JSS715N

Servo Drive

User Guide

Data code: C2312010XXX

Version: A00

JSS-MOTOR

Power range: 0.05 kW to 7.5 kW

Legal Information Statement:

- The product described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation.
- All operations on the product must follow respective descriptions provided in the documentation, in particular, its warning notices and safety instructions.
- Damage caused by improper use is not covered by warranty.
- The company will disclaim any legal liability for any personal injury or property damage caused by improper usage.

Contents

Safety Information and Precautions

To avoid personal injury or damage to the equipment, matters to be followed are stated as follows:

- Read and follow the Safety Information and Precautions before use.
- Use this product according to the designated environment requirements.
- Follow all safety information and precautions described in the product identification and manual.

The degree of injury and damage caused by improper use of this product is distinguished and described as follows:

DANGER	This mark indicates that failure to comply with the notice will result in severe personal injury or even death.
WARNING	This mark indicates that failure to comply with the notice may result in severe personal injury or even death.
CAUTION	This mark indicates that failure to comply with the notice may result in minor or moderate personal injury or damage to the equipment.
NOTICE	If rated precautions are not taken, it may cause undesirable result or state.

Matters to be followed are described using the following graphic marks:

This graphic mark indicates contents that must be performed.	This graphic mark indicates contents that must not be performed.

DANGER

- Install this product on non-combustible materials such as metal.
- Set up the product in a clean place where it does not contact water or oil.
- Installation and wiring must be performed by qualified electricians.
- Installation personnel must be familiar with product installation requirements and relevant technical materials.
- The moving, installation, wiring, and inspection of this product can be performed only after you cut off the power supply, wait at least 10 minutes, and determine that there is no risk of electric shock.
- Follow the proper electrostatic discharge (ESD) procedures and wear an anti-static wrist strap to perform wiring.
- The cables should be properly connected. The energized part must be properly insulated using an insulator.

- Do not place any combustible material around this product.
- Do not place this product around heating elements such as heaters and large wire-wound resistors.
- Do not use this product in a corrosive and inflammable gas environment or in a place close to combustible materials.
- Do not use this product in a place with strong vibration or impact.
- Do not use this product after the cables are immersed in oil or water.
- Do not perform wiring at power-on.
- Do not damage the cables or apply any excessive external force, weight, or pinch to them.
- Do not connect this product directly to the commercial power supply.
- Do not perform installation and wiring in a place with strong electric or magnetic field.
- Do not perform wiring and equipment operations with wet hands.
- Do not reach your hands into this product.

WARNING

- Specialized loading and unloading equipment must be used to handle the product.
- When handling the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling.
- Handle the equipment with care during transportation and mind your steps.
- When this product is installed in a terminal device, the terminal device must be equipped with protection. The protection class must comply with relevant IEC standards and local regulations.
- Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at one end.

- Do not install the equipment if you find damage, rust, or signs of use on the equipment or accessories upon unpacking.
- Do not install the equipment if you find water seepage or missing or damaged components upon unpacking.
- Do not install the equipment if you find the packing list does not conform to the equipment you received.
- When the product is lifted by a crane, personnel cannot stand or stay under the product.
- Do not modify this product.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- Do not connect the input power supply to the output end of the equipment.

CAUTION

- Check whether the equipment or accessories show the evidence of damage, rust, impact, or dampness.
- Check whether the package contents are consistent with the packing list.
- After wiring is completed, ensure that there are no screws fallen or cables exposed in the equipment.
- Make sure that the temperature around the equipment is within the range of temperature and humidity.
- Dispose of the equipment as industrial waste during discarding.

- Do not stand on the equipment or place a weight on it.
- Do not let the equipment fall or invert it during the handling or setup.
- Do not place any barriers around the product and peripheral equipment to hinder ventilation.
- Do not let the equipment suffer from any strong impact.

Safety Signs

Danger

- Conduct protective grounding to prevent electric shock. Read through the guide and follow the safety instructions before use.

High Voltage

- Do not touch terminals with power-on or within 10 minutes after disconnecting the power supply to prevent the risk of electric shock.

Hot

- Do not touch the drive during operation and within a short time after shutdown. Failure to comply may cause burns.

Environmental Protection

Reuse

- Some components of the product can be reused due to high metal content. Dismantle the product into individual components to improve the metal recycling efficiency. Electrical and electronic components contain metal materials that can also be recycled through a specific separation process.

Disposal

- Discard components that cannot be degraded and recycled as industrial wastes according to local regulations.

Chapter 1 Product Information

Efficient, Reliable, and Reassuring

The JSS715N series is a fast, reliable, and accurate positioning platform servo drive from JSS-MOTOR covering the most common power range of 0.05 kW to 7.5 kW for general automation. It supports both single-phase and three-phase power supply systems. It features a space-saving design and excellent servo control performance.

Working together with the JSSMK1 servo drivethe JSS715N series servo drive can optimize the performance and the ease of use. Compatible with mainstream PLCs from brands such as Beckhoff and Omron, the JSS715N series servo drive provides efficient and convenient motion control solutions for various industries.

1.1 Features

Excellent performance

- High response: 2 kHz speed loop bandwidth
- High accuracy: 17-bit absolute encoder
- High speed: 125 μs synchronization period
- High synchronization: 300 nodes at 120 m distance, 15 ns synchronization error, ±20 ns synchronization jitter

Sophisticated and novel design

- Integrated communication ports, enhancing wiring efficiency
- Compact design, making the product be able to be installed in narrow space
- Easy to connect and use, with serial commissioning cable to improve commissioning efficiency
- Support to EtherCAT bus servo parameter copy for quick and easy access

Safe and reliable

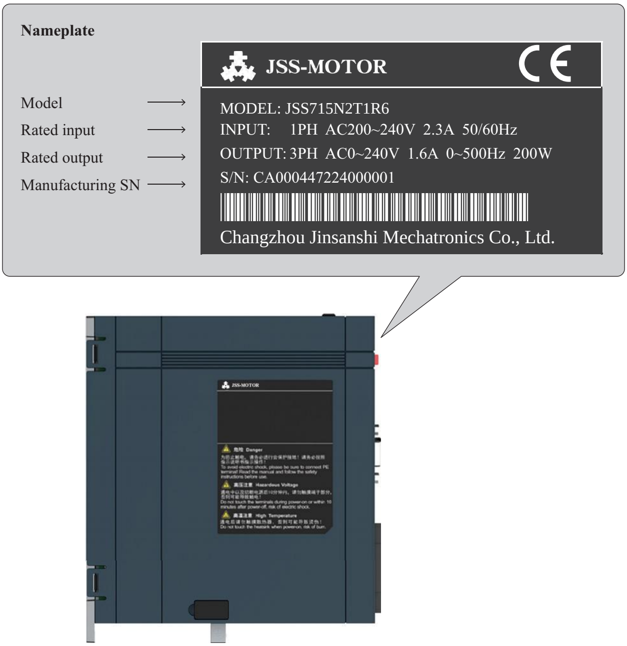
- Built-in dynamic brake function
- Optional high-protection model to cope with harsh application environments

1.2 Model

JSS715N - 2T - 2R8 - **

Standard mark	Default: Standard
Rated current	1R6: 1.6 A 2R8: 2.8 A 5R5: 5.5 A ... 021: 21 A 026: 26 A
Voltage class	2T: 220 V 4T: 380 V
Product type	N: EtherCAT bus
Product series	JSS715 series servo drive

1.3 Nameplate



1.4 Components

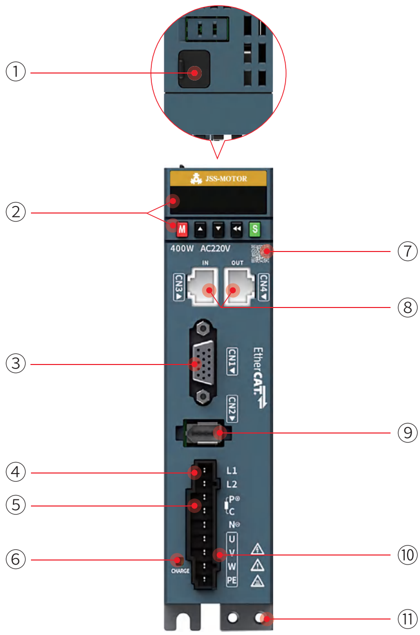


Figure 1-1 Components of the JSS715N servo drive (SIZE A)

No.	Name	No.	Name
①	Commissioning and communication port (CN6)	⑦	QR code on machine
②	Display and operation area	⑧	EtherCAT communication network port (CN3 and CN4)
③	Control signal port (CN1)	⑨	Encoder signal port (CN2)
④	Power input	⑩	Motor power output
⑤	Braking resistor port	⑪	System ground
⑥	Charging indicator	-	-

NOTICE

- The above figure describes the component layout of the SIZE A drive. Component layout of other models may be different. For positions of ports of other models, see section 3.3 Ports.

1.5 Rated Data

Single-phase 220 V servo drive

Item	SIZE-A		SIZE-B
Power	0.1 kW, 0.2 kW	0.4 kW	0.75 kW
Drive model JSS715N	2T1R6	2T2R8	2T5R5
Continuous output current (Arms)	1.6	2.8	5.5
Maximum output current (Arms)	5.8	10.1	16.9
Main circuit power supply	Single-phase 200–240 V AC, –10% to +10%, 50/60 Hz		
Control circuit power supply	Powered up by the bus, sharing one power supply and rectification part with the main circuit		
Braking capability	External braking resistor		Built-in braking resistor

Single-phase/Three-phase 220 V servo drive

Item	SIZE-C	SIZE-D
Power	1.0 kW	1.5 kW
Drive model JSS715N	2T7R6	2T012
Continuous output current (Arms)	7.6	11.6
Maximum output current (Arms)	23	32
Main circuit power supply	Single-phase/three-phase 200–240 V AC, –10% to +10%, 50/60 Hz	
Control circuit power supply	Single-phase 200–240 V AC, –10% to +10%, 50/60 Hz	
Braking capability	Built-in braking resistor	

NOTICE

- The main circuits of 2T7R6 and 2T012 drives can be connected to a single-phase or a three-phase power supply, depending on which one is available on site.

Three-phase 380 V servo drive

Item	SIZE-C		SIZE-D		SIZE-E		
Power	0.85 kW	1.5 kW	2.0 kW	3.0 kW	5.0 kW	6.0 kW	7.5 kW
Drive model JSS715N	4T3R5	4T5R4	4T8R4	4T012	4T017	4T021	4T026
Continuous output current (Arms)	3.5	5.4	8.4	11.9	16.5	20.8	25.7
Maximum output current (Arms)	11	14	20	29.8	42	55	65
Main circuit power supply	Three-phase 380–440 V AC, –10% to +10%, 50/60 Hz						
Control circuit power supply	Single-phase 380–440 V AC, –10% to +10%, 50/60 Hz						
Braking capability	Built-in braking resistor						

1.6 Technical Specifications

Basic specifications

Item	Specifications
Control mode	IGBT PWM control, sine wave current drive mode 220 V, 380 V: Single-phase or three-phase full-bridge rectification
Encoder feedback	17-bit multi-turn absolute encoder, which can be used as a single-turn absolute encoder in absence of the battery
Operating temperature	0°C to +55°C (over 45°C: derate 10% for every additional 5°C)
Storage temperature	–40°C to +70°C
Altitude	Up to 2000 m. For altitude above 1000 m, derate 1% for every additional 100 m
IP rating	IP20 (except for the power terminal IP00)

Speed/torque control mode

Item		Specifications
Performance	Speed control range	1:6000 (The lower limit is the threshold within which the servo drive keeps running with the rated torque load.)
	Speed loop bandwidth	2 kHz
	Torque control accuracy	±1%

Item		Specifications
	Ramp time	0 s to 100 s (This parameter can be set for acceleration and deceleration separately.)
Input signal	Speed reference input	Source of network-type references: EtherCAT communication
	Torque reference input	

Position control mode

Item		Specifications
Performance	Positioning time	1 ms to 10 ms
Input signal	Position reference	Source of network-type references: EtherCAT communication
Digital input (DI) signal	Supporting signal allocation change	P-OT (positive limit switch) N-OT (negative limit switch) HomeSwitch (home switch) TouchProbe1 (probe 1) TouchProbe2 (probe 2)
Digital output (DO) signal	Supporting signal allocation change	3 DOs Load capacity: 50 mA Voltage range: 5 V to 30 V
		S-RDY (servo ready) ALM (fault output) BK (brake output)

Built-in functions

Item	Specifications
Overtravel (OT) prevention	The servo drive stops immediately when P-OT or N-OT becomes active
Protection functions	Protections against overcurrent, overvoltage, undervoltage, overload, main circuit detection error, heatsink overheat, overspeed, encoder error, CPU error, and parameter error
LED display	Main power supply CHARGE indicator, 5-digit LED display
Vibration suppression	Five notches (including two adaptive notches), 50 Hz to 8000 Hz

Item		Specifications
Communication function	Connection protocol	Serial port 232 and USB
	Communication protocol	EtherCAT
	Multi-station communication	Up to 255 slave stations
	Axis address setting	0 to 255 set through the software
	Function	Status display, user parameter setting, monitored value display, alarm tracing display, jogging, and speed/torque reference signal observation
Other		Gain tuning, alarm record, and I/O setting

1.7 Communication Specifications

Item		Specifications
Basic performance of EtherCAT slaves	Communication protocol	EtherCAT protocol
	Service supported	CoE (PDO and SDO)
	Synchronization mode	Distributed clock (DC)
	Physical layer	100BASE-TX
	Baud Rate	100 Mbps (100BASE-TX)
	Duplex mode	Full duplex
	Topology	Ring and linear
	Transmission medium	Shielded Ethernet cable of Cat5e or above
	Transmission distance	Less than 100 m between two nodes (with proper environment and cables)
	Number of slaves	Up to 65535 supported by protocol, not exceeding 100 in actual use
	EtherCAT frame length	44 bytes to 1,498 bytes
	Process data	Up to 1486 bytes per Ethernet frame
	Synchronization jitter of two slaves	< 1 μs

Item		Specifications
	Update time	About 30 µs for 1000 on-off inputs and outputs About 100 µs in case of 100 servo axes The value varies with the interface type.
	Communication bit error ratio	10^{-10} Ethernet standard
EtherCAT configuration units	Number of FMMU units	8
	Number of storage synchronization management units	8
	Process data RAM	8 KB
	Distributed clock	64 bits
	EEPROM capacity	32 kbit The initialization data is written by the EtherCAT master.

