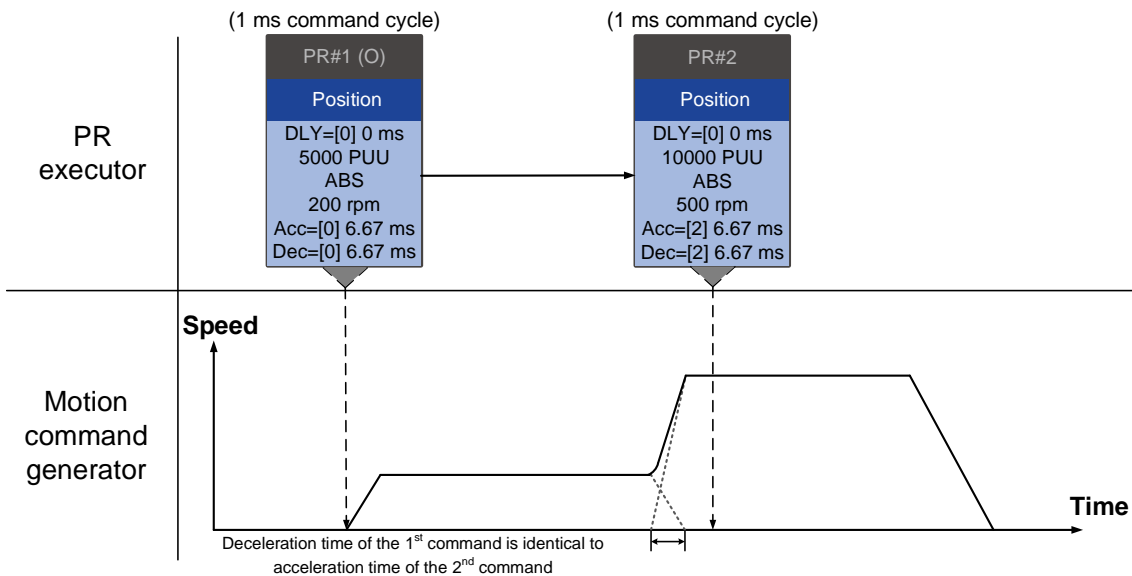
(b) Overlap command - Acceleration and deceleration time are identical

Figure 7.1.6.11 Overlap command

Interpret PR path flow

The PR paths mentioned above include commands such as Sequence, Interrupt, and Overlap. The replacement, integration, and overlapping for commands lead to different behavior depending on the settings. The suggested steps to interpret the PR path is as follows.

1. Check the command sequence. Check whether there are delay time (DLY) and interrupt (INS) commands because these two types change the command execution sequence.

2. Find the lead PR and identify each PR group of 1 ms.

3. In each PR group of 1 ms, only the last motion command is executed. The Jump and Write commands are immediately executed in the PR executor.

4. Position commands are combined based on the principle described in Section 7.1.3.3.

7.2 Application of motion control

The ASDA-B3 motion control includes the high-speed position capture function. It uses digital input DI3 (B3-F, M) or DI7 (B3-L) to instantly capture the motor's feedback position and store this position in the data array. You can find more details about the setting and how it works in the following sections.

Note: B3-E models do not support the Capture function.

7.2.1 Data array

The data array can store up to 128 sets of 32-bit data captured by the high-speed capture function. Set P2.008 to 30 and then 35 or use ASDA-Soft to write the data to EEPROM; otherwise, the data in RAM is not saved after you turn the power off. ASDA-Soft provides a user-friendly screen for reading and writing the data array. See the following figure.
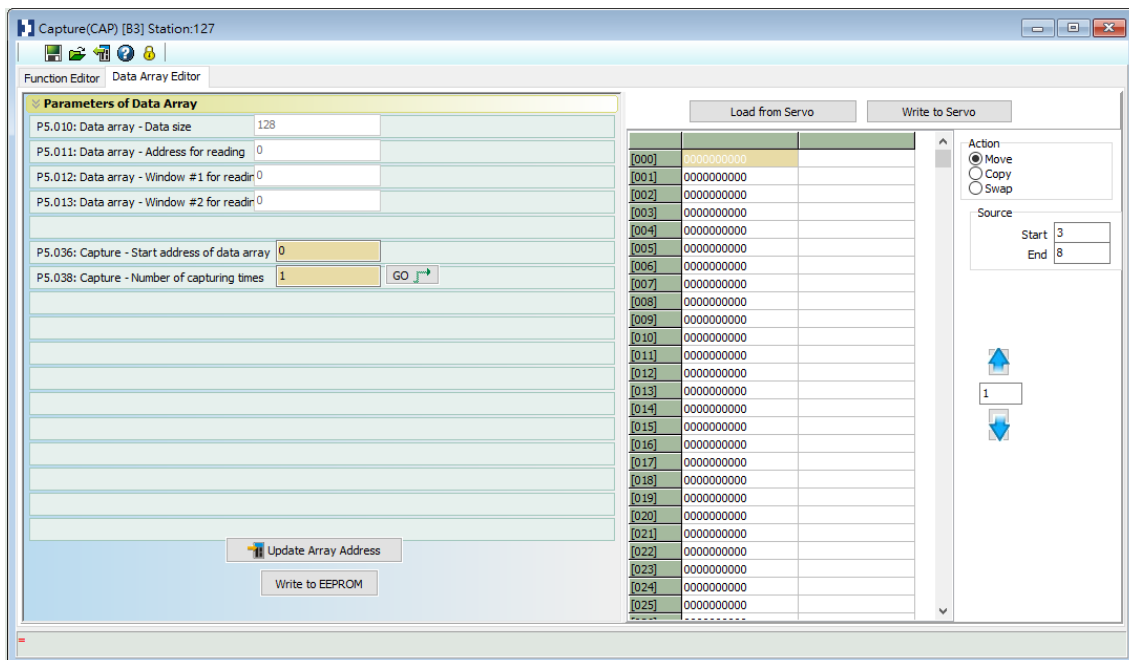
Figure 7.2.1.1 Data Array screen in ASDA-Soft

You can use the panel, communication, or ASDA-Soft to read data from or write data to the data array. Regardless of the methods, they are completed by parameter settings. The first group of parameters for reading and writing the data array are P5.011, P5.012, and P5.013. P5.011 specifies the address for reading and writing the data array. P5.012 and P5.013 are for reading and writing the actual data contents. You can use both to read and write, but the behaviors after reading and writing 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 - P5.103. P5.011 specifies the address for reading and writing the data array. 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 value accumulates and exceeds the maximum of 19, the returned address is 0. You can find more details in Table 7.2.1.2.

Table 7.2.1.1 Group 1 - reading and writing the data array

Parameter	Description		
P5.011 Address for reading / writing	Specify the address in the data array when reading and writing data.		
Window for reading / writing	by	Behavior after reading	Behavior after writing
P5.012 Window #1 for reading / writing	Panel	**Value of P5.011 does not add 1**	Value of P5.011 adds 1
	Communication / ASDA-Soft	Value of P5.011 adds 1	Value of P5.011 adds 1
P5.013 Window #2 for reading / writing	Panel	Value of P5.011 adds 1	**Cannot be written with the drive panel**
	Communication / ASDA-Soft	Value of P5.011 adds 1	Value of P5.011 adds 1

Example: when using the drive panel or communication for reading from or writing to the data array, input values to the data array address in sequence as follows: Data array #11 = 100, Data array #12 = 200, Data array #13 = 300. Then the data is read in sequence.

1.   Read / write with panel:

Write to data array   **Read from data array**
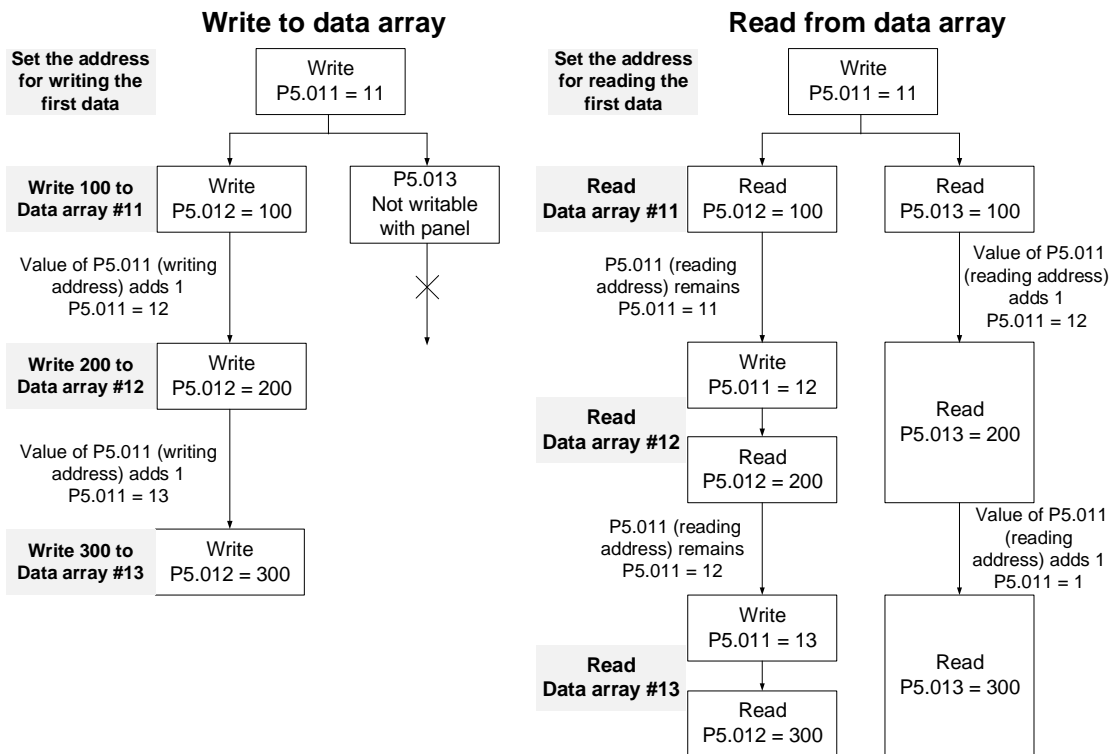
2.   Read / write with communication

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 a consecutive writing command to write 100 to Data array #11, 200 to Data array #12, and 300 to Data array #13. When reading, use a single data writing command to set the start address as Data array #11, then use a consecutive reading command to read P5.011 - P5.013 (Data array #11 and #12). This reads two values, so P5.011 is incremented by 2 and then it reads Data array #13.

Writing to the data array									
Packet	Communi-cation Cmd	Start address	Data length	P5.011		P5.012		P5.013	
				Low bit	High bit	Low bit	High bit	Low bit	High bit
1	0x10	P5.011	6 words	11	0	100	0	200	0
2	0x10	P5.011	6 words	13	0	300	0	0	0
Reading the data array									
Packet	Communi-cation Cmd	Start address	Data length	P5.011		P5.012		P5.013	
				Low bit	High bit	Low bit	High bit	Low bit	High bit
4	0x06	P5.011	-	11	0	-	-	-	-
5	0x03	P5.011	6 words	11	0	100	0	200	0
6	0x03	P5.011	6 words	13	0	300	0	0	0

Table 7.2.1.2 Group 2 - reading and writing the data array

Parameter	Description	Example 1		Example 2	
P5.011 Address for reading / writing	Specify the address in the data array when reading and writing data.	5		17	
Window for reading / writing	Description	Example 1		Example 2	
		Address	Content	Address	Content
P5.100 Window #3 for reading / writing	Read from or write to the address specified by P5.011.	5	1234	17	5678
P5.101 Window #4 for reading / writing	Read from or write to the first address following the address specified by P5.011.	6	2345	18	6789
P5.102 Window #5 for reading / writing	Read from or write to the second address following the address specified by P5.011.	7	3456	19	7890
P5.103 Window #6 for reading / writing	Read from or write to the third address following the address specified by P5.011.	8	4567	20	8901

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7.2.2 High-speed position capture function (Capture)

The high-speed position capturing function (CAP) uses the external-triggered high-speed digital input DI3 (B3-F, M) or DI7 (B3-L) (with execution time of only 5 μs) to capture the position data of the motion axis and store it in the data array for further motion control. As the Capture function is executed by the hardware, there is no lag in the software, and it is able to capture the motion axis' position accurately. While the Capture function is enabled, the servo drive sends a DI signal for the capture signal (the DI is not user-defined).

The flowchart for high-speed position capturing is shown in Figure 7.2.2.1. The relevant parameters are defined as follows. P5.036 sets the start position in the data array for storing the captured data; if it is not set, the default start position is #0. P5.038 sets the capturing amount. The amount has to be greater than 0, otherwise the Capture function is not executed. P1.019.X enables the cycle mode. When the last data is captured, the capturing amount is reset to 0 (P5.038 = 0), and the next cycle starts automatically to capture the set capturing amount. However, the start position for storing the captured position data is still determined by P5.036; that is, the captured data in the previous cycle is replaced by the data captured in the next cycle. P5.039 enables and disables the Capture function and other settings. See the following table for more information. To capture multiple position data, use P1.020 to set the masking range for capturing. This prevents the same position data being captured repeatedly because capturing more than once is not allowed in the masked area. You can set the Capture function in ASDA-Soft, as shown in Figure 7.2.2.2.

P5.039	Bit	Function	Description
X	0	Enable Capture function	When P5.038 > 0 and bit 0 = 1, the capturing starts and DO.CAP_OK is off. Each time a position is captured, the value of P5.038 is decremented by 1. When P5.038 = 0, it means the capturing is finished, DO.CAP_OK is on, and bit 0 is reset to 0. If bit 0 is already 1, the written value must not be 1; you must write 0 to disable the Capture function.
	1	Reset position when first data is captured	If bit 1 = 1, after the first data is captured, set the Capture axis' position to the value of P5.076.
	2	Reserved	-
	3	Execute PR#50 after the last data is captured	If bit 3 = 1, execute PR#50 once all data are captured.
Y	-	Source of Capture axis	0: disabled 1: reserved 2: CN1 3: CN2
Z	-	Trigger logic	0: NO (normally open) 1: NC (normally closed)
U	-	Minimum trigger interval (ms)	-
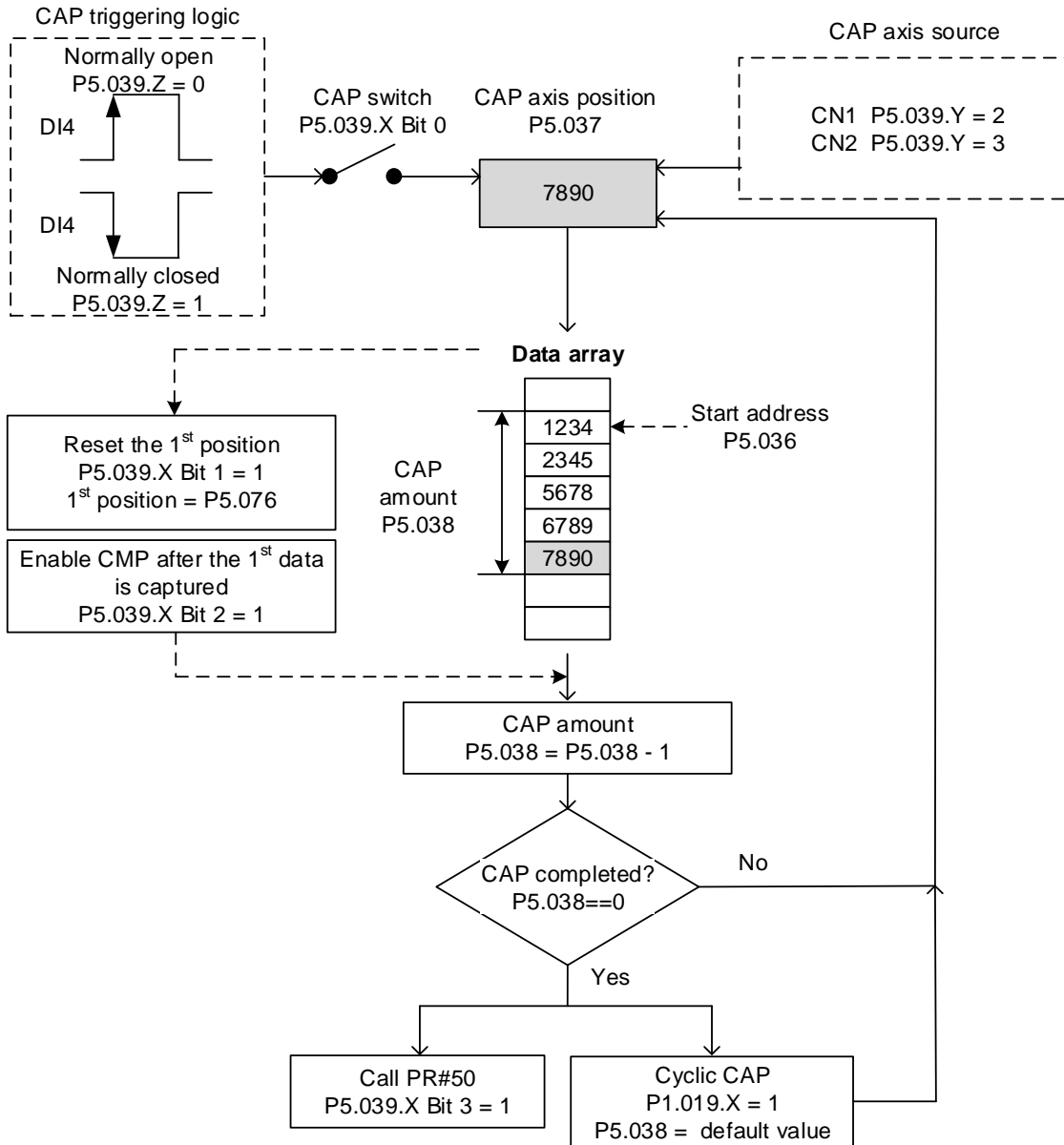
Figure 7.2.2.1 Flowchart for high-speed position capturing
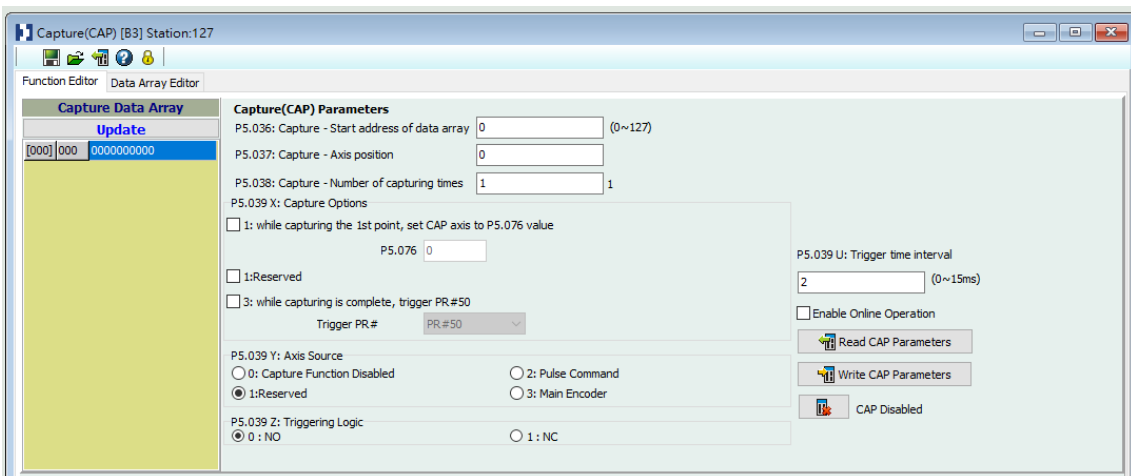
Figure 7.2.2.2 Capture function screen in ASDA-Soft

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It is suggested that you use the PR path programming to use the motion commands with the Capture function. You can use Write commands to set the high-speed position capture function, as well as to execute motion commands once capturing is complete.

See the example in Figure 7.2.2.3. PR#1 confirms that the Capture function is disabled (P5.039.X [Bit 0] = 0). PR#2 sets the start position of data array to #1. PR#3 sets the capturing amount to 3. PR#4 sets the capturing axis' position to 0 for the first capture point. PR#5 sets the cyclic capture mode with delay time of 1 ms to ensure that the next PR path can be executed with the Capture function. PR#6 enables the Capture function and resets the first point; and once completed, continue executing PR#50. This selects the motor's encoder as the capturing axis, using 'normally closed' contact as the trigger logic with a trigger interval of 2 ms. PR#7 sets the Speed command to 50 rpm. PR#50 sets the capture Position command to 50000 PUU. Once the command is completed, continue to PR#51 with the Speed command setting at 50 rpm.

From Figure 7.2.2.4, you can see that after the DI is triggered, the capturing axis is reset to 0 and the data stored in data array #1 because the Reset function for the first point is enabled and P5.076 is set to 0. At the moment the DI is triggered the second and third time, the position data is written to the data array #2 and #3. Once the first capture cycle is complete, DO: [0x16]CAP is set to on and then PR#50 (high-speed position capture command) and PR#51 (motion with fixed speed) are executed. Then, the servo drive continues executing the next cycle; meanwhile, DO: CAP is set to off when the procedure is complete and the capturing amount is set to 3. When the DI is triggered for the fourth time, the capture axis' position is not reset; the position data of the capturing axis is written to #1 again. Therefore, the data written in the previous cycle is replaced. At the moment the DI is triggered the fifth and sixth time, the position data is written to the data array #2 and #3. Once the second capture cycle is complete, DO: [0x16]CAP is set to on and then PR#50 (high-speed position capture command) and PR#51 (motion with fixed speed) are executed.

When using Cyclic Capture mode (P1.019.X = 1), the Reset function for the first point is only valid for the first cycle. Executing the PR path is valid for every cycle; in other words, every time a cycle ends, PR#50 is executed. The first position data captured in every cycle is written to the data array set by P5.036, and then the other data is written in sequence. So, position data written in the previous cycle is always replaced by the position data of the next cycle.

PR#1 (I)	PR#2 (I)	PR#3 (I)	PR#4 (I)
Write	Write	Write	Write
DLY=[0] 0 ms P5.039=0x2030	DLY=[0] 0 ms P5.036=100	DLY=[0] 0 ms P5.038=3	DLY=[0] 0 ms P5.076=0

PR#5 (I)	PR#6 (I)	PR#7 (I)
Write	Write	Speed
DLY=[10] 1 ms P1.019=0x0001	DLY=[0] 0 ms P5.039=0x203B	DLY=[0] 0 ms 50 rpm Acc=[0] 3.33 ms Dec=[0] 3.33 ms

PR#50 (I)	PR#51
Position	Speed
DLY=[0] 0 ms 50000 PUU CAP 100 rpm	DLY=[0] 0 ms 50 rpm Acc=[0] 3.33 ms Dec=[0] 3.33 ms
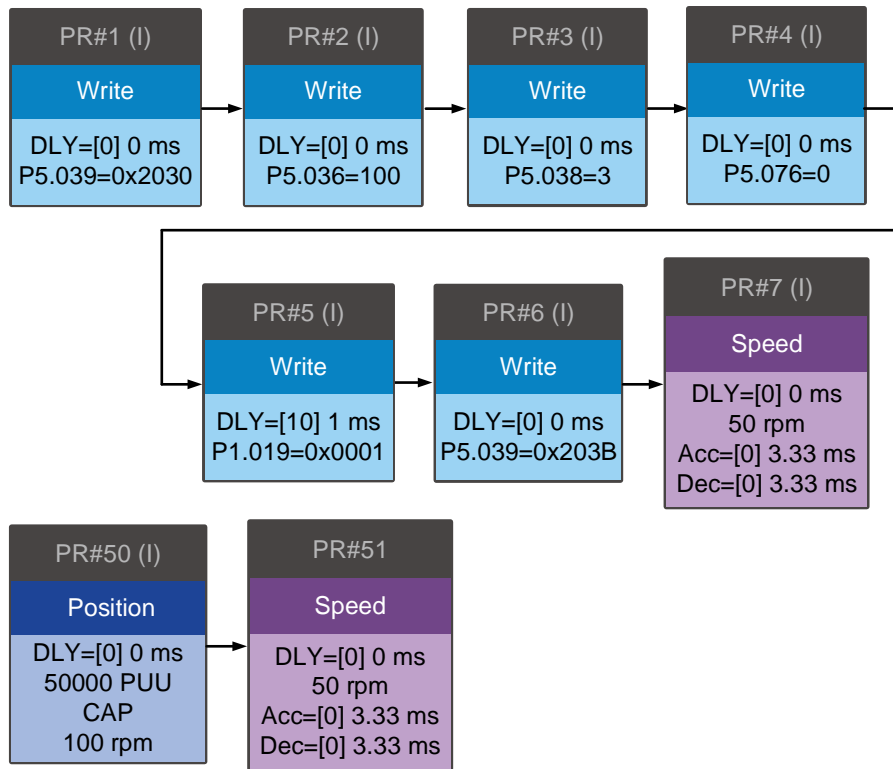
Figure 7.2.2.3 PR path with application of high-speed capture function
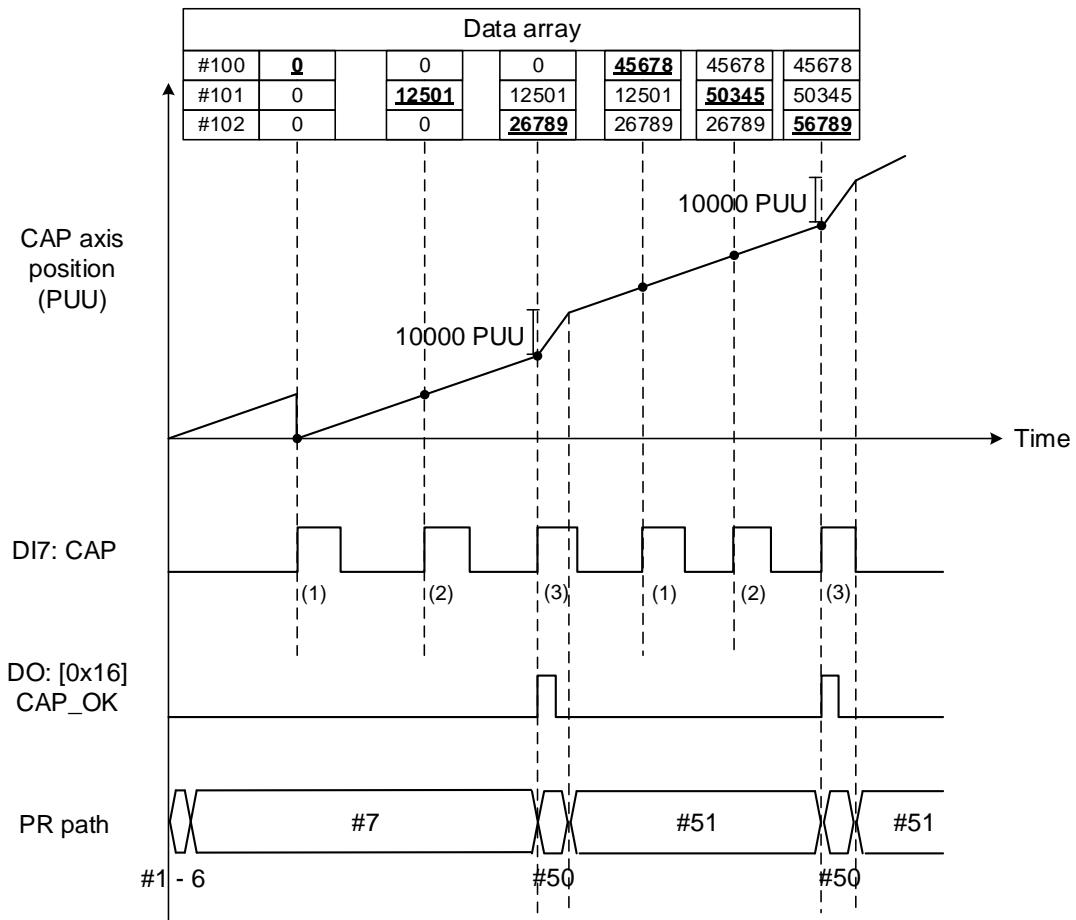
Figure 7.2.2.4 Application example for high-speed capture function

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Parameters

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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 number, expressed in hexadecimal. The parameter groups are:

Group 0: Monitoring parameters (Example: P0.xxx)

Group 1: Basic parameters (Example: P1.xxx)

Group 2: Extension parameters (Example: P2.xxx)

Group 3: Communication parameters (Example: P3.xxx)

Group 4: Diagnosis parameters (Example: P4.xxx)

Group 5: Motion control parameters (Example: P5.xxx)

Group 6: PR parameters (Example: P6.xxx)

Group 7: PR parameters (Example: P7.xxx)

Control mode description:

PT: Position control (command input through terminal block)

PR: Position control (command sent from internal register)

S: Speed control

T: Torque control

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 P4.000.
▲	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	-	O	O	O	O
P0.001■	Current drive alarm code (seven-segment display)	-	-	O	O	O	O
P0.002	Drive status	1	-	O	O	O	O
P0.003	Analog output monitoring	0x0000	-	O	O	O	O
P0.008★	Total servo drive operation time	0x00000000	hour	O	O	O	O
P0.009★■	Status monitoring register 1	-	-	O	O	O	O
P0.010★■	Status monitoring register 2	-	-	O	O	O	O
P0.011★■	Status monitoring register 3	-	-	O	O	O	O
P0.012★■	Status monitoring register 4	-	-	O	O	O	O
P0.013★■	Status monitoring register 5	-	-	O	O	O	O
P0.017	Select content displayed by status monitoring register 1	0	-	O	O	O	O
P0.018	Select content displayed by status monitoring register 2	0	-	O	O	O	O
P0.019	Select content displayed by status monitoring register 3	0	-	O	O	O	O
P0.020	Select content displayed by status monitoring register 4	0	-	O	O	O	O
P0.021	Select content displayed by status monitoring register 5	0	-	O	O	O	O
P0.025■	Mapping parameter #1	-	-	O	O	O	O
P0.026■	Mapping parameter #2	-	-	O	O	O	O
P0.027■	Mapping parameter #3	-	-	O	O	O	O
P0.028■	Mapping parameter #4	-	-	O	O	O	O
P0.029■	Mapping parameter #5	-	-	O	O	O	O
P0.030■	Mapping parameter #6	-	-	O	O	O	O
P0.031■	Mapping parameter #7	-	-	O	O	O	O
P0.032■	Mapping parameter #8	-	-	O	O	O	O
P0.035	Target setting for mapping parameter P0.025	-	-	O	O	O	O
P0.036	Target setting for mapping parameter P0.026	-	-	O	O	O	O
P0.037	Target setting for mapping parameter P0.027	-	-	O	O	O	O
P0.038	Target setting for mapping parameter P0.028	-	-	O	O	O	O

Monitoring and general output parameters (continued)

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P0.039	Target setting for mapping parameter P0.029	-	-	O	O	O	O
P0.040	Target setting for mapping parameter P0.030	-	-	O	O	O	O
P0.041	Target setting for mapping parameter P0.031	-	-	O	O	O	O
P0.042	Target setting for mapping parameter P0.032	-	-	O	O	O	O
P0.046★■	Servo drive digital output (DO) status	0x0000	-	O	O	O	O
P1.101■	Analog monitor output voltage 1	0	mV	O	O	O	O
P1.102■	Analog monitor output voltage 2	0	mV	O	O	O	O

(★)　　Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.000.
(▲)　　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	-	-	O	-
P1.007	Torque command smoothing constant (low-pass filter)	0	ms	-	-	-	O
P1.008	Position command smoothing constant (low-pass filter)	0	10 ms	O	O	-	-
P1.025	Low-frequency vibration suppression frequency (1)	1000	0.1 Hz	O	O	-	-
P1.026	Low-frequency vibration suppression gain (1)	0	-	O	O	-	-
P1.027	Low-frequency vibration suppression frequency (2)	1000	0.1 Hz	O	O	-	-
P1.028	Low-frequency vibration suppression gain (2)	0	-	O	O	-	-
P1.029	Auto low-frequency vibration suppression mode	0	-	O	O	-	-
P1.030	Low-frequency vibration detection	8000	pulse	O	O	-	-
P1.034	S-curve acceleration constant	200	ms	-	-	O	-
P1.035	S-curve deceleration constant	200	ms	-	-	O	-
P1.036	S-curve acceleration / deceleration constant	0	ms	-	O	O	-
P1.062	Percentage of friction compensation	0	%	O	O	O	-
P1.063	Constant of friction compensation	1	ms	O	O	O	-
P1.068	Position command - moving filter	4	ms	O	O	-	-

Filter and resonance suppression parameters (continued)

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.089	First set of vibration elimination - anti-resonance frequency	4000	0.1 Hz	O	O	-	-
P1.090	First set of vibration elimination - resonance frequency	4000	0.1 Hz	O	O	-	-
P1.091	First set of vibration elimination - resonance difference	10	0.1 dB	O	O	-	-
P1.092	Second set of vibration elimination - anti-resonance frequency	4000	0.1 Hz	O	O	-	-
P1.093	Second set of vibration elimination - resonance frequency	4000	0.1 Hz	O	O	-	-
P1.094	Second set of vibration elimination - resonance difference	10	0.1 dB	O	O	-	-
P2.023	Notch filter frequency (1)	1000	Hz	O	O	O	O
P2.024	Notch filter attenuation level (1)	0	-dB	O	O	O	O
P2.043	Notch filter frequency (2)	1000	Hz	O	O	O	O
P2.044	Notch filter attenuation level (2)	0	-dB	O	O	O	O
P2.045	Notch filter frequency (3)	1000	Hz	O	O	O	O
P2.046	Notch filter attenuation level (3)	0	-dB	O	O	O	O
P2.047	Auto resonance suppression mode	0x0001	-	O	O	O	O
P2.048	Auto resonance detection level	100	-	O	O	O	O
P2.025	Resonance suppression low-pass filter	1.0 (panel / software) 10 (communication)	1 ms (panel / software) 0.1 ms (communication)	O	O	O	O
P2.049	Speed detection filter and jitter suppression	1.0 (panel / software) 10 (communication)	1 ms (panel / software) 0.1 ms (communication)	O	O	O	O
P2.095	Notch filter bandwidth (1)	5	-	O	O	O	O
P2.096	Notch filter bandwidth (2)	5	-	O	O	O	O
P2.097	Notch filter bandwidth (3)	5	-	O	O	O	O
P2.098	Notch filter frequency (4)	1000	Hz	O	O	O	O
P2.099	Notch filter attenuation level (4)	0	-dB	O	O	O	O
P2.100	Notch filter bandwidth (4)	5	-	O	O	O	O
P2.101	Notch filter frequency (5)	1000	Hz	O	O	O	O
P2.102	Notch filter attenuation level (5)	0	-dB	O	O	O	O
P2.103	Notch filter bandwidth (5)	5	-	O	O	O	O

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Gain and switching parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.037	Load inertia ratio	6.0 0.0 (B3-F) (panel / software)	1 times (panel / software)	O	O	O	O
		60 0 (B3-F) (communication)	0.1 times (communication)				
P2.000	Position control gain	35	rad/s	O	O	-	-
P2.001	Position control gain rate of change	100	%	O	O	-	-
P2.002	Position feed forward gain	50	%	O	O	-	-
P2.003	Position feed forward gain smoothing constant	5	ms	O	O	-	-
P2.004	Speed control gain	500	rad/s	O	O	O	O
P2.005	Speed control gain rate of change	100	%	O	O	O	O
P2.006	Speed integral compensation	100	rad/s	O	O	O	O
P2.007	Speed feed forward gain	0	%	O	O	O	O
P2.026	Anti-interference gain	0	rad/s	O	O	O	O
P2.027	Gain switching condition and method selection	0x0000	-	O	O	O	O
P2.028	Gain switching time constant	10	ms	O	O	O	O
P2.029	Gain switching condition	16777216	pulse kpps rpm	O	O	O	O
P2.031	Bandwidth response level	19	-	O	O	O	O
P2.032	Gain adjustment mode	0x0001 0X0000 (B3-F)	-	O	O	O	O
P2.053	Position integral compensation	0	rad/s	O	O	O	O
P2.089	Command response gain	25	rad/s	O	O	-	-
P2.094▲	Special bit register 3	0x1010 0X0010 (B3-F)	-	O	O	O	-
P2.104	P/PI torque switching command condition	800	%	O	O	O	-
P2.105	Automatic gain adjustment level 1	11	-	O	O	-	-
P2.106	Automatic gain adjustment level 2	2000	pulse	O	O	-	-
P2.112▲	Special bit register 4	0x0018	-	O	O	O	-

(★)   Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.000.
(▲)   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 0x000B (B3-F)	-	O	O	O	O
P1.002▲	Speed and torque limits	0x0000	-	O	O	O	O
P1.003	Encoder pulse output polarity	0x0000	-	O	O	O	O
P1.012 - P1.014	Internal Torque command / internal torque limit 1 - 3	100	%	O	O	O	O
P1.044▲	E-Gear ratio (numerator) (N1)	16777216	pulse	O	O	-	-
P1.045▲	E-Gear ratio (denominator) (M)	100000	pulse	O	O	-	-
P1.046▲	Encoder pulse number output	2500	pulse	O	O	O	O
P1.055	Maximum speed limit	Rated speed	rpm	O	O	O	O
P1.097▲	Encoder output denominator (OA, OB)	0	-	O	O	O	O
P5.003	Deceleration time for auto-protection	0xEEEFEEFF	-	-	O	O	O
P5.020 - P5.035	Acceleration / deceleration times (Number #0 - 15)	Refer to description of each parameter	ms	-	O	-	-
P5.016■	Axis position - motor encoder	0	PUU	O	O	O	O
P5.018	Axis position - pulse command	0	pulse	O	O	O	O

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

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

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

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

(★)   Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.000.
(▲)   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 0x000B (B3-F)	-	O	O	O	O
P1.002▲	Speed and torque limits	0x0000	-	O	O	O	O
P1.003	Encoder pulse output polarity	0x0000	-	O	O	O	O
P1.046▲	Encoder pulse number output	2500	pulse	O	O	O	O
P1.055	Maximum speed limit	Rated speed	rpm	O	O	O	O
P1.009 - P1.011	Internal Speed command / internal speed limit 1 - 3	1000 - 3000	0.1 rpm	-	-	O	O
P1.012 - P1.014	Internal Torque command / internal torque limit 1 - 3	100	%	O	O	O	O
P1.040	First set of maximum rotation speed for analog Speed command	3000	rpm	-	-	O	O
P1.081	Second set of maximum rotation speed for analog Speed command	Rated speed	rpm	-	-	O	O
P1.041▲	Maximum output for analog Torque command	100	%	O	O	O	O
P1.076▲	Maximum speed for encoder output (OA, OB)	5500	rpm	O	O	O	O

Torque control parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P1.001●	Input for control mode and control command	0x0000 0x000B (B3-F)	-	O	O	O	O
P1.002▲	Speed and torque limits	0x0000	-	O	O	O	O
P1.003	Encoder pulse output polarity	0x0000	-	O	O	O	O
P1.046▲	Encoder pulse number output	2500	pulse	O	O	O	O
P1.055	Maximum speed limit	Rated speed	rpm	O	O	O	O
P1.009 - P1.011	Internal Speed command / internal speed limit 1 - 3	1000 - 3000	0.1 rpm	-	-	O	O
P1.012 - P1.014	Internal Torque command / internal torque limit 1 - 3	100	%	O	O	O	O
P1.040	First set of maximum rotation speed for analog Speed command	3000	rpm	-	-	O	O
P1.081	Second set of maximum rotation speed for analog Speed command	Rated speed	rpm	-	-	O	O
P1.041▲	Maximum output for analog Torque command	100	%	O	O	O	O

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Planning of digital input / output pin and output parameters

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P0.053	General range compare DO output - filter time	0x0000	-	O	O	O	O
P0.054	General range compare digital output - first lower limit	0	-	O	O	O	O
P0.055	General range compare digital output - first upper limit	0	-	O	O	O	O
P0.056	General range compare digital output - second lower limit	0	-	O	O	O	O
P0.057	General range compare digital output - second upper limit	0	-	O	O	O	O
P0.058	General range compare digital output - third lower limit	0	-	O	O	O	O
P0.059	General range compare digital output - third upper limit	0	-	O	O	O	O
P0.060	General range compare digital output - fourth lower limit	0	-	O	O	O	O
P0.061	General range compare digital output - fourth upper limit	0	-	O	O	O	O
P2.009	DI response filter time	2	ms	O	O	O	O
P2.010	DI1 functional planning	0x0101 (B3-L) 0x0100	-	O	O	O	O
P2.011	DI2 functional planning	0x0104 (B3-L) 0x0022	-	O	O	O	O
P2.012	DI3 functional planning	0x0116 (B3-L) 0x0023	-	O	O	O	O
P2.013	DI4 functional planning	0x0117 (B3-L) 0x0021	-	O	O	O	O
P2.014	DI5 functional planning	0x0102 (B3-L) 0x0100	-	O	O	O	O
P2.015	DI6 functional planning	0x0022 (B3-L) 0x0100	-	O	O	O	O
P2.016	DI7 functional planning	0x0023 (B3-L) 0x0100	-	O	O	O	O
P2.017	DI8 functional planning	0x0021 (B3-L) 0x0100	-	O	O	O	O
P2.018	DO1 functional planning	0x0101 (B3-L) 0x0100	-	O	O	O	O
P2.019	DO2 functional planning	0x0103 (B3-L) 0x0100	-	O	O	O	O
P2.020	DO3 functional planning	0x0109 (B3-L) 0x0100	-	O	O	O	O
P2.021	DO4 functional planning	0x0105 (B3-L) 0x0100	-	O	O	O	O
P2.022	DO5 functional planning	0x0007 (B3-L) 0x0100	-	O	O	O	O
P2.036	DI9 functional planning	0x0100	-	O	O	O	O
P2.037	DI10 functional planning	0x0100	-	O	O	O	O

Planning of digital input / output pin and output parameters (continued)

Parameter No.	Function	Default value	Unit	Control mode			
				PT	PR	S	T
P2.038	DI11 functional planning	0x0100	-	O	O	O	O
P2.039	DI12 functional planning	0x0100	-	O	O	O	O
P2.040	DI13 functional planning	0x0100	-	O	O	O	O
P2.041	DO6 functional planning	0x0100	-	O	O	O	O
P1.038	Zero speed range	10.0 (panel / software)	1 rpm (panel / software)	O	O	O	O
		100 (communication)	0.1 rpm (communication)				
P1.039	Target speed detection level	3000	rpm	O	O	O	O
P1.042	Enable delay time for magnetic brake	0	ms	O	O	O	O
P1.043	Disable delay time for magnetic brake	0	ms	O	O	O	O
P1.047	Speed reached (DO.SP_OK) range	10	rpm	-	-	O	-
P1.054	Pulse range for position reached	167772	pulse	O	O	-	-
P1.056	Motor output overload warning level	120	%	O	O	O	O

(★)   Read-only parameter. Can only read the value of the parameter. For example, P0.000, P0.010, and P4.000.
(▲)   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	-	O	O	O	O
P3.001●	Transmission speed	0x0203 0x3203 (B3-F)	-	O	O	O	O
P3.002	Communication protocol	0x0006	-	O	O	O	O
P3.003	MODBUS communication error handling	0x0000	-	O	O	O	O
P3.004	Communication timeout	0	sec	O	O	O	O
P3.006■	Digital input (DI) control switch	0x0000	-	O	O	O	O
P3.007	MODBUS communication response delay time	0	0.5 ms	O	O	O	O

Diagnosis parameters

Parameter No.	Function	Default value	Unit	Control mode PT	PR	S	T
P4.000★	Fault record (N)	0x00000000	-	O	O	O	O
P4.001★	Fault record (N-1)	0x00000000	-	O	O	O	O
P4.002★	Fault record (N-2)	0x00000000	-	O	O	O	O
P4.003★	Fault record (N-3)	0x00000000	-	O	O	O	O
P4.004★	Fault record (N-4)	0x00000000	-	O	O	O	O
P4.005	Servo motor JOG control	20	rpm	O	O	O	O
P4.006■	Digital output register (readable and writable)	0x0000	-	O	O	O	O
P4.007■	Multi-function for digital input	0x0000	-	O	O	O	O
P4.008★	Input status of servo drive panel (read-only)	-	-	O	O	O	O
P4.009★	Digital output status (read-only)	-	-	O	O	O	O
P4.010▲■	Adjustment function	0	-	O	O	O	O
P4.011	Analog speed input (1) offset adjustment	Factory setting	-	O	O	O	O
P4.012	Analog speed input (2) offset adjustment	Factory setting	-	O	O	O	O
P4.013	Analog torque input (1) offset adjustment	Factory setting	-	O	O	O	O
P4.014	Analog torque input (2) offset adjustment	Factory setting	-	O	O	O	O
P4.015	Current encoder (V1 phase) offset adjustment	Factory setting	-	O	O	O	O
P4.016	Current encoder (V2 phase) offset adjustment	Factory setting	-	O	O	O	O
P4.017	Current encoder (W1 phase) offset adjustment	Factory setting	-	O	O	O	O
P4.018	Current encoder (W2 phase) offset adjustment	Factory setting	-	O	O	O	O
P4.019	IGBT NTC adjustment level (cannot reset)	Factory setting	-	O	O	O	-
P4.020	Offset adjustment for analog monitor output (Ch1)	0	mV	O	O	O	O
P4.021	Offset adjustment for analog monitor output (Ch2)	0	mV	O	O	O	O
P4.022	Analog speed input offset	0	mV	-	-	O	-
P4.023	Analog torque input offset	0	mV	-	-	-	O

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

Settings:

Displays the firmware version of the servo drive.

P0.001■	**Current drive alarm code (seven-segment display)**		Address: 0002H 0003H
Default:	-	Control mode:	All
Unit:	-	Setting range:	0x0000: alarm clear (same as DI.ARST) 0x0001 - 0xFFFF: displays the alarm code (not writable)
Format:	HEX	Data size:	16-bit

Settings:

For the list of alarms, 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

Settings:

The parameter setting displayed on the panel. 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 - 0x0077
Format:	HEX	Data size:	16-bit

Settings:

```
 0000
 ----
U Z Y X
```

X	MON2 value	Z	Reserved
Y	MON1 value	U	Reserved

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MON1 and MON2 value	Description	MON1 and MON2 value	Description
0	Motor speed (+/- 8 volts / Maximum speed)	4	Torque command (+/- 8 volts / Maximum Torque command)
1	Motor torque (+/- 8 volts / Maximum torque)	5	VBUS voltage (+/- 8 volts / 450V)
2	Pulse command frequency (+8 volts / 4.5 Mpps)	6	Analog output voltage is the set value of P1.101
3	Speed command (+/- 8 volts / Maximum Speed command)	7	Analog output voltage is the set 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 01 (MON1 is the analog output of motor speed; MON2 is the analog output of motor torque):

$$\text{MON1 output voltage} = 8 \times \frac{\text{Motor speed}}{(\text{Maximum speed} \times \frac{P1.004}{100})} \text{ (Unit: volts)}$$

$$\text{MON2 output voltage} = 8 \times \frac{\text{Motor torque}}{(\text{Maximum torque} \times \frac{P1.005}{100})} \text{ (Unit: volts)}$$

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

Settings:

Displays the total servo drive operation and Servo On time. The unit is in hours and durations of less than 1 hour are not recorded. The recorded hours are saved when the servo power is off.

High bit   Low bit

h052A   L052A

D C B A   U Z Y X

DCBA	Servo On time	UZYX	Servo power applied time

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

Settings:

Set the value to be monitored in P0.017 through the drive panel or communication. Please refer to P0.002. To get the status, read the communication address through the communication port.

For example, if you set P0.017 to 7 to access P0.009, the panel displays the motor speed (rpm).

If accessing the data through MODBUS communication, it reads two 16-bit values (0012H and 0013H) as a single 32-bit value. (0013H : 0012H) = (Hi-word : Low-word). Set P0.002 to 23 and the panel displays "VAR-1" 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

Settings:

Set the value to be monitored in P0.018 through the drive panel or communication. Please refer to P0.002. To get the status, read the communication address through the communication port. 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

Settings:

Set the value to be monitored in P0.019 through the drive panel or communication. Please refer to P0.002. To get the status, read the communication address through the communication port. 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

Settings:

Set the value to be monitored in P0.020 through the drive panel or communication. Please refer to P0.002. To get the status, read the communication address through the communication port. 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

Settings:

Set the value to be monitored in P0.021 through the drive panel or communication. Please refer to P0.002. To get the status, 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

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

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

Settings:

Refer to Table 8.3 for the available values.

8

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

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

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

Settings:

You can continuously read and write parameters faster if they are not in the same group. Use P0.035 to

specify the mapping parameter number through the panel or communication. The value of the parameter

that is specified by P0.035 is shown in P0.025. Refer to P0.035 for its settings.

P0.026■	Mapping parameter #2	Address: 0034H 0035H
Default:	-	Control mode: All
Unit:	-	Setting range: Determined by the corresponding parameter P0.036
Format:	HEX	Data size: 32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.036.

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P0.027■	Mapping parameter #3		Address: 0036H 0037H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.037
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.037.

P0.028■	Mapping parameter #4		Address: 0038H 0039H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.038
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.038.

P0.029■	Mapping parameter #5		Address: 003AH 003BH
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.039
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.039.

P0.030■	Mapping parameter #6		Address: 003CH 003DH
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.040
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.040.

P0.031■	Mapping parameter #7		Address: 003EH 003FH
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.041
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.041.

P0.032■	Mapping parameter #8	Address: 0040H 0041H

Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the corresponding parameter P0.042
Format:	HEX	Data size:	32-bit

Settings:

This setting is the same as P0.025, except its mapping target is set in P0.042.

P0.033 - P0.034	Reserved

P0.035	Target setting for mapping parameter P0.025	Address: 0046H 0047H

Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:

The formats of the high-bit parameter (PH) and the low-bit parameter (PL) are:

High bit

```
hOS2A
 D C  BA
```

Low bit

```
LOS2A
 U Z  YX
```

BA	Hexadecimal code for the parameter index	YX	Hexadecimal code for the parameter index
C	Hexadecimal code for the parameter group	Z	Hexadecimal code for the parameter group
D	N/A	U	N/A

Select the data block to access the parameter corresponding to register 1. The mapping value is 32 bits and can map to two 16-bit parameters or one 32-bit parameter.

P0.035: (Mapping parameter: P0.035; Mapping content: P0.025)

	Set the parameter to be mapped for P0.025 high bit	Set the parameter to be mapped for P0.025 low bit
P0.035		
	↓	↓
P0.025	Map the parameter set in P0.035 high bit	Map the parameter set in P0.035 high bit
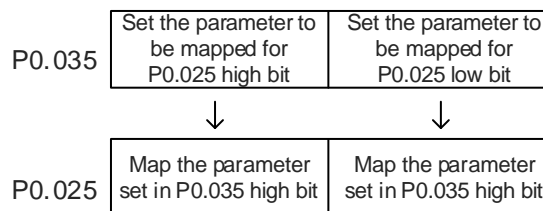
1. When PH ≠ PL, it indicates that the content of P0.025 includes two 16-bit parameters.

   Example: Target: set P2.003 to 0 in the mapping parameter and set P2.005 to 100.

   Setting: set the P0.035 high bit to 0203 (P2.003) and low bit to 0205 (P2.005).

   Thus, P0.035 = 0x02030205.

P0.035	P2.003	P2.005
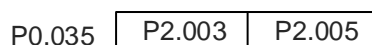
Write: in the mapping content, set P0.025 to 0x00050064, and the values of P2.003 and

P2.005 are:

P0.025 | 0005 | 0064

P2.003 | 0005   P2.005 | 0064
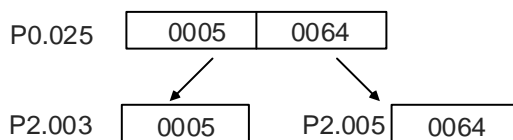
2. When PH = PL = P, it indicates that the content of P0.025 includes one 32-bit parameter.

Example: Target: set P6.010 to 0x00050064 in the mapping parameter.

Setting: set both the high bit and low bit of P0.035 to 060A (P6.010).

Thus, P6.010 = 0x060A060A.

P0.035 | P6.010 | P6.010
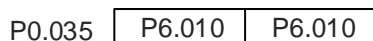
Write: in the mapping content, set P0.025 to 0x00050064 and P6.010 changes

immediately.

P0.036	Target setting for mapping parameter P0.026	Address: 0048H 0049H
Default:	-	Control mode: All
Unit:	-	Setting range: Determined by the communication address of the parameter group
Format:	HEX	Data size: 32-bit

Settings:

High bit   Low bit

P0.036 | Position of mapping parameter | Position of mapping parameter

↓   ↓

P0.026 | Content of mapping parameter | Content of mapping parameter
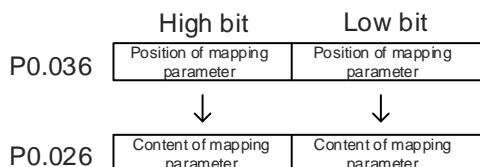
P0.037	Target setting for mapping parameter P0.027	Address: 004AH 004BH
Default:	-	Control mode: All
Unit:	-	Setting range: Determined by the communication address of the parameter group
Format:	HEX	Data size: 32-bit

Settings:

High bit   Low bit

P0.037 | Position of mapping parameter | Position of mapping parameter

↓   ↓

P0.027 | Content of mapping parameter | Content of mapping parameter
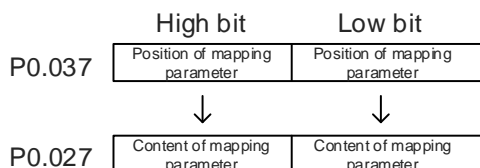
P0.038	**Target setting for mapping parameter P0.028**		**Address: 004CH 004DH**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:

High bit · Low bit

P0.038 | Position of mapping parameter | Position of mapping parameter
↓ ↓
P0.028 | Content of mapping parameter | Content of mapping parameter
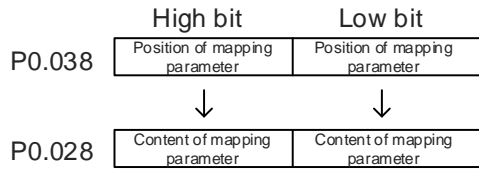
P0.039	**Target setting for mapping parameter P0.029**		**Address: 004EH 004FH**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:

High bit · Low bit

P0.039 | Position of mapping parameter | Position of mapping parameter
↓ ↓
P0.029 | Content of mapping parameter | Content of mapping parameter
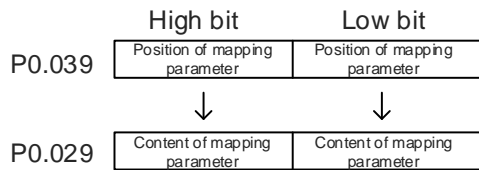
P0.040	**Target setting for mapping parameter P0.030**		**Address: 0050H 0051H**
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:

High bit · Low bit

P0.040 | Position of mapping parameter | Position of mapping parameter
↓ ↓
P0.030 | Content of mapping parameter | Content of mapping parameter
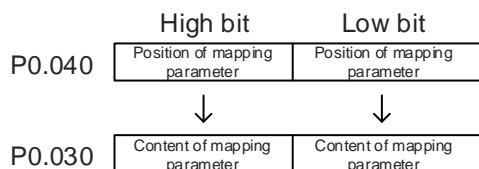
8

P0.041	Target setting for mapping parameter P0.031	Address: 0052H 0053H	
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit
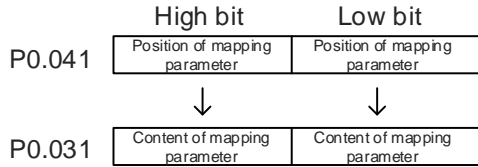
Settings:

P0.042	Target setting for mapping parameter P0.032	Address: 0054H 0055H	
Default:	-	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	HEX	Data size:	32-bit

Settings:
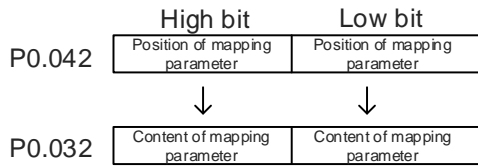
P0.043	Reserved

P0.044★■	Status monitoring register (for PC software)	Address: 0058H 0059H	
Default:	0	Control mode:	All
Unit:	-	Setting range:	Determined by the communication address of the parameter group
Format:	DEC	Data size:	32-bit

Settings:

This setting is the same as P0.009.

P0.045■	Status monitoring register content selection (for PC software)		Address: 005AH 005BH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-300 to 127
Format:	DEC	Data size:	16-bit

Settings:

This setting is the same as P0.017.

P0.046★■	Servo drive digital output (DO) status		Address: 005CH 005DH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x00FF
Format:	HEX	Data size:	16-bit

Settings:

Bit	7	6	5	4	3	2	1	0

Bit	15	14	13	12	11	10	9	8

Bit	Function	Bit	Function
0	SRDY (servo ready)	8	HOME (homing complete)
1	SON (servo activated)	9	OLW (early warning for motor overload)
2	ZSPD (zero speed detection)	10	WARN (This DO is on when servo warning, CW, CCW, EMGS, undervoltage, or communication error occurs.)
3	TSPD (target speed reached)	11	Reserved
4	TPOS (target position reached)	12	Reserved
5	TQL (torque limit activated)	13	Reserved
6	ALRM (servo alarm)	14	Reserved
7	BRKR (magnetic brake control output)	15	Reserved

P0.047 - P0.048	Reserved

P0.049■	Update encoder absolute position		Address: 0062H 0063H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0002
Format:	HEX	Data size:	16-bit

Settings:

```
 0002
U Z Y X
```

X	Command processing	Z	Reserved
Y	Reserved	U	Reserved

■ X: command processing

0: N/A

1: update the encoder data in P0.050 - P0.052.

2: update the values in 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 coordinate system status**		**Address: 0064H** **0065H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x001F
Format:	HEX	Data size:	16-bit

Settings:

Bit	7	6	5	4	3	2	1	0

Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0	Absolute position status	0: normal. 1: lost.
Bit 1	Battery voltage status	0: normal. 1: undervoltage.
Bit 2	Status for absolute number of turns	0: normal. 1: overflows.
Bit 3	PUU status	0: normal. 1: overflows.
Bit 4	Absolute coordinate status	0: established. 1: not yet established.
Bit 5 - Bit 15	Reserved	-

P0.051★■	**Encoder absolute position - multiple turns**		**Address: 0066H** **0067H**
Default:	0	Control mode:	All
Unit:	rev	Setting range:	-32768 to +32767
Format:	DEC	Data size:	16-bit

Settings:

When you set P2.070 [Bit 1] to 1 for reading the pulse number, this parameter indicates the number of turns of the motor (absolute position). 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 or PUU within single turn		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

Settings:

When you set P2.070 [Bit 1] to 1 for reading the pulse number, this parameter indicates the pulse number of the encoder which refers to the motor's absolute position within a single turn. When you set P2.070 [Bit 1] to 0 for reading the PUU number, this parameter indicates the motor's absolute position in PUU.

P0.053	General range compare DO output - filter time		Address: 006AH 006BH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0xFFFF
Format:	HEX	Data size:	16-bit

Settings:

```
0002
```
U Z Y X

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:
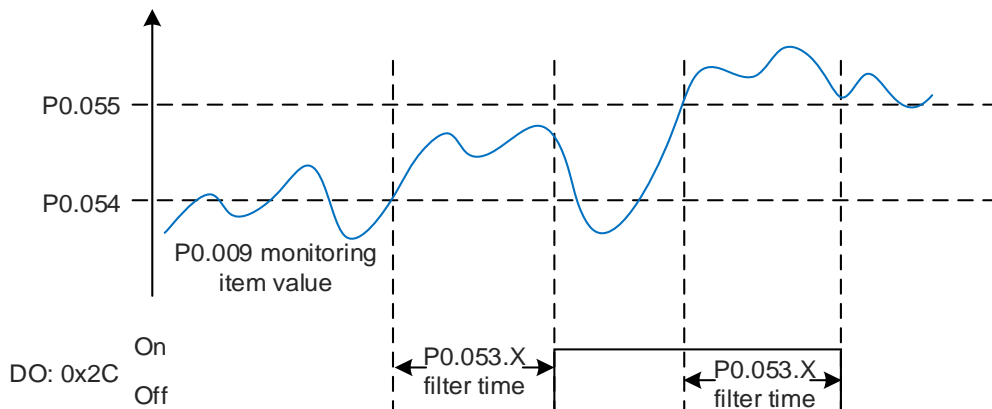
8

P0.054	General range compare digital output - first lower limit	Address: 006CH 006DH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Before using this function, set the digital output function to [0x2C] (first set of general range comparison) and the monitoring items 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 - first upper limit	Address: 006EH 006FH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P0.054.

P0.056	General range compare digital output - second lower limit	Address: 0071H 0072H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Before using this function, set the digital output function to [0x2D] (second set of general range comparison) and the monitoring items 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 - second upper limit	Address: 0073H 0074H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P0.056.

P0.058	General range compare digital output - third lower limit	Address: 0075H 0076H
Default:	0	Control mode: All
Unit:	-	Setting range: -2147483648 to +2147483647
Format:	DEC	Data size: 32-bit

Settings:

Before using this function, set the digital output function to [0x2E] (third set of general range comparison) and the monitoring items 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 - third upper limit	Address: 0077H 0078H
Default:	0	Control mode: All
Unit:	-	Setting range: -2147483648 to +2147483647
Format:	DEC	Data size: 32-bit

Settings:

Refer to the description of P0.058.

P0.060	General range compare digital output - fourth lower limit	Address: 0079H 007AH
Default:	0	Control mode: All
Unit:	-	Setting range: -2147483648 to +2147483647
Format:	DEC	Data size: 32-bit

Settings:

Before using this function, set the digital output function to [0x2F] (fourth set of general range comparison) and the monitoring items 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 - fourth upper limit	Address: 007BH 007CH
Default:	0	Control mode: All
Unit:	-	Setting range: -2147483648 to +2147483647
Format:	DEC	Data size: 32-bit

Settings:

Refer to the description of P0.060.

P0.062	Reserved

8

P0.063	Duration of voltage exceeding 400V		Address: 007EH 007FH
Default:	0	Control mode:	All
Unit:	ms	Setting range:	0x00000000 - 0x7FFFFFFF
Format:	DEC	Data size:	32-bit

Settings:

Records the total time during which the voltage of the servo drive exceeded 400V.

P1.xxx   Basic parameters

P1.000▲	External pulse input type		Address: 0100H 0101H
Default:	0x1042	Control mode:	PT
Unit:	-	Setting range:	0x0000 - 0x11F2
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

X	Pulse type	Z	Logic type
Y	Filter width	U	Filter width

■   X: pulse type

0: AB phase pulse (4x)

1: clockwise and counterclockwise pulse

2: pulse + 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
Z = 0	X = 0	Pulse phase lead	Pulse phase lag
	X = 1		

8

Logic type	Pulse type	Pulse input	
		Forward	Reverse
		Sign = low	Sign = high
Z = 0	X = 2		
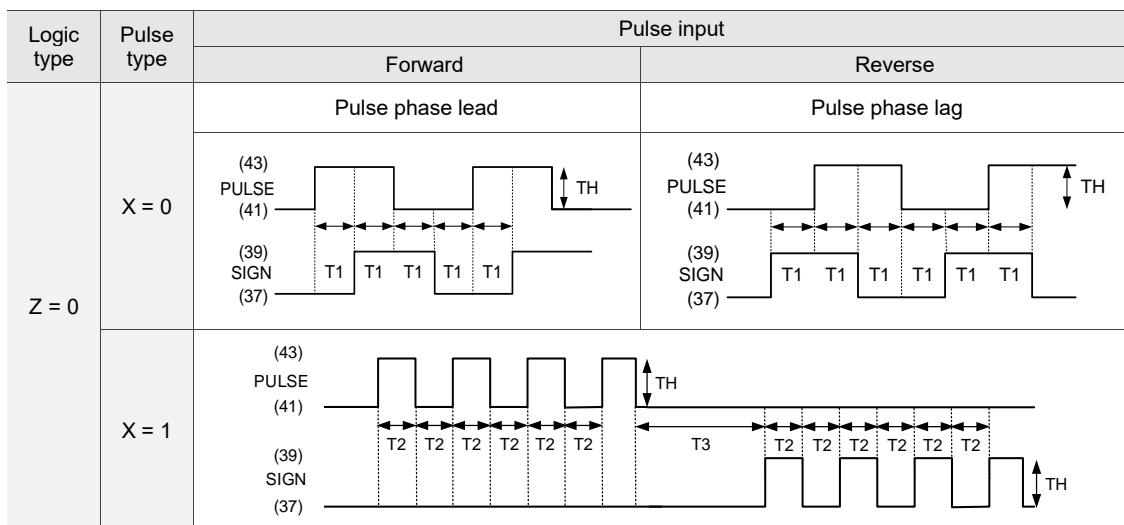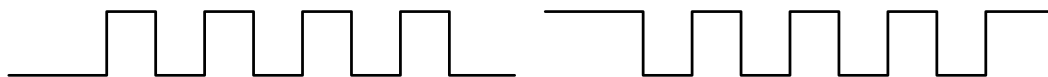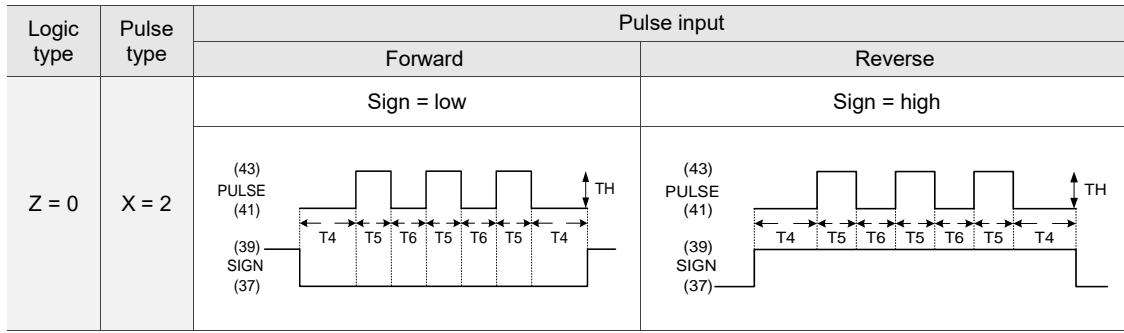
Note: pin definition of the communication type models is different from that of the L model. Communication type model pins: SIGN (23), /SIGN (24), PULSE (25), and /PULSE (26).

Pulse type		Maximum input frequency (single-phase)	Minimum allowed time width					
			T1	T2	T3	T4	T5	T6
Differential signa	Pulse train + sign	4 Mpps	62.5 ns	125 ns	250 ns	200 ns	125 ns	125 ns
	Forward and reverse pulse trains							
	AB phase pulse train	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
			Forward and reverse pulse trains			
			AB phase pulse train	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. Contact Delta for the production week of the servo drives that support the low speed pulse function.

■ UY: filter width setting

If the pulse frequency is too high, causing a pulse width smaller than the filter width, then this pulse gets filtered out as noise. Therefore, set the filter width smaller than the actual pulse width. You should set the filter width as 4 times smaller than the actual pulse width.

Y	U = 0 Unit: µs (kHz)	U = 1 Unit: µs (kHz)
0	No filter function	No filter function
1	2 (250)	0.2 (2500)
2	3 (166)	0.3 (1666)
3	4 (125)	0.4 (1250)
4	5 (100)	0.5 (1000)
5	6 (83)	0.6 (833)
6	7 (71)	0.7 (714)
7	8 (62)	0.8 (625)

Y	U = 0 Unit: µs (kHz)	U = 1 Unit: µs (kHz)
8	9 (55)	0.9 (555)
9	10 (50)	1 (500)
A	11 (45)	1.1 (454)
B	12 (41)	1.2 (416)
C	13 (38)	1.3 (384)
D	14 (35)	1.4 (357)
E	15 (33)	1.5 (333)

Example:

When you set U and Y to 1 respectively (and filter width is therefore 0.2 µs), and when the high and low duty width of the command pulse are both larger than 0.8 µs (four times the filter width 0.2 µs), then the pulse command is not filtered out.
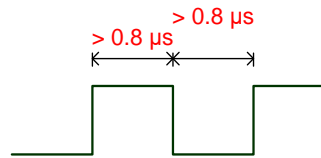
When the high or low duty width of the pulse is smaller than the filter width, then it is filtered out.
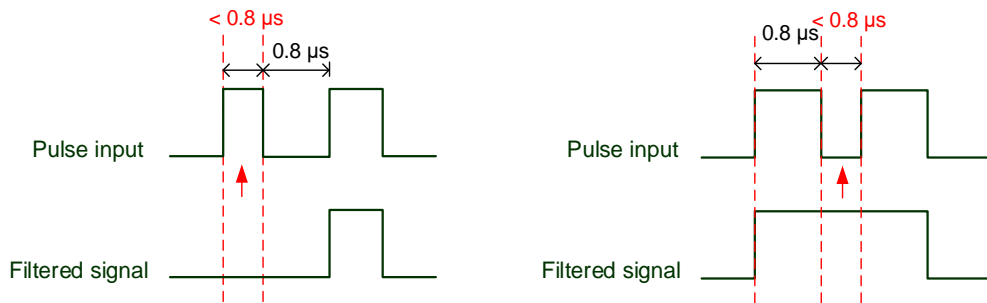
If the first pulse width is smaller than 0.8 µs, it may be filtered out, and thus two input pulses will be regarded as one pulse. If the pulse width is smaller than 0.2 µs, it will be filtered out.

If the low level pulse width is smaller than 0.8 µs, it may be filtered out, and thus two input pulses will be regarded as one pulse. If this low level pulse width is smaller than 0.2 µs, it will be filtered out.

If you use a 125 ns (4 Mpps) input pulse, set the filter value Y to 0 to disable the filter function.

Note: when the high-speed pulse specification of the signal is 4 Mpps and the value of the filter is 0, then the pulse is not filtered out.

8

P1.001●	**Input for control mode and control command**	Address: 0102H 0103H
Default:	0x0000 0x000B (B3-F)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x111F
Format:	HEX	Data size:	16-bit

Settings:

U Z YX

YX	Control mode setting	Z	Direction control
-	-	U	DIO value control

■ YX: control mode setting

Mode	PT	PR	S	T	Sz	Tz
00	▲					
01		▲				
02			▲			
03				▲		
04					▲	
05						▲
Dual mode						
06	▲		▲			
07	▲			▲		
08		▲	▲			
09		▲		▲		
0A			▲	▲		
0B	Communication mode for Delta PLC DVP-15MC and DVP-50MC series models, DMCNET mode					
0C	CANopen mode, EtherCAT mode					
Multi-mode						
0D	▲	▲				
0E	▲	▲	▲			
0F	▲	▲		▲		

PT: Position control mode; the command source is from the external pulse and the external analog voltage (coming soon).

PR: Position control mode; the command source is from the 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 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 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.

■   Z: direction control

	Z = 0	Z = 1
Positive direction	P(CCW)	P(CW)
Negative direction	N(CW)	N(CCW)
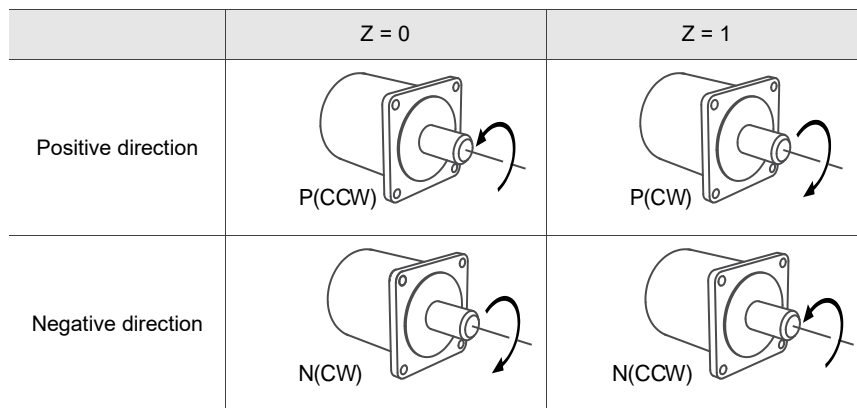
■   U: DIO value control (volatile)

0: when you switch the mode, DIO settings (P2.010 - P2.022) remain the same.

1: when you switch the mode, DIO settings (P2.010 - P2.022) are reset to the default corresponding to each mode.

P1.002▲	**Speed and torque limits**		**Address: 0104H 0105H**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0011
Format:	HEX	Data size:	16-bit

Settings:

```
0002
U Z Y X
```

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)

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See the following diagram for Speed Limit setting:
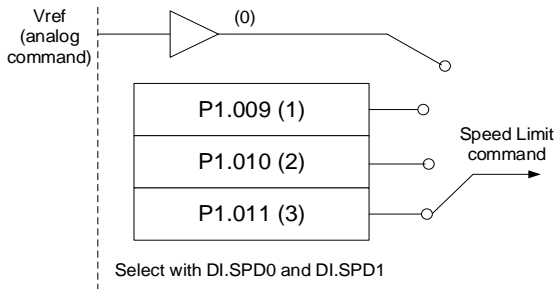
- Y: disable / enable Torque Limit function

  0: disable Torque Limit function

  1: enable Torque Limit function

See the following diagram for Torque Limit setting:
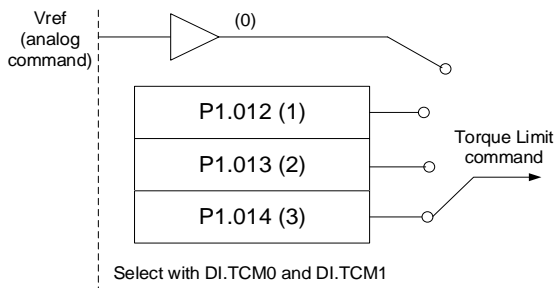
When using the Torque Limit function, set this parameter to 1 to limit the torque permanently without occupying a DI setting. Alternatively, you can enable or disable the limit function with DI.TRQLM, which is more flexible, but the setting then occupies a DI setting. You can enable the Torque Limit function with either P1.002 or DI.

P1.003	Encoder pulse output polarity		Address: 0106H 0107H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0013
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

X	Polarity of monitor analog output	Z	Reserved
Y	Polarity 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: polarity of encoder pulse output

     0: pulse output in positive direction

     1: pulse output in negative direction

P1.004	MON1 analog monitor output proportion	Address: 0108H 0109H
Default:	100	Control mode: All
Unit:	% (full scale)	Setting range: 0 - 100
Format:	DEC	Data size: 16-bit

Settings:

Refer to P0.003 for the analog output setting.

Example 1:

If the requirement is for the motor to run at 1,000 rpm, which corresponds to 8V, and its maximum

speed is 5,000 rpm, then the setting is:

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

Refer to the following examples for the motor's current speed and corresponding voltage output:

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

P1.005	MON2 analog monitor output proportion	Address: 010AH 010BH
Default:	100	Control mode: All
Unit:	% (full scale)	Setting range: 0 - 100
Format:	DEC	Data size: 16-bit

Settings:

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 - 1000
Format:	DEC	Data size: 16-bit

Settings:

0: disable this function.

8

P1.007	Torque command smoothing constant (low-pass filter)	Address: 010EH 010FH
Default:	0	Control mode:	T / Tz
Unit:	ms	Setting range:	0 - 1000
Format:	DEC	Data size:	16-bit

Settings:

0: disable this function.

P1.008	Position command smoothing constant (low-pass filter)	Address: 0110H 0111H
Default:	0	Control mode:	PT / PR
Unit:	10 ms	Setting range:	0 - 1000
Format:	DEC	Data size:	16-bit
Example:	11 = 110 ms		

Settings:

0: disable this function.

P1.009	Internal Speed command 1 / internal speed limit 1	Address: 0112H 0113H
Default:	1000	Control mode:	S / Sz: internal Speed command 1 T / Tz: internal speed limit 1
Unit:	0.1 rpm	Setting range:	-60000 to +60000
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.		

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:	-60000 to +60000
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.		

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:	-60000 to +60000
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.		

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:	-500 to +500
Format:	DEC	Data size:	16-bit
Example:	Internal Torque command: 30 = 30% Internal torque limit: positive and negative values are identical. Refer to the following descriptions.		

Settings:

Internal Torque command 1: first internal Torque command.

Internal torque limit 1: first internal torque limit.

Example of internal torque limit:

Torque limit value of P1.012	Valid torque range	Torque limit in forward direction	Torque limit in reverse direction
30	-30 to 30%	30%	-30%
-30			

P1.013	Internal Torque command 2 / internal torque limit 2		Address: 011AH 011BH
Default:	100	Control mode:	T / Tz: internal Torque command 2 PT / PR / S / Sz: internal torque limit 2
Unit:	%	Setting range:	-500 to +500
Format:	DEC	Data size:	16-bit
Example:	Internal Torque command: 30 = 30% Internal torque limit: positive and negative values are identical. Refer to the following descriptions.		

Settings:

Internal Torque command 2: second internal Torque command.

Internal torque limit 2: second internal torque limit.

Example of internal torque limit:

Torque limit value of P1.013	Valid torque range	Torque limit in forward direction	Torque limit in reverse direction
30	-30 to 30%	30%	-30%
-30			

P1.014	Internal Torque command 3 / internal torque limit 3		Address: 011CH 011DH
Default:	100	Control mode:	T / Tz: internal Torque command 3 PT / PR / S / Sz: internal torque limit 3
Unit:	%	Setting range:	-500 to +500
Format:	DEC	Data size:	16-bit
Example:	Internal Torque command: 30 = 30% Internal torque limit: positive and negative values are identical. Refer to the following descriptions.		

Settings:

Internal Torque command 3: third internal Torque command.

Internal torque limit 3: third internal torque limit.

Example of internal torque limit:

Torque limit value of P1.014	Valid torque range	Torque limit in forward direction	Torque limit in reverse direction
30	-30 to 30%	30%	-30%
-30			

P1.015 - P1.018	**Reserved**

P1.019	**Additional function for Capture**	Address: 0126H 0127H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0101
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

X	Additional function for Capture	Z	Reserved
Y	Reserved	U	Reserved

■   X: additional function for Capture

Bit	3	2	1	0
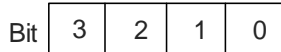
Bit	Function	Description
Bit 0	Cycle mode	0: disable this function. When the number of capturing times (P5.038) is 0, capturing is complete. 1: enable this function. When the number of capturing times (P5.038) is 0, it automatically resets the number of capturing times to the default setting.
Bit 1 - Bit 3	Reserved	-

P1.020	**Capture - masking range**	Address: 0128H 0129H
Default:	0	Control mode:	All
Unit:	Pulse unit of capture source	Setting range:	0 to +100000000
Format:	DEC	Data size:	32-bit

Settings:

When the Capture function is enabled and set to capture multiple points (P5.038 > 1), the system stops receiving the DI captured signal within this range once the data is captured. The DI captured signal received within this range is not recognized as valid. Use this function to avoid the system seeing noise as effective signals within the non-capture range.

After capturing this mark, activate the
masking area.
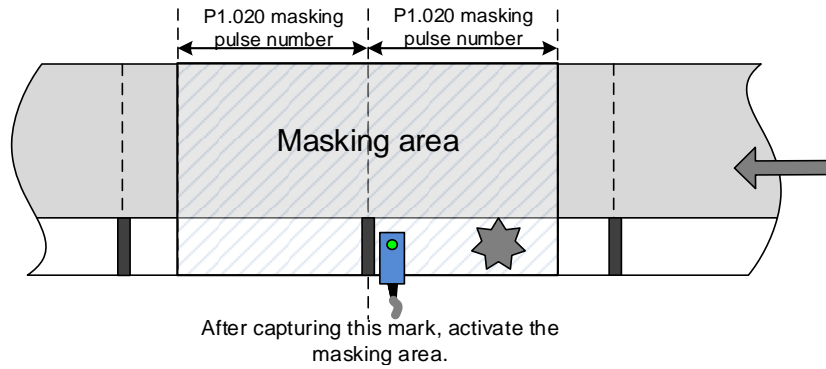
P1.021	Reserved

P1.022	PR command special filter	Address: 012CH 012DH

Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 - 0x107F
Format:	HEX	Data size:	16-bit

Settings:

U Z YX

YX	Acceleration / deceleration time limit (0 - 1270 ms)	Z	Reserved
-	-	U	Reverse inhibit

■ YX: acceleration / deceleration time limit (0 - 1270 ms)

The setting range is 00 to 7F, with the data format as HEX and unit as 10 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) with this function. If the acceleration / deceleration time of the command is shorter than this limit, the filter takes effect to smooth the acceleration / deceleration which prevents the command from changing too drastically and causing mechanical vibration. When the filter is functioning, the following error caused by the smooth command is automatically compensated after the command is smoothed, so the final position is not deviated.

Example:

Set YX to 12, so 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.

Command slows down and the two commands overlap | Command changes drastically so the filter takes effect
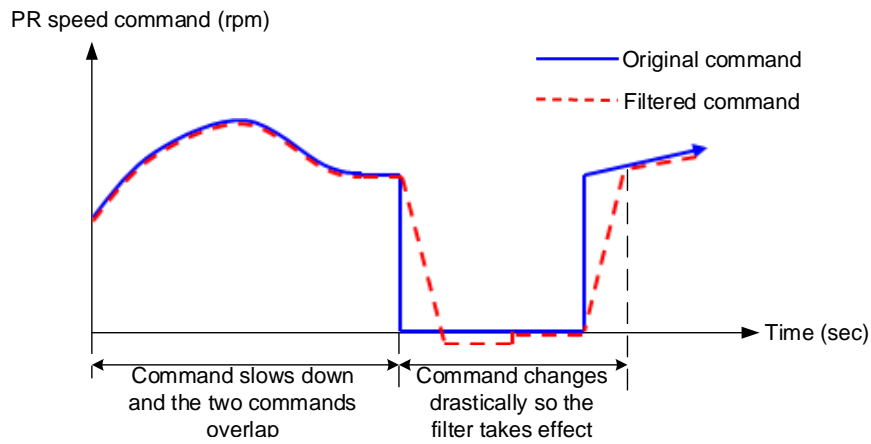
Note: if the command does not slow down, the following error of the internal position exceeds the allowable

range and then triggers AL404.

■ Z: reserved

■ 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.
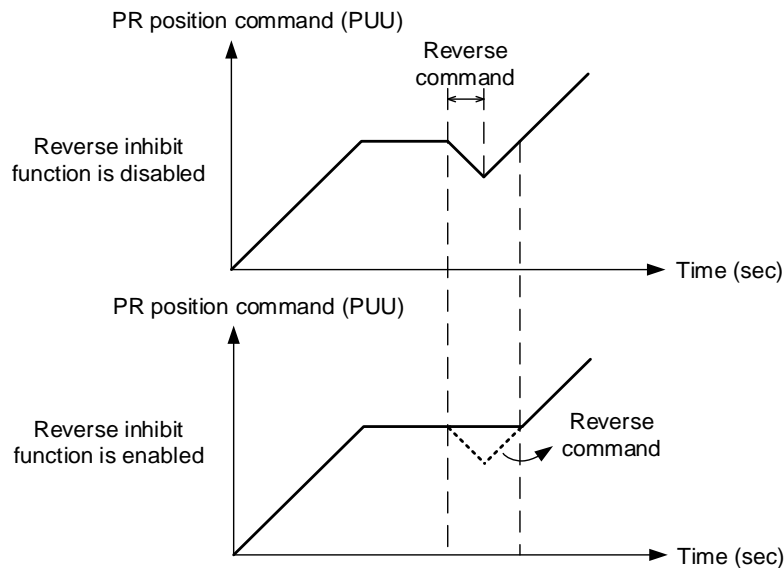
P1.023 - P1.024	Reserved	

P1.025	Low-frequency vibration suppression frequency (1)	Address: 0132H 0133H
Default:	1000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 - 1000
Format:	DEC	Data size:	16-bit
Example:	150 = 15 Hz	-	-

Settings:

Sets the first low-frequency vibration suppression frequency. When you set P1.026 to 0, the first

low-frequency vibration suppression filter is disabled.

P1.026	Low-frequency vibration suppression gain (1)		Address: 0134H 0135H
Default:	0	Control mode:	PT / PR
Unit:	-	Setting range:	0 - 9
Format:	DEC	Data size:	16-bit

Settings:

Sets the gain of the first low-frequency vibration suppression. The higher the value, the better the position response. If you set the value too high, the motor may not operate smoothly. The suggested value is 1. Set P1.026 to 0 to disable the first low-frequency vibration suppression filter.

P1.027	Low-frequency vibration suppression frequency (2)		Address: 0136H 0137H
Default:	1000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 - 1000
Format:	DEC	Data size:	16-bit
Example:	150 = 15 Hz	-	-

Settings:

Sets the second low-frequency vibration suppression frequency. 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 - 9
Format:	DEC	Data size:	16-bit

Settings:

Sets the gain of the second low-frequency vibration suppression. The higher the value, the better the position response. If you set the value too high, the motor may not operate smoothly. The suggested value is 1. Set P1.028 to 0 to disable the second low-frequency vibration suppression filter.

P1.029	Auto low-frequency vibration suppression mode		Address: 013AH 013BH
Default:	0	Control mode:	PT / PR
Unit:	-	Setting range:	0 - 1
Format:	DEC	Data size:	16-bit

Settings:

0: disable the automatic low-frequency vibration detection function.

1: disable the function automatically after vibration suppression. The value resets to 0 automatically.

Auto mode setting description:

When the value is 1, vibration suppression is in automatic mode. When the vibration cannot be detected or the vibration frequency is stable, the system automatically resets the parameter to 0 and 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 - 128000
Format:	DEC	Data size:	32-bit

Settings:

When enabling automatic vibration suppression (P1.029 = 1), the system automatically finds the detection level. The lower the value, the more sensitive the detection, but the system may misjudge noise or treat other low-frequency vibrations as frequencies to be suppressed. If the value is high, the system is less likely to misjudge, but if the mechanical vibration 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 - 0x0020
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

X	Reserved	Z	Reserved
Y	Dynamic brake operation options	U	Reserved

■ Y: options for using the dynamic brake when the servo is in the Servo Off state or an alarm (including EMGS) occurs

Bit	7	6	5	4

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, then let the motor run freely once the speed is slower than the value of P1.038
Bit 6	Trigger stop	0: disable this function

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Bit	Function	Description
	command when AL022 occurs	1: when P1.043 is a negative value and 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: the function of Bit 6 is only available in PT, PR, S, and Sz modes and is effective only when P1.043 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 - 65500
Format:	DEC	Data size: 16-bit

Settings:

P1.034, P1.035, and P1.036 represent the acceleration time for the Speed command from zero to the rated speed. You can set each parameter individually. When using an internal command, if you set P1.036 to 0, the acceleration and deceleration follow a trapezoid-curve; when using an analog command, you must set P1.036 larger than 0 so that the acceleration and deceleration follow a trapezoid-curve.