Chapter 2 Mechanical Installation

CAUTION

- To facilitate heat dissipation upward, fix the drive longitudinally on the mounting surface.
- When installing the drive in a control cabinet, take into consideration the temperature change of the cooling air. Rapid temperature drop of the cooling air is not allowed.
- For installation of multiple servo drives inside the cabinet, install them side by side.
- For dual-row installation, install an air guide plate.
- Use the flame-retardant mounting bracket if necessary.
- Ground the grounding terminal properly. Failure to comply may cause an electric shock or malfunction due to interference.
- Route the servo drive cables downwards to prevent liquid from flowing into the servo drive along the cables.

2.1 Installation Environment

Item	Requirements
Place	Indoors
Grid	Overvoltage category (OVC): III
Altitude	Below 1000 m, up to 2000 m. For altitude above 1000 m, derate 1% for every additional 100 m.
Temperature	Storage: –40°C to +70°C Operation: 0°C to +55°C (For temperature above 45°C, derate 10% for every additional 5°C.), with temperature change less than 0.5°C/min
Humidity	Less than 95% RH, non-condensing
Vibration	Less than 4.9 m/s^2
Heat dissipation	Install and fix the device to the surface of an incombustible object and leave sufficient surrounding space for heat dissipation
Protection	● IP rating: IP20 (except for the power terminal IP00) ● Avoid places with direct sunlight exposure, moisture, and water drop ● Avoid places with corrosive, combustible, or explosive gas ● Avoid places with oil and dust ● Avoid places with strong electromagnetic interference ● Avoid places with constant vibration or physical shock

2.2 Installation clearance

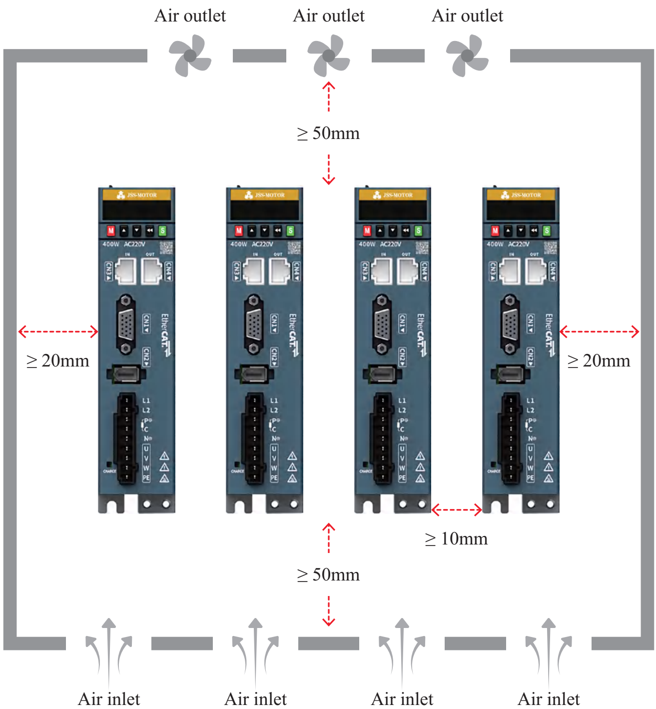
The JSS715N drive can only operate in an enclosed housing or control cabinet and must be fitted with a protective device and protective cover. Three clearances are allowed based on the drive power rating and heat dissipation requirements.

CAUTION

- To ensure the cooling effect and uniform temperature distribution in the control cabinet, reserve sufficient space and install a fan.
- The drive heats up as the motor runs, and running the drive in an enclosed control cabinet may cause abnormal temperature rise inside the cabinet. Install a cooling device for the drive to meet the ambient temperature requirements.

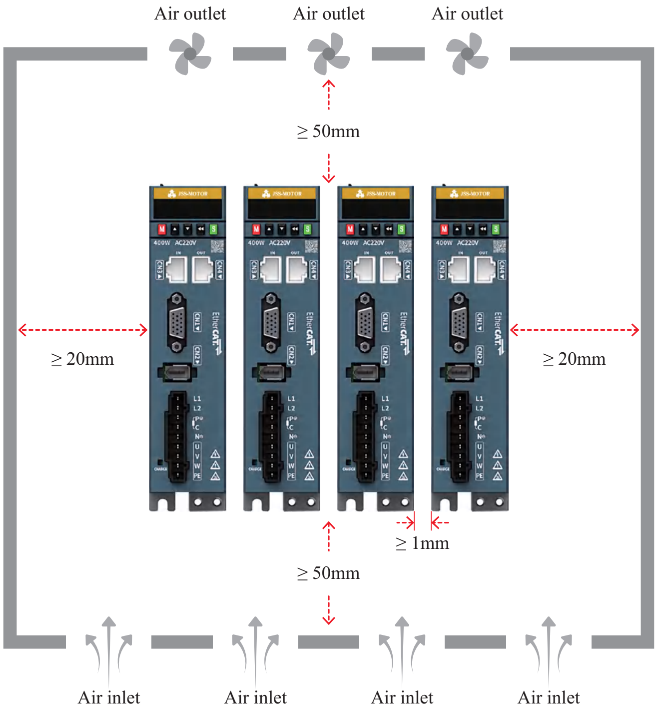
Clearance for side-by-side installation:

Applicable for all models.



Clearance for compact installation:

Applicable for models of SIZE A and SIZE B (0.2 kW to 0.75 kW).

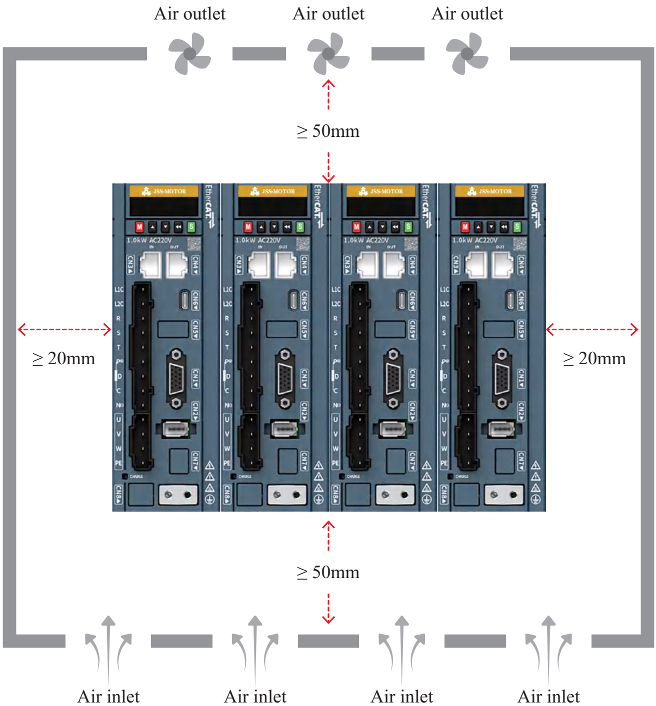


CAUTION

- The distance between adjacent servo drives must be equal to or greater than 1 mm. Take the installation tolerance into consideration.
- When adopting compact installation, derate the rated load rate to 75%.

Zero-clearance installation:

Applicable for models of SIZE C, SIZE D, and SIZE E (0.85 kW to 7.5 kW), no derating.



2.3 Installation Orientation

The JSS715N drive can only be installed vertically, and improper installation orientation may cause over-temperature.

CAUTION

- The JSS715N series servo drive has a vertical structure and thus must be installed vertically. Improper installation orientation may cause over-temperature and then damage to the drive.

2.4 Installation Dimensions

SIZE A (rated power: 0.2 kW to 0.4 kW)

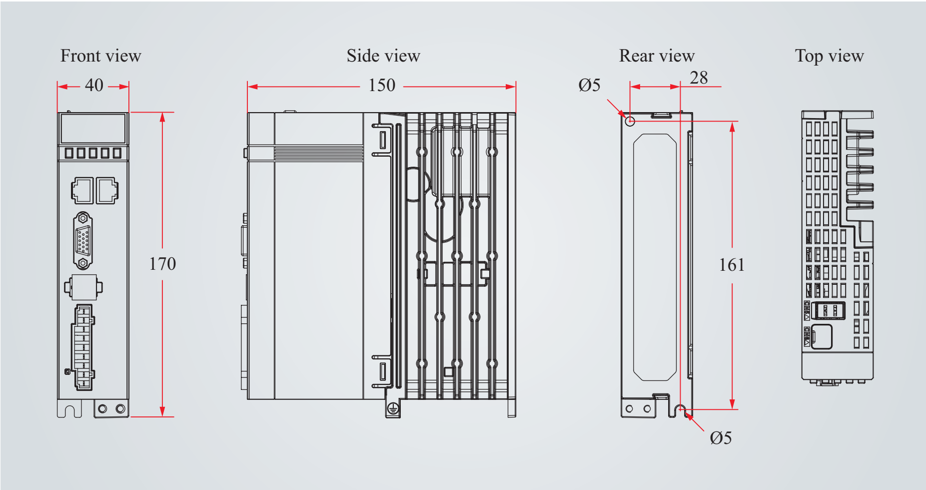


Figure 2-1 Installation dimensions for SIZE A (unit: mm)

SIZE B (rated power: 0.75 kW)

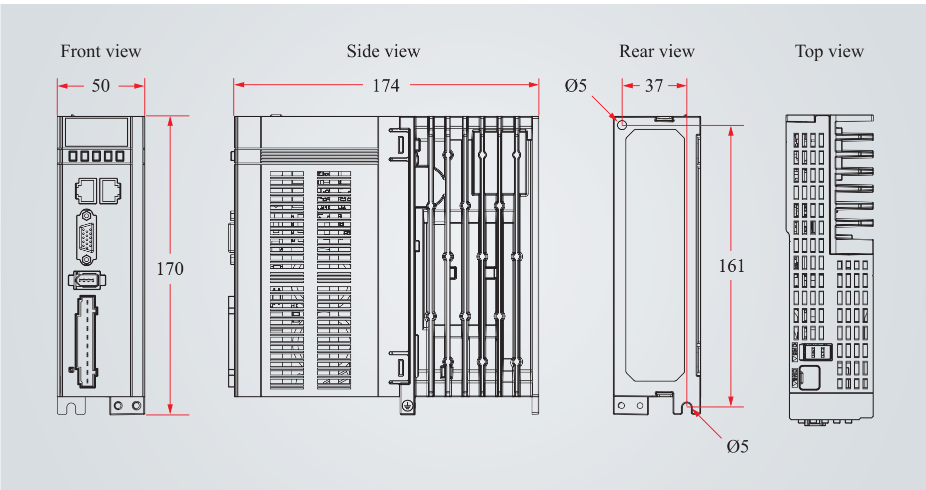


Figure 2-2 Installation dimensions for SIZE B (unit: mm)

SIZE C (rated power: 0.85 kW to 1.5 kW)