P1.035	**S-curve deceleration constant**	Address: 0146H 0147H
Default:	200	Control mode: S / Sz
Unit:	ms	Setting range: 1 - 65500
Format:	DEC	Data size: 16-bit

Settings:

P1.034, P1.035, and P1.036 represent the deceleration time for the Speed command from the rated speed to zero. You can set each parameter individually. When using an internal command, if you set P1.036 to 0, the acceleration and deceleration follow a trapezoid-curve; when using an analog command, you must set P1.036 larger than 0 so that the acceleration and deceleration follow a trapezoid-curve.

P1.036	S-curve acceleration / deceleration constant	Address: 0148H 0149H
Default:	0	Control mode: PR / S / Sz
Unit:	ms	Setting range: 0 - 65500
Format:	DEC	Data size: 16-bit

Settings:

0: disable this function.

Acceleration / deceleration constant of S-curve:
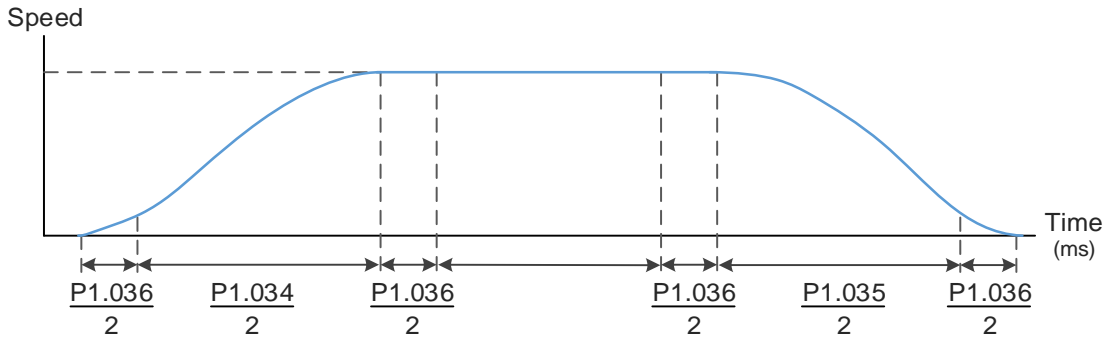
P1.034: set the acceleration time for the trapezoid-curve.

P1.035: set the deceleration time for the trapezoid-curve.

P1.036: set the smoothing time for the S-curve acceleration 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 trapezoid-curve.

Note the following error compensation:

	P1.036 = 0	P1.036 = 1	P1.036 > 1
Smoothing function for S-curve	Disabled	Disabled	Enable
Following error compensation function	Disabled	Enable	Determined by P2.068.X

P1.037	Load inertia ratio	Address: 014AH 014BH

Operation interface:	Panel / software	Communication	Control mode:	All
Default:	6.0 0.0 (B3-F)	60 0 (B3-F)	Data size:	16-bit
Unit:	1 times	0.1 times	-	-
Setting range:	0.0 - 200.0	0 - 2000	-	-
Format:	One decimal	DEC	-	-
Example:	1.5 = 1.5 times	15 = 1.5 times	-	-

Settings:

Load inertia ratio of servo motor (rotary motor): (J_load / J_motor)

J_motor: moment of inertia of the servo motor

J_load: total equivalent moment of inertia of external mechanical load

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P1.038	Zero speed range			Address: 014CH 014DH
Operation interface:	Panel / software	Communication	Control mode:	All
Default:	10.0	100	Data size:	16-bit
Unit:	1 rpm	0.1 rpm	-	-
Setting range:	0.0 - 200.0	0 - 2000	-	-
Format:	One decimal	DEC	-	-
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-

Settings:

Sets the range for the zero-speed signal (ZSPD). When the forward or reverse speed of the motor is

slower than this value, the zero-speed signal is triggered and DO.ZSPD is on.

P1.039	Target speed detection level		Address: 014EH 014FH
Default:	3000	Control mode:	All
Unit:	rpm	Setting range:	0 - 30000
Format:	DEC	Data size:	16-bit

Settings:

When the forward or reverse speed of the motor is faster than this value, the target speed signal is

triggered and DO.TSPD is on.

P1.040	First set of maximum rotation speed for analog Speed command		Address: 0150H 0151H
Default:	3000	Control mode:	S / T
Unit:	rpm	Setting range:	0 - 50000
Format:	DEC	Data size:	32-bit

Settings:

Maximum rotation speed for analog Speed command:

Speed mode:

$$\text{Speed control command} = \frac{\text{Voltage\_input} \times \text{Setting\_value}}{10}$$

Set the rotation speed corresponding to 10V (maximum voltage) for the analog speed control

command. If the value is 2000 and the external voltage input is 5V, then the speed control command is

1000 rpm.

$$\text{Speed control command} = \frac{5V \times 2000\_rpm}{10} = 1000 \text{ rpm}$$

Torque mode:

$$\text{Speed limit command} = \frac{\text{Voltage\_input} \times \text{Setting\_value}}{10}$$

Set the rotation speed corresponding to 10V (maximum voltage) for the analog speed limit command.

If the value is 2000 and the external voltage input is 5V, then the speed limit command is 1000 rpm.

$$\text{Speed limit command} = \frac{5V \times 2000\_rpm}{10} = 1000 \text{ rpm}$$

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P1.041▲	**Maximum output for analog Torque command**		Address: 0152H 0153H
Default:	100	Control mode:	All
Unit:	%	Setting range:	-1000 to 1000
Format:	DEC	Data size:	16-bit

Settings:

Torque mode:

Set the torque corresponding to 10V (maximum voltage) for the analog torque command.

$$\text{Torque control command} = \frac{\text{Voltage input} \times \text{P1.041}}{10} \text{ (Unit: \%)}$$

In Speed, PT, and PR modes:

Set the torque limit corresponding to 10V (maximum voltage) for the analog torque limit.

$$\text{Torque limit command} = \frac{\text{Voltage input} \times \text{Setting value}}{10} \text{ (Unit: \%)}$$

Example:

If P1.041 = 10

When the external analog voltage input is 10V, the torque control command = $\frac{10V \times 10}{10}$ = 10%

When the external analog voltage input is 5V, the torque control command = $\frac{5V \times 10}{10}$ = 5%

P1.042	**Enable delay time for magnetic brake**		Address: 0154H 0155H
Default:	0	Control mode:	All
Unit:	ms	Setting range:	0 - 1000
Format:	DEC	Data size:	16-bit

Settings:

Sets the delay time from Servo On status to the activation of the magnetic brake signal (DO: 0x08, BRKR).
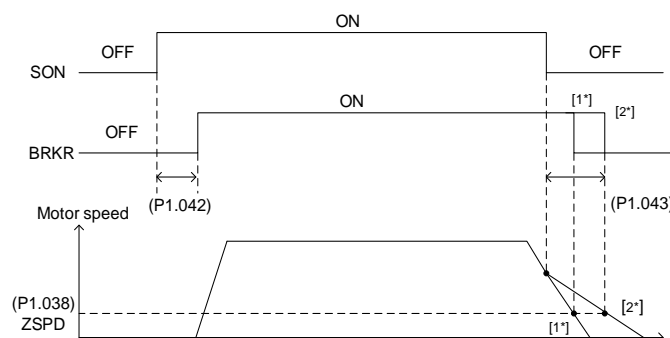
Note:

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	Disable delay time for magnetic brake		Address: 0156H 0157H
Default:	0	Control mode:	All
Unit:	ms	Setting range:	-1000 to 1000
Format:	DEC	Data size:	16-bit

Settings:

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, this setting does not function. This is equivalent to setting the delay time to 0.

P1.044▲	E-Gear ratio (numerator) (N1)		Address: 0158H 0159H
Default:	16777216	Control mode:	PT / PR
Unit:	pulse	Setting range:	1 to (2^{29}-1)
Format:	DEC	Data size:	32-bit

Settings:

For the E-Gear ratio setting, refer to Section 6.2.5. For multiple E-Gear ratio (numerator) settings, refer to P2.060 - P2.062.

Note: do not change the setting in the Servo On state.

P1.045▲	E-Gear ratio (denominator) (M)		Address: 015AH 015BH
Default:	100000	Control mode:	PT / PR
Unit:	pulse	Setting range:	1 to (2^{31}-1)
Format:	DEC	Data size:	32-bit

Settings:

If the setting is incorrect, the servo motor is prone to sudden unintended acceleration. Follow these instructions.

Setting of pulse input:

$$\xrightarrow[f1]{\text{Command pulse input}} \boxed{\frac{N}{M}} \xrightarrow[f2]{\text{Position command}} f2 = f1 \times \frac{N}{M}$$

Command pulse input range: $1/4 < Nx/M < 262144$.

For the E-Gear ratio setting, refer to Section 6.2.5.

Note: do not change the setting in the Servo On state.

P1.046▲	Encoder pulse number output		Address: 015CH 015DH
Default:	2500	Control mode:	All
Unit:	pulse	Setting range:	1 - 536870912
Format:	DEC	Data size:	32-bit

Settings:

The number of single-phase pulse outputs per revolution. The maximum output frequency of the hardware is 19.8 MHz.

Note:

In the following circumstances, pulse output of the encoder may exceed the maximum allowable output pulse frequency of the drive, causing AL018:

1. Encoder error

2. The motor speed is faster than 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 - 300
Format:	DEC	Data size:	16-bit

Settings:

In Speed mode, when the deviation between the Speed command and the motor feedback speed is less than this parameter and the difference reaches the time set in P1.049, the digital output DO.SP_OK (DO code: 0x19) is on.

Note: when the deviation 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    │──────────┐
        └──────────────────────┘          │
                                        + ↓
        ┌──────────────────────┐   ┌──────────────────────────┐
        │  2. Feedback speed   │──▶○─▶│  3. Obtain absolute value │
        └──────────────────────┘ -     └──────────────────────────┘
                                                  │
                                                  ↓
                              ┌──────────────────────────────┐
                              │  4. Determine if the         │
                              │  absolute value of speed     │
                              │  deviation is smaller than   │
                              │  P1.047                      │
                              └──────────────────────────────┘
                     ┌─────────────────┘        └─────────────────┐
                     ↓                                             ↓
        ┌──────────────────────┐                   ┌──────────────────────┐
        │  5. DO.SP_OK is on   │                   │  6. DO.SP_OK is off  │
        └──────────────────────┘                   └──────────────────────┘
```
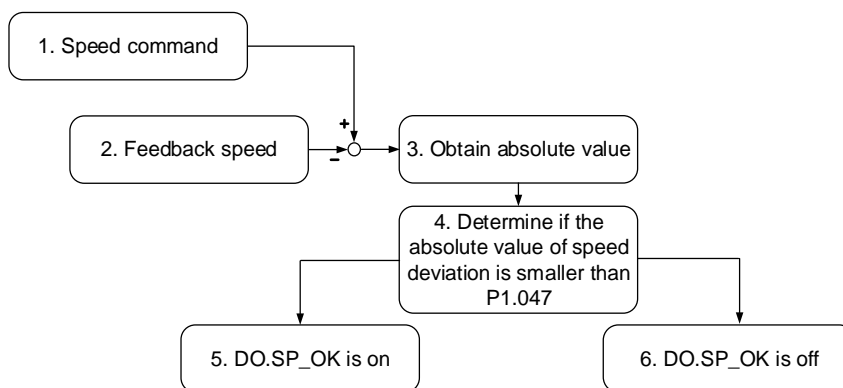
1. Speed command: the command that you input without acceleration or deceleration, rather than the command from the front end speed circuit. Its source is from the register.

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 deviation 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, DO.SP_OK 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 - 0x0011
Format:	HEX	Data size:	16-bit

Settings:

Control selection of digital output DO.MC_OK (DO code: 0x17).

U Z Y X

X	DO output hold option	Z	Reserved
Y	Position deviation alarm (AL380) option	U	Reserved

- X: DO output hold option

   0: output status is not retained

   1: output status is retained

- Y: position deviation alarm (AL380) option

   0: AL380 not functioning

   1: AL380 functioning

Diagram:
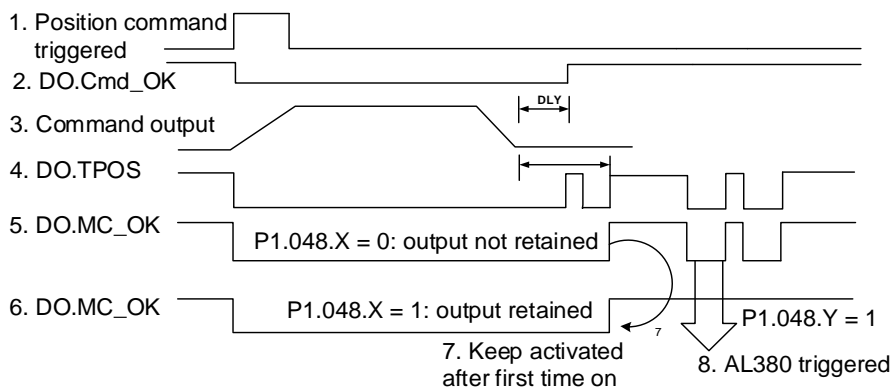
Description:

1. Command triggered: new PR command is effective. Command 3 starts and clears signals 2, 4, 5, and 6 simultaneously. Command triggering source: DI.CTRG, DI.EV1/EV2, 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: indicates whether 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. Can only select either signal 5 or signal 6 to output, and the choice is specified in P1.048.X.

8. Position deviation: when event 7 occurs, if signal 4 (or 5) is off, it means the position has deviated and AL380 can be triggered. Use P1.048.Y to set whether AL380 is functioning.

P1.049	Accumulated time to reach desired speed		Address: 0162H 0163H
Default:	0	Control mode:	S / Sz
Unit:	ms	Setting range:	0 - 65535
Format:	DEC	Data size:	16-bit

Settings:

Refer to the description of P1.047.

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 note.
Format:	DEC	Data size:	16-bit

Settings:

Model	Default (Ω)	Model	Default (Ω)
1.5 kW or below	100	2 - 3 kW (included)	20

Refer to the description of P1.053 for the parameter values when connecting the regenerative resistor through different methods.

Note:

Model	Setting range	Model	Setting range
750 W or below	60 - 750	2 - 3 kW	15 - 750
1 - 1.5 kW	30 - 750	-	-

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 - 3000
Format:	DEC	Data size:	16-bit

Settings:

Model	Default (Watt)	Model	Default (Watt)
200 W or below	0	2 - 3 kW (included)	80
400 W - 1.5 kW	40	-	-

Setting the parameter value when connecting the regenerative resistor with different methods:

External regenerative resistor	Setting
External regenerative resistor P⊕○━━ ⊰1 kW, 10Ω C○━━	Setting: P1.052 = 10 (Ω) P1.053 = 1000 (W)
External regenerative resistor (in series) P⊕○━━ ⊰1 kW, 10Ω ⊰1 kW, 10Ω C○━━	Setting: P1.052 = 20 (Ω) P1.053 = 2000 (W)
External regenerative resistor (in parallel) P⊕○━━●━━● 1 kW, 10Ω⊰ ⊰1 kW, 10Ω C○━━●━━●	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 - 1000000
Format:	DEC	Data size:	32-bit

Settings:

In Position (PT) mode, when the deviation pulse number is smaller than the range set by P1.054, DO.TPOS is on.

In Position Register (PR) mode, when the deviation between the target position and the actual motor position is smaller than the range set by P1.054, DO.TPOS is on.

Example:

For a rotary motor, if P1.054 = 167772 and the deviation is less than 167,772 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

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 - 120
Format:	DEC	Data size:	16-bit

Settings:

When the value is 0 - 100 and the servo motor continuously outputs load that is higher than the setting of P1.056, the pre-warning signal for overload (DO code: 0x10, OLW) is on. If the value is over 100, this function is disabled.

P1.057	Motor hard stop (torque percentage)		Address: 0172H 0173H
Default:	0	Control mode:	All
Unit:	%	Setting range:	0 - 300
Format:	DEC	Data size:	16-bit

Settings:

Sets the protection level. For 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.

P1.058	Motor hard stop (protection time)		Address: 0174H 0175H
Default:	1	Control mode:	All
Unit:	ms	Setting range:	1 - 1000
Format:	DEC	Data size:	16-bit

Settings:

Sets the protection time: when the motor 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 (set P1.037 correctly).

P1.059	Speed command - moving filter		Address: 0176H 0177H	
Operation interface:	Panel / software	Communication	Control mode:	S
Default:	0.0	0	Data size:	16-bit
Unit:	1 ms	0.1 ms	-	-
Format:	One decimal	DEC	-	-
Setting range:	0.0 - 4.0	0 - 40	-	-
Example:	1.5 = 1.5 ms	15 = 1.5 ms	-	-

Settings:

0: disable 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. If the setting is only for the speed control, then use the moving filter for better smoothing.
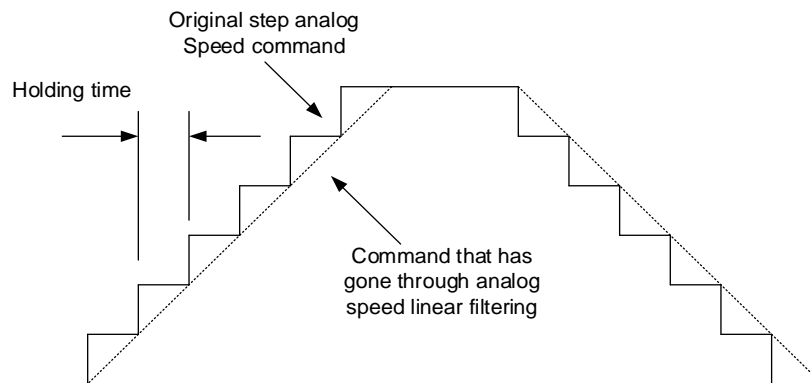
P1.060 - P1.061	Reserved

P1.062	Percentage of friction compensation	Address: 017CH 017DH	
Default:	0	Control mode:	PT / PR / S / Sz
Unit:	%	Setting range:	0 - 100
Format:	DEC	Data size:	16-bit

Settings:

Sets the level of friction compensation. For 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.

P1.063	**Constant of friction compensation**		**Address: 017EH 017FH**
Default:	1	Control mode:	PT / PR / S / Sz
Unit:	ms	Setting range:	1 - 1000
Format:	DEC	Data size:	16-bit

Settings:

Sets the smoothing constant of friction compensation.

P1.064	**Analog position command: activation control**		**Address: 0180H 0181H**
Default:	0x0000	Control mode:	PT
Unit:	-	Setting range:	0x0000 - 0x0011
Format:	HEX	Data size:	16-bit

Settings:

```
0000
U Z Y X
```

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 will operate to the position according to the command issued by analog input.
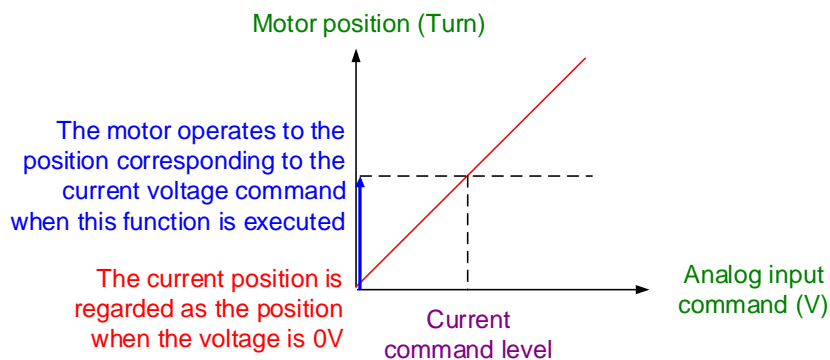
1: after the servo is on, if the command level is not changed, the motor does not operate.

   The position the motor stops at is the position corresponding to the current command level.

8
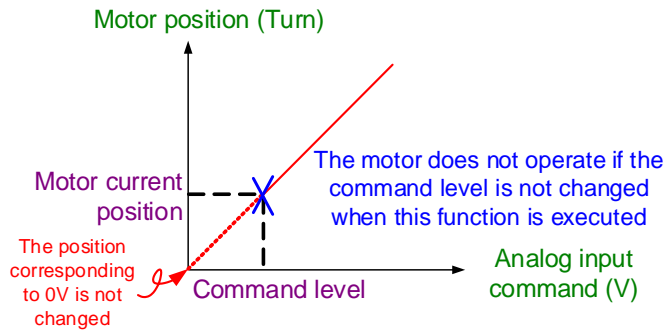
P1.065	**Smooth constant of analog Position command**		**Address: 0182H 0183H**
Default:	1	Control mode:	PT
Unit:	10 ms	Setting range:	1 - 1000
Format:	DEC	Data size:	16-bit

Settings:

The smooth constant of analog Position command is only effective to analog Position command.

P1.066	**Maximum rotation number of analog Position command**			**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 - 200.0	0 - 2000	-	-
Example:	1.5 = 1.5 cycles	15 = 1.5 cycles	-	-

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 Set 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 - 100
Format:	DEC	Data size:	16-bit

Settings:

0: disable this function.

The moving filter smooths the beginning and end of the step command, but it also delays the command.
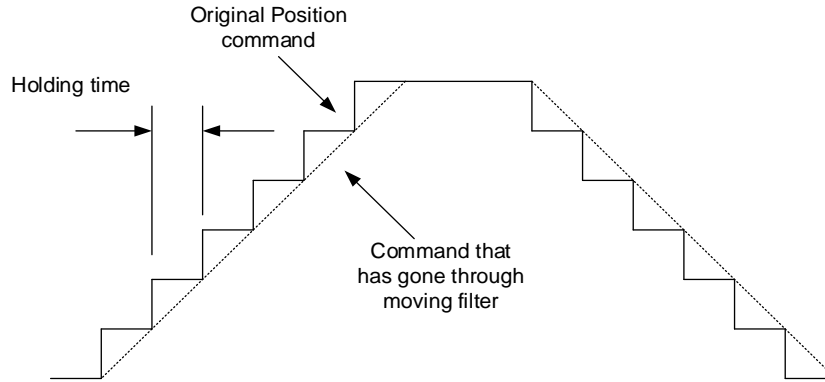
P1.069 - P1.073	Reserved

P1.074	Output source of OA / OB / OZ		Address: 0194H 0195H
Default:	0x0000	Control mode:	PT
Unit:	-	Setting range:	0x0000 - 0x0030
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

X	Reserved	Z	Reserved
Y	Selection of OA / OB / OZ output source	U	Reserved

■ Y: selection of OA / OB / OZ output source

0: output source is from the encoder connected to CN2

1: reserved

2: output source is the pulse command from CN1

(If P1.097 = 0, the output ratio has to 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 - 6000 (0: disable this function)
Format:	DEC	Data size:	16-bit

Settings:

The reference value of the filtered maximum speed which is actually input to the motor.

P1.077 - P1.080	Reserved	

P1.081	Second set of maximum rotation speed for analog Speed command	Address: 01A2H 01A3H
Default:	Rated speed	Control mode:	S / T
Unit:	rpm	Setting range:	0 - 50000
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P1.040.

P1.082	Filter switching time between P1.040 and P1.081	Address: 01A4H 01A5H
Default:	0	Control mode:	S / T
Unit:	ms	Setting range:	0 - 1000 (0: disable this function)
Format:	DEC	Data size:	16-bit

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 - 12000 (0: disable this function)
Format:	DEC	Data size:	16-bit

Settings:

When the absolute value of the analog input voltage is higher than this set 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).

P1.084 - P1.086	Reserved	

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

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 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 to return

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: set P1.087 to 50%, then 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 - 2000
Format:	DEC	Data size:	16-bit

Settings:

The setting of the level reached timer for the torque homing mode. Refer to P1.087 for the timing diagram of torque homing mode.

P1.089	First set of vibration elimination - anti-resonance frequency		Address: 01B2H 01B3H
Default:	4000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 - 4000
Format:	DEC	Data size:	16-bit

Settings:

Anti-resonance frequency for the first set of low frequency vibration elimination.

Use this function in flexible machines with low rigidity. The definition of a flexible machine is one for which when the target position is reached, due to lack of rigidity, the machine vibrates and needs more time to become stable.

B3 provides two sets of vibration elimination. The first set is P1.089 - P1.091 and the second set is P1.092 - P1.094. The vibration elimination setting must be obtained through the system module and enabling the low-frequency analysis option is needed.

Vibration elimination takes effect only when the two dimensional control function is enabled (P2.094 [Bit 12] = 1). After enabling the two dimensional 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	First set of vibration elimination - resonance frequency		Address: 01B4H 01B5H
Default:	4000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 - 4000
Format:	DEC	Data size:	16-bit

Settings:

Resonance frequency for the first set of low frequency vibration elimination.

P1.091	First set of vibration elimination - resonance difference		Address: 01B6H 01B7H
Default:	10	Control mode:	PT / PR
Unit:	0.1 dB	Setting range:	10 - 4000
Format:	DEC	Data size:	16-bit

Settings:

Attenuation rate for the first set of low frequency vibration elimination.

P1.092	Second set of vibration elimination - anti-resonance frequency		Address: 01B8H 01B9H
Default:	4000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 - 4000
Format:	DEC	Data size:	16-bit

Settings:

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	Second set of vibration elimination - resonance frequency		Address: 01BAH 01BBH
Default:	4000	Control mode:	PT / PR
Unit:	0.1 Hz	Setting range:	10 - 4000
Format:	DEC	Data size:	16-bit

Settings:

Resonance frequency for the second set of low frequency vibration elimination.

P1.094	Second set of vibration elimination - resonance difference	Address: 01BCH 01BDH
Default:	10	Control mode:	PT / PR
Unit:	0.1 dB	Setting range:	10 - 4000
Format:	DEC	Data size:	16-bit

Settings:

Attenuation rate for the second set of low frequency vibration elimination.

P1.095 - P1.096	Reserved

P1.097▲	Encoder output denominator (OA, OB)	Address: 01C2H 01C3H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 - 160000
Format:	DEC	Data size:	32-bit

Settings:

1. When P1.074.Y = 0 (output source is from the encoder connected to CN2):

    (a) When P1.097 = 0, OA / OB pulse output refers to the value of P1.046. (Refer to Example 1.)

    (b) When P1.097 ≠ 0, OA / OB pulse output refers to the values of P1.046 and P1.097. (Refer to Example 2.)

2. When P1.074.Y = 2 (output source is the pulse command from CN1):

    (a) When P1.097 = 0, OA / OB pulse output does not refer to the value of P1.046, but outputs according to the ratio of 1:1 instead.

    (b) When P1.097 ≠ 0, OA / OB pulse output refers to the values 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,

   OA / OB output is P1.046 multiplied by 4 times the frequency, which is 10,000 pulses.

Example 2 (the calculated value does not need to be multiplied by 4 times the frequency):

   When P1.097 = 7 and P1.046 = 2500,

   OA / OB output = $\dfrac{2500}{7}$

P1.098	Disconnection detection protection (UVW) response time	Address: 01C4H 01C5H
Default:	0	Control mode:	All
Unit:	ms	Setting range:	0, 100 - 800
Format:	DEC	Data size:	16-bit

Settings:

When the disconnection detection protection (UVW) function is enabled (P2.065 [Bit 9] = 1), select 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 setting range should be between 100 and 800 as 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 the motor does not move (servo drive has not issued the command),

    it is recommended that you set this parameter if disconnection detection is needed.

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

Settings:

When you set 6 for the monitor source of P0.003 [YX], then the analog monitor output voltage refers to the voltage value of P1.101.

Note: the analog monitor output voltage should be within the range of -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

Settings:

When you set 7 for the monitor source of P0.003 [YX], then the analog monitor output voltage refers to the voltage value of P1.102.

Note: the analog monitor output voltage should be within the range of -8V to 8V.

P1.103 - 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 maximum speed
Format:	DEC	Data size:	32-bit

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 is triggered.

P1.112	Single-direction torque limit	Address: 01F0H 01F1H
Default:	500	Control mode:	All
Unit:	%	Setting range:	-500 to 500
Format:	DEC	Data size:	16-bit

Settings:

Sets the torque limit for one of the motor operation directions. If the value of P1.112 is smaller than the values of P1.012 - P1.014, the torque limit changes according to the setting of P1.112. Otherwise, the torque limit remains unchanged.

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P2.xxx   Extension parameters

P2.000	Position control gain		Address: 0200H 0201H
Default:	35	Control mode:	PT / PR
Unit:	rad/s	Setting range:	0 - 2047
Format:	DEC	Data size:	16-bit

Settings:

Increasing the position control gain can enhance the position response and reduce the deviation in position control. If you set the value too high, it may cause vibration and noise.

P2.001	Position control gain rate of change		Address: 0202H 0203H
Default:	100	Control mode:	PT / PR
Unit:	%	Setting range:	10 - 500
Format:	DEC	Data size:	16-bit

Settings:

Adjust the rate of change for the position control gain according to the gain switching condition.

P2.002	Position feed forward gain		Address: 0204H 0205H
Default:	50	Control mode:	PT / PR
Unit:	%	Setting range:	0 - 100
Format:	DEC	Data size:	16-bit

Settings:

If the position control command changes position smoothly, increasing the gain value can reduce the position following errors. If it does not change smoothly, decreasing the gain value can reduce the mechanical vibration during operation.

Note: this gain parameter is disabled when the two dimensional control function is on (P2.094 [Bit 12] = 1).

P2.003	Position feed forward gain smoothing constant		Address: 0206H 0207H
Default:	5	Control mode:	PT / PR
Unit:	ms	Setting range:	2 - 100
Format:	DEC	Data size:	16-bit

Settings:

If the position control command changes position smoothly, decreasing the smoothing constant value can reduce the position following errors. If it does not change smoothly, increasing the smoothing constant value can reduce the mechanical vibration during operation.

P2.004	Speed control gain	Address: 0208H 0209H	
Default:	500	Control mode:	All
Unit:	rad/s	Setting range:	0 - 8191
Format:	DEC	Data size:	16-bit

Settings:

Increasing the speed control gain can enhance the speed response. If you set the value too high, it may cause vibration and noise.

P2.005	Speed control gain rate of change	Address: 020AH 020BH	
Default:	100	Control mode:	All
Unit:	%	Setting range:	10 - 500
Format:	DEC	Data size:	16-bit

Settings:

Adjust the rate of change for the speed control gain according to the gain switching condition.

P2.006	Speed integral compensation	Address: 020CH 020DH	
Default:	100	Control mode:	All
Unit:	rad/s	Setting range:	0 - 1023
Format:	DEC	Data size:	16-bit

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 - 100
Format:	DEC	Data size:	16-bit

Settings:

If the speed control command changes speed smoothly, increasing the gain value can reduce the speed following errors. If it does not change smoothly, decreasing the gain value can reduce the mechanical vibration during operation.

P2.008■	Special parameter write-in function	Address: 0210H 0211H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 - 501
Format:	DEC	Data size:	16-bit

Settings:

Special parameter write-in function:

Code	Function
10	Reset all parameters (cycle the power after reset).
20	P4.010 is writable.
22	P4.011 - P4.021 are writable.
30, 35	Save Capture data.
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 - 20
Format:	DEC	Data size:	16-bit

Settings:

When environmental interference is high, increasing this value can enhance the control stability.

If you set the value too high, it affects the response time.

P2.010	DI1 functional planning	Address: 0214H 0215H
Default:	0x0101 (B3-L) 0x0100 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

U Z YX

YX	Input function selection		Z	Input contact: A or B contact
-	-		U	Reserved

■ YX: input function selection

    Refer to Table 8.1.

■ Z: input contact: A or B contact

    0: set this input contact to be normally closed (B contact)

    1: set this input contact to be normally open (A contact)

Note that you can use P3.006 to determine the source of the digital 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 (B3-L) 0x0022 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.010.

P2.012	DI3 functional planning		Address: 0218H 0219H
Default:	0x0116 (B3-L) 0x0023 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.010.

P2.013	DI4 functional planning		Address: 021AH 021BH
Default:	0x0117 (B3-L) 0x0021 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.010.

P2.014	DI5 functional planning		Address: 021CH 021DH
Default:	0x0102 (B3-L) 0x0100 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.010. There is no physical pin for DI5 on B3-F, B3-E, and B3-M models. DI5 is a virtual digital input which you can use when the number of physical DI points is insufficient and trigger through communication. You can set this virtual DI for a normally closed contact if the DI has to switch on as soon as power is applied, such as DI.SON.

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P2.015	DI6 functional planning		Address: 021EH 021FH
Default:	0x0022 (B3-L) 0x0100 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.010. There is no physical pin for DI6 on B3-F, B3-E, and B3-M models. DI6 is a virtual digital input which you can use when the number of physical DI points is insufficient and trigger through communication. You can set this virtual DI for a normally closed contact if the DI has to switch on as soon as power is applied, such as DI.SON.

P2.016	DI7 functional planning		Address: 0220H 0221H
Default:	0x0023 (B3-L) 0x0100 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.010. There is no physical pin for DI7 on B3-F, B3-E, and B3-M models. DI7 is a virtual digital input which you can use when the number of physical DI points is insufficient and trigger through communication. You can set this virtual DI for a normally closed contact if the DI has to switch on as soon as power is applied, such as DI.SON.

P2.017	DI8 functional planning		Address: 0222H 0223H
Default:	0x0021 (B3-L) 0x0100 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.010. There is no physical pin for DI8 on B3-F, B3-E, and B3-M models. DI8 is a virtual digital input which you can use when the number of physical DI points is insufficient and trigger through communication. You can set this virtual DI for a normally closed contact if the DI has to switch on as soon as power is applied, such as DI.SON.

P2.018	DO1 functional planning		Address: 0224H 0225H
Default:	0x0101 (B3-L) 0x0100 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x013F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit

Settings:

U Z YX

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).

P2.019	DO2 functional planning		Address: 0226H 0227H
Default:	0x0103 (B3-L) 0x0100 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x013F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.018.

P2.020	DO3 functional planning		Address: 0228H 0229H
Default:	0x0109 (B3-L) 0x0100 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x013F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.018.

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P2.021	**DO4 functional planning**		Address: 022AH 022BH
Default:	0x0105 (B3-L) 0x0100 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x013F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.018.

P2.022	**DO5 functional planning**		Address: 022CH 022DH
Default:	0x0007 (B3-L) 0x0100 (B3-F, E, M)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x013F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.018.

P2.023	**Notch filter frequency (1)**		Address: 022EH 022FH
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 - 5000
Format:	DEC	Data size:	16-bit

Settings:

The first setting for resonance frequency. This function is disabled if P2.024 is 0. P2.043 and P2.044 are the second Notch filter parameters.

P2.024	**Notch filter attenuation level (1)**		Address: 0230H 0231H
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 - 40 (0: disable this function)
Format:	DEC	Data size:	16-bit

Settings:

The first Notch filter attenuation level. For example, an attenuation level of 5 indicates -5 dB.

P2.025	Resonance suppression low-pass filter			Address: 0232H 0233H
Operation interface:	Panel / software	Communication	Control mode:	All
Default:	1.0	10	Data size:	16-bit
Unit:	1 ms	0.1 ms	-	-
Setting range:	0.0 - 100.0	0 - 1000	-	-
Format:	One decimal	DEC	-	-
Example:	1.5 = 1.5 ms	15 = 1.5 ms	-	-

Settings:

Sets the time constant for the low-pass filter for resonance suppression. This function is disabled if P2.025 is 0.

P2.026	Anti-interference gain		Address: 0234H 0235H
Default:	0	Control mode:	All
Unit:	rad/s	Setting range:	0 - 1023
Format:	DEC	Data size:	16-bit

Settings:

Increasing this parameter can increase the damping of the speed loop and reduce the speed loop response. Setting the value of P2.026 to equal 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: this gain parameter is disabled when the two dimensional control function is on (P2.094 [Bit 12] = 1).

P2.027	Gain switching condition and method selection		Address: 0236H 0237H
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0018
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

X	Gain switching condition	Z	Reserved
Y	Gain switching method	U	Reserved

■ X: gain switching condition

X	Function
0	Disable gain switching function
1	Signal of gain switching (DI.GAINUP) is on

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X	Function
2	In position control mode, position error is larger than P2.029
3	Frequency of Position command is larger than P2.029
4	Rotation speed of servo motor is faster than P2.029
5	Signal of gain switching (DI.GAINUP) is off
6	In position control mode, position error is smaller than P2.029
7	Frequency of Position command is smaller than P2.029
8	Rotation speed of servo motor is slower than P2.029

■ 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% P2.004 x 100%	P2.004 x 100%	Before switching
	P2.000 x P2.001 P2.004 x P2.005	P2.004 x P2.005	After switching
1	P2.006 x 0%; P2.026 x 0%		Before switching
	P2.006 x 100%; P2.026 x 100%		After switching

P2.028	**Gain switching time constant**		Address: 0238H 0239H
Default:	10	Control mode:	All
Unit:	ms	Setting range:	0 - 1000 (0: disable this function)
Format:	DEC	Data size:	16-bit

Settings:

Controls the switching of smoothing gain.

P2.029	**Gain switching condition**		Address: 023AH 023BH
Default:	16777216	Control mode:	All
Unit:	pulse; kpps; rpm	Setting range:	0 - 50331648
Format:	DEC	Data size:	32-bit

Settings:

You determine the gain switching (pulse error, kpps, rpm) by the selection of gain switching condition (P2.027).

P2.030■	Auxiliary function	Address: 023CH 023DH

Default:	0	Control mode:	All
Unit:	-	Setting range:	-8 to +8
Format:	DEC	Data size:	16-bit

Settings:

Setting 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 save the data, this setting can avoid continually writing the parameters to EEPROM and shortening the lifetime of the EEPROM. You must use this function when controlling through communication.
6	This setting enables command simulation mode. In this mode, use the DI/O in ASDA-Soft to Servo On as both the external Servo On signal and the force Servo On of the PR mode in ASDA-Soft cannot work. Also, the DSP Error (variable 0x6F) is read as 0 and P0.001 only shows the external error code (positive / negative limit, emergency stop). In this mode, DO.SRDY is on, commands are accepted in each mode and can be observed through the scope function of the software, but the motor does not operate. Use this mode to examine command accuracy.
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 the value 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 - 50
Format:	DEC	Data size:	16-bit

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.

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P2.032	Gain adjustment mode		Address: 0240H 0241H
Default:	0x0001 0x0000 (B3-F)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0004
Format:	HEX	Data size:	16-bit

Settings:

The servo drive provides three gain adjustment modes for fine tuning. You can then easily complete tuning by increasing or decreasing the bandwidth response level (P2.031). Follow the tuning procedure in Section 5.1.

Setting value	Adjustment mode	Inertia estimation	Parameter	
			Manual	Auto
0	Manual	Fixed set value of P1.037	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102	N/A
1	Gain adjustment mode 1	Real-time estimation	P2.031	P1.037, P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102
2	Gain adjustment mode 2	Fixed set value of P1.037	P1.037 P2.031	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.089, P2.098, P2.099, P2.101, P2.102
3	Gain adjustment mode 3 (only when two dimensional control function is enabled)	Fixed set value of P1.037	P1.037 P2.031 P2.089	P2.000, P2.004, P2.006, P2.023, P2.024, P2.025, P2.043, P2.044, P2.045, P2.046, P2.049, P2.098, P2.099, P2.101, P2.102
4	Gain adjustment mode 4	Reset to default gain value		

Note: when the two dimensional control function is disabled (P2.094 [Bit 12] = 0), the effect of gain adjustment mode 3 is equivalent to that of gain adjustment mode 2, so setting P2.089 is invalid in that scenario.

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P2.033	Reserved

P2.034	Speed command error warning	Address: 0244H 0245H
Default:	5000	Control mode:	S / Sz
Unit:	rpm	Setting range:	1 - 30000
Format:	DEC	Data size:	16-bit

Settings:

In Speed mode, this parameter sets the acceptable difference between the command speed and the feedback speed. If the difference is greater than this value, AL007 occurs.

P2.035	Excessive deviation of Position command warning	Address: 0246H 0247H
Default:	50331648	Control mode:	PT / PR
Unit:	pulse	Setting range:	1 - 1677721600
Format:	DEC	Data size:	32-bit

Settings:

In Position mode, this parameter sets the condition of 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 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.010. There is no physical pin for DI9 on all models. DI9 is a virtual digital input which you can use when the number of physical DI points is insufficient and trigger through commuicaiton. You can set this virtual DI for a normally closed contact if the DI has to switch on as soon as power is applied, such as DI.SON.

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P2.037	DI10 functional planning	Address: 024AH 024BH
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.010. There is no physical pin for DI10 on all models. DI10 is a virtual digital input which you can use when the number of physical DI points is insufficient and trigger through communication. You can set this virtual DI for a normally closed contact if the DI has to swtich on as soon as power is applied, such as DI.SON.

P2.038	DI11 functional planning	Address: 024CH 024DH
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.010. There is no physical pin for DI11 on all models. DI11 is a virtual digital input which you can use when the number of physical DI points is insufficient and trigger through communication. You can set this virtual DI for a normally closed conact if the DI has to swtich on as soon as power is applied, such as DI.SON.

P2.039	DI12 functional planning	Address: 024EH 024FH
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.010. There is no physical pin for DI12 on all models. DI12 is a virtual digital input which you can use when the number of physical DI points is insufficient and trigger through communication. You can set this virtual DI for a normally closed contact if the DI has to switch on as soon as power is applied, such as DI.SON.

P2.040	DI13 functional planning		Address: 0250H 0251H
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x015F (last two codes are DI codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.010. There is no physical pin for DI13 on all models. DI13 is a virtual digital input which you can use when the number of physical DI points is insufficient and trigger through communication. You set this virtual DI for a normally closed contact if the DI has to switch on as soon as power is applied, such as DI.SON.

P2.041	DO6 functional planning		Address: 0252H 0253H
Default:	0x0100	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x013F (last two codes are DO codes)
Format:	HEX	Data size:	16-bit

Settings:

Refer to the description of P2.018.

P2.042	Reserved

P2.043	Notch filter frequency (2)		Address: 0256H 0257H
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 - 5000
Format:	DEC	Data size:	16-bit

Settings:

The second setting for resonance frequency. This function is disabled if P2.044 is 0.

P2.044	Notch filter attenuation level (2)		Address: 0258H 0259H
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 - 40 (0: disable this function)
Format:	DEC	Data size:	16-bit

Settings:

The second Notch filter attenuation level. A value of 5 indicates -5 dB.

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P2.045	Notch filter frequency (3)		Address: 025AH 025BH
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 - 5000
Format:	DEC	Data size:	16-bit

Settings:

The third setting for resonance frequency. This function is disabled if P2.046 is 0.

P2.046	Notch filter attenuation level (3)		Address: 025CH 025DH
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 - 40 (0: disable this function)
Format:	DEC	Data size:	16-bit

Settings:

The third Notch filter attenuation level. A value of 5 indicates -5 dB.

P2.047	Auto resonance suppression mode		Address: 025EH 025FH
Default:	0x0001	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x01F2
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

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 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, 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 to EEPROM are lost and will not be saved. The resonance suppression points that have been stored to EEPROM are not 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 system clears the unfixed Notch filter, and sets the frequency to 1,000 Hz and the suppression level 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, set the Notch filters to use manual resonance suppression.

Bit	3	2	1	0
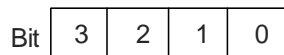
Bit	Function	Description
Bit 0	Notch 1 auto / manual setting	0: auto resonance suppression 1: manually set the first set of resonance suppression parameters
Bit 1	Notch 2 auto / manual setting	0: auto resonance suppression 1: manually set the second set of resonance suppression parameters
Bit 2	Notch 3 auto / manual setting	0: auto resonance suppression 1: manually set the third set of resonance suppression parameters
Bit 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, set the Notch filters to use manual resonance suppression.

Bit	3	2	1	0
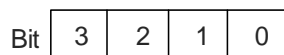
Bit	Function	Description
Bit 0	Notch 5 auto / manual setting	0: auto resonance suppression 1: manually set the fifth set of resonance suppression parameters

Example: if P2.047 = 0x0021, and the auto resonance suppression function is enabled, the servo searches for the resonance point and suppresses it. When you set 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 - 1000
Format:	DEC	Data size:	16-bit

Settings:

The smaller this parameter value, the more sensitive it is to resonance. The larger this parameter value, the less sensitive it is to resonance.

P2.049	Speed detection filter and jitter suppression			Address: 0262H 0263H
Operation interface:	Panel / software	Communication	Control mode:	All
Default:	1.0	10	Data size:	16-bit
Unit:	1 ms	0.1 ms	-	-
Setting range:	0.0 - 100.0	0 - 1000	-	-
Format:	One decimal	DEC	-	-
Example:	1.5 = 1.5 ms	15 = 1.5 ms	-	-

Settings:

Sets the filter for speed estimation. 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	Pulse Clear mode		Address: 0264H 0265H
Default:	0x0000	Control mode:	PT
Unit:	-	Setting range:	0x0000 - 0x0001
Format:	HEX	Data size:	16-bit

Settings:

Refer to Table 8.1 for digital input descriptions. Set digital input (DI) as CCLR to enable the Pulse Clear function. If this DI is on, the accumulated position error is reset to 0.

When P2.050 = 0: DI.CCLR is rising-edge triggered.

When P2.050 = 1: DI.CCLR is level triggered.

P2.051	Reserved

P2.052▲	**Indexing coordinates scale**		Address: 0268H 0269H
Default:	1000000000	Control mode:	All
Unit:	PUU	Setting range:	0 - 1000000000
Format:	DEC	Data size:	32-bit

Settings:

Sets the scale of the indexing coordinates, indexing command position, and indexing feedback position.

If the value is too small, it may cause errors in the indexing coordinates. The ranges of values for

P2.052 are:

P2.052 > 1.05 x Maximum motor speed (rpm) x $\frac{16777216}{60000}$ x $\frac{P1.045}{P1.044}$

P2.052 > 279.62 x Maximum motor speed (rpm) x $\frac{P1.045}{P1.044}$

P2.053	**Position integral compensation**		Address: 026AH 026BH
Default:	0	Control mode:	All
Unit:	rad/s	Setting range:	0 - 1023
Format:	DEC	Data size:	16-bit

Settings:

Increase the position control integral 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:	PT
Unit:	pulse	Setting range:	1 to (2^{29}-1)
Format:	DEC	Data size:	32-bit

Settings:

The numerator of the E-Gear ratio can be selected with DI.GNUM0 and DI.GNUM1 (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 DI.GNUM0 and DI.GNUM1 only when the servo is stopped in order to avoid mechanical vibration.
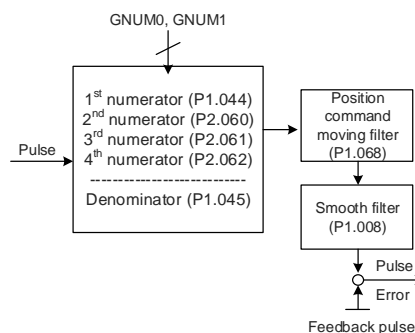
8

P2.061	E-Gear ratio (numerator) (N3)		Address: 027AH 027BH
Default:	16777216	Control mode:	PT
Unit:	pulse	Setting range:	1 to $(2^{29}-1)$
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P2.060.

P2.062	E-Gear ratio (numerator) (N4)		Address: 027CH 027DH
Default:	16777216	Control mode:	PT
Unit:	pulse	Setting range:	1 to $(2^{29}-1)$
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P2.060.

P2.063 - P2.064	Reserved

P2.065	Special bit register		Address: 0282H 0283H
Default:	0x0104	Control mode:	PT / PR / S / Sz
Unit:	-	Setting range:	0 - 0xFFFF
Format:	HEX	Data size:	-

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 2	Reserved	-
Bit 3	Methods for regenerative energy consumption	0: determined by the servo's internal algorithm. 1: determined by the DC Bus voltage.
Bit 4 - Bit 5	Reserved	-
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	U, V, W wiring error detection function	0: disable the function. 1: enable the function.
Bit 9	U, V, W disconnection detection function	0: disable the function. 1: enable the function.
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

- 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.
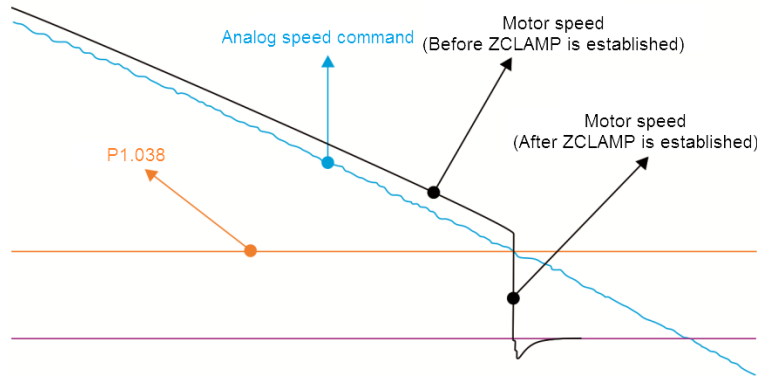
- Bit 10 = 0 and command source is the internal register.
  The ZCLAMP function uses the register Speed command with acceleration or deceleration to determine if this function should be enabled. The motor is clamped at the position where ZCLAMP conditions are met.
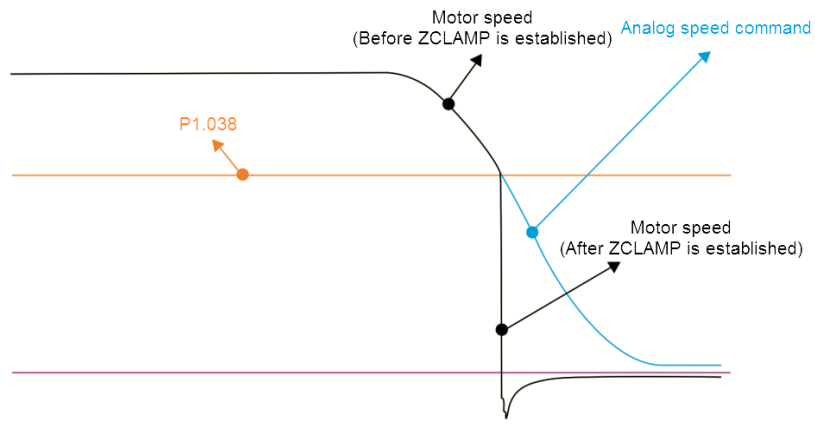
- Bit 10 = 1 and command source is the analog voltage.
  ZCLAMP function uses the analog Speed command without acceleration / deceleration to determine if this function is enabled. When ZCLAMP conditions are met, the motor speed decelerates to 0 rpm by S-curve deceleration. If ZCLAMP conditions are not met, the motor follows the analog Speed command through the S-curve.

8
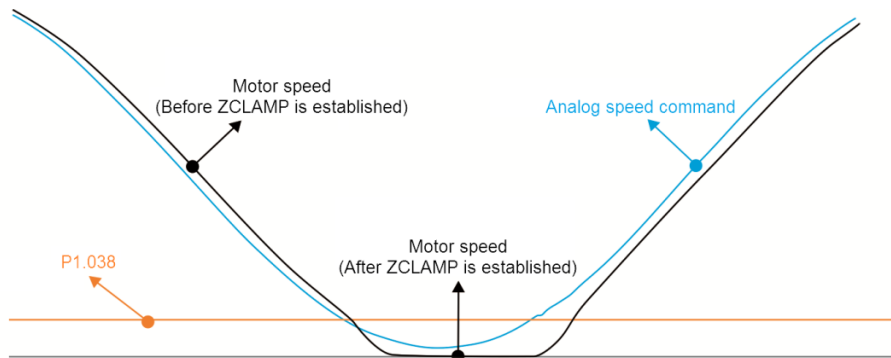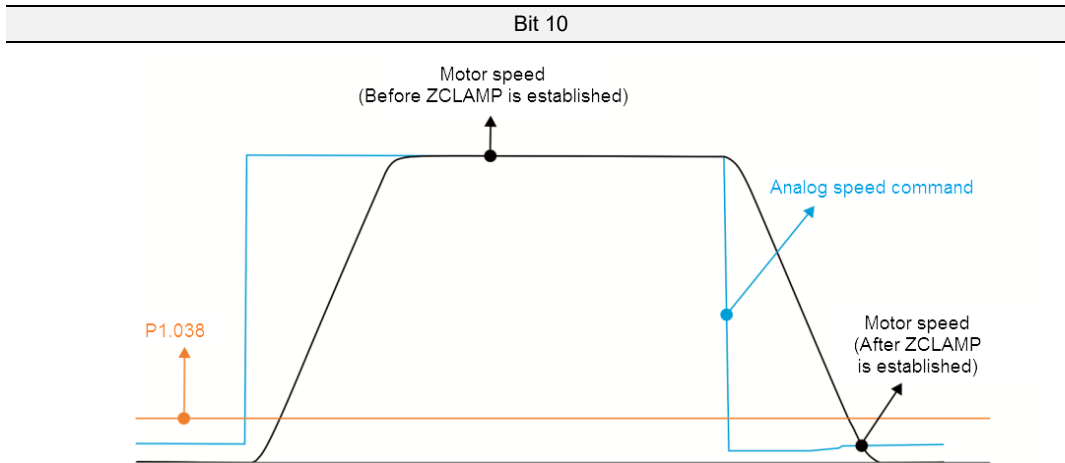
Bit 10

■ Bit 10 = 1 and command source is the internal register.
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 switch	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 NL or PL. 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 opertaion and stops receiving pulse position commands for positive-direction operataion. 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	Leak phase detection function	0: enable the leak phase (AL022) detection function. 1: disable the leak phase (AL022) detection function.
Bit 13	Encoder output error detection function	0: enable encoder output error (AL018) detection function. 1: disable encoder output error (AL018) detection function.
Bit 14	Reserved	-
Bit 15	Friction compensation mode selection	0: the compensation value remains unchanged when motor speed is slower than the value of P1.038. 1: the compensation value reduces to 0 when motor speed is slower than the value of P1.038.

P2.066	Special bit register 2	Address: 0284H 0285H
Default:	0x0000	Control mode:	PT / PR / S / Sz
Unit:	-	Setting range:	0x0000 - 0x187F
Format:	HEX	Data size:	16-bit

Settings:

Bit	7	6	5	4	3	2	1	0

Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0 - Bit 1	Reserved	-
Bit 2	Low voltage error (AL003) latch switch	0: enable the function, so the low voltage error is not cleared automatically. 1: disable the function, so the low voltage error is cleared automatically.
Bit 3	Reserved	-
Bit 4	AL044 detection (servo function overload warning) function switch	0: enable the function. 1: disable the function.
Bit 5	Reserved	-
Bit 6	Leak phase error latch	0: disable the function, so leak phase error (AL022) is cleared automatically. 1: enable the function, so leak phase error (AL022) is not cleared automatically.
Bit 7 - Bit 8	Reserved	-
Bit 9	Low voltage error (AL003) error type selection	0: set AL003 as WARN. 1: set AL003 as ALM.
Bit 10 - Bit 11	Reserved	-
Bit 12	RST leak phase (AL022) error type selection	0: set AL002 as WARN. 1: set AL002 as ALM.
Bit 13 - Bit 15	Reserved	-

P2.067	Reserved

P2.068	Following error compensation switch	Address: 0288H 0289H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	0x00000000 - 0x00000101
Format:	HEX	Data size:	32-bit

Settings:

High bit

H0000

D C B A

Low bit

L0020

U Z Y X

A	Reserved		X	Following error compensation switch
B	Reserved		Y	Reserved
C	Reserved		Z	DI.STP triggering method
D	Reserved		U	Reserved

■ X: following error compensation switch (functions under the condition of P1.036 > 1)

0: disable following error compensation

1: enable following error compensation

■ Z: DI.STP triggering method

0: DI.STP is rising-edge triggered

1: DI.STP is level triggered

P2.069●	Absolute encoder	Address: 028AH 028BH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0111
Format:	HEX	Data size:	16-bit

Settings:

0000

U Z Y X

X	Operation mode setting	Z	Index coordinates function setting when overflow occurs
Y	Pulse command setting when absolute position is lost	U	Reserved

■ X: operation mode setting

0: incremental type. An absolute type motor can be operated as an incremental type motor.

1: absolute type. 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 accept a pulse command.

1: when AL060 or AL06A occurs, the system can accept a pulse command.

■   Z*: index coordinates function setting when overflow occurs

0: index coordinates are lost when overflow occurs.

1: index coordinates are not affected by overflow, but absolute coordinates are not retained.

Note: this function is coming soon.

8

P2.070	**Read data selection**	**Address: 028CH** **028DH**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0007
Format:	HEX	Data size:	16-bit

Settings:

Bit	7	6	5	4	3	2	1	0

Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0	DI/DO data unit setting	0: PUU. 1: pulse.
Bit 1	Communication data unit setting	0: PUU. 1: pulse.
Bit 2	Overflow warning setting	0: overflow warning, including AL289 (PUU) and AL062 (pulse). 1: no overflow warning.
Bit 3 - Bit 15	Reserved	-

P2.071■	**Absolute position homing**	**Address: 028EH** **028FH**
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0001
Format:	HEX	Data size:	16-bit

Settings:

When P2.071 is 1, the current absolute position of the encoder is the home position. Set P2.008 to 271 and then you can enable this function.

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 - 2000
Format:	DEC	Data size:	16-bit

Settings:

Increasing this gain speeds up the responsiveness of the Position command and shortens the tuning time, but when the gain is too large, it causes position overshoot which leads to machine jitter.

Note: enable the two-degrees-of-freedom control function (P2.094 [Bit 12] = 1) before adjusting this parameter.

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P2.090 - P2.093	**Reserved**

P2.094▲	**Special bit register 3**	Address: 02BCH 02BDH

Default:	0x1010 0x0010 (B3-F)	Control mode:	PT / PR / S / Sz
Unit:	-	Setting range:	0x0000 - 0xF3F6
Format:	HEX	Data size:	16-bit

Settings:

Bit	7	6	5	4	3	2	1	0

Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 0 - Bit 3	Reserved	-
Bit 4	Dynamic brake options	0: disable new dynamic brake 1: enable new dynamic brake and force use the DC Bus voltage to determine the timing of regenerative energy consumption
Bit 5	AL016 IGBT overheat alarm switch	0: enable AL016 IGBT overheat alarm 1: disable AL016 IGBT overheat alarm
Bit 6 - Bit 7	Reserved	-

Bit	Function	Description
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-degrees-of-freedom control function (P2.094 [Bit 12]) is enabled.
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-degrees-of-freedom control function (P2.094 [Bit 12]) is enabled.
Bit 10 - Bit 11	Reserved	-
Bit 12	Two-degrees-of-freedo control function	0: disable two-degrees-of-freedom control function (A2 and B2 models do not have this function.) 1: enable two-degrees-of-freedom control function
Bit 13 - Bit 15	Reserved	-

P2.095	**Notch filter bandwidth (1)**	Address: 02BEH 02BFH

Default:	5	Control mode:	All
Unit:	-	Setting range:	1 - 10
Format:	DEC	Data size:	16-bit

Settings:

The first value of resonance width. This function is disabled if P2.024 is 0. P2.023, P2.024, and P2.095 are the first Notch filter parameters.

P2.096	**Notch filter bandwidth (2)**		**Address: 02C0H** **02C1H**
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 - 10
Format:	DEC	Data size:	16-bit

Settings:

The second value of resonance width. This function is disabled if P2.044 is 0. P2.043, P2.044, and P2.096 are the second Notch filter parameters.

P2.097	**Notch filter bandwidth (3)**		**Address: 02C2H** **02C3H**
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 - 10
Format:	DEC	Data size:	16-bit

Settings:

The third value of resonance width. This function is disabled if P2.046 is 0. P2.045, P2.046, and P2.097 are the third Notch filter parameters.

P2.098	**Notch filter frequency (4)**		**Address: 02C4H** **02C5H**
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 - 5000
Format:	DEC	Data size:	16-bit

Settings:

The fourth value of resonance frequency. This function is disabled if P2.099 is 0. P2.098, P2.099, and P2.100 are the fourth set of Notch filter parameters.

P2.099	**Notch filter attenuation level (4)**		**Address: 02C6H** **02C7H**
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 - 40 (0: disable this function)
Format:	DEC	Data size:	16-bit

Settings:

The fourth Notch filter attenuation level. For example, if you set the attenuation level to 5, then the value is -5 dB.

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P2.100	Notch filter bandwidth (4)		Address: 02C8H 02C9H
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 - 10
Format:	DEC	Data size:	16-bit

Settings:

The fourth value of resonance width. This function is disabled if P2.099 is 0. P2.098, P2.099, and

P2.100 are the fourth set of Notch filter parameters.

P2.101	Notch filter frequency (5)		Address: 02CAH 02CBH
Default:	1000	Control mode:	All
Unit:	Hz	Setting range:	50 - 5000
Format:	DEC	Data size:	16-bit

Settings:

The fifth value of resonance frequency. This function is disabled if P2.102 is 0. P2.101, P2.102, and

P2.103 are the fifth set of Notch filter parameters.

P2.102	Notch filter attenuation level (5)		Address: 02CCH 02CDH
Default:	0	Control mode:	All
Unit:	-dB	Setting range:	0 - 40 (0: disable this function)
Format:	DEC	Data size:	16-bit

Settings:

The fifth Notch filter attenuation level. For example, if you set the attenuation level to 5, then the value is

-5 dB.

P2.103	Notch filter bandwidth (5)		Address: 02CEH 02CFH
Default:	5	Control mode:	All
Unit:	-	Setting range:	1 - 10
Format:	DEC	Data size:	16-bit

Settings:

The fifth value of resonance width. This function is disabled if P2.102 is 0. P2.101, P2.102, and P2.103

are the fifth set of Notch filter parameters.

P2.104	**P/PI torque switching command condition**	Address: 02D0H 02D1H
Default:	800	Control mode:	PT / PR / S / Sz
Unit:	%	Setting range:	1 - 800
Format:	DEC	Data size:	16-bit

Settings:

When the Torque command exceeds P2.104, the speed controller gain is switched from PI to P in order to reduce response overshoot.

P2.105	**Automatic gain adjustment level 1**	Address: 02D2H 02D3H
Default:	11	Control mode:	PT / PR
Unit:	-	Setting range:	1 - 21
Format:	DEC	Data size:	16-bit

Settings:

Use this parameter to adjust the bandwidth when auto-tuning. If the value is larger, the bandwidth after auto-tuning is higher, but if the bandwidth margin is insufficient, it may cause machine jitter. If the value is smaller, the bandwidth after auto-tuning is lower, but the response is slower.
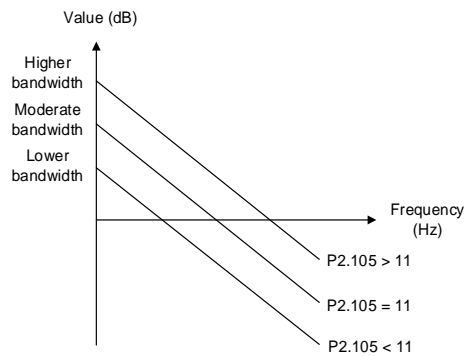
P2.106	**Automatic gain adjustment level 2**	Address: 02D4H 02D5H
Default:	2000	Control mode:	PT / PR
Unit:	pulse	Setting range:	1 - 50331648
Format:	DEC	Data size:	32-bit

Settings:

Use this parameter to adjust the maximum allowable overshoot when auto-tuning. The overshoot range is set for either the user or the machine. If the value is larger, the maximum overshoot allowed by auto-tuning is greater, but the response is faster. If the value is smaller, the maximum overshoot allowed by auto-tuning is smaller, but the response is slower.

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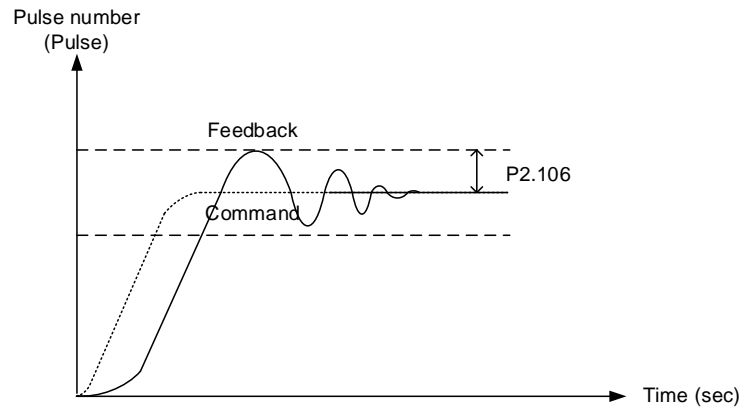
P2.107 - P2.111	**Reserved**

P2.112▲	**Special bit register 4**		**Address: 02E0H** **02E1H**
Default:	0x0018	Control mode:	PT / PR / S / Sz
Unit:	-	Setting range:	0x0000 - 0x153F
Format:	HEX	Data size:	16-bit

Settings:

Bit	7	6	5	4	3	2	1	0

Bit	15	14	13	12	11	10	9	8

Bit	Function	Description
Bit 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 15	Reserved	-

P3.xxx Communication parameters

P3.000●	Address		Address: 0300H 0301H
Default:	0x007F	Control mode:	All
Unit:	-	Setting range:	0x0001 - 0x007F 0x0001 - 0xFFFF (B3-E)
Format:	HEX	Data size:	16-bit

Settings:

U Z   YX

UZYX	Communication address setting

When using RS-485 to communicate, one servo drive can set only one address. Setting more than one addresses causes abnormal communications.

This address represents the absolute address of the servo drive in the communication network.

It is applicable to RS-485, CANopen, DMCNET, and EtherCAT.

When the communication address of MODBUS is 0xFF, the servo drive automatically receives and replies the data regardless of the address, but P3.000 cannot be set to 0xFF.

P3.001●	Transmission speed		Address: 0302H 0303H
Default:	0x0203 (B3-L, M, E) 0x3203 (B3-F)	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0405 (B3-L, M, E) 0x0000 - 0xF405 (B3-F)
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

X	RS-485 transmission speed	Z	CANopen / DMCNET transmission speed
Y	Reserved	U	DMCNET motion card

■　X: RS-485 transmission speed

0: 4800 bps	1: 9600 bps	2: 19200 bps
3: 38400 bps	4: 57600 bps	5: 115200 bps

■　Z: CANopen / DMCNET transmission speed

0: 125 Kbps	1: 250 Kbps	2: 500 Kbps
3: 750 Kbps	4: 1.0 Mbps	-

■ U: DMCNET motion card

| 0: use Delta's controller, such as PLC or HMI |
| 3: use Delta's motion card |

Note:

1. The communication speed of USB is set at 1.0 Mbps and cannot be changed.

2. If this parameter is set through CANopen, only Z can be set and the others remain unchanged.

3. After the Z value is set, cycle the power to take effect.

P3.002	Communication protocol		Address: 0304H 0305H
Default:	0x0006	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x0008
Format:	HEX	Data size:	16-bit

Settings:

Definition of each value:

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 - 0x0001
Format:	HEX	Data size:	16-bit

Settings:

0: display warning and let motor continue operating.

1: display warning and let motor decelerate to a stop. Deceleration time is set in P5.003.B.

P3.004	Communication timeout		Address: 0308H 0309H
Default:	0	Control mode:	All
Unit:	sec	Setting range:	0 - 20 (0: disable this function)
Format:	DEC	Data size:	16-bit

Settings:

If the value is not 0, communication timeout is enabled immediately.

P3.005	Reserved

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P3.006■	Digital input (DI) control switch		Address: 030CH 030DH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0x1FFF
Format:	HEX	Data size:	16-bit

Settings:

Source of the DI that controls the switch. Each bit of this parameter determines one input source of DI signal: Bit 0 - Bit 8 correspond to DI1 - DI9; Bit 9 - Bit 12 correspond to DI10 - 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, please see:

DI1 - DI8: P2.010 - P2.017

DI9 - DI13: P2.036 - P2.040

P3.007	Modbus communication response delay time		Address: 030EH 030FH
Default:	0	Control mode:	All
Unit:	0.5 ms	Setting range:	0 - 1000
Format:	DEC	Data size:	16-bit

Settings:

Delay the time of RS-485 communication response from servo drive to controller.

P3.008	Reserved

P3.009	Communication synchronization		Address: 0312H 0313H
Default:	0x5055	Control mode:	CANopen
Unit:	-	Setting range:	Shown as follows
Format:	HEX	Data size:	16-bit

Settings:

The synchronous setting is divided into U, Z, Y, and X (hexadecimal):

Digit	U	Z	Y	X
Function	Range of synchronous error	Target value	Deadband	-
Range	1 - 9	0 - 9	0 - F	-

The slave synchronizes with the master via SYNC. The definition is as follows:

■ X: reserved.

■ Y: set the size of deadband (unit: μsec). If the deviation between the SYNC arrival time and the target value does not exceed the deadband, a correction is not needed.

■ Z: target value of SYNC arrival time. The standard value is 500 μsec, but you need to take the

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initial lead into account.

Target value = 400 + 10 x T. For example, if T = 5, the target value is 450.

■   U: if the deviation between the SYNC arrival time and the target value is smaller than the range, it means the synchronization is successful (unit: 10 µs).

P3.010	CANopen / DMCNET protocol		Address: 0314H 0315H
Default:	0x1010	Control mode:	CANopen / DMCNET
Unit:	-	Setting range:	0x0000 - 0xFFFF
Format:	HEX	Data size:	16-bit

Settings:

Communication protocol is divided into U, Z, Y, and X (hexadecimal):

Digit	U	Z	Y	X
Function	PDO alarm is cleared automatically or not	Source for torque limit	Motor status when communication error occurs	-
Range	0 - 1	0 - 1	0 - 1	-

■   X: reserved.

■   Y: motor status when communication error occurs.

0: motor keeps operating when communication error (AL170) occurs (only applicable in DMCNET mode and CANopen B).

1: motor switches to Servo Off status when communication error (AL180) occurs.

■   Z: source for torque limit (only applicable in DMCNET mode).

0: communication commands are the source for the torque limit.

1: DI commands are the source for the torque limit.

■   U: PDO alarm is cleared automatically or not

0: if PDO error (AL121 - AL132) occurs, the PDO alarm must be cleared by DI.ARST, NMT: reset node, or 0x6040 fault reset.

1: if PDO error (AL121 - AL132) disappears, the alarm is automatically cleared.

P3.011	CANopen / DMCNET options		Address: 0316H 0317H
Default:	0x0000	Control mode:	CANopen / DMCNET
Unit:	-	Setting range:	Shown as follows
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

Communication setting is divided into X, Y, Z, and U (hexadecimal):

Digit	U	Z	Y	X
Function	-	-	-	Parameter is stored in EEPROM or not
Range	-	-	-	0 - 1

■ X: parameter is stored in EEPROM or not

0: parameters are not stored in EEPROM.

1: when you write parameters through CANopen / DMCNET PDOs, parameters are stored in EEPROM.

Note: if you set X to 1 and continuously write parameters through DMCNET PDO, it shortens the lifetime of the EEPROM.

P3.012	Fieldbus support setting		Address: 0318H 0319H
Default:	0x0000	Control mode:	CANopen / DMCNET / EtherCAT
Unit:	-	Setting range:	0x0000 - 0x0111
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

Digit	U	Z	Y	X
Function	Reserved	Load in CANopen / DMCNET / EtherCAT values	Reserved	Reserved
Range	-	0 - 1	-	-

X: reserved.

Y: reserved.

Z: P parameters are overwritten by the CANopen / DMCNET / EtherCAT parameters.

Z = 0: when you cycle the power on the servo drive or reset the communication, P parameters in the following table load the values in CANopen / DMCNET / EtherCAT mode.

Z = 1: when you cycle the power on the servo drive or reset the communication, P parameters in the following table retain the same settings and do not load the values in CANopen / DMCNET / EtherCAT mode.

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Related variables for Z settings:

Variables during initialization	P3.012.Z = 0	P3.012.Z = 1	Note
P1.032	0x0010	EEPROM	-
P2.035	50331648	EEPROM	-
P1.047	100	EEPROM	-
P1.049	0	EEPROM	-
P1.038	100	EEPROM	-
P6.001	0	EEPROM	-
Acc (P1.034)	200	EEPROM	Used in PV and PP modes
Dec (P1.034)	200	EEPROM	Used in PV and PP modes
Torque slope (P1.034)	200	EEPROM	Used in PT mode
P1.044	1	EEPROM	-
P1.045	1	EEPROM	-
P1.055	Depending on the motor specifications	EEPROM	-
P5.008	2147483647	EEPROM	-
P5.009	-2147483648	EEPROM	-

Methods to write parameters to EEPROM (even when the power is off):

SDO: parameters are stored in EEPROM when written.

PDO: refer to the setting of P3.011.X. (X = 1: when you write parameters through PDOs, parameters are stored in EEPROM; X = 0: when you write parameters through PDOs, parameters are not stored in EEPROM.)

Note: when using OD 1010 Store Parameter, the servo drive stores the CANopen OD in non-volatile memory.

If P3.012.Z = 0, then the initial values are the corresponding CANopen OD vaues specified in the CANopen Stardard document. If P3.012.Z = 1, then the initial values are the values listed in the above table.

P3.013 - P3.017	Reserved

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:

High bit

h0020

D C B A

Low bit

L0020

U Z Y X

A	Reserved	X	Reserved
B	Reserved	Y	Reserved
C	Reserved	Z	AL185 communication disconnection detection setting
D	Reserved	U	Reserved

■ 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: disconnection detection disabled.

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P3.019 - P3.021	Reserved	

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 set the alarm conditions for AL180 and AL3E3 respectively to ensure that the drive receives the PDO properly. When one of the alarm occurs, it means the allowable duration for packet loss exceeds the set range.

U Z Y X

Digit	UZ	YX
Function	AL180 alarm condition	AL3E3 alarm condition
Range	0x00 (disabled) - 0xFF (default)	02 - 14

■ YX: AL3E3 alarm condition (allowable cycle for elapsed time); applicable to IP / CSP / CSV / CST modes.

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 02 (allow two cycles), it means AL3E3 occurs when the servo drive does not receive any PDO within 8 ms.

■ UZ: AL180 alarm condition (allowable duration for elapsed time); applicable to all motion modes.

AL180 occurs when the servo drive does not receive the PDO within the set duration (unit: ms).

Set 0x01 for 1 ms, 0x02 for 2 ms, and 0xFF for 255 ms.

P4.xxx   Diagnosis parameters

P4.000★	Fault record (N)		Address: 0400H 0401H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit

Settings:

The last abnormal status record.

Low word (LXXXX): the alarm number.

High word (hYYYY): the alarm number.

P4.001★	Fault record (N-1)		Address: 0402H 0403H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit

Settings:

The second to last abnormal status record.

Low word (LXXXX): the alarm number.

High word (hYYYY): the alarm number.

P4.002★	Fault record (N-2)		Address: 0404H 0405H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit

Settings:

The third to last abnormal status record.

Low word (LXXXX): the alarm number.

High word (hYYYY): the alarm number.

P4.003★	Fault record (N-3)		Address: 0406H 0407H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit

Settings:

The fourth to last abnormal status record.

Low word (LXXXX): the alarm number.

High word (hYYYY): the alarm number.

P4.004★	Fault record (N-4)		Address: 0408H 0409H
Default:	0x00000000	Control mode:	All
Unit:	-	Setting range:	-
Format:	HEX	Data size:	32-bit

Settings:

The fifth to last abnormal status record.

Low word (LXXXX): the alarm number.

High word (hYYYY): the alarm number.

P4.005	Servo motor JOG control		Address: 040AH 040BH
Default:	20	Control mode:	All
Unit:	rpm	Setting range:	0 - 5000 (rotary motor)
Format:	DEC	Data size:	16-bit

Settings:

The control methods are as follows:

1. Operation test:

    After the JOG speed is set by P4.005, the panel displays "JOG". Pressing the UP key controls the JOG operation in the positive direction; pressing the DOWN key controls the JOG operation in the negative direction. Stop pressing to stop the JOG operation. If there is any error in this setting, then the motor cannot operate. The maximum JOG speed is the maximum speed of the servo motor.

2. DI control:

    If you set the DI to JOGU and JOGD (refer to Table 8.1), then the JOG operation in the positive or negative direction is controlled with this DI.

3. Communication control:

1 - 5000: JOG speed	4998: JOG operation in counterclockwise direction
4999: JOG operation in clockwise direction	0: stop operation

Note: when using communication to write values, and the frequency is high, set P2.030 to 5.

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P4.006∎	Digital output register (readable and writable)	Address: 040CH 040DH
Default:	0x0000	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0xFFFF
Format:	HEX	Data size:	16-bit

Settings:

bit 00: corresponds to DO code = 0x30	bit 08: corresponds to DO code = 0x38
bit 01: corresponds to DO code = 0x31	bit 09: corresponds to DO code = 0x39
bit 02: corresponds to DO code = 0x32	bit 10: corresponds to DO code = 0x3A
bit 03: corresponds to DO code = 0x33	bit 11: corresponds to DO code = 0x3B
bit 04: corresponds to DO code = 0x34	bit 12: corresponds to DO code = 0x3C
bit 05: corresponds to DO code = 0x35	bit 13: corresponds to DO code = 0x3D
bit 06: corresponds to DO code = 0x36	bit 14: corresponds to DO code = 0x3E
bit 07: corresponds to DO code = 0x37	bit 15: corresponds to DO code = 0x3F

If you set P2.018 to 0x0130, then the output of DO#1 is the bit 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 - 0x3FFF
Format:	HEX	Data size:	16-bit

Settings:

The source of the DI input signal can be the external terminal (DI1 - DI5) or the software (SDI1 - SDI5 corresponding to Bit 0 - 4 of P4.007), which is determined by P3.006. If the corresponding bit of P3.006 is 1, which means the source is the software SDI (P4.007); if the corresponding bit is 0, then the source is the hardware DI. See the following figure:
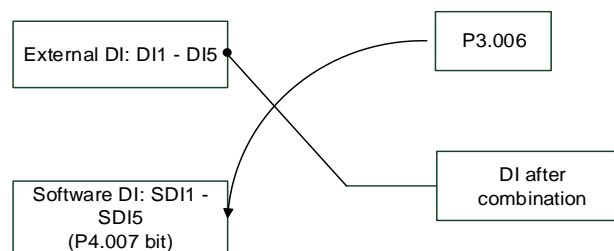
Read parameters: shows the DI status after combining external DI and software DI.

Write parameters: writes the software SDI status. This function is the same whether using the panel or communication to set the parameter.

For example: if the read value of P4.007 is 0x0011, it means DI1 and DI5 are on; if the written value of P4.007 is 0x0011, it means the software SDI1 and SDI5 are on. Refer to P2.010 - P2.014 for more information on digital input pins (DI1 - DI5).

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P4.008★	Input status of servo drive panel (read-only)	Address: 0410H 0411H
Default:	-	Control mode:	All
Unit:	-	Setting range:	Read-only
Format:	HEX	Data size:	16-bit

Settings:

Use this communication parameter to read 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 - 0x001F
Format:	HEX	Data size:	16-bit

Settings:

There is no difference whether reading by panel or through communication.

P4.010▲■	Adjustment function	Address: 0414H 0415H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 - 6
Format:	DEC	Data size:	16-bit

Settings:

0: reserved	4: execute current encoder (W phase) offset adjustment
1: execute analog speed input offset adjustment	5: execute 1 - 4 offset adjustment
2: execute analog torque input offset adjustment	6 - 14: reserved
3: execute current encoder (V phase) offset adjustment	-

Note: the function must be enabled by setting P2.008. When adjusting, the external analog voltage wiring connected

to the torque needs to be removed completely and must be in the Servo Off state.

P4.011	Analog speed input (1) offset adjustment	Address: 0416H 0417H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 - 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary

adjustment as this parameter cannot be reset.

8

P4.012	Analog speed input (2) offset adjustment		Address: 0418H 0419H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 - 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.013	Analog torque input (1) offset adjustment		Address: 041AH 041BH
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 - 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.014	Analog torque input (2) offset adjustment		Address: 041CH 041DH
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 - 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.015	Current encoder (V1 phase) offset adjustment		Address: 041EH 041FH
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 - 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

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P4.016	Current encoder (V2 phase) offset adjustment		Address: 0420H 0421H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 - 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.017	Current encoder (W1 phase) offset adjustment		Address: 0422H 0423H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 - 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.018	Current encoder (W2 phase) offset adjustment		Address: 0424H 0425H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	0 - 32767
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset. The function must be enabled by setting P2.008. Do not change the auxiliary adjustment as this parameter cannot be reset.

P4.019	IGBT NTC adjustment level (cannot reset)		Address: 0426H 0427H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	1 - 4
Format:	DEC	Data size:	16-bit

Settings:

Cool down the drive to 25°C (77°F) before adjustment. The function must be enabled by setting P2.008.

8

P4.020	Offset adjustment for analog monitor output (Ch1)		Address: 0428H 0429H
Default:	0	Control mode:	All
Unit:	mV	Setting range:	-800 to 800
Format:	DEC	Data size:	16-bit

Settings:

Offset adjustment value (cannot reset). The function must be enabled by setting P2.008.

P4.021	Offset adjustment for analog monitor output (Ch2)		Address: 042AH 042BH
Default:	0	Control mode:	All
Unit:	mV	Setting range:	-800 to 800
Format:	DEC	Data size:	16-bit

Settings:

Offset adjustment value (cannot reset). The function must be enabled by setting P2.008.

P4.022	Analog speed input offset		Address: 042CH 042DH
Default:	0	Control mode:	S
Unit:	mV	Setting range:	-5000 to 5000
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset.

P4.023	Analog torque input offset		Address: 042EH 042FH
Default:	0	Control mode:	T
Unit:	mV	Setting range:	-5000 to 5000
Format:	DEC	Data size:	16-bit

Settings:

Manually adjust the offset.

P4.024	Level of undervoltage error		Address: 0430H 0431H
Default:	160	Control mode:	All
Unit:	V (rms)	Setting range:	140 - 190
Format:	DEC	Data size:	16-bit

Settings:

When the voltage of the DC Bus is lower than P4.024*$\sqrt{2}$, the undervoltage alarm occurs.

P5.xxx   Motion control parameters

P5.000★■	**Firmware subversion**	Address: 0500H 0501H
Default:	Factory setting	Control mode:	All
Unit:	-	Setting range:	-
Format:	DEC	Data size:	32-bit

Settings:

The low bit is the subversion of the firmware.

P5.001 - P5.002	**Reserved**

P5.003	**Deceleration time for auto-protection**	Address: 0506H 0507H
Default:	0xEEEFEEFF	Control mode:	PR / S / T
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

The parameter setting is divided into D, C, B, A, W, Z, Y, and X (hexadecimal), including:

1.   Deceleration time when the auto-protection function is enabled: OVF (DO: 0x12, Position command / feedback overflows), CTO (communication timeout, AL020), SPL, SNL, PL, and NL.

2.   Deceleration time for stop command: STP

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

Use 0 - F to index the deceleration time of P5.020 - P5.035. For example: if you set X to A, then the deceleration time of PL is determined by P5.030.

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

Settings:

U Z Y X

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

8

Definition of each setting value:

U	Z	Y	X
Reserved	Limit setting	Z pulse setting	Homing method
	0 - 1	0 - 2	0 - 8
-	-	Y = 0: return 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: return 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: return 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 - 2000.0	1 - 20000	-	-	
Format:	DEC	DEC	-	-	
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-	

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 - 500.0	1 - 5000	-	-	
Format:	DEC	DEC	-	-	
Example:	1.5 = 1.5 rpm	15 = 1.5 rpm	-	-	

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 - 1000
Format:	DEC	Data size:	16-bit

Settings:

Set P5.007 to 0 to start homing.

Set P5.007 to 1 - 99 to execute the specified PR procedure, which is the same as using

DI.CTRG+POSn. You cannot set P5.007 to 100 - 999 as the value exceeds the valid range.

Example: to trigger PR#2

Method 1	Trigger by DI: Register Position command selection 1 - 99 Bit 1 (DI: 0x12) + Trigger command (DI: 0x08)
Method 2	Trigger by P5.007: Set P5.007 to 2 to start executing PR#2

Write 1000 to execute stop command, which is the same as DI.STP.

When reading P5.007, if the command is incomplete, the drive reads the current command (1 - 99).

If the command is complete but DO.TPOS is off (motor position not reached), the drive reads the

current command +10000.

If the command is complete and DO.TPOS is on (motor position reached), the drive reads the current

command +20000.

Commands triggered by DI are also applicable.

Example:

If the value read is 3, it means PR#3 is in execution but incomplete. If the value read is 10003, it means

PR#3 completed, but the motor has not reached the target position yet. If the value read is 20003,

it means PR#3 completed and the motor reached the target position.

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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

Settings:

In PR mode, if the motor rotates 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

Settings:

In PR mode, if the motor rotates 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

Settings:

Data size (N x 32 bits) means size N of data array.

P5.011■	Data array - address for reading and writing		Address: 0516H 0517H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 to (value set by P5.010 minus 1)
Format:	DEC	Data size:	16-bit

Settings:

Specify the address in the data array when reading and writing data. Refer to Chapter 7 for detailed instructions.

P5.012■	Data array - window #1 for reading and writing		Address: 0518H 0519H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Window #1: when you read the parameter with the panel, the value set in P5.011 does not add 1,

but reading or writing by other methods adds 1.

Refer to Section 7.2.1 Data array for detailed instructions.

P5.013■	Data array - window #2 for reading and writing		Address: 051AH 051BH
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Window #2: when you read the parameter with the panel or read and write the parameter through

communication, the value set inP5.011 adds 1, but the panel is write-protected.

Refer to Section 7.2.1 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 - 0x0011
Format:	HEX	Data size:	16-bit

Settings:

This parameter allows you to write data to the target continuously through communication.

$$\boxed{0\ 0\ 0\ 0}$$
U Z Y X

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

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P5.016∎	Axis position - motor encoder		Address: 0520H 0521H
Default:	0	Control mode:	All
Unit:	PUU	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Read: feedback position of the encoder, which is the monitoring variable 000(00h) + offset value.

Write: write any value to the parameter, and it neither changes the monitoring variable 000(00h) nor affects the positioning coordinate system. It is only for observation when you adjust the offset value.

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

Settings:

Pulse count from the pulse command.

P5.019	Reserved

P5.020	Acceleration / deceleration time (Number #0)		Address: 0528H 0529H
Default:	200	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

The duration of acceleration and deceleration in PR mode, which is the length of time to accelerate from 0 to 3,000 rpm.

P5.021	Acceleration / deceleration time (Number #1)		Address: 052AH 052BH
Default:	300	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.022	**Acceleration / deceleration time (Number #2)**		**Address: 052CH** **052DH**
Default:	500	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.023	**Acceleration / deceleration time (Number #3)**		**Address: 052EH** **052FH**
Default:	600	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.024	**Acceleration / deceleration time (Number #4)**		**Address: 0530H** **0531H**
Default:	800	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.025	**Acceleration / deceleration time (Number #5)**		**Address: 0532H** **0533H**
Default:	900	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.026	**Acceleration / deceleration time (Number #6)**		**Address: 0534H** **0535H**
Default:	1000	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

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P5.027	**Acceleration / deceleration time (Number #7)**		**Address: 0536H** **0537H**
Default:	1200	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.028	**Acceleration / deceleration time (Number #8)**		**Address: 0538H** **0539H**
Default:	1500	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.029	**Acceleration / deceleration time (Number #9)**		**Address: 053AH** **053BH**
Default:	2000	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.030	**Acceleration / deceleration time (Number #10)**		**Address: 053CH** **053DH**
Default:	2500	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.031	**Acceleration / deceleration time (Number #11)**		**Address: 053EH** **053FH**
Default:	3000	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.032	**Acceleration / deceleration time (Number #12)**		**Address: 0540H**
			0541H
Default:	5000	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.033	**Acceleration / deceleration time (Number #13)**		**Address: 0542H**
			0543H
Default:	8000	Control mode:	PR
Unit:	ms	Setting range:	1 to 65500
Format:	DEC	Data size:	16-bit

Settings:

Refer to P5.020 for the acceleration / deceleration time in PR mode.

P5.034	**Acceleration / deceleration time (Number #14)**		**Address: 0544H**
			0545H
Default:	50	Control mode:	PR
Unit:	ms	Setting range:	1 to 1500
Format:	DEC	Data size:	16-bit

Settings:

This parameter is for the deceleration time for auto protection, and the default value of this is small (shorter deceleration time).

P5.035	**Acceleration / deceleration time (Number #15)**		**Address: 0546H**
			0547H
Default:	30	Control mode:	PR
Unit:	ms	Setting range:	1 to 1200
Format:	DEC	Data size:	16-bit

Settings:

This parameter is for the deceleration time for auto protection, and the default value of this is small (shorter deceleration time).

P5.036	**Capture - start address of data array**		**Address: 0548H**
			0549H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 to (value set by P5.010 minus 1)
Format:	DEC	Data size:	16-bit

Settings:

The first data Capture obtained is saved at this address in the data array. This parameter is only writable when Capture stops (refer to P5.039).

P5.037■	Capture－Axis position		Address: 054AH
			054BH
Default:	0	Control mode:	All
Unit:	Pulse unit of capture source	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Displays the axis position of Capture pulse source. Note that this parameter is only writable when Capture stops (refer to P5.039). If the axis source of Capture is the main encoder, this parameter is write-protected and the Capture axis position is the feedback position of the motor (monitoring variable 00h).

P5.038■	Capture－Number of capturing times		Address: 054CH
			054DH
Default:	1	Control mode:	All
Unit:	-	Setting range:	1 to (value set by P5.010 minus value set by P5.036)
Format:	DEC	Data size:	16-bit

Settings:

When Capture stops, this parameter indicates the number of data expected to be captured (readable and writable). When Capture activates, this parameter indicates the remaining number of data to be captured (read-only); each time it captures one data, the value of P5.038 decrements by 1 until the value is 0, indicating that capturing is complete.

Note: the total number of data from Capture cannot exceed 100.

P5.039■	Capture－Activate CAP control		Address: 054EH
			054FH
Default:	0x2010	Control mode:	All
Unit:	-	Setting range:	0x0000 - 0xF13F
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

X	Capture setting	Z	Trigger logic
Y	Axis source of Capture	U	Trigger minimum interval

■ X: Capture setting

Bit	Function	Description
0	Activate Capture	Start capturing; after finishing capturing, set to 0
1	Reset position	After capturing the first data, reset the position coordinate of the first data. The reset coordinate position is set by P5.076
2	Reserved	-
3	Execute PR	Execute PR#50 after capturing is complete

■   Y: axis source of Capture

     0: Capture is not working

     1: reserved

     2: pulse command (CN1)

     3: motor encoder (CN2)

     Note: when the source of Compare is the Capture axis, the source of Capture (P5.039.Y) cannot be changed.

■   Z: trigger logic

     0: NO (normally open)

     1: NC (normally closed)

■   U: trigger minimum interval (unit: ms)

Note: refer to Chapter 7 for detailed instructions for Capture.

P5.040	Delay time after position reached (Number #0)		Address: 0550H 0551H
Default:	0	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The first delay time of PR mode.

P5.041	Delay time after position reached (Number #1)		Address: 0552H 0553H
Default:	100	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The second delay time of PR mode.

P5.042	Delay time after position reached (Number #2)		Address: 0554H 0555H
Default:	200	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The third delay time of PR mode.

P5.043	Delay time after position reached (Number #3)		Address: 0556H 0557H
Default:	400	Control mode:	PR

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Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The fourth delay time of PR mode.

P5.044	Delay time after position reached (Number #4)		Address: 0558H 0559H
Default:	500	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The fifth delay time of PR mode.

P5.045	Delay time after position reached (Number #5)		Address: 055AH 055BH
Default:	800	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The sixth delay time of PR mode.

P5.046	Delay time after position reached (Number #6)		Address: 055CH 055DH
Default:	1000	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The seventh delay time of PR mode.

P5.047	Delay time after position reached (Number #7)		Address: 055EH 055FH
Default:	1500	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The eighth delay time of PR mode.

P5.048	**Delay time after position reached (Number #8)**		**Address: 0560H** **0561H**
Default:	2000	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The ninth delay time of PR mode.

P5.049	**Delay time after position reached (Number #9)**		**Address: 0562H** **0563H**
Default:	2500	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The tenth delay time of PR mode.

P5.050	**Delay time after position reached (Number #10)**		**Address: 0564H** **0565H**
Default:	3000	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The eleventh delay time of PR mode.

P5.051	**Delay time after position reached (Number #11)**		**Address: 0566H** **0567H**
Default:	3500	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The twelfth delay time of PR mode.

P5.052	**Delay time after position reached (Number #12)**		**Address: 0568H** **0569H**
Default:	4000	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The thirteenth delay time of PR mode.

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P5.053	Delay time after position reached (Number #13)		Address: 056AH 056BH
Default:	4500	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The fourteenth delay time of PR mode.

P5.054	Delay time after position reached (Number #14)		Address: 056CH 056DH
Default:	5000	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The fifteenth delay time of PR mode.

P5.055	Delay time after position reached (Number #15)		Address: 056EH 056FH
Default:	5500	Control mode:	PR
Unit:	ms	Setting range:	0 to 32767
Format:	DEC	Data size:	16-bit

Settings:

The sixteenth delay time of 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 6000.0	0 to 60000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-

Settings:

First target speed 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 6000.0	0 to 60000	-	-	
Format:	DEC	DEC	-	-	
Example:	15 = 15 rpm	150 = 15 rpm	-	-	

Settings:

Second target speed 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 6000.0	0 to 60000	-	-	
Format:	DEC	DEC	-	-	
Example:	15 = 15 rpm	150 = 15 rpm	-	-	

Settings:

Third target speed 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 6000.0	0 to 60000	-	-	
Format:	DEC	DEC	-	-	
Example:	15 = 15 rpm	150 = 15 rpm	-	-	

Settings:

Fourth target speed of PR mode.

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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 6000.0	0 to 60000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-

Settings:

Fifth target speed 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 6000.0	0 to 60000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-

Settings:

Sixth target speed 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 6000.0	0 to 60000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-

Settings:

Seventh target speed 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 6000.0	0 to 60000	-	-	
Format:	DEC	DEC	-	-	
Example:	15 = 15 rpm	150 = 15 rpm	-	-	

Settings:

Eighth target speed 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 6000.0	0 to 60000	-	-	
Format:	DEC	DEC	-	-	
Example:	15 = 15 rpm	150 = 15 rpm	-	-	

Settings:

Ninth target speed 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 6000.0	0 to 60000	-	-	
Format:	DEC	DEC	-	-	
Example:	15 = 15 rpm	150 = 15 rpm	-	-	

Settings:

Tenth target speed of PR mode.

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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 6000.0	0 to 60000	-	-	
Format:	DEC	DEC	-	-	
Example:	15 = 15 rpm	150 = 15 rpm	-	-	

Settings:

Eleventh target speed 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 6000.0	0 to 60000	-	-	
Format:	DEC	DEC	-	-	
Example:	15 = 15 rpm	150 = 15 rpm	-	-	

Settings:

Twelfth target speed 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 6000.0	0 to 60000	-	-	
Format:	DEC	DEC	-	-	
Example:	15 = 15 rpm	150 = 15 rpm	-	-	

Settings:

Thirteenth target speed 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 6000.0	0 to 60000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-

Settings:

Fourteenth target speed 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 6000.0	0 to 60000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-

Settings:

Fifteenth target speed 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 6000.0	0 to 60000	-	-
Format:	DEC	DEC	-	-
Example:	15 = 15 rpm	150 = 15 rpm	-	-

Settings:

Sixteenth target speed of PR mode.

P5.076	Capture - reset position after first data	Address: 0598H 0599H	
Default:	0	Control mode:	All
Unit:	Pulse unit of capture source	Setting range:	-1073741824 to +1073741823
Format:	DEC	Data size:	32-bit

Settings:

If the position reset function is enabled (P5.039.X [Bit 1] = 1), after the first position data is captured, the servo resets the coordinates of the first point, which is defined by this parameter.

P5.077 - P5.092	Reserved		

P5.093	Motion control macro command: command parameter #4	Address: 05BAH 05BBH	
Default:	0	Control mode:	All
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Before executing the macro command, set the relevant parameters in advance. The function of the parameter is determined by the macro command. 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

Settings:

Before executing the macro command, set the relevant parameters in advance. The function of the parameter is determined by the macro command. Not every macro command requires this parameter.

P5.095	Motion control macro command: command parameter #2	Address: 05BEH 05BFH	
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Before executing the macro command, set the relevant parameters in advance. The function of the parameter is determined by the macro command. Not every macro command requires this parameter.

P5.096	Motion control macro command: command parameter #1	Address: 05C0H 05C1H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Before executing the macro command, set the relevant parameters in advance. The function of the parameter is determined by the macro command. Not every macro command requires this parameter.

P5.097■	Motion control macro command: issue command / execution result	Address: 05C2H 05C3H
Default:	0	Control mode:	All
Unit:	-	Setting range:	0 - 0x099F
Format:	HEX	Data size:	16-bit

Settings:

Write to this parameter to issue a macro command; read this parameter to examine the execution result of a macro command.

If the command 0x0003 is issued, 0x1003 is returned if successful; and 0xF03X if unsuccessful (depending on the command description). If you execute 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 groups 5, 6, and 7 are write-protected 0: no protection 1: enable protection P5.094 = read protection range of parameter and data array (-1 to 7) -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 P5.095 = set new password (1 to 16777215) P5.096 = confirm new password (1 to 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 to 16777215)
	0xF034: protection range P5.094 exceeds the allowable range (-1 to 7)
	0xF035: protection level P5.093 exceeds the allowable range (0 to 1)

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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 it is locked. You can only reset all parameters (P2.008 = 10) to unlock.
Macro parameter	P5.096 = enter password (1 to 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 to 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, it is locked and does not allow further attempts.

P5.098	PR# triggered by event rising-edge	Address: 05C4H 05C5H
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 - 0xDDDD
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

X	PR triggered by EV1 rising-edge	Z	PR triggered by EV3 rising-edge
Y	PR triggered by EV2 rising-edge	U	PR triggered by EV4 rising-edge

- X: PR triggered when EV1 is on

  0: no action

  1 - D: execute PR# 51 - 63

- Y: PR triggered when EV2 is on

  0: no action

  1 - D: execute PR# 51 - 63

- Z: PR triggered when EV3 is on

  0: no action

  1 - D: execute PR# 51 - 63

- U: PR triggered when EV4 is on

  0: no action

  1 - D: execute PR# 51 - 63

P5.099	PR# triggered by event falling-edge	Address: 05C6H 05C7H
Default:	0x0000	Control mode:	PR
Unit:	-	Setting range:	0x0000 - 0xDDDD
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

X	PR triggered by EV1 falling-edge	Z	PR triggered by EV3 falling-edge
Y	PR triggered by EV2 falling-edge	U	PR triggered by EV4 falling-edge

■ X: PR triggered when EV1 is off

0: no action

1 - D: execute PR# 51 - 63

■ Y: PR triggered when EV2 is off

0: no action

1 - D: execute PR# 51 - 63

■ Z: PR triggered when EV3 is off

0: no action

1 - D: execute PR# 51 - 63

■ U: PR triggered when EV4 is off

0: no action

1 - D: execute PR# 51 - 63

P5.100■	Data array - window #3 for reading and writing	Address: 05C8H 05C9H
Default:	0	Control mode:	All
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Window #3: when you read or write the parameter by any method, the value set in P5.011 does

not add 1.

Refer to Section 7.2.1 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

Settings:

Window #4: when you read or write the parameter by any method, the value set in P5.011 does not add 1.

Refer to Section 7.2.1 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

Settings:

Window #5: when you read or write the parameter by any method, the value set by P5.011 does not add 1.

Refer to Section 7.2.1 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

Settings:

Window #6: when you read or write the parameter by any method, the value set by P5.011 does not add 1.

Refer to Section 7.2.1 Data array for detailed instructions.

P6.xxx   PR parameters

P6.000	Homing definition		Address: 0600H 0601H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFF6F
Format:	HEX	Data size:	32-bit

Settings:

Homing definition:

High bit

```
h0020
```
D C B A

Low bit

```
L052A
```
U Z YX

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

■ YX: PATH: path type

0x00: Stop: homing complete and stop

0x01 - 0x63: Auto: homing complete and execute the specified path (Path#1 - Path#99)

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

0: do not execute homing

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

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

1. P5.004 homing methods.

2. P5.005 - P5.006 speed setting of searching for the origin.

3. P6.001: ORG_DEF is the coordinate of the origin and may not be 0. This function is used as a traversal of the coordinate.

Note:

1. After the origin is found (sensor or Z), the motor 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 zero.

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If returning to the origin is needed, set PATH to a non-zero value and set PABS = ORG_DEF.

Example:

Upon completion of P6.000 = 0x0001, automatically execute Path#1.

Set from absolute position (ABS) to 0 as the route of Path#1 (set P6.002 & P6.003).

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

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

Settings:

Origin definition.

P6.002	PATH#1 definition		Address: 0604H 0605H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Format of this parameter: (High word h) DCBA : (Low word L) UZYX

High bit

h0020

D C B A

Low bit

L0020

U Z Y X

A	SPD, Target speed index*	X	TYPE, Path type
B	DLY, Delay time index	Y	OPT, Option
C	AUTO*[1]	Z	ACC, Acceleration time index*
D	Reserved	U	DEC, Deceleration time index*

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 specified parameter to specified path.
DIR		OVLP	INS	A: indexing position control.

TYPE, Path type: when executing 1 - 3, it can be interrupted and stopped by DI.STP and software limits.

INS: executing this path interrupts the previous path.

OVLP: allow overlapping of the next path. Overlapping is not allowed in Speed mode.

When overlapping in Position mode, DLY has no function.

AUTO: once current PR path is finished, automatically load the next path.

CMD: refer to Section 7.1.3 Motion control commands.

■ UZ

U: DEC, Deceleration time index	Z: ACC, Acceleration time index	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 index

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 index

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 only enabled when X = A indexing 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 above table when the path type is [7]: write the specified parameter to the 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

Settings:

P6.002 defines the property of the target point; P6.003 defines the target position of P6.002 or the target path for the Jump command.

P6.004	**PATH#2 definition**		**Address: 0608H**
			0609H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P6.005	**PATH#2 data**		**Address: 060AH**
			060BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.006	**PATH#3 definition**		**Address: 060CH**
			060DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P6.007	**PATH#3 data**		**Address: 060EH**
			060FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.008	**PATH#4 definition**		**Address: 0610H**
			0611H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

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P6.009	PATH#4 data		Address: 0612H 0613H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.010	PATH#5 definition		Address: 0614H 0615H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

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

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

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

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

Settings:

Refer to the description of P6.002.

P6.015	**PATH#7 data**		**Address: 061DH**
			061FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

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

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

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

Settings:

Refer to the description of P6.002.

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P6.019	**PATH#9 data**		**Address: 0626H**
			0627H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.020	**PATH#10 definition**		**Address: 0628H**
			0629H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

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

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

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

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

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

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

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

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

Settings:

Refer to the description of P6.002.

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P6.029	PATH#14 data		Address: 063AH 063BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.030	PATH#15 definition		Address: 063CH 063DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

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

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

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

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

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

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

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

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

Settings:

Refer to the description of P6.002.

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P6.039	PATH#19 data		Address: 064EH 064FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.040	PATH#20 definition		Address: 0650H 0651H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

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

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

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

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

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

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

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

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

Settings:

Refer to the description of P6.002.

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P6.049	PATH#24 data		Address: 0662H 0663H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.050	PATH#25 definition		Address: 0664H 0665H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

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

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

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

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

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

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

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

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

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

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

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

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

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

Settings:

Refer to the description of P6.003.

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P6.064	PATH#32 definition		Address: 0680H 0681H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P6.065	PATH#32 data		Address: 0682H 0683H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.066	PATH#33 definition		Address: 0684H 0685H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P6.067	PATH#33 data		Address: 0686H 0687H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.068	PATH#34 definition		Address: 0688H 0689H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

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P6.069	PATH#34 data		Address: 068AH 068BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

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

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

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

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

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

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

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

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

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

Settings:

Refer to the description of P6.002.

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P6.079	PATH#39 data		Address: 069EH 069FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.080	PATH#40 definition		Address: 06A0H 06A1H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

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

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

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

Settings:

Refer to the description of P6.003.

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P6.084	PATH#42 definition		Address: 06A8H 06A9H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P6.085	PATH#42 data		Address: 06AAH 06ABH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.086	PATH#43 definition		Address: 06ACH 06ADH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P6.087	PATH#43 data		Address: 06AEH 06AFH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.088	PATH#44 definition		Address: 06B0H 06B1H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

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P6.089	PATH#44 data		Address: 06B2H 06B3H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P6.090	PATH#45 definition		Address: 06B4H 06B5H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

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

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

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

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

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

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

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

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

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

Settings:

Refer to the description of P6.003.

P7.xxx   PR parameters

P7.000	PATH#50 definition		Address: 0700H 0701H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.001	PATH#50 data		Address: 0702H 0703H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.002	PATH#51 definition		Address: 0704H 0705H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.003	PATH#51 data		Address: 0706H 0707H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.004	PATH#52 definition		Address: 0708H 0709H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

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P7.005	**PATH#52 data**		**Address: 070AH** **070BH**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.006	**PATH#53 definition**		**Address: 070CH** **070DH**
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.007	**PATH#53 data**		**Address: 070EH** **070FH**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.008	**PATH#54 definition**		**Address: 0710H** **0711H**
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.009	**PATH#54 data**		**Address: 0712H** **0713H**
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

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

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

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

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

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

Settings:

Refer to the description of P6.002.

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P7.015	PATH#57 data	Address: 071EH 071FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.016	PATH#58 definition	Address: 0720H 0721H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.017	PATH#58 data	Address: 0722H 0723H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.018	PATH#59 definition	Address: 0724H 0725H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.019	PATH#59 data	Address: 0726H 0727H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

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

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

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

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

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

Settings:

Refer to the description of P6.002.

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P7.025	PATH#62 data		Address: 0732H 0733H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.026	PATH#63 definition		Address: 0734H 0735H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.027	PATH#63 data		Address: 0736H 0737H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.028	PATH#64 definition		Address: 0738H 0739H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.029	PATH#64 data		Address: 073AH 073BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.030	PATH#65 definition		Address: 073CH 073DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.031	PATH#65 data		Address: 073EH 073FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.032	PATH#66 definition		Address: 0740H 0741H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.033	PATH#66 data		Address: 0742H 0743H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.034	PATH#67 definition		Address: 0744H 0745H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

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P7.035	**PATH#67 data**		**Address: 0746H**
			0747H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.036	**PATH#68 definition**		**Address: 0748H**
			0749H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.037	**PATH#68 data**		**Address: 074AH**
			074BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.038	**PATH#69 definition**		**Address: 074CH**
			074DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.039	**PATH#69 data**		**Address: 074EH**
			074FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

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P7.040	**PATH#70 definition**		**Address: 0750H**
			0751H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.041	**PATH#70 data**		**Address: 0752H**
			0753H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.042	**PATH#71 definition**		**Address: 0754H**
			0755H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.043	**PATH#71 data**		**Address: 0756H**
			0757H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.044	**PATH#72 definition**		**Address: 0758H**
			0759H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

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P7.045	PATH#72 data		Address: 075AH 075BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.046	PATH#73 definition		Address: 075CH 075DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.047	PATH#73 data		Address: 075EH 075FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.048	PATH#74 definition		Address: 0760H 0761H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.049	PATH#74 data		Address: 0762H 0763H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

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

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

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

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

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

Settings:

Refer to the description of P6.002.

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P7.055	PATH#77 data		Address: 076EH 076FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.056	PATH#78 definition		Address: 0770H 0771H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.057	PATH#78 data		Address: 0772H 0773H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.058	PATH#79 definition		Address: 0774H 0775H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.059	PATH#79 data		Address: 0776H 0777H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

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

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

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

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

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

Settings:

Refer to the description of P6.002.

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P7.065	**PATH#82 data**		**Address: 0782H**
			0783H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.066	**PATH#83 definition**		**Address: 0784H**
			0785H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.067	**PATH#83 data**		**Address: 0786H**
			0787H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.068	**PATH#84 definition**		**Address: 0788H**
			0789H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.069	**PATH#84 data**		**Address: 078AH**
			078BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

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

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

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

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

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

Settings:

Refer to the description of P6.002.

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P7.075	PATH#87 data		Address: 0796H 0797H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.076	PATH#88 definition		Address: 0798H 0799H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.077	PATH#88 data		Address: 079AH 079BH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.078	PATH#89 definition		Address: 079CH 079DH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.079	PATH#89 data		Address: 079EH 079FH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

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

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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

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

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

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

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

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

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

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

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

Settings:

Refer to the description of P6.003.

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P7.090	**PATH#95 definition**		**Address: 07B4H**
			07B5H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.091	**PATH#95 data**		**Address: 07B6H**
			07B7H
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.092	**PATH#96 definition**		**Address: 07B8H**
			07B9H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

P7.093	**PATH#96 data**		**Address: 07BAH**
			07BBH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.094	**PATH#97 definition**		**Address: 07BCH**
			07BDH
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

Refer to the description of P6.002.

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P7.095	PATH#97 data		Address: 07BEH 07BFH
Default:	0	Control mode:	PR
Unit:	-	Setting range:	-2147483648 to +2147483647
Format:	DEC	Data size:	32-bit

Settings:

Refer to the description of P6.003.

P7.096	PATH#98 definition		Address: 07C0H 07C1H
Default:	0x00000000	Control mode:	PR
Unit:	-	Setting range:	0x00000000 - 0xFFFFFFFF
Format:	HEX	Data size:	32-bit

Settings:

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

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
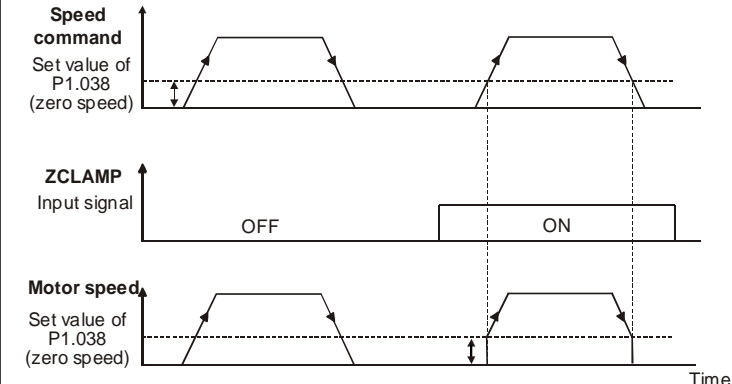
Settings:

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

Settings:

Refer to the description of P6.003.

Table 8.1   Digital input (DI) descriptions

Value: 0x01			
DI name	Description	Triggering method	Control mode
SON	When this DI is on, servo is activated (Servo On).	Level triggered	All

Value: 0x02			
DI name	Description	Triggering method	Control mode
ARST	After the alarm is cleared, the drive shows that the alarm is cleared when this DI is on.	Rising-edge triggered	All

Value: 0x03			
DI name	Description	Triggering method	Control mode
GAINUP	In Speed and Position modes, when this DI is on (P2.027 set to 1), the gain switches to the original gain multiplied by the switching rate.	Level triggered	PT, PR, S

Value: 0x04			
DI name	Description	Triggering method	Control mode
CCLR	Clear pulse counter and P2.050. Set DI.CCLR to 0 to clear position pulse deviation (applicable to PT mode). When this DI is on, the accumulative pulse deviation of the drive is cleared to 0.	Rising-edge triggered, level triggered	PT, PR

Value: 0x05			
DI name	Description	Triggering method	Control mode
ZCLAMP	When the speed is slower than the setting of zero speed (P1.038), the motor stops operating when this DI is on.	Level triggered	S

Value: 0x06			
DI name	Description	Triggering method	Control mode
CMDINV	In Speed and Torque modes, the input command is reversed when this DI is on.	Level triggered	S, Sz, T

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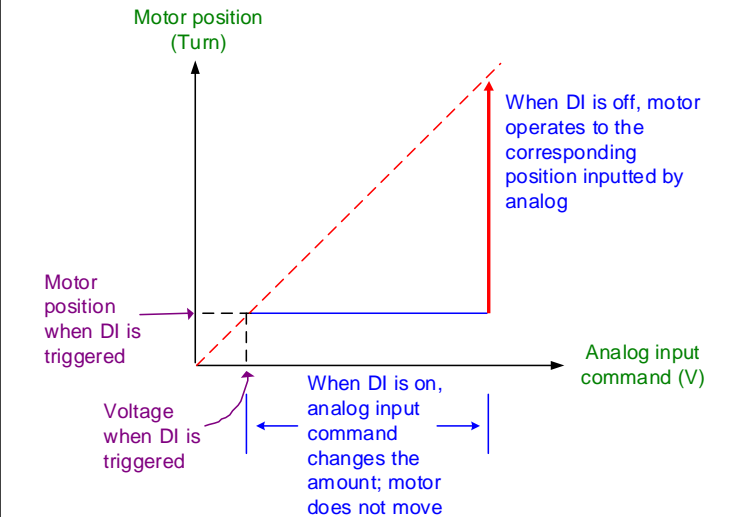
Value: 0x08			
DI name	Description	Triggering method	Control mode
CTRG	In PR mode, after you select the PR command (POS0 - 6), the motor operates according to the command issued by the register when this DI is on.	Rising-edge triggered	PR

Value: 0x09			
DI name	Description	Triggering method	Control mode
TRQLM	In Speed and Position modes, motor torque is limited when this DI is on, and source of the limited Torque command is the internal register or analog voltage.	Level triggered	PT, PR, S

Value: 0x0C			
DI name	Description	Triggering method	Control mode
VPL	Latch function of analog Position command. If this DI is on, position of the motor is held at the current position when the DI is triggered. During the time 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 the DI was on.	Level triggered	PT

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Value: 0x0D			
DI name	Description	Triggering method	Control mode
VPRS	Clear function of analog Position command. If this DI is on, the position of the motor is held at the current position when DI is triggered. Despite the change in the analog command during the time DI is on, the motor remains at the current position even when the DI is off. However, the position that the motor remains at corresponds to the new analog command. Thus, the analog input command redefines the coordinate system of the motor. Motor Position (Turn) Motor position when DI is triggered When DI is on, all input commands are cleared Voltage when DI is triggered Analog input command (V) Analog input command (V) When DI is off, motor does not move, but the zero point of the coordinate is redefined	Level triggered	PT

Value: 0x10			
DI name	Description	Triggering method	Control mode
SPDLM	In Torque mode, motor speed is limited when this DI is on, and source of the limited Speed command is the internal register or analog voltage.	Level triggered	T

Value: 0x11, 0x12, 0x13, 0x1A, 0x1B, 0x1C, 0x1E			
DI name	Description	Triggering method	Control mode
POS0 POS1 POS2 POS3 POS4 POS5 POS6	PR command selection (0 - 99) | Position CMD	POS 6	POS 5	POS 4	POS 3	POS 2	POS 1	POS 0	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 |	Level triggered	PR

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Value: 0x1D

DI name	Description	Triggering method	Control mode
ABSE	When DI.ABSE is on, it is in absolute mode and can enable the functions of DI.ABSQ, DI.ABSR, DI.ABSD, and DI.ABSC at the same time. When DI.ABSE is on, the functions of DI4, DO2, and DO3 are no longer the ones assigned by the parameter. The DI4 function will be DI.ABSQ, DO2 will be DI.ABSR, and DO3 will be DI.ABSD. In addition, DI pin of DI.ABSC can be assigned by parameters.	Level triggered	All

Value: 0x1F

DI name	Description	Triggering method	Control mode
ABSC	When DI.ABSC is on, the number of turns stored in absolute encoder are cleared. But this DI is only valid when DI.ABSE is on.	Rising-edge triggered	All

Value: when DI.ABSE is on, the DI.ABSQ from DI4 replaces the DI4 function from P2.013

DI name	Description	Triggering method	Control mode
ABSQ always input by DI4	During I/O transmission, the controller sends the handshaking signal. When DI.ABSQ is off, the controller issues the request; when DI.ABSQ is on, the controller has processed the ABSD signal. This DI is only valid when DI.ABSE is on. Refer to Figure 10.3.5.1.1 for the timing diagram.	Rising- and falling-edge triggered	All

Value: 0x14, 0x15

DI name	Description					Triggering method	Control mode
SPD0 SPD1	Register Speed command selection (1 - 4)					Level triggered	S, Sz

	Speed command number	DI signal of CN1		Command source		Content	Range		
		SPD1	SPD0						
	S1	0	0	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	+/- 6000 rpm		
	S3	1	0			P1.010	+/- 6000 rpm		
	S4	1	1			P1.011	+/- 6000 rpm		

Value: 0x16, 0x17

DI name	Description					Triggering method	Control mode
TCM0 TCM1	Register Torque command selection (1 - 4)					Level triggered	T, Tz

	Torque command number	DI signal of CN1		Command source		Content	Range		
		TCM1	TCM0						
	T1	0	0	T	External analog signal	Voltage difference between T_REF and GND	-10V to +10V		
				Tz	N/A	Torque command is 0	0		
	T2	0	1	Internal register parameter		P1.012	+/- 500%		
	T3	1	0			P1.013	+/- 500%		
	T4	1	1			P1.014	+/- 500%		

Value: 0x18

DI name	Description	Triggering method	Control mode
S-P	In S-P dual mode, if DI is off, it is in Speed mode; if DI is on, it is in Position mode. In PT / PR / S modes, select PT or PR with DI.PT-PR (0x2B).	Level triggered	Dual mode

Value: 0x19

DI name	Description	Triggering method	Control mode
S-T	In S-T dual mode, if DI is off, it is in Speed mode; if DI is on, it is in Torque mode.	Level triggered	Dual mode

Value: 0x20

DI name	Description	Triggering method	Control mode
T-P	In T-P dual mode, if DI is off, it is in Torque mode; if DI is on, it is in Position mode. In PT / PR / T modes, select PT or PR with DI.PT-PR (0x2B).	Level triggered	Dual mode

Value: 0x21

DI name	Description	Triggering method	Control mode
EMGS	When this DI is on, the motor stops immediately.	Level triggered	All

Value: 0x22

DI name	Description	Triggering method	Control mode
NL (CWL)	Negative inhibit limit (contact B).	Level triggered	All

Value: 0x23

DI name	Description	Triggering method	Control mode
PL (CCWL)	Positive inhibit limit (contact B).	Level triggered	All

Value: 0x24

DI name	Description	Triggering method	Control mode
ORGP	During homing, when this DI is on, the servo uses this position as the homing 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, it activates the function to search for the origin. Refer to the setting of P5.004.	Rising-edge triggered	PR

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Value: 0x2B

DI name	Description	Triggering method	Control mode
PT-PR	Use this DI to select the command source in PT-PR dual mode or PT-PR-S multiple mode. If this DI is off, it is in PT mode; if this DI is on, it is in PR mode.	Level triggered	Dual mode

Value: 0x37

DI name	Description	Triggering method	Control mode
JOGU	When this DI is on, motor jogs in the positive direction.	Level triggered	All

Value: 0x38

DI name	Description	Triggering method	Control mode
JOGD	When this DI is on, 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

DO 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

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Value: 0x43, 0x44

DI name	Description	Triggering method	Control mode
GNUM0 GNUM1	E-Gear ratio (numerator) selection 0 E-Gear ratio (numerator) selection 1 GNUM0, GNUM1 Pulse → 1st numerator (P1.044) 2nd numerator (P2.060) 3rd numerator (P2.061) 4th numerator (P2.062) -------------------------- Denominator (P1.045) → Position command moving filter (P1.068) → Smooth filter (P1.008) → Pulse Error ← Feedback pulse	Level triggered	PT
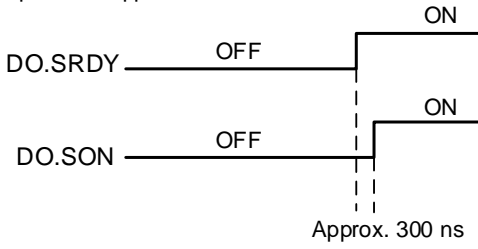
Value: 0x45

DI name	Description	Triggering method	Control mode
INHP	In Position mode, the external pulse input command has no function when this DI is on. Note: this function has to be set to DI4 to ensure immediate pulse inhibition.	Level triggered	PT

Value: 0x46

DI name	Description	Triggering method	Control mode
STP	Motor stops.	Rising-edge triggered	PR

Value: 0x47

DI name	Description	Triggering method	Control mode
PFQS	Use this DI to set the emergency stop for deceleration time. The value for deceleration time is same as P5.003. If this DI is triggered, AL35F occurs and the motor starts decelerating. When the speed reaches 0, AL3CF occurs and servo is switched to Servo Off. Reset the alarm to switch the drive to the Servo On state.	Rising-edge triggered	PT, PR, T, S

Note: the input function is disabled when P2.010 - P2.017 and P2.036 - P2.040 are set to 0.

Table 8.2 Digital output (DO) descriptions

Value: 0x01			
DO name	Description	Triggering method	Control mode
SRDY	When the control and main circuit power is applied to the drive, this DO is on if no alarm occurs.	Level triggered	All

Value: 0x02			
DO name	Description	Triggering method	Control mode
SON	When the servo is activated (Servo On), this DO is on if no alarm occurs. The time difference between DO.SRDY and DO.SON 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 value of the zero speed (P1.038), this DO is on.	Level triggered	All

Value: 0x04			
DO name	Description	Triggering method	Control mode
TSPD	When the motor speed is faster than the target speed setting (P1.039), this DO is on.	Level triggered	All

Value: 0x05			
DO name	Description	Triggering method	Control mode
TPOS	When the deviation pulse number is smaller than the position range setting (setting value of P1.054), this DO is on.	Level triggered	PT, PR

Value: 0x06			
DO name	Description	Triggering method	Control mode
TQL	When it is in torque limit, this DO is on.	Level triggered	All (except for T and Tz)

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Value: 0x07			
DO name	Description	Triggering method	Control mode
ALRM	When an alarm occurs, this DO is on. (Except for positive / negative limit, communication error, undervoltage, and fan error.)	Level triggered	All

Value: 0x08			
DO name	Description	Triggering method	Control mode
BRKR	When the magnetic brake control signal is detected, adjust the settings of P1.042 and P1.043. 	Level triggered	All

Value: 0x09			
DO name	Description	Triggering method	Control mode
HOME	When homing is complete, it means the position coordinate system and position counter are defined and this DO is on. When power is applied, this DO is off; when homing is complete, this DO is on. During operation, this DO is on until the position counter overflows (including commands or feedback). Then, this DO turns off. When the homing command is triggered, this DO is off; after homing is complete, this DO is on.	Level triggered	PR

Value: 0x0D			
DO name	Description	Triggering method	Control mode
ABSW	When there are absolute encoder alarms, this DO is on.	-	All

Value: 0x0E			
DO name	Description	Triggering method	Control mode
IDXD	Indexing coordinate is defined. When homing is complete, indexing coordinate is defined as well.	-	PR

Value: 0x10			
DO name	Description	Triggering method	Control mode
OLW	This DO is on when the overload level setting is reached. t_{OL} = Overload allowable time of the servo x value for the overload warning level (P1.056). When the overload accumulative time exceeds t_{OL}, it sends the overload pre-warning (OLW). However, if the overload accumulative time exceeds the overload allowable time of the servo, it sends the overload error (ALRM). For example: the value for the overload warning level is 60%. (P1.056 = 60) When the output average load of the servo drive is 200% and the	Level triggered	All

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Value: 0x10			
DO name	Description	Triggering method	Control mode
	output time exceeds 8 seconds, the overload alarm (AL006) occurs. t_{OL} = Duration when the output average load of the servo is 200% x value for the overload warning level = 8 sec x 60% = 4.8 sec Result: when the output average load of the servo drive is 200% for over t_{OL} = 4.8 seconds, this overload warning DO is on (DO: 0x10). If the duration exceeds 8 seconds, then the overload alarm (AL006) occurs and sends the overload error (ALRM).		

Value: 0x11			
DO name	Description	Triggering method	Control mode
WARN	Warning outputs (positive / negative limit, communication error, undervoltage, and fan error).	Level triggered	All

Value: 0x12			
DO name	Description	Triggering method	Control mode
OVF	Position command / feedback overflows.	Level triggered	PT, PR

Value: 0x13			
DO name	Description	Triggering method	Control mode
SNL (SCWL)	Software limit (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 executing, this DO is off; after the command completes, 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: 0x16			
DO name	Description	Triggering method	Control mode
CAP_OK	Capture procedure is complete.	Level triggered	All

Value: 0x17			
DO name	Description	Triggering method	Control mode
MC_OK	When DO.Cmd_OK and DO.TPOS are both on, then this DO is on. 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 deviation between the speed feedback and the command is smaller than the value of P1.047, this DO is on.	Level triggered	S, Sz

Value: 0x2C

DO name	Description	Triggering method	Control mode
Zon1	First set of general range comparison: when the value of the item monitored by P0.009 ranges between the values of P0.054 and P0.055, then this DO is on.	-	All

Value: 0x2D

DO name	Description	Triggering method	Control mode
Zon2	Second set of general range comparison: when the value of the item monitored by P0.010 ranges between the values of P0.056 and P0.057, then this DO is on.	-	All

Value: 0x2E

DO name	Description	Triggering method	Control mode
Zon3	Third set of general range comparison: when the value of the item monitored by P0.011 ranges between the values of P0.058 and P0.059, then this DO is on.	-	All

Value: 0x2F

DO name	Description	Triggering method	Control mode
Zon4	Fourth set of general range comparison: when the value of the item monitored by P0.012 ranges between the values of P0.060 and P0.061, then this DO is on.	-	All

Value: 0x30

DO name	Description	Triggering method	Control mode
SPO_0	Output bit 00 of P4.006.	Level triggered	All

Value: 0x31

DO name	Description	Triggering method	Control mode
SPO_1	Output bit 01 of P4.006.	Level triggered	All

Value: 0x32

DO name	Description	Triggering method	Control mode
SPO_2	Output bit 02 of P4.006.	Level triggered	All

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Value: 0x33

DO name	Description	Triggering method	Control mode
SPO_3	Output bit 03 of P4.006.	Level triggered	All

Value: 0x34

DO name	Description	Triggering method	Control mode
SPO_4	Output bit 04 of P4.006.	Level triggered	All

Value: 0x35

DO name	Description	Triggering method	Control mode
SPO_5	Output bit 05 of P4.006.	Level triggered	All

Value: 0x36

DO name	Description	Triggering method	Control mode
SPO_6	Output bit 06 of P4.006.	Level triggered	All

Value: 0x37

DO name	Description	Triggering method	Control mode
SPO_7	Output bit 07 of P4.006.	Level triggered	All

Value: 0x38

DO name	Description	Triggering method	Control mode
SPO_8	Output bit 08 of P4.006.	Level triggered	All

Value: 0x39

DO name	Description	Triggering method	Control mode
SPO_9	Output bit 09 of P4.006.	Level triggered	All

Value: 0x3A

DO name	Description	Triggering method	Control mode
SPO_A	Output bit 10 of P4.006.	Level triggered	All

Value: 0x3B

DO name	Description	Triggering method	Control mode
SPO_B	Output bit 11 of P4.006.	Level triggered	All

Value: 0x3C			
DO name	Description	Triggering method	Control mode
SPO_C	Output bit 12 of P4.006.	Level triggered	All

Value: 0x3D			
DO name	Description	Triggering method	Control mode
SPO_D	Output bit 13 of P4.006.	Level triggered	All

Value: 0x3E			
DO name	Description	Triggering method	Control mode
SPO_E	Output bit 14 of P4.006.	Level triggered	All

Value: 0x3F			
DO name	Description	Triggering method	Control mode
SPO_F	Output bit 15 of P4.006.	Level triggered	All

Note: the output function is disabled when P2.018 - P2.022 are set to 0.

Value: when DI.ABSE is on, DI.ABSR triggered by DO2 will replace the DO2 assigned by P2.019			
DO name	Description	Triggering method	Control mode
ABSR always output by DO2	When DO.ABSR is off, it indicates servo drive can receive request issued by DI.ABSQ; when DO.ABSR is on, it indicates after receiving the request, the data has been prepared and the ABSD data is valid so that the controller can access the ABSD data. This output is only valid when DI.ABSE is on. Refer to Figure 10.3.5.1.1 for the timing diagram.	Level triggered	All

Value: when DI.ABSE is on, DI.ABSD triggered by DO3 will replace the DO3 assigned by P2.020			
DO name	Description	Triggering method	Control mode
ABSD always output by DO3	DO pin of ABS data. The data is valid when DO.ABSR is on. This output is only valid when DI.ABSE is on. Refer to Figure 10.3.5.1.1 for the timing diagram.	Level triggered	All

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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) of the servo drive.
Category	Basic variables / expansion variables: 1. Basic variables: variables (P0.002 = 0 to 26) within the cycle; in monitoring mode, use the UP / DOWN keys on the panel to display the variables. 2. Expansion variables: variables other than basic variables. (P0.002 = 80, -91, -124, and 27 to 127)
Monitoring method	Panel display / mapping: 1. Panel display: monitor with the panel 2. Mapping: monitor variables or parameters by mapping parameters
Panel display	1. Use the MODE key to switch to the monitor mode and press the UP / DOWN keys to select the variable to monitor. 2. Input the variable code to monitor into P0.002 and start monitoring. Press the SHIFT key on the panel to switch between high and low digit display; Press the SET key on the panel to switch between decimal and hexadecimal display.
Mapping	1. Parameters that support monitoring variable mapping: 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). Read the data specified by P0.017 through communication. Or, set P0.002 to 23, and 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; D2 indicates 2 decimal places.
Dec	Only decimal display is available on the panel, and you cannot switch to hexadecimal display by pressing the SET key.
Hex	Only hexadecimal display is available on the panel, and you cannot switch to decimal display by pressing the SET key.

Monitoring variables are described in the following table by the code sequence:

Code	Variable name / property	Description
000 (00h)	Feedback position (PUU) B	Current feedback position of the motor encoder. Unit: Pulse of User Unit (PUU).
001 (01h)	Position command (PUU) B	Current coordinate of the Position command. Unit: Pulse of User Unit (PUU). PT mode: number of pulse commands received by the servo drive. PR mode: absolute coordinates of the Position command.
002 (02h)	Position deviation (PUU) B	Deviation between the Position command and the feedback position. Unit: Pulse of User Unit (PUU).
003 (03h)	Feedback position (pulse) B	Current feedback position of the motor encoder. Unit: encoder unit (pulse).
004 (04h)	Position command (pulse) B	Current coordinate of the Position command. Unit: encoder unit (pulse). This is the command after the E-Gear ratio conversion.

Code	Variable name / property	Description
005 (05h)	Position deviation (pulse) B	Deviation between the Position command and the feedback position. Unit: encoder unit (pulse).
006 (06h)	Pulse command frequency B	Frequency of the pulse command received by the drive. Unit: Kpps. Applicable to PT / PR modes.
007 (07h)	Speed feedback B D1 Dec	Current motor speed. Unit: 0.1 rpm. This is the speed after applying 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 position loop.
012 (0Ch)	Average load rate B	Average load rate (moving average every 20 ms) from the servo drive. Unit: percentage (%).
013 (0Dh)	Peak load rate B	Maximum load rate from the drive. Unit: percentage (%).
014 (0Eh)	DC Bus voltage B	Rectified capacitor voltage. Unit: Volt.
015 (0Fh)	Load inertia ratio B D1 Dec	Ratio of the load inertia to the motor inertia. Unit: 0.1 times.
016 (10h)	IGBT temperature B	Temperature of IGBT. Unit: °C.
017 (11h)	Resonance frequency B Dec	Resonance frequency of the system consists of two groups 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. 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. Where it overlaps with Z phase, the value is 0; the greater the value, the greater the offset.
019 (13h)	Mapping parameter content #1 B	Returns the value of P0.025 which is mapped by P0.035.
020 (14h)	Mapping parameter content #2 B	Returns the value of P0.026 which is mapped by P0.036.
021 (15h)	Mapping parameter content #3 B	Returns the value of P0.027 which is mapped by P0.037.
022 (16h)	Mapping parameter content #4 B	Returns the value of P0.028 which is mapped by P0.038.
023 (17h)	Mapping monitoring variable #1 B	Returns the value of P0.009 which is mapped by P0.017.
024 (18h)	Mapping monitoring variable #2 B	Returns the value of P0.020 which is mapped by P0.018.

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Code	Variable name / property	Description
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.
035 (23h)	Indexing coordinate command	Current command for the indexing coordinates. Unit: Pulse of User Unit (PUU).
038 (26h)	Voltage level of the battery	Voltage level of the battery in an absolute encoder. To display the voltage level, enable the absolute encoder setting (P2.069).
039 (27h)	DI status (integrated) Hex	Integrated DI status of the drive. Each bit corresponds to one DI channel. Source includes hardware channel / 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 P0.046. Refer to the description of this parameter.
043 (2Bh)	CAP data capturing	The latest data captured by CAP hardware. Note: CAP can continuously capture multiple points.
049 (31h)	Pulse command CNT	Pulse counts from the pulse command (CN1).
050 (32h)	Speed command (integrated) D1 Dec	Integrated Speed command. Unit: 0.1 rpm. Source includes analog, register, or position loop.
051 (33h)	Speed feedback (immediate) D1 Dec	Current actual motor speed. Unit: 0.1 rpm.
053 (35h)	Torque command (integrated) D1 Dec	Integrated Torque command. Unit: 0.1%. Source includes analog, register, or position loop.
054 (36h)	Torque feedback D1 Dec	Current actual motor torque. Unit: 0.1%.
055 (37h)	Current feedback D2 Dec	Current actual motor current. Unit: 0.01 ampere (Amp).
056 (38h)	DC Bus voltage D1 Dec	Rectified capacitor voltage. Unit: 0.1 Volt.
064 (40h)	Endpoint register of PR command	In PR mode, the endpoint of the Position command (Cmd_E).
065 (41h)	Output register of PR command	In PR mode, the accumulative output of the Position command.
067 (43h)	PR target speed	Target speed specified in the PR path. Unit: PPS (pulse per second).
072 (48h)	Speed command (analog) B D1 Dec	Speed command from the analog channel. Unit: 0.1 rpm.
081 (51h)	Capture synchronous axis Incremental pulse input	When the synchronous Capture axis is enabled, the actual Mark distance can be measured by the received pulse number between two captures.
084 (54h)	Capture synchronous axis Pulse number of synchronous deviation	The accumulative deviation between the actual output pulse and the target pulse when the synchronous Capture axis is enabled. This value is close to 0 if synchronization is reached.
091 (5Bh)	Indexing coordinate feedback	Immediate feedback position of the indexing coordinates. Unit: Pulse of User Unit (PUU).

Code	Variable name / property	Description
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.
123 (7Bh)	Value returned when monitoring by panel	Monitoring value displayed when returned to the monitoring panel.
-80	Encoder communication error rate	When this value continues to increase, it indicates that there is communication interference. In an interference-free environment, this value should not increase.
-91	Overload (AL006) protection counter	Displays the motor load during operation. When the value reaches 100%, AL006 occurs.
-124	Encoder temperature	Monitor the encoder temperature.

8

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MODBUS Communication

9

This chapter describes the MODBUS communication which you use for setting, reading, and writing general parameters. For the motion control network, refer to the related DMCNET, CANopen, and EtherCAT documentation. The details of ASCII and RTU modes are also provided in this chapter.

9.1 RS-485 communication interface (hardware)

The ASDA-B3 series servo drive supports RS-485 serial communication that you can use to access and change the parameters of the servo system. See the following description of the wiring:
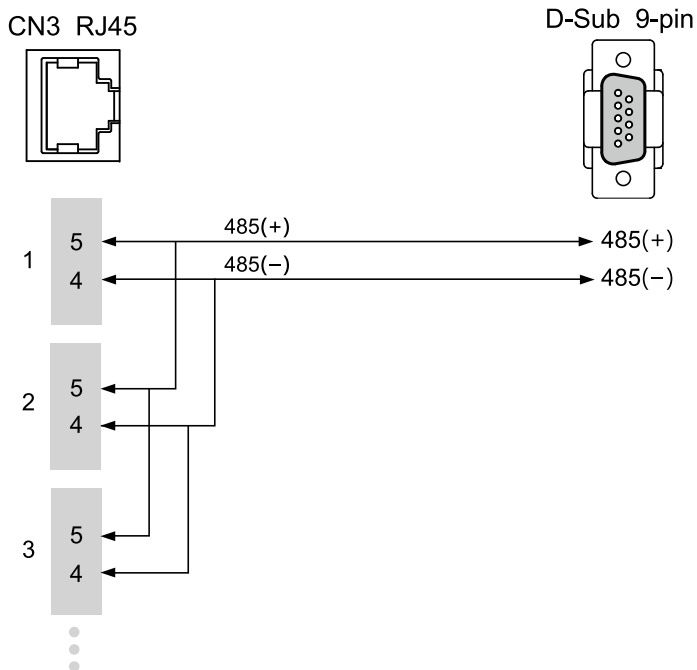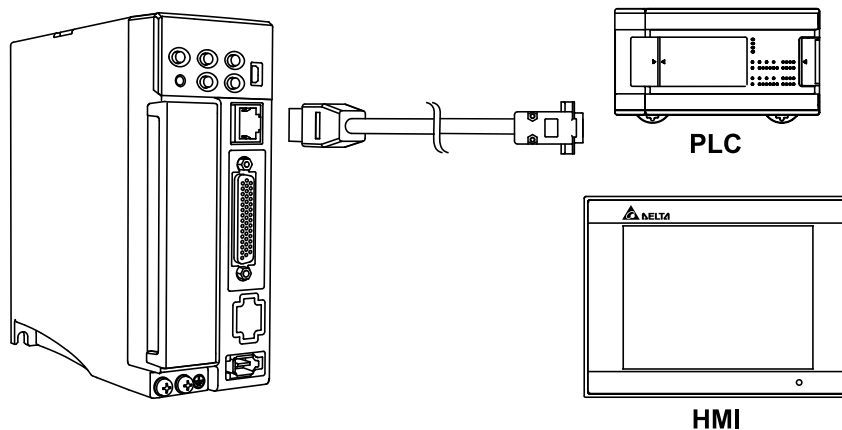
Note:

1. The cable length can be up to 100 meters when the servo drive is installed in a quiet environment. If the required transmission speed is over 38,400 bps, a 15-meter cable is recommended to ensure data transmission accuracy.

2. The numbers 4 and 5 in the above figure represent the pin number of each connector.

3. Use 12 V_{DC} for the power supply.

4. When using RS-485 communication, you may connect up to 32 servo drives. Install a repeater to connect more servo drives (the maximum is 127 stations).

5. Refer to Wiring for the CN3 communication connector in Chapter 3.

9.2 RS-485 communication parameter settings

The required parameters for a single servo drive connection are: P3.000 (Address), P3.001 (Transmission speed), and P3.002 (Communication protocol). P3.003 (Communication error handling), P3.004 (Communication timeout), P3.006 (Digital input (DI) control switch), and P3.007 (Communication response delay time) are optional settings. 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 ASDA-B3 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 format. For instance, when transmitting "64H" between the master and slave, the master sends 36H to represent "6" and 34H to represent "4".

The ASCII codes for the digits 0 to 9 and the characters A to F are as follows:

Character	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H
Character	'8'	'9'	'A'	'B'	'C'	'D'	'E'	'F'
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

RTU mode:

Every data frame consists of 8-bit hexadecimal characters, 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, just send "64H".

Characters are encoded into the following frames and transmitted in series. The method for checking each type of frame is as follows.

10-bit character frame (for 7-bit character)
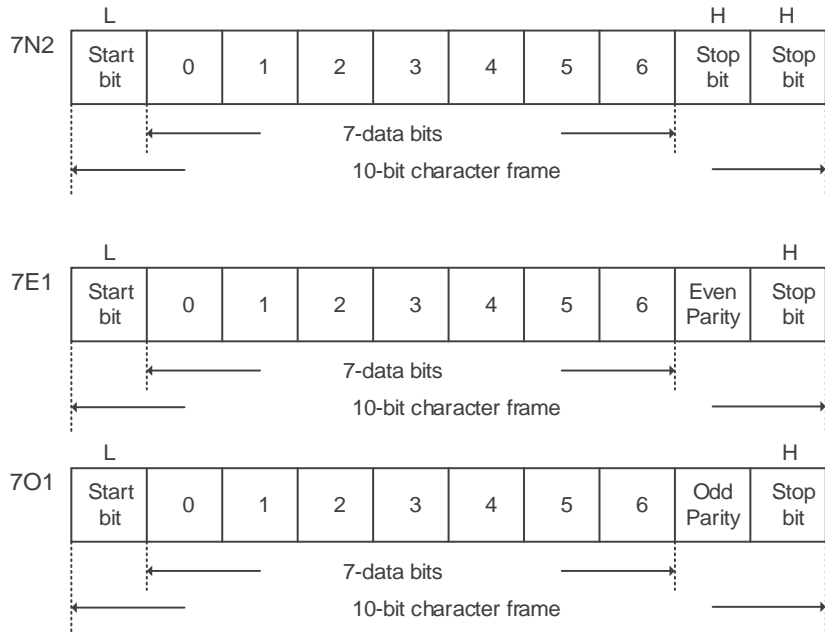
11-bit character frame (for 8-bit character)
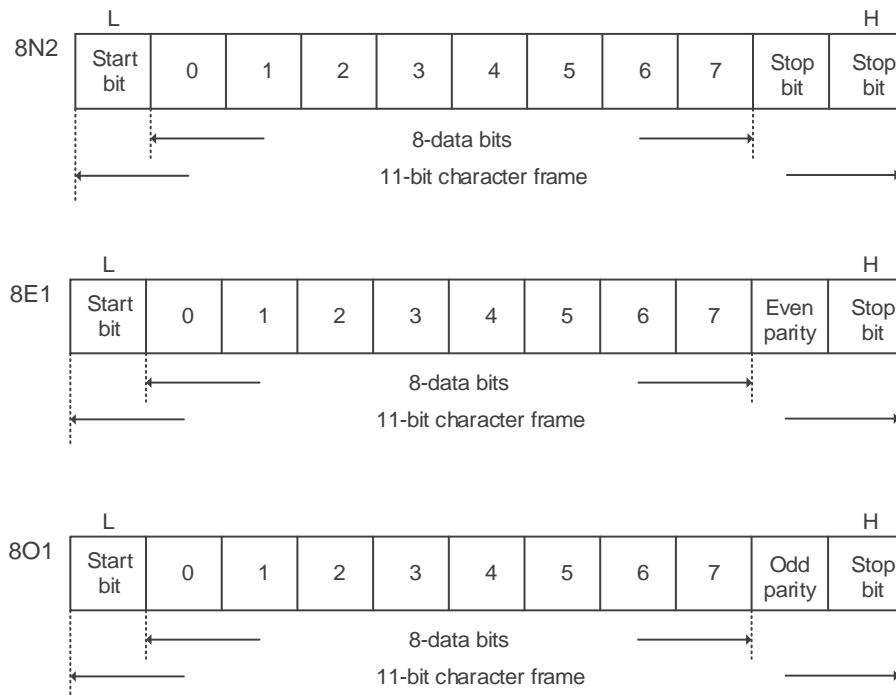
Communication data structure

Definitions for the data frames in the two modes are as follows:

ASCII mode:

Start	Start character ':' (3AH)
Slave Address	Communication address: 1 byte consists of 2 ASCII codes
Function	Function code: 1 byte consists of 2 ASCII codes
Data (n-1)	
…….	Data content: n word = 2n-byte consists of 4n ASCII codes, n ≤ 10
Data (0)	
LRC	Error check: 1 byte consists of 2 ASCII codes
End 1	End code 1: (0DH) (CR)
End 0	End code 0: (0AH) (LF)

RTU mode:

Start	A silent interval of more than 10 ms
Slave Address	Communication address: 1 byte
Function	Function code: 1 byte
Data (n-1)	
…….	Data content: n-word = 2n-byte, n ≤ 10
Data (0)	
CRC	Error check: 1 byte
End 1	A silent interval of more than 10 ms

Example 1: function code 03H, read multiple words

When 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 in one single access is 10.

ASCII mode:

Command Message (Master):

Start	':'
Slave Address	'0'
	'1'
Function	'0'
	'3'
Start Data Address	'0'
	'2'
	'0'
	'0'
Data Number (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 Number (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 Number (in words)	00H
	02H
CRC (Check Low)	C5H (Low)
CRC (Check High)	B3H (High)

Response Message (Slave):

Slave Address	01H
Function	03H
Data Number (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.

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Example 2: function code 06H, write single word

When 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 writing is complete.

ASCII mode:

Command Message (Master):			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)

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):

Address	01H
Slave Function	06H
Start Data Address	02H (High)
	00H (Low)
Data Content	00H (High)
	64H (Low)
CRC (Check Low)	89H (Low)
CRC (Check High)	99H (High)

Response Message (Slave):

Address	01H
Slave Function	06H
Start Data Address	02H (High)
	00H (Low)
Data Content	00H (High)
	64H (Low)
CRC (Check Low)	89H (Low)
CRC (Check High)	99H (High)

Note: a silent interval of 10 ms is required before and after each transmission in RTU mode.

Example 3: function code 10H, write multiple words

When the master issues a write command to the first slave:

The slave writes two words 0BB8H and 0000H starting from the start address 0112H. In other words, 0BB8H is written into 0112H and 0000H is written into 0113H. The maximum allowable number of data in one single access is 8. The slave sends a response message to the master after writing is complete.

ASCII mode:

Command Message (Master):

Start	':'
Slave Address	'0'
	'1'
Function	'1'
	'0'
Start Data Address	'0'
	'1'
	'1'
	'2'
Data Number (in words)	'0'
	'0'
	'0'
	'2'
Data Number (in bytes)	'0'
	'4'
Content of the 1st Data Frame	'0'
	'B'
	'B'
	'8'
Content of the 2nd Data Frame	'0'
	'0'
	'0'
	'0'
LRC	'1'
	'3'
End 1	(0DH) (CR)
End 0	(0AH) (LF)

Response Message (Slave):

Start	':'
Slave Address	'0'
	'1'
Function	'1'
	'0'
Start Data Address	'0'
	'1'
	'1'
	'2'
Data Number	'0'
	'0'
	'0'
	'2'
LRC	'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 Number (in words)	00H (High)
	02H (Low)
Data Number (in bytes)	04H
Content of the 1st Data Frame	0BH (High)
	B8H (Low)
Content of the 2nd Data Frame	00H (High)
	00H (Low)
CRC (Check Low)	FCH (Low)
CRC (Check High)	EBH (High)

Response Message (Slave):

Slave Address	01H
Function	10H
Start Data Address	01H (High)
	12H (Low)
Data Number (in words)	00H (High)
	02H (Low)
CRC (Check Low)	E0H (Low)
CRC (Check High)	31H (High)

Note: a silent interval of 10 ms is required before and after each transmission in RTU mode.

LRC and CRC transmission error check

The error check used in ASCII mode is LRC (Longitudinal Redundancy Check) and that used in RTU mode is CRC (Cyclical 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 Number	'0'
	'0'
	'0'
	'1'
LRC	'B'
	'4'
End 1	(0DH) (CR)
End 0	(0AH) (LF)

To calculate the LRC value: add all the bytes, round down the carry, and take the two's complement.

For example:

7FH + 03H + 05H + C4H + 00H + 01H = 14CH, round down the carry 1 and take 4CH.

The two's complement of 4CH is B4H.

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: (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 execute (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 word of the CRC value in the command message, and then the high word. For example, if the result of CRC calculation is 3794H, put 94H in the low word and 37H in the high word as shown in the following table.

ARD	01H
CMD	03H
Start Data Address	01H (High)
	01H (Low)
Data Number (in words)	00H (High)
	02H (Low)
CRC (Check Low)	94H (Low)
CRC (Check High)	37H (High)

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CRC program example:

This function calculates the CRC value in the C language. It needs two parameters:

```c
unsigned char* data;
unsigned char length
//The function returns the CRC value as a type of unsigned integer.
unsigned int crc_chk(unsigned char* data, unsigned char length) {
    int j;
    unsigned int reg_crc=0xFFFF;

    while( length-- ) {
        reg_crc^= *data++;
        for (j=0; j<8; j++ ) {
            if( reg_crc & 0x01 ) { /*LSB(bit 0 ) = 1 */
                reg_crc = (reg_crc >> 1)^0xA001;
            } else {
                reg_crc = (reg_crc>>1);
            }
        }
    }
    return reg_crc;
}
```

Example of a PC communication program:

```c
#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);
```

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```
outportb(PORT+BRDH,0x00);
outportb(PORT+LCR,0x06);        /* set prorocol
                                   <7,E,1> = 1AH,        <7,O,1> = 0AH
                                   <8,N,2> = 07H         <8,E,1> = 1BH
                                   <8,O,1> = 0BH                     */

for( I = 0; I<=16; I++ ) {
    while( !(inportb(PORT+LSR) & 0x20) );  /*  wait until THR empty  */
    outportb(PORT+THR,tdat[I]);            /*  send data to THR  */
}
I = 0;
while( !kbhit() ) {
    if( inportb(PORT+LSR)&0x01 ) {  /*  b0==1, data is read  */
        rdat[I++] = inportb(PORT+RDR); /*   read data from RDR  */
    }
}
}
```

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9.4   Writing and reading communication parameters

Refer to Chapter 8 for the descriptions of the parameters that you can write or read through the communication interface.

The ASDA-B3 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).

Writing parameters through communication

You can set these parameters through communication:

Group 0, except P0.000 - P0.001, P0.008 - P0.013, and P0.046.

Group 1

Group 2

Group 3

Group 4, except P4.000 - P4.004 and P4.008 - P4.009.

Group 5, except P5.010, P5.016, and P5.076.

Group 6

Group 7

Note the following additional details:

P3.001: when changing the communication speed, the next data is written at the new transmission speed after the new speed is set.

P3.002: when changing the communication protocol setting, the next data is written with the new communication protocol setting after the new values are set.

P4.005: 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. Set P4.006 to 1, 2, 4, 8, 16, and 32 to test DO1, DO2, DO3, DO4, DO5, and DO6, respectively. Then, set P4.006 to 0 to complete the test.

P4.010: adjustment function. First set P2.008 to 20 (14H in hexadecimal format) to enable this function.

P4.011 - P4.021: these parameters are for adjusting the hardware offset. The parameters were adjusted before delivery, so changing the parameter settings is not recommended. If you need to modify these parameters, first set P2.008 to 22 (16H in hexadecimal format).

Reading parameters through communication

You can read the values from all parameters of Group 0 to Group 7 through communication.

9.5 RS-485 communication specification

9

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 its use, so note the following when wiring.

- Number of stations

  CN3 can only support up to 32 servo drives. If your application requires more than 32 stations, 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 15-meter cable 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 to use a shielded twisted-pair cable as it has metal shielded cover 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 0Ω, 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 cable, 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.

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■ Anti-interference methods

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 magnetic ring at the power input.
6. Add X capacitor and Y capacitor, which are IEC 60384-14 certified, 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.

10

Note

A complete absolute servo system includes an ASDA-B3 servo drive, an absolute motor, and a backup battery box. The backup battery supplies power to the system so that the encoder continues to operate even when the power is off. In addition, the absolute encoder can continuously record the motor's actual position at any time, even when the motor shaft is rotated after the power is off. The absolute servo system must be used only with an absolute motor. If the servo is set up with other types of motors and the system is enabled, AL069 occurs.

When using an absolute motor connected to power, the motor speed should not exceed 250 rpm. When operating with the battery, make sure the maximum speed does not exceed 200 rpm.

To determine whether your motor is an absolute type, check the model name as shown in the following:

ECM-A3 series servo motor

ECM – A3 □ – □ □ □ □ □ □ □ □

A / Y: absolute motor

ECM-B3 series servo motor

ECM – B3 □ – □ □ □ □ □ □ □ □

A / P: absolute motor

ECMC series servo motor

ECMC - □ W □ □ □ □ □ □

W / V: absolute motor

Install the battery correctly on 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 its accessories.

10.1 Battery box (absolute type) and wiring

10.1.1 Specifications

Precautions

Carefully read through the following safety precautions. Use batteries only in accordance with the specifications to avoid damage or dangerous conditions.

> ⚠️ **WARNING**
> - Make sure the installation location is free of vapor, corrosive and inflammable gas.
> - Correctly place the battery into the battery box to avoid short-circuiting.
> - Do not short-circuit the positive and negative electrodes of the battery, and do not install the battery in reverse direction.
> - Do not mix new and used batteries to avoid losing power or shortening the life of the new batteries. It is suggested to replace all batteries with new ones.
> - Follow the instructions when wiring the battery box to avoid dangerous conditions.

> ✋ **STOP**
> - Do not place the battery in a high-temperature environment over 100°C, as this may cause a fire or an explosion.
> - The batteries are non-rechargeable. Do not charge the batteries as this may result in an explosion.
> - Do not directly weld on the surface of the battery.

Battery specifications

Item	Li/SOCl2 Cylindrical Battery
Type	ER14505
International standard size	AA
Standard voltage	3.6V
Standard capacity	2700 mAh
Maximum continuous discharge current	100 mA
Maximum pulse current	200 mA
Dimensions (D x H)	14.5 x 50.5 mm
Weight	Approx. 19 g
Operating temperature	-40 to +85°C
Supplier	EVE Energy Co., Ltd
Part number for the battery with cable	0991023281

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Battery life
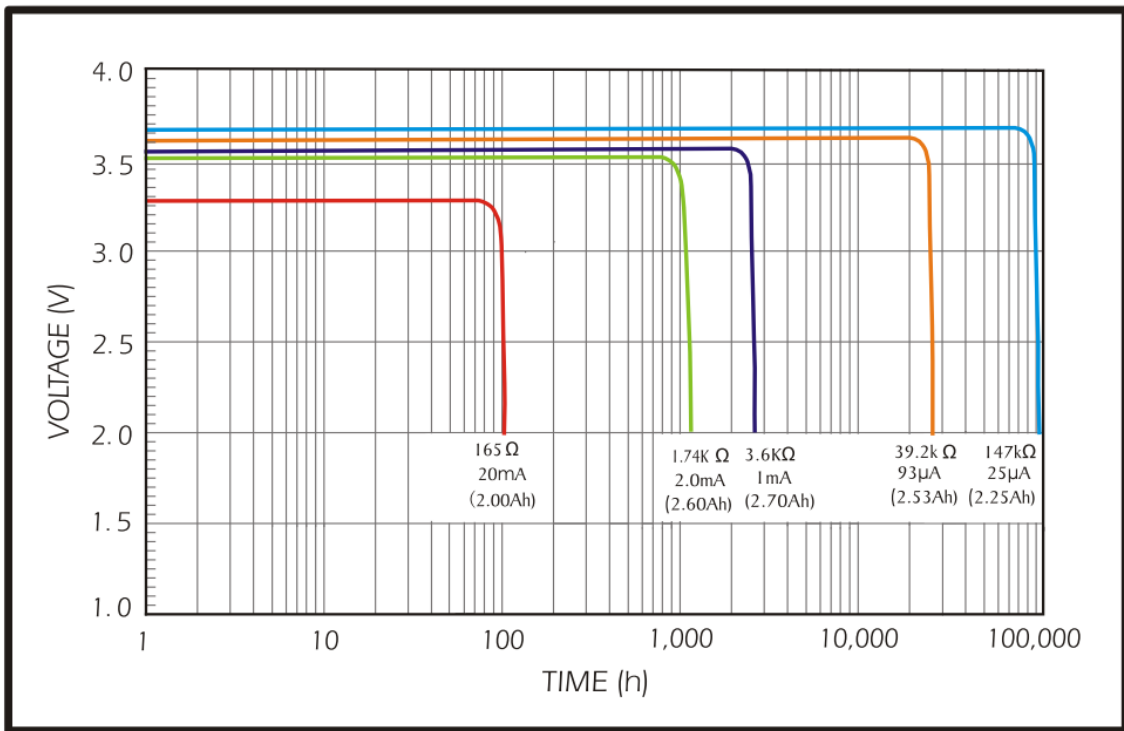
Source: EVE Energy Co. ER14505 Discharge Characteristics

(1) The above figure illustrates the discharge current curves measured in the constant current test. According to the five curves shown above, if the voltage of the battery keeps at 3V or higher, the expected battery life is as shown in the following table. Therefore, the lowest battery voltage level for an absolute encoder is set to 3.1V.

Motor	Battery mode current consumption[2] (µA)	Battery life expectancy (month)
ECM-A3□-□A□□□□□□□□ ECM-B3□-□A□□□□□□□□ ECM-B3□-□P□□□□□□□	30	87.5
ECMC-□W□□□□□□□□ ECM-A3□-□Y□□□□□□□	45	58.33
ECMC-□V□□□□□□□	35	75

(2) The battery voltage can keep at 3.6V or above up to 5 years when stored in a cool dry place.

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 nearly 0 when the absolute origin coordinates are not established. Once you established the absolute origin coordinates, the battery power consumption starts. To avoid battery power consumption when shipping the machine, it is recommended that you leave the servo drive and battery disconnected, or leave the absolute origin coordinates unestablished.

10.1.2   Battery box dimensions

Single battery box

Delta part number: ASD-MDBT0100
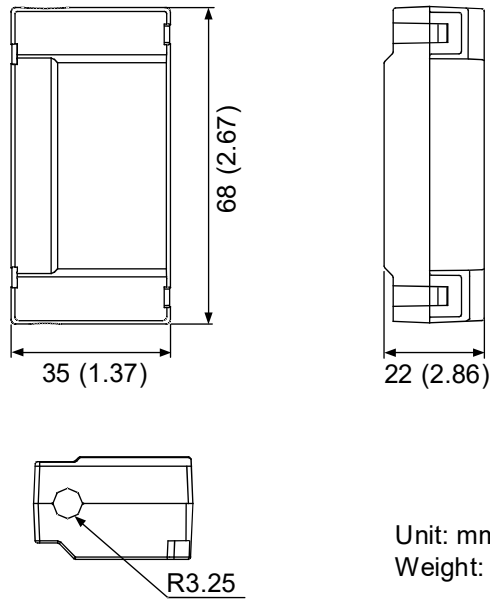
10

68 (2.67)

35 (1.37)   22 (2.86)

R3.25

Unit: mm (inch)
Weight: 44 g

Dual battery box

Delta part number: ASD-MDBT0200

72.5 (2.85)

45 (1.77)   26 (1.02)

64.5 (2.54)

R2.5
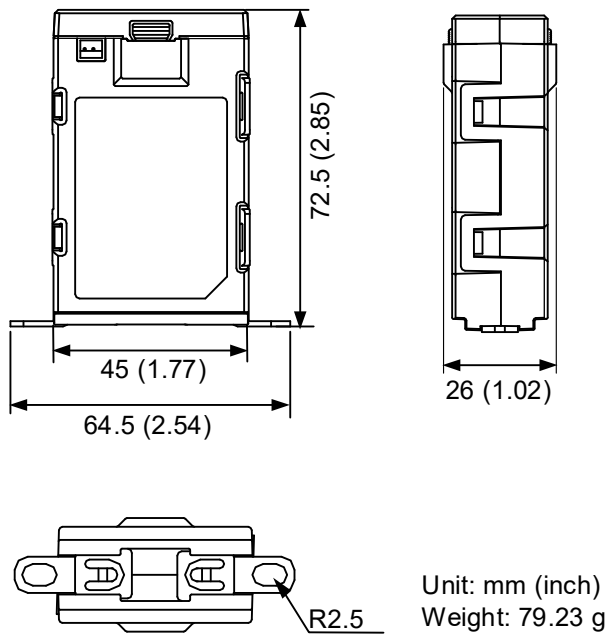
Unit: mm (inch)
Weight: 79.23 g

10.1.3   Connection cable for the absolute encoder

A. Quick connector
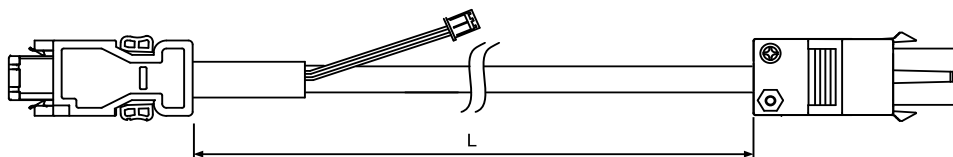
Model name	L	
	mm	inch
ACS3-CAE□1003	3000 ± 50	118 ± 2
ACS3-CAE□1005	5000 ± 50	197 ± 2
ACS3-CAE□1010	10000 ± 100	394 ± 4
ACS3-CAE□1020	20000 ± 100	788 ± 4

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

Connection method:

Caution Follow these instructions when wiring. Incorrect wiring may cause battery explosion.
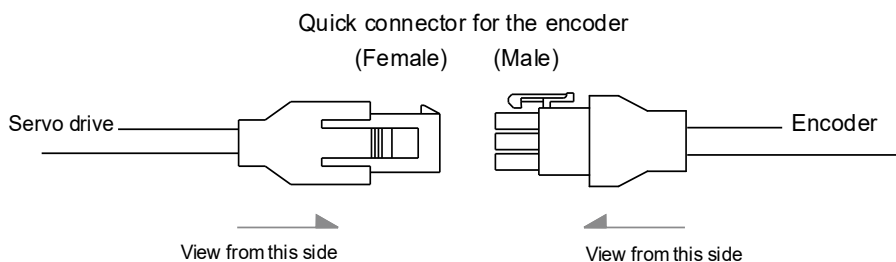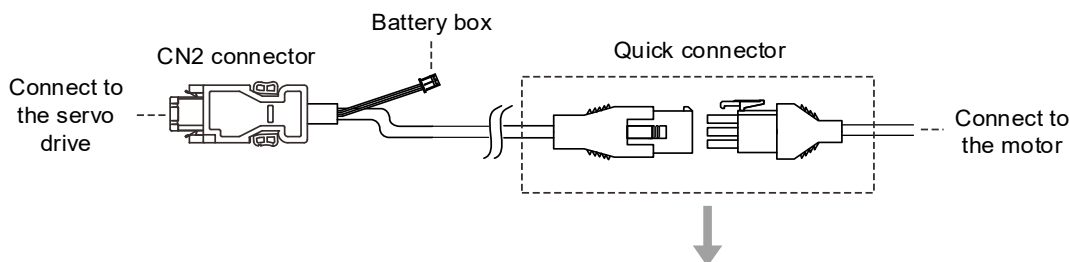
1	2	3
White	Red	Reserved
T+	BAT+	
4	5	6
White/Red	Black	Reserved
T-	BAT-	
7	8	9
Brown	Blue	Shield
DC+5V	GND	

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

Note: the wire colors of the ASDA-B3 servo drive are for reference only. Refer to the actual servo drive.

B. Military connector

Model name	Straight	L	
		mm	inch
ACS3-CAE□2703	CMV1-10S	3000 ± 50	118 ± 2
ACS3-CAE□2705	CMV1-10S	5000 ± 50	197 ± 2
ACS3-CAE□2710	CMV1-10S	10000 ± 100	394 ± 4
ACS3-CAE□2720	CMV1-10S	20000 ± 100	788 ± 4

Note: select cables according to the □ in the model name. 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	-

10.1.4　Battery box cable

Battery box cable that connects to the encoder (part number: 3864573700)

25 ±5 (0.98 ±0.2)　　　　　　　　　　　　　15 ±5 (0.59± 0.2)

See detail A ──

── See detail B

200 ±10 (7.87 ±0.4)

detail A

detail B

(RED) 1
(BLACK) 2

1 (RED)
2 (BLACK)

Unit：mm (inch)

Battery box cable for self-wiring (part number: 3864850600)

5±1(0.1±0.04)　　　　　　　　　　　15±5 (0.59±0.2)

1
2

200±10 (7.87±0.4)
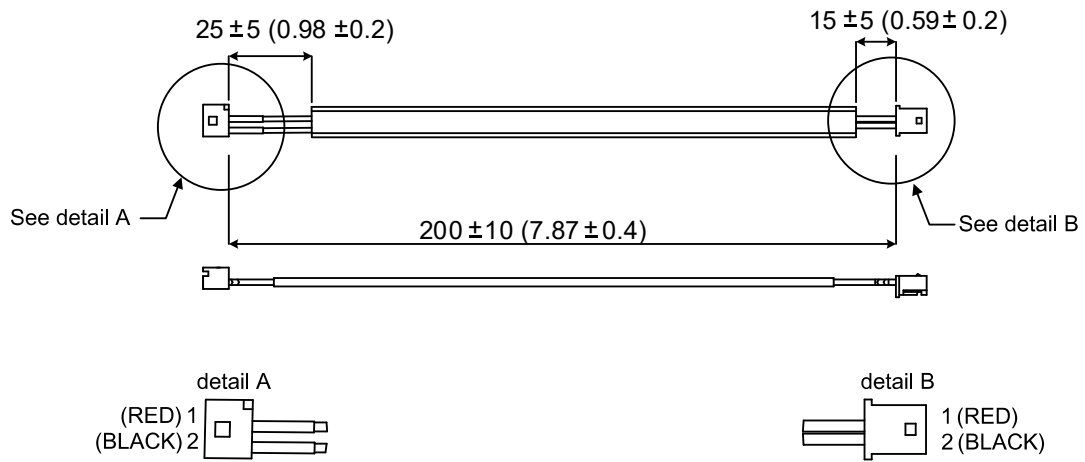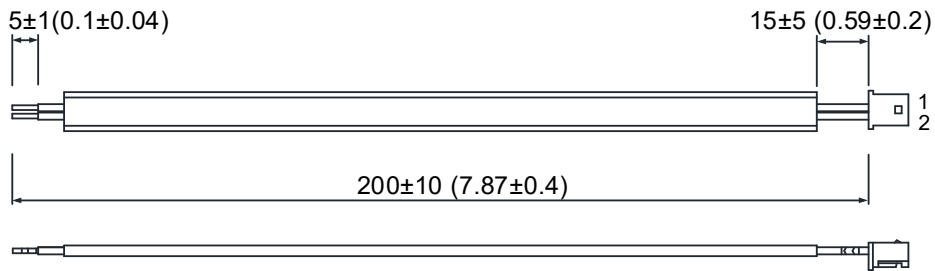
Unit: mm (inch)

10.2   Installation

10.2.1   Installing the battery box in the servo system

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⚠ WARNING	■ DO NOT wire Pin 3 and Pin 4 of the servo drive CN2 connector. They are for internal use only; wiring them will cause damage to the internal circuit.
	■ When using an absolute encoder, the battery supplies power directly to the encoder, so wiring to the CN2 connector of the servo drive is not required.

Single battery box (standard wiring)
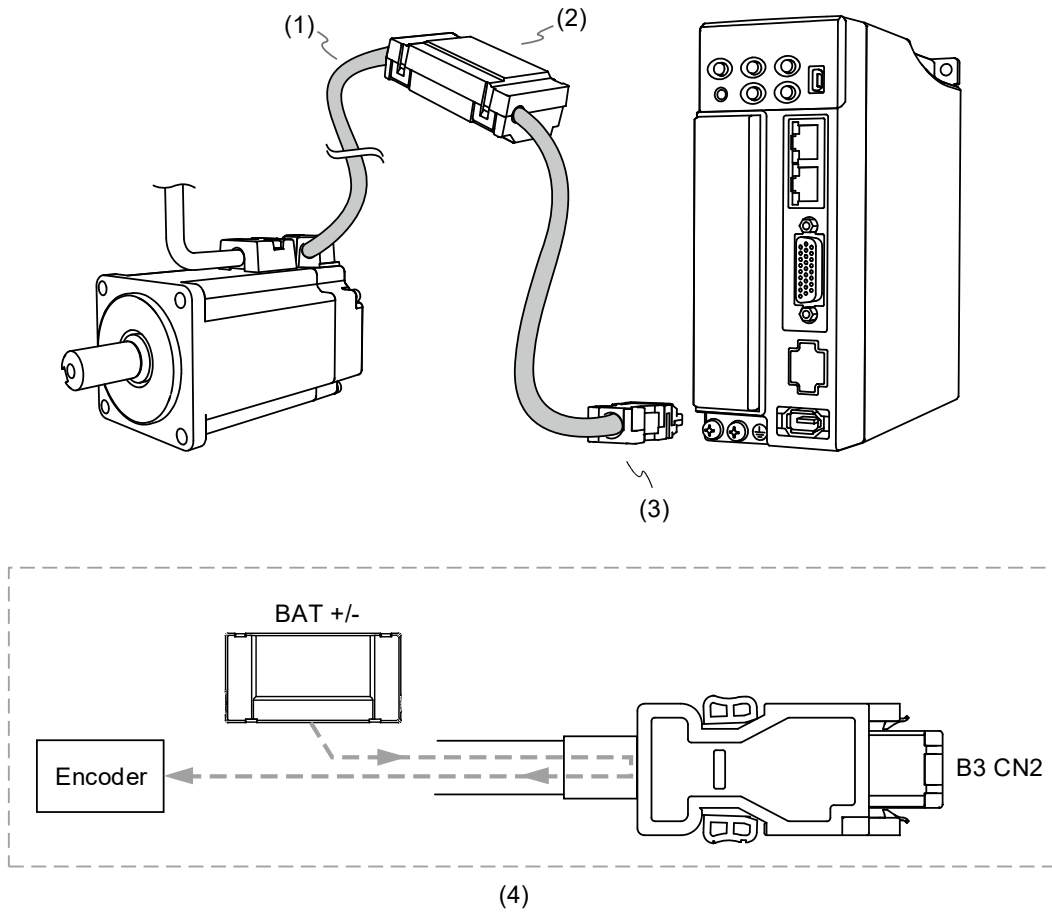
(1) Encoder cable; (2) Single battery box (absolute type); (3) CN2 connector; (4) Battery box wiring

Pin assignment of CN2 connector:

The end that connects to the encoder				The end that connects to the servo drive		
Military connector	Quick connector	IP67 connector	Color	Pin No.	Signal	Description
4	7	4	Brown	1	DC+5V	+5V power supply
9	8	3	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	1	White	5	T+	Serial communication signal (+)
2	4	2	White / Red	6	T-	Serial communication signal (-)
10	9	8	-	Case	Shield	Shielding
6	2	6	Red	-	-	Battery +3.6V
5	5	5	Black	-	-	Battery ground

Note: for the absolute battery wiring, refer to Section 3.1.5 Specification for the encoder connector.

Dual battery box (connects to CN2)
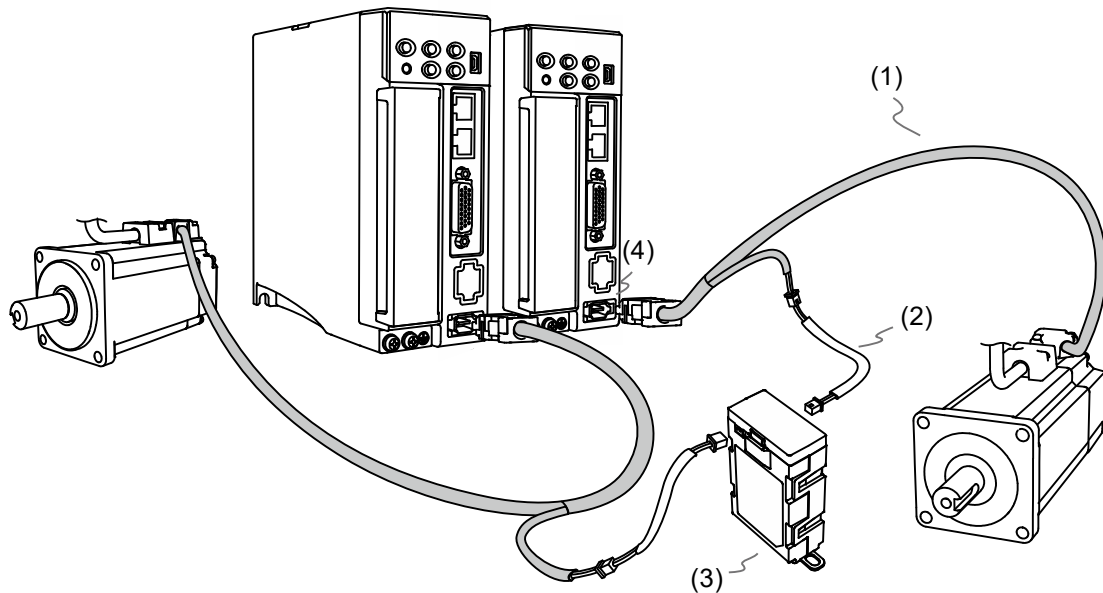
(1) Encoder cable; (2) Battery box cable AW; (3) Dual battery box (absolute type); (4) CN2 connector

10.2.2   Installing and replacing a battery

Single battery box
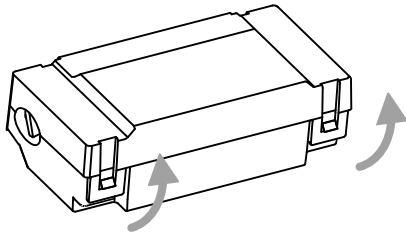
Step 1:

Release the snap-fit tabs on both sides and remove the battery box cover.
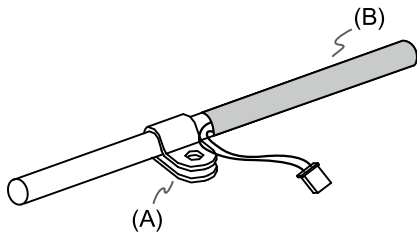
Step 2:

Position the cable clamp to the encoder connection cable. Note that the cable clamp should be placed close to the heat shrink tube.

(A) Cable clamp; (B) Heat shrink tube
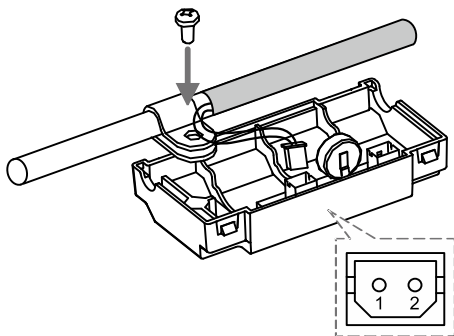
Step 3:

Plug in the lead wire and tighten the cable clamp screw.
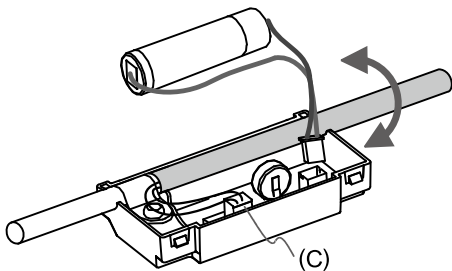
Step 4:

Install a new battery and connect the wire.