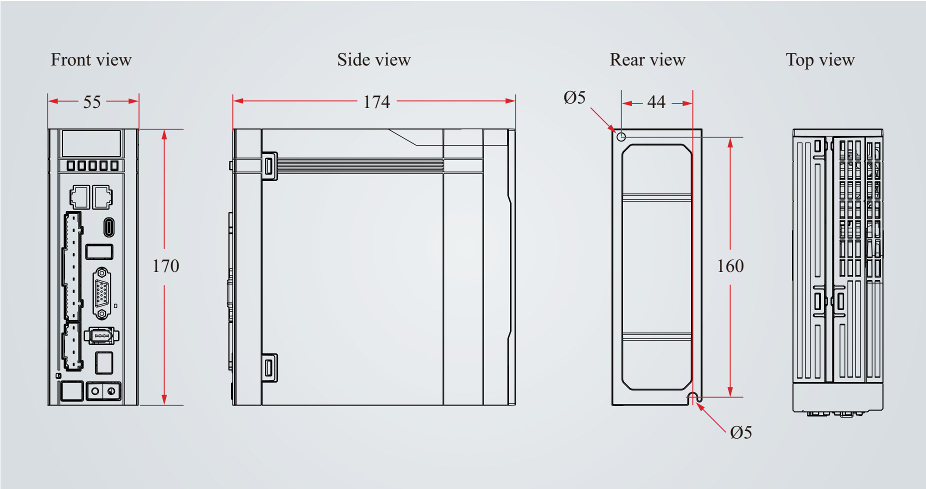


Figure 2-3　Installation dimensions for SIZE C (unit: mm)

SIZE D (rated power: 1.5 kW to 3.0 kW)

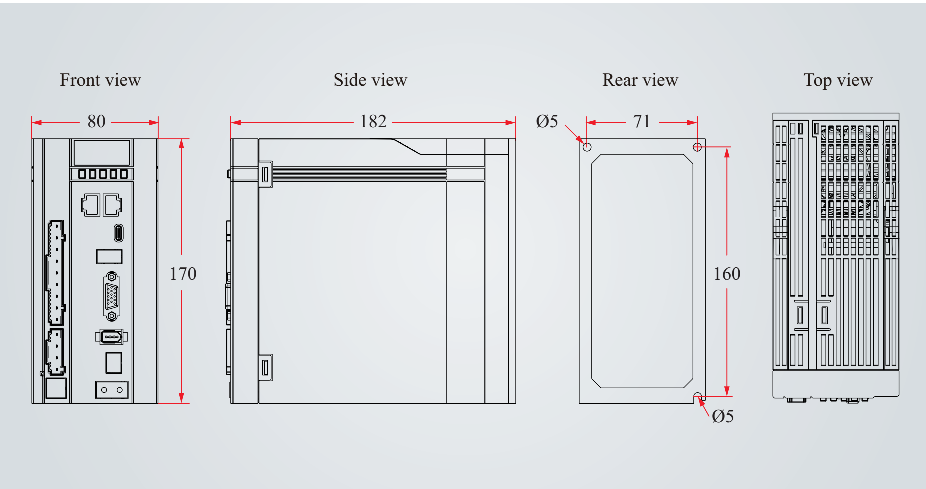


Figure 2-4　Installation dimensions for SIZE D (unit: mm)

SIZE E (rated power: 5.0 kW to 7.5 kW)

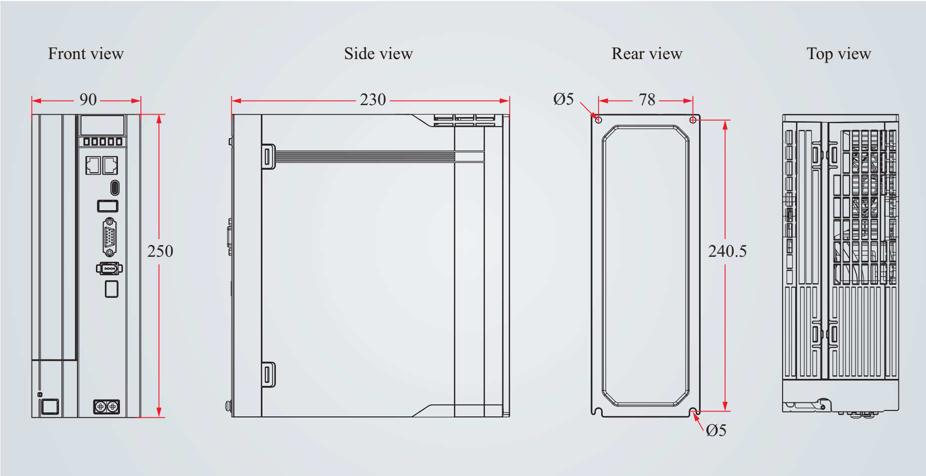


Figure 2-5 Installation dimensions for SIZE E (unit: mm)

Table 2-1 Dimensions of the outer packing box

SIZE	Drive Model	Outer Length	Outer Height	Outer Width	Weight
A	JSS715N2T1R6, JSS715N2T2R8	215 mm	85 mm	195 mm	0.78 kg
B	JSS715N2T5R5	220 mm	95 mm	215 mm	1.04 kg
C	JSS715N2T7R6, JSS715N4T3R5, JSS715N4T5R4	220 mm	95 mm	215 mm	1.20 kg
D	JSS715N2T012, JSS715N4T8R4, JSS715N4T012	280 mm	120 mm	200 mm	1.70 kg
E	JSS715N4T017, JSS715N4T021, JSS715N4T026	325 mm	165 mm	320 mm	3.68 kg

2.5 Installation Guide

The JSS715N series servo drive must be installed on a base through a backplate. For the mounting holes, see the dimensions diagrams of each model.

NOTICE

Fixing with upper and lower screws

- SIZE-A/B/C: M4 screws, 1 each on top and bottom. Torque: 1.3 N·m to 1.6 N·m
- SIZE-D: M4 screws, 2 on top and 1 on bottom. Torque: 1.3 N·m to 1.6 N·m
- SIZE-E: M4 screws, 2 each on top and bottom. Torque: 1.3 N·m to 1.6 N·m

Figure 2-6 Backplate mounting

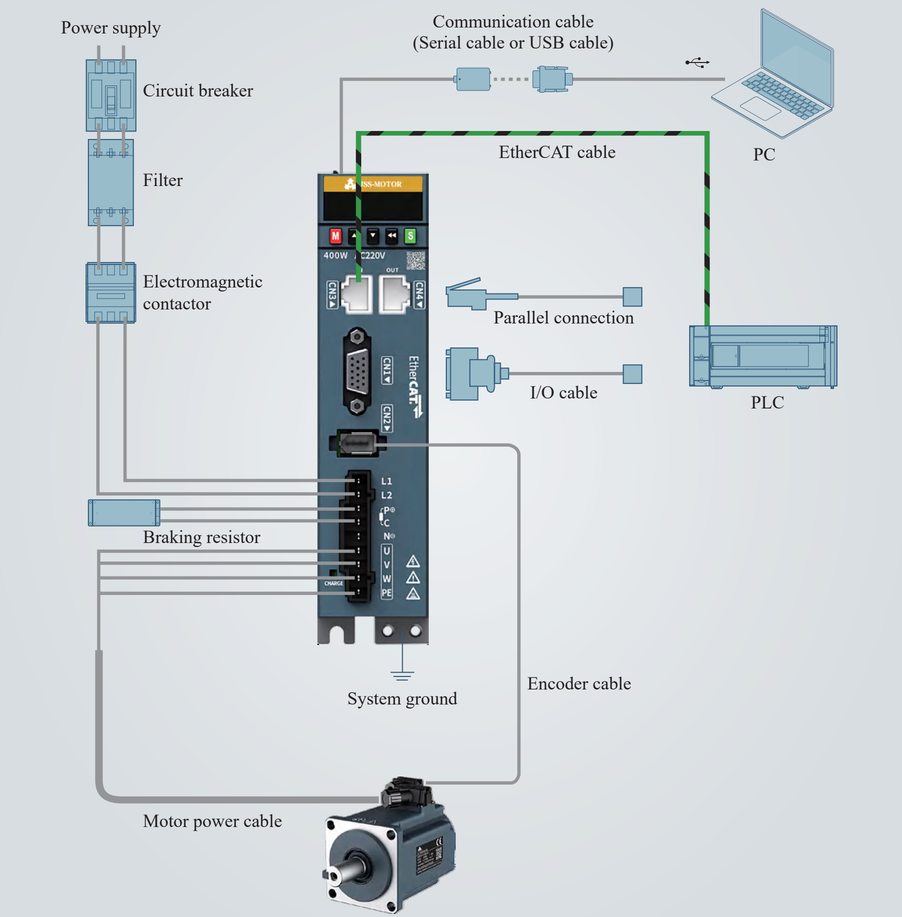
CAUTION

- For the tightening torque of the mounting screws, take into account the strength of the screws used and the material of the mounting position, and ensure that there is no looseness or damage.