(C) Replace the battery only when the main power to the servo drive is still on. Do not remove the power cable, or else the system may lose data.
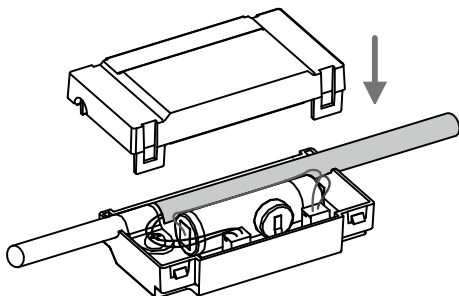
Step 5:

Place the battery wire into the box and fit the cover.

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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. Use P0.002 (monitoring variable 26h) to check the battery power. When it displays 31, it means the voltage is below 3.1V.

Important When the voltage is below 2.7V, the motor's position record may be lost if the drive operates under battery power, so you need to re-establish the absolute origin coordinates after installing a new battery. Thus, it is suggested that you replace the battery when the main power to the servo drive is on to avoid loss of absolute position data.

10.3 System initialization and operating procedures

10.3.1 System initialization

After the servo system resumes operation, the controller can acquire the motor's current absolute position either with communication (such as RS-485) or DI/DO. Delta's absolute system provides two types of position value for the controller: pulse and PUU.

AL06A occurs when you initialize the absolute system for the first time because the coordinate system has not been established. Clear the alarm by setting up the coordinate system. When insufficient battery power or interruption of battery power causes loss of the coordinate system, AL060 occurs. In the absolute system, when the number of motor rotations exceeds the range -32768 to 32767, AL062 occurs. When the PUU position value goes outside the range -2147483648 to 2147483647, AL289 occurs.

Except for the alarms mentioned above, you can use P2.070 to set up Delta's absolute servo system. You can choose not to show AL062 and AL289 if the absolute coordinate system overflows when the number of rotations exceeds the range -32768 to 32767 or when the PUU exceeds the range -2147483648 to 2147483647. For example, you might do this on a system that uses incremental commands to operate in a single direction.

P2.070 setting:

1. Establish the absolute origin coordinates. When the coordinate setting is complete, AL06A (or AL060) is automatically cleared. There are two representations to establish the controllers absolute or igin coordinates: pulse number and PUU number. You can establish the absolute origin coordinates with DI/DO, parameters, or the PR homing function.

2. When the system is powered on again, the controller can access the motor's absolute position either with DI/DO or the communication function. Based on the setting of P2.070, the controller can select the requested value, either the PUU (refer to Section 10.3.3) or the pulse value of 16777216, within a single turn (refer to Section 10.3.2).

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10.3.2   Pulse number

When the motor is running in the clockwise direction, the cycle number is expressed as a negative value. When the motor runs in the counterclockwise direction, the cycle number is expressed as a positive value. The range of the number of rotations is between -32768 and +32767, and AL062 occurs once the number exceeds the range. To clear the alarm, re-establish the absolute origin coordinates. If P2.070 has been set to ignore the AL062 alarm, then the system shows no error. If the system is operating in the counterclockwise direction and reaches 32,767 turns, the value jumps to -32768 once it reaches the target position in the next cycle, and the value keeps increasing from -32768 to 32767. When the system is operating in the clockwise direction and reaches -32,768 turns, the value jumps to 32767 once it reaches the target position in the next cycle, and the value keeps decreasing from 32767 to -32768.

In addition to the cycle counter, there are 16,777,216 pulses (0 - 16777215) in one rotation. Pay attention to the motors running direction. You can read the cycle number and the pulse number either with communication or DI/DO. Pulse number = m (cycle number) x 16777216 + pulse number (0 - 16777215). The conversions between pulse number and PUU are as follows:

When P1.001.Z = 0, then the PUU number when power on = pulse number x $\frac{P1.045}{P1.044}$ + P6.001.

When P1.001.Z = 1, then the PUU number when power on = (-1) x pulse number x $\frac{P1.045}{P1.044}$ + P6.001.
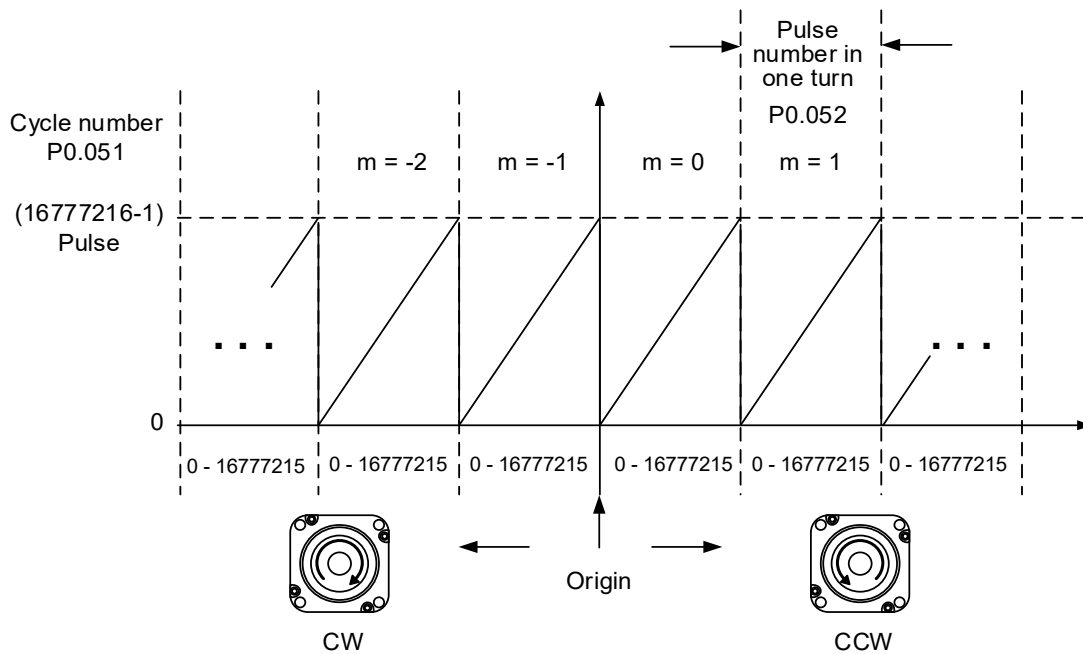
Figure 10.3.2.1 Absolute position for pulse number

10.3.3 PUU number

The PUU number is a 32-bit absolute value with a positive or negative sign. When the motor is running in the forward direction, the PUU number increases; when it is running in the reverse direction, the PUU number decreases. The forward direction does not mean the motor is running clockwise; the direction is defined by P1.001.Z. The range of the cycle number is -32768 to +32767. AL062 occurs when the number of cycles overflows. If the PUU number exceeds the range -2147483648 to +2147483647, the position counter overflows and AL289 occurs. Establish the absolute origin coordinates to clear AL062 or AL289. You can determine whether or not to show AL062 and AL289 when the position overflows with P2.070. When reaching the maximum PUU number in the forward direction, the value changes from 2147483647 to -2147483648, and then increases from -2147483648 to 2147483647. The value changes the other way when the motor operates in the reverse direction. See the following examples:

Example 1:

When P1.044 = 16777216 and P1.045 = 100000, the motor needs 100,000 PUU to run a cycle. 2147483647 ÷ 100000 ≒ 21474.8, so once the motor runs over 21,474.8 (< 32767) cycles in the forward direction, AL289 occurs.

Example 2:

When P1.044 = 16777216 and P1.045 = 10000, the motor needs 10,000 PUU to run a cycle. 2147483647 ÷ 10000 ≒ 214748.3, so once the motor runs over 32,767 (< 214748.3) cycles in the forward direction, AL062 occurs.
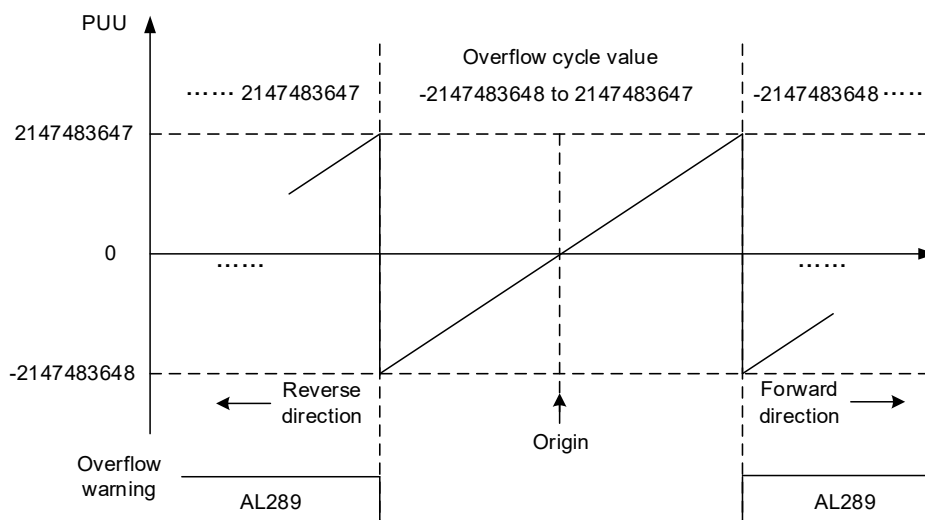
Figure 10.3.3.1 Absolute position for PUU number

Note: after establishing the absolute origin coordinates, any change to P1.001.Z or E-Gear ratio (P1.044 and P1.045) changes the original setting of the absolute origin coordinates. If the above parameters are changed, re-establish the absolute origin coordinates.

10.3.4 Establish the absolute origin coordinates

When the absolute coordinates are lost, the ASDA-B3 servo drive provides three ways to establish the absolute origin coordinates: DI/DO, parameter setting, or the PR homing function. The following provides more details for each operation mode.

10.3.4.1 Establishing the absolute origin coordinates with DI/DO

When the servo system is controlled by the controller, you can reset the absolute coordinate system with DI/DO. Once established, the pulse number is set to 0 and the PUU number is the value of P6.001. Refer to the following diagram for detailed descriptions.

Description:

1. When the controller triggers DI.ABSE (rising-edge triggered), it needs to wait for T_S before proceeding to the next step.
2. After reaching T_S, the controller starts to reset the coordinate system. When DI.ABSC turns on and remains on for T_Q the pulse number is set to zero and the PUU number is set to the value of P6.001.
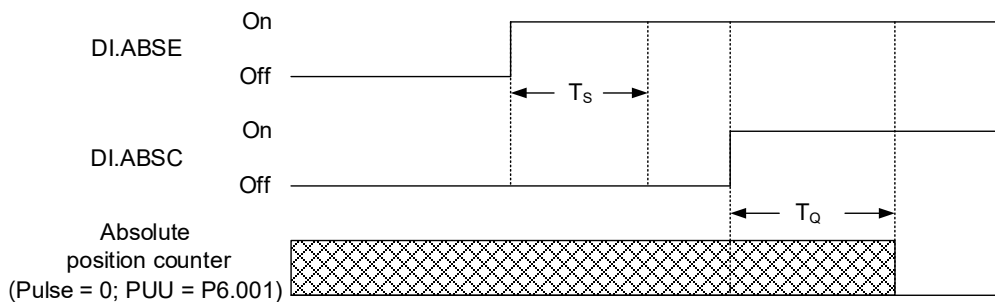
Figure 10.3.4.1.1 Timing diagram for establishing the absolute coordinates with DI/DO

The following table describes the T_S and T_Q delay time after triggering DI.ABSE and DI.ABSC.

	$T_{S(ms)}$	$T_{Q(ms)}$
Min (T_S, T_Q)	P2.009 + 2	
Max	P2.009 + 10	

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10.3.4.2 Establishing the absolute origin coordinates with parameters

Set P2.071 to 1 to establish the absolute origin coordinates through the panel or with communication. Since the write-protect function of P2.071 is protected by P2.008, you must set P2.008 to 271 first. In other words, the sequence is: set P2.008 to 271, then set P2.071 to 1. As soon as P2.071 is set to 1, the absolute coordinate system resets.

10.3.4.3 Establishing the absolute origin coordinates with the PR homing function

You can use the 11 homing modes in the PR mode to establish the absolute origin coordinates. 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
Check Sum	Encoder PUU -2147483648 to 2147483647	0	Encoder status (P0.050)

Set P2.070 Bit 0 to 1 so that you can read the pulse number with DI/DO. See the following descriptions.

Bit 79 - Bit 64	Bit 63 - Bit 32	Bit 31 - Bit 16	Bit 15 - Bit 0
Check Sum	Pulse number in one rotation 0 to 16777215 (= 16777216 - 1)	Encoder turn -32768 to +32767	Encoder status (P0.050)

Description:

Check Sum = (((((((WORD_0+0xA700) XOR WORD_1)+0x605A) XOR WORD_2)+0x30A5) XOR WORD_3)+0x5A06)
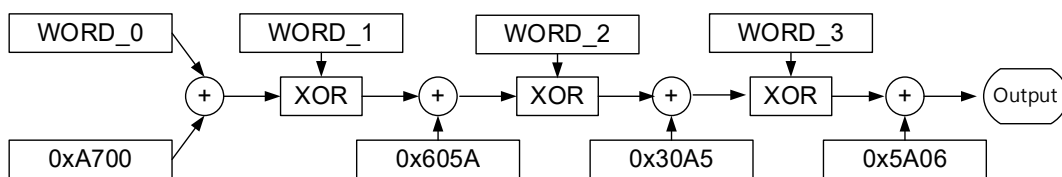
Note:

1. This algorithm has no positive or negative sign.

2. 0xA700, 0x605A, 0x30A5, and 0x5A06 are constants in hexadecimal format.

3. WORD_0: encoder status (Bit 15 - 0)

   WORD_1: encoder turn (Bit 31 - 16)

   WORD_2: encoder pulse number (Bit 47 - 32)

   WORD_3: encoder pulse number (Bit 63 - 48)

You can read the pulse number or PUU number with DI/DO and P2.070. See the following timing diagram.

10
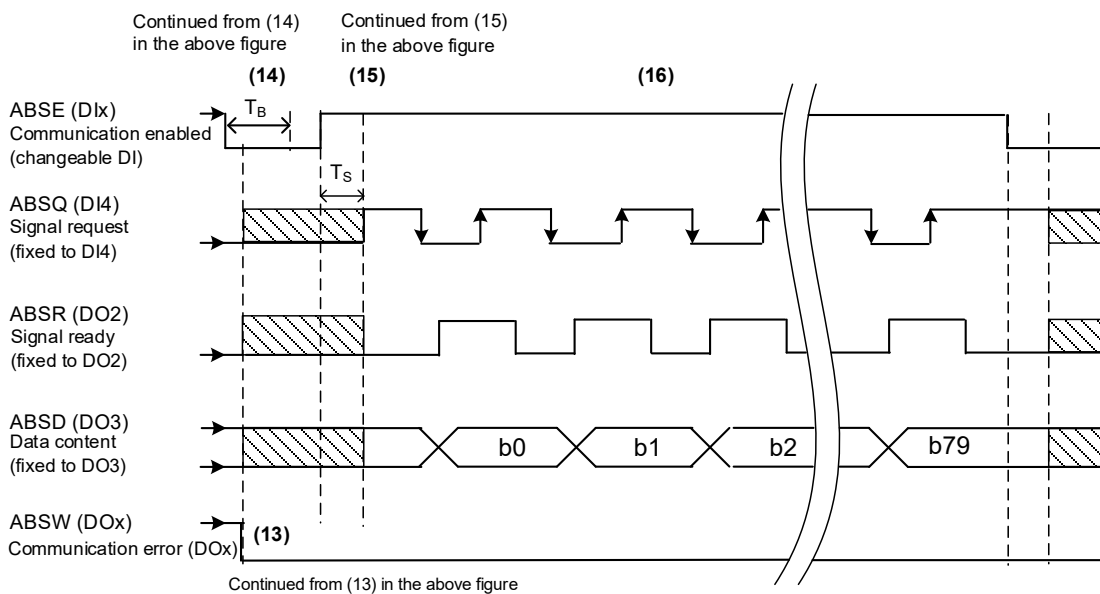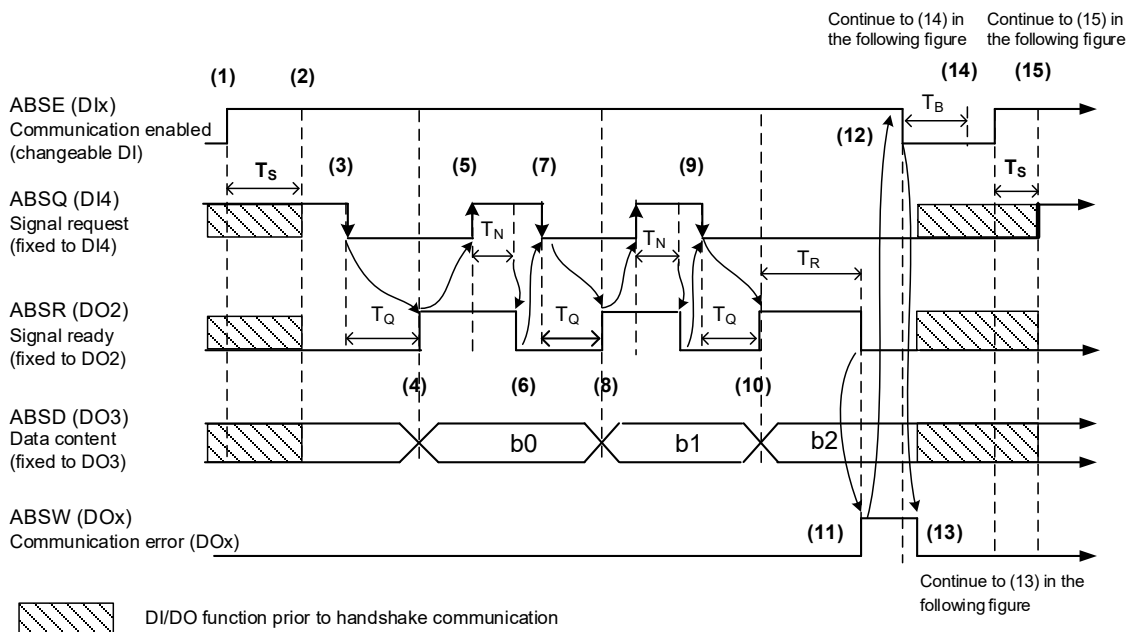
Figure 10.3.5.1.1 Timing diagram for reading the absolute position with DI/DO

The following table describes the delay time when reading 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 (make sure the signal is on), the functions for DI4, DO2, and DO3 are switched to ABSQ, ABSR, and ABSD, respectively. If DI4 was in the high-level state before, it remains in the high-level state when switched to ABSQ (logic high-level signal). DI4, DO2, and DO3 are dual-function DI/DO, which means DI4, DO2, and DO3 share the same DI with ABSQ, ABSR, and ABSD. Pay special attention when switching functions or set the DI/DO to 0 to disable the dual-function of DI/DO.

3. If DI4 was in the high-level state and 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 data access command.

4. After the T_Q time, the handshake data is ready and the absolute position is sent to ABSD. Now the servo drive turns on the ABSR signal and the controller can access the data.
   If the controller still cannot detect the ABSR status while it is changing to high level after the maximum T_Q time (refer to Figure 10.3.5.1.1), there may be a communication error.

5. Once the ABSR signal is set to high level, the controller accesses the data, and the ABSQ signal is set to high level to notify the servo drive that data was read.

6. When ABSQ is at high level, ABSR is set to low level after the T_N time in order to send the data for the next bit communication.

7. When ABSR is at low level, ABSQ is also set to low level and the servo drive needs to send the data 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 has read and 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 turned on the ABSQ signal, the servo drive sends the ABSW signal (communication error) and stops the handshake communication.

12. When the controller receives the communication error signal, it sets ABSE to low level and prepares to restart the handshake communication.

13. ABSW resumes to low level after the servo drive receives the ABSE signal.

14. The controller resumes communication after the T_B time.

15. Repeat step 1.

16. If no error occurs, the controller completes 80 bits (0 - 79) of the handshake communication with the servo drive. DI4, DO2, and DO3 then resume their original functions.

Note: if ABSE is set to low level first and then changed to high level, but ABSW does not resume to high level and the alarm remains on, it means some other errors exist. Check for the following possible warnings: absolute position lost, low battery voltage level, or absolute position overflows. Restart a new communication cycle after those errors have been cleared.

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10.3.5.2   Reading the absolute position with communication

You can access the data of the absolute encoder through two communication methods: instant access or parameter access. Instant access refers to reading the motor's feedback position as soon as power is supplied to the servo. When you set the status monitoring register 1 to the motors feedback pulse number (P0.017 = 0), you can access the motor's current position by reading P0.009.

Parameter access means the motor's position is temporarily stored in parameters. Once you set P0.049 with communication, the encoder status and motor absolute position (cycle number), and pulse number (or PUU) are stored in P0.050, P0.051, and P0.052, respectively. You can choose to read the pulse number or PUU through P2.070 Bit 1. When P0.049 is set to 1, the drive does not clear the error when reading the position value. If P0.049 is set to 2, the drive clears the error at the same time when reading the position value. Even when the motor is stopped, it still moves slightly forward and backward for position correction which is normal for the servo system. To avoid difference between the read coordinates and the actual positioning of the motor, set to clear the position error at the same time when reading the coordinates, so the motors actual positioning is changed to the read coordinates, which clears the position error. For example, the motor's current position is 20000, but it varies between 19999 and 20001. If you send the command to read the motor's position when it stops at 20001, then the motor's position is updated to 20001. After all positions are updated in P0.050 - P0.052, P0.049 is automatically reset to 0. At that point, the controller can access the values of P0.050 - P0.052. P0.050 shows the status of the absolute encoder. When it shows absolute position lost or cycle number overflow, that indicates the read absolute position is invalid. You must re-establish the absolute origin coordinates.
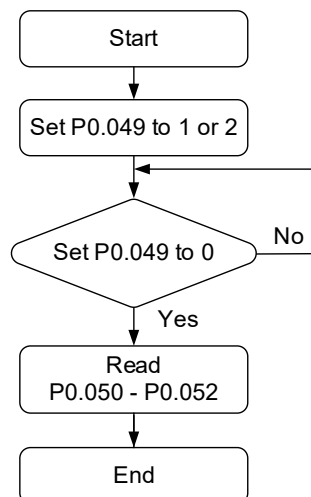
10.4   List of absolute parameters, DI/DO, and alarms

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

Parameter	Function
P0.002	Drive status
P0.049	Update encoder absolute position
P0.050	Absolute coordinate system status
P0.051	Encoder absolute position - multiple turns
P0.052	Encoder absolute position - pulse number or PUU within single turn
P2.069	Absolute encoder
P2.070	Read data selection
P2.071	Absolute position homing

Relevant DI/DO (refer to Chapter 8 for detailed information):

Setting value	DI name	Setting value	DO name
0x1D	ABSE	When DI.ABSE is on, DI.ABSR triggered by DO2 replaces the DO2 assigned by P2.019.	ABSR always output by DO2
When DI.ABSE is on, the DI.ABSQ from DI4 replaces the DI4 function from P2.013.	ABSQ always input by DI4	When DI.ABSE is on, DI.ABSD triggered by DO3 replaces the DO3 assigned by P2.020.	ABSD always output by DO3
0x1F	ABSC	0x0D	ABSW

Relevant alarms (refer to Chapter 12 for detailed information):

Display	Alarm name
AL060	Absolute position is lost
AL061	Encoder undervoltage
AL062	Number of turns for the absolute encoder overflows
AL069	Wrong motor type
AL072	Encoder overspeed
AL073	Encoder memory error
AL074	Encoder single-turn absolute position error
AL075	Encoder absolute number of turns is in error
AL077	Encoder internal error
AL079	Encoder parameter error
AL07B	Encoder memory busy
AL07C	Command to clear the absolute position is issued when the motor speed is over 200 rpm
AL07D	Motor stops operating when servo drive power is cycled before AL07C is cleared
AL07E	Encoder clearing procedure error
AL289	Position counter overflows

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CANopen Mode

11

This chapter provides details for the required parameter settings when the servo communicates with the controller through the CANopen communication function.

11.1 Basic configuration

11.1.1 Supported functions

CANopen functions supported by Delta servo drives:

- CANopen communication protocol: NMT, SYNC, SDO, PDO, and EMCY.

- SDO transmission: acyclic data exchange for reading / writing parameters and communication related settings.

- PDO transmission / reception: time-triggered, event-triggered, synchronous transmission (cyclic), and asynchronous transmission (acyclic).

- Node guarding.

- Heartbeat.

CANopen function not supported by Delta servo drives:

- Time stamp.

11.1.2 Hardware configuration

Pin assignment (RJ-45) for CAN bus wiring
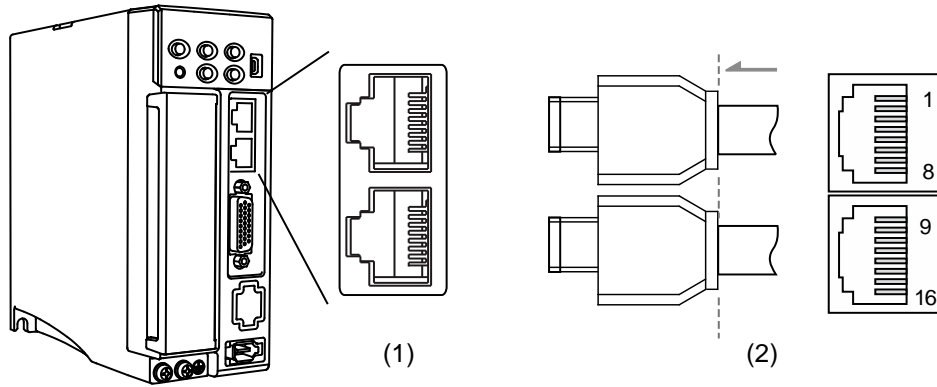
(1) CN3 connector (female); (2) CN3 connector (male)

Pin assignment:

Pin No.	Signal	Description
1, 9	CAN_H	CAN_H bus line (dominant high)
2, 10	CAN_L	CAN_L bus line (dominant low)
3, 11	GND_ISO	Signal GND
4, 12	-	-
5, 13	-	-
6, 14	-	-
7, 15	GND_ISO	Signal GND
8, 16	-	-

■   Baud rate setting

Baud rate and bus length

Baud rate	Maximum bus length
1 Mbps	25 m
750 Kbps	50 m
500 Kbps (default)	100 m
250 Kbps	250 m
125 Kbps	500 m

11.1.3 Parameter settings of CANopen mode

Follow these instructions to connect the CANopen controller and the ASDA-B3 servo drive:

1. Set CANopen mode: set P1.001 to 0x0C.

2. Set node ID: set the range of P3.000 to 01h - 7Fh.

3. Set P3.001 to 0403h for baud rate as 1 Mbps (Z = 0: 125 Kbps; 1: 250 Kbps; 2: 500 Kbps; 3: 750 Kbps; 4: 1 Mbps).

4. It is suggested to set P3.012 to 0x0100, so the parameters in the following table are non-volatile.

Variables during initialization	P3.012.Z = 0	P3.012.Z = 1	Note
P1.032	0x0010	EEPROM	-
P2.035	50331648	EEPROM	-
P1.047	100	EEPROM	-
P1.049	0	EEPROM	-
P1.038	100	EEPROM	-
P6.001	0	EEPROM	-
Acc (P1.034)	200	EEPROM	Used in PV and PP modes
Dec (P1.034)	200	EEPROM	Used in PV and PP modes
Torque slope (P1.034)	200	EEPROM	Used in PT mode
P1.044	1	EEPROM	-
P1.045	1	EEPROM	-
P1.055	Depending on the motor specifications	EEPROM	-
P5.008	2147483647	EEPROM	-
P5.009	-2147483648	EEPROM	-

5. It is suggested to enable the dynamic brake function (P1.032 = 0x0000).

11.2 Communication specification

11.2.1 Servo communication architecture
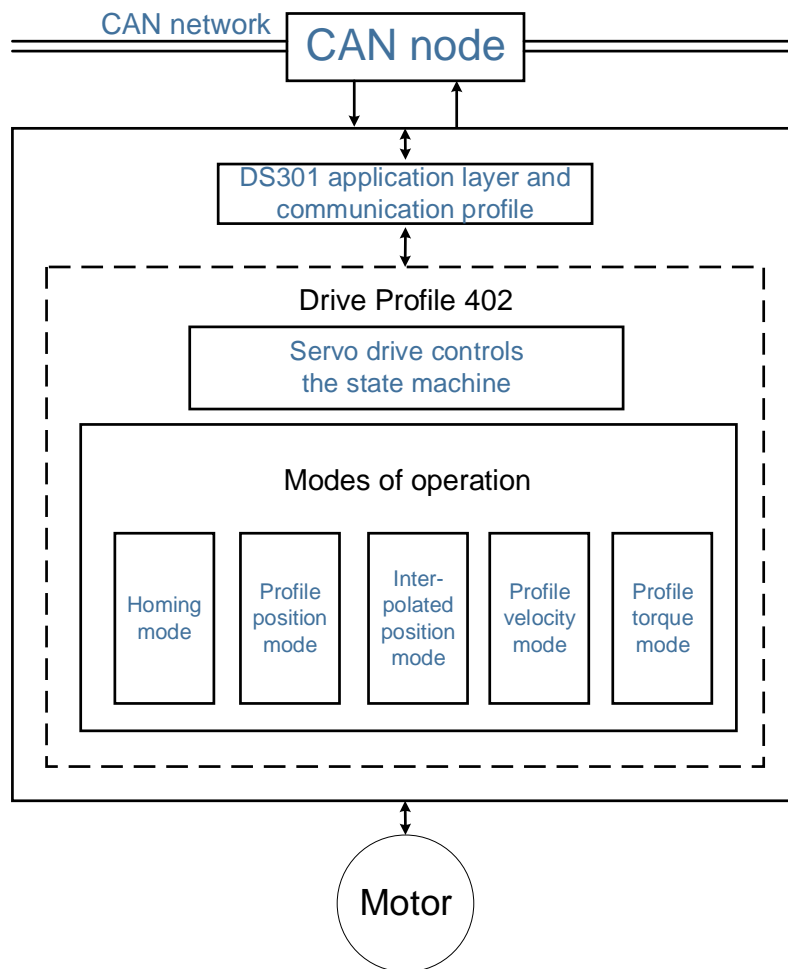
The CANopen architecture of the servo drive is as follows:

■　　DS301 is the communication profile: this protocol includes the communication objects (PDO, SDO, SYNC, and Emergency object), NMT service, and related communication object dictionary.

■　　DS402 is the device profile for drives and motion control: defines the behavior of each motion mode and the required object parameter settings for execution.

11.2.2 Communication objects

The default of the Delta servo drive complies with the DS301 protocol. All CANopen data contains an 11-bit identifier, generally referred to as "COB-ID". The COB-ID data format is as follows:

Bit	10	9	8	7	6	5	4	3	2	1	0
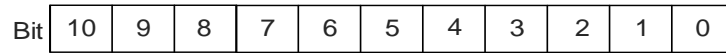
Bit	Function	Description
Bit 6 - Bit 0	Node-ID	The data size is 7-bit and the setting range is 0 - 127.
Bit 10 - Bit 7	Function code	The data size is 4-bit and the setting range is 0 - 15.

The following table lists the supported objects and the corresponding COB-IDs:

Communication object	Function code Bit 10 9 8 7	Node ID Bit 6 5 4 3 2 1 0	COB-ID DEC (HEX)	Object parameter
NMT service	0 0 0 0	0 0 0 0 0 0 0	0 (0h)	-
SYNC object	0 0 0 1	0 0 0 0 0 0 0	128 (80h)	1005h - 1007h
EMCY object	0 0 0 1	X X X X X X	128 (80h)	1014h
T_PDO1	0 0 1 1	X X X X X X	384 (180h) + Node-ID	1800h
R_PDO1	0 1 0 0	X X X X X X	512 (200h) + Node-ID	1400h
T_PDO2	0 1 0 1	X X X X X X	640 (280h) + Node-ID	1801h
R_PDO2	0 1 1 0	X X X X X X	768 (300h) + Node-ID	1401h
T_PDO3	0 1 1 1	X X X X X X	896 (380h) + Node-ID	1802h
R_PDO3	1 0 0 0	X X X X X X	1024 (400h) + Node-ID	1402h
T_PDO4	1 0 0 1	X X X X X X	1152 (480h) + Node-ID	1803h
R_PDO4	1 0 1 0	X X X X X X	1280 (500h) + Node-ID	1403h
T_SDO	1 0 1 1	X X X X X X	1408 (580h) + Node-ID	1200h
R_SDO	1 1 0 0	X X X X X X	1536 (600h) + Node-ID	1200h
NMT error control	1 1 1 0	X X X X X X	1792 (700h) + Node-ID	1016h, 1017h

0 indicates the bit is off; 1 indicates the bit is on; X indicates the bit is set according to the requirement.

Communication dictionary

Communication object	Object area
1000 - 1FFF	Communication Profile Area
2000 - 2FFF	Manufacturer Specific Profile Area
6000 - 9FFF	Standardized Device Profile Area

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11.2.2.1 Process data object (PDO)

Real-time data transmission can be achieved with Process data objects (PDOs). There are two types of PDOs: the sent TxPDO and the received RxPDO. This definition is from the perspective of the servo drive, for example, the sent TxPDO refers to the object that the servo drive sends to the controller. Set the communication parameters and mapping parameters as shown in the following table to use the PDOs.

Received RxPDO			Sent TxPDO		
Communication object	Communication object parameter	Mapping object parameter	Communication object	Communication object parameter	Mapping object parameter
R_PDO1	1400h	1600h	T_PDO1	1800h	1A00h
R_PDO2	1401h	1601h	T_PDO2	1801h	1A01h
R_PDO3	1402h	1602h	T_PDO3	1802h	1A02h
R_PDO4	1403h	1603h	T_PDO4	1803h	1A03h

The mapping parameter format of PDO 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 length
Bit 8 - Bit 15	Object sub-index
Bit 16 - Bit 31	Object index

Example:

To set three PDOs (OD 6040h, OD 607Ah, and OD 6060h) in the first group of PDOs, the setting is as follows:

Mapping parameter setting for received PDO	Data			Description
OD 1600 sub0	3			Set 3 PDO mappings.
OD 1600 sub1	6040h	00h	10h	-
OD 1600 sub2	607Ah	00h	20h	-
OD 1600 sub3	6060h	00h	08h	-
Note	The total length is 38h (56-bit) which meets the specification of less than 64-bit.			

11.2.2.2   Service data object (SDO)

With Service data objects (SDOs), you can write or read objects. The SDO message format is mainly composed of COB-ID and SDO data. SDO data can transmit up to 4 bytes.
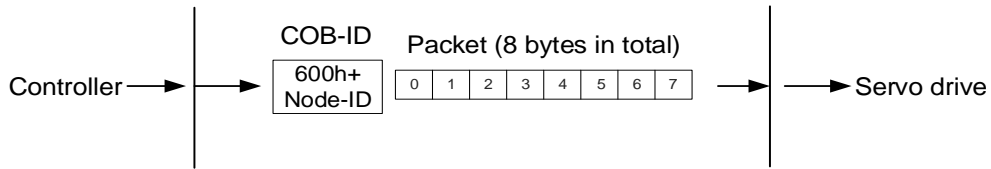
Byte	Function
Byte 0	Command code
Byte 1 - Byte 2	Object index
Byte 3	Object sub-index
Byte 4 - Byte 7	Data

■ Write data with SDO

To use an SDO to write data with the controller, you need to write the request code, index, and data according to the SDO format. The servo drive then returns the corresponding message based on the written data.

The following figure shows the packet format when the controller sends the SDO for writing data:
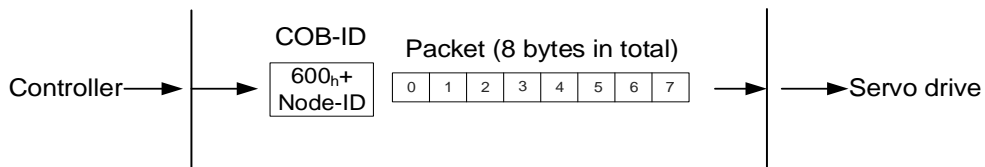
Function code	Object index		Object sub-index	Data				Description
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	
23h	-	-	-	Data				Write 4 bytes of data.
2Bh	-	-	-	Data				Write 2 bytes of data.
2Fh	-	-	-	Data				Write 1 byte of data.

The following figure shows the packet format returned by the servo drive when the controller sends the SDO for writing data:

Note: for SDO abort codes, refer to Section 11.2.2.3.
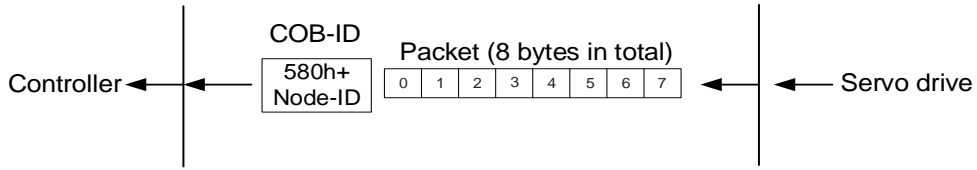
Function code	Object index		Object sub-index	Data				Description
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	
60h	-	-	-					Write-in is successful.
80h	-	-	-	SDO abort codes				Error code.

Note: for SDO abort codes, refer to Section 11.2.2.3.

Example:

Write the value of 300,000 (493E0h) to the servo parameter P7.001 (OD 2701h).

The write-in format is as follows:

Function code	Object index		Object sub-index	Data				Description
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	
23h	01	27	0	E0	93	04	00	Write 4 bytes of data.

The returned packet is as follows:

Function code	Object index		Object sub-index	Data				Description
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	
60h	01	27	0					Write-in is successful.

■ Read data with SDO

To use an SDO to read data with the controller, you need to write the request code and index according to the SDO format. The servo drive then returns the object's data based on the object to be read.

The following figure shows the packet format when the controller sends the SDO for reading data:
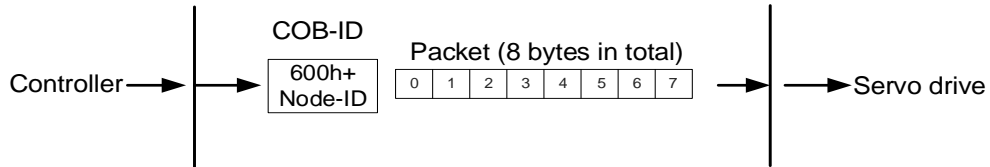
Function code	Object index		Object sub-index	Data				Description
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	
40h	-	-	-					Read data.

The following figure shows the packet format returned by the servo drive when the controller sends the SDO for reading data:
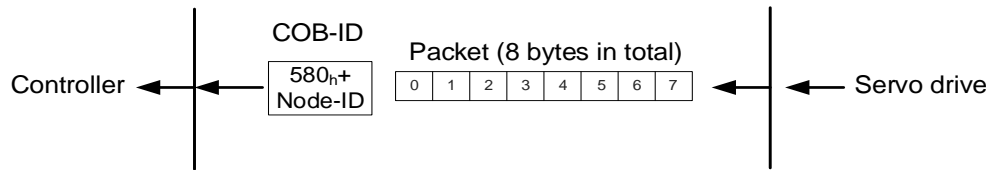
Function code	Object index		Object sub-index	Data				Description
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	
43h	-	-	-	Data				Read 4 bytes of data.
4Bh	-	-	-	Data				Read 2 bytes of data.
4Fh	-	-	-	Data				Read 1 byte of data.
80h	-	-	-	SDO abort codes				Error code.

Note: for SDO abort codes, refer to Section 11.2.2.3.

11.2.2.3 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 reading an object from EEPROM.
080000a2h	An error occurred when writing an object to EEPROM.
080000a3h	Invalid range when accessing EEPROM.
080000a4h	EEPROM data content error occurred when accessing EEPROM.
080000a5h	The entered password is incorrect when writing 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.

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11.2.2.4 Synchronization object (SYNC)

The Synchronization objects (SYNCs) are periodically broadcast by the SYNC producer.
There is no data in the SYNC packet (L = 0).

The SYNC protocol is as follows:
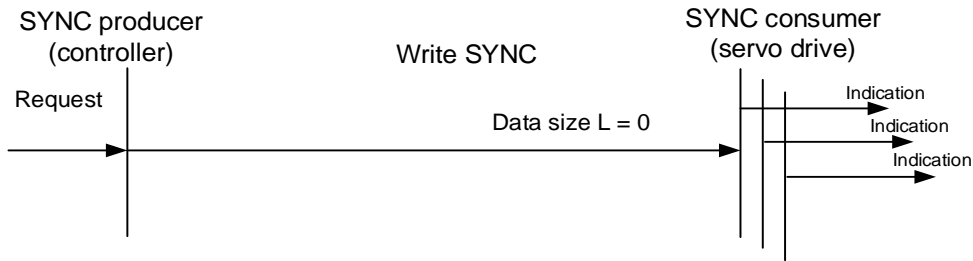
The SYNC object is used to achieve PDO transmission and reception synchronization between the controller and servo drive. The SYNC object transmission cycle is set by the object OD 1006h (see Section 11.4 for detailed settings).

The following figure shows the timing sequence between the servo drive RxPDO reception and the controller SYNC transmission. The controller transmits RxPDO to the servo drive between two SYNCs (communication cycle), and the servo drive will not execute the RxPDO received in the previous communication cycle until it receives the SYNC.
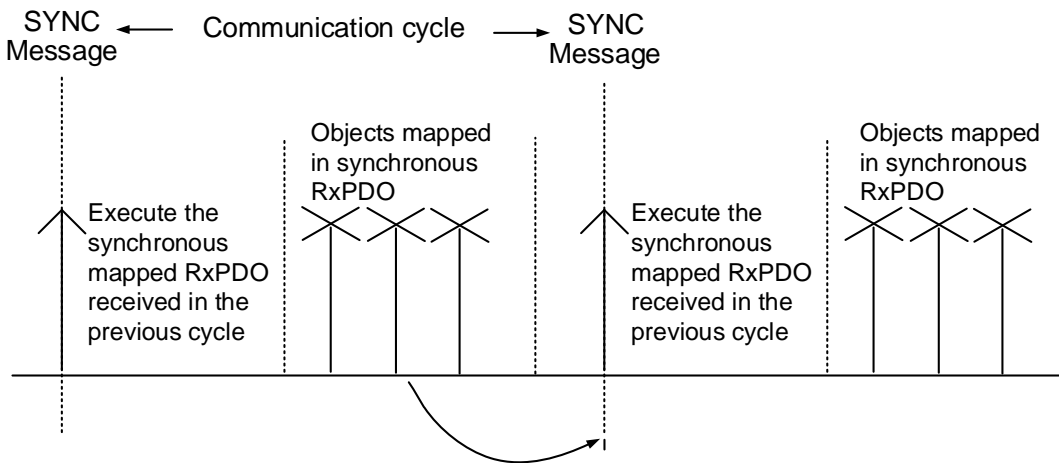
The following figure shows the timing sequence between the servo drive TxPDO transmission and the controller SYNC transmission. The servo drive transmits the TxPDO data to the controller as soon as it receives the SYNC.
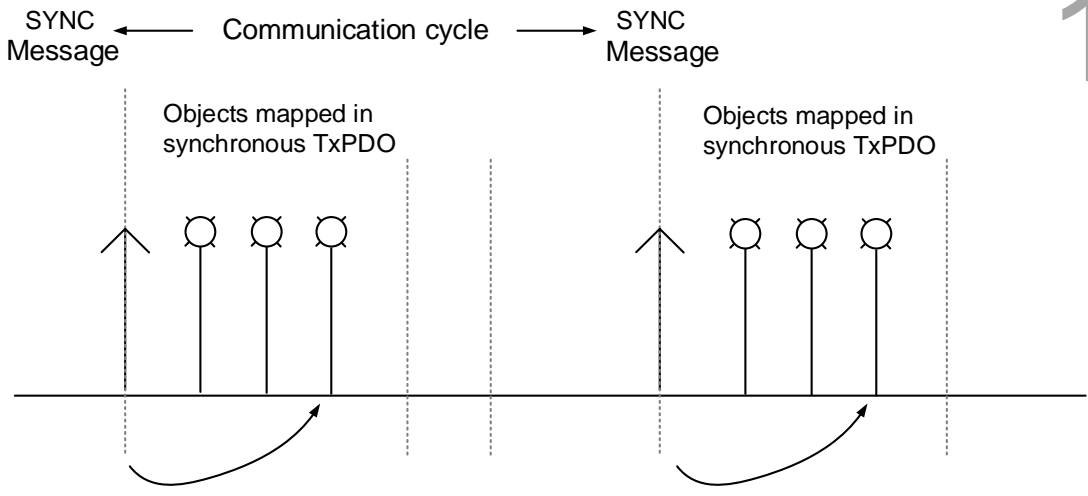
11.2.2.5 Emergency object (EMCY)

When the servo detects an abnormality, it sends an alarm and notifies the controller with the Emergency object. The Emergency object can only transmit one alarm at a time. When a higher priority alarm occurs before the previous lower priority alarm is cleared, the higher priority alarm overwrites the previous alarm and notifies the controller as an Emergency object.
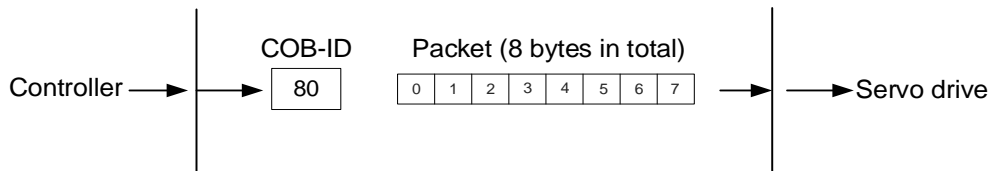
Error code		Error register	Servo alarm	N/A
Byte 0	Byte 1	Byte 2	Byte 3	Bytes 4 - 7
See OD 603Fh on the error code table.		OD 1001h	Refer to Chapter 12 for details.	

11.2.2.6 NMT services

■ State machine

The NMT state machine is shown as follows. After the servo drive completes the Initialization state, it enters the Pre-operational state. The NMT state machine determines the behavior of the communication function, such as PDO functions only in the Operational state.

Power On or Hardware Reset
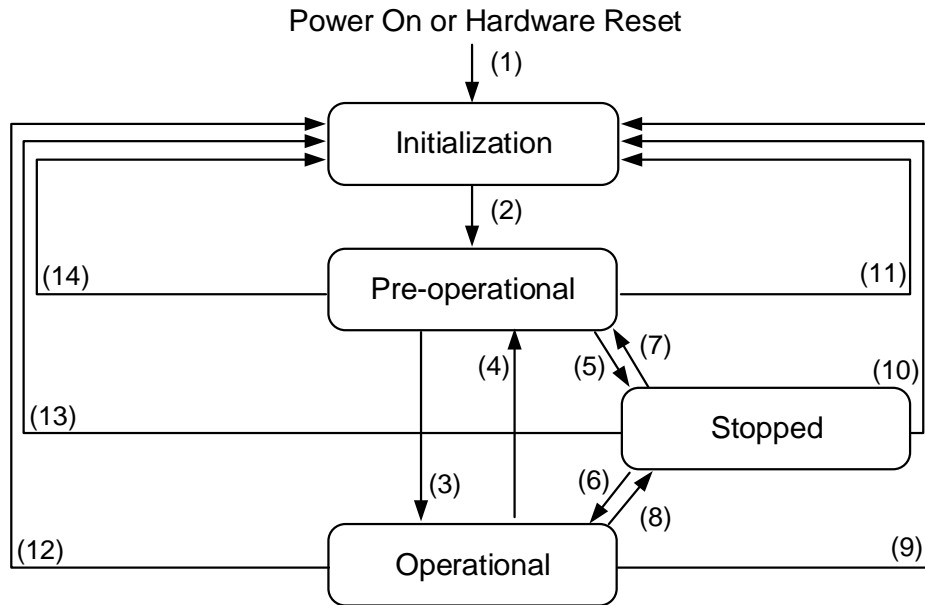
State	Description
Initialization	The servo drive successfully completes initialization after being powered on without errors occurring. The packet could still not be transmitted in this state.
Pre-operational	Data can be exchanged with SDO. If an alarm occurs in the servo drive, an emergency message is sent to notify the controller.
Stopped	SDO and TxPDO data packets can be used to exchange data with the controller.
Operational	This state allows for all data exchanges including SDO and PDO (TxPDO and RxPDO).

The following table shows the communication objects that can be used for each communication state:

Communication object	Initialization	Pre-operational	Operational	Stopped
PDO			V	
SDO		V	V	
Synchronization object		V	V	
Emergency object		V	V	
Boot-up object	V			
NMT object		V	V	V

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■   Heartbeat

The Heartbeat mechanism is mainly to enable the producer to periodically send packets to the consumer. The producer can be a controller or servo drive; on the other hand, a controller or servo drive can also be the consumer.

If you use the servo drive as the consumer and the controller to send the heartbeat, you need to set the heartbeat receiving time (OD 1016h) of the servo drive. When the servo drive does not receive the heartbeat signal within the receiving time, the heartbeat event is triggered, meaning AL180 is triggered. Consumer heartbeat time (OD 1016h) is defined as the time the servo drive expects to receive a heartbeat. For the setting, consumer heartbeat time (OD 1016h) must be greater than the producer heartbeat time. The producer time is set by the controller. Due to delays and other uncontrollable external factors in transmitting the heartbeat, you must retain a tolerance margin value.

COB-ID = 700h+Node-ID

Example for Node-ID = 1
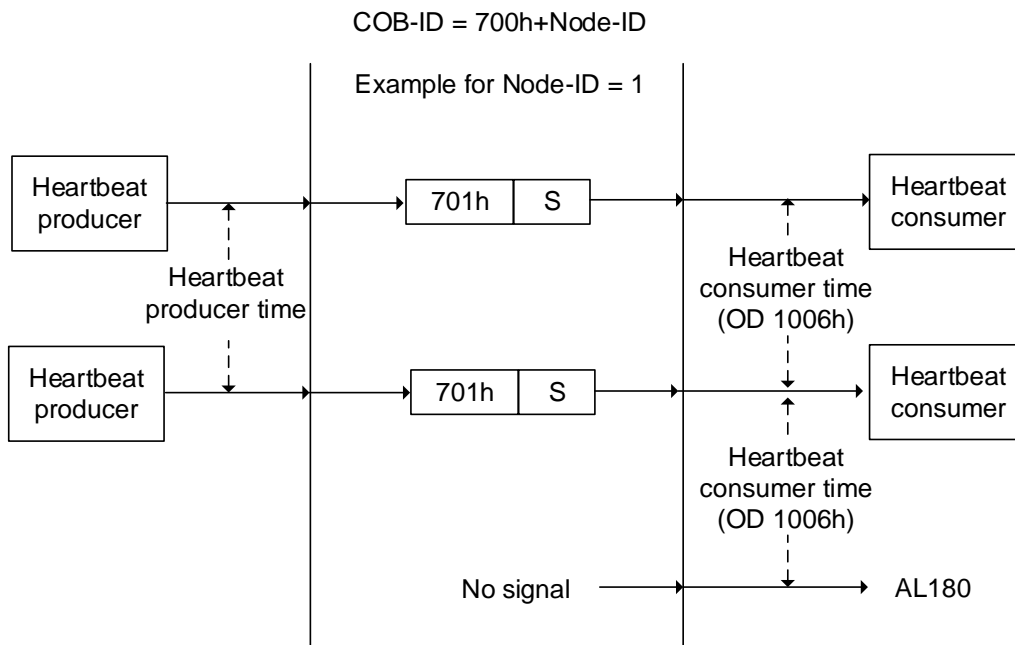
The S code is described as follows:

S	Function
0	Bootup
4	Stopped
5	Operational
127	Pre-operational

If you want to use the servo drive as the producer, then the heartbeat is sent by the drive and you need to set the producer heartbeat time (OD 1017h). Set the consumer heartbeat time for the controller, which must be greater than the producer heartbeat time. When the controller does not receive the heartbeat signal within the receiving time, it triggers the heartbeat event which corresponds to the alarm defined by the controller.

The servo drive can play two roles simultaneously, the consumer and producer, but you need to set OD 1016h and OD 1017h at the same time. And the controller must also be set as the producer and consumer.

■ Node / Life Guarding

The Node / Life Guarding mechanism is similar to that of Heartbeat. The main difference between the two is that Heartbeat only uses the consumer to judge whether there are packets or not, and the producer does not make this judgment. The mechanism of Node / Life Guarding is mainly based on the master-slave axis and the two-way relationship. The master axis periodically sends packets to the slave axis, and the slave axis must return the packets to the master axis within the set guard time (OD 100Ch), otherwise an error occurs. You must set the life time for the slave axis and the master slave must send the packets within the life guard time. If the slave axis does not receive the packets, AL180 is triggered. Life time is set by multiplying the guard time by a life time factor (OD 100Dh).

The Node / Life Guarding architecture is as follows:

COB-ID = 700h + Node-ID
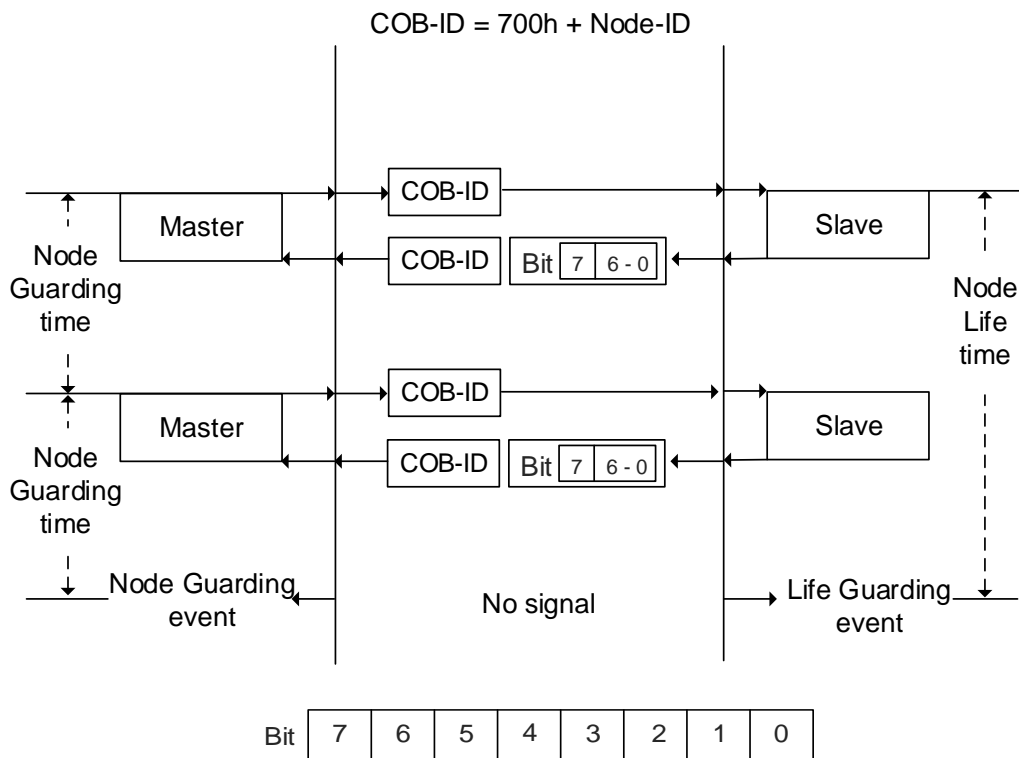
Bit	Function	Description
Bit 6 - Bit 0	State of the NMT slave	4 = Stopped 5 = Operational 127 = Pre-operational
Bit 7	-	-

11.3   CANopen operation mode

This section describes the servo motion mode (Mode of Operation) specified by CiA402 in CANopen mode. The content includes basic operation settings and related object descriptions.

11.3.1   Profile Position Mode

After the servo drive receives the position command transmitted by the controller, the servo drive controls the servo motor to reach the target position. In the position control mode, the controller only informs the servo drive of the target position, speed command, and acceleration / deceleration settings at the beginning. The motion plan from command triggering to the arrival of the target position is performed by the motion command generator in the servo drive. The following figure shows the position control mode architecture of the servo drive:
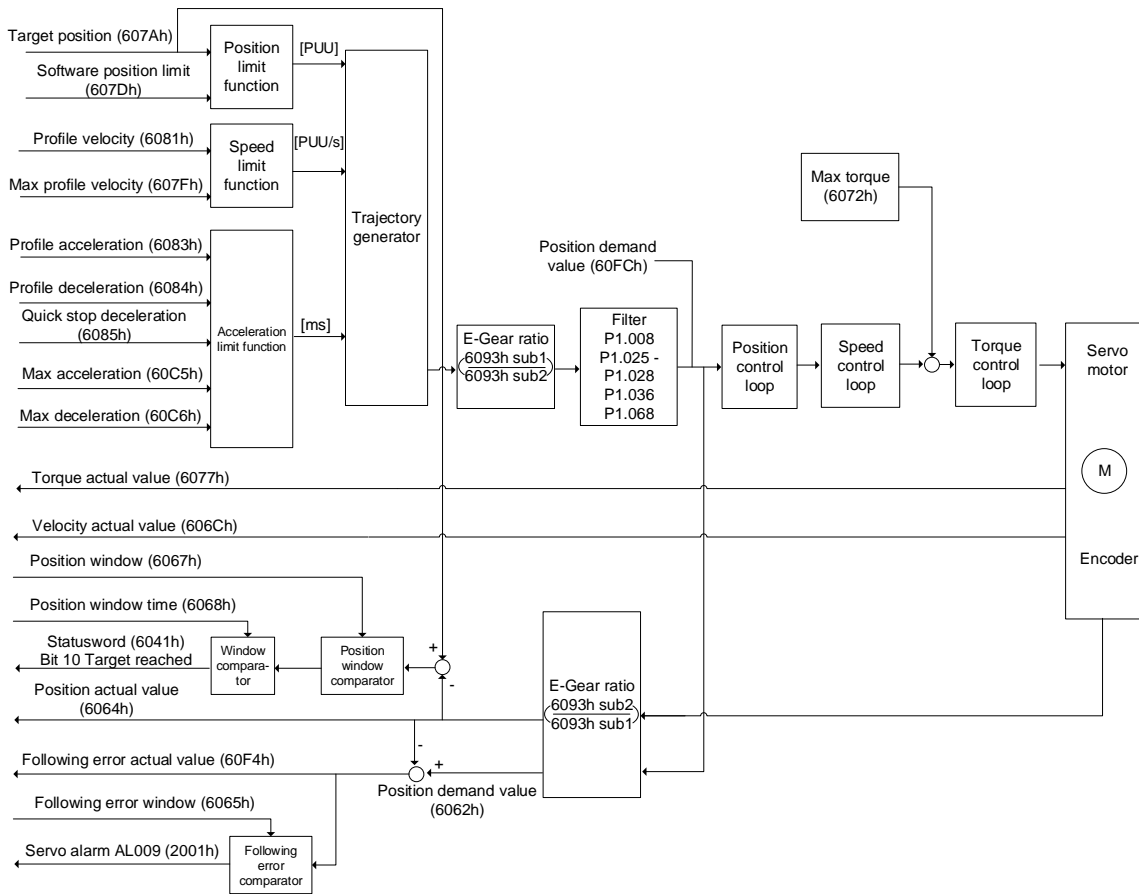
Operation steps:

1. Set OD 6060h to 01h to set the mode as the position control mode.

2. Set OD 607Ah for the target position (unit: PUU).

3. Set OD 6081h for the speed command (unit: PUU/sec).

4. Set OD 6083h for the acceleration time slope (unit: ms).

5. Set OD 6084h for the deceleration time slope (unit: ms).

6. Set OD 6040h for the control command. Follow these steps. 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.

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 triggered (rising-edge triggering).

7. After the servo completes the first motion command, the servo sets the target position, speed and other conditions to execute the next motion command.

8. Set OD 6040h for the control command. 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 triggered (rising-edge triggering).

Read the servo drive information:

1. Read OD 6064h to obtain the current motor feedback position.

2. Read OD 6041h to obtain the servo drive status, including the following error and notifications for set-point acknowledge and target reached.

Command to take immediate effect

In the position control mode, set the command to take effect immediately or not with 6040h Bit 5.

■ When 6040h Bit 5 is set to 0, the command to take immediate effect is disabled.

If the command to take immediate effect is not enabled, 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 only acknowledged and executed after the current command is complete.

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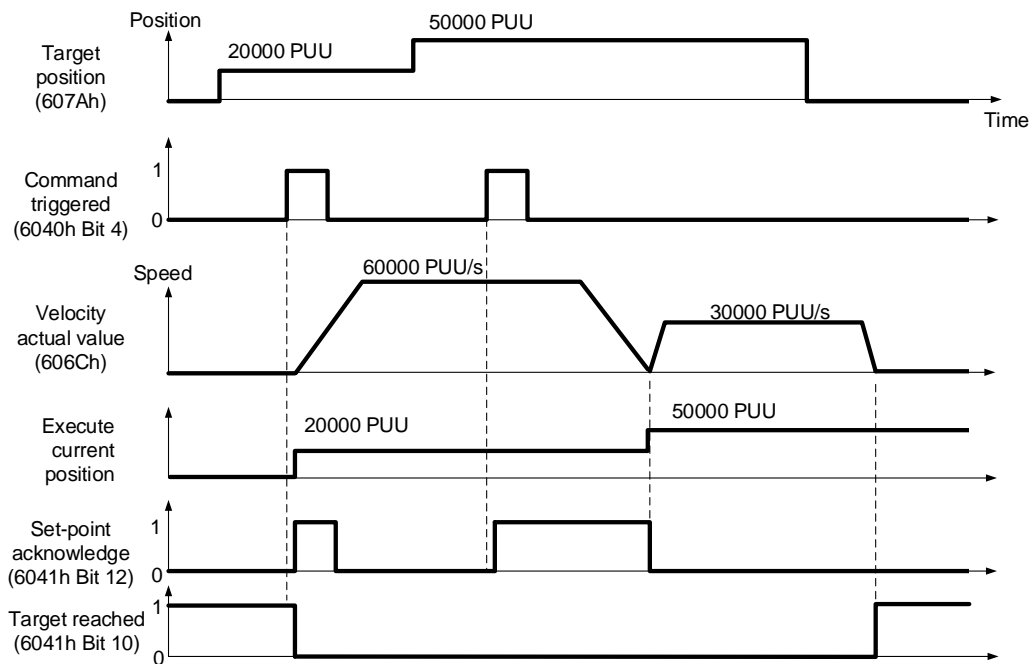
■ When 6040h Bit 5 is set to 1, the command to take immediate effect is enabled (only valid in Profile Position Mode).

If the command to take immediate effect is enabled, when the current motion command is in execution (not yet complete), the servo immediately interrupts the current command and executes the new command once the servo receives a 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	INTEGER32	RO
6064h	Position actual value	INTEGER32	RO
6065h	Following error window	UNSIGNED32	RW
6067h	Position window	UNSIGNED32	RW
6068h	Position window time	UNSIGNED16	RW
607Ah	Target position	INTEGER32	RW
6081h	Profile velocity	UNSIGNED32	RW
6083h	Profile acceleration	UNSIGNED32	RW
6084h	Profile deceleration	UNSIGNED32	RW
6093h	Position factor	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   Interpolation Position Mode

Interpolation Position Mode requires a series of position data to complete the interpolation positioning. The difference between IP (Interpolation Mode) and PP (Position Mode) is all the motion command paths of the IP mode are issued by the controller. The servo drive only follows each position that the controller issues and finally completes a motion command. Delta servo drives only support synchronous operation which is the controller periodically sends the SYNC object (COB-ID = 0x80). The interpolation cycle can be set by OD 60C2h. And the controller issues the position command to the interpolation position of OD 60C1h.
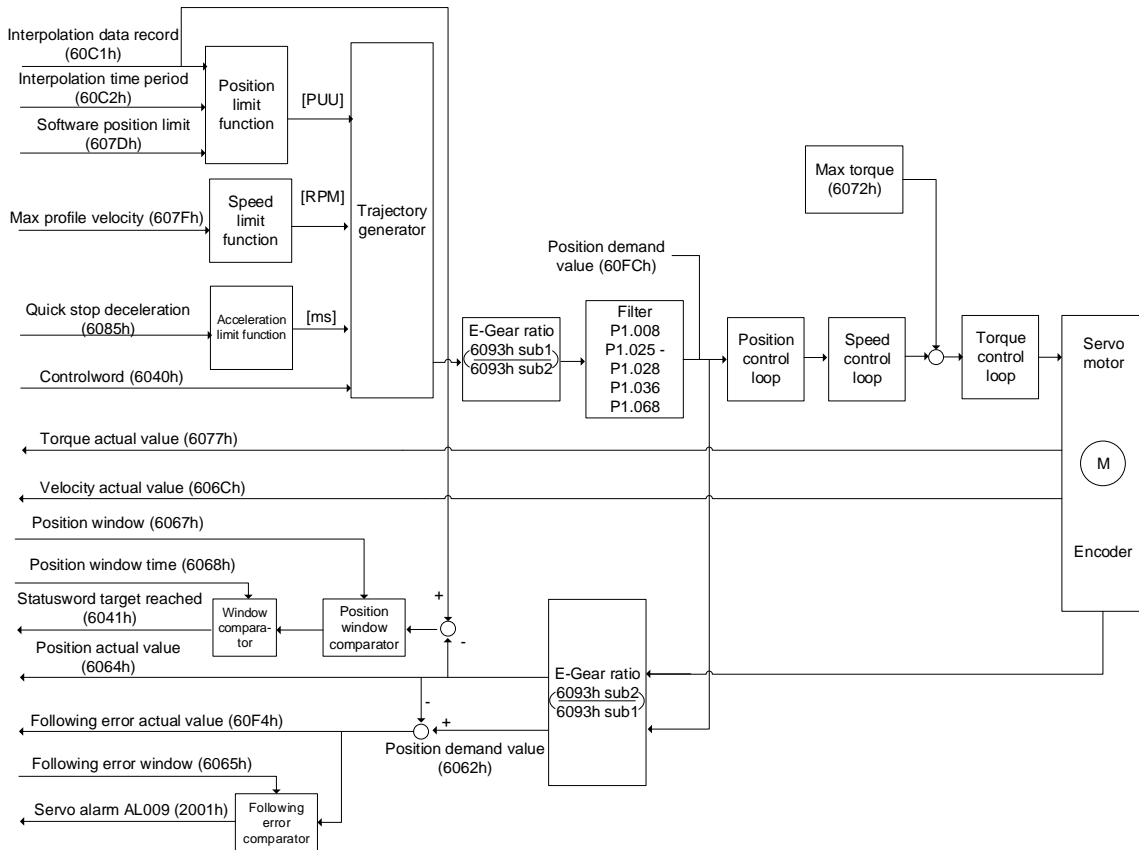
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Operation steps:

1. Set OD 6060h to 07h to set the mode as Interpolation Position Mode.

2. Set OD 60C2h for the interpolation cycle. The setting must be the same as the communication cycle of OD 1006h.

3. In the PDO mapping setting of the controller, configure one set of RxPDO to be OD 60C1h sub1 and OD 60C1h sub2.

4. In the PDO mapping setting of the controller, configure the objects to be monitored in TxPDO according to the requirements, such as the feedback position (OD 6064h).

5. Set OD 6040h for the control command. Follow these steps. 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 Section 11.2.2.6.

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).
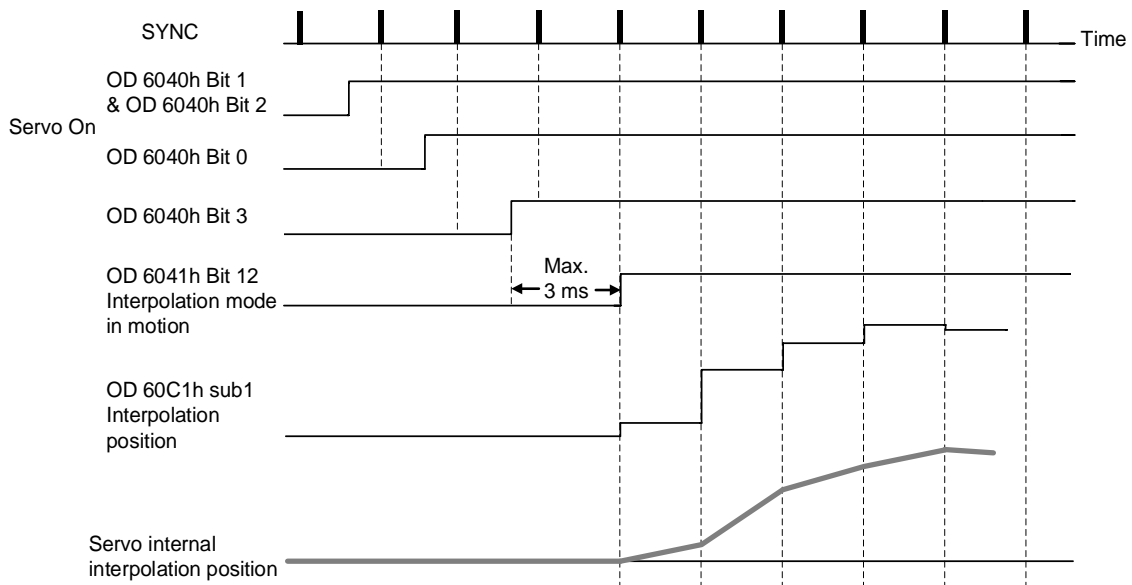
Adjustment method:

It is suggested to set the SYNC communication cycle (OD 1006h) between 1 ms and 10 ms. Since the cycle time is too long, the position error also increases. If the position change is big, it causes speed fluctuations. In this case, use P1.036 (S-curve acceleration / deceleration constant) or P1.068 (Position command - moving filter) to smooth the position difference. Since the jitter of each controller is different, the servo receives a difference between the SYNC and SYNC communication cycle time. When this happens, adjust the error value (U) of P3.009 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.

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
6093h	Position factor	UNSIGNED32	RW
60C0h	Interpolation sub mode select	INTEGER16	RW
60C1h	Interpolation data record	INTEGER32	RW

Note: for more details, refer to Section 11.4.3 Details of objects.

11.3.3 Homing Mode

After homing is complete, the coordinate system of the servo drive is established and the drive can start executing the position command issued by the controller. Delta servo drives offer 35 homing modes, including finding the home switch, positive and negative limits, and motor Z pulse.
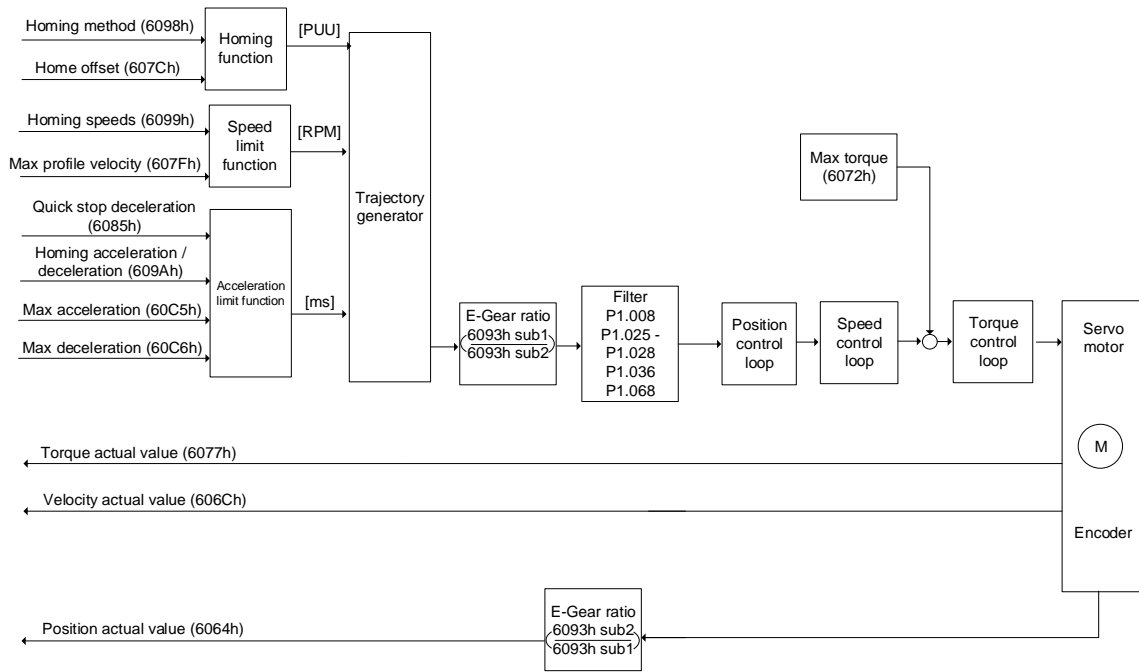
Operation steps:

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 method to find the origin point.

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 / deceleration time.

7. Set OD 6040h for the control command. Follow these steps. 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 Section 11.2.2.6.

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	Command triggered (rising-edge triggering).

Read the servo drive information:

1. Read OD 6041h to obtain the servo drive status.

2. Read OD 6064h to obtain the current motor feedback position.

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
607Ch	Home offset	INTEGER32	RW
6093h	Position factor	UNSIGNED32	RW
6098h	Homing method	INTEGER8	RW
6099h	Homing speeds	UNSIGNED32	RW
609Ah	Homing acceleration	UNSIGNED32	RW

Note: for more details, refer to Section 11.4.3 Details of objects.

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11.3.4 Profile Velocity Mode

In PV (Profile Velocity) mode, the controller specifies the speed command and acceleration / deceleration conditions, and the motion command generator of the servo drive plans the motion path according to these conditions.
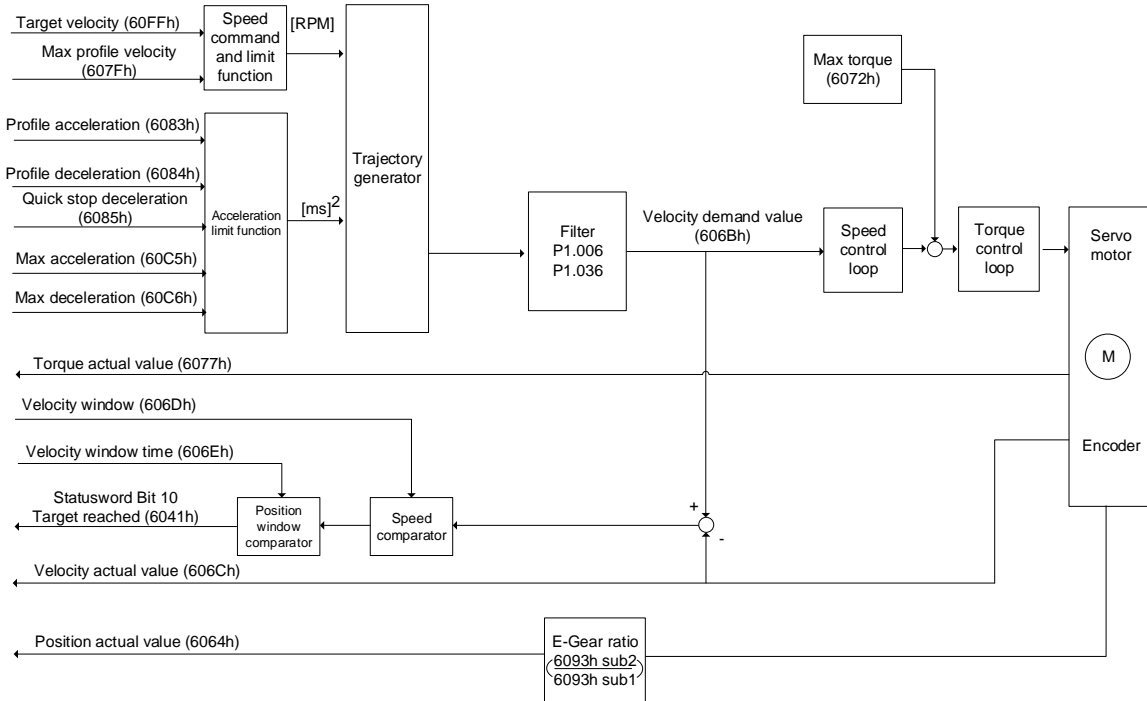
Operation steps:

1. Set OD 6060h to 03h to set the mode as the speed control mode.

2. Set OD 6083h for the acceleration time slope.

3. Set OD 6084h for the deceleration time slope.

4. Set the target speed (OD 60FFh) to 0. In speed mode, the servo motor starts operating once it is switched to servo on (Step 5). Therefore, setting the target speed (OD 60FFh) to 0 is to ensure that the motor maintains at 0 rpm at the time of servo on.

5. Set OD 6040h for the control command. Follow these steps. 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 Section 11.2.2.6.

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 speed.

Read the servo drive information:

1. Read OD 6041h to obtain the servo drive status.

2. Read OD 606Ch to obtain the current speed feedback.

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
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
60FFh	Target velocity	INTEGER32	RW

Note: for more details, refer to Section 11.4.3 Details of objects.

11.3.5 Profile Torque Mode

In PT (Profile Torque) mode, the controller specifies the torque command and filtering conditions, and the motion command generator of the servo drive plans the torque slope according to these conditions.
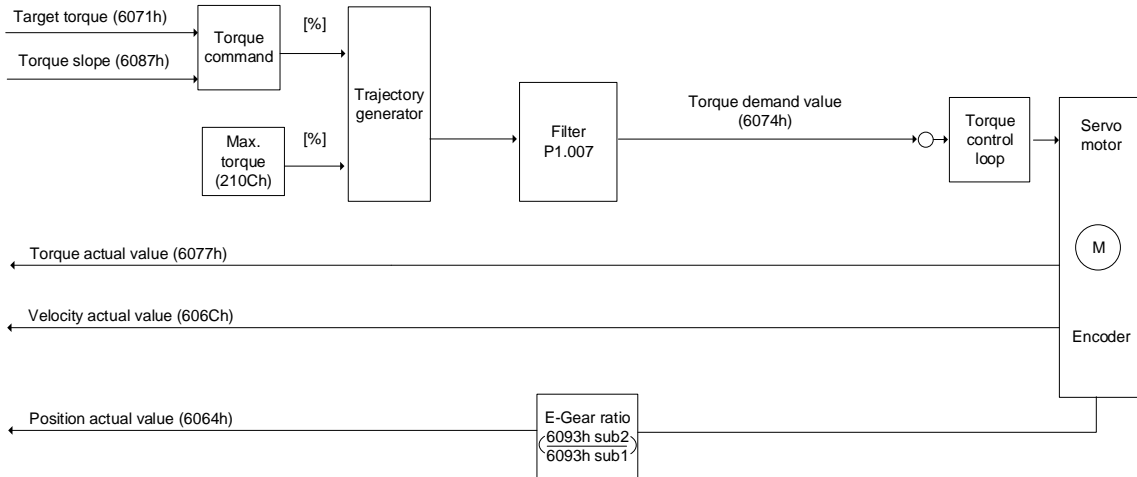
Operation steps:

1. Set OD 6060h to 04h to set the mode as the torque control mode.

2. Set OD 6087h for the torque slope.

3. Set the target torque (OD 6071h) to 0. In torque mode, the servo target torque takes effect once the servo is switched to servo on (Step 4). Therefore, set the target torque (OD 6071h) to 0 for safety reasons.

4. Set OD 6040h for the control command. Follow these steps. 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 Section 11.2.2.6.

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 feedback.

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
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
607Fh	Max profile velocity	UNSIGNED32	RW
6080h	Max motor speed	UNSIGNED32	RW
6087h	Torque slope	UNSIGNED32	RW

Note: for more details, refer to Section 11.4.3 Details of objects.

11.4 Object dictionary

This section details the CANopen objects supported by the servo. The contents include object index, name, data type, data length, and access properties.

11.4.1 Specifications for objects

Object type

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 Standard 301.

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
1005h	VAR	COB-ID SYNC	UNSIGNED32	RO
1006h	VAR	Communication cycle period	UNSIGNED32	RW
100Ch	VAR	Guard time	UNSIGNED16	RW
100Dh	VAR	Life time factor	UNSIGNED8	RW
1010h	ARRAY	Store parameters	UNSIGNED32	RW
1011h	ARRAY	Restore parameters	UNSIGNED32	RW
1014h	VAR	COB-ID EMCY	UNSIGNED32	RO
1016h	ARRAY	Consumer heartbeat time	UNSIGNED32	RW
1017h	VAR	Producer heartbeat time	UNSIGNED16	RW
1018h	RECORD	Identity object	UNSIGNED32	RO
1029h	ARRAY	Error behavior	UNSIGNED8	RW
1200h	RECORD	1st Server SDO parameter	SDO parameter	RO
1400h - 03h	RECORD	Receive PDO parameter	UNSIGNED16/32	RW
1600h - 03h	RECORD	Receive PDO mapping	UNSIGNED32	RW
1800h - 03h	RECORD	Transmit PDO parameter	UNSIGNED16/32	RW
1A00h - 03h	RECORD	Transmit PDO mapping	UNSIGNED32	RW

Note: only 1001h can be mapped to PDO.

OD 2XXXh servo parameter group

Index	Object code	Name	Data type	Access	Mappable
Delta parameter definition					
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	N
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	INTEGER32	RO	Y
6064h	VAR	Position actual value	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

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Index	Object code	Name	Data type	Access	Mappable
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
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
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
60C0h	VAR	Interpolation sub mode select	INTEGER16	RW	Y
60C1h	ARRAY	Interpolation data record	INTEGER32	RW	Y
60C2h	RECORD	Interpolation time period	UNSIGNED8	RW	Y
60C5h	VAR	Max acceleration	UNSIGNED32	RW	Y
60C6h	VAR	Max deceleration	UNSIGNED32	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
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
Corresponding servo parameter	N/A

Format of this object: (High word h) DCBA : (Low word L) UZYX

A		X	
B	Bit 16 - Bit 31	Y	Bit 0 - Bit 15
C	Model type	Z	Device profile number
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

Object 1001h: Error register

Index	1001h
Name	Error register
Object code	VAR
Data type	UNSIGNED8
Access	RO
PDO mapping	Yes
Setting range	UNSIGNED8
Corresponding servo parameter	N/A
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
Corresponding servo parameter	N/A

Sub-index	1 - 5
Description	Standard error field
Data type	UNSIGNED32
Access	RO
PDO mapping	No
Setting range	UNSIGNED32
Default	0
Corresponding servo parameter	N/A

Format of this object: (High word h) DCBA : (Low word L) UZYX

A		X	
B	Bit 16 - Bit 31	Y	Bit 0 - Bit 15
C	Delta servo alarm	Z	Error code
D		U	

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Definitions are as follows:

■ UZYX: error code. Refer to the error code definition in DS 402.

■ 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 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 encoder error based on the Delta servo alarm.

Error code: 0x7305 is defined as an Incremental Sensor 1 fault according to DS 402.

Object 1005h: COB-ID SYNC message

Index	1005h
Name	COB-ID SYNC message
Object code	VAR
Data type	UNSIGNED32
Access	RO
PDO mapping	No
Setting range	UNSIGNED32
Default	80 h

Object function:

This object is read-only and cannot be set.

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	Description
Bit 31 - Bit 11	Reserved	-
Bit 10 - Bit 0	SYNC-COB-ID = 0x80	-

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 (unit: µs). The communication cycle is the interval between two SYNCs. If you are not using SYNC, set this object to 0.

Object 100Ch: Guard time

Index	100Ch
Name	Guard time
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	No
Setting range	UNSIGNED16
Default	0
Unit	ms

Object function:

The Life Guarding Protocol includes OD 100Ch and 100Dh. OD 100Ch is the guard time in milliseconds and OD 100Dh is the multiplying factor. Therefore, OD 100Ch multiplied by OD 100Dh gives the life time for the Life Guarding Protocol. If the time (OD 100Ch) is set to 0, then this setting is invalid.

Example: if OD 100Ch = 5 ms and OD 100Dh = 10, then life time equals 50 ms.

Object 100Dh: Life time factor

Index	100Dh
Name	Life time factor
Object code	VAR
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	UNSIGNED8
Default	0

Object function:

The Life Guarding Protocol includes OD 100Ch and 100Dh. OD 100Ch is the guard time in milliseconds and OD 100Dh is the multiplying factor. Therefore, OD 100Ch multiplied by OD 100Dh gives the life time for the Life Guarding Protocol. If the time (OD 100Ch) is set to 0, then this setting is invalid.

Example: if OD 100Ch = 5 ms and OD 100Dh = 10, then life time equals 50 ms.

Object 1010h: Store parameters

Index	1010h
Name	Store parameters
Object code	ARRAY
Data type	UNSIGNED32
Access	RW
PDO mapping	No

Sub-index	0
Description	Number of sub-index
Data type	UNSIGNED8
Access	RO
PDO mapping	No
Setting range	UNSIGNED8
Default	1

Sub-index	1
Description	Store communication parameters
Data type	UNSIGNED32
Access	RW
PDO mapping	No
Setting range	No
Default	1

Object function:

Write 0x65766173 (save) to sub-index 1 to write all current OD values to the EEPROM.

Object 1011h: Restore parameters

Index	1011h
Name	Restore parameters
Object code	ARRAY
Data type	UNSIGNED32
Access	RW
PDO mapping	No

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Sub-index	0
Description	Number of sub-index
Data type	UNSIGNED8
Access	RO
PDO mapping	No
Setting range	UNSIGNED8
Default	1

Sub-index	1
Description	Restore communication parameters
Data type	UNSIGNED32
Access	RW
PDO mapping	No
Setting range	No
Default	1

Object function:

Write 0x64616F6C (load) to sub-index 1 to reset all OD parameters to their default values.

Object 1014h: COB-ID EMCY

Index	1014h
Name	COB-ID emergency message
Object code	VAR
Data type	UNSIGNED32
Access	RO
PDO mapping	No
Setting range	UNSIGNED32
Default	80h + Node-ID

Object function:

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	Description
Bit 31	Emergency (EMCY) function	0: the emergency (EMCY) function is enabled (servo drive sends the EMCY command). 1: the emergency (EMCY) function is disabled (servo drive does not send the EMCY command).
Bit 30 - Bit 11	Reserved	-
Bit 10 - Bit 0	11-bit Identifier COB-ID	80h + Node-ID

The emergency (EMCY) function is as follows:

Communication object	Function code	Node ID	COB-ID	Object parameter index
EMCY object	0001	1 - 127	129 (81h) - 255 (FFh)	1014h

Node ID and corresponding COB-ID

Node ID	COB-ID
1	129 (81h)
2	130 (82h)
~	~
127	255 (FFh)

Object 1016h: Consumer heartbeat time

Index	1016h
Name	Consumer heartbeat time
Object code	ARRAY
Data type	UNSIGNED32
Access	RW
PDO mapping	No

Sub-index	0
Description	Number of sub-index
Data type	UNSIGNED8
Access	RO
PDO mapping	No
Setting range	1
Default	1

Sub-index	1
Description	Consumer heartbeat time
Data type	UNSIGNED32
Access	RW
PDO mapping	No
Setting range	UNSIGNED32
Default	0

Object function:

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	Description
Bit 31 - Bit 24	Reserved	-
Bit 23 - Bit 16	Node-ID	UNSIGNED8
Bit 15 - Bit 0	Heartbeat time	UNSIGNED8; unit: ms

Consumer heartbeat time is defined as the time the servo drive expects to receive a heartbeat. For the setting, consumer heartbeat time must be greater than the producer heartbeat time. Due to delays and other uncontrollable external factors in transmitting the heartbeat, you must retain a tolerance margin value. When the heartbeat consumer does not receive the heartbeat signal within the receiving time, the heartbeat event is triggered, meaning AL180 is triggered.