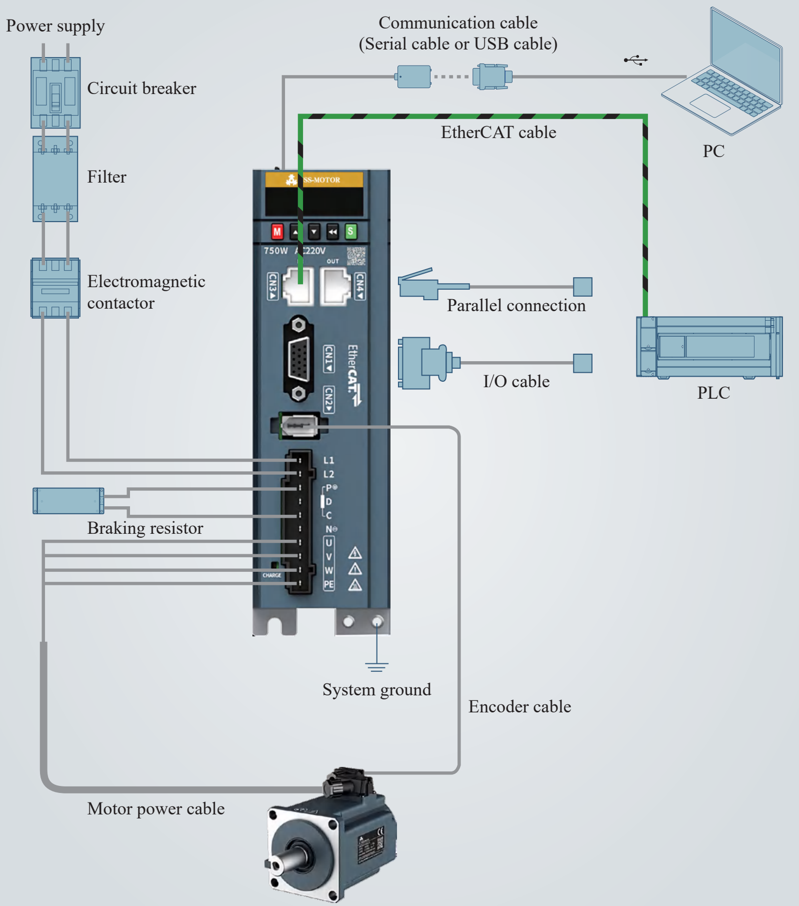
Chapter 3 Electrical Installation

3.1 System Topology

SIZE A

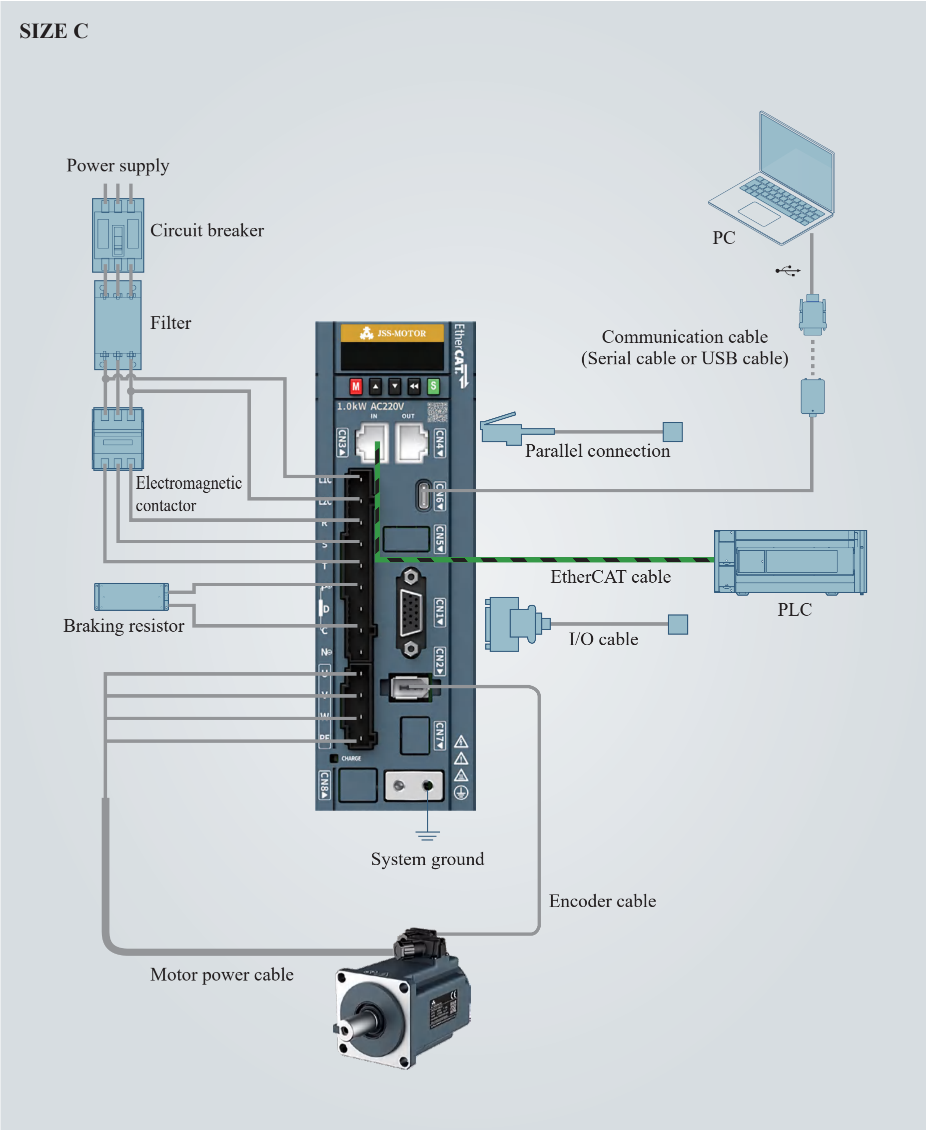


SIZE B



NOTICE

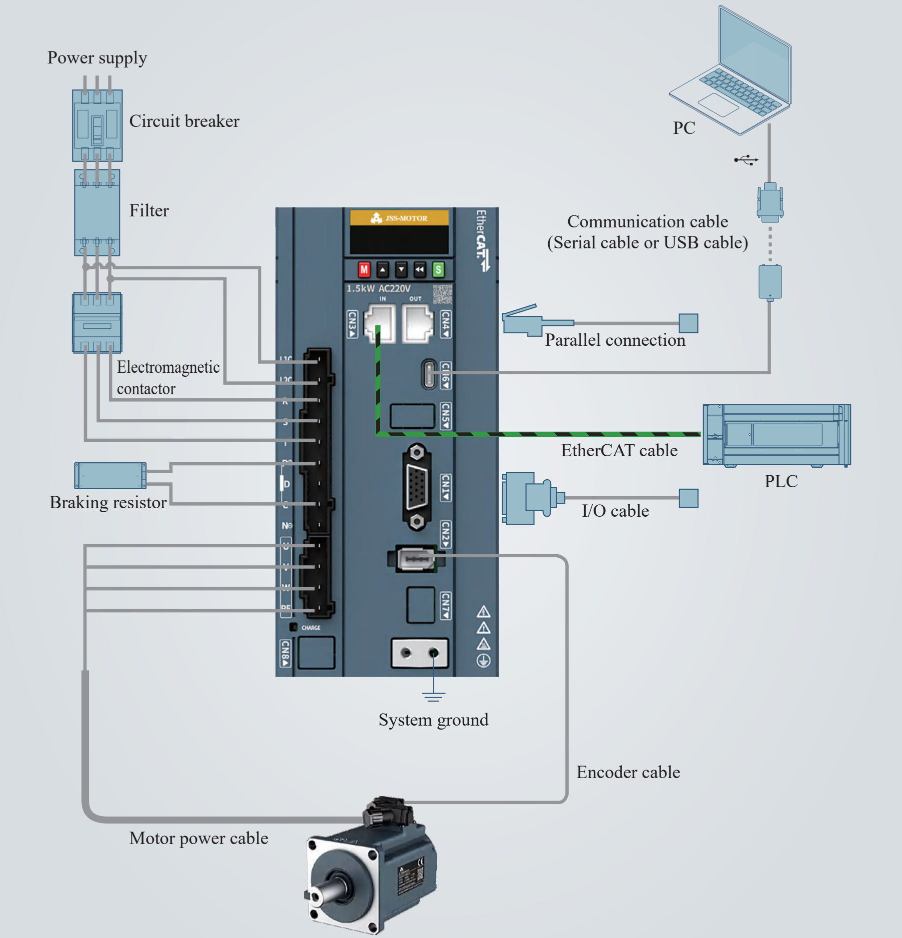
- Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor.



NOTICE

- Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor.

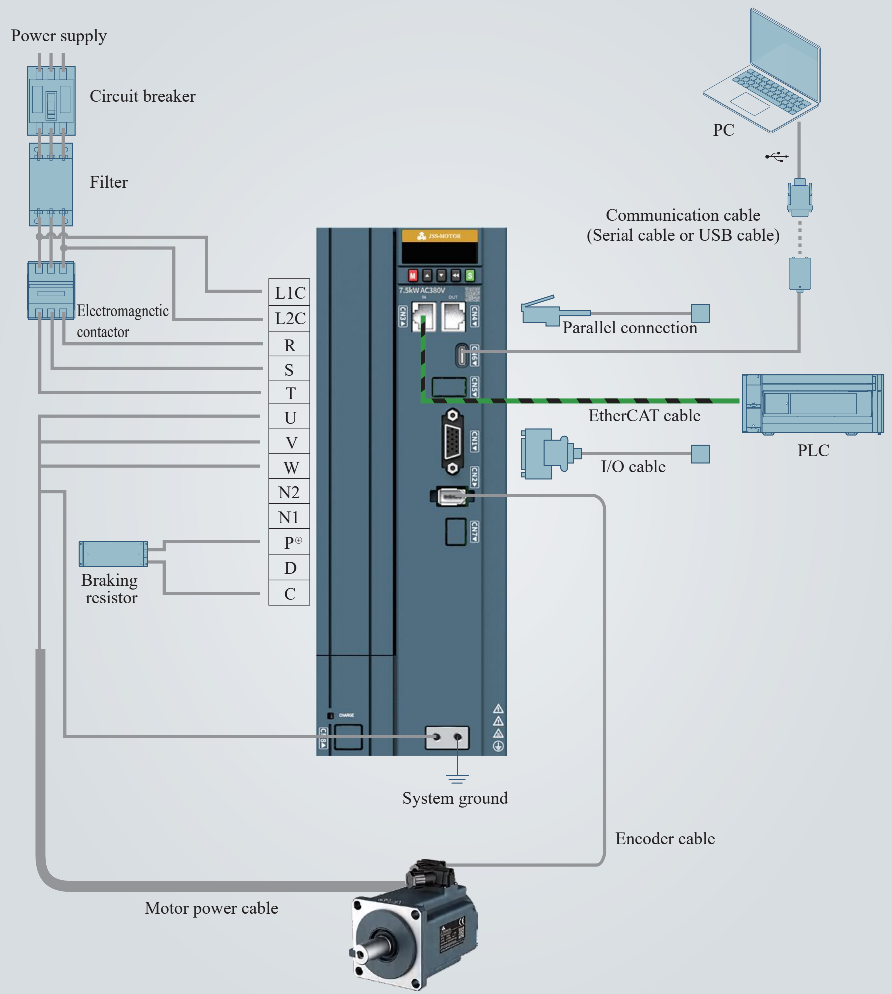
SIZE D



NOTICE

- Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor.

■ SIZE E



NOTICE

- Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor.

3.2 System Wiring

WARNING

- Only electrical engineering specialists can perform wiring.
- Connect an electromagnetic contactor between the input power supply and the main circuit of the drive, to form a structure that can cut off the power supply on the power side of the drive. If no electromagnetic contactor is connected, continuous large current upon drive faults may cause a fire.
- Ensure that the input voltage of the drive is within the allowable range. Failure to comply may result in product faults.
- Connect the drive protective earth (PE) terminal to that of the control cabinet. Failure to comply may result in an electric shock.
- Insulate the connection part of power supply terminals during wiring of the power supply and main circuit. Failure to comply may result in an electric shock.
- Ground the entire system. Failure to comply may result in malfunction.
- After power-off, wait at least 10 minutes before further wiring operations because residual voltage exists after power-off. Failure to comply may result in an electric shock.

- Never power the servo drive with the IT grid. Use the TN or TT grid instead. Failure to comply may result in an electrical shock.
- Do not connect the output terminals U, V, and W of the drive to a three-phase power supply. Failure to comply may result in physical injury or a fire.
- Do not connect the motor terminals U, V, and W to a mains power supply. Failure to comply may result in physical injury or a fire.
- Do not power on the device before wiring is completed. Failure to comply may result in an electrical shock.

CAUTION

- Protect external wiring, branches, and short circuits according to local regulations.
- When using peripheral devices, read the user guide for each component and use it properly after fully confirming the precautions.
- Route the device properly. Improper wiring may cause damage to the drive and motor.
- Connect the drive to the motor directly, without connecting any electromagnetic contactor between them. Failure to comply may result in faults.
- Separate the main circuit cables from the I/O signal cables and encoder cables by at least 30 cm. Failure to comply may result in drive malfunction.
- Use twisted pairs or multi-conductor shielded twisted pairs as I/O signal cables or encoder cables. Failure to comply may result in drive malfunction.
- The maximum wiring lengths of I/O signal cables and encoder cables are 3 m and 10 m, respectively.
- Use a power filter to reduce electromagnetic interference on electronic devices around the drive.

- When wiring, do not allow conductive materials such as wire shavings to fall inside the drive.
- Never place cables under heavy objects or drag cables vigorously. Failure to comply may result in an electric shock due to cable damage.

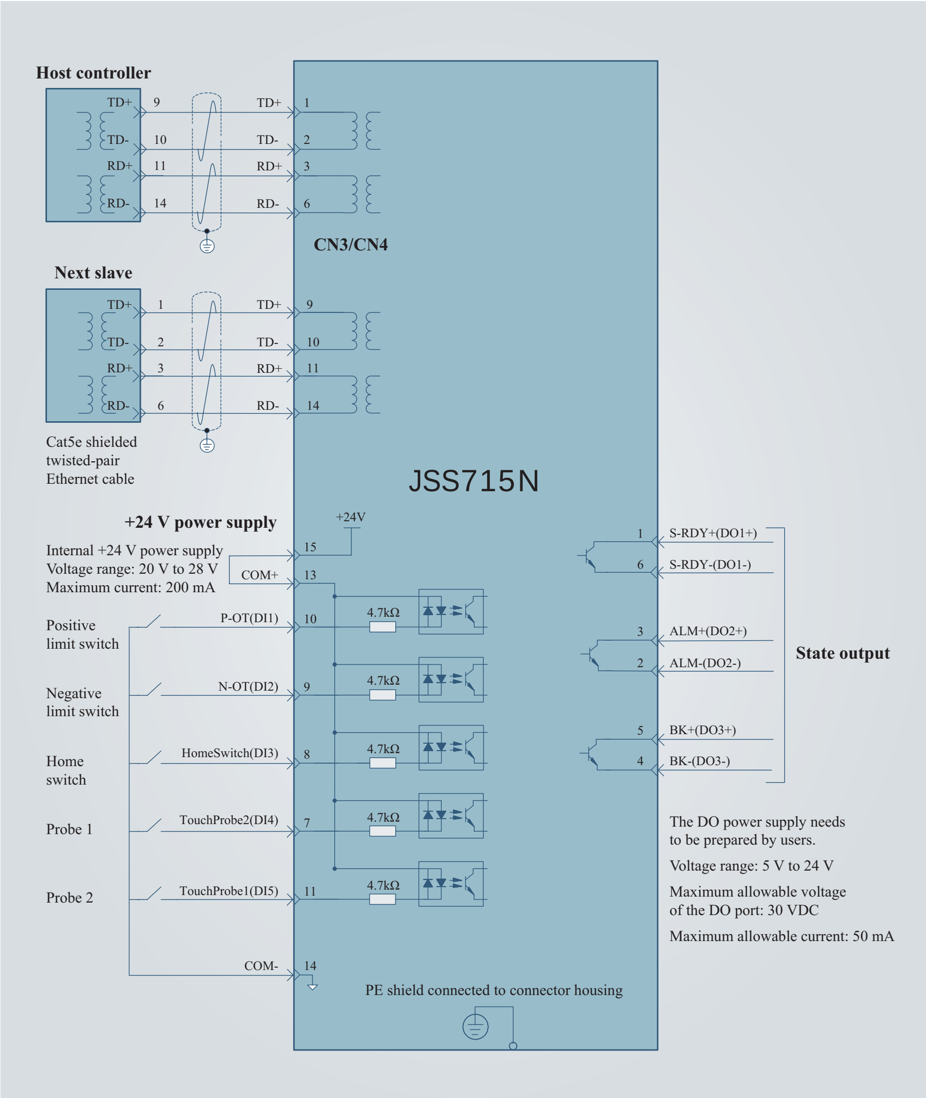
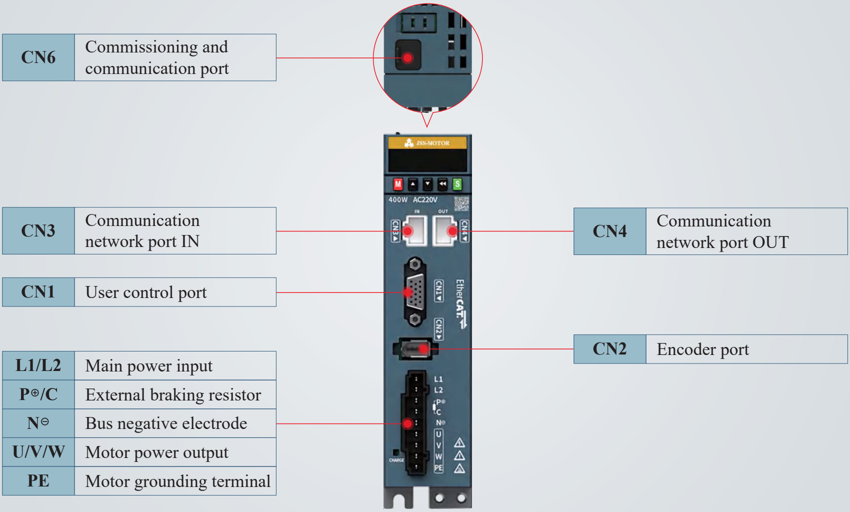