Object 1017h: Producer heartbeat time

Index	1017h
Name	Producer heartbeat time
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	No
Setting range	UNSIGNED16
Default	0

Object function:

Producer heartbeat time is defined as the cycle time of the heartbeat. When this value is set to 0, this function is invalid.

Object 1018h: Identity object

Index	1018h
Name	Identity object
Object code	RECORD
Data type	Identity
Access	RO
PDO mapping	No

Sub-index	0
Description	Number of sub-index
Data type	UNSIGNED8
Access	RO
PDO mapping	No
Setting range	3
Default	3
Sub-index	1
Description	Vendor ID
Data type	UNSIGNED32
Access	RO
PDO mapping	No
Setting range	UNSIGNED32
Default	1DDh

Sub-index	2
Description	Product code
Data type	UNSIGNED32
Access	RO
PDO mapping	No
Setting range	UNSIGNED32
Default	6000h: A2 series 6010h: A3 series 6030h: M series 6080h: B3 series

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Sub-index	3
Description	Version
Data type	UNSIGNED32
Access	RO
PDO mapping	No
Setting range	UNSIGNED32
Default	N/A

Object function:

This object includes the servo drive information.

Object 1029h: Error behavior

Index	1029h
Name	Error behavior
Object code	ARRAY
Data type	UNSIGNED8
Access	RW
PDO mapping	No

Sub-index	0
Description	Number of error types
Data type	UNSIGNED8
Access	RO
PDO mapping	No
Setting range	1
Default	1

Sub-index	1
Description	Communication error
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	UNSIGNED8
Default	0

Object function:

Generally, when the servo drive detects a serious fault in the Operational state, the state is automatically switched to the Pre-operational state. Use this object setting to switch the state to the Pre-operational state, maintain in the original state, or switch to the Stopped state.

OD 1029h sub1 setting	Switch the state to
0	Pre-operational (only if current is operational)
1	Keep the original state
2	Stopped

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Object 1200h: Server SDO parameter

Index	1200h
Name	Server SDO parameter
Object code	RECORD
Data type	SDO parameter
Access	RO
PDO mapping	No

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	Controller sends to servo drive COB-ID Client->Server (rx)
Data type	UNSIGNED32
Access	RO
PDO mapping	No
Setting range	UNSIGNED32
Default	Index 1200h: 600h + Node-ID

Sub-index	2
Description	Servo drive returns to controller COB-ID Server->Client (tx)
Data type	UNSIGNED32
Access	RO
PDO mapping	No
Setting range	UNSIGNED32
Default	Index 1200h: 580h + Node-ID

Object function:

This object is read-only and cannot be set. Read the station number for transmitting and receiving the SDO with this object.

Example:

If the servo drive station number for receiving is 10:

600h + Node-ID:Ah = 60Ah => OD 1200 sub1 reads 60Ah.

If the servo drive station number for transmitting is 10:

580h + Node-ID:Ah = 58Ah => OD 1200 sub2 reads 58Ah。

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Object 1400h - 1403h: RPDO communication parameter

Index	1400h - 1403h
Name	Receive PDO parameter
Object code	RECORD
Data type	PDO CommPar
Access	RW

Sub-index	0
Description	Maximum number of sub-index supported
Data type	UNSIGNED8
Access	RO
PDO mapping	No
Setting range	5
Default	5

Sub-index	1
Description	COB-ID used by PDO
Data type	UNSIGNED32
Access	RW
PDO mapping	No
Setting range	UNSIGNED32
Default	Node-ID: 0

Object function:

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	Description
Bit 10 - Bit 0	COB-ID	The data size is 10-bit.
Bit 30 - Bit 11	-	-
Bit 31	PDO function switch	0: enable PDO function. 1: disable PDO function. Enable / disable the PDO function to determine if PDO is used in the Operational state.

The COB-ID setting format is as follows:

Communication object	Object parameter	COB-ID DEC (HEX)
R_PDO1	1400h	512 (200h) + Node-ID
R_PDO2	1401h	768 (300h) + Node-ID
R_PDO3	1402h	1024 (400h) + Node-ID
R_PDO4	1403h	1280 (500h) + Node-ID

Sub-index	2
Description	Reception type
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	UNSIGNED8
Default	0

Object function:

The type setting is as follows.

Setting value	Transmission type				
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only
00h (0)		V	V		
01h - F0h (1 - 240)	V		V		
F1h - FBh (241 - 251)	Reserved				
FCh (252)			V		V
FDh (253)				V	V
FEh (254)				V	
FFh (255)				V	

Sub-index	3
Description	Inhibit time (not used for RPOD)
Data type	UNSIGNED16
Access	RW
PDO mapping	No
Setting range	UNSIGNED16
Default	0

Sub-index	4
Description	Compatibility entry
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	UNSIGNED8
Default	0

Sub-index	5
Description	Event timer (not used for RPDO)
Data type	UNSIGNED16
Access	RW
PDO mapping	No
Setting range	UNSIGNED16
Default	0

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Object 1600h - 1603h: RPDO mapping parameter

Index	1600h - 1603h
Name	Receive PDO mapping
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	Set n PDO mapping application objects
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 length
Bit 8 - Bit 15	Object sub-index
Bit 16 - Bit 31	Object index

Example:

To set three PDOs (OD 6040h, OD 607Ah, and OD 6060h) in the first group of PDO, the setting is as follows:

Mapping parameter setting for received PDO	Data			Description
OD 1600 sub0	3			Set 3 PDO mappings.
OD 1600 sub1	6040h	00h	10h	Mapping control command (6040h), data length is 16-bit
OD 1600 sub2	607Ah	00h	20h	Mapping target position (607Ah), data length is 32-bit
OD 1600 sub3	6060h	00h	08h	Mapping mode position (6060h), data length is 8-bit
Note	The total length is 38h (56-bit) which meets the specification of less than 64-bit.			

Object 1800h - 1803h: TPDO communication parameter

Index	1800h - 1803h
Name	Transmit PDO parameter
Object code	RECORD
Data type	PDO CommPar
Access	RW

Sub-index	0
Description	Largest sub-index supported
Data type	UNSIGNED8
Access	RO
PDO mapping	No
Setting range	5
Default	5

Sub-index	1
Description	COB-ID used by PDO
Data type	UNSIGNED32
Access	RW
PDO mapping	No
Setting range	UNSIGNED32
Default	Default Node-ID: 0 Index 1800h: 180h + Node-ID Index 1801h: 280h + Node-ID Index 1802h: 380h + Node-ID Index 1803h: 480h + Node-ID

Object function:

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	Description
Bit 10 - Bit 0	COB-ID	The data size is 10-bit.
Bit 30 - Bit 11	-	-
Bit 31	PDO function switch	0: enable PDO function. 1: disable PDO function. Enable / disable the PDO function to determine if PDO is used in the Operational state.

Sub-index	2
Description	Transmission type
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	UNSIGNED8
Default	0

Object function:

The type setting is as follows:

Setting value	Transmission type				
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only
00h (0)		V	V		
01h - F0h (1 - 240)	V		V		
F1h - FBh (241 - 251)	Reserved				
FCh (252)			V		V
FDh (253)				V	V
FEh (254)				V	
FFh (255)				V	

Sub-index	3
Description	Inhibit time
Data type	UNSIGNED16
Access	RW
PDO mapping	No
Setting range	UNSIGNED16
Default	0

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Sub-index	4
Description	Reserved
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	UNSIGNED8
Default	0

Sub-index	5
Description	Event timer
Data type	UNSIGNED16
Access	RW
PDO mapping	No
Setting range	0: not in use UNSIGNED16
Default	0

Object 1A00h - 1A03h: TPDO mapping parameter

Index	1A00h - 1A03h
Name	Transmit PDO mapping
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	Set n PDO mapping application objects
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 length
		UZ	Bit 8 - Bit 15 object sub-index

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 servo parameters with the OD 2XXXh group. The parameter number and index are converted as follows:

Pa-bc   <= = >   2aBCh

'**BC**' is '**bc**' in hexadecimal format

Read the index first to get the information of the parameter length, and then use SDO or PDO to change the data.

Example 1:

Object 2300h: Node-ID [P3.000]

Index	2300h
Name	Node-ID
Object code	VAR
Data type	INTEGER16
Access	RW
PDO mapping	Yes
Setting range	INTEGER16
Default	7Fh

Example 2:

Object 212Ch: Electronic Gear [P1.044]

Index	212Ch
Name	Electronic Gear
Object code	VAR
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	INTEGER32
Default	1

11.4.3.3 OD 6XXXh communication object group

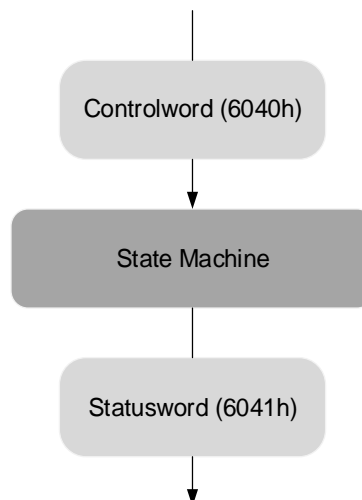Object 603Fh: Error code (error code of CANopen defined)

Index	603Fh
Name	Error code
Object code	VAR
Data type	UNSIGNED16
Access	RO
PDO mapping	Yes
Setting range	UNSIGNED16
Corresponding servo parameter	N/A
Default	0

Object 6040h: Controlword

Index	6040h
Name	Controlword
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED16
Corresponding servo parameter	N/A
Default	0x0004

Object function:

The control command contains many functions, such as Servo on, command triggering, fault reset, and emergency stop. The state machine architecture is as follows:
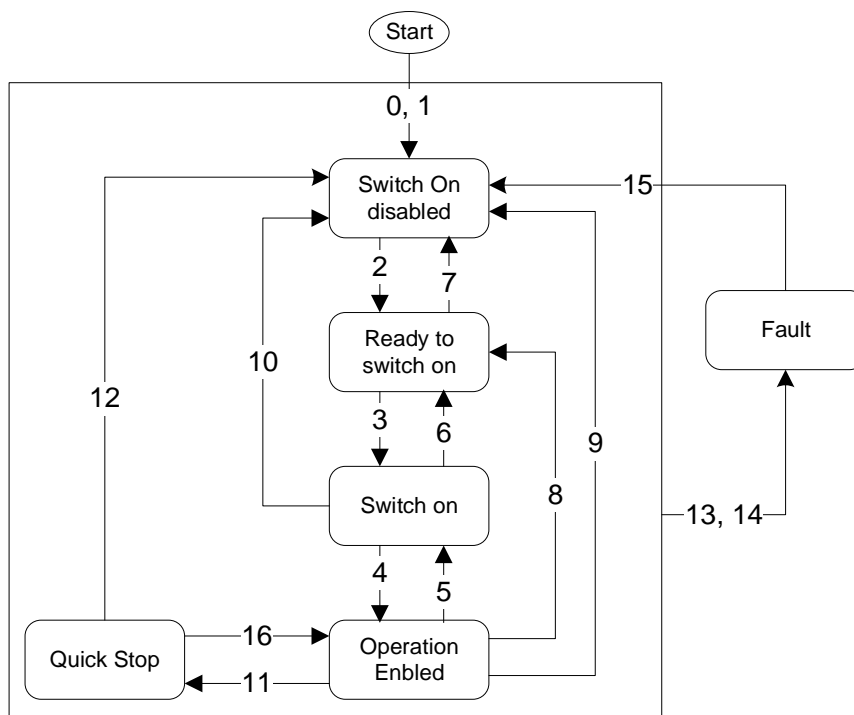
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Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function	Description
Bit 0	Switch on	-
Bit 1	Enable voltage	-
Bit 2	Quick stop (B-connect)	-
Bit 3	Enable operation	-
Bit 4 - Bit 6	Operation mode definition	This bit is individually defined according to the control mode, as shown in the following table.
Bit 7	Fault reset	-
Bit 8	Halt	-
Bit 9 - Bit 15	-	-

Bits 4 - 6 are individually defined according to the mode, as shown in the following table:

Bit	Operation mode definition		
	Profile Position Mode	Homing Mode	Profile Velocity Mode Profile Torque Mode Interpolated Position Mode
Bit 4	Command triggered (rising-edge triggered)	Homing (rising-edge triggered)	-
Bit 5	Command to take immediate effect	-	-
Bit 6	0: absolute position command 1: relative position command	-	-

Finite state automation (as shown in the following diagram) defines the behavior of a servo drive system. Each state represents an internal or external behavior. For example, point-to-point motion can only be received and executed in the operation enabled state.

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The state transition is defined as follows:

Transition	Event	Action
0, 1	Automatic transition after power-on	Device boot and initialization
2	Command shutdown	N/A
3	Command switch on	Servo is ready for servo on
4	Command enable operation	Servo on and executes motion mode
5	Command disable voltage	Servo off
6	Command shutdown	N/A
7	Command disable voltage or command quick stop	N/A
8	Command shutdown	Servo off
9	Command disable voltage	Servo off
10	Command disable voltage or command quick stop	N/A
11	Command quick stop The following two errors belong to this quick stop type: 1. Trigger positive / negative limit switch 2. Quick stop triggered by a control command (OD 6040h = xxxx x0xxx)	Quick stop function is enabled
12	Command Disable Voltage (OD 6040h: 0000 0110 or xxxx xx0x)	Servo off
13, 14	Alarm occurs	Servo off
15	Alarm is cleared	N/A
16	Command enable operation and no alarm	Motion operation restart. The restart action is mode-dependent.

State changes can be achieved with control commands. The commands are as follows:

Setting value	Bit of OD 6040h					State change
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shutdown	0	X	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on + Enable operation	0	1	1	1	1	3 + 4
Disable voltage	0	X	X	0	X	7, 9, 10, 12
Quick stop	0	X	0	1	X	7, 10, 11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4, 16
Fault reset	⌐	X	X	X	X	15

Object 6041h: Statusword

Index	6041h
Name	Statusword
Object code	VAR
Data type	UNSIGNED16
Access	RO
PDO mapping	Yes
Setting range	UNSIGNED16
Corresponding servo parameter	N/A
Default	0

Object function:

The control command contains many functions, such as Servo on, command triggering, fault reset, and emergency 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	Ready to switch on	Bit 0 - Bit 6: current status of the servo drive (see the following table for details).
Bit 1	Switch on	
Bit 2	Operation enabled	
Bit 3	Fault	
Bit 4	Voltage enabled	
Bit 5	Quick stop	
Bit 6	Switch on disabled	
Bit 7	Warning	Warning output, but the servo remains with the servo on signal.
Bit 8	-	-
Bit 9	Remote	-
Bit 10	Target reached	-
Bit 11	-	-
Bit 12 - Bit 13	-	Individually defined according to the control mode.
Bit 14	Positive limit	-
Bit 15	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	Switch 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 off).

Note: 0 indicates the bit is off; 1 indicates the bit is on; - indicates the bit is invalid.

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Bit 12 and Bit 13: current status of the servo drive.

Bit	Operation mode definition				
	Profile Position Mode	Homing Mode	Interpolated Position Mode	Profile Velocity Mode	Profile Torque Mode
Bit 12	Set-point acknowledge	Homing is complete	Interpolation mode in motion	Zero speed	-
Bit 13	Following error	Homing error	-	-	-

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
Corresponding servo parameter	N/A
Default	0

Object function:

Set to 0: when servo off, the dynamic brake has no effect, so the motor runs freely and the mechanism stops only by the frictional force.

Set to 1: when servo off, the servo stops with the operation of the dynamic brake.

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
3	Profile Velocity Mode
4	Profile Torque Mode
6	Homing Mode
7	Interpolated Position Mode

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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.

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 command position is the interpolation command calculated by the servo internal interpolator. This command passes through the servo internal filter. For detailed position, refer to the servo architecture diagram of each mode.

Object 6063h: Position actual internal value

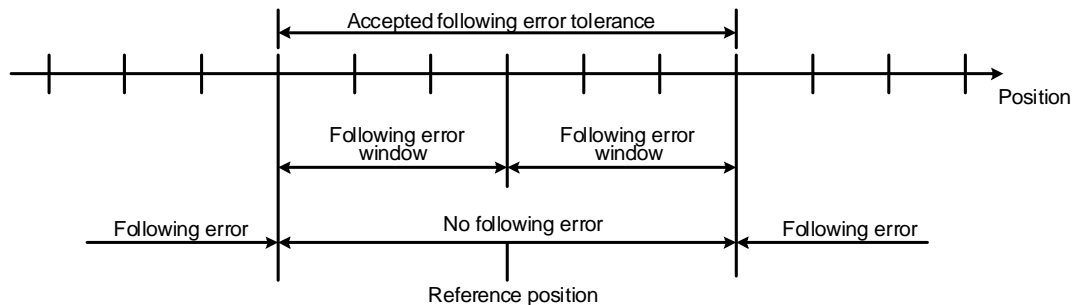| Index	6063h
Name	Position actual internal value
Object code	VAR
Data type	INTEGER32
Access	RO
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	Pulse (unit for encoder pulse resolution) ASDA-A2 corresponds to 1,280,000 pulses per motor rotation. ASDA-A3 / ASDA-B3 correspond to 16,777,216 pulses per motor rotation.

Object 6064h: Position actual value

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	3840000
Unit	PUU

Object function:

When the position error (60F4h) exceeds this setting range, AL009 (Excessive deviation of Position command) is triggered.
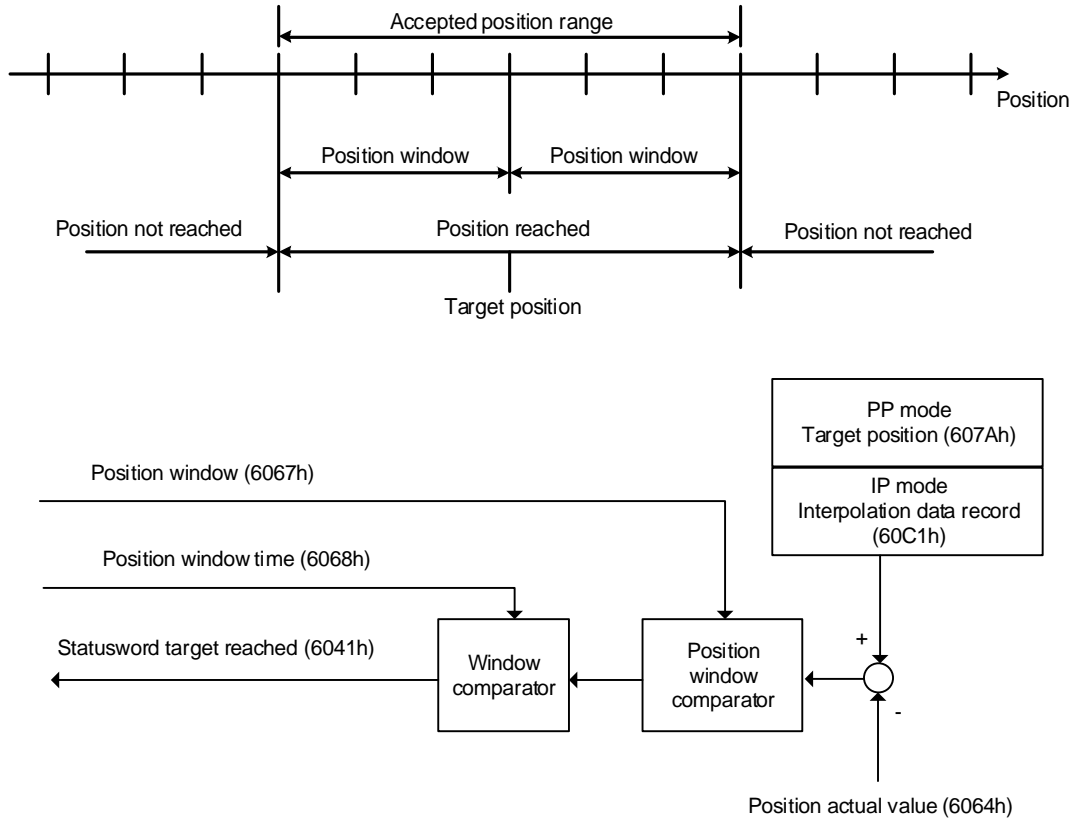

Object 6067h: Position window

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 error value between the command (PP mode: OD 607Ah; IP mode: OD 60C1h) and the position actual value (OD 6064h) is smaller than this object, and the time is greater than OD 6068h (position window time), Bit 10 of Statusword 6041h outputs once the target is reached.
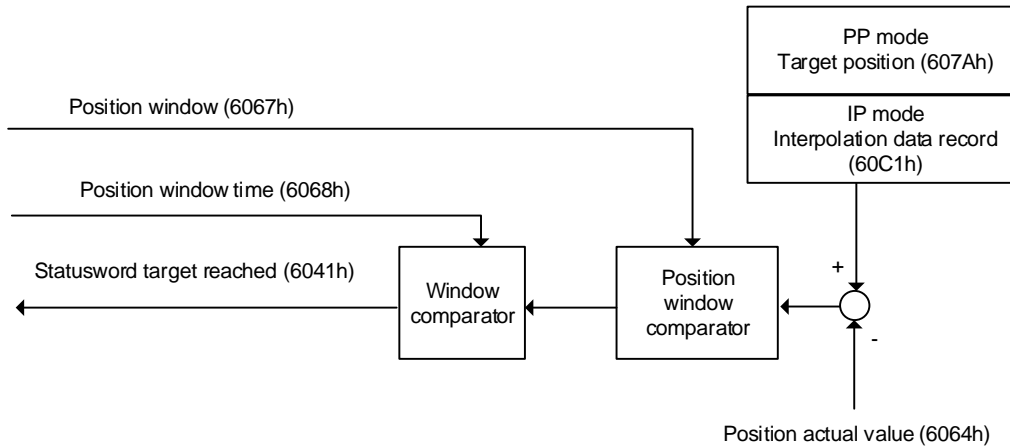
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Object 6068h: Position window time

Index	6068h
Name	Position window time
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED16
Default	0
Unit	ms

Object function:

When the error value between the command (PP mode: OD 607Ah; IP mode: OD 60C1h) and the position actual value (OD 6064h) is smaller than this object, and the time is greater than OD 6068h (position window time), Bit 10 of Statusword 6041h outputs once the target is reached.

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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
Default	0.1 rpm

Object function:

The internal speed command is a command generated by the speed motion command generator and command filter of the drive. This object only works in Profile 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
Default	0.1 rpm

Object function:

Returns the current motor speed for the users to monitor.

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

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Object function:

The speed comparator compares the speed error with OD 606Dh (velocity window). When the error is less than the velocity window and the retaining time is greater than OD 606Eh (velocity window time), then OD 6041h Bit 10 (target reached) is output. This object only works in Profile Velocity Mode.
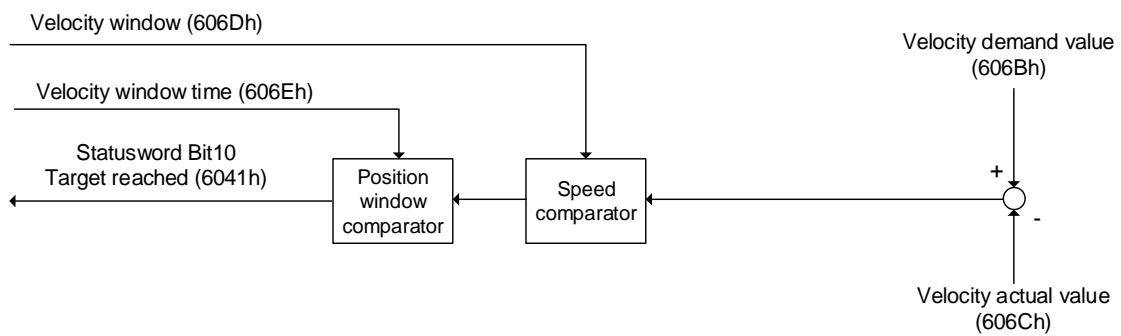
Object 606Eh: Velocity window time

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 the object.

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 6071h: Target torque

Index	6071h
Name	Target torque
Object code	VAR
Data type	INTEGER16
Access	RW
PDO mapping	Yes
Setting range	-3000 to 3000
Default	0
Unit	0.1%

Object function:

This object sets the target torque in torque mode (unit: 0.1%). If this object is set to 1000 (100.0%), it corresponds to the rated torque of the motor.

Object 6072h: Max torque

Index	6072h
Name	Max torque
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 maximum torque in torque mode (unit: 0.1%).

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 internal torque command is a command generated by the speed motion command generator and command filter of the drive. This object only works in Profile 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	0.1 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 current motor torque feedback percentage.

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 current motor current feedback percentage.

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 is only available in Profile Position Mode. For more details, refer to Section 11.3.1 Profile Position Mode.

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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:

Home Position is the origin reference point found when executing homing, 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.
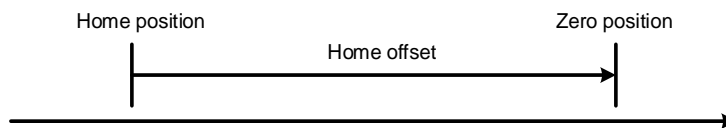
Object 607Dh: Software position limit

Index	607Dh
Name	Software position limit
Object code	ARRAY
Data type	INTEGER32
Access	RW
Note	-

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
Note	Unit: PUU

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Sub-index	2
Description	Max position limit
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	-2147483648 to +2147483647
Default	+2147483647
Note	Unit: PUU

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
Corresponding servo parameter	P1.055 (rpm) * 10
Unit	0.1 rpm

Object function:

The unit of this object is 0.1 rpm, so it is equivalent to P1.055 (maximum speed limit, unit: 1 rpm) multiplied by 10 times.

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
Corresponding servo parameter	P1.055
Unit	rpm

Object function:

This object is equivalent to P1.055, which is the maximum speed limit.

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 is only available in Profile Position Mode. For more details, refer to Section 11.3.1 Profile Position Mode.

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 to accelerate from 0 rpm to 3,000 rpm.

This object is only available 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 to decelerate from 3,000 rpm to 0 rpm.

This object is only available 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 to decelerate from 3,000 rpm to 0 rpm.

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 from 0% to 100% of the rated torque.

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

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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.

Object 6098h: Homing method

Index	6098h
Name	Homing method
Object code	VAR
Data type	INTEGER8
Access	RW
PDO mapping	Yes
Setting range	0 - 35
Default	0

Object function:

There are a total of 35 homing methods. The 1st - 16th homing methods look for the Z pulse;

the 17th - 34th do not look for the Z pulse; and the 35th defines the current position as the origin.

Method 1: homing on the negative limit switch and Z pulse
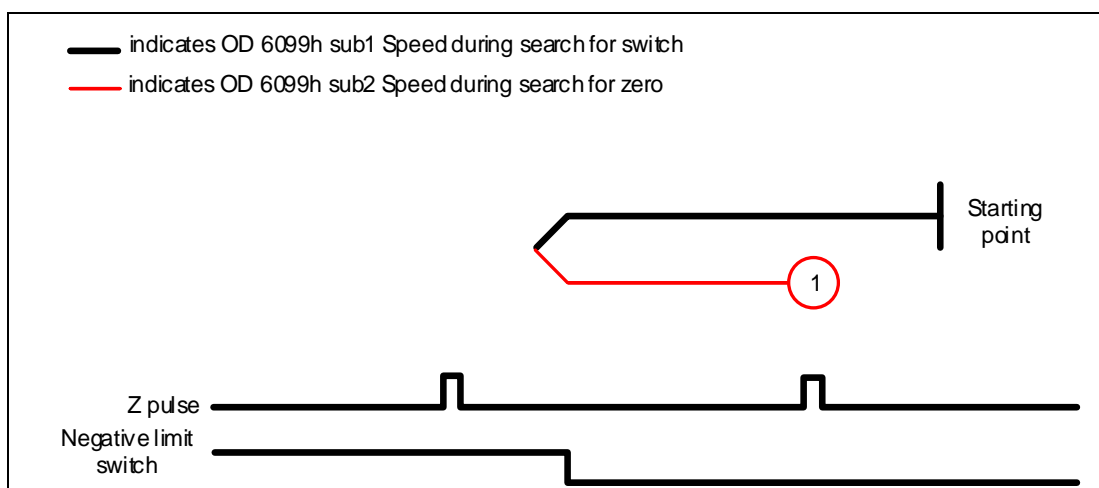
Method 2: homing on the positive limit switch and Z pulse

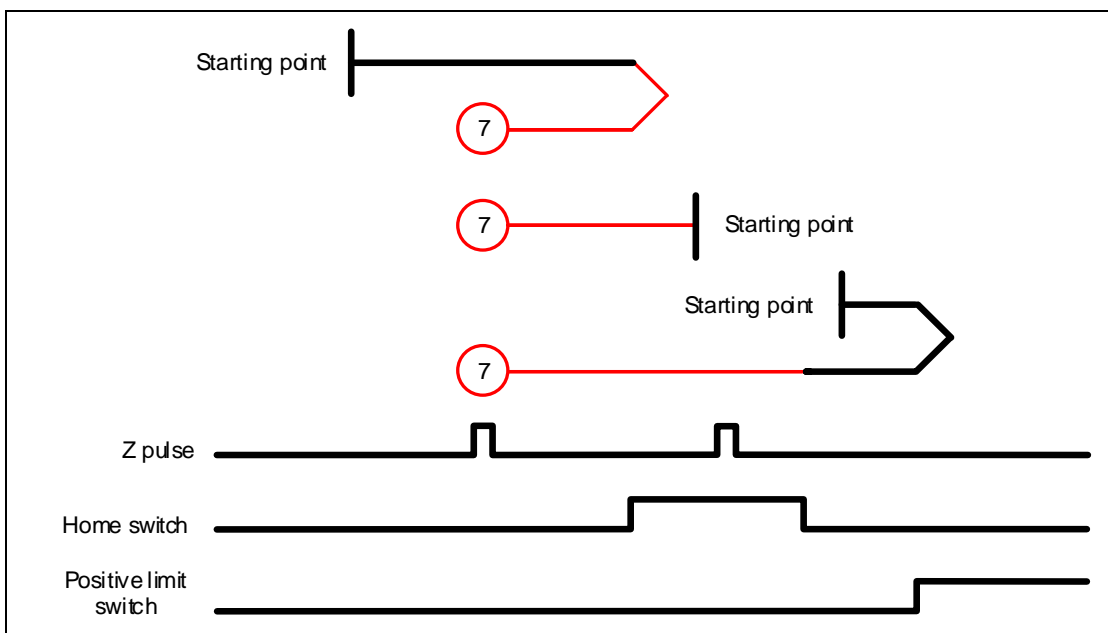Methods 3 and 4: homing on the rising edge of home switch and Z pulse

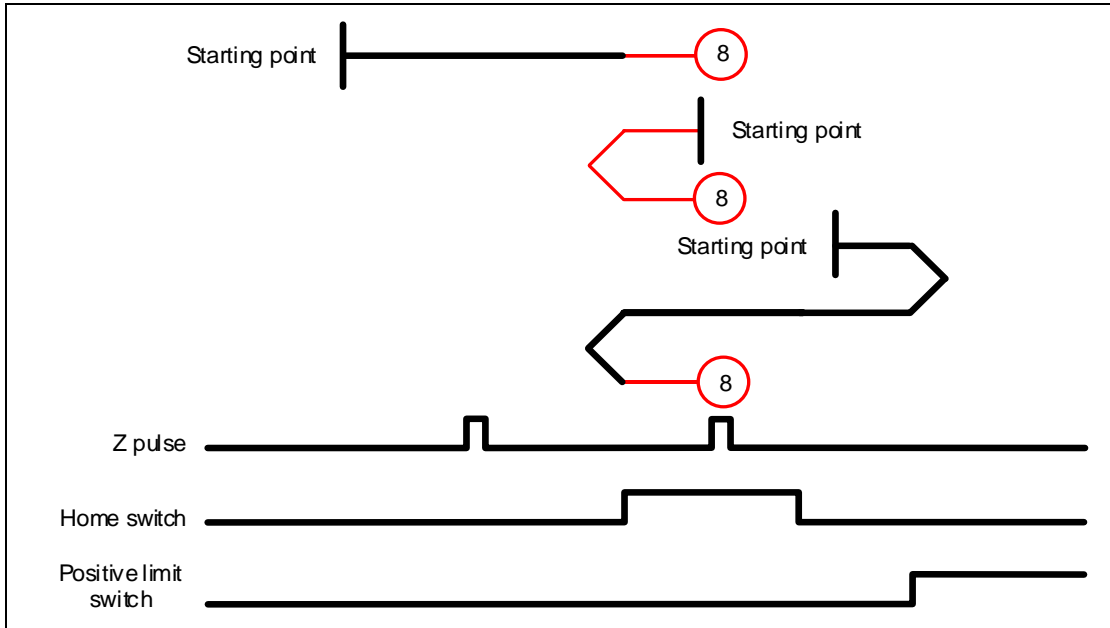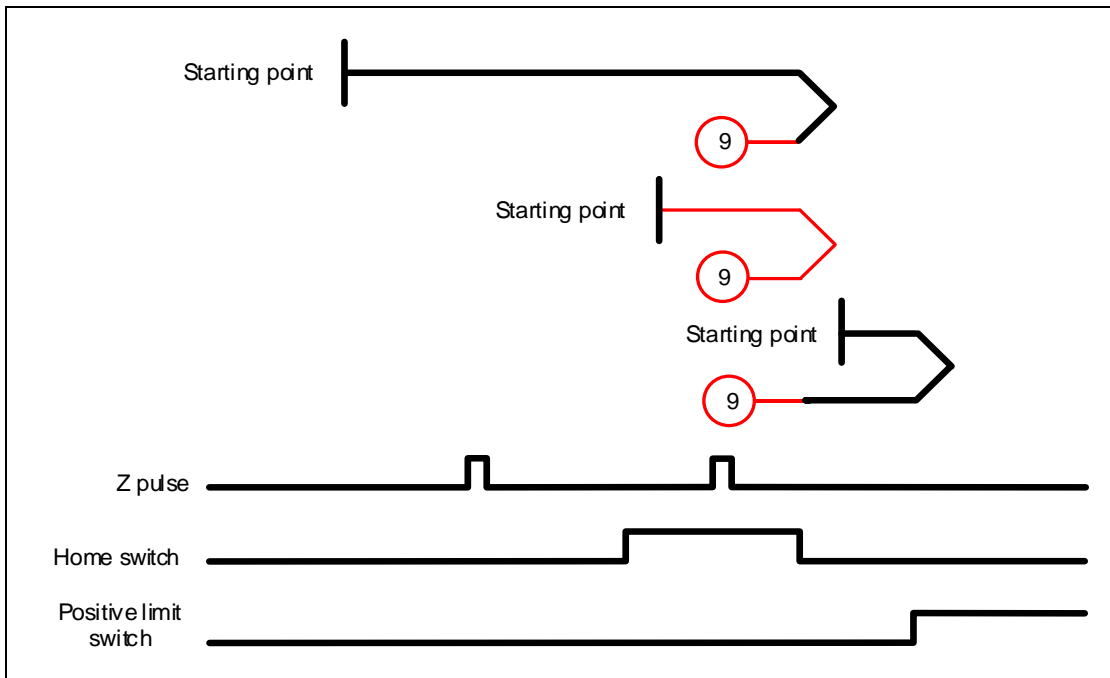Methods 5 and 6: homing on the falling edge of home switch and Z pulse
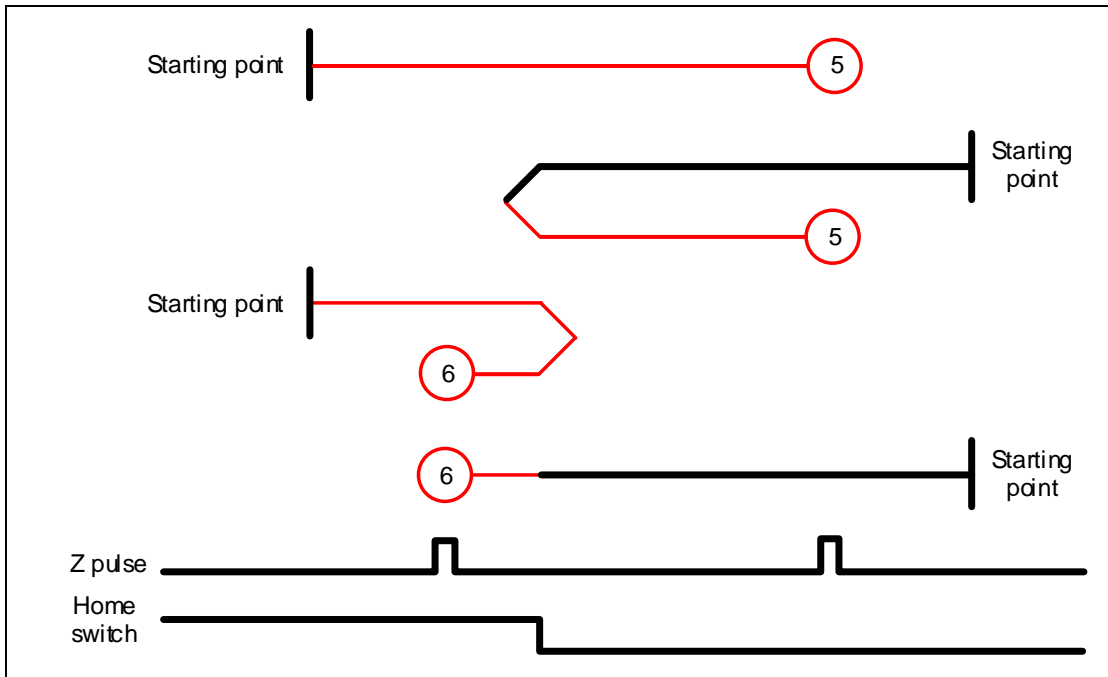
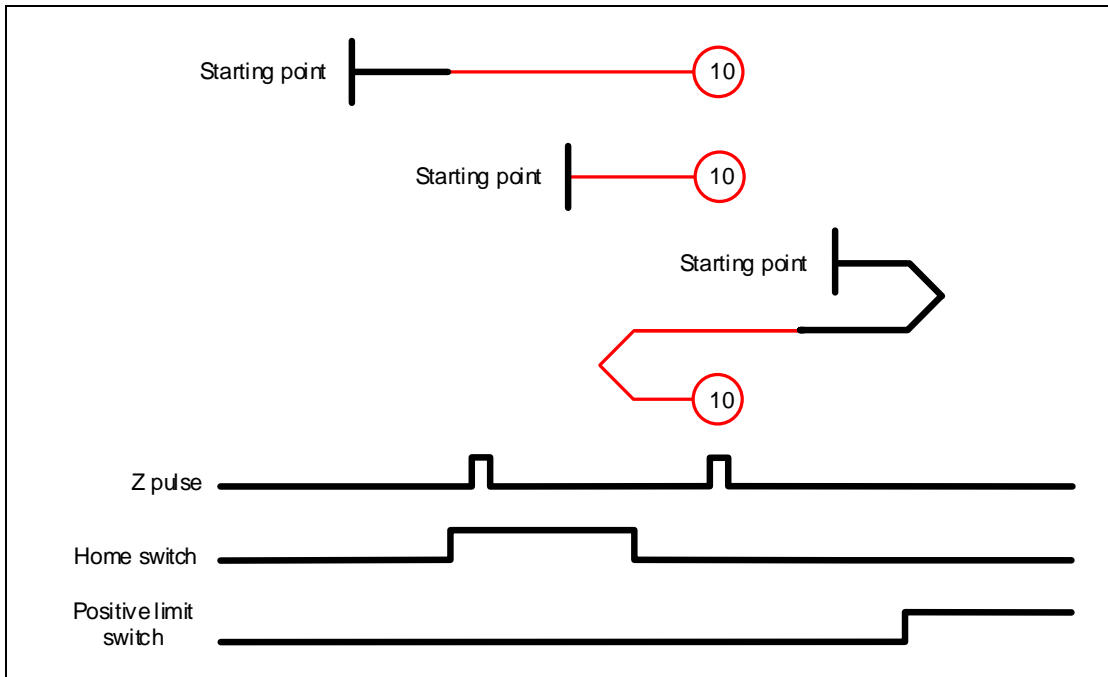Method 7: homing on the positive limit switch, rising edge of home switch, and Z pulse

Method 8: homing on the positive limit switch, rising edge of home switch, and Z pulse

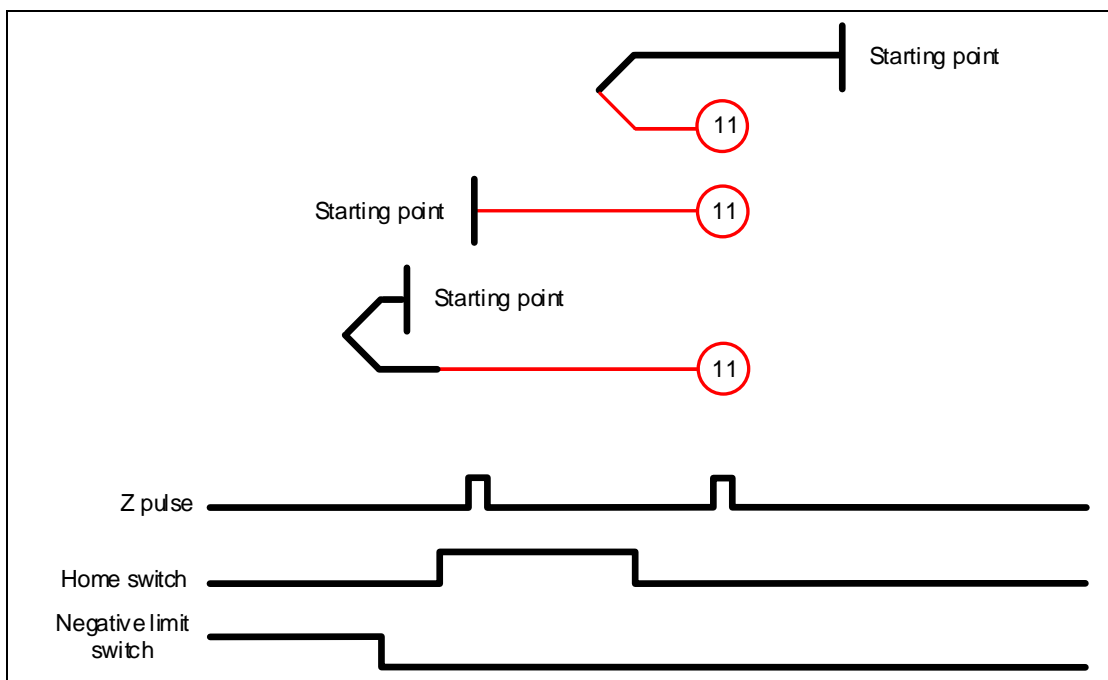Method 9: homing on the positive limit switch, falling edge of home switch, and Z pulse

Method 10: homing on the positive limit switch, falling edge of home switch, and Z pulse
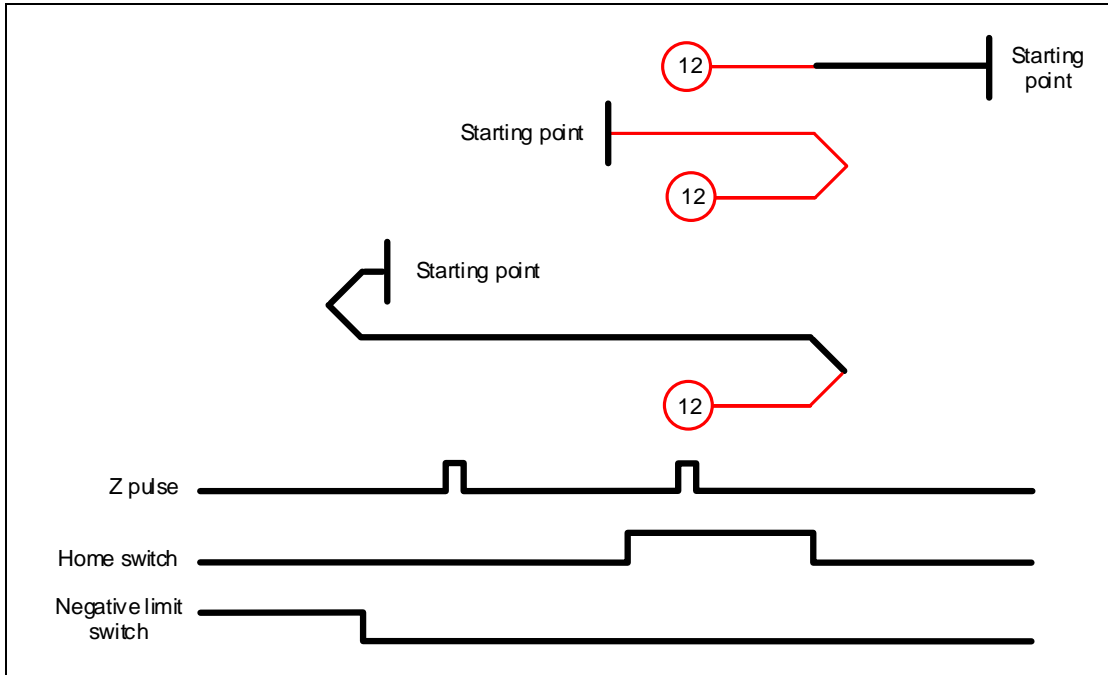

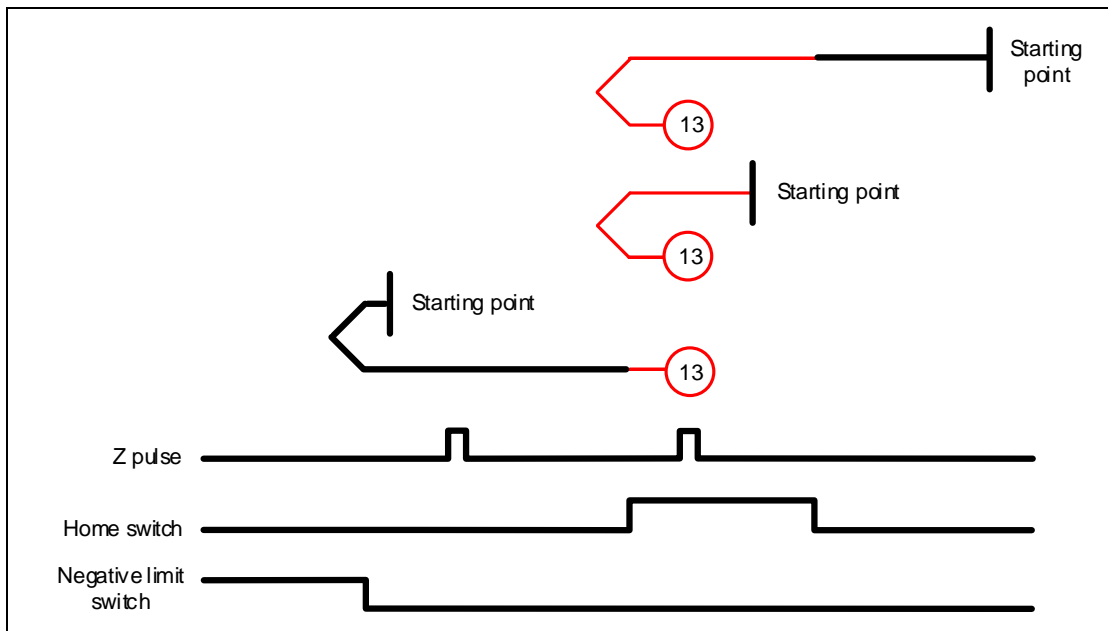Method 11: homing on the negative limit switch, rising edge of home switch, and Z pulse
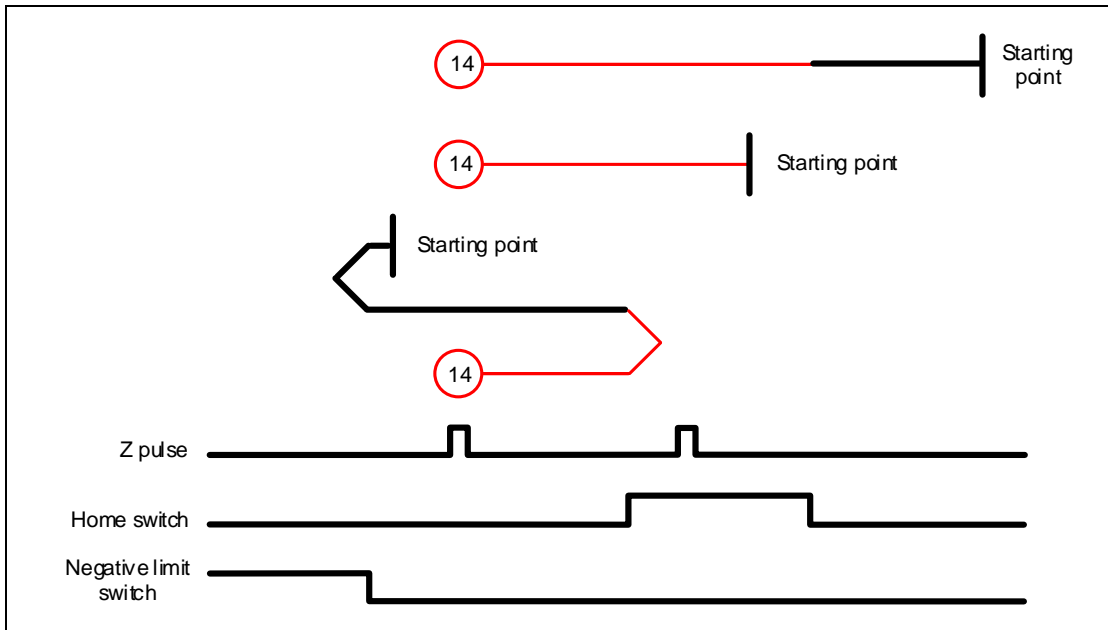
Method 12: homing on the negative limit switch, falling edge of home switch, and Z pulse

Method 13: homing on the negative limit switch, rising edge of home switch, and Z pulse

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Method 14: homing on the negative limit switch, rising edge of home switch, and Z pulse

Methods 15 and 16: reserved

Method 17: homing on the negative limit switch
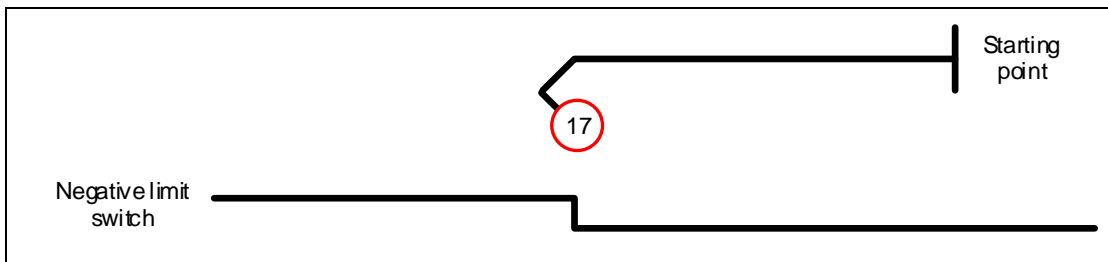
Method 18: homing on the positive limit switch

Methods 19 and 20: homing on the rising edge of home switch

Methods 21 and 22: homing on the falling edge of home switch

Methods 23 and 24: homing on the positive limit switch and rising edge of home switch

Methods 25 and 26: homing on the positive limit switch and falling edge of home switch

Methods 27 and 28: homing on the negative limit switch and falling edge of home switch

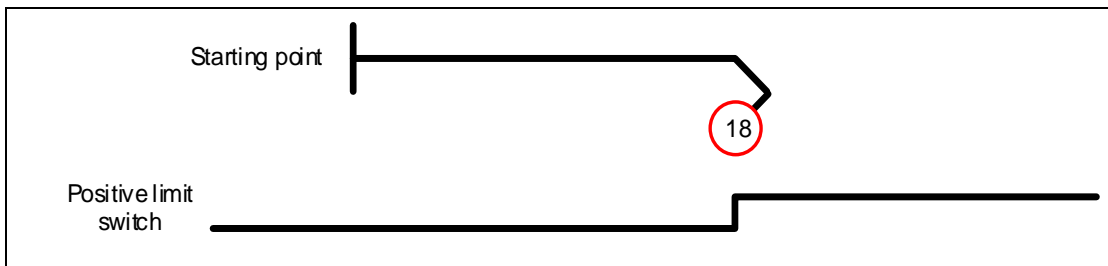Methods 29 and 30: homing on the negative limit switch and rising edge of home switch

Methods 31 and 32: reserved

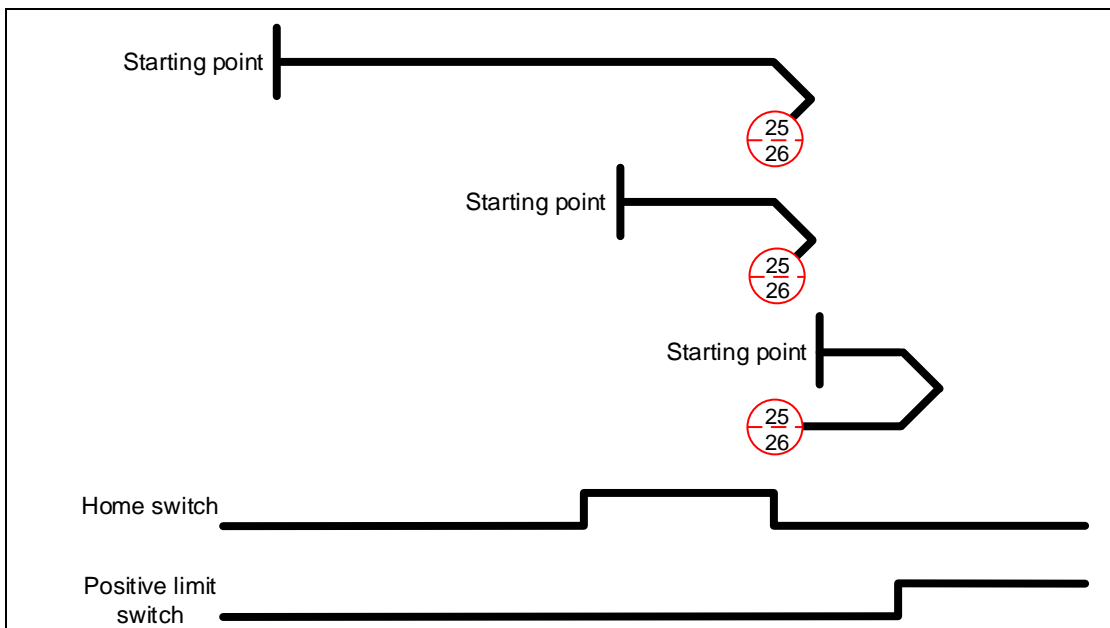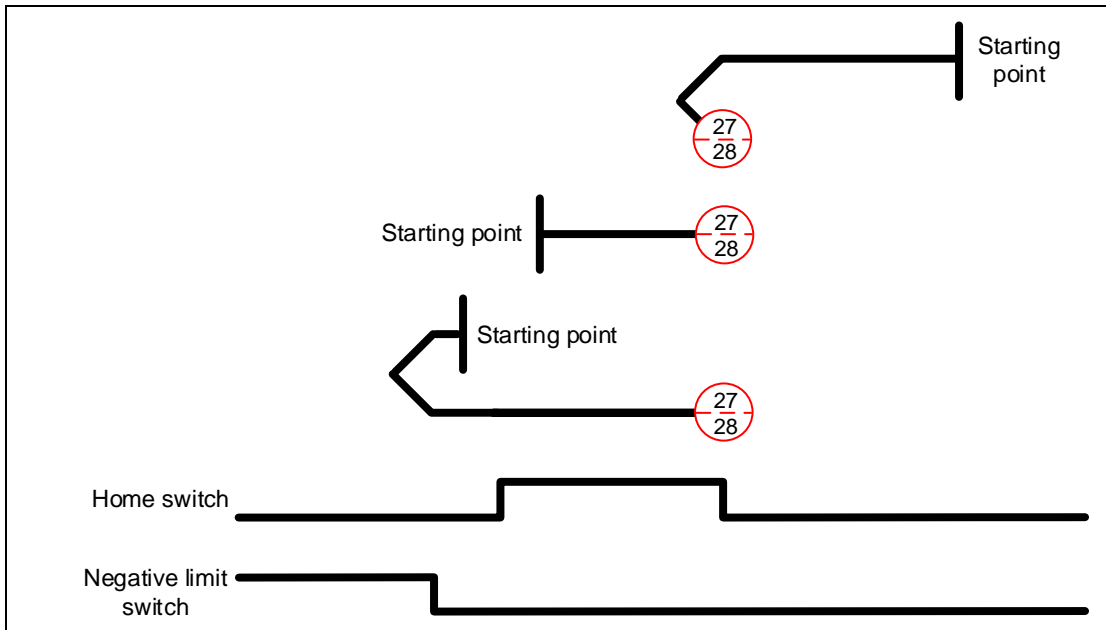Methods 33 and 34: homing on the Z pulse

Method 35: define the current feedback position as the origin

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 - 2000
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 - 500
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 to accelerate from 0 rpm to 3,000 rpm and decelerate from 3,000 rpm to 0 rpm. This object is only available in Homing Mode.

Object 60C0h: Interpolation sub mode select

Index	60C0h
Name	Interpolation sub mode select
Object code	VAR
Data type	INTEGER16
Access	RW
PDO mapping	Yes
Value range	INTEGER16
Default value	0

Object function: no need to set this object.

Object 60C1h: Interpolation data record

Index	60C1h
Name	Interpolation data record
Object code	ARRAY
Data type	INTEGER32
Access	RW
PDO mapping	Yes

Object function:

PDO sets this record every T ms before receiving the SYNC message; the T value is specified by 60C2h: 01h.

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	Command position Pos_Cmd
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	INTEGER32
Default	0
Unit	PUU

Object function:

This object only works in IP Mode. For more details, refer to Section 11.3.2 Interpolation Position Mode.

Object 60C2h: Interpolation time period

Index	60C2h
Name	Interpolation time period
Object code	RECORD
Data type	UNSIGNED8
Access	RW
PDO mapping	Yes

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	Interpolation cycle time constant
Data type	UNSIGNED8
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED8
Default	1

Sub-index	2
Description	Power of 10
Data type	INTEGER8
Access	RW
PDO mapping	Yes
Setting range	-128 to 63
Default	-3

Object function:

This object only works in IP Mode. The interpolation cycle time is calculated by two objects, OD 60C2h sub1 and OD 60C2h sub2. The calculation is as follows:

$$\text{Interpolation cycle time} = 60C2h \ \text{sub1} \times 10^{60C2h \ \text{sub2}}$$

Example:

If you want to set the interpolation cycle time to 2 ms, set OD 60C2h sub1 to 2 and OD 60C2h sub2 to -3.

$$\text{Interpolation cycle time} = 2 \times 10^{-3} = 0.002 \ s$$
$$= 2 \ ms$$

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	200
Unit	ms

Object function:

The time slope set by this object is the time required 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	200
Unit	ms

Object function:

The time slope set by this object is the time required to decelerate from 3,000 rpm to 0 rpm.

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 is the difference between the command position (OD 6062h) and feedback position (OD 6064h). For more details, refer to the architecture diagram 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 diagram 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:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function
Bit 0	Negative limit signal
Bit 1	Positive limit signal
Bit 2	Homing signal
Bit 3 - Bit 15	-

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 speed. This object is only available in Profile 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	6Dh

Object function:

This object is read-only and provides the control modes supported by Delta servo drives in CANopen mode (OD 6502h = 6Dh).

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	Interpolation Position Mode
Bit 7 - Bit 31	Reserved

11.5 Diagnostics and troubleshooting

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This section provides diagnostics and troubleshooting information related to communication or interference with the controller. For information about the servo drive alarms, refer to Chapter 12.

1. The SYNC communication cycle of the controller and servo drive is different

   Since the jitter of each controller is different, the communication cycle time between the servo drive receiving the Sync and Sync synchronization action is different. When this happens, increase the error value (T) by adjusting P3.009 and let the servo drive automatically correct the internal timer so it is consistent with the communication cycle of the controller.

2. Clear 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 cable shield is firmly connected to the servo drive communication port. Also, ensure the ground wire is properly connected and grounded.

EtherCAT Mode

<div style="text-align: right; font-size: 3em;">12</div>

This chapter provides details for the required parameter settings when the servo communicates with the controller through the EtherCAT communication function.

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12.1   Basic configuration

12.1.1   Hardware configuration

The pin assignments of the two EtherCAT connectors (CN6) are the same. Note that the IN
connector can connect to the controller (master) or the previous servo drive for receiving
signals, and the OUT connector can only connect to the next servo drive for outputting signals.
Incorrect connection will cause communication failure.
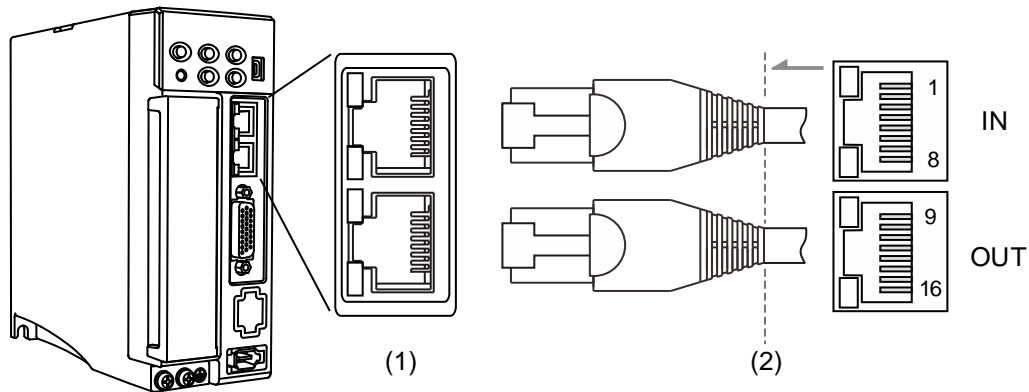
(1) CN6 connector (female); (2) CN6 connector (male)

Pin assignment:

Pin No.	Terminal	Signal	Description
1, 9	TX+	TX+	Transmit+
2, 10	TX-	TX-	Transmit -
3, 11	RX+	RX+	Receive+
4, 12	-	-	-
5, 13	-	-	-
6, 14	RX-	RX-	Receive-
7, 15	-	-	-
8, 16	-	-	-

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Description of each indicator for the CN6 connector:
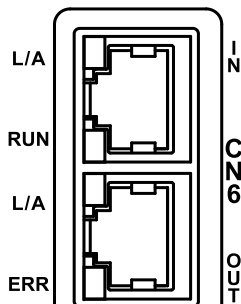
■ LED indicator status description

Indicator	Description
Steady on	ON ──────────────── OFF
Continuous flashing	ON (200 ms / 200 ms pulses) OFF
Single flashing	ON (200 ms / 1000 ms pulses) OFF
Steady off	ON OFF ────────────────

■ Network status indicator (L/A)

Indicator	Status	Description
Steady on	Connection is established.	Connection is established but no data transmission.
Continuous flashing	Connection is established and in data transmission.	Data in transmission.
Steady off	No connection.	Connection is not established.

■ EtherCAT connection status indicator (RUN)

Indicator	Status	Description
Steady off	Initial	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.
Steady on	Operational	SDO, TxPDO, and RxPDO data packets can be transmitted.
Continuous flashing	Pre-Operational	The controller can exchange data through the mailbox.
Single flashing	Safe-Operational	The servo drive can use the SDO and TxPDO data packets to exchange data with the controller.

■　　EtherCAT error indicator (ERR)

Indicator	Status	Description
Steady off	No error	No error has occurred.
Steady on	PDI Watchdog timeout	Servo drive malfunction. Contact Delta's distributor for assistance.
Continuous flashing	State change error	Parameter setting error causes the system unable to switch states. Refer to Figure 12.1.1.1.
Single flashing	Synchronization error / SyncManager error	The synchronization between the controller and the servo drive failed or the data was lost during data reception.
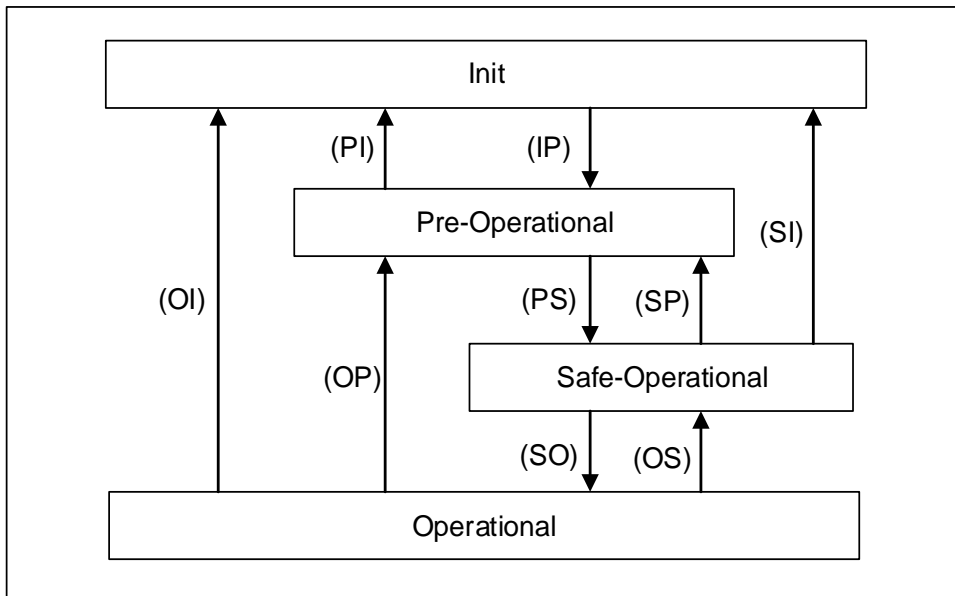
Figure 12.1.1.1 State transition diagram

Connecting multiple servo drives:
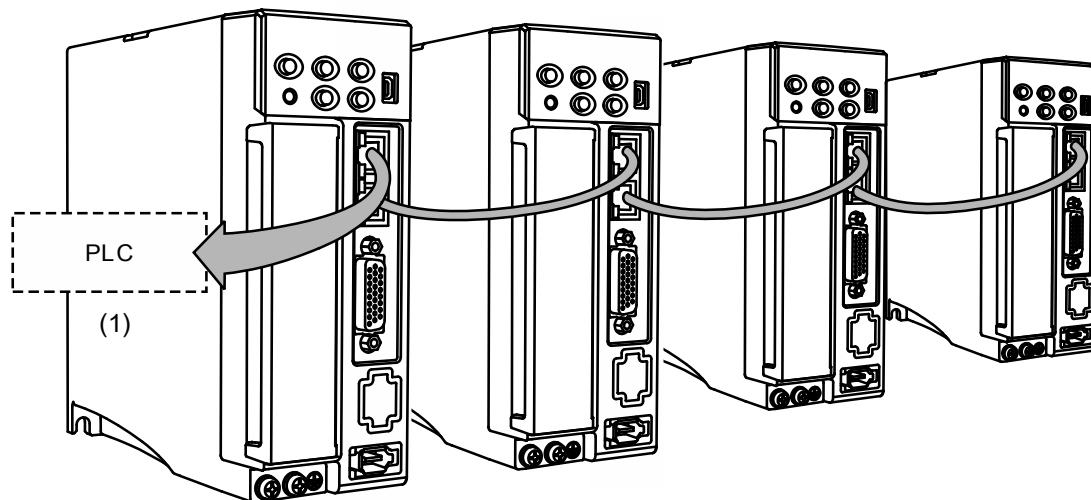
Note:

1. When multiple servo drives are connected, the maximum distance between each drive is 50 m (164.04 inches).

2. Use CAT5e shielded twisted-pair (STP) cables with metal connectors.

3. It is suggested to use a Beckhoff network cable (model number: ZB9020).

4. Check if the wiring is correct. Note that the IN connector can connect to the controller (master) or the previous servo drive for receiving signals, and the OUT connector can only connect to the next servo drive for outputting signals.

12.1.2   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 objects for each slave device.
Generally, the ESI file is an XML file.

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 and B3-E servo drives share the same ESI file.
To import ESI files to non-Delta controllers, refer to the manufacturer's instruction manual.

Delta controller

No need to import ESI files.

Download the ESI file for the A3-E and B3-E servo drives from Delta's website:
https://downloadcenter.deltaww.com/en-US/DownloadCenter

The storage paths of ESI files in 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.

12.1.3 Parameter settings of EtherCAT mode

Follow these instructions to connect the EtherCAT controller and the ASDA-B3 servo drive:

1. Set to EtherCAT mode: set P1.001 to 0x000C.

2. Set the slave station number: set P3.000 to 01h - 7Fh.

3. It is suggested to 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 E-Gear ratio varies with the set value of P3.012.Z.

Settings	P3.012 = 0x0100 (Z = 1)		P3.012 = 0x0000 (Z = 0)	
	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 range (DO.SP_OK)	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	Rated by motor (rpm)	607Fh	Rated by motor (0.1 rpm)
			6080h	Rated by motor (rpm)
Excessive deviation of Position command warning	P2.035	50331648	6065h	50331648
Positive software limit (PP / CSP / CSV / CST Modes)	P5.008	2147483647	607Dh sub2	2147483647
Negative software limit (PP / CSP / CSV / CST Modes)	P5.009	-2147483648	607Dh sub1	-2147483648
Origin definition (HM Mode)	P6.001	0	607Ch	0

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P3.009	Communication synchronization		Address: 0312H 0313H
Default:	0x5055	Control mode:	CANopen / EtherCAT
Unit:	-	Setting range:	Shown as follows
Format:	HEX	Data size:	16-bit

Settings:

U Z Y X

Digit	Z
Function	Target value
Range	0 - F

■ Z: if the servo is operating in the DC Synchronous mode, you can adjust the timing of the servo for accessing EtherCAT packets to ensure that it does not conflict with the timing when the controller sends the packets. The delay time in the following figure is 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:

High bit

D C B A

Low bit

U Z Y X

A	Reserved	X	Unit selection for Target velocity (OD 60FF) and Velocity actual value (OD 606C) 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 607F and OD 6080.	Z	AL185 communication disconnection detection setting.
D	Reserved	U	Reserved

■ X: unit selection for Target velocity (OD 60FF) and Velocity actual value (OD 606C) when in the PV (Profile Velocity) mode or CSV (Cyclic Synchronous Velocity) mode.

0: 0.1 rpm

1: pulse/sec

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■ 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.

■ C: unit selection for the maximum speed of OD 607F and OD 6080.

0: 0.1 rpm for OD 607F and rpm for OD 6080.

1: pulse/sec for OD 607F and OD 6080.

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.

```
0020
────
U Z Y X
```

Digit	UZ	YX
Function	AL180 alarm condition	AL3E3 alarm condition
Range	0x00 (disabled) - 0xFF (default)	0x02 - 0x14

■ YX: AL3E3 trigger condition (allowable cycle for elapsed time); applicable to IP / CSP / CSV / CST modes.

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 02 (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 motion modes.

AL180 occurs when the servo drive does not receive the PDO within the set duration (unit: ms).

Set 0x01 for 1 ms, 0x02 for 2 ms, and 0xFF for 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:

The parameter setting is displayed on the panel. 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.

Code	Variable name	Description
119 (77h)	EtherCAT state machine	1: Init 2: Pre-Operational (Pre-OP) 4: Safe-Operational (Safe-OP) 8: Operational (OP)
120 (78h)	Communication error rate	When this value continues to increase, it indicates that there is communication interference. In an interference-free environment, this value should not increase. (Applicable to all models except B3-L.)

12.2 Communication function

12.2.1 Specifications

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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 (On RJ45 connector)	EtherCAT Error (ERR) × 1 EtherCAT Link / Activity (L/A) × 2 EtherCAT Run (RUN) × 1
	Application layer specifications	IEC61800-7 CiA402 Drive Profile
Supported CiA402 operation modes		■ Profile Position (PP) Mode ■ Profile Velocity (PV) Mode ■ Profile Torque (PT) Mode ■ Homing (HM) Mode ■ Cycle Synchronized Position (CSP) Mode ■ Cycle Synchronized Velocity (CSV) Mode ■ Cycle Synchronized 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: defines the behavior of each motion mode and the required object parameter settings for execution.
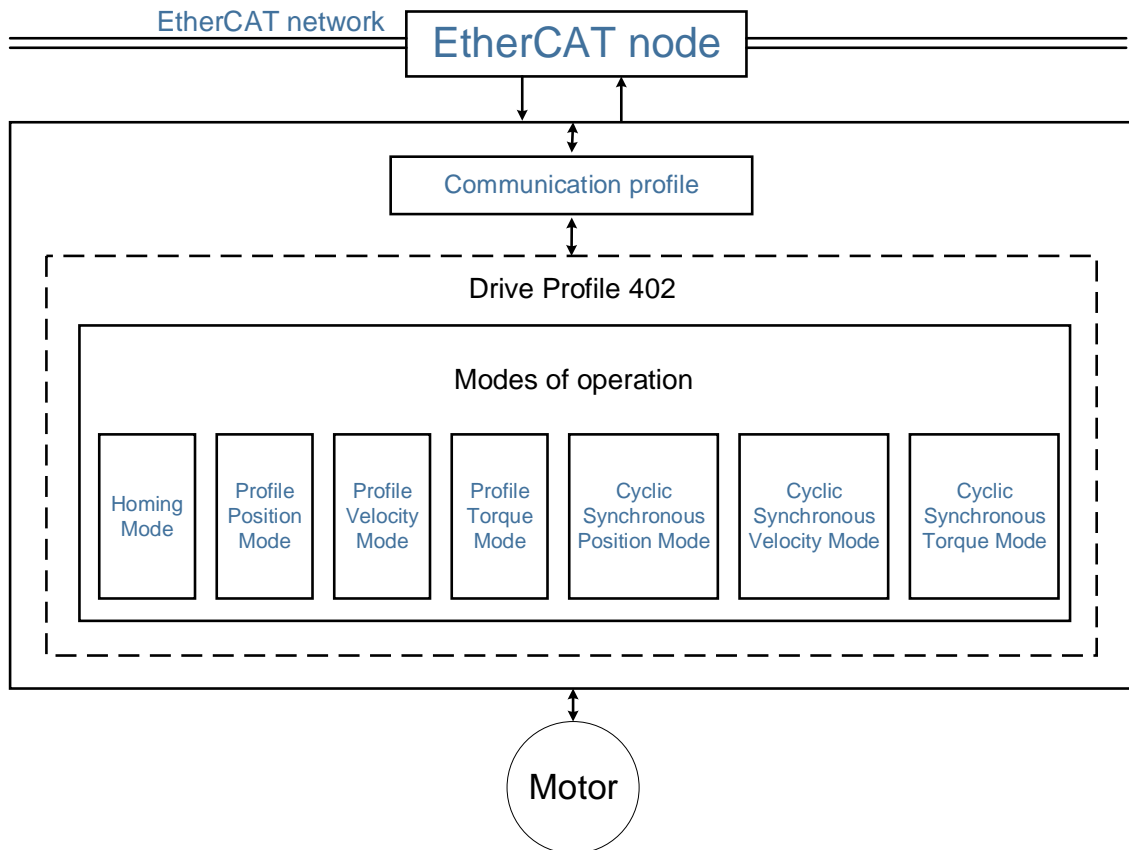
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12.2.2   DC-Synchronous mode

12.2.2.1   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)

The master and slave stations run asynchronously. Each station has an individual clock that calculates the time. In other words, the clocks of the master and slave 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 time T1, and the slave receives the PDO at T2 after the SM2 event.
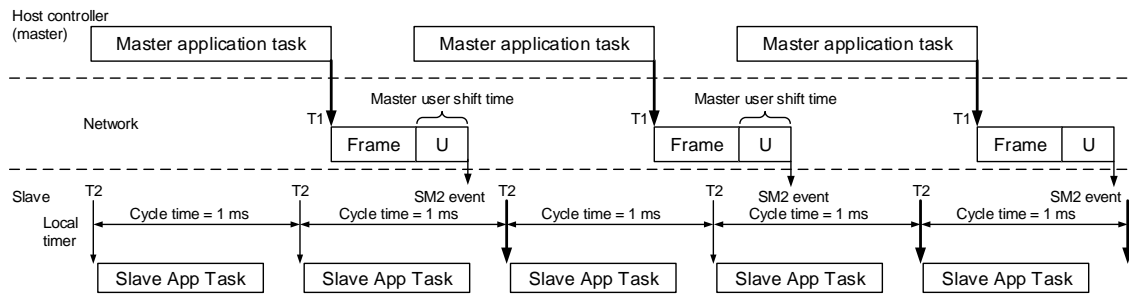
DC-Synchronous mode (SYNC0 synchronization)

There is precise time synchronization between the master and slave stations. The master periodically executes the control program and sends PDO packets at a fixed time according to the synchronous clock. The master transmits the command to the slave and receives the feedback from the slave. The slave receives and updates the PDO data at a fixed time according to the synchronous clock.
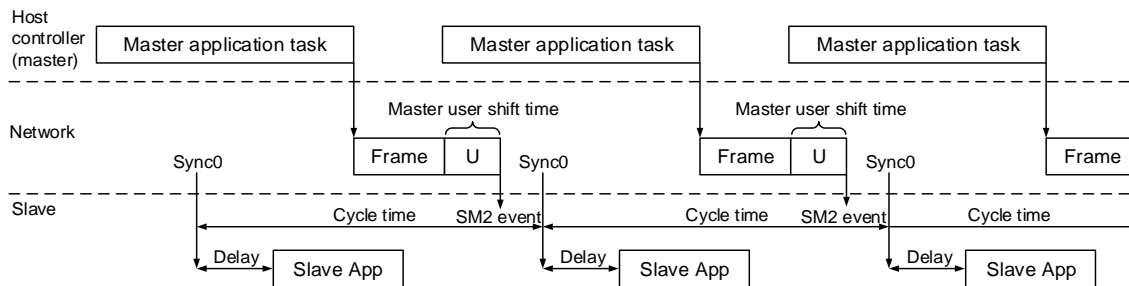
Note: Delay = P3.009.Z * 10 (μs)

12.2.2.2   Select Synchronization mode

Follow these steps to select DC-Synchronous or Free Run mode.

1.   Select **Drive 4 (ASDA-B3-E CoE Drive)** in the left column of the TwinCAT System
     Manager window.

2.   Select **DC-Synchronous** or **Free Run** as the operation mode under the **DC** tab in the right
     column.
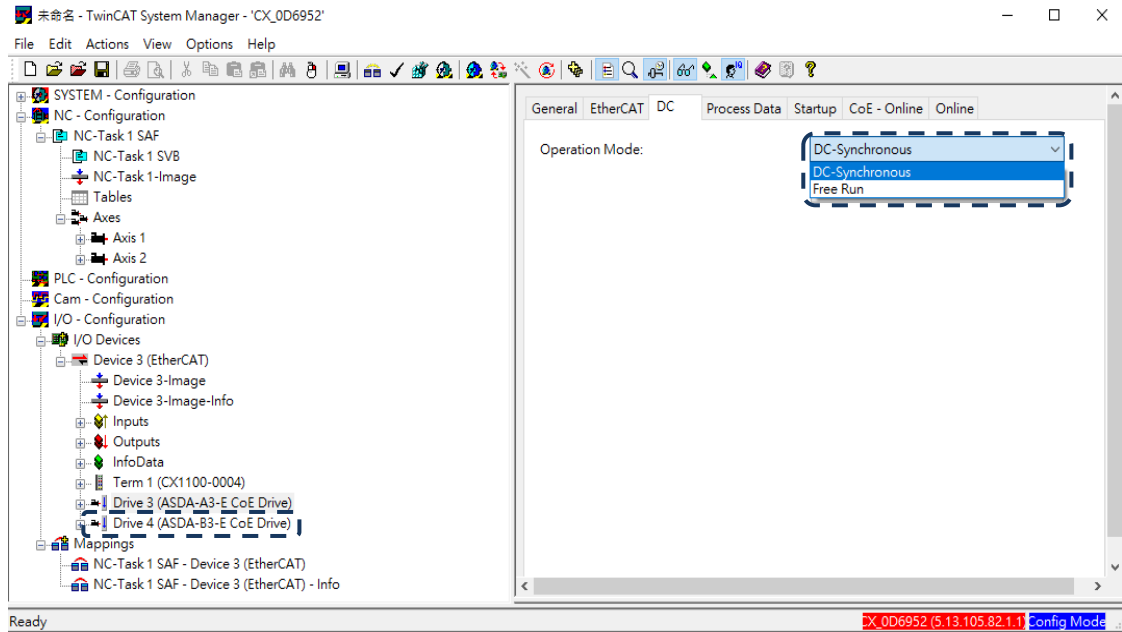
12.2.2.3   Synchronous clock setting

Follow these steps to set the data exchange cycle.

1.   Select **NC-Task 1 SAF** in the left column of the TwinCAT System Manager window.

2.   Set the data exchange cycle in the **Cycle ticks** field under the **Task** tab in the right column.
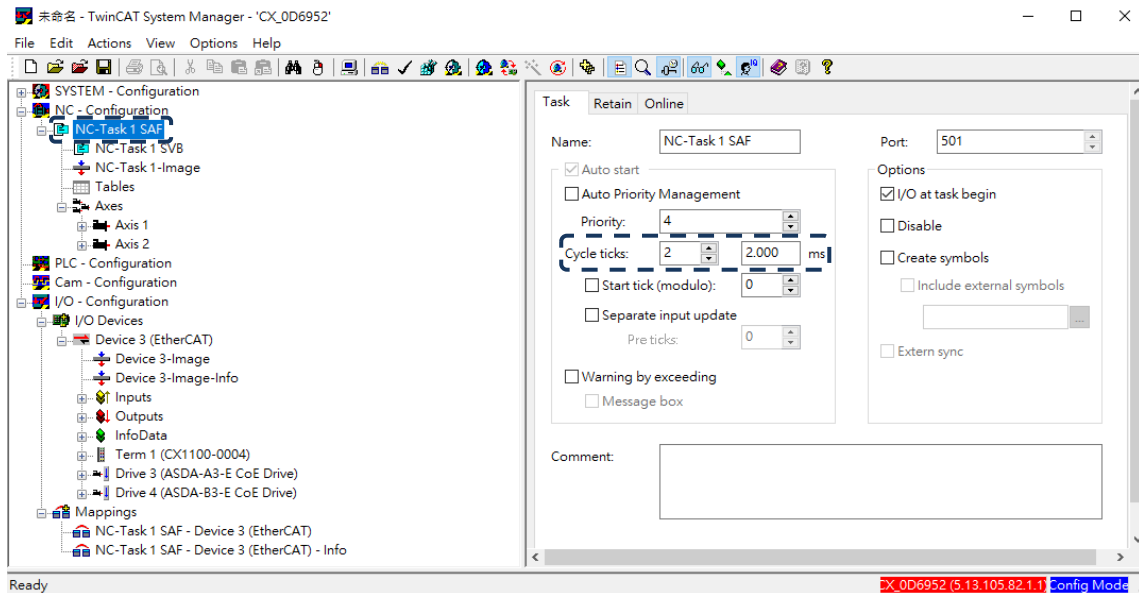
Figure 12.2.2.3.1

The SYNC0 cycle is used to define the PDO cycle time. The minimum unit of the SYNC0 cycle for A3-E and B3-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 is the minimum unit (1 ms) of A2-E.

12.2.3 EtherCAT state machine

In EtherCAT communication, the servo includes 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.
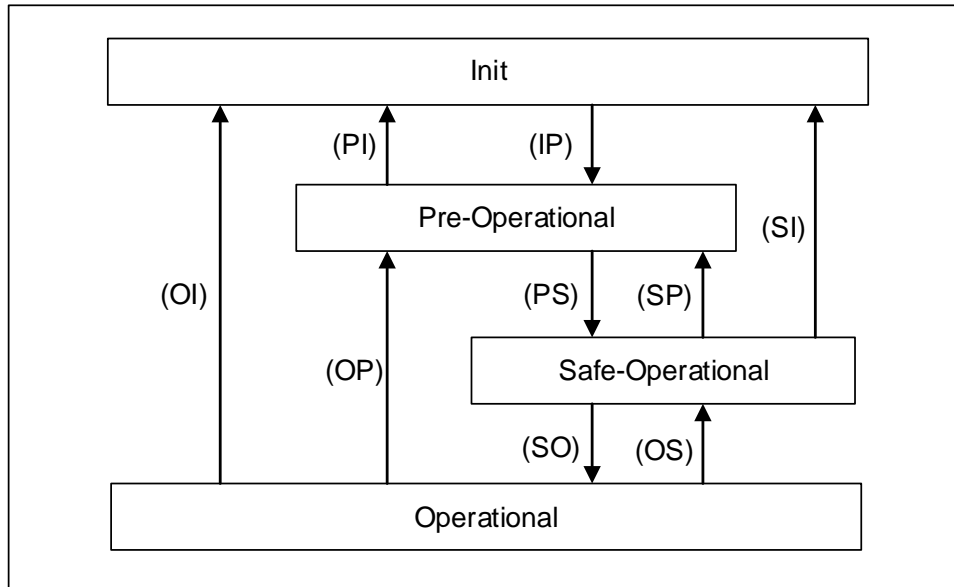
Value displayed on the panel when P0.002 = 119	State	Description
1	Init	The servo drive successfully completes initialization after being powered on without errors occurring. The packet cannot be transmitted in this state.
2	Pre-Operational (Pre-OP)	Data can be exchanged with the SDO. If an alarm occurs 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)	This state allows all data exchanges including the SDO and PDO (TxPDO and RxPDO).

The controller issues corresponding commands to the servo according to the state transition.

State transition	Description
IP	- The master confirms the VendorID, ProductCode, and RevisionNumber of the slave. - Initialize and calibrate the DC synchronous clock (DC-Synchronous mode). - The master defines the slave address and SyncManager (0, 1) register, 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 SDO to set the PDO mapping and DC related parameters. - The master defines the FMMU and SyncManager (2, 3) 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). - Start the DC synchronization process between the master and slave.
PI, SI, OI	- Disable all communication functions, including the SDO and PDO. - Switch to the Init state.
SP, OP	- Disable the PDO function. - Switch to the Pre-Operational state.
OS	- The master stops transmitting PDOs (RxPDOs). - Switch to the Safe-Operational state.

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12.2.4   PDO mapping configuration

The PDO mapping objects are allocated from index OD 1600 to OD 1603 for RxPDOs and
OD 1A00 to OD 1A03 for TxPDOs in the object dictionary. Each group of RxPDO and TxPDO
can support PDO data update of up to 8 sets of 32-bit objects.