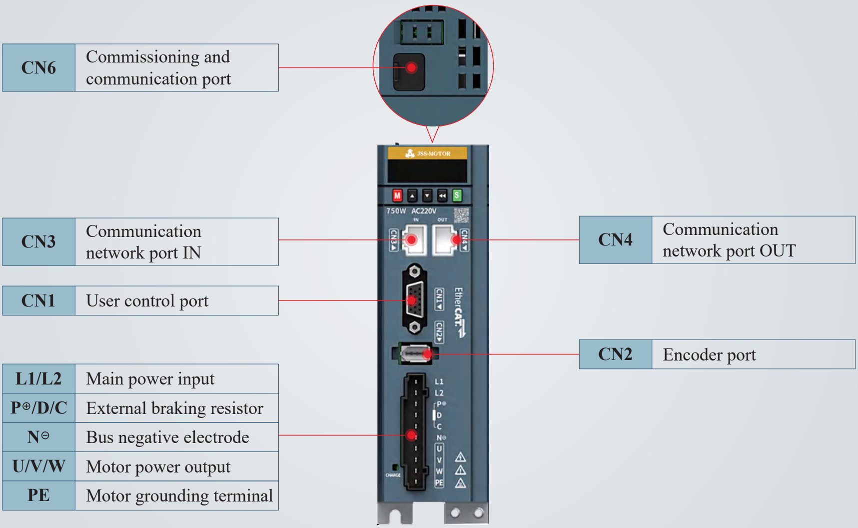
Figure 3-1 System wiring

3.3 Ports

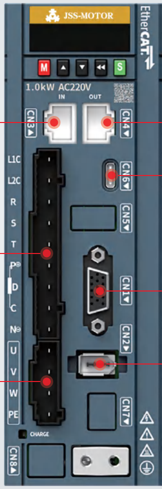
SIZE A



SIZE B



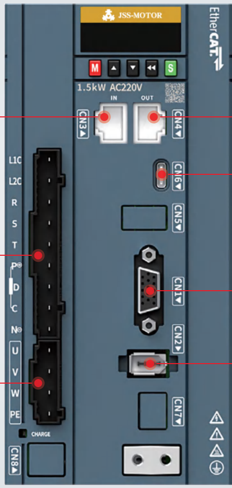
SIZE C



CN3	Communication network port IN
L1C/L2C	Control power input
R/S/T	Main power input
P⊕/D/C	External braking resistor
N⊖	Bus negative electrode
U/V/W	Motor power output
PE	Motor grounding terminal

CN4	Communication network port OUT
CN6	Commissioning and communication port
CN1	User control port
CN2	Encoder port

SIZE D



CN3	Communication network port IN
L1C/L2C	Control power input
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CN4	Communication network port OUT
CN6	Commissioning and communication port
CN1	User control port
CN2	Encoder port

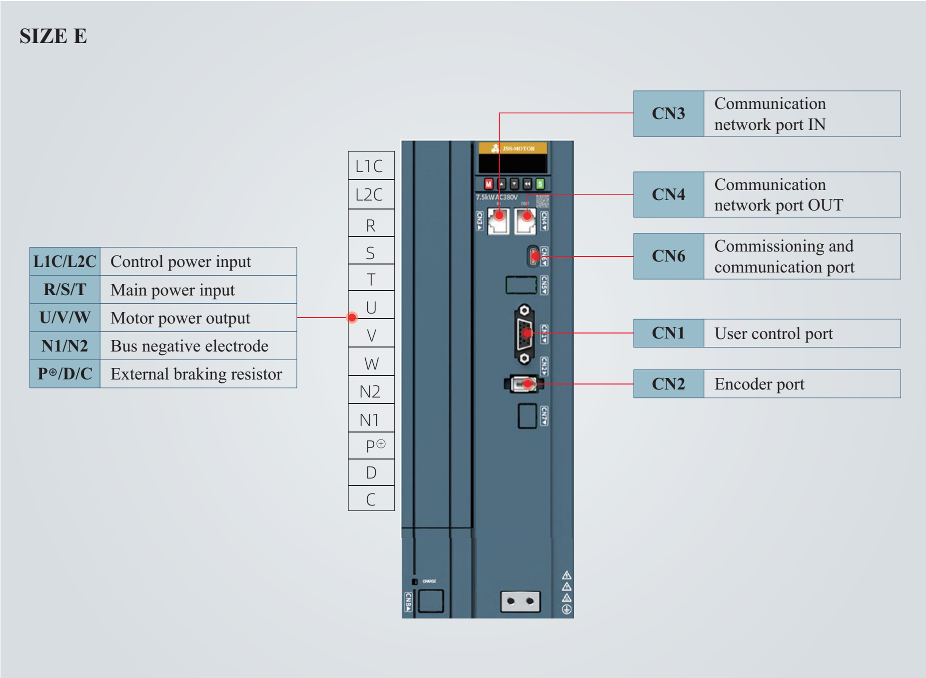
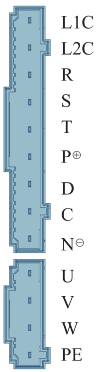
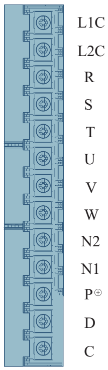
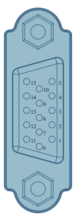
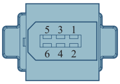


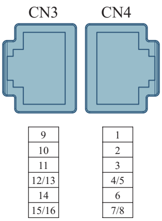
Table 3-1 Drive terminals

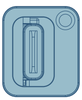
Terminal	Pin	Description
 Main circuit terminals of SIZE A	L1 and L2: Power input terminals	Connected to the input power supply as per the rated voltage class on the nameplate.
	P⊕ and N⊖: Servo bus terminals	Used when multiple servo drives share one DC bus.
	P⊕ and C: External braking resistor connection terminals	If an external braking resistor is needed, connect it between terminals P⊕ and C.
	U, V, and W: Servo motor connection terminals	Connected to U, V, and W phases of the servo motor.
	PE: Motor grounding terminal	Connected to the grounding terminal of the motor for grounding purpose.

Terminal	Pin	Description
 Main circuit terminals of SIZE B	L1 and L2: Power input terminals	Connected to the input power supply as per the rated voltage class on the nameplate.
	P⊕ and N⊖: Servo bus terminals	Used when multiple servo drives share one DC bus.
	P⊕, D, and C: External braking resistor connection terminals	If an external braking resistor is needed, connect it between terminals P⊕ and C. Note: Remove the jumper between terminals P⊕ and D before installing an external braking resistor. Otherwise, the braking transistor will be damaged due to overcurrent.
	U, V, and W: Servo motor connection terminals	Connected to U, V, and W phases of the servo motor.
	PE: Motor grounding terminal	Connected to the grounding terminal of the motor for grounding purpose.
 Main circuit terminals of SIZE C/D	L1C and L2C: Control circuit power input terminals	Connected to the control circuit power supply as per the rated voltage class on the nameplate.
	R, S, and T: Main circuit power input terminals	Connected to the main circuit power supply as per the rated voltage class on the nameplate.
	P⊕ and N⊖: Servo bus terminals	Used when multiple servo drives share one DC bus.
	P⊕, D, and C: External braking resistor connection terminals	If an external braking resistor is needed, connect it between terminals P⊕ and C. Note: Remove the jumper between terminals P⊕ and D before installing an external braking resistor. Otherwise, the braking transistor will be damaged due to overcurrent.
	U, V, and W: Servo motor connection terminals	Connected to U, V, and W phases of the servo motor.
	PE: Motor grounding terminal	Connected to the grounding terminal of the motor for grounding purpose.

<table>
<tr><th>Terminal</th><th colspan="2">Pin</th><th>Description</th></tr>
<tr><td rowspan="5">
Main circuit terminals of SIZE E</td><td colspan="2">L1C and L2C:
Control circuit power input terminals</td><td>Connected to the control circuit power supply as per the rated voltage class on the nameplate.</td></tr>
<tr><td colspan="2">R, S, and T:
Main circuit power input terminals</td><td>Connected to the main circuit power supply as per the rated voltage class on the nameplate.</td></tr>
<tr><td colspan="2">U, V, and W:
Servo motor connection terminals</td><td>Connected to U, V, and W phases of the servo motor.</td></tr>
<tr><td colspan="2">N1, N2:
External reactor connection terminals</td><td>N1 is shorted to N2 with a jumper by default. To suppress harmonics in the power supply, remove the jumper and connect an external DC reactor between terminals N1 and N2.</td></tr>
<tr><td colspan="2">P⊕, D, and C:
External braking resistor connection terminals</td><td>If an external braking resistor is needed, connect it between terminals P⊕ and C.
Note: Remove the jumper between terminals P⊕ and D before installing an external braking resistor. Otherwise, the braking transistor will be damaged due to overcurrent.</td></tr>
<tr><td rowspan="14">
CN1 user control terminal</td><td>10</td><td>DI1</td><td>Positive limit switch</td></tr>
<tr><td>9</td><td>DI2</td><td>Negative limit switch</td></tr>
<tr><td>8</td><td>DI3</td><td>Home switch</td></tr>
<tr><td>7</td><td>DI4</td><td>Probe 2</td></tr>
<tr><td>11</td><td>DI5</td><td>Probe 1</td></tr>
<tr><td>15</td><td>+24 V</td><td rowspan="2">Internal 24 V power supply
Voltage range: 20 V to 28 V
Max. output current: 200 mA</td></tr>
<tr><td>14</td><td>COM–</td></tr>
<tr><td>13</td><td>COM+</td><td>Common terminal of DI terminals</td></tr>
<tr><td>1</td><td>DO1+</td><td rowspan="2">Servo ready</td></tr>
<tr><td>6</td><td>DO1–</td></tr>
<tr><td>3</td><td>DO2+</td><td rowspan="2">Fault</td></tr>
<tr><td>2</td><td>DO2–</td></tr>
<tr><td>5</td><td>DO3+</td><td rowspan="2">Brake</td></tr>
<tr><td>4</td><td>DO3–</td></tr>
</table>

<table>
<tr><th>Terminal</th><th colspan="2">Pin</th><th>Description</th></tr>
<tr><td rowspan="7">

CN2 encoder terminal</td><td>1</td><td>+5 V</td><td>5 V power supply</td></tr>
<tr><td>2</td><td>0 V</td><td>-</td></tr>
<tr><td>3</td><td>Reserved</td><td>-</td></tr>
<tr><td>4</td><td>Reserved</td><td>-</td></tr>
<tr><td>5</td><td>PS+</td><td rowspan="2">Encoder signal</td></tr>
<tr><td>6</td><td>PS–</td></tr>
<tr><td>Enclosure</td><td>PE</td><td>Shield</td></tr>
<tr><td rowspan="12">

EtherCAT communication terminals</td><td>1</td><td>TD+</td><td>Data transmit+</td></tr>
<tr><td>2</td><td>TD–</td><td>Data transmit–</td></tr>
<tr><td>3</td><td>RD+</td><td>Data receive+</td></tr>
<tr><td>4/5</td><td>-</td><td>-</td></tr>
<tr><td>6</td><td>RD–</td><td>Data receive–</td></tr>
<tr><td>7/8</td><td>-</td><td>-</td></tr>
<tr><td>9</td><td>TD+</td><td>Data transmit+</td></tr>
<tr><td>10</td><td>TD–</td><td>Data transmit–</td></tr>
<tr><td>11</td><td>RD+</td><td>Data receive+</td></tr>
<tr><td>12/13</td><td>-</td><td>-</td></tr>
<tr><td>14</td><td>RD–</td><td>Data receive–</td></tr>
<tr><td>15/16</td><td>-</td><td>-</td></tr>
<tr><td>
CN6 commissioning and communication terminal</td><td colspan="2">Type-c</td><td>1: Type-c to serial, serial to USB
2: Type-c → USB</td></tr>
</table>

3.4 Power Supply Connection

CAUTION

- Do not connect the input power cables to the output terminals U, V and W. Failure to comply may cause damage the servo drive.
- Do not touch power terminals within 10 minutes after power-off because high voltage exists inside the drive after power off.
- Do not bundle power cables and signal cables together or route them through the same duct. Power cables and signal cables must be separated by a distance of at least 30 cm to prevent interference.
- Do not turn on and off the power supply frequently (once a minute). Failure to comply may cause drive faults.
- Do not power on the servo drive when any screw of the terminal block or any cable becomes loose. Failure to comply may cause a fire.