12.2.4.1   Default PDO mapping configuration

The following table shows 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 rev0.03.xml, the first to fourth groups of PDO configuration are shown as
follows:

First group of RxPDO mapping

RxPDO (0x1600)	Control Word (0x6040)	Target Position (0x607A)	Target Velocity (0x60FF)	Touch Probe Function (0x60B8)

First group of TxPDO mapping

TxPDO (0x1A00)	Status Word (0x6041)	Actual Position (0x6064)	Actual Velocity (0x606C)	Touch Probe Status (0x60B9)
	Touch Probe Pos1 Pos Value (0x60BA)	Digital inputs (0x60FD)		

Second group of RxPDO mapping (default)

RxPDO (0x1601)	Control Word (0x6040)	Target Position (0x607A)	Target Velocity (0x60FF)	Target Torque (0x6071)
	Touch Probe Function (0x60B8)			

Second group of TxPDO mapping (default)

TxPDO (0x1A01)	Status Word (0x6041)	Actual Position (0x6064)	Velocity actual value (0x606C)	Actual Torque (0x6077)
	Touch Probe Status (0x60B9)	Touch Probe Pos1 Pos Value (0x60BA)	Digital inputs (0x60FD)	

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Third group of RxPDO mapping

RxPDO (0x1602)	Control Word (0x6040)	Target Position (0x607A)	Target Velocity (0x60FF)	Target Torque (0x6071)
	Mode Of Operation (0x6060)	Touch Probe Function (0x60B8)		

Third group of TxPDO mapping

TxPDO (0x1A02)	Status Word (0x6041)	Actual Position (0x6064)	Velocity actual value (0x606C)	Actual Torque (0x6077)
	Mode Of Operation Display (0x6061)	Touch Probe Status (0x60B9)	Touch Probe Pos1 Pos value (0x60BA)	Digital inputs (0x60FD)

Fourth group of RxPDO mapping (for Omron controllers)

RxPDO (0x1603)	Control Word (0x6040)	Target Position (0x607A)	Target Velocity (0x60FF)	Target Torque (0x6071)
	Mode Of Operation (0x6060)	Positive torque limit (0x60E0)	Negative torque limit (0x60E1)	Touch Probe Function (0x60B8)

Fourth group of TxPDO mapping (for Omron controllers)

TxPDO (0x1A03)	Status Word (0x6041)	Actual Position (0x6064)	Actual Torque (0x6077)	Mode Of Operation Display (0x6061)
	Touch Probe Status (0x60B9)	Touch Probe Pos1 Pos value (0x60BA)	Error code (0x603F)	Digital inputs (0x60FD)

12.2.4.2 Set PDO mapping

Take the second group of PDO configuration OD 1601 and OD 1A01 as an example.

The settings are as follows:

1. Disable the PDO configuration: set OD 1C12 sub 0 to 0 (RxPDO) and OD 1C13 sub 0 to 0 (TxPDO).

2. Disable the PDO mapping setting: set OD 1600 sub 0 to 0 (RxPDO) and OD 1A01 sub 0 to 0 (TxPDO).

3. Set the contents and number of RxPDO mappings: set OD 1601 sub 1 to sub 5 (RxPDO) for the content and set OD 1601 sub 0 to 5 (RxPDO) for the number of RxPDO mappings.

Mapping parameter setting for RxPDO	Data			Description
OD 1601 sub1	6040h	00h	10h	Control command (6040h), data length is 16-bit
OD 1601 sub2	607Ah	00h	20h	Target position (607Ah), data length is 32-bit
OD 1601 sub3	60FFh	00h	20h	Target velocity (60FFh), data length is 32-bit
OD 1601 sub4	6071h	00h	10h	Target torque (6071h), data length is 16-bit
OD 1601 sub5	60B8h	00h	10h	Touch Probe setting (60B8h), data length is 16-bit
OD 1601 sub0	5			Set 5 for the number of RxPDO mappings

4. Set the contents and number of TxPDO mappings: set OD 1A01 sub 1 to sub 7 (TxPDO) for the content and set OD 1A01 sub 0 to 7 (TxPDO) for the number of TxPDO mappings.

Mapping parameter setting for TxPDO	Data			Description
OD 1A01 sub1	6041h	00h	10h	Statusword (6041h), data length is 16-bit
OD 1A01 sub2	6064h	00h	20h	Position actual value (6064h), data length is 32-bit
OD 1A01 sub3	606Ch	00h	20h	Velocity actual value (606Ch), data length is 32-bit
OD 1A01 sub4	6077h	00h	10h	Torque actual value (6077h), data length is 16-bit
OD 1A01 sub5	60B9h	00h	10h	Touch Probe Status (60B9h), data length is 16-bit
OD 1A01 sub6	60BAh	00h	20h	Touch Probe Pos1 Pos Value (60BAh), data length is 32-bit
OD 1A01 sub7	60FDh	00h	20h	Digital inputs (60FDh), data length is 32-bit
OD 1A01 sub0	7			Set 7 for the number of TxPDO mappings

5. Set the PDO mapping configuration: set OD 1C12 sub 1 to 0x1601 (RxPDO) and OD 1C13 sub 1 to 0x1A01 (TxPDO).

6. Enable the PDO configuration: set OD 1C12 sub 0 to 1 (RxPDO) and OD 1C13 sub 0 to 1 (TxPDO).

12.2.4.3 PDO mapping object

Real-time data transmission can be achieved with Process data objects (PDOs). There are two types of PDOs: the sent TxPDO and the received RxPDO. This definition is from the perspective of the servo drive, for example, the sent 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 parameter	Communication object	Mapping object parameter
RxPDO1	1600h	TxPDO1	1A00h
RxPDO2	1601h	TxPDO2	1A01h
RxPDO3	1602h	TxPDO3	1A02h
RxPDO4	1603h	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

12.2.4.4 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 accessing EEPROM.
080000a5h	The entered password is incorrect when writing 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.

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12.3 EtherCAT operation mode

This section describes the modes of operation specified by CiA402 when the servo is in the EtherCAT mode. The content includes basic operation settings and related object descriptions.

12.3.1 Profile Position Mode

After the servo drive receives the position command transmitted by the controller, the servo drive controls the servo motor to reach the target position. In the Profile Position 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 motion command generator in the servo drive. The following figure shows the Profile Position Mode architecture of the servo drive:
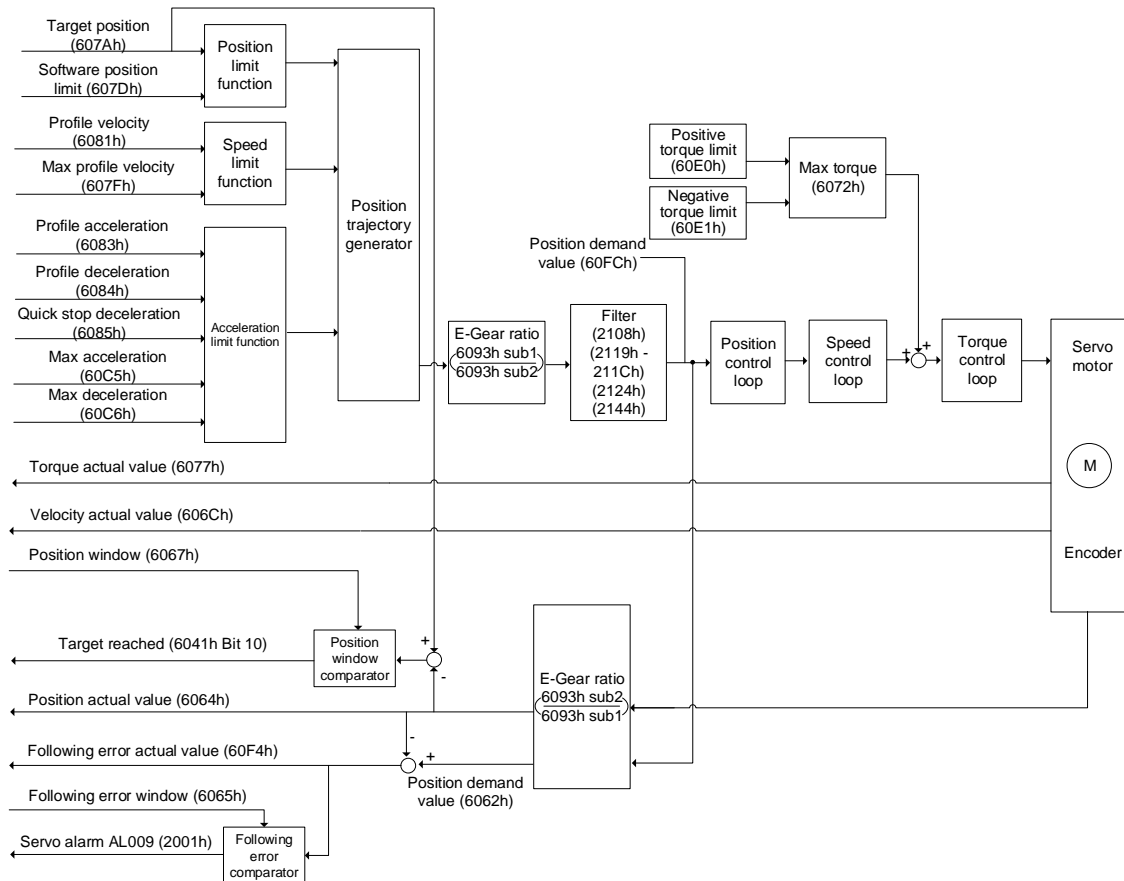
Operation steps:

1. Set OD 6060h to 01h to set the mode as the Profile Position Mode.

2. Set OD 607Ah for the target position (unit: PUU).

3. Set OD 6081h for the speed command (unit: PUU/sec).

4. Set OD 6083h for the acceleration time slope (unit: ms).

5. Set OD 6084h for the deceleration time slope (unit: ms).

6. Set OD 6040h for the control command. Follow these steps. 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 12.4.

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 triggered (rising-edge triggered)

7. After the servo completes the first motion command, the servo sets the target position, speed, and other conditions to execute the next motion command.

8. Set OD 6040h for the control command. 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 triggered (rising-edge triggered)

Read the servo drive information:

1. Read OD 6064h to obtain the current motor feedback position.

2. Read OD 6041h to obtain the servo drive status, including the following error and notifications for set-point acknowledge and target reached.

Enable / disable the command to take immediate effect

In the Profile Position Mode, set the command to take effect immediately or not with 6040h Bit 5.

- Set 6040h Bit 5 to 0 to disable the command from taking immediate effect

If the command is not enabled to take immediate effect, when the current motion command is in execution (not yet complete), the servo continues to execute the current motion command even if a new command is triggered. The new command is acknowledged and executed only after the current command is complete.
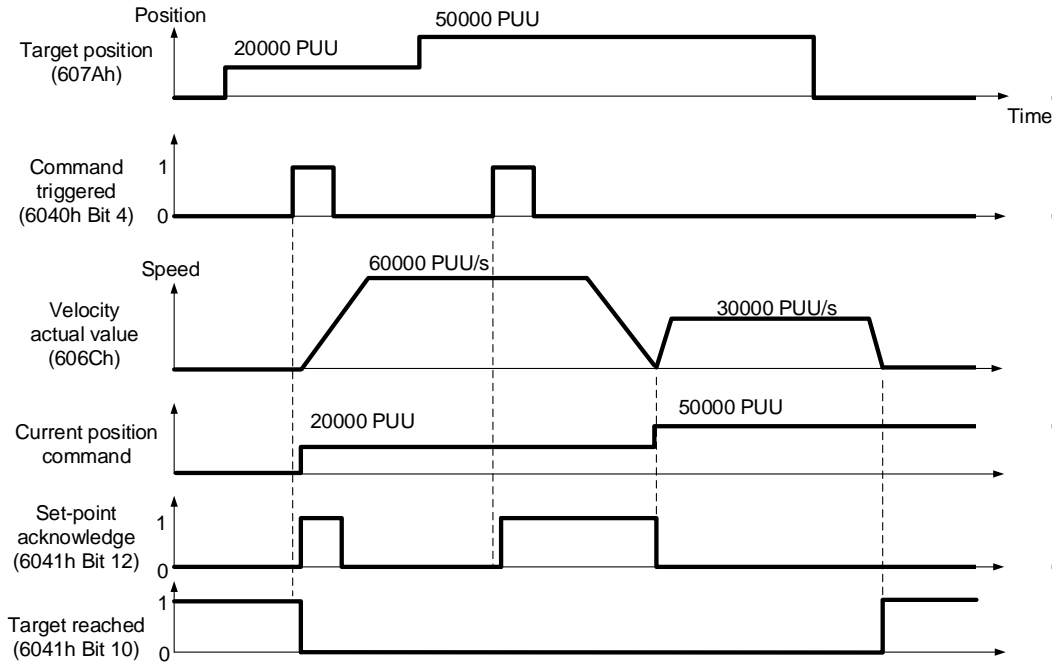
■ Set 6040h Bit 5 to 1 to enable the command to take immediate effect (only valid in Profile Position Mode).

If the command is enabled to 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 the servo receives a 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
606Ch	Velocity actual value	INTEGER32	RO
6072h	Max torque	UNSIGNED16	RW
6077h	Torque actual value	INTEGER16	RO
607Ah	Target position	INTEGER32	RW
607Dh	Software position limit	INTEGER32	RW
607Fh	Max profile velocity	UNSIGNED32	RW
6081h	Profile velocity	UNSIGNED32	RW
6083h	Profile acceleration	UNSIGNED32	RW
6084h	Profile deceleration	UNSIGNED32	RW
6085h	Quick stop deceleration	UNSIGNED32	RW
6093h	Position factor	UNSIGNED32	RW
60C5h	Max acceleration	UNSIGNED32	RW
60C6h	Max deceleration	UNSIGNED32	RW

Index	Name	Data type	Access
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 12.4.3 Details of objects.

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12.3.2 Profile Velocity Mode

In Profile Velocity (PV) Mode, the controller specifies the speed command and acceleration / deceleration conditions, and the motion command generator of the servo drive plans the motion path according to these conditions.
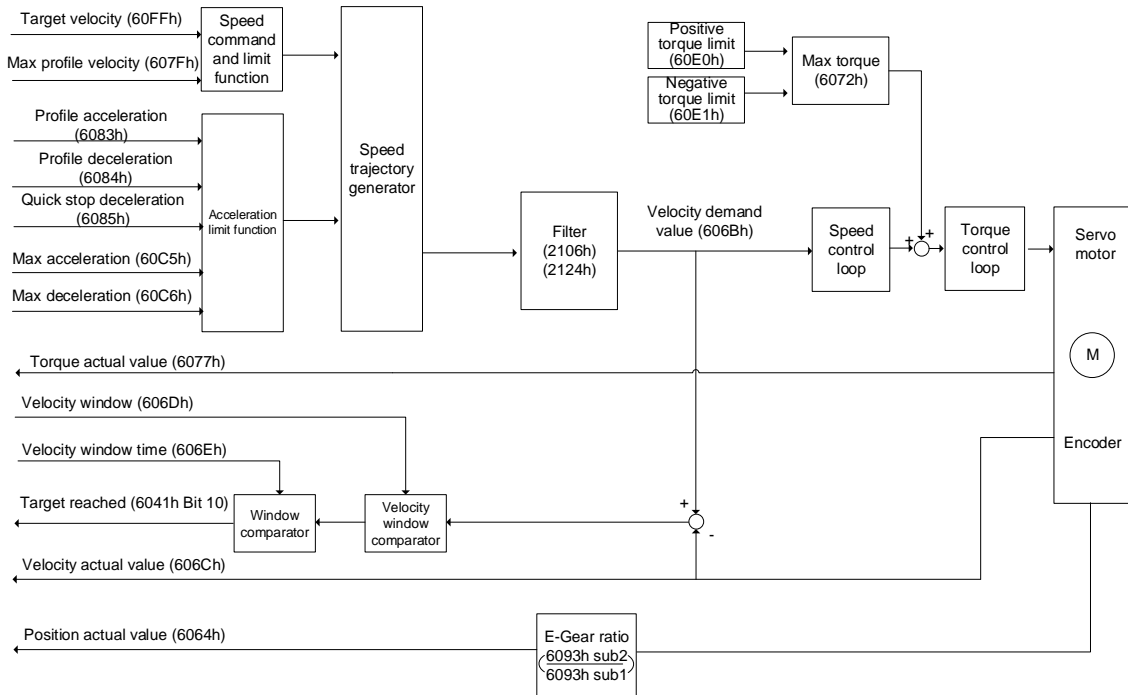
Operation steps:

1. Set OD 6060h to 03h to set the mode as the Profile Velocity Mode.

2. Set OD 6083h for the acceleration time slope.

3. Set OD 6084h for the deceleration time slope.

4. Set the target velocity (OD 60FFh) to 0. In Profile Velocity Mode, the servo motor starts operating once it 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 time of Servo On.

5. Set OD 6040h for the control command. Follow these steps. 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 description for OD 6040h in Section 12.4.

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 speed.

Read the servo drive information:

1. Read OD 6041h to obtain the servo drive status.

2. Read OD 606Ch to obtain the current speed feedback.

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 12.4.3 Details of objects.

12.3.3 Profile Torque Mode

In Profile Torque (PT) Mode, the controller specifies the torque command and filtering conditions, and the motion command generator of the servo drive plans the torque slope according to these conditions.
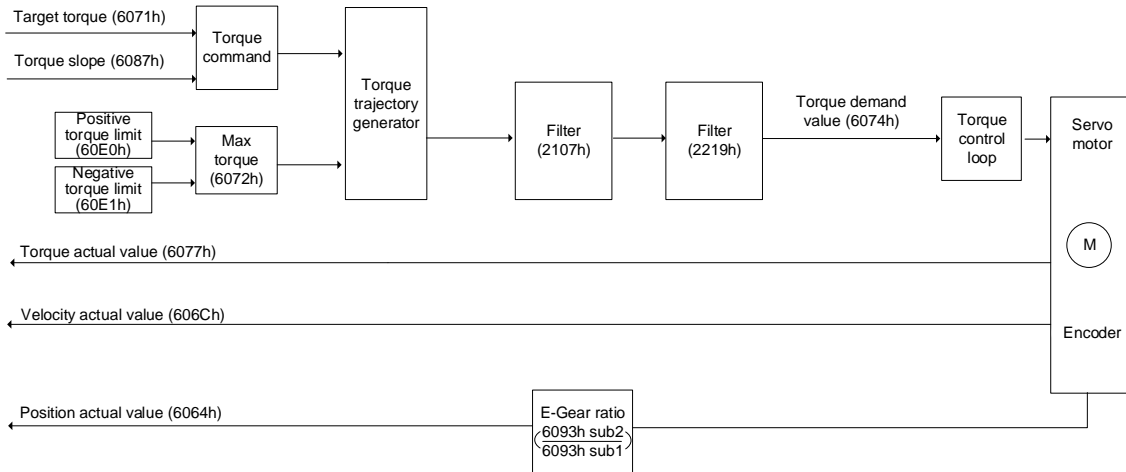
Operation steps:

1. Set OD 6060h to 04h to set the mode as the 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 is switched to Servo On (Step 4). Therefore, set the target torque (OD 6071h) to 0 for safety reasons.

4. Set OD 6040h for the control command. Follow these steps. 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 description for OD 6040h in Section 12.4.

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 feedback.

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
6072h	Max torque	UNSIGNED16	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
60E0h	Positive Torque Limit	UNSIGNED16	RW
60E1h	Negative Torque Limit	UNSIGNED16	RW

Note: for more details, refer to Section 12.4.3 Details of objects.

12.3.4　Homing Mode

After homing is complete, the coordinate system of the servo drive is established and the drive can start executing the position command issued by the controller. Delta servo drives offer 35 Homing Modes, including finding the home switch, positive and negative limits, and motor Z pulse.
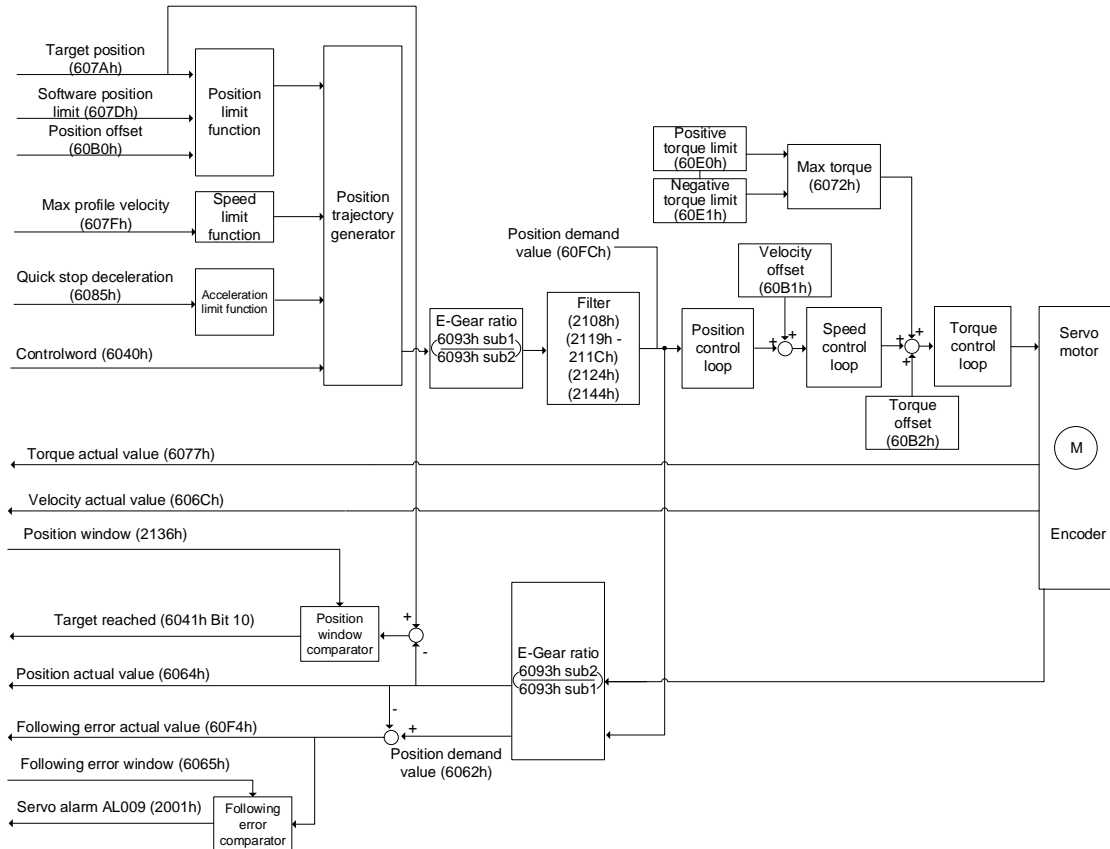
Operation steps:

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 / deceleration time.

7.　Set OD 6040h for the control command. Follow these steps. 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 description for OD 6040h in Section 12.4.

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	Command triggered (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 current motor feedback position.

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
607Ch	Home offset	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
6098h	Homing method	INTEGER8	RW
6099h	Homing speeds	UNSIGNED32	RW
609Ah	Homing acceleration	UNSIGNED32	RW
60B0h	Position 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 12.4.3 Details of objects.

12.3.5 Cyclic Synchronous Position Mode

The controller plans the path in Cyclic Synchronous Position Mode and transmits PDOs to the servo drive periodically. In this mode, when the controller transmits each PDO, it simultaneously transmits the target position and controlword to the servo drive. The velocity offset and torque offset can be used as the velocity and torque feed forward control setting.
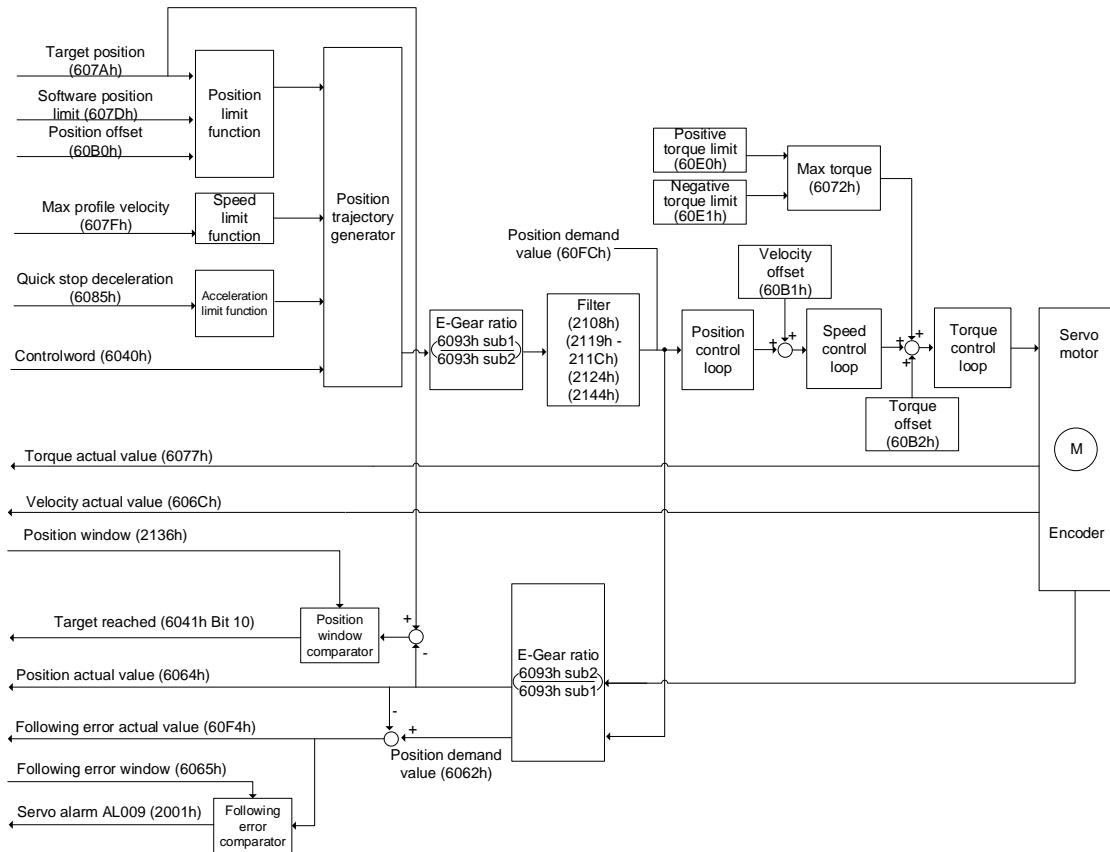
Operation steps:

1. Set OD 6060h to 08h to set the mode as the Cyclic Synchronous Position Mode.

2. Set OD 607Ah for the target position (unit: PUU).

3. Set OD 6040h for the control command. Follow these steps. 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 12.4.

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).

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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
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

12.3.6 Cyclic Synchronous Velocity Mode

The controller plans the speed in Cyclic Synchronous Velocity Mode and transmits PDOs to the servo drive periodically. In this mode, when the controller transmits each PDO, it simultaneously transmits the target velocity and controlword to the servo drive. The velocity offset and torque offset can be used as the velocity and torque feed forward control setting.
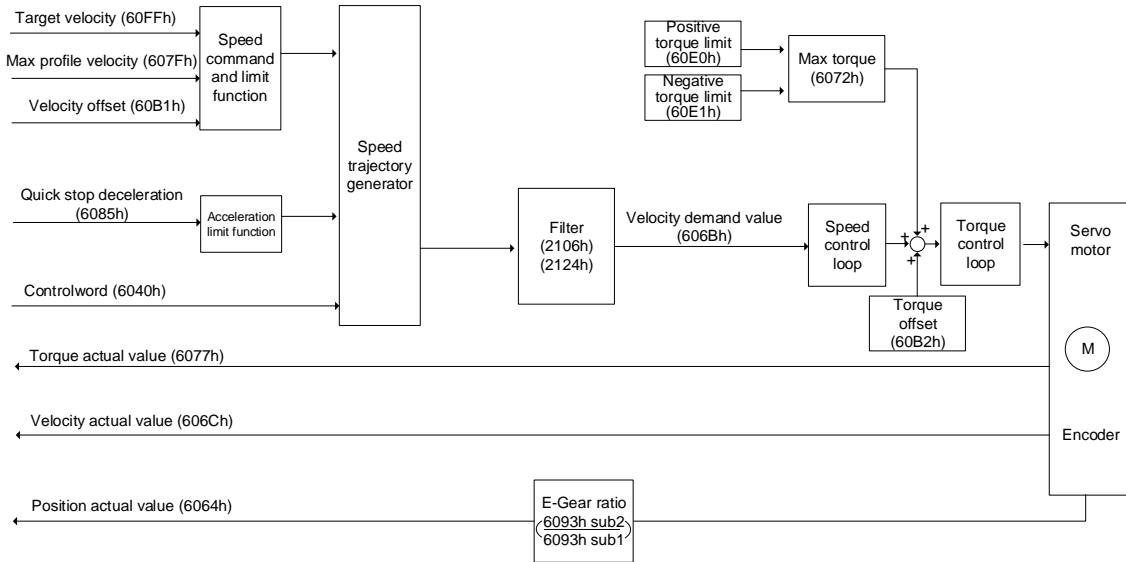
Operation steps:

1. Set OD 6060h to 09h to set the mode as the Cyclic Synchronous Velocity Mode.

2. Set the target velocity (OD 60FFh) to 0. In Cyclic Synchronous Velocity Mode, the servo motor starts operating once it 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 time of Servo On.

3. Set OD 6040h for the control command. Follow these steps. 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 12.4.

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 speed.

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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

12.3.7 Cyclic Synchronous Torque Mode

The controller plans the torque in Cyclic Synchronous Torque 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.
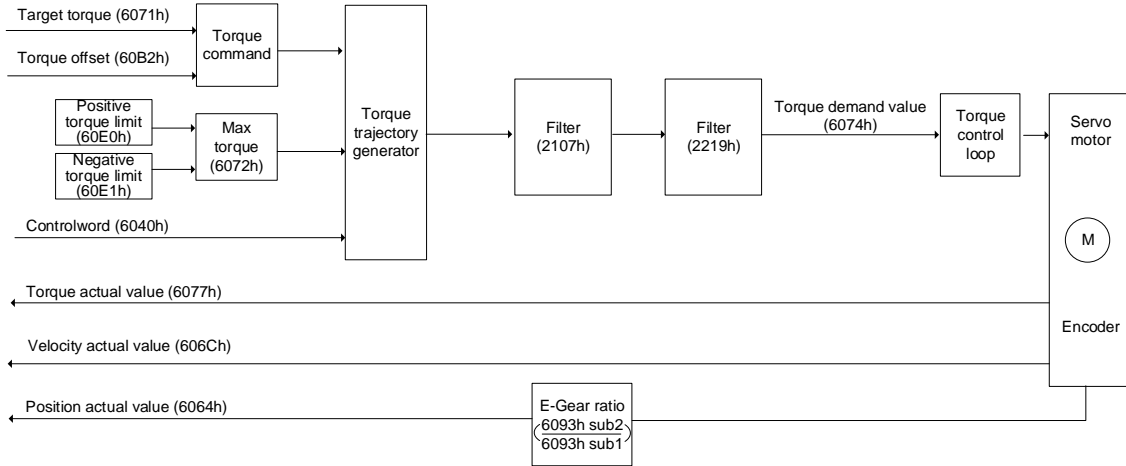
Operation steps:

1. Set OD 6060h to 0Ah to set the mode as the Cyclic Synchronous Torque Mode.

2. Set the target torque (OD 6071h) to 0. In Cyclic Synchronous Torque Mode, the servo target torque takes effect once the servo is switched to Servo On (Step 3). Therefore, set the target torque (OD 6071h) to 0 for safety reasons.

3. Set OD 6040h for the control command. Follow these steps. 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 description for OD 6040h in Section 12.4.

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.

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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
6072h	Max torque	UNSIGNED16	RW
6074h	Torque demand value	INTEGER16	RO
6077h	Torque actual value	INTEGER16	RO
6093h	Position factor	UNSIGNED32	RW
60B2h	Torque Offset	INTEGER16	RW
60E0h	Positive Torque Limit	UNSIGNED16	RW
60E1h	Negative Torque Limit	UNSIGNED16	RW

12.3.8 Touch Probe function (Position capture function and position capture status)

The Touch Probe function can be triggered by high-speed digital inputs (only DI1 and DI2 with the hardware response up to 5 µs) 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 the DI of CN1, note the following:

1. To capture the motor Z pulse, you can only set it with Touch Probe 1. Regardless of the settings of OD 60B8 Bit 4 and Bit 5, the command is rising-edge triggered and the data is stored in OD 60BA.

2. When the capture source is set to the DI of CN1, the previously set function code for the DI will be 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

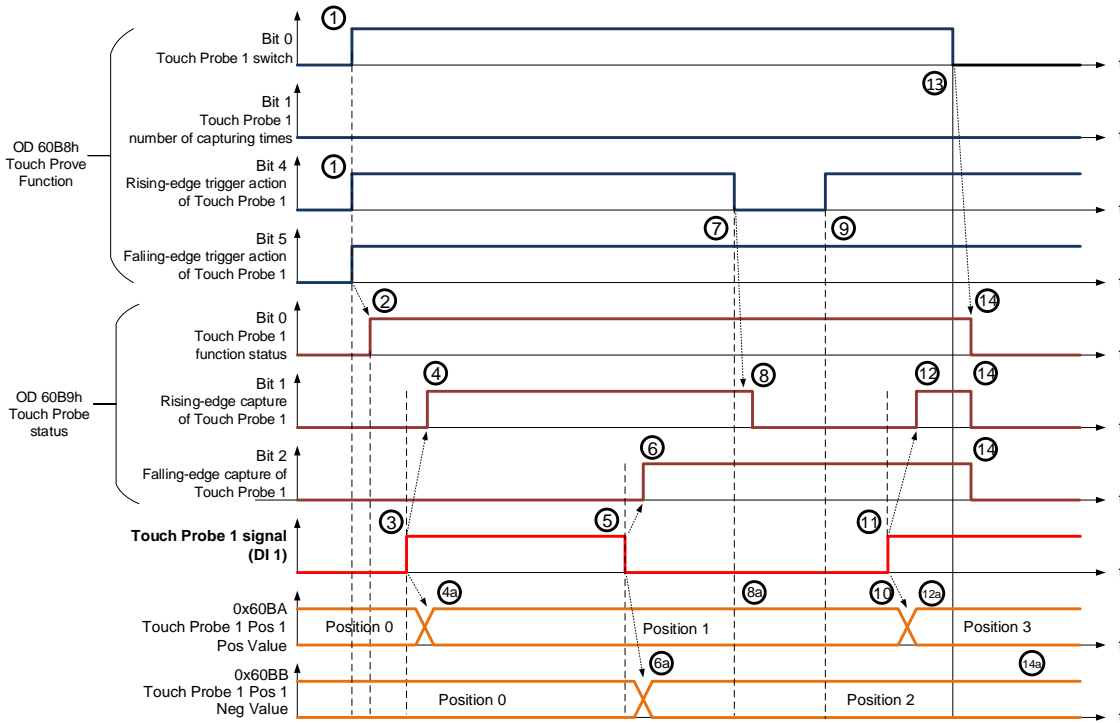| Bit	Function	Description
Bit 0	Touch Probe 1 switch	0: disable Touch Probe 1. 1: enable Touch Probe 1.
Bit 1	Touch Probe 1 number of capturing times	0: capture one time. 1: capture multiple times.
Bit 2	Touch Probe 1 capture source	0: DI 1 of CN1 1: motor Z pulse
Bit 3	Reserved	-
Bit 4	Rising-edge 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. 1: capture multiple times.
Bit 10	Touch Probe 2 capture source	0: DI 2 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	-

Get the position capture status with the Touch Probe function with OD 60B9h. The definition of each bit is as follows.

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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 function disabled 1: Touch Probe 1 function enabled
Bit 1	Rising-edge capture of Touch Probe 1	0: not captured 1: rising-edge triggered; data successfully captured
Bit 2	Falling-edge capture of Touch Probe 1	0: not captured 1: falling-edge triggered; data successfully captured
Bit 3 - Bit 5	Reserved	-
Bit 6	Touch Probe 1 capture source	0: DI 1 of CN1 1: motor Z pulse
Bit 7	Multi-capture signal of Touch Probe 1 (60B8 Bit 1 is active when multi-capture function is enabled)	Each time the data is successfully captured, the signal is reversed. Refer to the timing diagram of Example 3.
Bit 8	Touch Probe 2 function status	0: Touch Probe 2 fuction disabled 1: Touch Probe 2 function enabled
Bit 9	Rising-edge capture of Touch Probe 2	0: not captured 1: rising-edge triggered; data successfully captured
Bit 10	Falling-edge capture of Touch Probe 2	0: not captured 1: falling-edge triggered; data successfully captured
Bit 11 - Bit 13	Reserved	-
Bit 14	Touch Probe 2 capture source	0: DI 2 of CN1
Bit 15	Multi-capture signal of Touch Probe 2 (60B8 Bit 9 is active when multi-capture function is enabled)	Each time the data is successfully captured, the signal is reversed.

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 4 is enabled, the data is captured once whenever the Touch Probe 1 signal is rising-edge or falling-edge triggered.


| 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 capturing when Touch Probe 1 signal is rising-edge triggered.
(8)	OD 60B9h Bit 1 = 0	Touch Probe status: reset the rising-edge triggered 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.
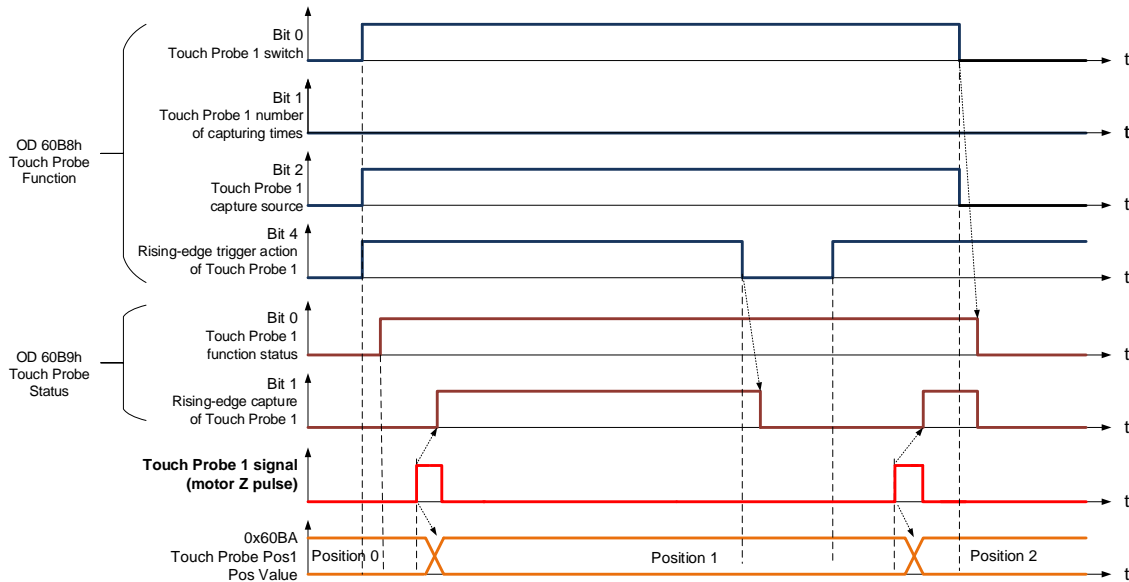
Example 3: the following is the timing diagram for the Touch Probe 1 function. In this example, the Touch Probe 1 function is triggered by the motor Z pulse. The data is captured **multiple times** when the Touch Probe 1 signal is rising-edge triggered.
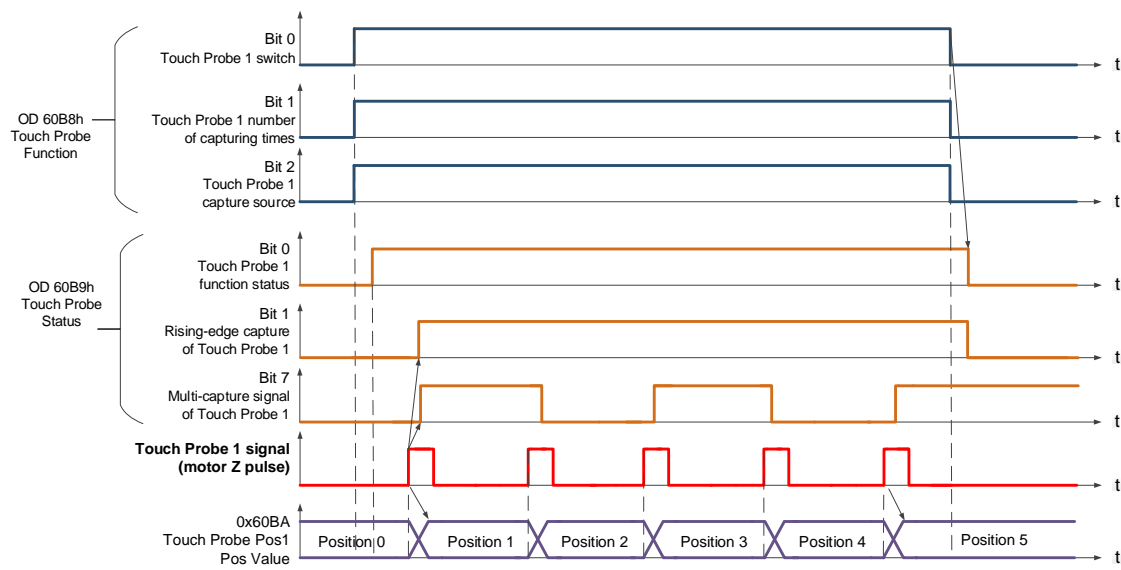
Relevant object list

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

12.4   Object dictionary

This section details the EtherCAT objects supported by the servo. The contents include object index, name, data type, data length, and access properties.

12.4.1   Specifications for objects

Object type

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 Standard 301.

12.4.2   List of objects

OD 1XXXh communication 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	UNSIGNED32	RW
1A00h - 1A03h	RECORD	Transmit PDO Mapping Parameter	UNSIGNED32	RW
1C12h	ARRAY	RxPDO assign	UNSIGNED16	RW
1C13h	ARRAY	TxPDO assign	UNSIGNED16	RW

Note: only 1001h can be mapped to PDO.

OD 2XXXh servo parameter group

Index	Object code	Name	Data type	Access	Mappable
2XXXh	VAR	Parameter Mapping	INTEGER16/32	RW	Y

OD 6XXXh communication object group

Index	Object code	Name	Data type	Access	Mappable
603Fh	VAR	Error code	UNSIGNED16	RO	Y
6040h	VAR	Controlword	UNSIGNED16	RW	Y
6041h	VAR	Statusword	UNSIGNED16	RO	Y
605Bh	VAR	Shutdown option code	INTEGER16	RW	Y
6060h	VAR	Modes of operation	INTEGER8	RW	Y
6061h	VAR	Modes of operation display	INTEGER8	RO	Y
6062h	VAR	Position demand value [PUU]	INTEGER32	RO	Y
6063h	VAR	Position actual internal value [Pulse]	INTEGER32	RO	Y
6064h	VAR	Position actual value [PUU]	INTEGER32	RO	Y
6065h	VAR	Following error window	UNSIGNED32	RW	Y
6067h	VAR	Position window	UNSIGNED32	RW	Y
6068h	VAR	Position window time	UNSIGNED16	RW	Y
606Bh	VAR	Velocity demand value	INTEGER32	RO	Y
606Ch	VAR	Velocity actual value	INTEGER32	RO	Y
606Dh	VAR	Velocity window	UNSIGNED16	RW	Y
606Eh	VAR	Velocity window time	UNSIGNED16	RW	Y
606Fh	VAR	Velocity threshold	UNSIGNED16	RW	Y
6071h	VAR	Target torque	INTEGER16	RW	Y
6072h	VAR	Max torque	UNSIGNED16	RW	Y
6074h	VAR	Torque demand value	INTEGER16	RO	Y
6075h	VAR	Motor rated current	UNSIGNED32	RO	Y
6076h	VAR	Motor rated torque	UNSIGNED32	RO	Y
6077h	VAR	Torque actual value	INTEGER16	RO	Y
6078h	VAR	Current actual value	INTEGER16	RO	Y
607Ah	VAR	Target position	INTEGER32	RW	Y
607Ch	VAR	Home offset	INTEGER32	RW	Y

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Index	Object code	Name	Data type	Access	Mappable
607Dh	ARRAY	Software position limit	INTEGER32	RW	Y
607Fh	VAR	Max profile velocity	UNSIGNED32	RW	Y
6080h	VAR	Max motor speed	UNSIGNED32	RW	Y
6081h	VAR	Profile velocity	UNSIGNED32	RW	Y
6083h	VAR	Profile acceleration	UNSIGNED32	RW	Y
6084h	VAR	Profile deceleration	UNSIGNED32	RW	Y
6085h	VAR	Quick stop deceleration	UNSIGNED32	RW	Y
6086h	VAR	Motion profile type	INTEGER16	RO	Y
6087h	VAR	Torque slope	UNSIGNED32	RW	Y
6093h	ARRAY	Position factor	UNSIGNED32	RW	Y
6098h	VAR	Homing method	INTEGER8	RW	Y
6099h	ARRAY	Homing speeds	UNSIGNED32	RW	Y
609Ah	VAR	Homing acceleration	UNSIGNED32	RW	Y
60B0h	VAR	Position Offset	INTEGER32	RW	Y
60B1h	VAR	Velocity Offset	INTEGER32	RW	Y
60B2h	VAR	Torque Offset	INTEGER16	RW	Y
60B8h	VAR	Touch Probe Setting	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
60FFh	VAR	Target velocity	INTEGER32	RW	Y
6502h	VAR	Supported drive modes	UNSIGNED32	RO	Y

12.4.3   Details of objects

12.4.3.1   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		X		
B	Bit 16 - Bit 31	Y	Bit 0 - Bit 15	
C	Model type	Z	Device profile number	
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

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		X	
B	Bit 16 - Bit 31	Y	Bit 0 - Bit 15
C	Delta servo alarm	Z	Error code
D		U	

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Definitions are as follows:

■ UZYX: error code. Refer to the error code definition in DS 402.

■ DCBA: Delta servo alarm. Refer to Chapter 13 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 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 encoder error based on the Delta servo alarm.

Error code: 0x7305 is defined as an Incremental Sensor 1 fault according to DS 402.

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 (unit: µs). The communication cycle is the interval between two SYNCs. If you are not using SYNC, set this object to 0.

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 supported
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	0 - 1
Default	1

Sub-index	1
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 supported
Data type	UNSIGNED8
Access	RW
PDO mapping	No
Setting range	0 - 1
Default	1

Sub-index	1
Description	Specify the TxPDO index to be used
Data type	UNSIGNED16
Access	RW
PDO mapping	No
Setting range	0x1A00, 0x1A01, 0x1A02, 0x1A03
Default	0x1A01

Object 1600h - 1603h: Receive PDO mapping parameter

Index	1600h, 1601h, 1602h, 1603h
Name	Receive PDO mapping
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) object and its content to be mapped
Data type	UNSIGNED32
Access	RW
PDO mapping	No
Setting range	UNSIGNED32
Default	0

The format of this object is as follows:

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

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 three PDOs (OD 6040h, OD 607Ah, and OD 6060h) in the first group of PDO, the setting is as follows.

Mapping parameter setting for received PDO	Data			Description
OD 1600 sub0	3			Set 3 PDO mappings.
OD 1600 sub1	6040h	00h	10h	Mapping control command (6040h), data length is 16-bit

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Mapping parameter setting for received PDO	Data			Description
OD 1600 sub2	607Ah	00h	20h	Mapping target position (607Ah), data length is 32-bit
OD 1600 sub3	6060h	00h	08h	Mapping mode position (6060h), data length is 8-bit
Note	The total length is 38h (56-bit) which meets the specification of less than 64-bit.			

Object 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) object and its content to be mapped
Data type	UNSIGNED32
Access	RW
PDO mapping	No
Setting range	UNSIGNED32
Default	0

Format of this object: (High word h) DCBA : (Low word L) UZYX

DCBA	Bit 16 - Bit 31 Object index	YX	Bit 0 - Bit 7 object data length
		UZ	Bit 8 - Bit 15 object sub-index

12.4.3.2 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 servo parameters with the OD 2XXXh group. The parameter number and index are converted as follows:

> **Pa.bcd   <= = >   2aBCh**
>
> '**BC**' is hexadecimal format of '**bcd**'

Read the index first to get the information of the parameter length, and then use SDO or PDO to change the data.

Example 1:

Object 2300h: Node-ID [P3.000]

Index	2300h
Name	Node-ID
Object code	VAR
Data type	INTEGER16
Access	RW
PDO mapping	Yes
Setting range	INTEGER16
Default	7Fh

Example 2:

Object 212Ch: Electronic Gear [P1.044]

Index	212Ch
Name	Electronic Gear
Object code	VAR
Data type	INTEGER32
Access	RW
PDO mapping	Yes
Setting range	INTEGER32
Default	1

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12.4.3.3 OD 6XXXh communication object group

Object 603Fh: Error code (error code of 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 control command contains many functions, such as Servo On, command triggering, fault reset, and emergency stop. The state machine architecture is as follows:
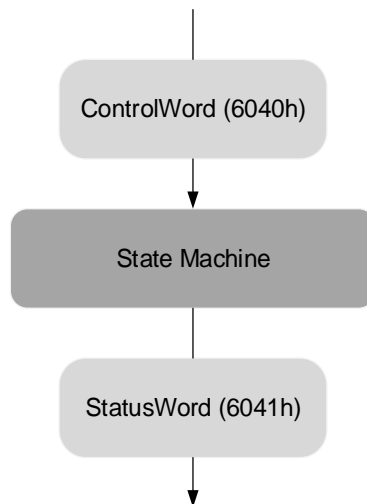
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function	Description
Bit 0	Switch on	-
Bit 1	Enable voltage	-
Bit 2	Quick stop (B contact (NC))	-
Bit 3	Enable operation	-

Bit	Function	Description
Bit 4 - Bit 6	Operation mode definition	This bit is individually defined according to the control mode, as shown in the following table.
Bit 7	Fault reset	-
Bit 8	Halt	-
Bit 9 - Bit 15	Reserved	-

Bits 4 - Bit 6 are individually defined according to the mode, as shown in the following table:

Bit	Operation mode definition					
	PP	Homing	PV / PT	CSP	CSV	CST
Bit 4	Command triggered (rising-edge triggered)	Homing (rising-edge triggered)	-	-	-	-
Bit 5	Enable / disable the command to take immediate effect	-	-	-	-	-
Bit 6	0: absolute position command 1: relative position command	-	-	-	-	-

Finite state automation (as shown in the following diagram) defines the behavior of a servo drive system. Each state represents an internal or external behavior. For example, point-to-point motion event can only be received and executed in the Operation Enabled state.

The state transition is defined as follows:

Transition	Event	Action
0, 1	Automatic transition after power-on	Device is started and initialized
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 executes motion mode
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. Trigger positive / negative limit switch 2. Quick stop triggered by a control command (OD 6040h = xxxx x0xxx)	Quick stop function is enabled
12	Disable voltage command (OD 6040h: 0000 0110 or xxxx xx0x)	Servo switches to Servo Off
13, 14	Alarm occurs	Servo switches to Servo Off
15	Fault reset	N/A
16	Enable operation command and no alarm	Motion operation restart. The restart action is mode-dependent.

State changes can be achieved with controlword commands. The commands are as follows:

Command	Bit of OD 6040h					State change
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shutdown	0	X	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on + Enable operation	0	1	1	1	1	3 + 4
Disable voltage	0	X	X	0	X	7, 9, 10, 12
Quick stop	0	X	0	1	X	7, 10, 11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4, 16
Fault reset	⌐	X	X	X	X	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 control command contains many functions, such as Servo on, command triggering, fault reset, and emergency 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	Ready to switch on	Ready to switch on	Bit 0 - Bit 6: current status of the servo drive (see the following table for details).
Bit 1	Switched on	Servo ready	
Bit 2	Operation enabled	Servo enabled	
Bit 3	Fault	Fault signal	
Bit 4	Voltage enabled	Servo is powered on	
Bit 5	Quick stop	Quick stop	
Bit 6	Switch on disabled	Switch on disabled	
Bit 7	Warning	Warning signal	Warning output, but the servo remains with 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	-	-	Defined according to the control 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	Switch 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 Off).

Note: 0 indicates the bit is off; 1 indicates the bit is on; - indicates the bit is invalid.

Bit 12 - Bit 13: current status of the servo drive.

Bit	Operation mode definition						
	PP	PV	PT	Homing	CSP	CSV	CST
Bit 12	Set-point acknowledge	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:

Set to 0: when Servo Off, the dynamic brake has no effect, so the motor runs freely and the machine stops only by the frictional force.

Set to -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

Setting value	Mode
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.

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 command is the interpolation command calculated by the servo internal interpolator. This command passes through 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 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 position error (60F4h) exceeds this setting range, AL009 (Excessive deviation of Position command) is triggered.
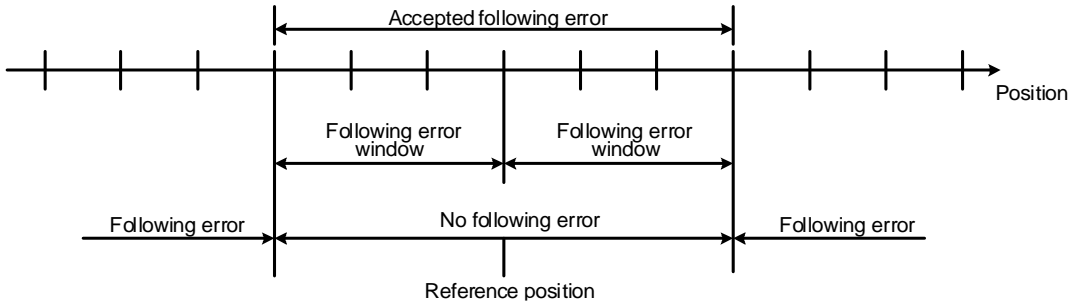
Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.

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 absolute error value between the command position (PP mode: OD 607Ah) and the position actual value (OD 6064h) is within the position range of OD 6067h (Position window), OD 6041h Bit 10 (Target reached) is output.
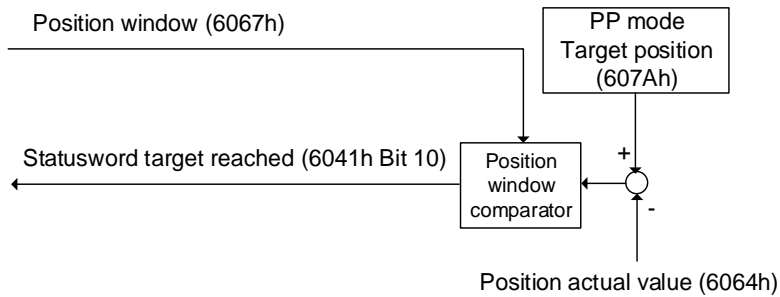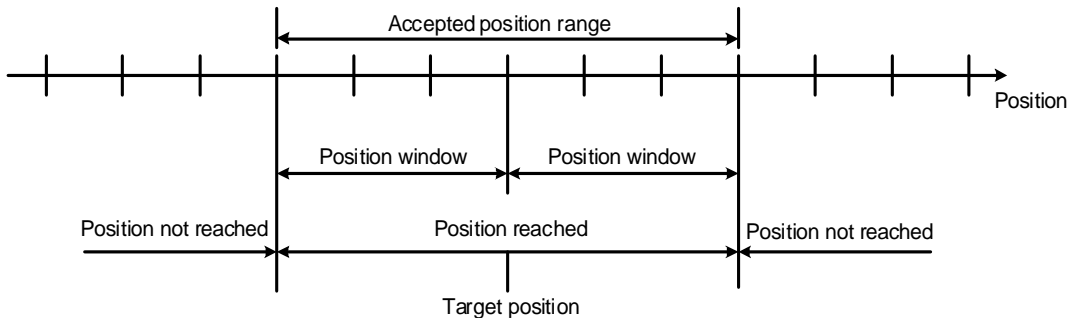
Object 6068h: Position window time

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 error between the command position (PP mode: OD 607Ah) and the position actual value (OD 6064h) is within the position range of OD 6067h (Position window), and the retaining duration is greater than 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 internal speed command is a command generated by the speed motion command generator and processed by the command filter of the drive. This object only works in Profile 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 current motor speed for the users to monitor.

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 speed comparator compares the speed error with OD 606Dh (velocity window). When the error is within the range of the velocity window and the retaining time is greater than OD 606Eh (Velocity window time), then 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.
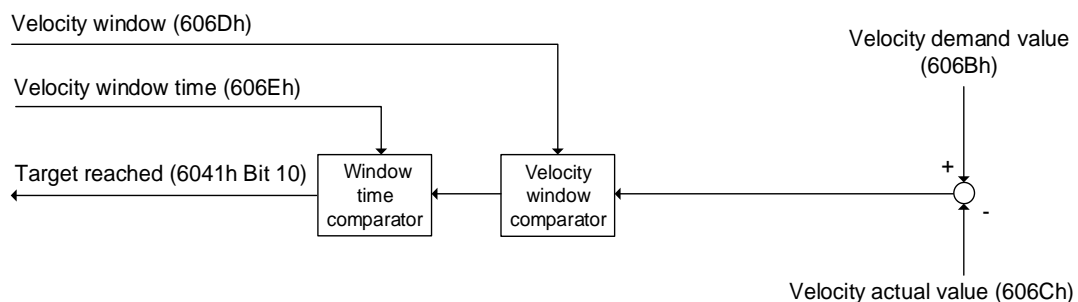
Object 606Eh: Velocity window time

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 the 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 outputting the zero-speed signal. When the forward or reverse speed (absolute value) of the motor is slower than this set value, the zero speed signal OD 6041h Bit 10 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%

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Object function:

This object sets the target torque in torque mode (unit: 0.1%). If this object is set to 1000 (100.0%), it corresponds to the rated torque of the motor.

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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 torque mode (unit: 0.1%).

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 internal torque command is a command generated by the speed motion command generator and processed by the command filter of the drive. This object only works in Profile 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	0.1 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

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Object function:

This object is available in Profile Position Mode and Cyclic Synchronous Position Mode. For more details, refer to Section 12.3.1 Profile Position Mode and Section 12.3.5 Cyclic Synchronous Position Mode.

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:

Home Position is the origin reference point found when homing is executed, 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.

Note: when P3.012.Z is set to 1, the non-volatile setting for this object is enabled.
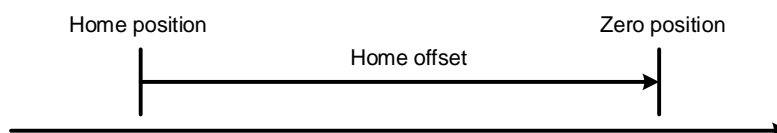
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Object 607Dh: Software position limit

Index	607Dh
Name	Software position limit
Object code	ARRAY
Data type	INTEGER32
Access	RW

Sub-index	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 unit of this object is 0.1 rpm. When this object is multiplied by 10, it is equivalent to

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

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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:

This object is equivalent to P1.055, which is the maximum speed limit of the motor.

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 is available in Profile Position Mode. For more details, refer to Section 12.3.1
Profile Position Mode.

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 to accelerate from 0 rpm to 3,000 rpm.

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This object is available 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 to decelerate from 3,000 rpm to 0 rpm.

This object is available 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 to decelerate from 3,000 rpm to 0 rpm.

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	Mode
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 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
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
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
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	0 - 35
Default	0

Object function:

There are a total of 35 homing methods. The 1st - 16th homing methods look for the Z pulse; the 17th - 34th do not look for the Z pulse; the 35th defines the current position as the origin.

Method 1: homing on the negative limit switch and Z pulse
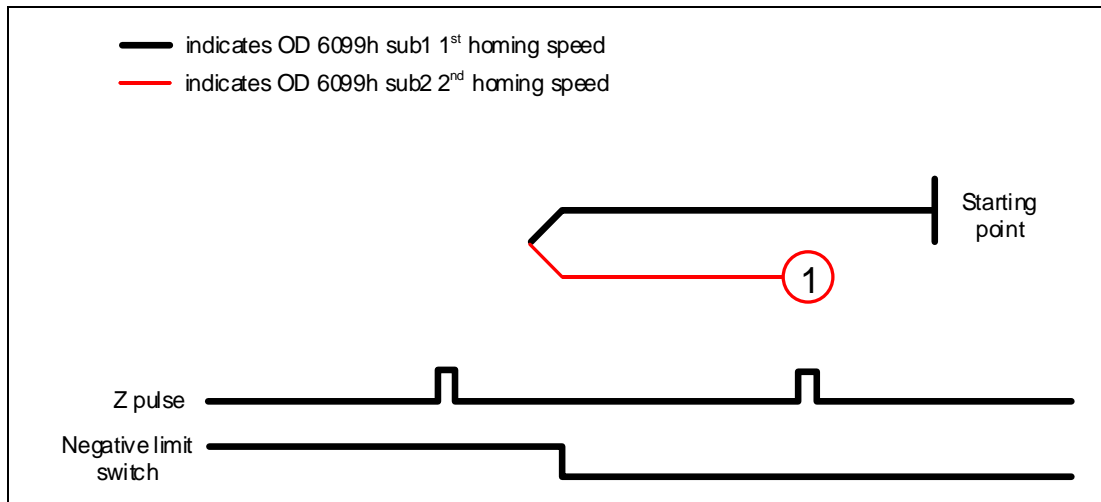
Method 2: homing on the positive limit switch and Z pulse
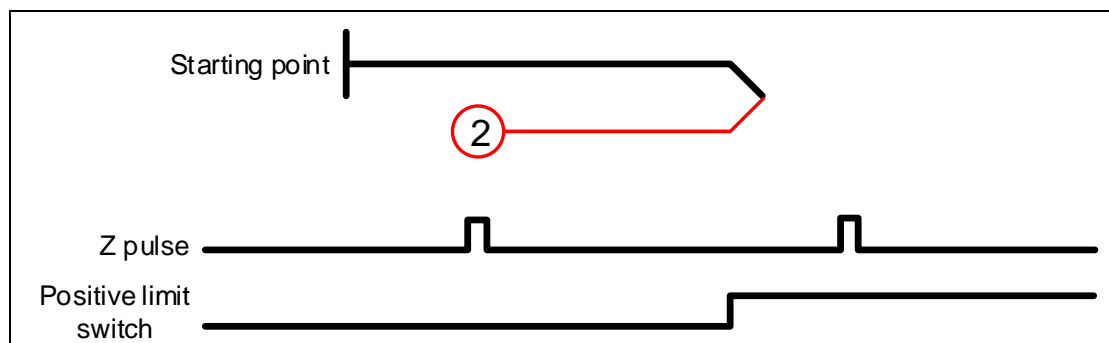
Methods 3 and 4: homing on the home switch and Z pulse
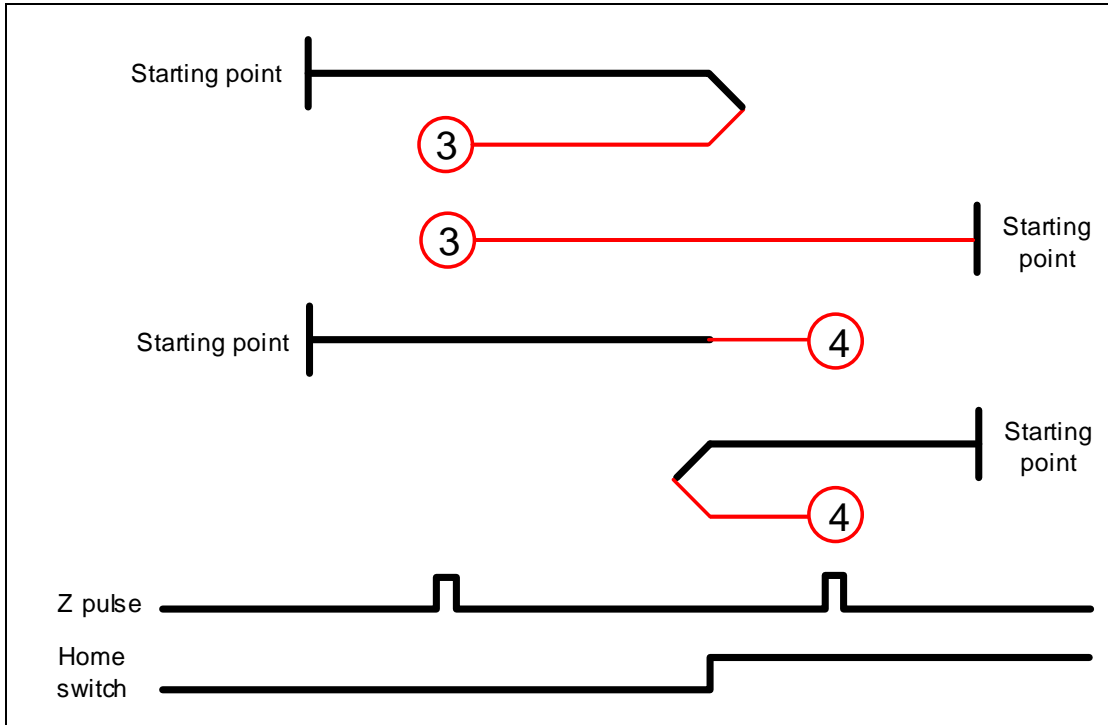
Methods 5 and 6: homing on the home switch and Z pulse
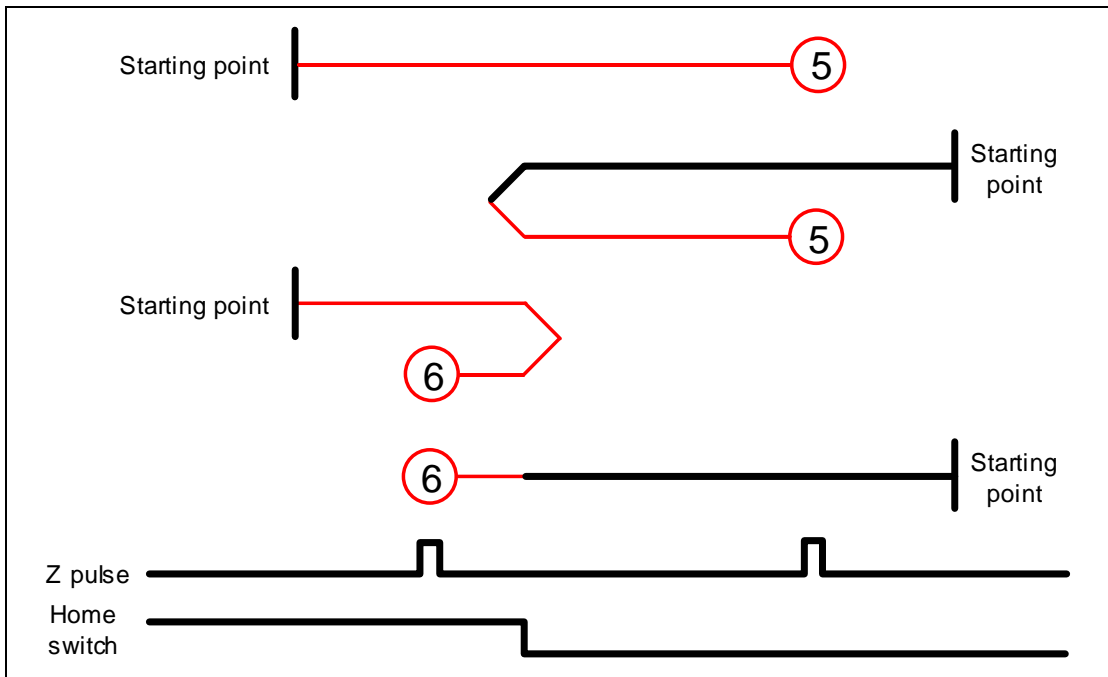
Method 7: homing on the positive limit switch, home switch, and Z pulse

Method 8: homing on the positive limit switch, home switch, and Z pulse
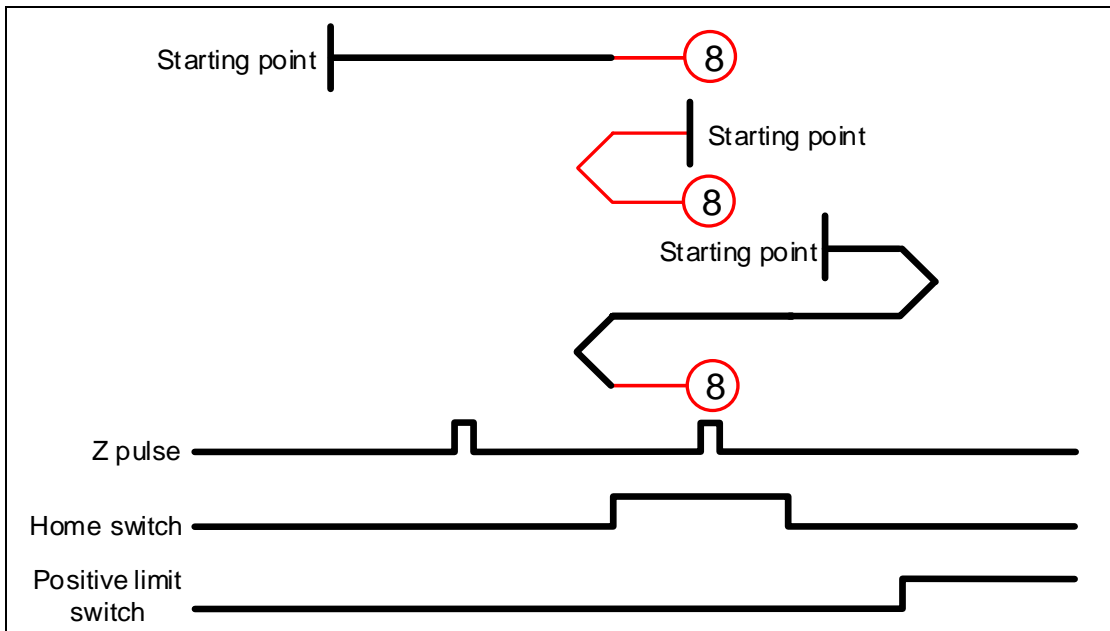
Method 9: homing on the positive limit switch, home switch, and Z pulse
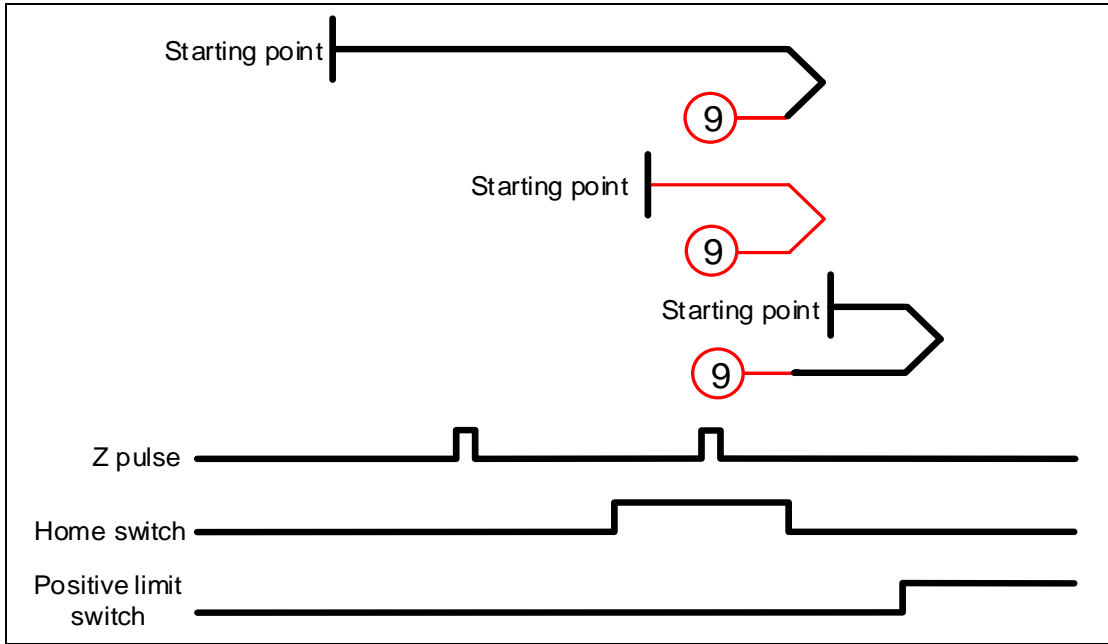
Method 10: homing on the positive limit switch, home switch, and Z pulse
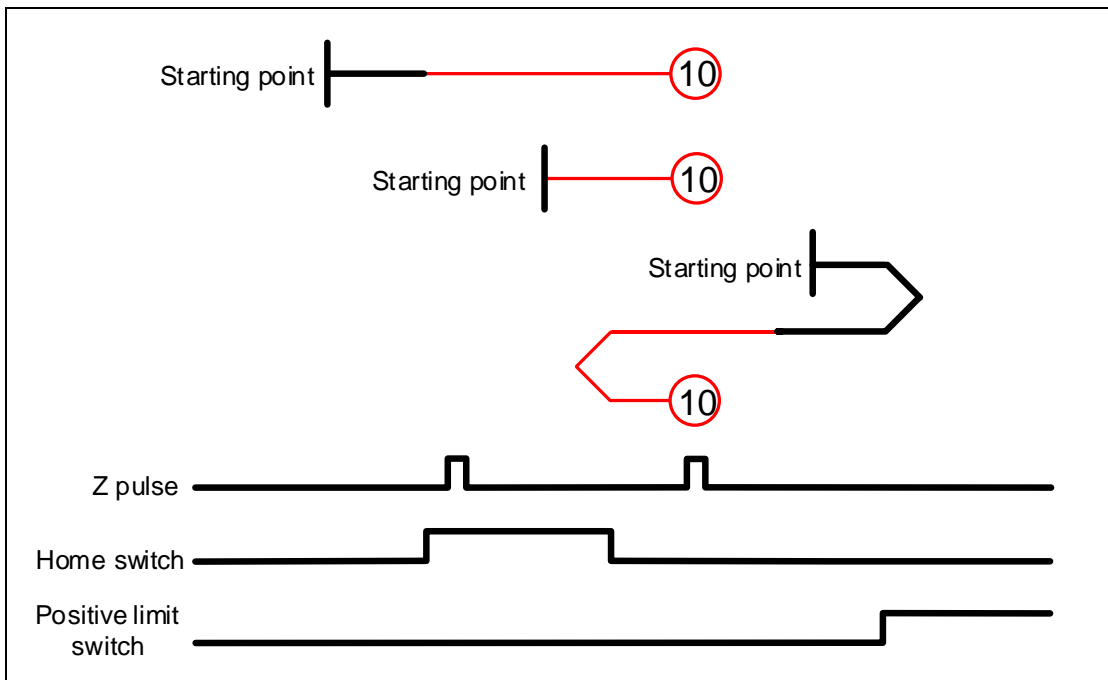
Method 11: homing on the negative limit switch, home switch, and Z pulse

Method 12: homing on the negative limit switch, home switch, and Z pulse
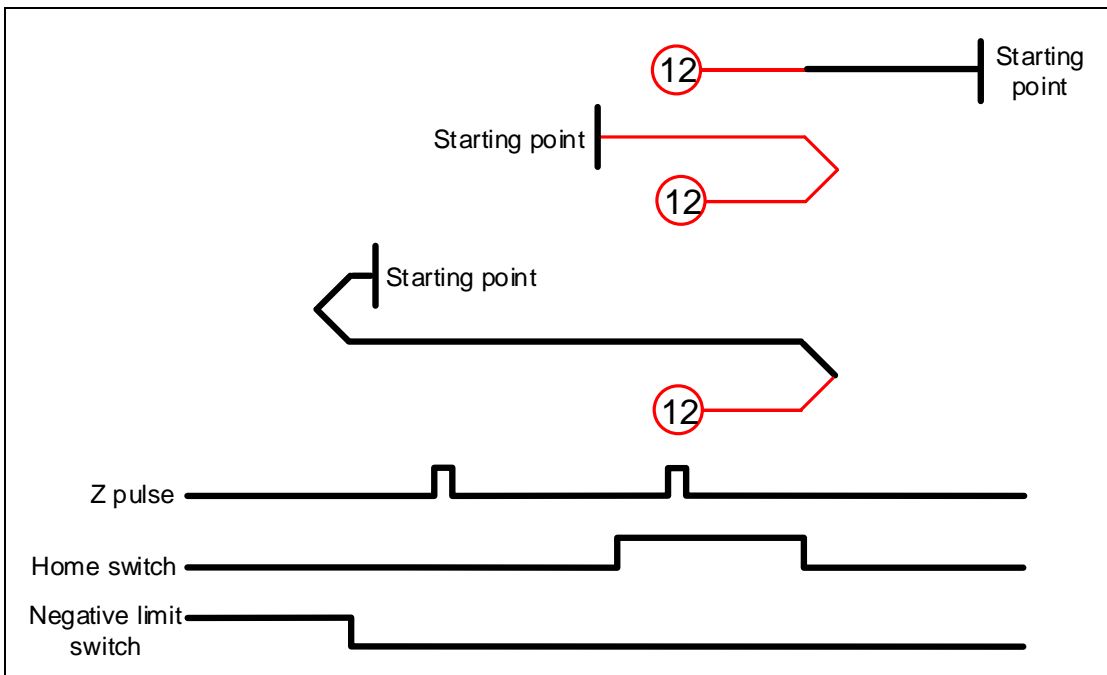
Method 13: homing on the negative limit switch, home switch, and Z pulse

Method 14: homing on the negative limit switch, home switch, and Z pulse
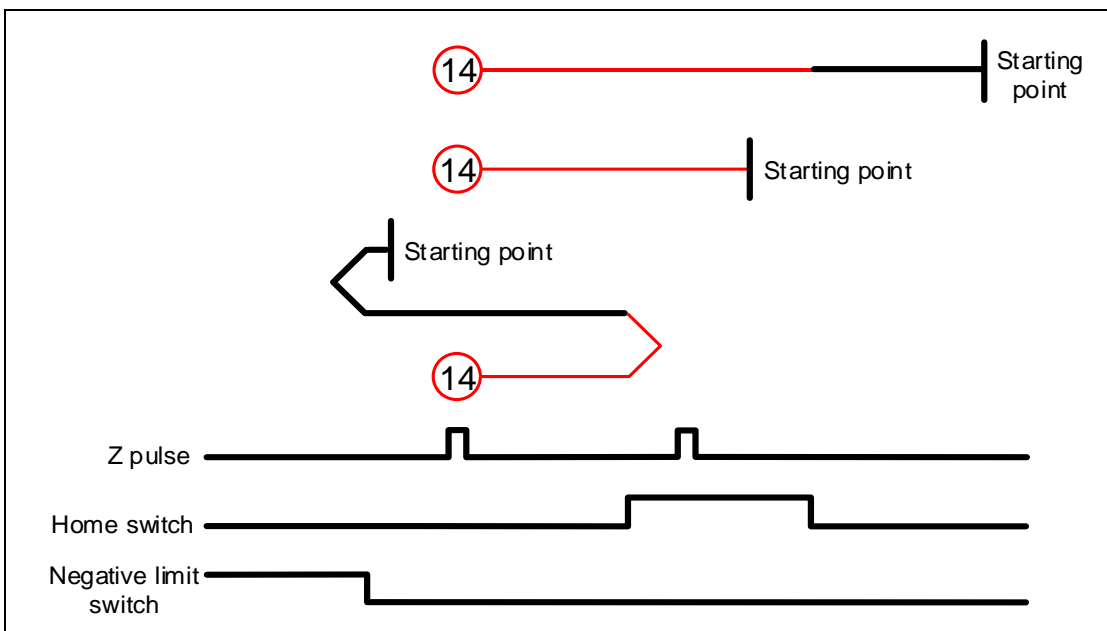
Methods 15 and 16: reserved

Method 17: homing on the negative limit switch
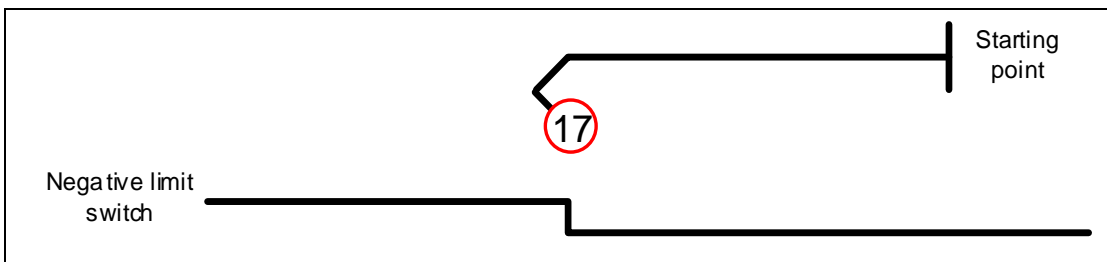
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Method 18: homing on the positive limit switch
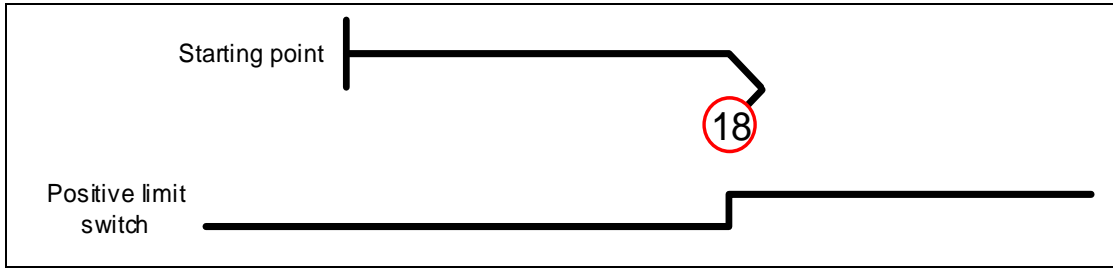
Methods 19 and 20: homing on the home switch

Methods 21 and 22: homing on the home switch

Methods 23 and 24: homing on the positive limit switch and home switch

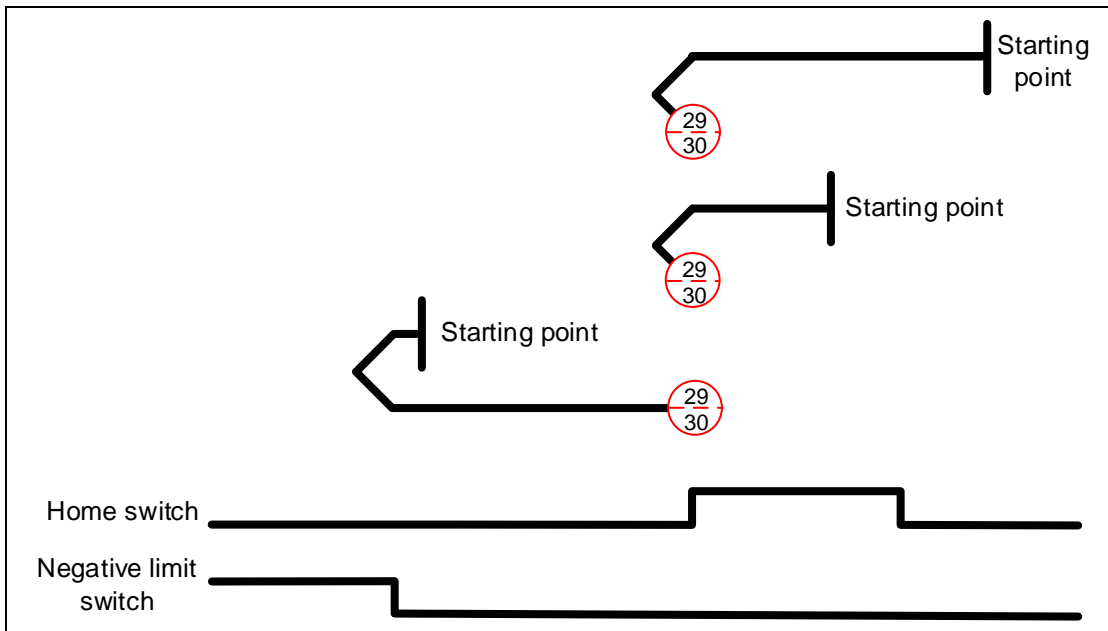Methods 25 and 26: homing on the positive limit switch and home switch

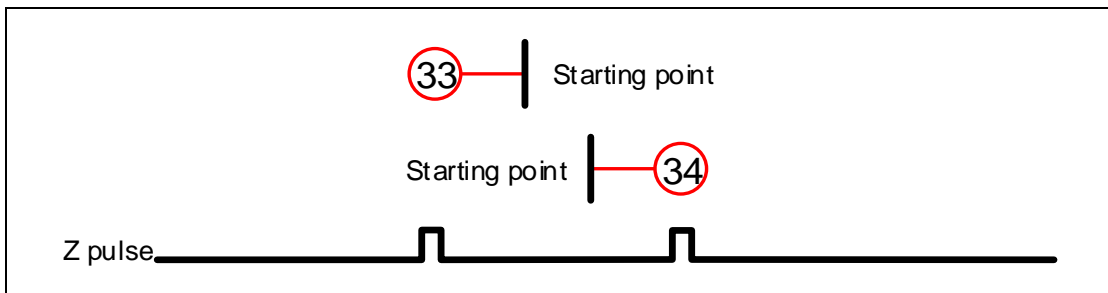Methods 27 and 28: homing on the negative limit switch and home switch

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: define the current feedback position as the origin

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 - 2000
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 - 500
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 to accelerate from 0 rpm to 3,000 rpm

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and decelerate from 3,000 rpm to 0 rpm. This object is available 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 12.3.5 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 12.3.6 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 12.3.7 Cyclic Synchronous Torque Mode.

Object 60B8h: Touch Probe setting

Index	60B8h
Name	Touch Probe setting
Object code	VAR
Data type	UNSIGNED16
Access	RW
PDO mapping	Yes
Setting range	UNSIGNED16
Default	0

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Object function:

This object sets the Touch Probe related function settings. For the operation details, refer to Section 12.3.8.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function	Description
Bit 0	Touch Probe 1 switch	0: disable Touch Probe 1. 1: enable Touch Probe 1.
Bit 1	Touch Probe 1 number of capturing times	0: capture one time. 1: capture multiple times.
Bit 2	Touch Probe 1 capture source	0: DI 1 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	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. 1: capture multiple times.
Bit 10	Touch Probe 2 capture source	0: DI 2 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 use this object to get the position capturing status. For the function of this object, refer to Section 12.3.8 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 function disabled 1: Touch Probe 1 function enabled
Bit 1	Rising-edge capture of Touch Probe 1	0: not captured 1: rising-edge triggered; data successfully captured
Bit 2	Falling-edge capture of Touch Probe 1	0: not captured 1: falling-edge triggered; data successfully captured
Bit 3 - Bit 5	Reserved	-
Bit 6	Touch Probe 1 capture source	0: DI 1 of CN1 1: motor Z pulse
Bit 7	Multi-capture signal of Touch Probe 1 (60B8 Bit 1 is active when multi-capture function is enabled)	Each time the data is successfully captured, the signal is reversed. Refer to the timing diagram of Example 3.
Bit 8	Touch Probe 2 function status	0: Touch Probe 2 fuction disabled 1: Touch Probe 2 function enabled
Bit 9	Rising-edge capture of Touch Probe 2	0: not captured 1: rising-edge triggered; data successfully captured
Bit 10	Falling-edge capture of Touch Probe 2	0: not captured 1: falling-edge triggered; data successfully captured
Bit 11 - Bit 13	Reserved	-
Bit 14	Touch Probe 2 capture source	0: DI 2 of CN1
Bit 15	Multi-capture signal of Touch Probe 2 (60B8 Bit 9 is active when multi-capture function is enabled)	Each time the data is successfully captured, the signal is reversed.