- When cables are bundled in a metal duct, take the current reduction ratio into consideration because of the inadequate cooling condition of the duct.
- Select cables based on the ambient temperature of the controller:
  When the ambient temperature is high, use heat-resistant cables. Teflon cables are recommended.
  Take heat preservation measures in low-temperature environments because the surface of regular cables may be easily hardened and cracked under low temperature.
- Use cables whose bending radius is over 10 times its outer diameter, to prevent the internal conductor from breaking due to long-term bending.
- Use cables that can resist a voltage of 600 V AC or above and have a rated temperature of 75°C or above for the main circuit.
- Use a grounding cable with the same cross-sectional area as the main circuit cable. If the cross-sectional area of the main circuit cable is less than 1.6 mm^2, use a grounding cable with a cross-sectional area of 2.0 mm^2.
- Ground the drive reliably. Failure to comply may result in malfunction or even damage of the drive.
- Use shielded cables to comply with the EMC requirements.

3.4.1 Main circuit wiring

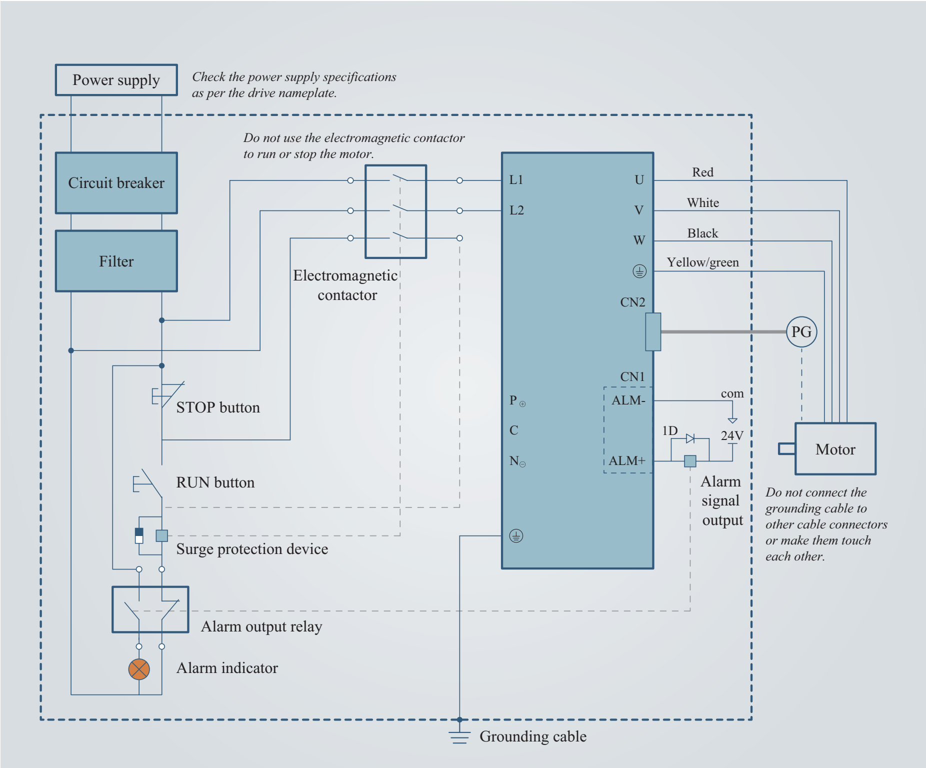


Figure 3-2 Wiring of the single-phase 220 V main circuit

NOTICE

Models with a single-phase 220 V power supply

- Model SIZE-A: JSS715N2T1R6, JSS715N2T2R8
- Model SIZE-B: JSS715N2T5R5
- Model SIZE-C: JSS715N2T7R6 (The main circuit can be connected to a single-phase or a three-phase 220 V power supply, depending on which one is available on site.)
- Model SIZE-D: JSS715N2T012 (The main circuit can be connected to a single-phase or a three-phase 220 V power supply, depending on which one is available on site.)

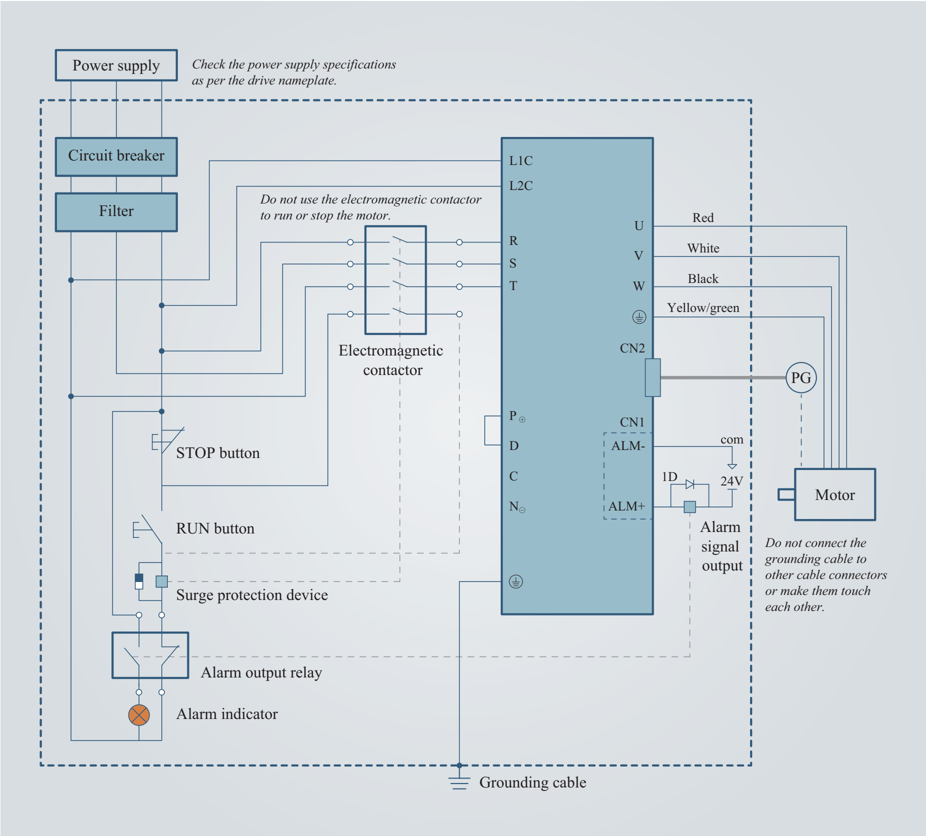


Figure 3-3 Wiring of the three-phase 220 V or 380 V main circuit

NOTICE

Models with a three-phase 220 V power supply

- Model SIZE-C: JSS715N2T7R6 (The main circuit can be connected to a single-phase or a three-phase 220 V power supply, depending on which one is available on site.)
- Model SIZE-D: JSS715N2T012 (The main circuit can be connected to a single-phase or a three-phase 220 V power supply, depending on which one is available on site.)

Models with a three-phase 380 V power supply

- Model SIZE-C: JSS715N4T3R5, JSS715N4T5R4
- Model SIZE-D: JSS715N4T8R4, JSS715N4T012
- Model SIZE-E: JSS715N4T017, JSS715N4T021, JSS715N4T026

3.4.2 Cable specifications and recommendations

Table 3-2 Drive input and output current and recommended cables

Drive Model		Rated Input Current	Rated Output Current	Max. Output Current	Input Cable Specifications
Single-phase 220 V					
SIZE A	JSS715N2T1R6	2.3 A	1.6 A	5.8 A	0.75 mm^2
SIZE A	JSS715N2T2R8	4 A	2.8 A	10.1 A	0.75 mm^2
SIZE B	JSS715N2T5R5	7.9 A	5.5 A	16.9 A	0.75 mm^2
SIZE C	JSS715N2T7R6	9.6 A	7.6 A	23 A	1 mm^2
SIZE D	JSS715N2T012	12.8 A	11.6 A	32 A	1.5 mm^2
Three-phase 220 V					
SIZE C	JSS715N2T7R6	5.1 A	7.6 A	23 A	0.75 mm^2
SIZE D	JSS715N2T012	8 A	11.6 A	32 A	0.75 mm^2
Three-phase 380 V					
SIZE C	JSS715N4T3R5	2.4 A	3.5 A	11 A	0.75 mm^2
SIZE C	JSS715N4T5R4	3.6 A	5.4 A	14 A	0.75 mm^2
SIZE D	JSS715N4T8R4	5.6 A	8.4 A	20 A	0.75 mm^2
SIZE D	JSS715N4T012	8 A	11.9 A	29.8 A	0.75 mm^2
SIZE E	JSS715N4T017	12 A	16.5 A	41.3 A	1.5 mm^2
SIZE E	JSS715N4T021	16 A	20.8 A	52.1 A	2.5 mm^2
SIZE E	JSS715N4T026	21 A	25.7 A	64.3 A	4 mm^2

Table 3-3 Drive cable specifications and recommendations

Cable Type	Cable Size	Outer Diameter (OD)
Power cable	4 × 12 AWG	12.2 ± 0.4 mm
	4 × 14 AWG	10.5 ± 0.3 mm
	4 × 16 AWG	9.5 ± 0.4 mm
	4 × 18 AWG	7.8 ± 0.2 mm
	4 × 20 AWG	6.5 ± 0.2 mm

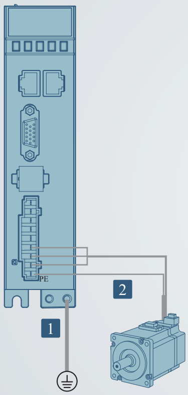
Cable Type	Cable Size	Outer Diameter (OD)
Power shielded cable	4 × 12 AWG	12.9 ± 0.4 mm
	4 × 14 AWG	11.2 ± 0.4 mm
	4 × 16 AWG	10.1 ± 0.4 mm
	4 × 18AWG	8.3 ± 0.2 mm
	4 × 20 AWG	6.5 ± 0.2 mm
Power cable + brake cable	4 × 20 AWG + 2 × 24 AWG	6.5 ± 0.2 mm
Brake cable	2 × 18 AWG	5.8 ± 0.2 mm
	2 × 20 AWG	5.0 ± 0.2 mm

3.4.3 Grounding

CAUTION

- To prevent electric shock, ground the grounding terminal properly.
- Use grounding cables that meet technical standards for electrical devices and use protective grounding conductors that meet technical specifications. and shorten the grounding cable as much as possible.
- For use of multiple servo drives, ground them all. Improper grounding of the device may cause malfunction of the servo drive and the device.
- Do not use one grounding cable for multiple devices. Improper grounding of the device may result in servo drive or device faults caused by electrical interference.
- For drives equipped with selective grounding screws for VDR and insulation resistor, remove the selective grounding screw for VDR before voltage resistance test. Failure to comply may cause the servo drive to fail the test.
- Install the servo drive on a conductive metal mounting surface. Ensure that the whole conductive bottom of the device is attached properly to the mounting surface.
- Fix the grounding screw with the recommended torque. Avoid loosening or over-tightening of the protective grounding conductor.

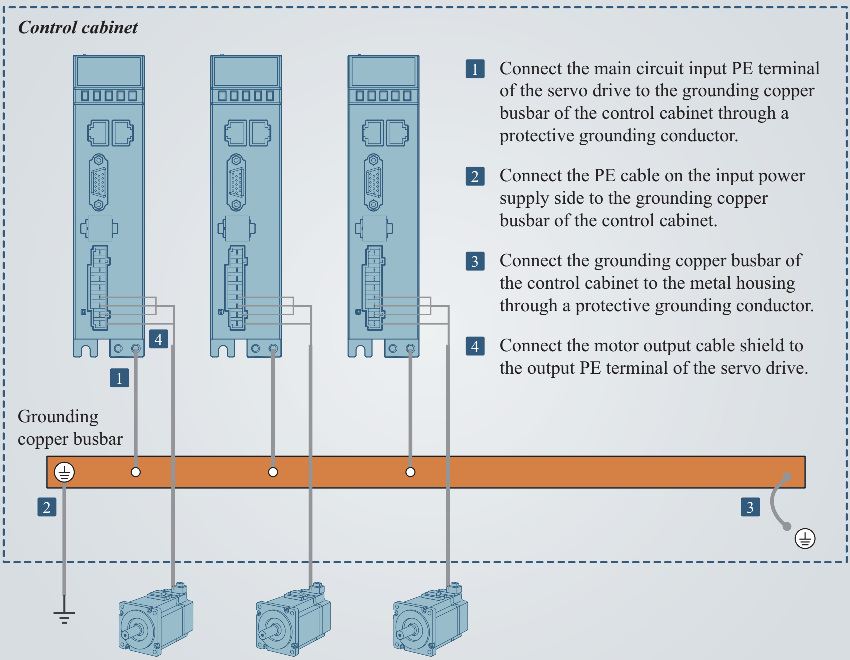
Grounding one servo drive alone



1 Connect the PE cable on the input power supply side to the input PE terminal of the drive.

2 Connect the output PE terminal of the drive to the motor output cable shield.

Grounding multiple servo drives



1 Connect the main circuit input PE terminal of the servo drive to the grounding copper busbar of the control cabinet through a protective grounding conductor.