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 12.3.8 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 12.3.8 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 12.3.8 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 12.3.8 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 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 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 is the difference between the command position (OD 6062h) and feedback position (OD 6064h). For more details, refer to the architecture diagram in Section 12.3.

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 diagram in Section 12.3.

Object 60FDh: Digital inputs

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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
User-defined		Reserved		Home switch	Positive limit switch	Negative limit switch

MSB   LSB

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
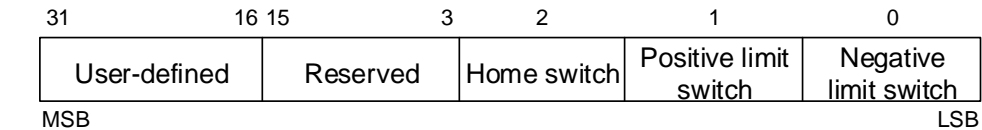
Bit	Function
Bit 0	Negative limit signal
Bit 1	Positive limit signal
Bit 2	Homing signal
Bit 3 - Bit 15	Reserved
Bit 16	DI1
Bit 17	DI2
Bit 18	DI3
Bit 19	DI4
Bit 20	DI5
Bit 21	DI6
Bit 22	DI7
Bit 23 - Bit 31	Reserved

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 speed. This object is available 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

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Object function:

This object is read-only and provides the control 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

12.5   Diagnostics and troubleshooting

This section provides diagnostics and troubleshooting information related to communication or interference with the controller. For information about the servo drive alarms, refer to Chapter 13.

1. The SYNC communication cycle of the controller and servo drive is different

    Since the jitter of each controller is different, the communication cycle time between the servo drive receiving the Sync and Sync synchronization action is different. When this happens, increase the error value (U) by adjusting P3.009 and let the servo drive automatically correct the internal timer so it is consistent with the communication cycle of the controller.

2. Clear 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 cable shield is firmly connected to the servo drive communication port. Also, ensure the ground wire is properly connected and grounded.

12.5.1   EtherCAT diagnostic system

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** and press **Diagnosis** to get the following EtherCAT connection information for error detection. For more details, refer to the ASDA-Soft User Guide.

1. Check if the servo parameter P1.001.X is set to C 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 station number (Config ID) and logical station number (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 operating mode status display (OD 6060h, 6061h, 6071h, 6072h, 6080h, 60FFh, 60E0h, 60E1h, and 607Ah)

Note: refer to the latest version of the ASDA-Soft User Guide for updates of the EtherCAT diagnostic system.

12.5.2 Alarm list

Alarm	Description	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	Encoder error	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	Encoder output error	7306h
AL020	Serial communication timeout	7520h
AL022	RST leak phase	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
AL030	Motor collision error	7121h
AL031	Motor power cable wiring error / disconnection	3300h
AL032	Abnormal encoder vibration	7305h
AL034	Encoder internal communication error	7305h
AL035	Encoder temperature exceeds the protective range	7305h
AL036	Encoder alarm status error	7305h
AL042	Analog voltage input for Speed command is too high	FF01h
AL044	Servo function operational warning	6100h
AL045	E-Gear ratio value error	6320h
AL048	Encoder output error	7036h
AL053	Motor parameters are not confirmed	0000h
AL056	Excessive motor speed	0000h
AL05C	Motor position feedback error	0000h
AL060	Absolute position is lost	7305h
AL061	Encoder undervoltage	7305h
AL062	Number of revolutions of the absolute encoder overflows (issued by encoder)	7305h

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Alarm	Description	16-bit error code
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 coordinate and the encoder coordinate 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 - pause time is too short	7305h
AL08C	Auto-tuning function - inertia estimation error	7305h
AL099	DSP firmware error	5500h
AL09C	Parameter reset failed	5500h
AL0A6	Absolute position coordinates of the servo drive and motor do not match	7305h
AL111	Buffer overflow occurs when SDO is received	8110h
AL112	Buffer overflow occurs when PDO is received	8110h
AL113	TxPDO transmission failed	8110h
AL121	Object's index does not exist when PDO is accessed	8200h
AL122	Object's sub-index does not exist when PDO is accessed	8200h
AL123	Data length error occurs when PDO is accessed	8200h
AL124	Data range error occurs when PDO is accessed	8200h
AL125	PDO object is read-only and write-protected	8200h
AL126	Specified object does not support PDO mapping	8200h
AL127	PDO object is write-protected when servo drive is on	8200h

Alarm	Description	16-bit error code
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	Write parameters: read-only	0215h
AL217	Write parameters: write-protected when Servo On	0217h
AL219	Write parameters: parameter cannot be written	0219h
AL231	Monitoring item of Type [8] PR is out of range	0231h
AL235	Position counter overflow warning	0235h
AL237	Indexing coordinate 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
AL301	CANopen synchronization failure	6200h
AL302	Synchronization signal of CANopen is sent too soon	6200h
AL303	CANopen synchronization signal timeout	6200h
AL304	Invalid interpolation mode command	6200h
AL305	SYNC period error	6200h
AL35F	Emergency stop during deceleration	6200h
AL380	Position offset alarm for DO.MC_OK	6200h
AL3CF	Emergency stop	6200h
AL3E1	Communication fails to synchronize	6200h
AL3E2	Communication synchronization signal is sent too soon	6200h
AL3E3	Communication synchronization signal timeout	6200h
AL3F1	Absolute position command of the communication type servo drive is in error	6200h
AL400	Indexing coordinate setting error	FF05h
AL401	NMT reset command is received when servo is on	0000h
AL404	PR special filter setting value is too great	FF07h
AL422	Write-in failed caused by power supply cut-off	0000h
AL500	STO function is enabled	9000h
AL501	STO_A lost (signal loss or signal error)	9000h
AL502	STO_B lost (signal loss or signal error)	9000h
AL503	STO self-diagnostic error	9000h
AL510	Internal parameter update program of the servo drive is abnormal	0000h
AL520	Calculation program timeout	0000h

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Alarm	Description	16-bit error code
AL521	Vibration elimination parameter error	6100h
AL555	System failure	-
AL809	PR motion setting error or command decoding error	0000h

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Troubleshooting

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This chapter provides alarm descriptions and the corrective actions you can use for troubleshooting.

There are four types of alarms: General, Motion control, STO, and Communication. The detailed information is as follows.

General type: alarms caused by signal errors of the hardware or encoder.

Motion control type: alarms caused by motion control command (in PR mode) errors.

STO type: alarms caused by STO errors.

Communication type: alarms caused by CANopen, DMCNET, or EtherCAT communication errors.

AL.nnn is the alarm format on the 7-segment display.

If the recommended alarm clearing method is DI.ARST, set DI.ARST (alarm reset) to On or P0.001 to 1 for clearing the alarm.

13.1   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	Encoder error	○			○
AL012	Calibration error	○			○
AL013	Emergency stop		○		○
AL014	Negative limit error		○	○	
AL015	Positive limit error		○	○	
AL016	Abnormal IGBT temperature	○			○
AL017	EEPROM error	○			○
AL018	Encoder output error	○			○
AL020	Serial communication timeout		○	○	
AL022	RST leak phase		○		○
AL023	Early overload warning		○	○	
AL024	Encoder initial magnetic field error	○			○
AL025	Encoder internal error	○			○
AL026	Encoder unreliable internal data	○			○
AL027	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 / disconnection	○			○
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	○			○

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General type (continued)

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL042	Analog voltage input for Speed command is too high	○			○
AL044	Servo function operational warning		○	○	
AL045	E-Gear ratio value error	○			○
AL048	Encoder output error	○			○
AL053	Motor parameters are not confirmed	○			○
AL056	Excessive motor speed	○			○
AL05C	Motor position feedback error	○			○
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 coordinate and the encoder coordinate 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	○			○

General type (continued)

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
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 - pause time is too short		○	○	
AL08C	Auto-tuning function - inertia estimation error		○	○	
AL099	DSP firmware error	○			○
AL09C	Parameter reset failed	○			○
AL09F	Capacitor charging error	○			○
AL0A6	Absolute position coordinates of the servo drive and motor do not match		○	○	
AL422	Write-in failed caused by power supply cut-off	○			○
AL521	Vibration elimination parameter error	○			○
AL35F	Emergency stop during deceleration		○	○	
AL3CF	Emergency stop		○		○

Note: if the servo drive shows an alarm that is not in this table, contact the local distributor or technician.

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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	Write parameters: read-only		○	○	
AL217	Write parameters: write-protected when Servo On		○	○	
AL219	Write parameters: parameter cannot be written		○	○	
AL231	Monitoring item of Type [8] PR is out of range		○	○	
AL235	Position counter overflow warning		○	○	
AL237	Indexing coordinate 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	Indexing coordinate 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.

STO type

Display	Alarm name	Error type		Servo state	
		ALM	WARN	ON	OFF
AL500	STO function is enabled	○			○
AL501	STO_A lost (signal loss or signal error)	○			○
AL502	STO_B lost (signal loss or signal error)	○			○
AL503	STO self-diagnostic error	○			○

Note: if the servo drive shows an alarm that is not in this table, 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	○			○
AL301	CANopen synchronization failure		○	○	
AL302	Synchronization signal of CANopen is sent too soon		○	○	
AL303	CANopen synchronization signal timeout		○	○	
AL304	Invalid interpolation mode command		○	○	
AL305	SYNC period error		○	○	
AL3E1	Communication fails to synchronize		○	○	
AL3E2	Communication synchronization signal is sent too soon		○	○	
AL3E3	Communication synchronization signal timeout		○	○	
AL401	NMT reset command is received when servo is on	○			○

Note: if the servo drive shows an alarm that is not in this table, contact the local distributor or technician.

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13.2   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 for connecting the motor to the servo drive as described in this manual. 2. If the temperature of the heat sink is abnormal, send your servo drive back to the distributor or contact Delta. Check if the set value of the parameter is much greater than the default. It is recommended to 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 the regenerative resistor 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 rated value (refer to Appendix A Specifications). If not, use the right voltage source or connect the regulator in series. Use a voltmeter to check if the power system complies with the specifications. If not, use the right voltage source or connect the transformer in series. 2. 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, re-calculate the value for the regenerative resistor, and correctly set the values of P1.052 and P1.053.

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AL002 Overvoltage	
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 voltage wiring is correct and the wiring of input voltage 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. Check if using the right voltage source or connecting the transformer in series.
How to clear the alarm?	Set P2.066 [Bit 2] to clear AL003: 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 once 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 servo drive is connected to the wrong motor). 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 (motor) is not operating properly, replace the motor.
How to clear the alarm?	Cycle power on the servo drive.

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AL005 Regeneration error	
Trigger condition and cause	Condition: an error occurs during regeneration. Cause: 1. Incorrect selection of the regenerative resistor or no connection to an external regenerative resistor. 2. P1.053 (Regenerative resistor capacity) is not set to 0 when the 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, re-calculate the value for the regenerative resistor, and 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 parameter settings. 3. Incorrect wiring of motor and encoder. 4. Encoder malfunction.
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 UVW and the encoder cables are correct. 4. Send the motor back to the distributor or contact Delta.
How to clear the alarm?	DI.ARST

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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 UVW and the encoder cables.
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 UVW and the encoder cables 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 correctly set the input pulse 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 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 cables are loose. 7. The maximum speed limit is set too low.

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AL009 Excessive deviation of Position command	
Checking method and corrective action	1. Check the value of the maximum deviation (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 for P1.044 and P1.045 are appropriate for the application. If not, set them to proper values. 6. Check if the power cables are 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. When the voltage remains at 400V for a period of time during regeneration, the possible cause may be the regenerative resistor is incorrectly selected or no external regenerative resistor is connected. 2. P1.053 (Regenerative resistor capacity) is not set to 0 when the regenerative resistor is not connected.
Checking method and corrective action	1. Check the connection for the regenerative resistor, re-calculate the value for the regenerative resistor, and 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 Encoder error	
Trigger condition and cause	Condition: the encoder produces abnormal pulses. Cause: 1. Encoder wiring is incorrect. 2. Encoder connector is loose. 3. Encoder wiring is poor. 4. Connection to the encoder is cut off due to interference.

AL011 Encoder error	
	5. Encoder is damaged.
Checking method and corrective action	1. Check if the wiring follows the instructions in the user manual. If not, connect the wiring correctly. 2. Check the connection between CN2 and encoder connector. If the connector is loose, reconnect it to CN2. 3. Check for the encoder 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 this value continues to accumulate, it means there is interference. Check the following items: (a) Check if the motor is properly grounded. Make sure the power cable (green end) 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 a shielded cable for the encoder, pull out the shielded mesh, and ground it. 5. If you took all corrective actions but the issue persists, replace the motor.
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 electronic 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. Reset the power supply. If the issue persists, 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.

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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

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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 indicated parameter. 1. Press the SHIFT key to display the parameter code. If this alarm occurs when power is supplied to the drive, it means a parameter value has exceeded the range. 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. Press the SHIFT key and 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 the drive is started, reset the parameters and then cycle the power. If the alarm occurs during operation, set DI.ARST to on.

AL018 Encoder output error	
Trigger condition and cause	Condition: the output pulse frequency of the encoder is higher than the maximum output frequency of the hardware. Cause: 1. The pulse resolution of the encoder is set too high. 2. There is interference or cable damage causing communication error. 3. Encoder error.
Checking method and corrective action	1. The settings of P1.076 and P1.046 should follow these requirements: P1.076 > motor speed and $\frac{Motor\ speed}{60} \times P1.046 \times 4 < 19.8 \times 10^6$ 2. Check the communication error rate by setting P0.002 to -80. If this value continues to accumulate, it means there is interference. Check the following items: (a) Check if the motor is properly grounded. Make sure the power cable

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AL018 Encoder output error	
	(green end) 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 a shielded cable for the encoder, pull out the shielded mesh, and ground it.
	3. Check the fault record (P4.000 - P4.004) and see if an alarm has occurred (AL011, AL024, AL025, or AL026). Use the checking methods and corrective actions to clear the alarm if any of them occurs.
	4. If you do not need to use the OA/OB pulse, set P2.065 [Bit 13] to 1 to disable the detection function for encoder output error (AL018).
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 parameter setting for P3.004 (Modbus communication timeout). 2. 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 broken and make sure it is correctly wired.
How to clear the alarm?	DI.ARST

AL022 RST leak phase	
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 leak phase.
Checking method and corrective action	Check if the RST power cable is loose or there is no power. For 1.5 kW (or below) ASDA-B3 servo drives, this alarm occurs when all three phases are not connected to the power supply. For 2 kW (or above) ASDA-B3 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.

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AL022 RST leak phase	
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 your motor is overloaded and refer to the corrective actions for 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 UVW phase of the encoder is in error. Cause: the initial magnetic field of the encoder is in error (UVW phase error).
Checking method and corrective action	1. Check if the motor is properly grounded. Make sure the power cable (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 a shielded cable for the encoder, pull out the shielded mesh, and ground it. 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. Check if the motor is properly grounded. Make sure the power cable (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.

AL025 Encoder internal error

	4. Use a shielded cable for the encoder, pull out the shielded mesh, and ground it.
	3. Make sure the motor shaft does not move when power is 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 power cable (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 a shielded cable for the encoder. 4. Set P0.002 to -80 through the panel to monitor the communication error rate. If the value is greater than 0 and increases continuously, check the previous three items again. If the value is 0, send your servo motor back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL027 Encoder internal reset error

Trigger condition and cause	Condition: encoder reset error. Cause: encoder reset.
Checking method and corrective action	1. Check if the encoder signal cable is firmly connected. 2. Check if the power supply for the encoder is stable and make sure to use a 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 drops to 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.

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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 power (5V) 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 power cable (green end) 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 a shielded cable for the encoder, pull out the shielded mesh, and ground it. 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 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

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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 the motor 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 motor 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 motor. 2. Check if the mechanical part connected to the motor is working normally. 3. Check if the wiring of the UVW and the encoder cables are 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: when the motor hits the device, the torque reaches the value set by P1.057 and the duration exceeds 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

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AL031 Motor power cable wiring error / disconnection	
Trigger condition and cause	Condition: incorrect wiring or disconnection of the motor power cable (U, V, W) and ground wire (GND).
	Cause: incorrect wiring or disconnection of the power cable (U, V, W) and ground wire (GND). The switch for disconnection detection is set by P2.065 [Bit 9], which is disabled by default. The switch for wiring error detection is set by P2.065 [Bit 8], which is disabled by default.
Checking method and corrective action	Check if the motor power cable (U, V, W) and ground wire (GND) are firmly connected. 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 is within 2.5 G. If the vibration is within the range but 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.

AL033 Motor is in error	
Trigger condition and cause	The motor is in error.
Checking method and corrective action	N/A
How to clear the alarm?	Send your servo motor back to Delta.

AL034 Encoder internal communication error	
Trigger condition and cause	Condition:
	1. Internal communication error for the absolute encoder.
	2. Internal error for other types of encoder.
	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

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AL034 Encoder internal communication error	
	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 limit 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 the servo motor back to Delta.
How to clear the alarm?	After the temperature detector shows a temperature below 100°C, cycle power on the servo drive.

AL036 Encoder alarm status error	
Trigger condition and cause	Condition: abnormal status 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 (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 a shielded cable for the encoder, pull out the shielded mesh, and ground it. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, 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 Analog voltage input for Speed command is too high	
Trigger condition and cause	Analog voltage input for the 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 is 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 unnecessary filter, 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 (1/4 - 262144), this alarm occurs once power is cycled to 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 (1/4 - 262144). If not, correct the value and then cycle power on the servo drive.
How to clear the alarm?	Cycle power on the servo drive after the value is corrected.

AL048 Encoder output error	
Trigger condition and cause	Condition: the output pulse frequency of the encoder is higher than the maximum output frequency of the hardware. Cause: 1. The pulse resolution of the encoder is set too high. 2. There is interference or cable damage causing communication error. 3. Encoder error.
Checking method and corrective action	1. The settings of P1.076 and P1.046 should follow these requirements: P1.076 > motor speed and $\frac{Motor\ speed}{60} \times P1.046 \times 4 < 19.8 \times 10^6$ 2. Check the communication error rate by setting P0.002 to -80. If this value continues to accumulate, it means there is interference. Check the following items: (a) Check if the motor is properly grounded. Make sure the power cable (green end) 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

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AL048 Encoder output error	
	or any high-current cables to avoid interference.
	(c) Use a shielded cable for the encoder, pull out the shielded mesh, and ground it.
	3. Check the fault record (P4.000 - P4.004) and see if an alarm has occurred (AL011, AL024, AL025, or AL026). Use the checking methods and corrective actions to clear the alarm if any of them occurs.
	4. If you do not need to use the OA/OB pulse, set P2.065 [Bit 13] to 1 to disable the detection function for encoder output error.
How to clear the alarm?	1. DI.ARST 2. Contact the distributor.

AL053 Motor parameters are not confirmed	
Trigger condition and cause	Condition: if the Motor Parameter Identification Wizard function has not been executed or the identification failed, once the servo is on, this alarm is triggered. Cause: the Motor Parameter Identification Wizard function has not been executed for the motor or the indentification process failed.
Checking method and corrective action	Execute or re-execute the Motor Parameter Identification Wizard function.
How to clear the alarm?	Switch the servo to the Servo Off state to clear this alarm.

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 upper limit of the current setting (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 properly set. 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.

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AL05C Motor position feedback error	
Checking method and corrective action	1. Check if the feedback signal is abnormal. Use the software scope 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 is increased 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 loss of power. Cause: 1. Voltage level of the battery is too low. 2. The battery is replaced when the main power of the servo drive is off. 3. The battery is not installed when the absolute function is enabled. 4. Poor connection or disconnection of the battery power circuit.
Checking method and corrective action	1. Check if the battery voltage is below 2.9V. Re-establish the absolute origin coordinate after replacing the battery. 2. Do not replace or remove the battery when the servo drive's main power 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 coordinate.
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 coordinate. Refer to Section 10.3.4 Establish the absolute origin coordinate for details.

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AL061 Encoder undervoltage	
Trigger condition and cause	Condition: voltage level of the absolute encoder battery is lower than the rated value (3.1V). Cause: voltage level of the battery is too low.
Checking method and corrective action	1. Read the battery voltage with monitoring variable 26h to see if it is below 3.1V. 2. Measure the battery voltage to see if it is below 3.1V. If the voltage is too low, replace the battery when the servo drive's main power is On.
How to clear the alarm?	The alarm is cleared automatically.

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 between -32768 and +32767. If not, re-establish the absolute origin coordinate.
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 2 G. If the vibration is within the range but 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.

AL066 Number of revolutions of the absolute encoder overflows (issued by servo drive)	
Trigger condition and cause	Condition: the number of revolutions of the absolute motor exceeds half the number of revolutions of the encoder resolution. 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	Check if the motor's number of revolutions during operation is within the range specified above. If not, re-establish the absolute origin coordinate.
How to clear the alarm?	Re-establish the absolute origin coordinate.

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 encoder 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 the 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.

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AL06A Absolute position is lost	
Trigger condition and cause	There are two conditions that may cause the loss of absolute position. One is that the absolute coordinate is not established. When the absolute origin coordinate is established, the origin is lost after power cycling of the servo drive. The other is that an error occurred. After the absolute origin coordinate is established, AL06A still occurs after power cycling of the servo drive. ■ Absolute coordinate is not established Condition: 1. Servo drive in use for the first time. 2. The battery is drained and the power supply of the servo drive is cut off. 3. When the bus communication type (CANopen, DMCNET, EtherCAT) servo 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 coordinate 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 communication type coordinate system needs to be re-established. ■ An error occurred. Condition: 1. Encoder cable is damaged (including the exterior and the 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, and J1 and J2 are connected reversely. 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 function of the capacitor is to act as a buffer to supply power when the power of the servo drive is cut off and switching to battery power supply.

AL06A Absolute position is lost	
Checking method and corrective action	1. Check if the absolute origin coordinate 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 to replace the battery when the servo drive is powered on, so the absolute encoder has continuous power supply. 3. Re-establish the absolute origin coordinate. 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 that 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 coordinate.

AL06B The error between the servo drive internal coordinate and the encoder coordinate 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 resolution. Cause: the error between the servo drive internal coordinate and the encoder coordinate 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 coordinate.

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.

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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 coordinate, contact your local distributor or technician.
How to clear the alarm?	Cycle power on the servo drive and re-establish the absolute origin coordinate.

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 wiring 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. When the encoder is powered by the servo drive: over 8,800 rpm. 2. When the encoder is powered by the battery: over 10,000 rpm. 3. Voltage level of the battery is too low.
Checking method and corrective action	1. Check if the motor is properly grounded. Make sure the power cable (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 a shielded cable for the encoder, pull out the shielded mesh, and ground it. 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.

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AL072 Encoder overspeed	
	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 power cable (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 a shielded cable for the encoder, pull out the shielded mesh, and ground it. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, 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 power cable (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 a shielded cable for the encoder, pull out the shielded mesh, and ground it. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, 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 power cable (green end) is grounded to the servo drive heat sink.

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AL075 Encoder absolute number of revolutions is in error	
	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 a shielded cable for the encoder, pull out the shielded mesh, and ground it. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, 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 power cable (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 a shielded cable for the encoder, pull out the shielded mesh, and ground it. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, 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 activate the parameter.
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

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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 power cable (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 a shielded cable for the encoder, pull out the shielded mesh, and ground it. 4. Check the motor speed and make sure it is within the rated range. If the issue persists, 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 while the motor speed is over 200 rpm. If so, 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?	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 power is cycled on the servo drive, causing the motor to stop 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?	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.

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AL07E Error occurs when the encoder clears the procedure	
How to clear the alarm?	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 cable is short-circuited. 2. Motor wiring is in error. 3. The analog signal GND for the servo drive is interfered.

Checking method and corrective action	1. Check the connection between the motor power cable and its connector. If metal wire is exposed or the wire is torn, the UVW cable can short-circuit. In this case, replace the power cable to prevent the metal conductor from being exposed.
	
	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.
	
	3. Check if the analog signal GND is mistakenly connected to another ground signal (incorrect connection can cause interference). Do not use a common ground for the analog signal GND and other signal cables. 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, re-calculate the value for the regenerative resistor, and 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

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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 the regenerative resistor or no connection to an external regenerative resistor. 2. Incorrect parameter settings for P1.052 and P1.053. 3. Other energy (such as interference) is input to the servo drive or the input voltage is higher than the allowable rated voltage. 4. Malfunction of the servo drive hardware.
Checking method and corrective action	1. Check the connection for the regenerative resistor and correctly set the values of P1.052 and P1.053. 2. Reassess whether the regenerative energy exceeds the value of P1.053. If the regenerative energy exceeds the set value, replace the regenerative resistor with a regenerative resistor that has a higher capacity. 3. Use a voltmeter to measure if the input voltage from the power supply is within the allowable rated voltage (refer to Appendix A Specifications). If the input voltage exceeds the rated range, remove the interference source. 4. Measure the voltage between P3 and $\ominus$ terminals. If it does not match the displayed DC Bus voltage when you enter monitoring code 14 to P0.002, the servo drive may be malfunctioning. Send your servo drive back to the distributor or contact Delta. 5. If you took the above actions and the issue persists, use a scope with a differential carbon rod to measure whether the input voltage has high-frequency signal interference. If there is interference, remove the interference source, and use the right voltage source or connect the regulator in series.
How to clear the alarm?	DI.ARST

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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.
Checking method and corrective action	1. Make sure a command is issued. 2. Set the two positioning points again. 3. Check for the wiring between the controller and the servo drive.
How to clear the alarm?	DI.ARST

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AL08B Auto-tuning function - pause time is too short	
Trigger condition and cause	Condition: the pause 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 pause time is too short. Cause: pause 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 slow. 3. Load inertia of the machine is too large. 4. Inertia variation of the machine 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 to 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

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. Set P2.008 to 30 first and then set it to 28. Next, cycle power on the servo drive. Contact Delta if this error persists.
How to clear the alarm?	Set P2.008 to 30 and then 28. Cycle power on the servo drive.

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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 procedure 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 and then 28. Cycle power on the servo drive.

AL09F Capacitor charging error	
Trigger condition and cause	Condition: the charging time of the capacitor exceeds the normal range. Cause: 1. The input voltage of the main circuit is lower than the allowable rated value or the current is too low. 2. Incorrect setting value of P4.024 (Level of undervoltage error). 3. IGBT error.
Checking method and corrective action	1. Check if the voltage wiring is correct and the wiring of input voltage 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. Check if using the right voltage source or connecting the transformer in series. 4. Check the wiring of the external regenerative resistor. 5. Send your servo drive back to the distributor or contact Delta.
How to clear the alarm?	Cycle power on the servo drive.

AL0A6 Absolute position coordinates 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 coordinates 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 coordinate.
How to clear the alarm?	Re-establish the absolute origin coordinate.

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AL111 Buffer overflow occurs when SDO is received	
Trigger condition and cause	SDO Rx Buffer overflows (the servo drive receives more than two SDOs within 1 ms).
Checking method and corrective action	Check if the servo drive (master) receives or sends more than one SDO within 1 ms.
How to clear the alarm?	NMT: reset node, 0x6040 fault reset, or DI.ARST.

AL112 Buffer overflow occurs when PDO is received	
Trigger condition and cause	PDO Rx Buffer overflows (the servo drive receives more than two PDOs of the same COB-ID within 1 ms).
Checking method and corrective action	Check if the servo drive (master) receives or sends more than one PDO of the same COB-ID within 1 ms.
How to clear the alarm?	NMT: reset node, 0x6040 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 properly.
How to clear the alarm?	NMT: reset node, 0x6040 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, 0x6040 fault reset, or DI.ARST.

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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, 0x6040 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 PDO.
How to clear the alarm?	NMT: reset node, 0x6040 fault reset, or DI.ARST.

AL124 Data range error occurs when PDO is accessed	
Trigger condition and cause	The data value in the message is out of range for the specified object.
Checking method and corrective action	Check if the written data is within range when the servo drive receives or sends PDO.
How to clear the alarm?	NMT: reset node, 0x6040 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, 0x6040 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 PDO.
How to clear the alarm?	NMT: reset node, 0x6040 fault reset, or DI.ARST.

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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 PDO in the Servo On state.
How to clear the alarm?	NMT: reset node, 0x6040 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 reads from EEPROM when the servo drive receives or sends PDO.
How to clear the alarm?	NMT: reset node, 0x6040 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 PDO.
How to clear the alarm?	NMT: reset node, 0x6040 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 is greater than the allowable space specified by the firmware. It is probably because the firmware has been updated, but the data in the ROM was stored by the 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 PDO.
How to clear the alarm?	NMT: reset node, 0x6040 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 PDO. Usually, this alarm is caused by an error in DSP.
How to clear the alarm?	NMT: reset node, 0x6040 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, 0x6040 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, 0x6040 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, 0x6040 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, 0x6040 fault reset, or DI.ARST.

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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, 0x6040 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 0x1011 to complete the setting. (b) To write the current value, set the CANopen object 0x1010. 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?	0x6040 fault reset, DI.ARST, or 0x1011.

AL207 Parameter group of Type [8] PR is out of range	
Trigger condition and cause	Condition: parameter group of Type [8] PR command is out of range. Cause: the group of Type [8] PR command source exceeds the range.
Checking method and corrective action	Write parameter using PR procedure: when the parameter group of command source exceeds the range, check the group setting of the written parameters.
How to clear the alarm?	DI.ARST

13

AL209 Parameter number of Type [8] PR is out of range	
Trigger condition and cause	Condition: parameter number of Type [8] PR command is out of range. Cause: the number of Type [8] PR command source exceeds the range.
Checking method and corrective action	Write parameter using PR procedure: when the parameter number of command source exceeds the range, check the set 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 do not match.
Checking method and corrective action	1. Check if the parameter format is correct. 2. Check if you are using the latest version of the ASDA-Soft software. 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 Write parameters: read-only	
Trigger condition and cause	Condition: when you use the PR procedure to write the parameter, the parameter is read-only. 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

13

AL217 Write parameters: write-protected when Servo On	
Trigger condition and cause	Condition: when you use the PR procedure 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 parameter 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 Write parameters: parameter cannot be written	
Trigger condition and cause	Condition: this parameter 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 item of Type [8] PR is out of range	
Trigger condition and cause	Condition: the code of the monitoring item for Type [8] PR command is out of range. Cause: the code of the monitoring item is out of range.
Checking method and corrective action	Write parameter using PR procedure: when the code of the monitoring item exceeds the range, check the code range for the monitoring item.
How to clear the alarm?	DI.ARST

AL235 Position counter overflow warning	
Trigger condition and cause	Condition: a positioning command is executed after the overflow of the position command counter. Cause: overflow of the position command counter.

13

AL235 Position counter overflow warning	
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 coordinate system cannot display the correct position. Issuing an absolute position command after overflow results in this error. Use the scope to check if the feedback position has overflowed and then execute the homing procedure. Absolute system: This error occurs when the absolute positioning command is issued in the following conditions: 1. Position feedback register (FB_PUU) overflows. 2. The absolute origin coordinate is not established after the setting of P1.001.Z is changed. 3. The absolute origin coordinate is not established after the E-Gear ratio (P1.044 and P1.045) is changed. 4. Established the absolute origin coordinate, but the procedure is incomplete. 5. When AL060 and AL062 occur, use the scope to check if the feedback position has overflowed. Check whether the above conditions have occurred, and then establish the absolute origin coordinate.
How to clear the alarm?	Incremental system: perform homing procedure after using DI.ARST to clear the alarm. Absolute system: establish the absolute origin coordinate.

AL237 Indexing coordinate is undefined	
Trigger condition and cause	The starting point of the indexing coordinate is not defined before you operate the indexing function and execute the indexing positioning command. This alarm occurs because the servo drive cannot identify the coordinate system.
Checking method and corrective action	Check if the indexing coordinate is undefined: perform the homing procedure before using the indexing function 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.

AL245 PR positioning timeout	
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 upper limit. 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 target position specified by the command exceeds the software positive limit. Cause: the software positive limit is triggered.
Checking method and corrective action	The software positive limit is determined by the Position command instead of the actual feedback position because the command is sent before the feedback is received. That is, the actual position may not have exceeded the limit when this limit protection is enabled. Set the 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 target position specified by the command exceeds the software negative limit. Cause: the software negative limit is triggered.
Checking method and corrective action	The software negative limit is determined by the Position command instead of the actual feedback position because the command is sent before the feedback is received. That is, the actual position may not have exceeded the limit when this limit protection is enabled. Set the 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.

13

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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 indexing coordinate from overflow), set P2.070 [Bit 2] to 1.
How to clear the alarm?	DI.ARST

AL301 CANopen synchronization failure	
Trigger condition and cause	Condition: the synchronization with the controller fails when you use the CANopen IP mode (in B mode). Cause: communication fails to synchronize.
Checking method and corrective action	1. Make sure the communication between the servo drive and controller is good. 2. After eliminating any problems that you find, allow the controller to re-send the synchronization signal and ensure that it is sent successfully. 3. Modify the setting for P3.009 (the default value is suggested).
How to clear the alarm?	NMT: reset node or 0x6040 fault reset.

AL302 Synchronization signal of CANopen is sent too soon	
Trigger condition and cause	Condition: the synchronization signal is received too early when you use the CANopen IP mode (in B mode). Cause: the synchronization signal of CANopen is sent too soon.
Checking method and corrective action	1. Make sure the setting of synchronization cycle (0x1006) is identical to that of the controller. 2. Modify the synchronization error range setting (P3.009.U). 3. Ensure the correct time sequence of sending packets from the controller. A drift or delay in packet sending time causes synchronization failure.
How to clear the alarm?	NMT: reset node or 0x6040 fault reset.

AL303 CANopen synchronization signal timeout	
Trigger condition and cause	Condition: the synchronization with the controller fails when you use the CANopen IP mode (in B mode). Cause: timeout of CANopen synchronization signal.

AL303 CANopen synchronization signal timeout	
Checking method and corrective action	1. Make sure the communication between the servo drive and controller is good. 2. Make sure the setting of synchronization cycle (0x1006) is identical to that of the controller. 3. Modify the synchronization error range setting (P3.009.U). 4. Ensure the correct time sequence of sending packets from the controller. A drift or delay in packet sending time causes synchronization failure. 5. When the servo drive is in the operation mode of PV (Profile velocity mode) or HM (Homing mode), check if P3.017 is set too low.
How to clear the alarm?	NMT: reset node or 0x6040 fault reset.

13

AL304 Invalid interpolation mode command	
Trigger condition and cause	Condition: the servo drive cannot send the command when in CANopen IP mode (except in B mode). Cause: the interpolation command fails.
Checking method and corrective action	The computing time takes too long. Disable the USB monitoring function.
How to clear the alarm?	NMT: reset node or 0x6040 fault reset.

AL305 SYNC period error	
Trigger condition and cause	Condition: CANopen 301 Obj 0x1006 Data Error. Cause: SYNC period is in error.
Checking method and corrective action	Check the value of 0x1006. If it is smaller than or equal to 0, this alarm occurs.
How to clear the alarm?	NMT: reset node or 0x6040 fault reset.

AL35F Emergency stop during deceleration	
Trigger condition and cause	The rising edge of DI(0x47) is triggered, and then the motor decelerates to 0 and triggers AL3CF.
Checking method and corrective action	Check if any of the parameters, P2.010 - P2.017 and P2.036 - P2.040, is set to DI(0x47) and is triggered.
How to clear the alarm?	Cycle power on the servo drive.

13

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. DO.MC_OK is on, but then it 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 DI(0x47) and is triggered.
How to clear the alarm?	Cycle power on the servo drive.

AL3E1 Communication fails to synchronize	
Trigger condition and cause	Condition: the communication synchronization with the controller fails in CANopen IP mode (except in B mode). Cause: communication fails to synchronize.
Checking method and corrective action	1. Make sure the communication between the servo drive and controller is good. 2. After eliminating any problems that you find, allow the controller to re-send the synchronization signal and ensure that it is sent successfully. 3. Modify the setting for P3.009 (the default value is suggested).
How to clear the alarm?	NMT: reset node or 0x6040 fault reset.

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 synchronization cycle (0x1006) is identical to that of the controller. 2. Modify the synchronization error range setting (P3.009.U). 3. Ensure the correct time sequence of sending packets from the controller. A drift or delay in packet sending time causes synchronization failure.
How to clear the alarm?	NMT: reset node or 0x6040 fault reset.

13

AL3E3 Communication synchronization signal timeout	
Trigger condition and cause	The target command is not received within a continuous communication cycle in CANopen IP mode (except in B mode).
Checking method and corrective action	1. Make sure the communication between the servo drive and controller is good. 2. Make sure the setting of synchronization cycle (0x1006) is identical to that of the controller. 3. Modify the synchronization error range setting (P3.009.U). (For B3-M and B3-F models.) 4. Modify the setting of IP command timeout (P3.022.YX). (For B3-E models.) 5. Ensure the correct time sequence of sending packets from the controller. A drift or delay in packet sending time causes synchronization failure.
How to clear the alarm?	NMT: reset node or 0x6040 fault reset.

AL3F1 Absolute position command of the communication type servo drive is in error	
Trigger condition and cause	Condition: the bus communication type (CANopen, DMCNET, and EtherCAT) servo drive is in combination with an incremental motor, and when the position overflow occurs and the absolute origin coordinate has not been established, the absolute positioning command is issued. Cause: 1. The absolute origin coordinate is not established. 2. Overflow occurs since the motor keeps rotating in the same direction.
Checking method and corrective action	Establish the absolute origin coordinate.
How to clear the alarm?	Establish the absolute origin coordinate.

AL400 Indexing coordinate setting error	
Trigger condition and cause	Condition: the position offset of the motor in 1 ms exceeds the setting of P2.052 (Indexing coordinates 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

13

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. Use NMT: reset node or 0x6040 fault reset.
How to clear the alarm?	DI.ARST

AL404 PR special filter setting value is too great	
Trigger condition and cause	Condition: 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. Cause: the following error of the internal position exceeds 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. 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 indexing coordinate from overflow) 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 depending on the version. 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.

13

AL500 STO function is enabled	
Trigger condition and cause	Safe torque off function (STO) is enabled.
Checking method and corrective action	Safe torque off function (STO) is enabled. Check why it is enabled.
How to clear the alarm?	1. Reset by using DI.ARST (Alarm reset), 0x6040 fault reset, or setting P0.001 to 0. 2. If not using the STO function, plug the short circuit terminal into CN10 or wire to short-circuit the block. Follow the instructions in Chapter 3 for the STO wiring.

AL501 STO_A lost (signal loss or signal error)	
Trigger condition and cause	Loss of STO_A signal or STO_A and STO_B signals are not synchronized for more than 1 second.
Checking method and corrective action	Make sure the wiring of STO_A is correct.
How to clear the alarm?	Cycle power on the servo drive.

AL502 STO_B lost (signal loss or signal error)	
Trigger condition and cause	Loss of STO_B signal or STO_A and STO_B signals are not synchronized for more than 1 second.
Checking method and corrective action	Make sure the wiring of STO_B is correct.
How to clear the alarm?	Cycle power on the servo drive.

AL503 STO self-diagnostic error	
Trigger condition and cause	An error occurs during STO self-diagnosis, which may be caused by an abnormality in the STO circuit.
Checking method and corrective action	N/A
How to clear the alarm?	Contact the distributor.

AL510 Internal parameter update program of the servo drive is abnormal	
Trigger condition and cause	Internal parameter update program of the servo drive is abnormal.
Checking method and corrective action	If this alarm occurs when the motor parameter identification function is executing, cycle power on the servo drive and re-execute the motor parameter identification function.
How to clear the alarm?	N/A

13

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 while the operation system is analyzing the program.
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.

Specifications

A

A.1 ASDA-B3 series servo drive

A.1.1 Specifications of the ASDA-B3 servo drive

ASDA-B3		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	0.88	1.29	2.04	3.52	5.72	6.33	7.6	10.3
	Input current (1PH) Unit: Arms	1.47	2.35	3.74	6.47	10.4	11.7	-	-
	Inrush current (220V) Unit: Arms	5.50	5.50	5.50	5.50	12.45	12.45	12.45	12.45
Control power	Phase / Voltage	Single-phase 220 V~AC~							
	Permissible voltage	Single-phase 200 - 230 V~AC~, -15% to +10%							
	Input current (220V) Unit: Arms	0.13	0.13	0.13	0.13	0.15	0.15	0.17	0.17
	Inrush current (220V) Unit: Arms	24.89	24.89	24.89	24.89	24.89	24.89	24.89	24.89
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	27	38.3	58.9
Regenerative resistor	Built-in / Resistance (Ohm)	-	-	100	100	100	100	20	20
	Built-in / Capacity (Watt)	-	-	40	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 shown above is tested when the servo drive is supplied with 200 VAC and its output current is within the rated specification.

2. When an electrical transformer is used, the actual output of the servo drive is 70% of its specification.

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 + Direction, CCW pulse + CW pulse, A phase + B phase
	Max. input pulse frequency		Pulse + Direction: 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
	Smoothing method		Low-pass, S-curve, and moving filters
	E-Gear ratio		E-Gear ratio: N/M times, limited to (1/4 < N/M < 262144) N: 1 - 536870911 / M: 1 - 2147483647
	Torque limit		Parameter settings
	Feed forward 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 and S-curve filters
	Torque limit		Parameter settings / Analog input
	Bandwidth		Maximum 3.1 kHz
	Speed calibration ratio[*2]		±0.01% at 0% to 100% load fluctuation
			±0.01% at ±10% power fluctuation
			±0.01% at 0˚C to 50˚C (32°F to 122°F) ambient temperature fluctuation
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 monitor output			Monitor signal can be set by parameters (voltage output range: ±8V); resolution:10-bit
Digital input			L model: 9 sets of input; M, F, and E models: 4 sets of input. Refer to Chapter 8 for the function settings.
Digital output			L model: 6 sets of output; M, F, and E models: 2 sets of output. Refer to Chapter 8 for the function settings.

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Item	Specification
Protection function	Overcurrent, Overvoltage, Undervoltage, Overheat, Regeneration error, Overload, Excessive speed deviation, Excessive position deviation, Encoder error, Calibration error, Emergency stop, Forward / reverse limit error, Serial communication error, RST leak phase, Serial communication timeout, Short-circuit protection for terminals U, V, and W.
Communication interface	RS-485 / USB / CANopen / DMCNET / EtherCAT

	Item	Specification
Environment	Installation site	Indoors (avoid direct sunlight), no corrosive vapor (avoid fumes, flammable gases, and dust)
	Altitude	Below 2,000 m above sea level
	Atmospheric pressure	86 kPa - 106 kPa
	Operating temperature	0˚C - 55˚C (32˚F - 131˚F) (If the operating temperature is above 45˚C (113˚F), forced cooling is required)
	Storage temperature	-20˚C to +65˚C (14˚F to 176˚F)
	Humidity	Under 0 - 90% RH (non-condensing)
	Vibrating	10 Hz to 57 Hz: 0.075 mm amplitude; 58 Hz to 150 Hz: 1G
	IP rating	IP20
	Power system	TN system[3][4]
	Approvals	IEC/EN/UL/TUV[5] 61800-5-1 CE UL CERTIFIED SAFETY US-CA IND. CONT. EQ. E176972 TÜVRheinland CERTIFIED Functional Safety www.tuv.com ID. 0600000000

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:

   (rotational speed with no load - rotational speed with full load) / rated speed.

3. TN system: the neutral point of the power system connects directly to the ground. The exposed metal components connect to the ground through the protective ground conductor.

4. Use a single-phase three-wire power system for the single-phase power model.

5. Only B3A series model is TUV certified.

6. Scan the QR code or visit Delta's website to download the CE certificate:

A.1.2 Dimensions of the servo drive

100 W / 200 W / 400 W

A
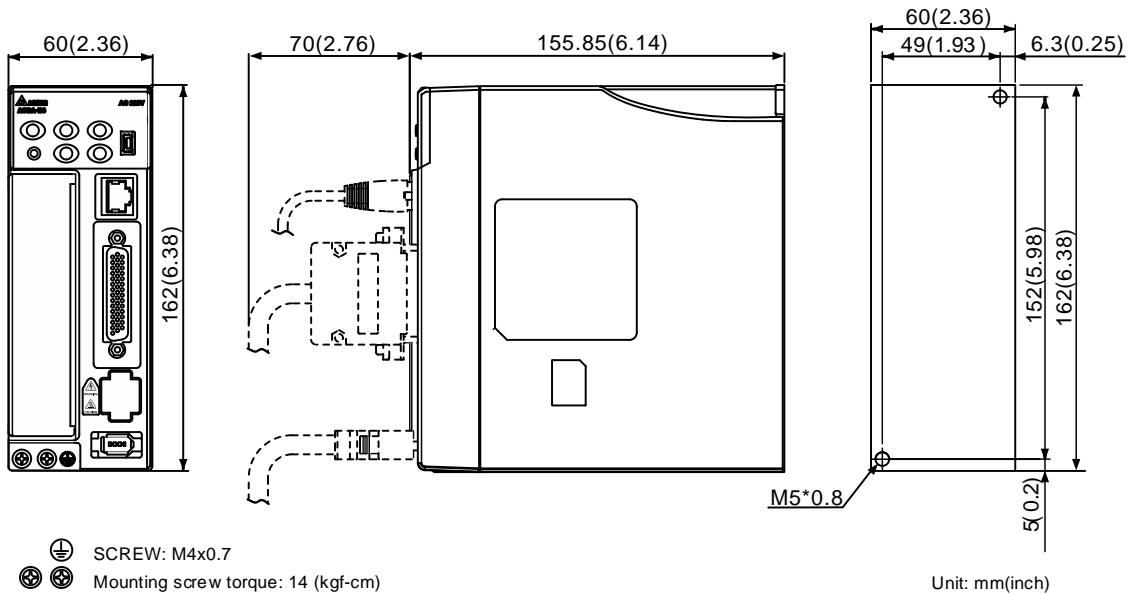
SCREW: M4x0.7
Mounting screw torque: 14 (kgf-cm)

Unit: mm(inch)

Weight	0.9 kg (1.98 lb)

750 W
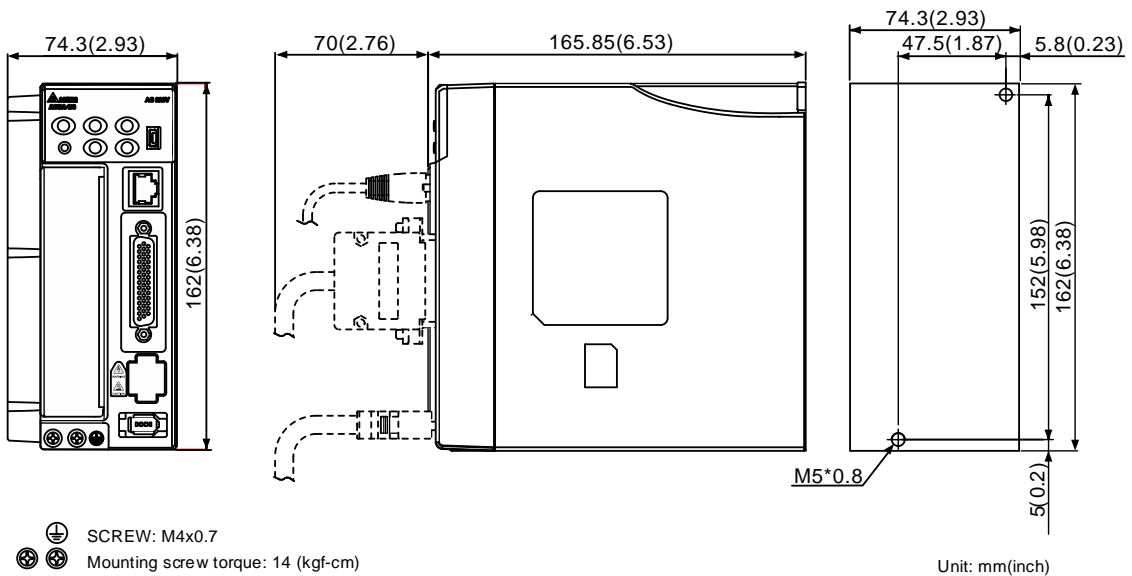
SCREW: M4x0.7
Mounting screw torque: 14 (kgf-cm)

Unit: mm(inch)

Weight	1.2 kg (2.64 lb)

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1 kW / 1.5 kW

80.2(3.16)   70(2.76)   194.15(7.64)   80.2(3.16)   7.7(0.3)

67(2.64)

162(6.38)   152(5.98)   162(6.38)

5(0.2)

M5*0.8

⏚ SCREW: M4x0.7
⊕ ⊕ Mounting screw torque: 14 (kgf-cm)

Unit: mm(inch)
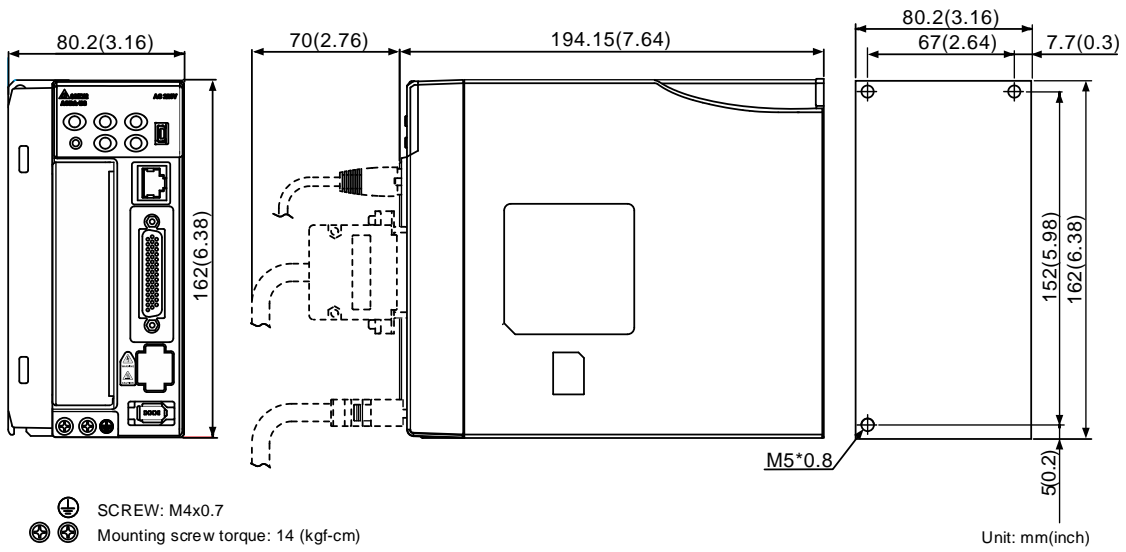
Weight	1.8 kg (3.96 lb)

2 kW / 3 kW

90(3.54)   70(2.76)   205.3(8.08)   90(3.54)

75(2.95)

225(8.86)   216(8.5)

3(0.12)

M5*0.8

⏚ SCREW: M4x0.7
⊕ ⊕ Mounting screw torque: 14 (kgf-cm)

Unit: mm(inch)
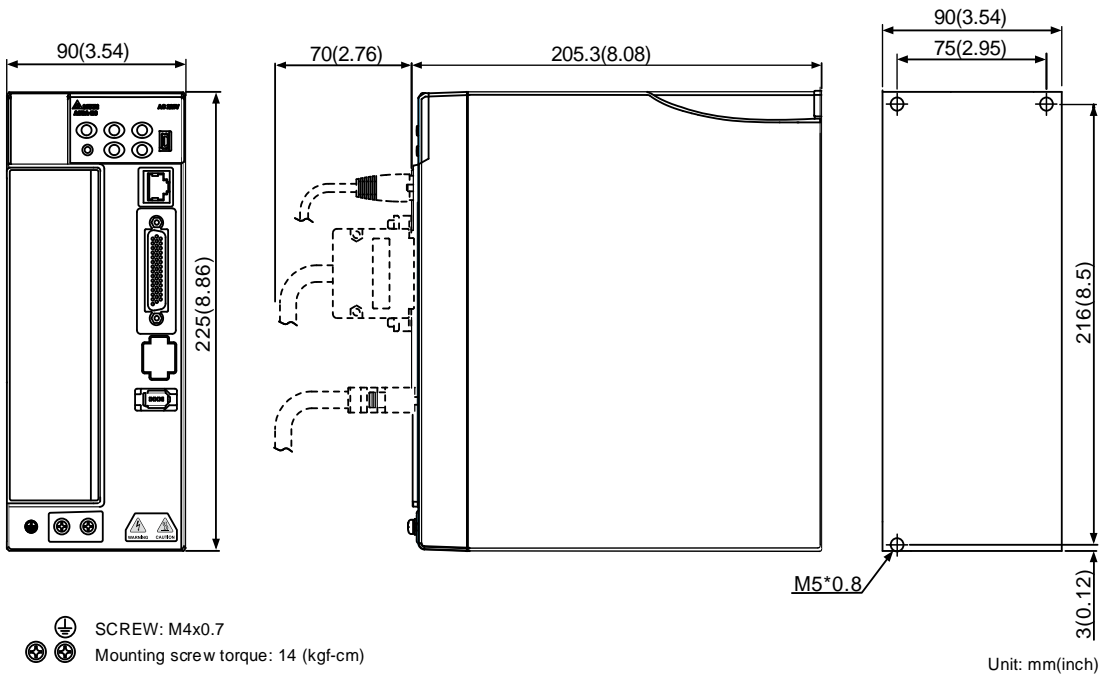
Weight	2.8 kg (6.17 lb)

Note: dimensions and weights of the servo drive may be updated without prior notice.

A.2   ECM-B3 series servo motor

ECM-B3 series servo motor

$$\underset{(1)}{\underline{\text{ECM}}} - \underset{(2)}{\underline{\text{B}}}\ \underset{(3)}{\underline{3}}\ \underset{(4)}{\underline{\text{M}}} - \underset{(5)}{\underline{\text{C}}}\ \underset{(6)}{\underline{2}}\ \underset{(7)}{\underline{06}}\ \underset{(8)}{\underline{04}}\ \underset{(9)}{\underline{\text{R}}}\ \underset{(10)}{\underline{\text{S}}}\ \underset{(11)}{\underline{1}}$$

A

(1) Product name

ECM: Electronic Commutation Motor

(2) Servo type

B: general 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: 24-bit absolute optical encoder

(resolution of single turn: 24-bit; number of revolutions: 16-bit)

2: 24-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: 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 kW
02	200 W	15	1.5 kW
04	400 W	20	2 kW
07	750 W	30	3 kW

(9) Shaft type and oil seal

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

Note: coming soon.

(10) Shaft diameter and connector type

S: standard shaft diameter and standard connectors

7: special shaft diameter (14 mm)* and standard connectors

J: standard shaft diameter and IP67 waterproof connectors

K: special shaft diameter (14 mm)* and IP67 waterproof connectors

Note: special shaft diameter is available for F80 400W models.

(11) Special code

1: standard products

Note: the model information is for reference only. Not all kinds of permutations are available. Contact the distributor or Delta for the details.

A.2.1 ECM-B3 series servo motor

Motor frame size: 80 mm and below

ECM-B3▢	C▢0401	C▢0602	C▢0604	C▢0804	C▢0807
Rated power (kW)	0.1	0.2	0.4	0.4	0.75
Rated torque (N-m)[*1]	0.32	0.64	1.27	1.27	2.4
Max. torque (N-m)	1.12	2.24	4.45	4.45	8.4
Rated speed (rpm)	3000				
Max. speed (rpm)	6000				
Rated current (Arms)	0.857	1.42	2.40	2.53	4.27
Max. instantaneous current (Arms)	3.44	6.62	9.47	9.42	15.8
Change of rated power (kW/s)	34.25	29.05	63.50	24.89	53.83
Change of rated power (kW/s) (with brake)	32.51	27.13	61.09	23.21	50.97
Rotor inertia ($\times 10^{-4}$kg.m^2)	0.0299	0.141	0.254	0.648	1.07
Rotor inertia ($\times 10^{-4}$kg.m^2) (with brake)	0.0315	0.151	0.264	0.695	1.13
Mechanical time constant (ms)	0.50	0.91	0.52	0.8	0.54
Mechanical time constant (ms) (with brake)	0.53	0.97	0.54	0.86	0.57
Torque constant-KT (N-m/A)	0.374	0.45	0.53	0.5	0.56
Voltage constant-KE (mV/rpm)	13.8	16.96	19.76	18.97	20.17
Armature resistance (Ohm)	8.22	4.71	2.04	1.125	0.55
Armature inductance (mH)	19.1	12.18	6.50	5.14	2.81
Electrical time constant (ms)	2.32	2.59	3.19	4.57	5.11
Weight (w/o brake) (kg)	0.5	0.9	1.2	1.7	2.34
Weight (with brake) (kg)	0.7	1.3	1.6	2.51	3.15
Max. radial loading (N)	78	245	245	392	392
Max. axial loading (N)	54	74	74	147	147
Brake operating voltage	24 V$_{DC}$ ± 10%				
Brake power consumption (at 20˚C (68˚F))[W]	6.1	7.6	7.6	8	8
Brake holding torque [Nt-m (min)] [*2]	0.3	1.3	1.3	2.5	2.5
Brake release time [ms (Max)]	20	20	20	20	20
Brake pull-in time [ms (Max)]	35	50	50	60	60
Derating rate with oil seal (%)	10	10	5	5	5
Insulation class	Class A (UL), Class B (CE)				
Insulation resistance	> 100 MΩ, DC 500V				
Insulation strength	1.8k V$_{AC}$, 1 sec				
Vibration grade (µm)	V15				

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ECM-B3①	C②0401	C②0602	C②0604	C②0804	C②0807
Operating temperature	-20˚C to +60˚C (-4°F to +140°F)[*4]
Storage temperature	-20˚C to +80˚C (14˚F to 176˚F)				
Operating humidity	20 - 90% RH (non-condensing)				
Storage humidity	20 - 90% RH (non-condensing)				
Vibration capacity	2.5 G				
IP rating	IP67 (for models using waterproof connectors and shaft seals or oil seals)				
Approvals					

Note:

1. The rated torque is the continuous permissible torque between 0˚C - 40˚C (32˚F - 104˚F) operating temperature which is suitable for the servo motor mounted with the heat sink of the following dimensions.

   F04, F06, and F08: 250 mm x 250 mm x 6 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. In the servo motor model name, ① represents the inertia and ② represents the encoder type.

4. If the ambient temperature is over 40˚C (104˚F), refer to Section A.2.3 Power derating curves of the B3 motor.

5. Follow the load specification for the motor shaft during operation. The load for the motor shaft is defined as follows.
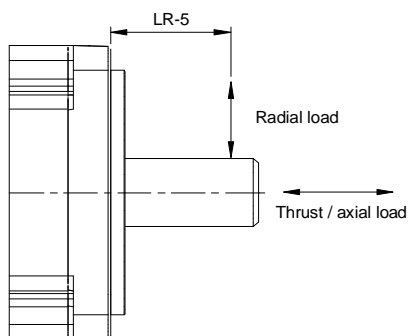
Motor frame size: 130 - 180 mm

ECM-B3□	E□1310	E□1315	E□1320	E□1820	F□1830
Rated power (kW)	1	1.5	2	2	3
Rated torque (N-m)[*1]	4.77	7.16	9.55	9.55	19.1
Max. torque (N-m)	14.3	21.48	28.65	28.65	57.29
Rated speed (rpm)	2000				1500
Max. speed (rpm)	3000				3000
Rated current (Arms)	5.96	8.17	10.59	11.43	18.21
Max. instantaneous current (Arms)	19.9	26.82	34.20	36.21	58.9
Change of rated power (kW/s)	29.21	45.69	62.25	31.33	68.02
Change of rated power (kW/s) (with brake)	28.66	45.09	61.62	30.02	66.45
Rotor inertia ($\times 10^{-4}$kg.m^2)	7.79	11.22	14.65	29.11	53.63
Rotor inertia ($\times 10^{-4}$kg.m^2) (with brake)	7.94	11.37	14.8	30.38	54.9
Mechanical time constant (ms)	1.46	1.10	1.03	1.74	1.21
Mechanical time constant (ms) (with brake)	1.49	1.12	1.04	1.81	1.24
Torque constant-KT (N-m/A)	0.80	0.88	0.90	0.88	1.05
Voltage constant-KE (mV/rpm)	29.30	31.69	32.70	31.6	37.9
Armature resistance (Ohm)	0.419	0.260	0.198	0.159	0.086
Armature inductance (mH)	4	2.81	2.18	2.34	1.52
Electrical time constant (ms)	9.55	10.81	11.01	14.72	17.67
Weight (w/o brake) (kg)	4.9	6.0	7	10	13.9
Weight (with brake) (kg)	6.3	7.4	8.5	13.7	17.6
Max. radial loading (N)	490	686	980	1470	1470
Max. axial loading (N)	98	343	392	490	490
Brake operating voltage	24 V$_{DC}$ ± 10%				
Brake power consumption (at 20°C (68°F))[W]	21.5	21.5	21.5	31	31
Brake holding torque [Nt-m (min)] [*2]	10	10	10	25	25
Brake release time [ms (Max)]	50	50	50	30	30
Brake pull-in time [ms (Max)]	110	110	110	120	120
Derating rate with oil seal (%)	5	5	5	5	5
Insulation class	Class A (UL), Class B (CE)				
Insulation resistance	> 100 MΩ, DC 500V				
Insulation strength	1.8k V$_{AC}$, 1 sec				
Vibration grade (µm)	V15				
Operating temperature	-20°C to +60°C (-4°F to +176°F)[*4]				
Storage temperature	-20°C to +80°C (14°F to 176°F)				

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ECM-B3①	E②1310	E②1315	E②1320	E②1820	F②1830
Operating humidity	20 - 90% RH (non-condensing)				
Storage humidity	20 - 90% RH (non-condensing)				
Vibration capacity	2.5 G				
IP rating	IP67 (for models using waterproof connectors and shaft seals or oil seals)				
Approvals	CE c ℞ US				

Note:

1. The rated torque is the continuous permissible torque between 0˚C - 40˚C (32˚F - 104˚F) operating

    temperature which is suitable for the servo motor mounted with the heat sink of the following

    dimensions.

    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. In the servo motor model name, ① represents the inertia and ② represents the encoder type.

4. If the ambient temperature is over 40˚C (104˚F), refer to Section A.2.3 Power derating curves of the B3

    motor.

5. Follow the load specification for the motor shaft during operation. The load for the motor shaft is defined

    as follows.
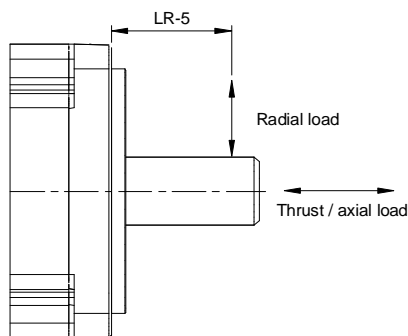
A.2.2   Torque features (T-N curves) of the B3 motors

Torque (N-m)

1.12 (350%)

0.52 (162%)

0.32 (100%)
0.16 (50%)

Intermittent duty zone

Continuous duty zone

Speed (rpm)

3000 3300   6000

ECM-B3L-C☐0401☐☐☐

Torque (N-m)

2.24 (350%)

1.30 (203%)

0.64 (100%)
0.32 (55%)

Intermittent duty zone

Continuous duty zone

Speed (rpm)

3000   6000

ECM-B3M-C☐0602☐☐☐

Torque (N-m)

4.45 (350%)

2.81 (221%)

1.27 (100%)
0.64 (50%)

Intermittent duty zone

Continuous duty zone

Speed (rpm)

3000 3300   6000

ECM-B3M-C☐0604☐☐☐

Torque (N-m)

4.45 (350%)

3 (236%)

1.27 (100%)
0.63 (50%)

Intermittent duty zone

Continuous duty zone

Speed (rpm)

3000 3700   6000

ECM-B3M-C☐0804☐☐☐

Torque (N-m)

ASD-B3☐-1021-☐
ASD-B3☐-0721-☐

8.4 (350%)
7.61 (317%)

6 (250%)
5.66 (236%)

2.4 (100%)
1.2 (50%)

Intermittent duty zone

Continuous duty zone

Speed (rpm)

3000   3700 3900 6000

ECM-B3M-C☐0807☐☐☐

Torque (N-m)

14.3 (300%)
13.81 (290%)

4.77 (100%)
3.18 (67%)

Intermittent duty zone

Continuous duty zone

Speed (rpm)

2000 2500 3000

ECM-B3M-E☐1310☐☐☐

Torque (N-m)

21.5 (300%)
20.47 (286%)

7.16 (100%)
4.77 (67%)

Intermittent duty zone

Continuous duty zone

Speed (rpm)

2000 2450 3000

ECM-B3M-E☐1315☐☐☐

Torque (N-m)

28.65 (300%)
26.75 (280%)

9.55 (100%)
6.37 (67%)

Intermittent duty zone

Continuous duty zone

Speed (rpm)

2000 2400 3000

ECM-B3M-E☐1320☐☐☐

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ECM-B3M-E②1820③④⑤

ECM-B3M-F②1830③④⑤

Note:

1. In the servo motor model name, ② represents the encoder type; ③ represents the brake or keyway / oil seal type; ④ represents the shaft diameter and connector type; ⑤ represents the special code.

2. The dotted line in ECM-B3M-C②0807③④⑤ is the specification for the ASD-B3①-0721-② servo drive; the solid line is the specification for the ASD-B3①-1021-② servo drive.

A.2.3   Power derating curves of the B3 motors
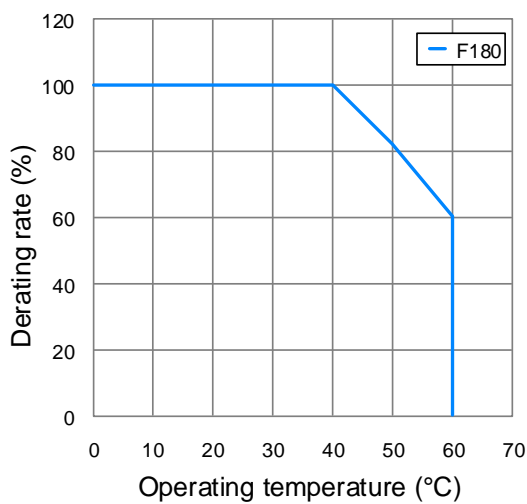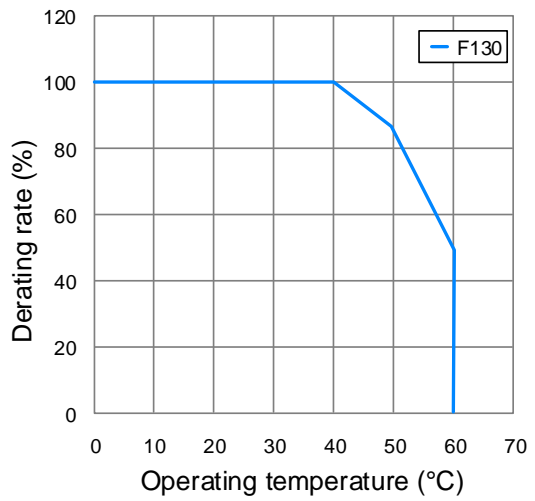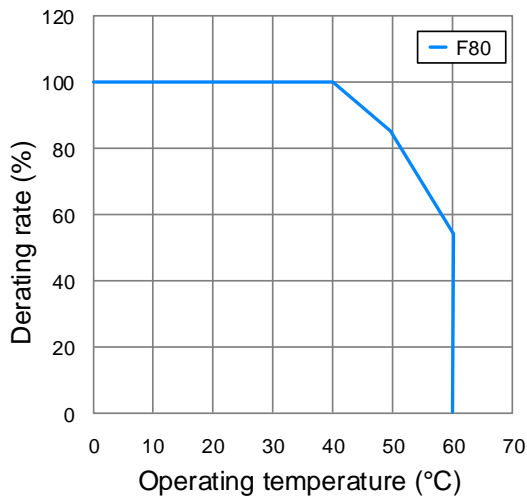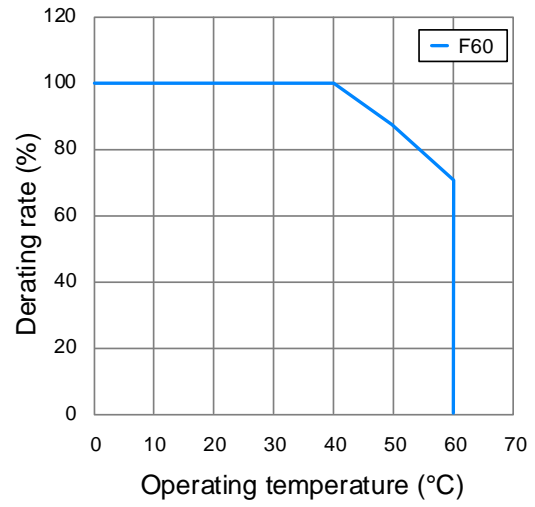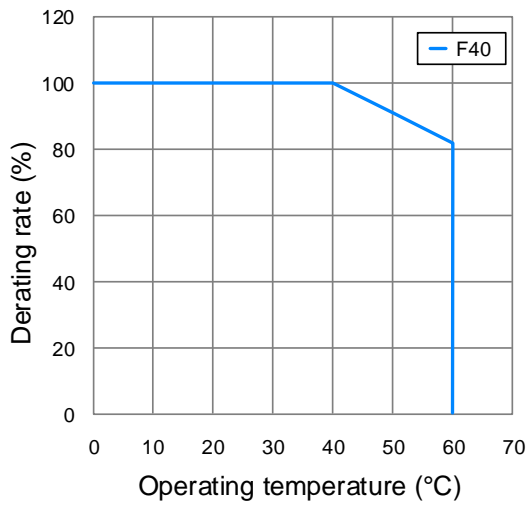
A.2.4 Overload features

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. You operate a motor with a built-in brake without releasing the brake.

Graph of load and operating time

Low inertia (ECM-B3L series), medium inertia (ECM-B3M-C series)
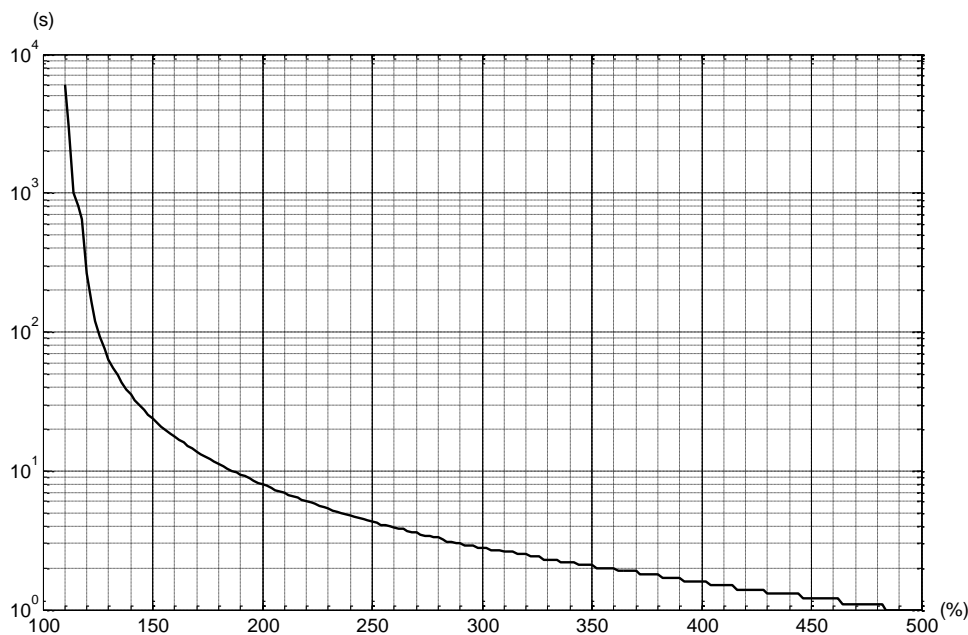
Load ratio	120%	140%	160%	180%	200%	220%	240%
Operating time	263.8 s	35.2 s	17.6 s	11.2 s	8 s	6.1 s	4.8 s
Load ratio	260%	280%	300%	350%	400%	450%	500%
Operating time	3.9 s	3.3 s	2.8 s	2.1 s	1.6 s	1.2 s	1.0 s

Medium inertia (ECM-B3M-E / F series)
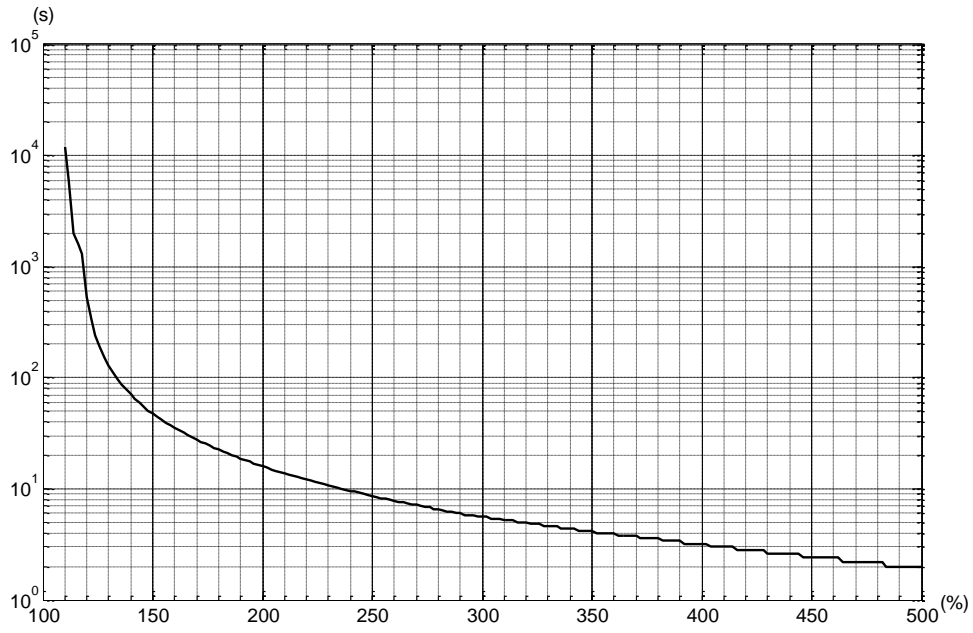
Load ratio	120%	140%	160%	180%	200%	220%	240%
Operating time	527.6 s	70.4 s	35.2 s	22.4 s	16 s	12.2 s	9.6 s
Load ratio	260%	280%	300%	350%	400%	450%	500%
Operating time	7.8 s	6.6 s	5.6 s	4.2 s	3.2 s	2.4 s	2.0 s

A.2.5   Dimensions of ECM-B3 series servo motor

Motor frame size: 80 mm and below

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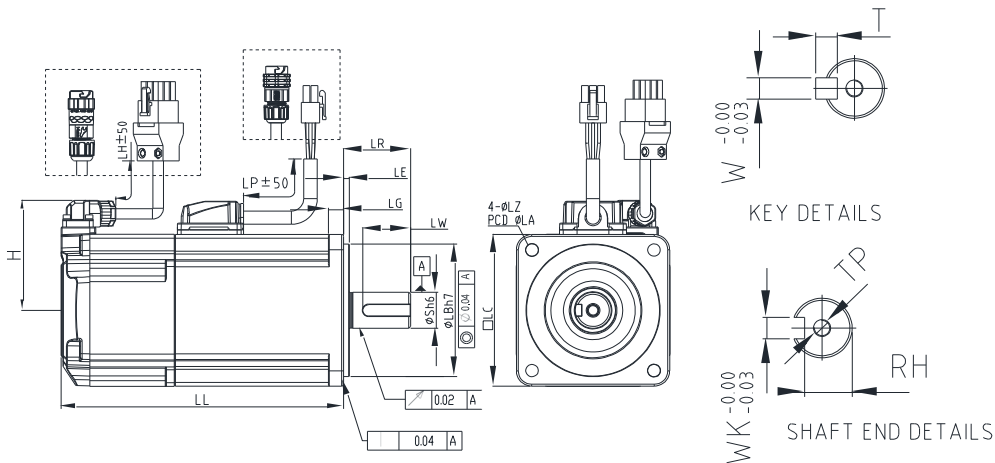
Model	C②0401③④⑤	C②0602③④⑤	C②0604③④⑤	C②0804③7⑤⑤	C②0807③④⑤
LC	40	60	60	80	80
LZ	4.5	5.5	5.5	6.6	6.6
LA	46	70	70	90	90
S	$8(^{+0}_{-0.009})$	$14(^{+0}_{-0.011})$	$14(^{+0}_{-0.011})$	$14(^{+0}_{-0.011})$	$19(^{+0}_{-0.013})$
LB	$30(^{+0}_{-0.021})$	$50(^{+0}_{-0.025})$	$50(^{+0}_{-0.025})$	$70(^{+0}_{-0.030})$	$70(^{+0}_{-0.030})$
LL (w/o brake)	77.6	72.5	91	86.7	105.2
LL (with brake)	111.7	109.4	127.9	126.3	144.8
LH	300	300	300	300	300
LP	300	300	300	300	300
H	40	48.5	48.5	58.5	58.5
LR	25	30	30	30	35
LE	2.5	3	3	3	3
LG	5	7.5	7.5	8	8
LW	16	20	20	20	25
RH	6.2	11	11	11	15.5
WK	3	5	5	5	6
W	3	5	5	5	6
T	3	5	5	5	6
TP	M3 Depth 8	M4 Depth 15	M4 Depth 15	M4 Depth 15	M6 Depth 20

Note:

1.   In the servo motor model name, ② represents the encoder type; ③ represents the brake or keyway / oil seal type; ④ represents the shaft diameter and connector type; ⑤ represents the special code.

2.   IP67 waterproof connectors are available for F80 and below models. Refer to Section A.2 for detailed model descriptions.

Motor frame size: 130 - 180 mm
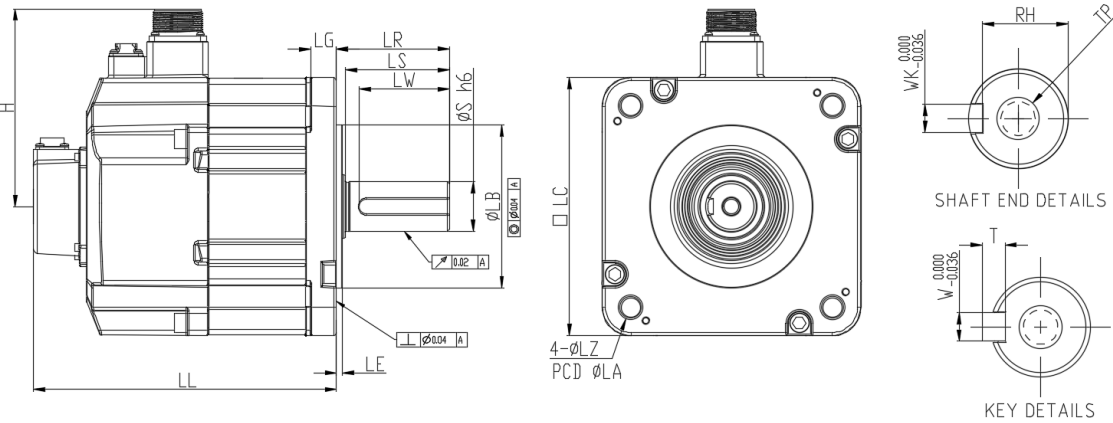
Model	E$\boxed{2}$1310$\boxed{3}$$\boxed{4}$$\boxed{5}$	E$\boxed{2}$1315$\boxed{3}$$\boxed{4}$$\boxed{5}$	E$\boxed{2}$1320$\boxed{3}$$\boxed{4}$$\boxed{5}$	E$\boxed{2}$1820$\boxed{3}$$\boxed{4}$$\boxed{5}$	F$\boxed{2}$1830$\boxed{3}$$\boxed{4}$$\boxed{5}$
LC	130	130	130	180	180
LZ	9	9	9	13.5	13.5
LA	145	145	145	200	200
S	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$22(^{+0}_{-0.013})$	$35(^{+0}_{-0.016})$	$35(^{+0}_{-0.016})$
LB	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$110(^{+0}_{-0.035})$	$114.3(^{+0}_{-0.035})$	$114.3(^{+0}_{-0.035})$
LL (w/o brake)	127.9	139.9	151.9	137.5	160.5
LL (with brake)	168.5	180.5	192.5	189.5	212.5
H	115	115	115	139	139
LS	47	47	47	73	73
LR	55	55	55	79	79
LE	6	6	6	4	4
LG	12.5	12.5	12.5	18	18
LW	36	36	36	63	63
RH	18	18	18	30	30
WK	8	8	8	10	10
W	8	8	8	10	10
T	7	7	7	8	8
TP	M6 Depth 12	M6 Depth 12	M6 Depth 12	M12 Depth 25	M12 Depth 25

Note: in the servo motor model name, $\boxed{2}$ represents the encoder type; $\boxed{3}$ represents the brake or keyway / oil seal type; $\boxed{4}$ represents the shaft diameter and connector type; $\boxed{5}$ represents the special code.

A

A.3 ECM-A3 series servo motor

ECM-A3 series servo motor

$$\underline{ECM}_{(1)} - \underline{A}_{(2)} \; \underline{3}_{(3)} \; \underline{L}_{(4)} - \underline{C}_{(5)} \; \underline{2}_{(6)} \; \underline{06}_{(7)} \; \underline{04}_{(8)} \; \underline{R}_{(9)} \; \underline{S}_{(10)} \; \underline{1}_{(11)}$$

(1) Product name

ECM: Electronic Commutation Motor

(2) Servo type

A: High-Precision Servo Motor

(3) Series

3: 3rd series

(4) Inertia

H: high inertia

L: low inertia

(5) Rated voltage and speed

C: 220V and 3,000 rpm

(6) Encoder type

Y: 24-bit absolute optical encoder

(resolution of single turn: 24-bit; number of revolutions: 16-bit)

1: 24-bit incremental optical encoder (single-turn absolute)

A: 24-bit absolute optical encoder

(resolution of single turn: 24-bit; number of revolutions: 16-bit)

2: 24-bit incremental optical encoder (single-turn absolute)

Note: number of revolutions means the maximum number of turns the encoder can record.

(7) Motor frame size

Code	Specification	Code	Specification
04	40 mm	08	80 mm
06	60 mm	-	-

(8) Rated power output

Code	Specification	Code	Specification
0F	50 W	04	400 W
01	100 W	07	750 W
02	200 W	-	-

(9) Shaft type and oil seal

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

Note: coming soon.

(10) Shaft diameter and connector type

S: standard shaft diameter and standard connector

7: special shaft diameter (14 mm)* and standard connectors.

J: standard shaft diameter and IP67 waterproof connectors

K: special shaft diameter (14 mm)* and IP67 waterproof connectors

Note: special shaft diameter is available for F80 400W models.

(11) Special code

1: standard products

Z: LS = 32 mm; LR = 35 mm. Refer to the note in Section A.3.5.

Note: the model information is for reference only. Not all kinds of permutations are available. Contact the distributor or Delta for the details.

A.3.1 ECM-A3L low inertia series servo motor

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ECM-A3L	040F	0401	0602	0604	0804	0807
Rated power (kW)	0.05	0.1	0.2	0.4	0.4	0.75
Rated torque (N-m)[*1]	0.159	0.32	0.64	1.27	1.27	2.39
Max. torque (N-m)	0.557	1.12	2.24	4.45	4.44	8.36
Rated speed (rpm)	3000					
Max. speed (rpm)	6000					
Rated current (Arms)	0.66	0.9	1.45	2.65	2.6	5.1
Max. instantaneous current (Arms)	2.82	3.88	6.2	10.1	10.6	20.6
Change of rated power (kW/s)	11	25.6	45.5	107.5	45.8	102.2
Change of rated power (kW/s) (with brake)	9.9	24	34.1	89.6	39.5	93
Rotor inertia ($\times 10^{-4}$kg.m^2)	0.0229	0.04	0.09	0.15	0.352	0.559
Rotor inertia ($\times 10^{-4}$kg.m^2) (with brake)	0.0255	0.0426	0.12	0.18	0.408	0.614
Mechanical time constant (ms)	1.28	0.838	0.64	0.41	0.68	0.44
Mechanical time constant (ms) (with brake)	1.44	0.892	0.85	0.5	0.78	0.48
Torque constant-KT (N-m/A)	0.241	0.356	0.441	0.479	0.488	0.469
Voltage constant-KE (mV/rpm)	9.28	13.3	16.4	18	17.9	17
Armature resistance (Ohm)	12.1	9.47	4.9	2.27	1.6	0.6
Armature inductance (mH)	18.6	16.2	18.52	10.27	10.6	4.6
Electrical time constant (ms)	1.54	1.71	3.78	4.52	6.63	7.67
Weight (w/o brake) (kg)	0.38	0.5	1.1	1.4	2.05	2.8
Weight (with brake) (kg)	0.68	0.8	1.6	1.9	2.85	3.6
Max. radial loading (N)	78	78	245	245	392	392
Max. axial loading (N)	54	54	74	74	147	147
Brake operating voltage	24 V$_{DC}$ ± 10%					
Brake power consumption (at 20°C (68°F))[W]	6.1	6.1	7.2	7.2	8	8
Brake holding torque [Nt-m (min)] [*2]	0.32	0.32	1.3	1.3	2.5	2.5
Brake release time [ms (Max)]	20	20	20	20	20	20
Brake pull-in time [ms (Max)]	35	35	50	50	60	60
Derating rate with oil seal (%)	20	10	10	5	5	5
Insulation class	Class A (UL), Class B (CE)					
Insulation resistance	> 100 MΩ, DC 500V					
Insulation strength	1.8k V$_{AC}$, 1 sec					
Vibration grade (μm)	V15					

ECM-A3L	040F	0401	0602	0604	0804	0807
Operating temperature	0˚C to 40˚C (14˚F to 176˚F)					
Storage temperature	-10˚C to +80˚C (14˚F to 176˚F)					
Operating humidity	20 - 90% RH (non-condensing)					
Storage humidity	20 - 90% RH (non-condensing)					
Vibration capacity	2.5 G					
IP rating	IP67 (for models using waterproof connectors and shaft seals or oil seals)					
Approvals	$C\epsilon$ $_c$ **ℜ** $_{US}$ ®					

Note:

1. The rated torque is the continuous permissible torque between 0˚C - 40˚C (32˚F - 104˚F) operating temperature which is suitable for the servo motor mounted with the heat sink of the following dimensions.

   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 in a stopped state. Do not use it for deceleration or as a dynamic brake.

3. Follow the load specification for the motor shaft during operation. The load for the motor shaft is defined as follows.

A.3.2 ECM-A3H high inertia series servo motor

A

ECM-A3H	040F	0401	0602	0604	0804	0807
Rated power (kW)	0.05	0.1	0.2	0.4	0.4	0.75
Rated torque (N-m)[*1]	0.159	0.32	0.64	1.27	1.27	2.39
Max. torque (N-m)	0.557	1.12	2.24	4.45	4.44	8.36
Rated speed (rpm)	3000					
Max. speed (rpm)	6000					
Rated current (Arms)	0.64	0.9	1.45	2.65	2.6	4.61
Max. instantaneous current (Arms)	2.59	3.64	5.3	9.8	9.32	16.4
Change of rated power (kW/s)	5.56	13.6	16.4	35.8	17.5	37.8
Change of rated power (kW/s) (with brake)	4.89	12.5	14.6	33.6	15.07	34.41
Rotor inertia ($\times 10^{-4}$kg.m^2)	0.0455	0.0754	0.25	0.45	0.92	1.51
Rotor inertia ($\times 10^{-4}$kg.m^2) (with brake)	0.0517	0.0816	0.28	0.48	1.07	1.66
Mechanical time constant (ms)	2.52	1.43	1.38	0.96	1.32	0.93
Mechanical time constant (ms) (with brake)	2.86	1.55	1.54	1.02	1.54	1.02
Torque constant-KT (N-m/A)	0.248	0.356	0.441	0.479	0.49	0.52
Voltage constant-KE (mV/rpm)	9.54	12.9	16.4	17.2	17.9	18.7
Armature resistance (Ohm)	12.5	8.34	3.8	1.68	1.19	0.57
Armature inductance (mH)	13.34	11	8.15	4.03	4.2	2.2
Electrical time constant (ms)	1.07	1.32	2.14	2.40	3.53	3.86
Weight (w/o brake) (kg)	0.38	0.5	1.1	1.4	2.05	2.8
Weight (with brake) (kg)	0.68	0.8	1.6	1.9	2.85	3.6
Max. radial loading (N)	78	78	245	245	392	392
Max. axial loading (N)	54	54	74	74	147	147
Brake operating voltage	24 V$_{DC}$ ± 10%					
Brake power consumption (at 20°C)[W]	6.1	6.1	7.2	7.2	8	8
Brake holding torque [Nt-m (min)] [*2]	0.32	0.32	1.3	1.3	2.5	2.5
Brake release time [ms (Max)]	20	20	20	20	20	20
Brake pull-in time [ms (Max)]	35	35	50	50	60	60
Derating rate with oil seal (%)	20	10	10	5	5	5
Insulation class	Class A (UL), Class B (CE)					
Insulation resistance	> 100 MΩ, DC 500V					

ECM-A3H	040F	0401	0602	0604	0804	0807
Insulation strength	1.8k V$_{AC}$, 1 sec					
Vibration grade (µm)	V15					
Operating temperature	0˚C to 40˚C (14˚F to 176˚F)					
Storage temperature	-10˚C to +80˚C (14˚F to 176˚F)					
Operating humidity	20 - 90% RH (non-condensing)					
Storage humidity	20 - 90% RH (non-condensing)					
Vibration capacity	2.5 G					
IP rating	IP67 (for models using waterproof connectors and shaft seals or oil seals)					
Approvals	CE c**ЯU**US					

Note:

1. The rated torque is the continuous permissible torque between 0˚C - 40˚C (32˚F - 104˚F) operating temperature which is suitable for the servo motor mounted with the heat sink of the following dimensions.

   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 in a stopped state. Do not use it for deceleration or as a dynamic brake.

3. Follow the load specification for the motor shaft during operation. The load for the motor shaft is defined as follows.

A.3.3 Torque features (T-N curves) of the A3 motors
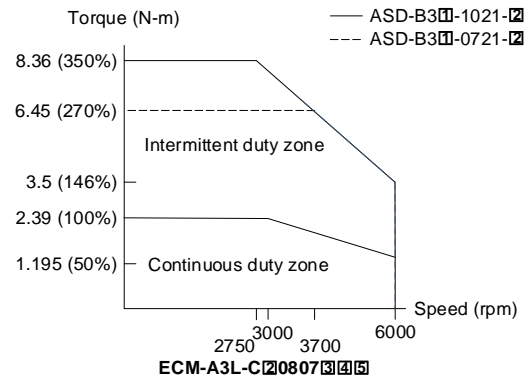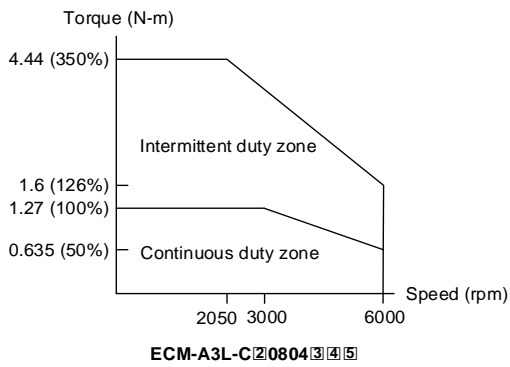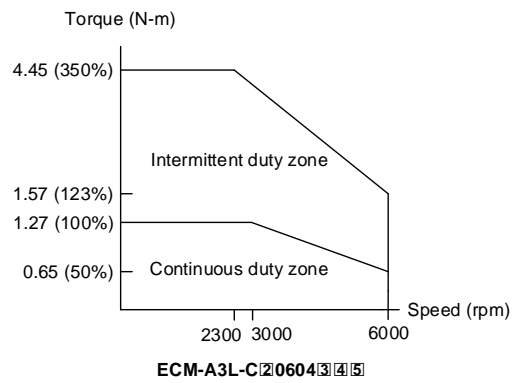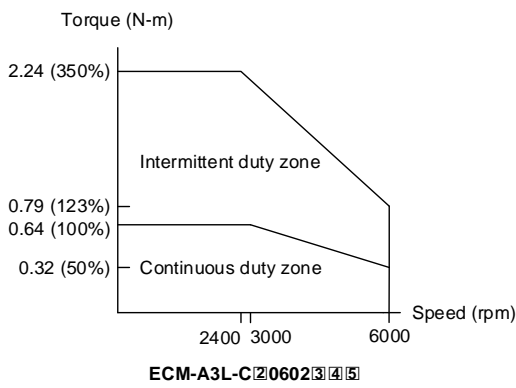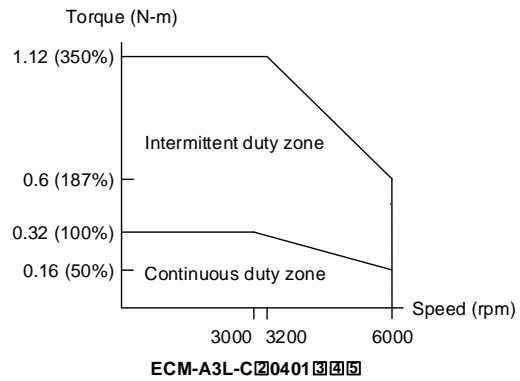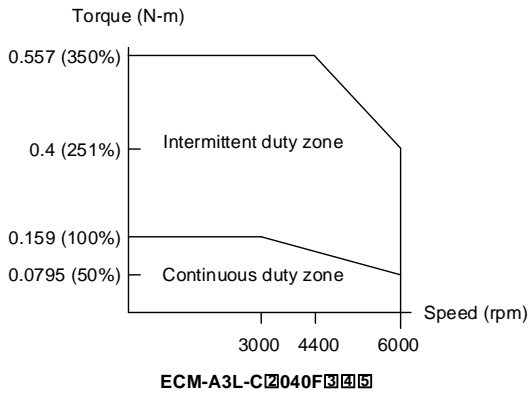
ECM-A3L-C②040F③④⑤

ECM-A3L-C②0401③④⑤

ECM-A3L-C②0602③④⑤

ECM-A3L-C②0604③④⑤

ECM-A3L-C②0804③④⑤

ECM-A3L-C②0807③④⑤

Note:

1. In the servo motor model name, ② represents the encoder type; ③ represents the brake or keyway / oil seal type; ④ represents the shaft diameter and connector type; ⑤ represents the special code.

2. The dotted line in ECM-A3L-C②0807③④⑤ is the specification for the ASD-B3①-0721-② servo drive; the solid line is the specification for the ASD-B3①-1021-② servo drive.

Torque (N-m)

0.557 (350%)
0.4 (251%)

Intermittent duty zone

0.159 (100%)
0.0795 (50%)
Continuous duty zone
Speed (rpm)

3000   5500 6000

ECM-A3H-C②040F③④⑤

Torque (N-m)

1.12 (350%)

Intermittent duty zone

0.9 (281%)

0.32 (100%)
0.16 (50%)
Continuous duty zone
Speed (rpm)

3000   4300   6000

ECM-A3H-C②0401③④⑤

Torque (N-m)

2.24 (350%)
1.9 (306%)

Intermittent duty zone

0.64 (100%)
0.32 (50%)
Continuous duty zone
Speed (rpm)

3000   4300   6000

ECM-A3H-C②0602③④⑤

Torque (N-m)

4.45 (350%)
3.9 (307%)

Intermittent duty zone

1.27 (100%)
0.65 (50%)
Continuous duty zone
Speed (rpm)

3000   4200   6000

ECM-A3H-C②0604③④⑤

Torque (N-m)

4.44 (350%)

Intermittent duty zone

3.28 (258%)

1.27 (100%)
0.635 (50%)
Continuous duty zone
Speed (rpm)

3000 4300   6000

ECM-A3H-C②0804③④⑤

Torque (N-m)

——— ASD-B3①-1021-②
——— ASD-B3①-0721-②

8.36 (350%)
7.23 (303%)
7 (290%)
6.25 (262%)

Intermittent duty zone

2.39 (100%)

1.195 (50%)
Continuous duty zone
Speed (rpm)

3000 4200 4400 6000

ECM-A3H-C②0807③④⑤

Note:

1. In the servo motor model name, ② represents the encoder type; ③ represents the brake or keyway / oil seal type; ④ represents the shaft diameter and connector type; ⑤ represents the special code.

2. The dotted line in ECM-A3H-C②0807③④⑤ is the specification for the ASD-B3①-0721-② servo drive; the solid line is the specification for the ASD-B3①-1021-② servo drive.

A

A.3.4 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. You operate a motor with a built-in brake without releasing the brake.

Graph of load and operating time

Low inertia (ECM-A3L series), high inertia (ECM-A3H series)
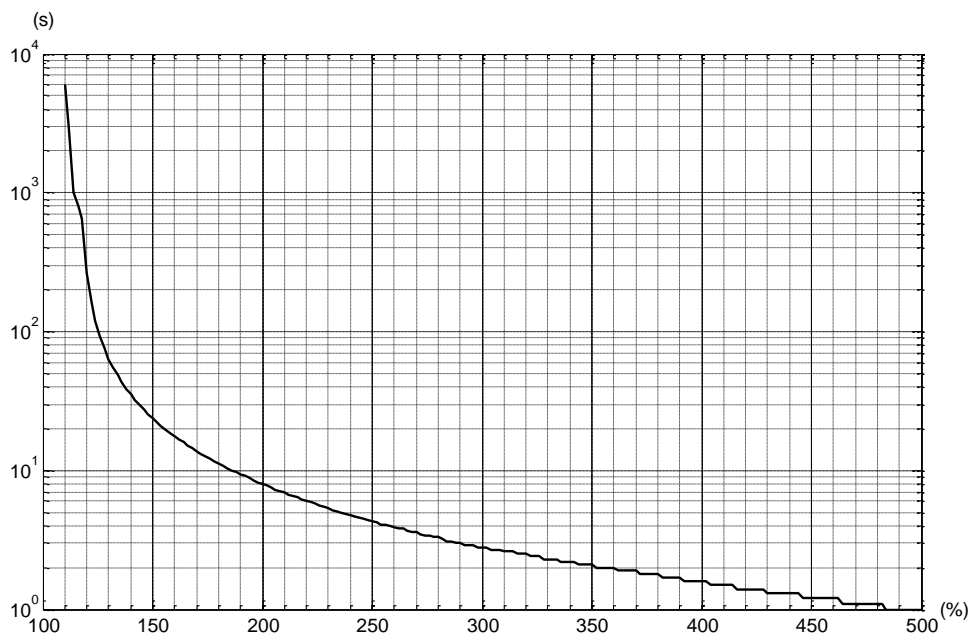
Load ratio	120%	140%	160%	180%	200%	220%	240%
Operating time	263.8 s	35.2 s	17.6 s	11.2 s	8 s	6.1 s	4.8 s
Load ratio	260%	280%	300%	350%	400%	450%	500%
Operating time	3.9 s	3.3 s	2.8 s	2.1 s	1.6 s	1.2 s	1.0 s

A.3.5   Dimensions of ECM-A3L/A3H series servo motor

Motor frame size: 80 mm and below
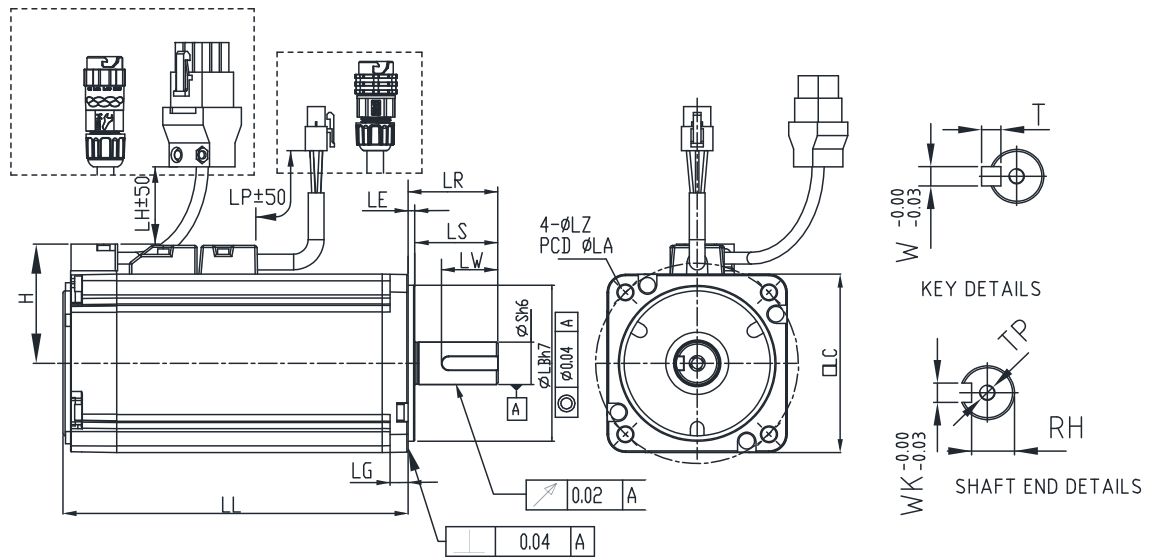
Model	C②040F③④⑤	C②0401③④⑤	C②0602③④⑤	C②0604③④⑤	C②0804③④⑤	C②0807③④⑤
LC	40	40	60	60	80	80
LZ	4.5	4.5	5.5	5.5	6.6	6.6
LA	46	46	70	70	90	90
S	$8\binom{+0}{-0.009}$	$8\binom{+0}{-0.009}$	$14\binom{+0}{-0.011}$	$14\binom{+0}{-0.011}$	$14\binom{+0}{-0.011}$	$19\binom{+0}{-0.013}$
LB	$30\binom{+0}{-0.021}$	$30\binom{+0}{-0.021}$	$50\binom{+0}{-0.025}$	$50\binom{+0}{-0.025}$	$70\binom{+0}{-0.030}$	$70\binom{+0}{-0.030}$
LL (w/o brake)	70.6	85.3	84	106	93.7	115.8
LL (with brake)	105.4	120.1	117.6	139.7	131.2	153.2
LH	300	300	300	300	300	300
LP	300	300	300	300	300	300
H	34	34	43.5	43.5	54.5	54.5
LS	21.5	21.5	27	27	27	37
LR	25	25	30	30	30	40
LE	2.5	2.5	3	3	3	3
LG	5	5	7.5	7.5	8	8
LW	16	16	20	20	20	25
RH	6.2	6.2	11	11	11	15.5
WK	3	3	5	5	5	6
W	3	3	5	5	5	6
T	3	3	5	5	5	6
TP	M3 Depth 6	M3 Depth 6	M4 Depth 8	M4 Depth 8	M4 Depth 8	M6 Depth 10

A

Note:

1. In the servo motor model name, ② represents the encoder type; ③ represents the brake or keyway / oil seal type; ④ represents the shaft diameter and connector type; ⑤ represents the special code.

2. When the special code of C②0807③S⑤ is Z, LS = 32 and LR = 35.

3. IP67 waterproof connectors are available for F80 and below models. Refer to Section A.3 for detailed model descriptions.

Accessories

B

B

B.1 Power connector

Delta model number: ASDBCAPW0000 (for F80 and below)
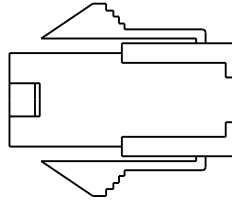
Delta model number: ASDBCAPW0100 (for F80 and below with brake)
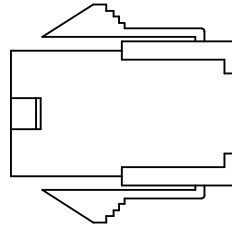
Delta model number: ACS3-CNPW1A00 (IP67 waterproof connector for F80 and below)
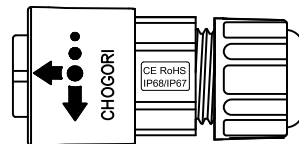
Delta model number: ACS3-CNPW2A00 (IP67 waterproof connector for F80 and below with
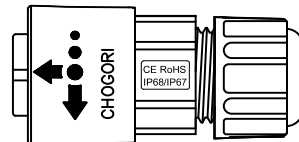
brake)

Delta model number: ACS3-CNPW5200 (military connector (MIL 18-10S) for F100 - F130)
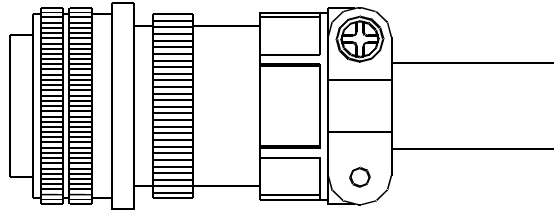
Delta model number: ACS3-CNPW5300 (military connector (MIL 22-22S) for F180)
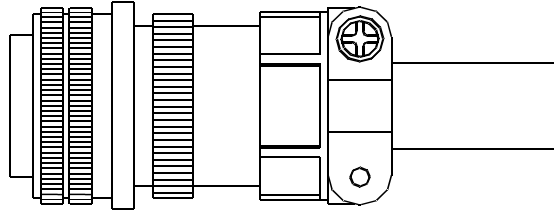
Delta model number: ACS3-CNPW6300 (military connector (CMV1-2S) for F100 - F180 with

brake)
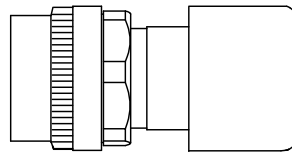
B

B.2   Power cable

Delta model number: ACS3-CAPW3103, ACS3-CAPW3105, ACS3-CAPW3110,

ACS3-CAPW3120, ACS3-CAPF3103, ACS3-CAPF3105, ACS3-CAPF3110, ACS3-CAPF3120

(for F80 and below)
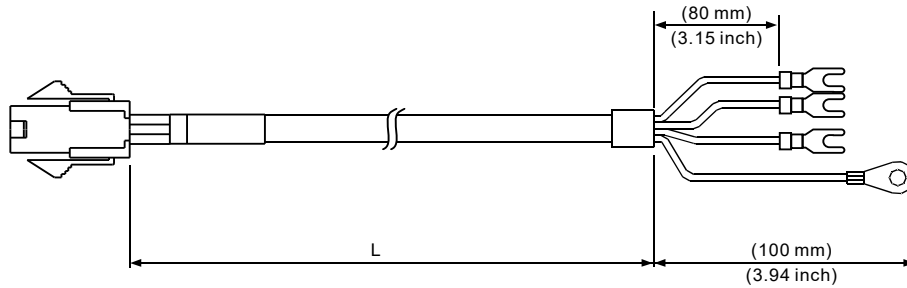
Model No.	L	
	mm	inch
ACS3-CAP□3103	3000 ± 50	118 ± 2
ACS3-CAP□3105	5000 ± 50	197 ± 2
ACS3-CAP□3110	10000 ± 100	394 ± 4
ACS3-CAP□3120	20000 ± 100	788 ± 4

Note: □ indicates the cable material. F represents flexible cables and W represents standard cables.

Delta model number: ACS3-CAPW4103, ACS3-CAPW4105, ACS3-CAPW4110,

ACS3-CAPW4120, ACS3-CAPF4103, ACS3-CAPF4105, ACS3-CAPF4110, ACS3-CAPF4120

(for F80 and below with brake)
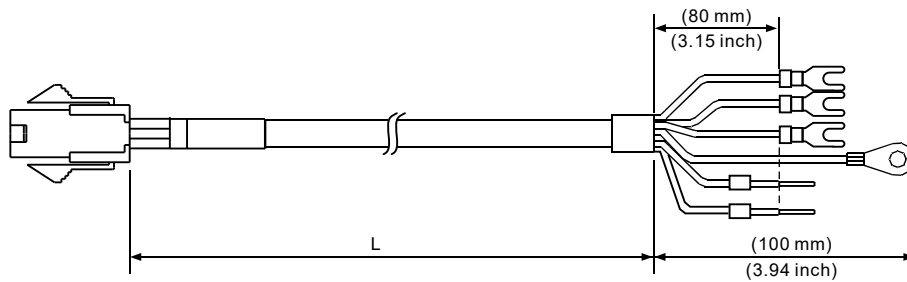
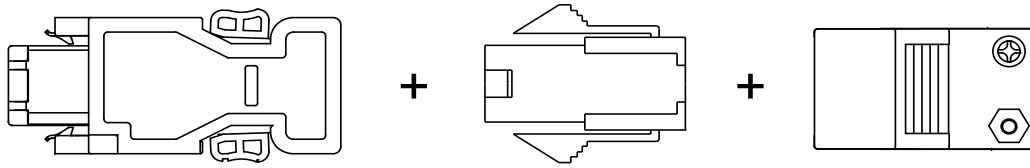| Model No.	L	
	mm	inch
ACS3-CAP□4103	3000 ± 50	118 ± 2
ACS3-CAP□4105	5000 ± 50	197 ± 2
ACS3-CAP□4110	10000 ± 100	394 ± 4
ACS3-CAP□4120	20000 ± 100	788 ± 4

Note: □ indicates the cable material. F represents flexible cables and W represents standard cables.

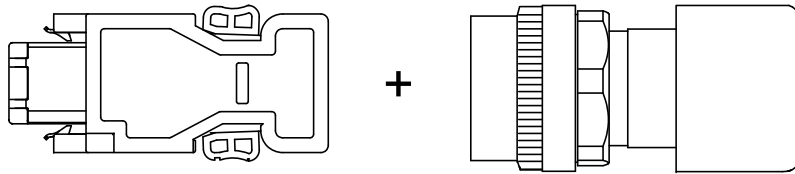Delta model number: ACS3-CAPW3A03, ACS3-CAPW3A05, ACS3-CAPW3A10,

ACS3-CAPW3A20, ACS3-CAPF3A03, ACS3-CAPF3A05, ACS3-CAPF3A10, ACS3-CAPF3A20

(for F80 and below with IP67 waterproof connector)
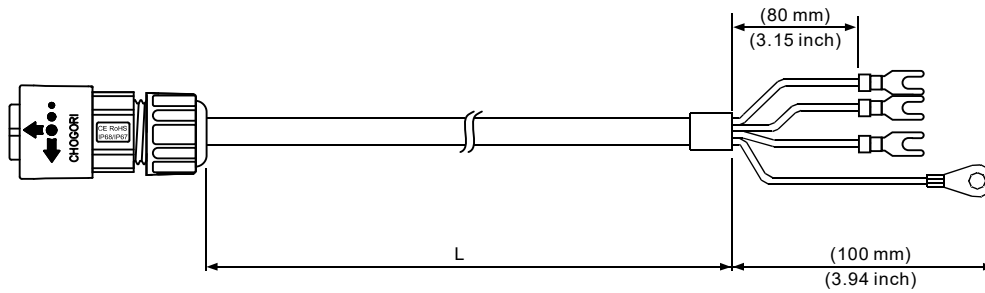
Model No.	L	
	mm	inch
ACS3-CAP□3A03	3000 ± 50	118 ± 2
ACS3-CAP□3A05	5000 ± 50	197 ± 2
ACS3-CAP□3A10	10000 ± 100	394 ± 4
ACS3-CAP□3A20	20000 ± 100	788 ± 4

Note: □ indicates the cable material. F represents flexible cables and W represents standard cables.

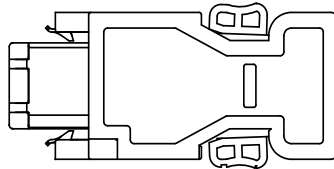Delta model number: ACS3-CAPW4A03, ACS3-CAPW4A05, ACS3-CAPW4A10,

ACS3-CAPW4A20, ACS3-CAPF4A03, ACS3-CAPF4A05, ACS3-CAPF4A10, ACS3-CAPF4A20

(for F80 and below with brake and IP67 waterproof connector)
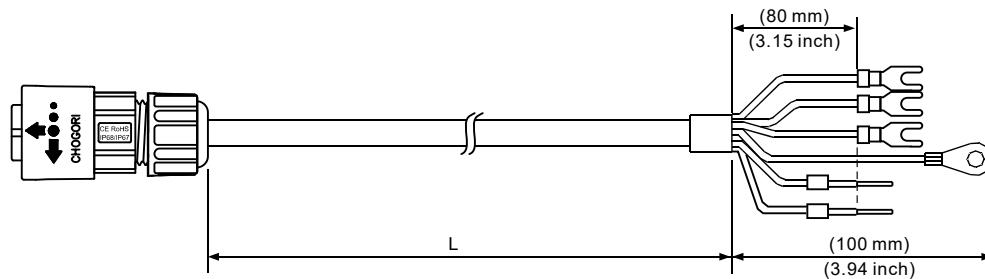
Model No.	L	
	mm	inch
ACS3-CAP□4A03	3000 ± 50	118 ± 2
ACS3-CAP□4A05	5000 ± 50	197 ± 2
ACS3-CAP□4A10	10000 ± 100	394 ± 4
ACS3-CAP□4A20	20000 ± 100	788 ± 4

Note: □ indicates the cable material. F represents flexible cables and W represents standard cables.

B

Delta model number: ACS3-CAPW3203, ACS3-CAPW3205, ACS3-CAPW3210,

ACS3-CAPW3220, ACS3-CAPF3203, ACS3-CAPF3205, ACS3-CAPF3210, ACS3-CAPF3220

(for F100 - F130)
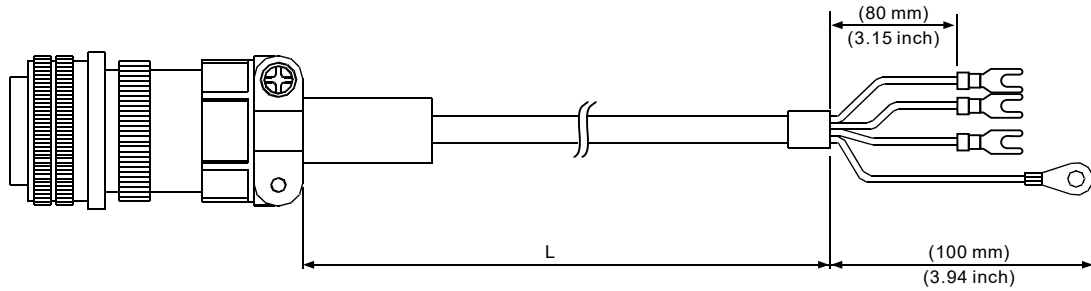
Model No.	Straight	L	
		mm	inch
ACS3-CAP☐3203	MIL 18-10S	3000 ± 50	118 ± 2
ACS3-CAP☐3205	MIL 18-10S	5000 ± 50	197 ± 2
ACS3-CAP☐3210	MIL 18-10S	10000 ± 100	394 ± 4
ACS3-CAP☐3220	MIL 18-10S	20000 ± 100	788 ± 4

Note: ☐ indicates the cable material. F represents flexible cables and W represents standard cables.

Delta model number: ACS3-CAPW4203, ACS3-CAPW4205, ACS3-CAPW4210,

ACS3-CAPW4220, ACS3-CAPF4203, ACS3-CAPF4205, ACS3-CAPF4210, ACS3-CAPF4220

(for F100 - F130 with brake)
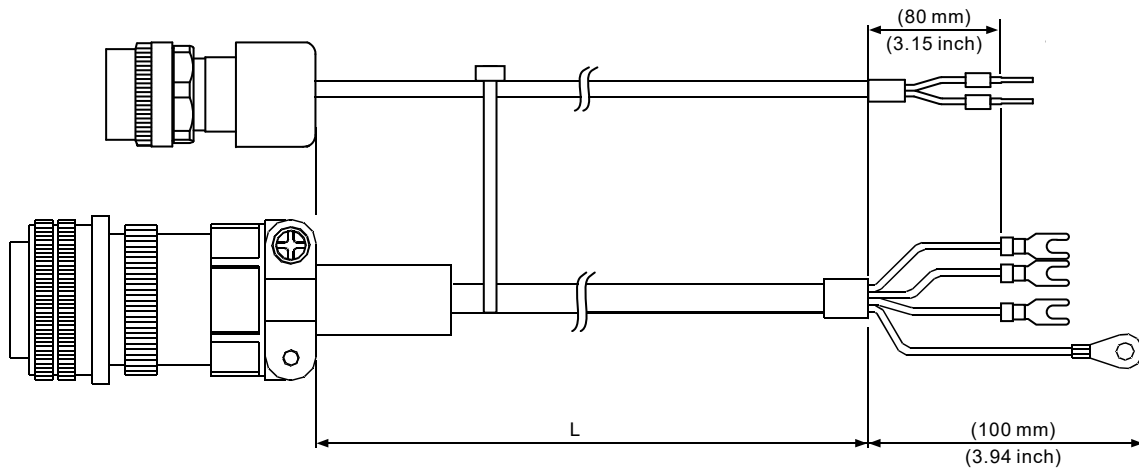
Model No.	Straight	L	
		mm	inch
ACS3-CAP☐4203	MIL 18-10S, CMV1-2S	3000 ± 50	118 ± 2
ACS3-CAP☐4205	MIL 18-10S, CMV1-2S	5000 ± 50	197 ± 2
ACS3-CAP☐4210	MIL 18-10S, CMV1-2S	10000 ± 100	394 ± 4
ACS3-CAP☐4220	MIL 18-10S, CMV1-2S	20000 ± 100	788 ± 4

Note: ☐ indicates the cable material. F represents flexible cables and W represents standard cables.

B

Delta model number: ACS3-CAPW3403, ACS3-CAPW3405, ACS3-CAPW3410,

ACS3-CAPW3420, ACS3-CAPF3403, ACS3-CAPF3405, ACS3-CAPF3410, ACS3-CAPF3420

(for F180)
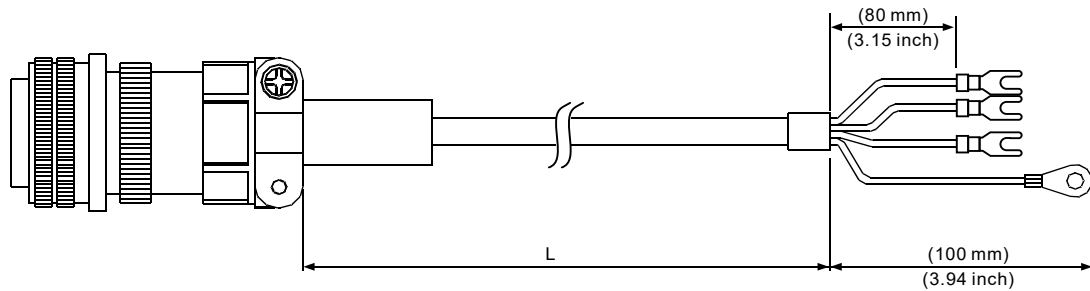
Model No.	Straight	L	
		mm	inch
ACS3-CAP☐3403	MIL 22-22S	3000 ± 50	118 ± 2
ACS3-CAP☐3405	MIL 22-22S	5000 ± 50	197 ± 2
ACS3-CAP☐3410	MIL 22-22S	10000 ± 100	394 ± 4
ACS3-CAP☐3420	MIL 22-22S	20000 ± 100	788 ± 4

Note: ☐ indicates the cable material. F represents flexible cables and W represents standard cables.

Delta model number: ACS3-CAPW4403, ACS3-CAPW4405, ACS3-CAPW4410,

ACS3-CAPW4420, ACS3-CAPF4403, ACS3-CAPF4405, ACS3-CAPF4410, ACS3-CAPF4420

(for F180 with brake)
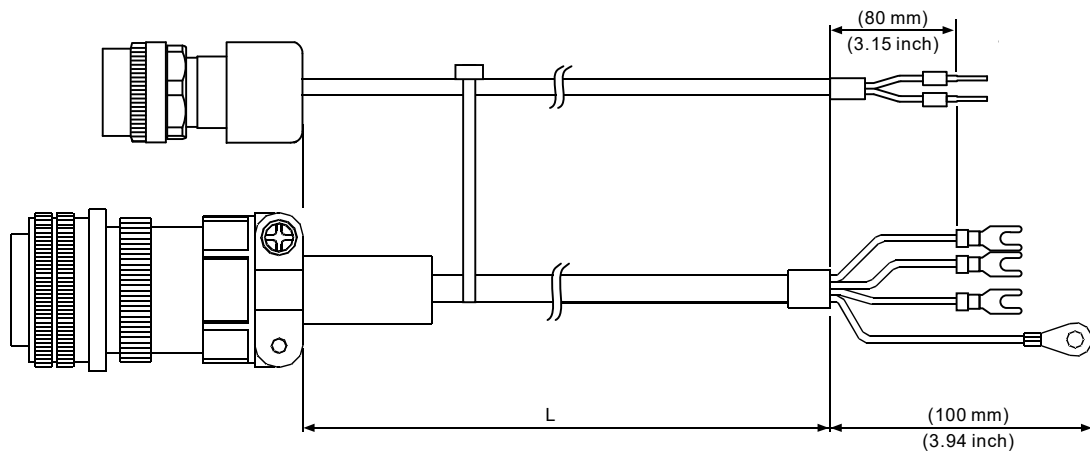
Model No.	Straight	L	
		mm	inch
ACS3-CAP☐4403	MIL 22-22S, CMV1-2S	3000 ± 50	118 ± 2
ACS3-CAP☐4405	MIL 22-22S, CMV1-2S	5000 ± 50	197 ± 2
ACS3-CAP☐4410	MIL 22-22S, CMV1-2S	10000 ± 100	394 ± 4
ACS3-CAP☐4420	MIL 22-22S, CMV1-2S	20000 ± 100	788 ± 4

Note: ☐ indicates the cable material. F represents flexible cables and W represents standard cables.

B.3   Encoder connector

Delta model number: ACS3-CNEN1100

Delta model number: ACS3-CNEN3000 (for F100 - F180; military connector: CMV1-10S)

Delta model number: ACS3-CNENC200

Delta model number: ACS3-CNEN2A00 (IP67 waterproof connector for F80 and below)
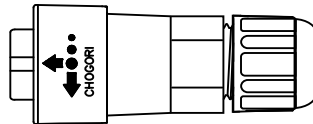
B.4   Encoder cable (incremental type)

Delta model number: ACS3-CAEN1003, ACS3-CAEN1005, ACS3-CAEN1010,

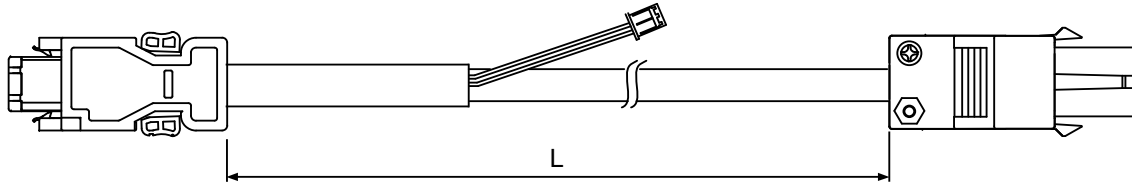ACS3-CAEN1020, ACS3-CAEF1003, ACS3-CAEF1005, ACS3-CAEF1010, ACS3-CAEF1020
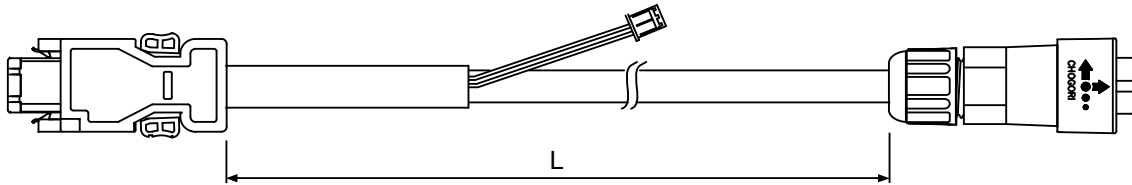
(for F80 and below)
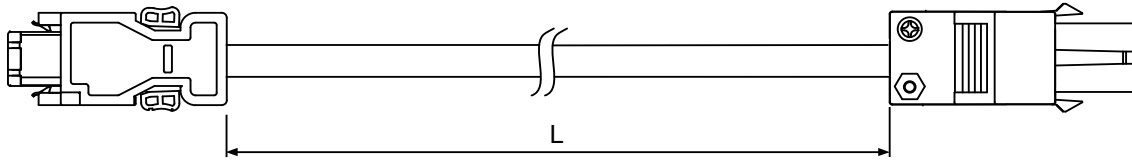
Model No.	L	
	mm	inch
ACS3-CAE□1003	3000 ± 50	118 ± 2
ACS3-CAE□1005	5000 ± 50	197 ± 2
ACS3-CAE□1010	10000 ± 100	394 ± 4
ACS3-CAE□1020	20000 ± 100	788 ± 4

Note: □ indicates the cable material. F represents flexible cables and N represents standard cables.

      Refer to Chapter 3 Wiring for cable specifications.

Delta model number: ACS3-CAEN2A03, ACS3-CAEN2A05, ACS3-CAEN2A10,

ACS3-CAEN2A20, ACS3-CAEF2A03, ACS3-CAEF2A05, ACS3-CAEF2A10, ACS3-CAEF2A20

(for F80 and below with IP67 waterproof connector)
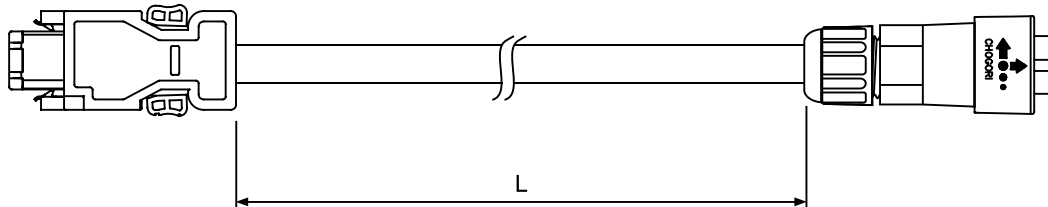
Model No.	L	
	mm	inch
ACS3-CAE□2A03	3000 ± 50	118 ± 2
ACS3-CAE□2A05	5000 ± 50	197 ± 2
ACS3-CAE□2A10	10000 ± 100	394 ± 4
ACS3-CAE□2A20	20000 ± 100	788 ± 4

Note: □ indicates the cable material. F represents flexible cables and N represents standard cables.

      Refer to Chapter 3 Wiring for cable specifications.

Delta model number: ACS3-CAEN2703, ACS3-CAEN2705, ACS3-CAEN2710,

ACS3-CAEN2720, ACS3-CAEF2703, ACS3-CAEF2705, ACS3-CAEF2710, ACS3-CAEF2720
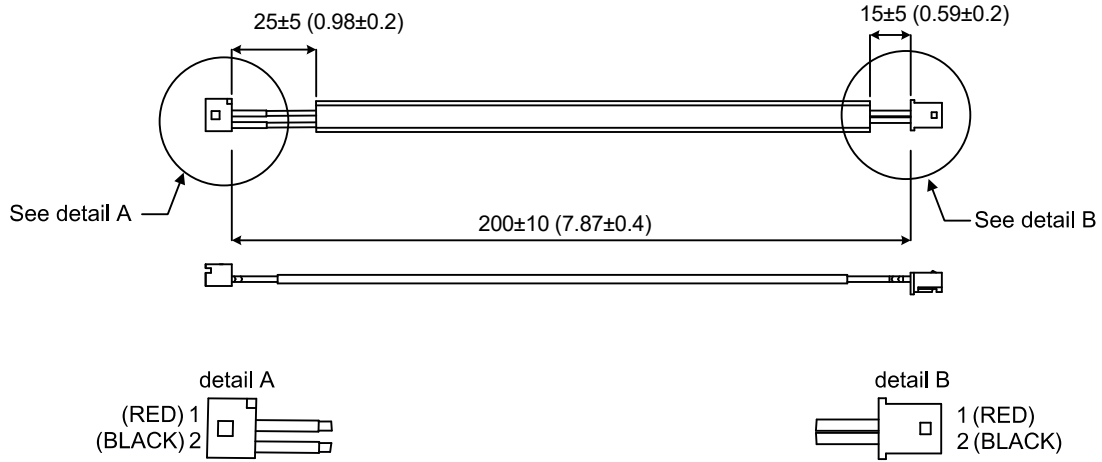
(for F100 - F180)
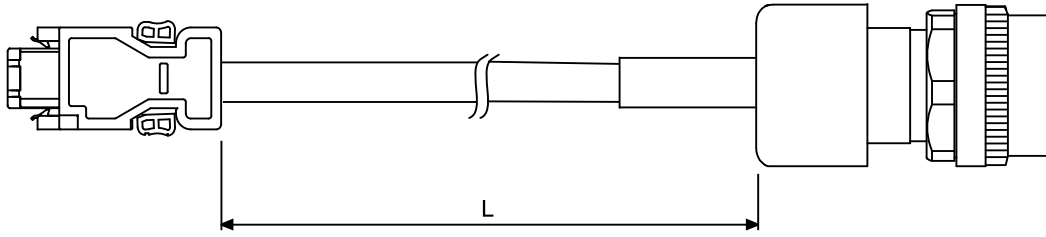
Model No.	Straight	L	
		mm	inch
ACS3-CAE□2703	CMV1-10S	3000 ± 50	118 ± 2
ACS3-CAE□2705	CMV1-10S	5000 ± 50	197 ± 2
ACS3-CAE□2710	CMV1-10S	10000 ± 100	394 ± 4
ACS3-CAE□2720	CMV1-10S	20000 ± 100	788 ± 4

Note: □ indicates the cable material. F represents flexible cables and N represents standard cables.

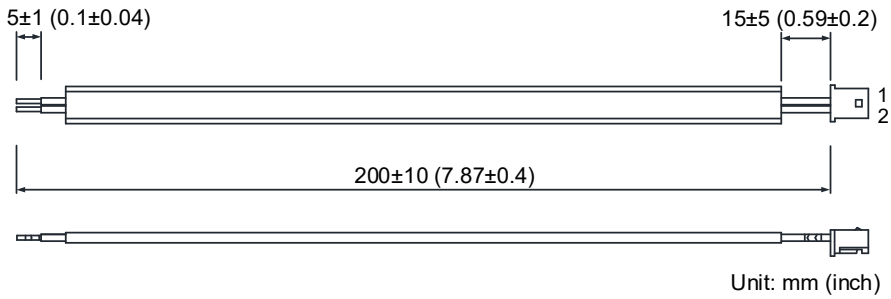Refer to Chapter 3 Wiring for cable specifications.

B.5   Encoder cable (absolute type)

Delta model number: ACS3-CAEA1003, ACS3-CAEA1005, ACS3-CAEA1010,

ACS3-CAEA1020, ACS3-CAEB1003, ACS3-CAEB1005, ACS3-CAEB1010, ACS3-CAEB1020

(for F80 and below)

Model No.	L	
	mm	inch
ACS3-CAE□1003	3000 ± 50	118 ± 2
ACS3-CAE□1005	5000 ± 50	197 ± 2
ACS3-CAE□1010	10000 ± 100	394 ± 4
ACS3-CAE□1020	20000 ± 100	788 ± 4

Note: □ indicates the cable material. B represents flexible cables and A represents standard cables.

Refer to Chapter 3 Wiring for cable specifications.

Delta model number: ACS3-CAEA2A03, ACS3-CAEA2A05, ACS3-CAEA2A10,

ACS3-CAEA2A20, ACS3-CAEB2A03, ACS3-CAEB2A05, ACS3-CAEB2A10, ACS3-CAEB2A20

(for F80 and below with IP67 waterproof connector)

Model No.	L	
	mm	inch
ACS3-CAE□2A03	3000 ± 50	118 ± 2
ACS3-CAE□2A05	5000 ± 50	197 ± 2
ACS3-CAE□2A10	10000 ± 100	394 ± 4
ACS3-CAE□2A20	20000 ± 100	788 ± 4

Note: □ indicates the cable material. B represents flexible cables and A represents standard cables.

Refer to Chapter 3 Wiring for cable specifications.

Delta model number: ACS3-CAEA2703, ACS3-CAEA2705, ACS3-CAEA2710, ACS3-CAEA2720, ACS3-CAEB2703, ACS3-CAEB2705, ACS3-CAEB2710, ACS3-CAEB2720 (for F100 - F180)
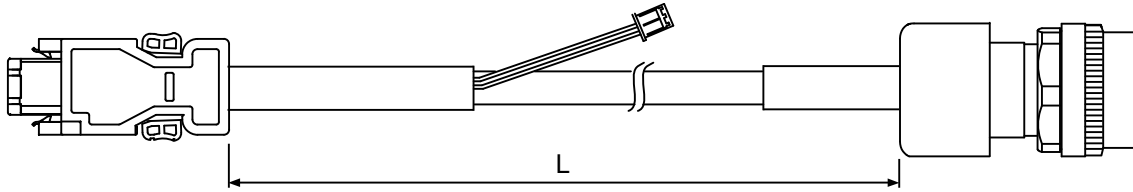
Model No.	Straight	L	
		mm	inch
ACS3-CAE☐2703	CMV1-10S	3000 ± 50	118 ± 2
ACS3-CAE☐2705	CMV1-10S	5000 ± 50	197 ± 2
ACS3-CAE☐2710	CMV1-10S	10000 ± 100	394 ± 4
ACS3-CAE☐2720	CMV1-10S	20000 ± 100	788 ± 4

Note: ☐ indicates the cable material. B represents flexible cables and A represents standard cables.

Refer to Chapter 3 Wiring for cable specifications.

B.6   Battery box cable

Battery box cable that connects to the encoder cable (part number: 3864573700)

25±5 (0.98±0.2)   15±5 (0.59±0.2)

B

See detail A   200±10 (7.87±0.4)   See detail B

detail A   detail B

(RED) 1   1 (RED)
(BLACK) 2   2 (BLACK)

Unit: mm (inch)

Battery box cable for self-wiring (part number: 3864850600)

5±1 (0.1±0.04)   15±5 (0.59±0.2)

1
2

200±10 (7.87±0.4)

Unit: mm (inch)

B

B.7   Battery box (absolute type)

Single battery box

Delta model number: ASD-MDBT0100
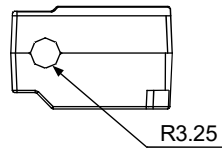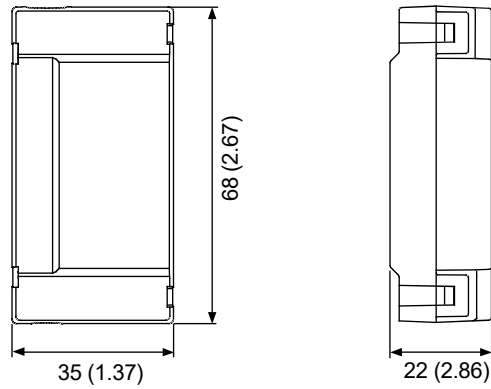
35 (1.37)   22 (2.86)

68 (2.67)

R3.25

Unit: mm (inch)
Weight: 44 g

Dual battery box

Delta model number: ASD-MDBT0200

72.5 (2.85)

45 (1.77)   26 (1.02)

64.5 (2.54)
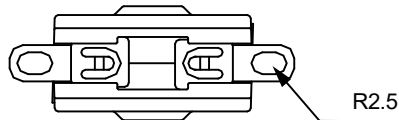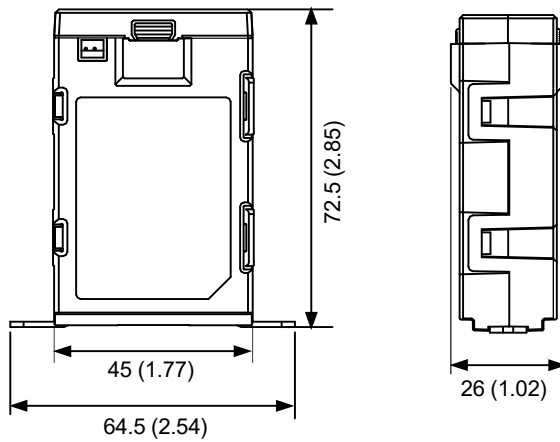
R2.5   Unit: mm (inch)
Weight: 79.23 g

B.8   CN1 connector

Delta model number: ASDBCNDS0044 (for B3-L only)
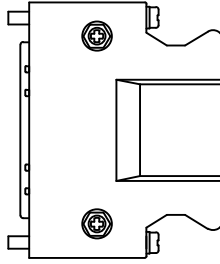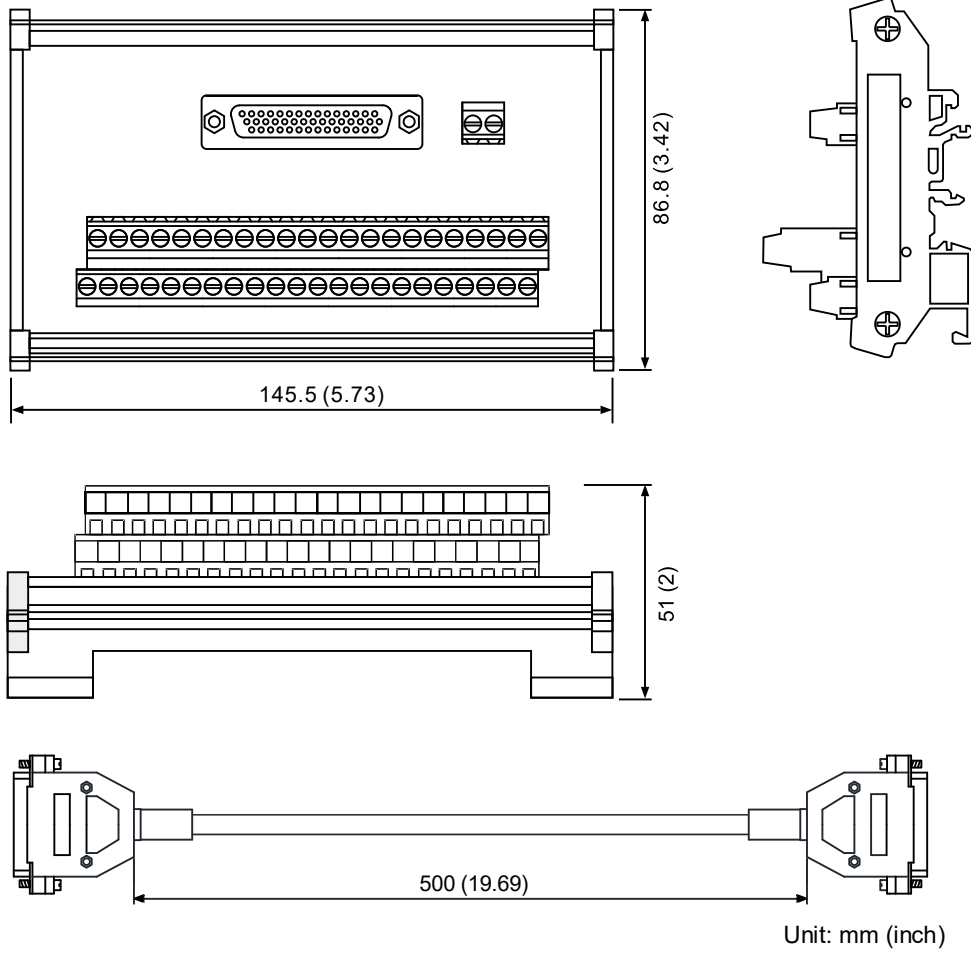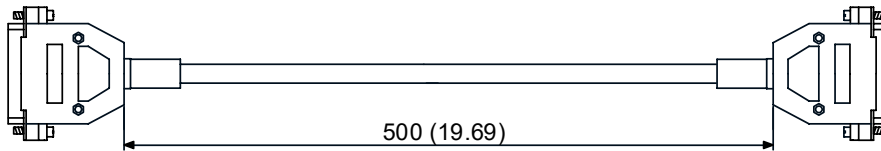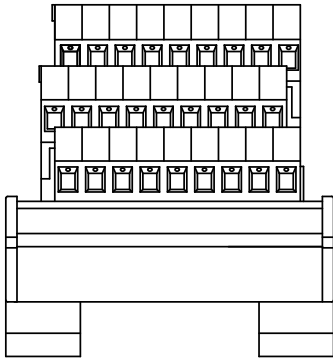

Delta model number: ACS3-CNTB0500 (for B3-M, F, E)
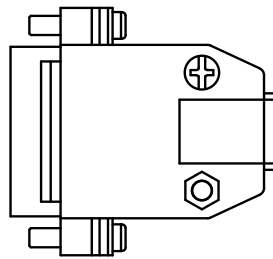
B

B.9   CN1 quick connector

Delta model number: ACS3-IFSC4444 (for B3-L only)

B
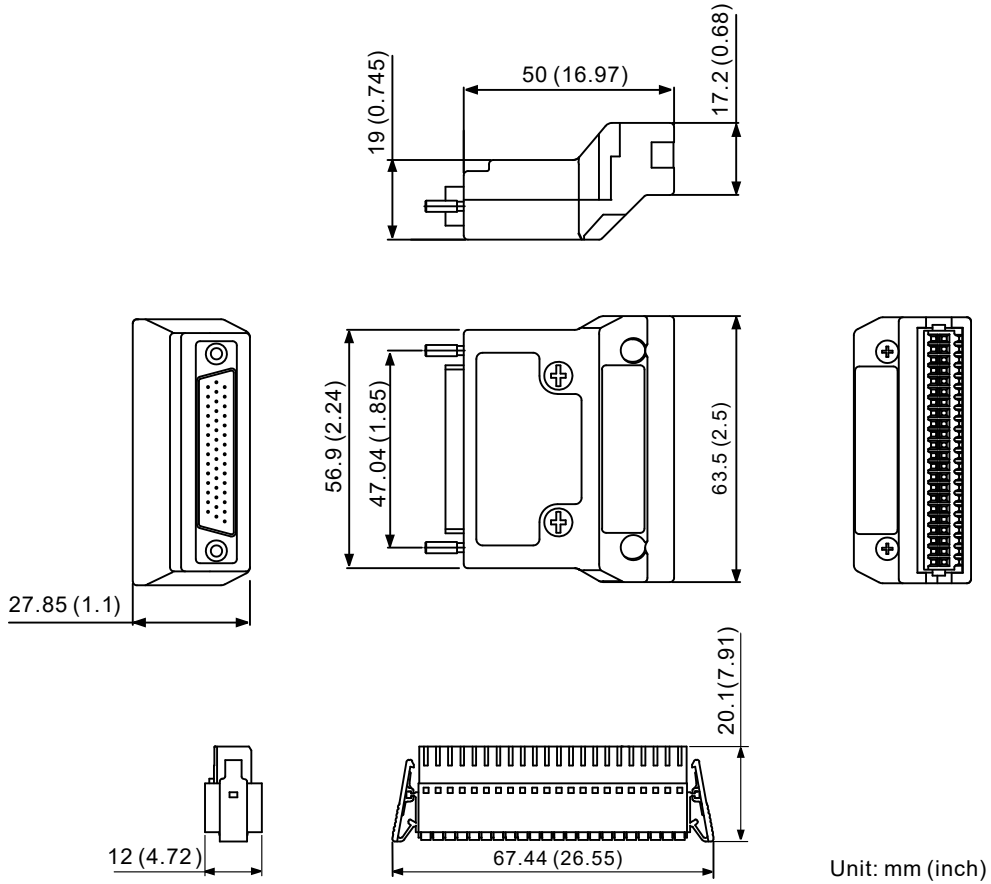
Unit: mm (inch)

B.10   Terminal block module

Delta model number: ACS3-MDTB4400 (for B3-L only)

86.8 (3.42)

145.5 (5.73)

51 (2)

500 (19.69)

Unit: mm (inch)

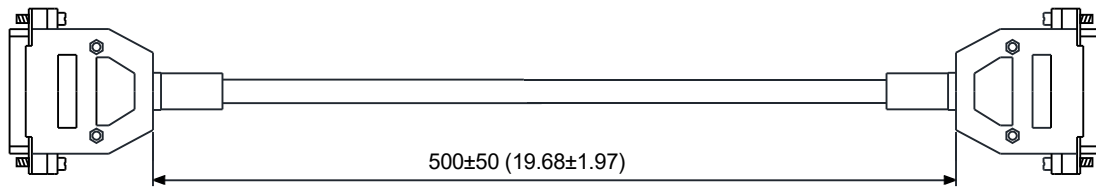Delta model number: ACS3-MDTD2600 (for B3-M, F, E)

B

87.0 (3.43)

61.5 (2.42)

62 (2.44)

500 (19.69)
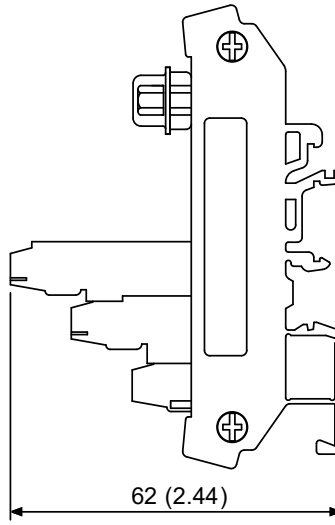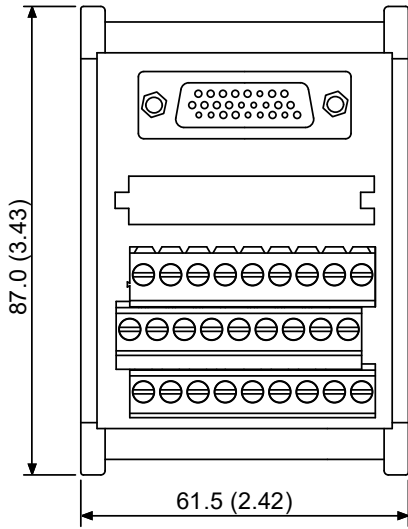
Unit: mm (inch)

B.11   B3 / B2 conversion cables

CN1 conversion cable (for B3-L only)

Delta model number: ACS3-CABDC1

B

500±50 (19.68±1.97)

Unit: mm (inch)

CN2 conversion cable

Delta model number: ACS3-CABDC2

150 (5.9)
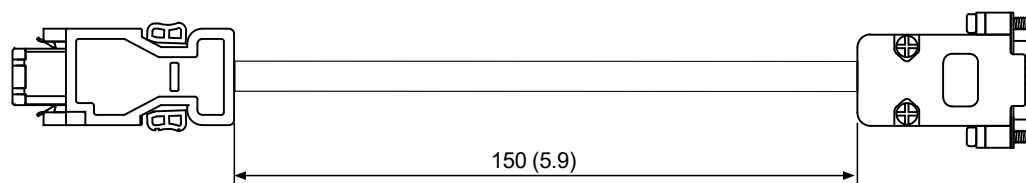
Unit: mm (inch)

B.12   CN3 RS-485 tap

Delta model number: ACS3-CNADC3RC

7.3 (0.29)

34.95 (1.37)

29.20 (1.15)

8   1

1   8

1   8

25.8 (1.01)

43.04 (1.69)

15.10 (0.59)

11.68 (0.46)
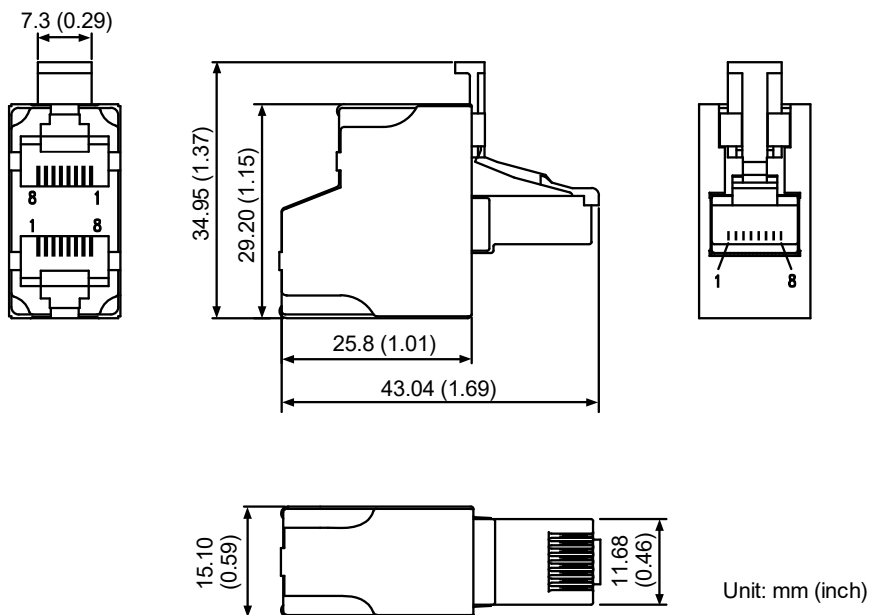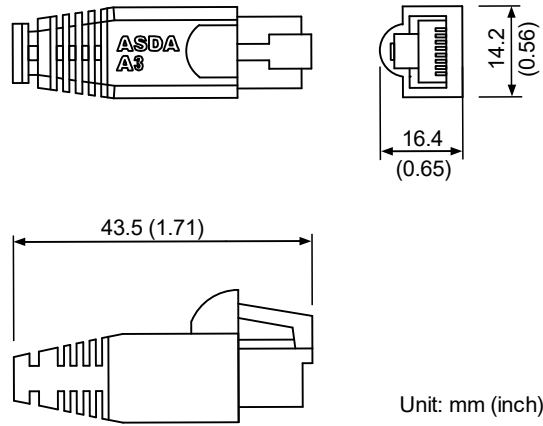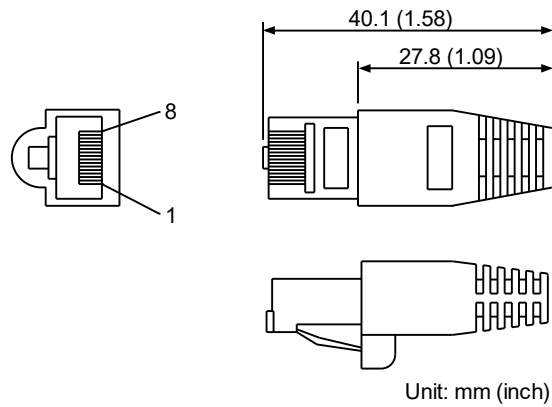
Unit: mm (inch)

B.13   CN3 RS-485 / CANopen terminal resistor

Delta model number: ACS3-CNADC3TR
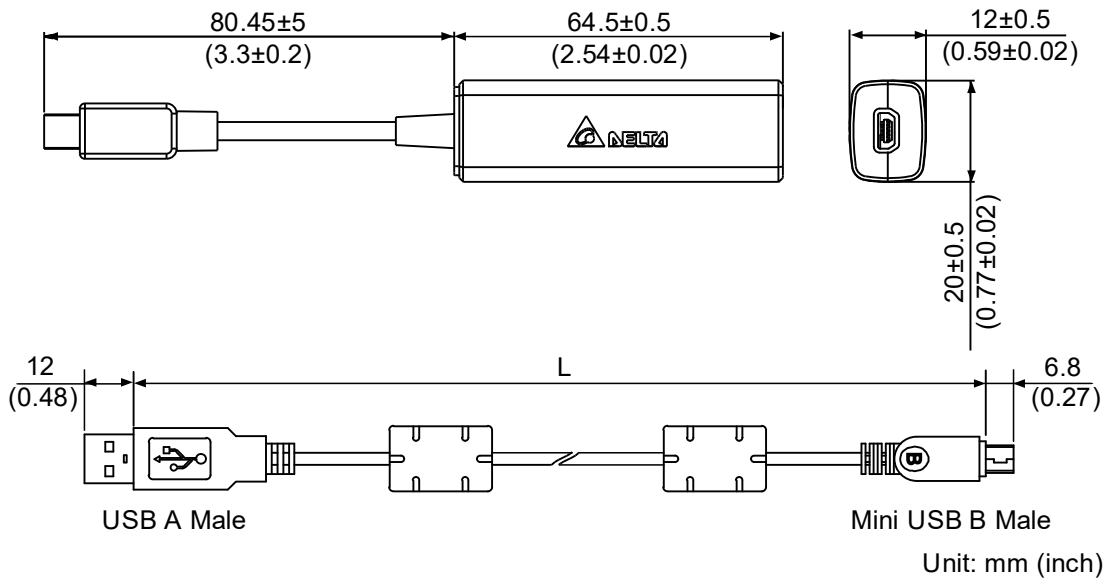

Unit: mm (inch)

B.14   CN6 DMCNET terminal resistor

Delta model number: ASD-TR-DM0008

Unit: mm (inch)

B.15   CN4 Mini USB communication module

Delta model number: UC-PRG015-01B, UC-PRG030-01B

80.45±5	64.5±0.5		12±0.5
(3.3±0.2)	(2.54±0.02)		(0.59±0.02)

20±0.5
(0.77±0.02)

12	L	6.8
(0.48)		(0.27)

USB A Male   Mini USB B Male

Unit: mm (inch)

Model No.	L	
	mm	inch
UC-PRG015-01B	1500 ± 100	59 ± 4
UC-PRG030-01B	3000 ± 100	118 ± 4

Delta model number: UC-ADP01-A

80.45±5	64.5±0.5	12±0.5
(3.3±0.2)	(2.54±0.02)	(0.59±0.02)

20±0.5
(0.77±0.02)
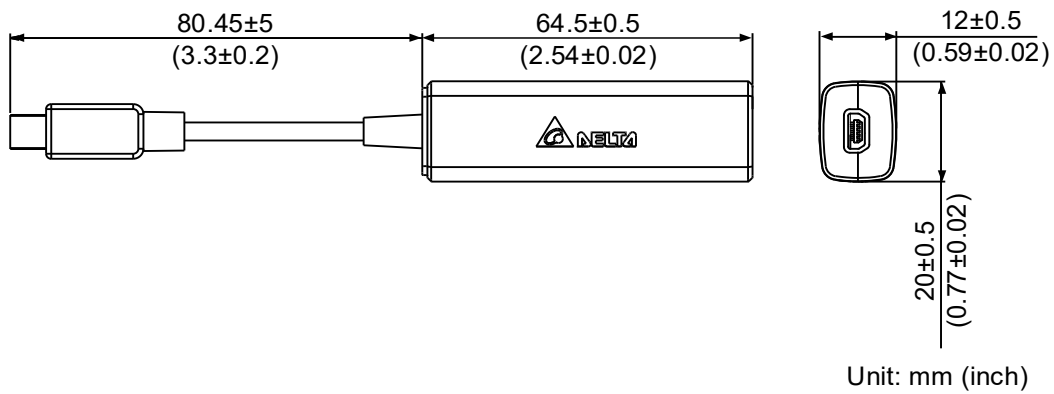
Unit: mm (inch)

Delta model number: UC-PRG015-01A, UC-PRG030-01A

B

USB A Male   Mini USB B Male
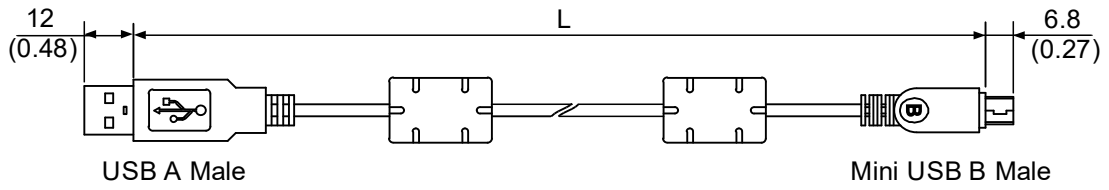
Unit: mm (inch)

Model No.	L	
	mm	inch
UC-PRG015-01A	1500 ± 100	59 ± 4
UC-PRG030-01A	3000 ± 100	118 ± 4

B.16   CANopen communication cable

Delta model number: UC-CMC030-01A, UC-CMC050-01A
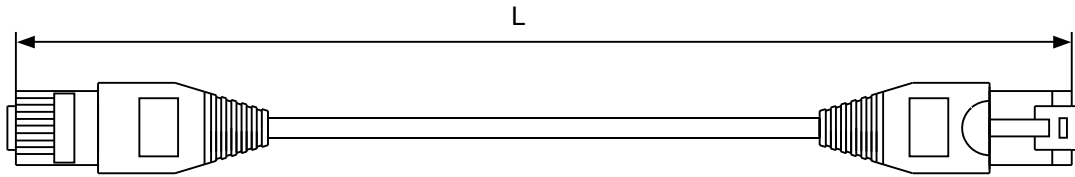
Model No.	L	
	mm	inch
UC-CMC030-01A	300 ± 10	11 ± 0.4
UC-CMC050-01A	500 ± 10	19 ± 0.4

Note: for cables of other length, refer to the Delta PLC/HMI Cable Selection Guide.

B.17   CANopen distribution box

Delta model number: TAP-CN03

Unit: mm (inch)

B

B.18   Optional accessories

100 W servo drive and 50 W / 100 W servo motor

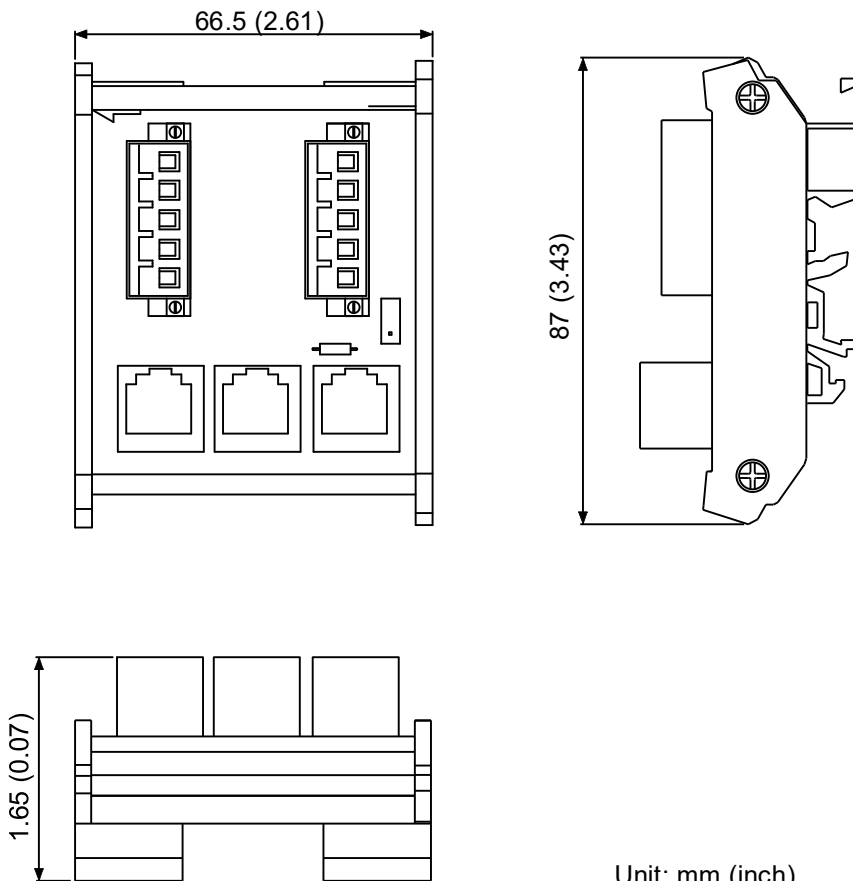| Servo drive model		ASD-B3①-0121-②
Servo motor model		ECM-B3①-C②0401③④⑤, ECM-A3①-C②040F③④⑤, ECM-A3①-C②0401③④⑤
Standard connector	Power connector (without brake)	ASDBCAPW0000
	Power connector (with brake)	ASDBCAPW0100
	Encoder connector	ACS3-CNENC200
Waterproof connector	Power connector (without brake)	ACS3-CNPW1A00
	Power connector (with brake)	ACS3-CNPW2A00
	Encoder connector	ACS3-CNEN2A00
Standard cable	Motor power cable (without brake)	ACS3-CAPW31XX
	Motor power cable (with brake)	ACS3-CAPW41XX
	Encoder cable (incremental type)	ACS3-CAEN10XX
	Encoder cable (absolute type)	ACS3-CAEA10XX
Flexible cable	Motor power cable (without brake)	ACS3-CAPF31XX
	Motor power cable (with brake)	ACS3-CAPF41XX
	Encoder cable (incremental type)	ACS3-CAEF10XX
	Encoder cable (absolute type)	ACS3-CAEB10XX

(XX indicates the cable length: 03 = 3 m, 05 = 5 m, 10 = 10 m, 20 = 20 m.)

200 W servo drive and 200 W servo motor

	Servo drive model	ASD-B3☐-0221-②
	Servo motor model	ECM-B3☐-C②0602③④⑤, ECM-A3☐-C②0602③④⑤
Standard connector	Power connector (without brake)	ASDBCAPW0000
	Power connector (with brake)	ASDBCAPW0100
	Encoder connector	ACS3-CNENC200
Waterproof connector	Power connector (without brake)	ACS3-CNPW1A00
	Power connector (with brake)	ACS3-CNPW2A00
	Encoder connector	ACS3-CNEN2A00
Standard cable	Motor power cable (without brake)	ACS3-CAPW31XX
	Motor power cable (with brake)	ACS3-CAPW41XX
	Encoder cable (incremental type)	ACS3-CAEN10XX
	Encoder cable (absolute type)	ACS3-CAEA10XX
Flexible cable	Motor power cable (without brake)	ACS3-CAPF31XX
	Motor power cable (with brake)	ACS3-CAPF41XX
	Encoder cable (incremental type)	ACS3-CAEF10XX
	Encoder cable (absolute type)	ACS3-CAEB10XX

(XX indicates the cable length: 03 = 3 m, 05 = 5 m, 10 = 10 m, 20 = 20 m.)

B

B

400 W servo drive and 400 W servo motor

Servo drive model		ASD-B3☐-0421-②
Servo motor model		ECM-B3①-C②0604③④⑤, ECM-B3①-C②0804③④⑤, ECM-A3①-C②0604③④⑤, ECM-A3①-C②0804③④⑤
Standard connector	Power connector (without brake)	ASDBCAPW0000
	Power connector (with brake)	ASDBCAPW0100
	Encoder connector	ACS3-CNENC200
Waterproof connector	Power connector (without brake)	ACS3-CNPW1A00
	Power connector (with brake)	ACS3-CNPW2A00
	Encoder connector	ACS3-CNEN2A00
Standard cable	Motor power cable (without brake)	ACS3-CAPW31XX
	Motor power cable (with brake)	ACS3-CAPW41XX
	Encoder cable (incremental type)	ACS3-CAEN10XX
	Encoder cable (absolute type)	ACS3-CAEA10XX
Flexible cable	Motor power cable (without brake)	ACS3-CAPF31XX
	Motor power cable (with brake)	ACS3-CAPF41XX
	Encoder cable (incremental type)	ACS3-CAEF10XX
	Encoder cable (absolute type)	ACS3-CAEB10XX

(XX indicates the cable length: 03 = 3 m, 05 = 5 m, 10 = 10 m, 20 = 20 m.)

750 W servo drive and 750 W servo motor

Servo drive model		ASD-B3①-0721-②
Servo motor model		ECM-B3①-C②0807③④⑤, ECM-A3①-C②0807③④⑤
Standard connector	Power connector (without brake)	ASDBCAPW0000
	Power connector (with brake)	ASDBCAPW0100
	Encoder connector	ACS3-CNENC200
Waterproof connector	Power connector (without brake)	ACS3-CNPW1A00
	Power connector (with brake)	ACS3-CNPW2A00
	Encoder connector	ACS3-CNEN2A00
Standard cable	Motor power cable (without brake)	ACS3-CAPW31XX
	Motor power cable (with brake)	ACS3-CAPW41XX
	Encoder cable (incremental type)	ACS3-CAEN10XX
	Encoder cable (absolute type)	ACS3-CAEA10XX
Flexible cable	Motor power cable (without brake)	ACS3-CAPF31XX
	Motor power cable (with brake)	ACS3-CAPF41XX
	Encoder cable (incremental type)	ACS3-CAEF10XX
	Encoder cable (absolute type)	ACS3-CAEB10XX

(XX indicates the cable length: 03 = 3 m, 05 = 5 m, 10 = 10 m, 20 = 20 m.)

Note:

1. The connectors and cables listed in the above table are applicable to all B3 series models.

2. In the servo drive model name, ① represents the product series and ② represents the model code.

3. In the servo motor model name, ① represents the motor inertia, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector type, and ⑤ represents the special code.

B

1 kW servo drive and 750 W servo motor

Servo drive model		ASD-B3①-1021-②
Servo motor model		ECM-A3①-C②0807
Standard connector	Power connector (without brake)	ASDBCAPW0000
	Power connector (with brake)	ASDBCAPW0100
	Encoder connector	ACS3-CNENC200
Waterproof connector	Power connector (without brake)	ACS3-CNPW1A00
	Power connector (with brake)	ACS3-CNPW2A00
	Encoder connector	ACS3-CNEN2A00
Standard cable	Motor power cable (without brake)	ACS3-CAPW31XX
	Motor power cable (with brake)	ACS3-CAPW41XX
	Encoder cable (incremental type)	ACS3-CAEN10XX
	Encoder cable (absolute type)	ACS3-CAEA10XX
Flexible cable	Motor power cable (without brake)	ACS3-CAPF31XX
	Motor power cable (with brake)	ACS3-CAPF41XX
	Encoder cable (incremental type)	ACS3-CAEF10XX
	Encoder cable (absolute type)	ACS3-CAEB10XX

(XX indicates the cable length: 03 = 3 m, 05 = 5 m, 10 = 10 m, 20 = 20 m.)

1 kW servo drive and 1 kW servo motor

	Servo drive model	ASD-B3☐-1021-②
	Servo motor model	ECM-B3①-E②1310③④⑤
Standard connector	Power connector (without brake)	ACS3-CNPW5200
	Power connector (with brake wires only)	ACS3-CNPW6300
	Encoder connector	ACS3-CNENC200
Standard cable	Motor power cable (without brake)	ACS3-CAPW32XX
	Motor power cable (with brake)	ACS3-CAPW42XX
	Encoder cable (incremental type)	ACS3-CAEN27XX
	Encoder cable (absolute type)	ACS3-CAEA27XX
Flexible cable	Motor power cable (without brake)	ACS3-CAPF32XX
	Motor power cable (with brake)	ACS3-CAPF42XX
	Encoder cable (incremental type)	ACS3-CAEF27XX
	Encoder cable (absolute type)	ACS3-CAEB27XX

(XX indicates the cable length: 03 = 3 m, 05 = 5 m, 10 = 10 m, 20 = 20 m.)

1.5 kW servo drive and 1.5 kW servo motor

	Servo drive model	ASD-B3☐-1521-②
	Servo motor model	ECM-B3①-E②1315③④⑤
Standard connector	Power connector (without brake)	ACS3-CNPW5200
	Power connector (with brake wires only)	ACS3-CNPW6300
	Encoder connector	ACS3-CNENC200
Standard cable	Motor power cable (without brake)	ACS3-CAPW32XX
	Motor power cable (with brake)	ACS3-CAPW42XX
	Encoder cable (incremental type)	ACS3-CAEN27XX
	Encoder cable (absolute type)	ACS3-CAEA27XX
Flexible cable	Motor power cable (without brake)	ACS3-CAPF32XX
	Motor power cable (with brake)	ACS3-CAPF42XX
	Encoder cable (incremental type)	ACS3-CAEF27XX
	Encoder cable (absolute type)	ACS3-CAEB27XX

(XX indicates the cable length: 03 = 3 m, 05 = 5 m, 10 = 10 m, 20 = 20 m.)

B

B

2 kW servo drive and 2 kW servo motor

Servo drive model		ASD-B3①-2023-②	
Servo motor model		ECM-B3①-E②1320③④⑤	ECM-B3①-E②1820③④⑤
Standard connector	Power connector (without brake)	ACS3-CNPW5200	ACS3-CNPW5300
	Power connector (with brake wires only)	ACS3-CNPW6300	
	Encoder connector	ACS3-CNENC200	
Standard cable	Motor power cable (without brake)	ACS3-CAPW32XX	ACS3-CAPW34XX
	Motor power cable (with brake)	ACS3-CAPW42XX	ACS3-CAPW44XX
	Encoder cable (incremental type)	ACS3-CAEN27XX	
	Encoder cable (absolute type)	ACS3-CAEA27XX	
Flexible cable	Motor power cable (without brake)	ACS3-CAPF32XX	ACS3-CAPF34XX
	Motor power cable (with brake)	ACS3-CAPF42XX	ACS3-CAPF44XX
	Encoder cable (incremental type)	ACS3-CAEF27XX	
	Encoder cable (absolute type)	ACS3-CAEB27XX	

(XX indicates the cable length: 03 = 3 m, 05 = 5 m, 10 = 10 m, 20 = 20 m.)

Note:

1. The connectors and cables listed in the above table are applicable to all B3 series models.

2. In the servo drive model name, ① represents the product series and ② represents the model code.

3. In the servo motor model name, ① represents the motor inertia, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector type, and ⑤ represents the special code.

3 kW servo drive and 3 kW servo motor

	Servo drive model	ASD-B3①-3023-②
	Servo motor model	ECM-B3①-F②1830③④⑤
Standard connector	Power connector (without brake)	ACS3-CNPW5300
	Power connector (with brake wires only)	ACS3-CNPW6300
	Encoder connector	ACS3-CNENC200
Standard cable	Motor power cable (without brake)	ACS3-CAPW34XX
	Motor power cable (with brake)	ACS3-CAPW44XX
	Encoder cable (incremental type)	ACS3-CAEN27XX
	Encoder cable (absolute type)	ACS3-CAEA27XX
Flexible cable	Motor power cable (without brake)	ACS3-CAPF34XX
	Motor power cable (with brake)	ACS3-CAPF44XX
	Encoder cable (incremental type)	ACS3-CAEF27XX
	Encoder cable (absolute type)	ACS3-CAEB27XX

(XX indicates the cable length: 03 = 3 m, 05 = 5 m, 10 = 10 m, 20 = 20 m.)

Note:

1. The connectors and cables listed in the above table are applicable to all B3 series models.

2. In the servo drive model name, ① represents the product series and ② represents the model code.

3. In the servo motor model name, ① represents the motor inertia, ② represents the encoder type, ③ represents the brake or keyway / oil seal type, ④ represents the shaft diameter and connector type, and ⑤ represents the special code.

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B

Revision History

Release date	Version	Chapter	Revision contents
May, 2022	V7.0 (Seventh edition)	1 3.5.2	Added the information of B3☐-M.
September, 2021	V6.0 (Sixth edition)	-	B3A series models has acquired the TUV certificate.
		1	Corrected the colors of the V and W connectors in the servo drive diagrams.
		13	Added alarms: AL02F, AL033, and AL09F.
		A	Modified the vibration specifications. Added the QR code for downloading the CE certificate.
August, 2021	V5.0 (Fifth edition)	1.3	Added the information of 750W motor corresponding to the 1 kW servo drive
		3.3.7	Added the maximum input pulse frequency specifications for differential signals Added the diode specification when an inductive load is connected to the drive for DO wirings.
		8.3	Added the parameter description for P1.000.
		12	Modified the trigger conditions, causes, and troubleshooting methods for alarms: AL009, AL018, AL020, AL028, AL044, AL060, AL062, AL06A, AL072, AL083, AL086, AL08A, AL099, AL129, AL237, AL303, AL3E3, and AL400. Added alarms: AL02A, AL02B, AL032, AL036, AL048, AL064, AL066, AL06B, AL06E, AL06F, AL071, AL07A, AL09C, AL0A6, AL113, AL211, AL219, AL422, AL510, and AL520
		13	New chapter: added the EtherCAT information.

Release date	Version	Chapter	Revision contents
August, 2021	V5.0 (Fifth edition)	A.1.1	Modified the 750W servo drive specification: the maximum instantaneous output current is 14.14 Arms. Modified the maximum input pulse frequency for differential signals (A phase + B phase). Modified the input current specification. Added the inrush current specification for the main circuit power supply. Added the input current and inrush current specifications for the control power supply. Changed the descriptions in the DI / DO fields into the quantity of input / output points.
August, 2021	V5.0 (Fifth edition)	A.1.1	Added the note for notifying that the B3A model is TUV certified.
		A.1.2	The tightening torque information is moved to Chapter 3.
		A.2	Added the descriptions for encoder types and special codes.
		A.2.1	Added the operating voltage for the brake. Modified the operating and storage temperatures of the B3 motors.
		A.2.2	Added the torque feature (T-N curves) for using ECM-B3M-C②0807③④⑤ with ASD-B3①-0721-②.
		A.2.7	Updated the graphs and tables of load and operating time.
		A.3.3	Added the torque feature (T-N curve) for using ECM-A3L-C②0807③④⑤ with ASD-B3①-0721-②. Added the torque feature (T-N curve) for using ECM-A3H-C②0807③④⑤ with ASD-B3①-0721-②.

Release date	Version	Chapter	Revision contents
February, 2021	V4.0 (Fourth edition)	3.1.6	Added the unit of mm² for the wire diameter. Changed the UVW terminal selection information for the 2 kW and 3 kW models.
December, 2020	V3.0 (Third edition)	3, 10, B	Changed the term of torsion-resistant cable to flexible cable.
July, 2020	V2.0 (Second edition)	3.3.7	Optimized the pulse input wiring diagram.
		3.4	Added the warning messages. Added CN2 pin descriptions.
		3.10	Added the standard wiring diagram for open-collector pulse signals. Optimized the wiring diagram for differential pulse signals. Added CN2 pin descriptions.
		10.2.1	Added the warning messages. Added CN2 pin descriptions.
November, 2019	V1.0 (First edition)	-	-

For relevant information about [ASDA-B3], please refer to:

(1) ASDA-B2 User Manual

(2) ASDA-A3 User Manual

(3) ASDA-A2 User Manual

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