2 Connect the PE cable on the input power supply side to the grounding copper busbar of the control cabinet.

3 Connect the grounding copper busbar of the control cabinet to the metal housing through a protective grounding conductor.

4 Connect the motor output cable shield to the output PE terminal of the servo drive.

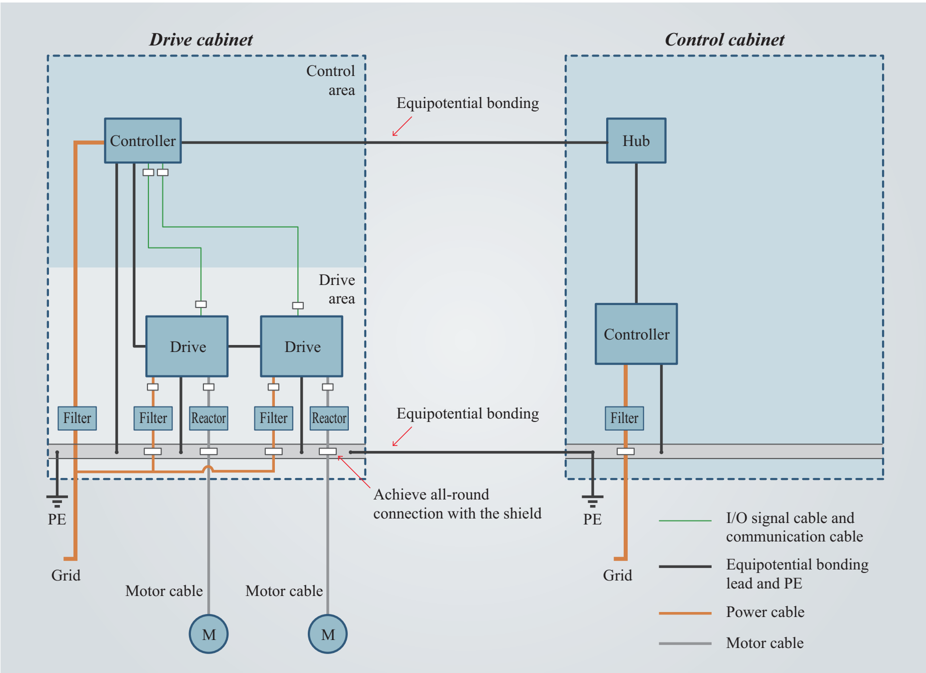
Grounding the control cabinet system

To suppress interference in the control cabinet, isolate the interference source from devices that may be interfered with. Divide the control cabinet into multiple EMC compartments or use multiple control cabinets based on the intensity of interference sources.

CAUTION

System installation principles:

- Place the control unit and the drive unit in two separate control cabinets.
- For installation involving multiple control cabinets, use a grounding cable with a cross-sectional area of at least 16 mm^2 to connect the control cabinets. This is to ensure equipotentiality between the cabinets.
- If only one control cabinet is used, place different devices in different compartments of the control cabinet based on signal intensity.
- Apply equipotential bonding to devices in different compartments inside the control cabinet.
- Shield all communication and signal cables drawn from the control cabinet.
- Place the power input filter in a position near the input interface of the control cabinet.
- Apply spray coating to each grounding point in the control cabinet.



Recommended grounding cable lugs for main circuit

Table 3-4 Recommended grounding cable lugs for power circuit

Drive Model		Rated Output Current	Lug Model of Power Cable	Lug Model of Brake Cable	Lug Model of PE Cable
SIZE A	JSS715N2T1R6	1.6 A	E1008	E0508	TVR2-4
SIZE A	JSS715N2T2R8	2.8 A	E1008	E0508	TVR2-4
SIZE B	JSS715N2T5R5	5.5 A	E1008	E0508	TVR2-4
SIZE C	JSS715N2T7R6	7.6 A	E1508	E1008	TVR2-4
SIZE C	JSS715N4T3R5	3.5 A	E1508	E1008	TVR2-4
SIZE C	JSS715N4T5R4	5.4 A	E1508	E1008	TVR2-4
SIZE D	JSS715N2T012	11.6 A	E1508	E1008	TVR2-4
SIZE D	JSS715N4T8R4	8.4 A	E1508	E1008	TVR2-4
SIZE D	JSS715N4T012	11.9 A	E1508	E1008	TVR2-4
SIZE E	JSS715N4T017	16.5 A	TVS1.25-4	E1008	TVR1.25-4
SIZE E	JSS715N4T021	20.8 A	TVS2-4	E1008	TNR2-4
SIZE E	JSS715N4T026	25.7 A	TVS3.5-4	E1008	TNR3.5-4

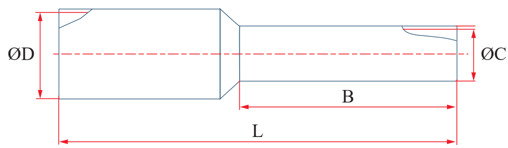
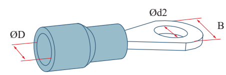


Table 3-5 Lug models and dimensions

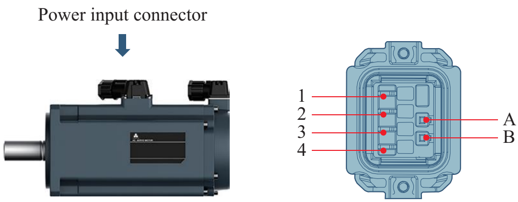
Lug model	L	B	ØC	ØD	Color
E0508	14 mm	8 mm	1.0 mm	2.6 mm	Orange
E1008	14 mm	8 mm	1.4 mm	3.0 mm	Yellow
E1508	14 mm	8 mm	1.7 mm	3.5 mm	Red

Table 3-6 Dimensions and appearance of TVR2-4 cable lugs of the grounding cable

Lug model		D	d2	B	Appearance
TVR	2-4	4.5mm	4.3mm	8.5mm	

3.5 Motor Connection

Terminal-type motor



Pin No.	Usage
1	Phase V
2	Phase U
3	Phase W
4	Grounding cable
A	Brake (polarity insensitive)
B	Brake (polarity insensitive)

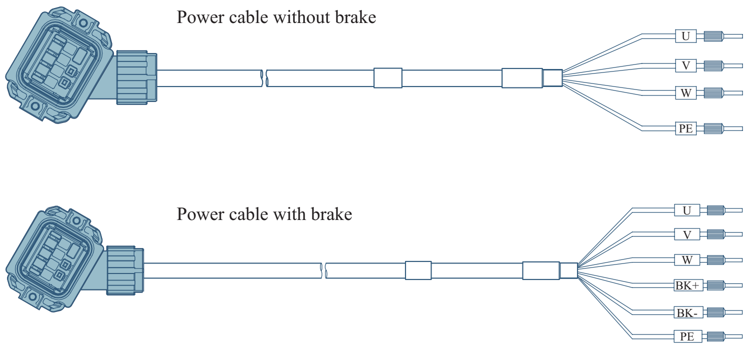
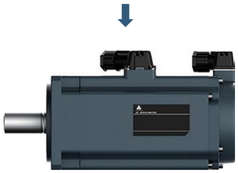
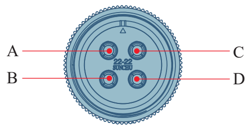


Figure 3-4 Power cable for terminal-type motor

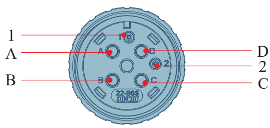
Aviation plug-type motor

Power input connector





Pin No.	Usage
A	Phase U
B	Phase V
C	Phase W
D	Grounding cable



Pin No.	Usage
A	Phase U
B	Phase V
C	Phase W
D	Grounding cable
1	Brake (polarity insensitive)
2	Brake (polarity insensitive)

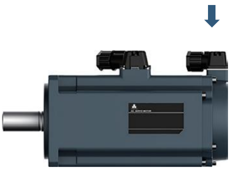
3.6 Encoder Connection (CN2)

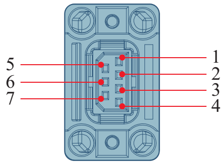
CAUTION

Precautions for wiring of encoder signal cables:

- Ground the shield on the drive side and the motor side. Otherwise, the drive will report false alarms.
- Do not connect cables to "reserved" terminals.
- When determining the length of the encoder cable, take into full account the voltage drop caused by cable resistance and signal attenuation caused by distributed capacitance. Use shielded twisted pairs above 26 AWG (as per UL2464 standard) and keep the length within 10 m.

Terminal-type motor





Pin No.	Usage
1	DATA+
2	DATA-
3	BAT+
4	BAT-
5	+5V
6	0V
7	FG

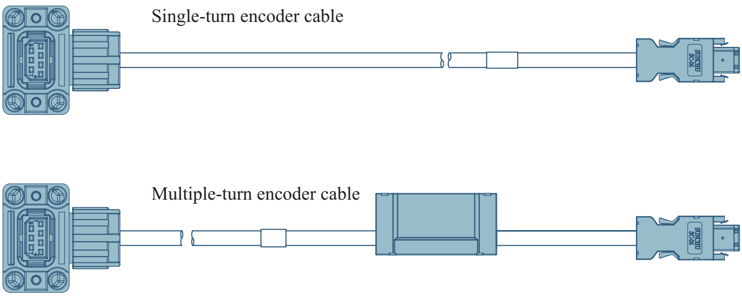


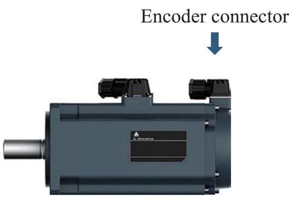
Figure 3-5 Absolute encoder signal cables

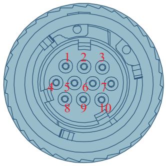
CAUTION

Battery box precautions:

- Install the battery in the correct direction. Do not pinch the connector cable when closing the battery box cover.
- Do not disassemble the battery because the internal electrolyte may spread out and cause physical injury.
- Do not short circuit the battery. Failure to comply may deteriorate the battery power and even incur the risk of explosion due to violent overheating.
- Before discarding the battery, insulate the battery with tape and then dispose of it according to local regulations.

Aviation plug-type motor





Pin No.	Usage
1	DATA+
2	DATA-
4	+5V
5	BAT-
6	BAT+
9	0V
10	Enclosure

3.7 Control Signal Connection (CN1)

3.7.1 I/O signal

Use shielded signal cables to protect I/O signal circuits against strong interference noise at the periphery.

- Use a separate shielded cable for each type of analog signal.
- Shielded twisted pairs are recommended as digital signal cables.

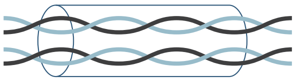


Figure 3-6 Shielded twisted pairs

⚠ CAUTION

- To avoid electromagnetic interference, keep a distance of at least 30 cm between I/O signal cables and power cables (input RST cables, output UVW cables, DC bus, and braking cables).

3.7.2 Digital input/output (DI/DO) signals

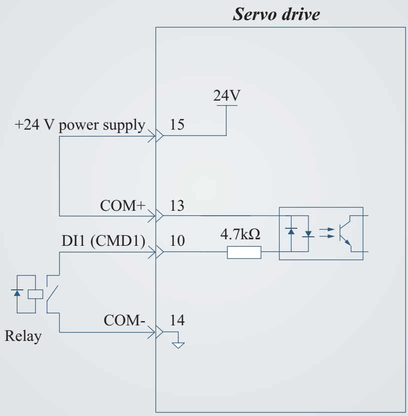
DI circuits

NOTICE

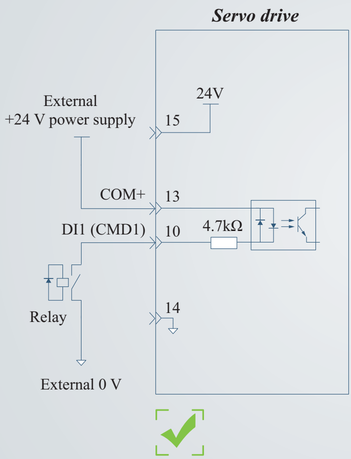
- The circuits for DI1 to DI5 are the same. The following takes the DI1 circuit as an example.

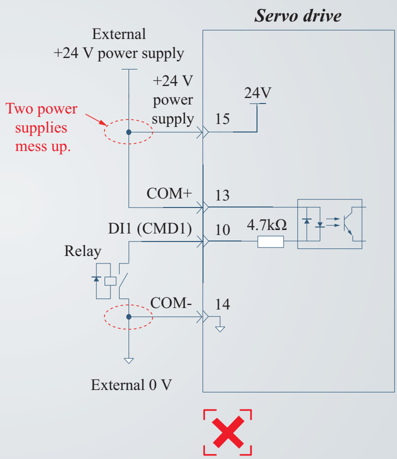
When the host controller adopts relay output:

- For use of the internal 24 V power supply of the servo drive.



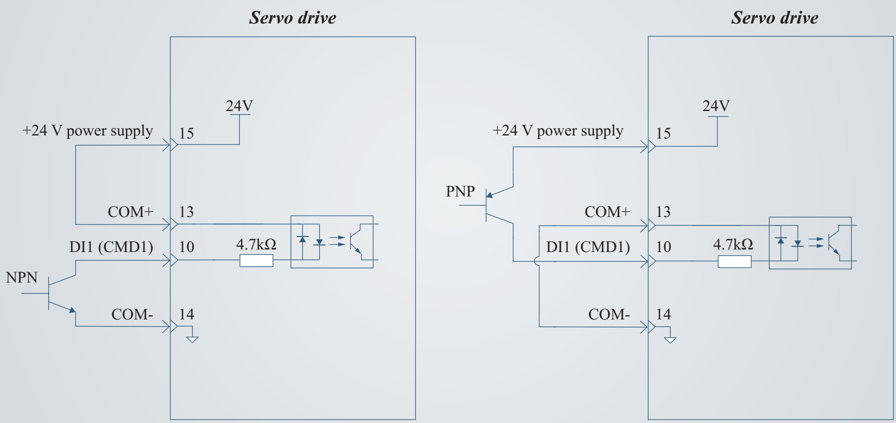
- For use of an external power supply.



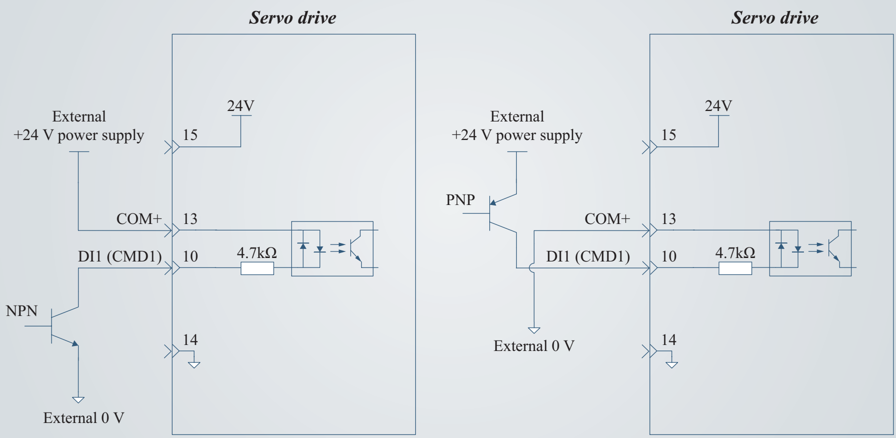


When the host controller adopts open collector output:

- For use of the internal 24 V power supply of the servo drive.



- For use of an external power supply.



CAUTION

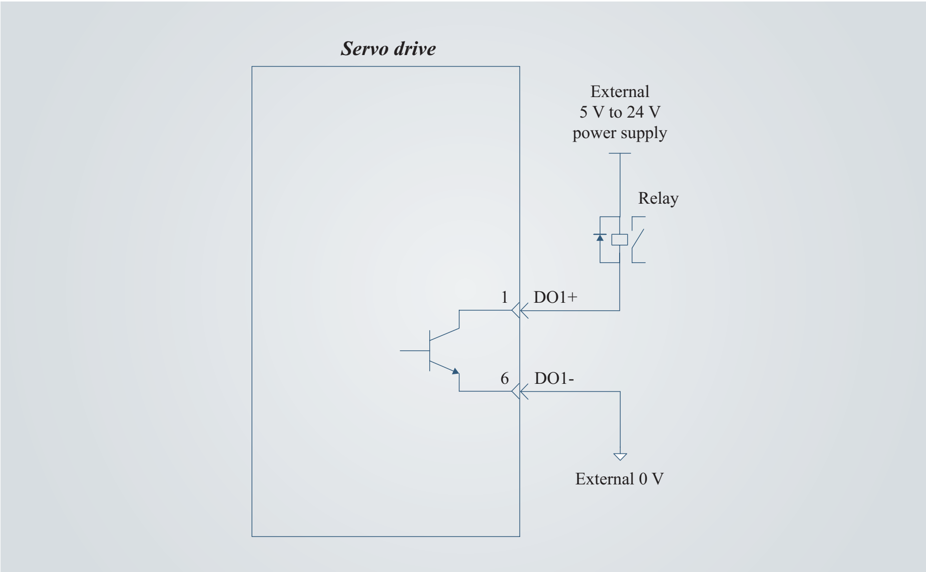
- PNP and NPN inputs cannot be used together in the same circuit.

DO circuits

NOTICE

- The circuits of DO1 to DO3 are the same. The following takes the DO1 circuit as an example.

When the host controller adopts relay input:



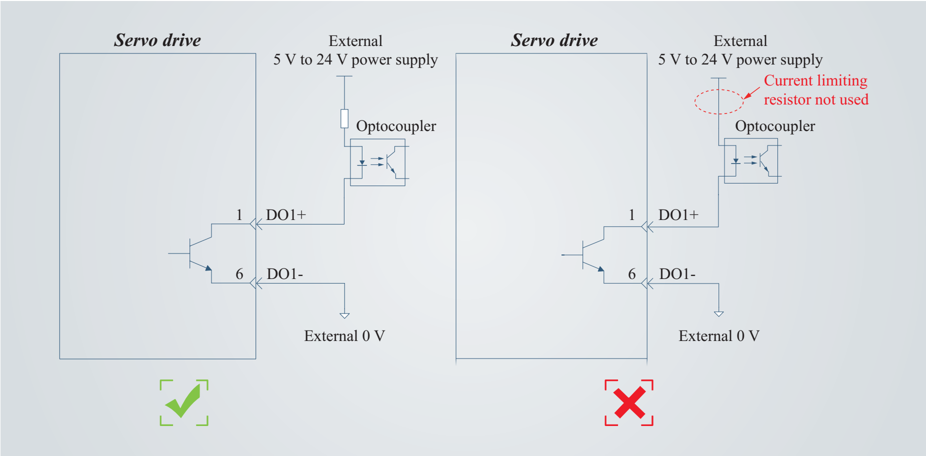
CAUTION

- When the host controller adopts relay input, a flywheel diode must be installed. Otherwise, the DO terminals may be damaged.

When the host controller adopts optocoupler input:

NOTICE

- The maximum allowable voltage and maximum current capacity of the optocoupler output circuit inside the servo drive are 30 VDC and DC50 mA, respectively.



3.7.3 Wiring of the brake

Some servo motors have a brake inside. The motor brake is used to prevent the movement of the servo motor shaft and keep the motor locked in the position when the servo motor may move unexpectedly due to external forces or its own weight during non-running conditions.

CAUTION

- The motor brake can only be used on a stopped motor and is only used to keep the load stationary. Do not use it to brake a moving load.

NOTICE

- The brake coil has no polarity.
- Switch off the S-ON signal after the servo motor stops.
- When the motor with a built-in brake runs, the brake may generate a click sound, which does not affect its function.
- When brake coils are energized (the brake is released), flux leakage may occur on the shaft end. Pay special attention when using magnetic sensors near the motor.

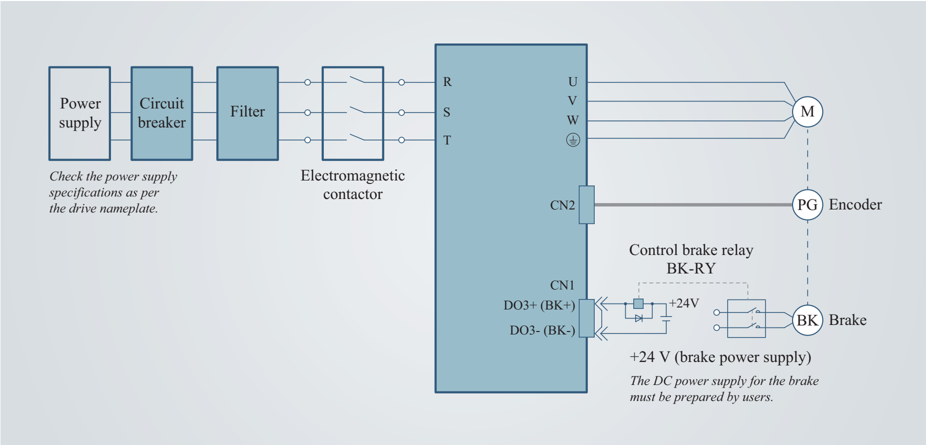


Figure 3-7 Wiring of the brake

Precautions during wiring:

When determining the length of the motor brake cable, take into full account the voltage drop caused by cable resistance. The input voltage must be at least 21.6 V to enable the brake to work properly.

Table 3-7 Brake specifications

Motor Model	Holding Torque	Rated Power	Power Supply Voltage
JSSMK1-H2T0130BC16	0.32 N·m	6.9 W	24 V DC
JSSMK1-H2T0130BC26	0.32 N·m	6.9 W	24 V DC
JSSMK1-H2T0230BE16	1.27 N·m	7.3 W	24 V DC
JSSMK1-H2T0230BE26	1.27 N·m	7.3 W	24 V DC
JSSMK1-H2T0430BE16	1.27 N·m	7.3 W	24 V DC
JSSMK1-H2T0430BE26	1.27 N·m	7.3 W	24 V DC
JSSMK1-H2T0830BE16	3.2 N·m	8.5 W	24 V DC
JSSMK1-H2T0830BE26	3.2 N·m	8.5 W	24 V DC
JSSMK1-H2T1030BE16-80	3.2 N·m	8.5 W	24 V DC
JSSMK1-H2T1030BE26-80	3.2 N·m	8.5 W	24 V DC
JSSMK1-H2T1030BE16	9 N·m	22 W	24 V DC
JSSMK1-H2T1030BE26	9 N·m	22 W	24 V DC

Motor Model	Holding Torque	Rated Power	Power Supply Voltage
JSSMK1-H4T1030BE16	9 N·m	22 W	24 V DC
JSSMK1-H4T1030BE26	9 N·m	22 W	24 V DC
JSSMK1-H2T1530BE16	9 N·m	22 W	24 V DC
JSSMK1-H2T1530BE26	9 N·m	22 W	24 V DC
JSSMK1-H4T1530BE16	9 N·m	22 W	24 V DC
JSSMK1-H4T1530BE26	9 N·m	22 W	24 V DC
JSSMK1-H4T2030BE16	9 N·m	22 W	24 V DC
JSSMK1-H4T2030BE26	9 N·m	22 W	24 V DC
JSSMK1-H4T2530BE16	9 N·m	22 W	24 V DC
JSSMK1-H4T2530BE26	9 N·m	22 W	24 V DC
JSSMK1-H2T0915BE16	12 N·m	23 W	24 V DC
JSSMK1-H2T0915BE26	12 N·m	23 W	24 V DC
JSSMK1-H4T0915BE16	12 N·m	23 W	24 V DC
JSSMK1-H4T0915BE26	12 N·m	23 W	24 V DC
JSSMK1-H2T1315BE16	12 N·m	23 W	24 V DC
JSSMK1-H2T1315BE26	12 N·m	23 W	24 V DC
JSSMK1-H4T1315BE16	12 N·m	23 W	24 V DC
JSSMK1-H4T1315BE26	12 N·m	23 W	24 V DC
JSSMK1-H4T1815BE16	12 N·m	23 W	24 V DC
JSSMK1-H4T1815BE26	12 N·m	23 W	24 V DC
JSSMK1-H4T2915BE16	50 N·m	36 W	24 V DC
JSSMK1-H4T2915BE26	50 N·m	36 W	24 V DC
JSSMK1-H4T4415BE16	50 N·m	36 W	24 V DC
JSSMK1-H4T4415BE26	50 N·m	36 W	24 V DC
JSSMK1-H4T5515BE16	50 N·m	36 W	24 V DC
JSSMK1-H4T5515BE26	50 N·m	36 W	24 V DC
JSSMK1-H4T7515BE16	50 N·m	36 W	24 V DC
JSSMK1-H4T7515BE26	50 N·m	36 W	24 V DC

3.8 Communication Signal Connection (CN3 and CN4)

Communication signals are connected by EtherCAT network cables. Connect CN3 (IN) to the communication port of the master and CN4 (OUT) to a slave.

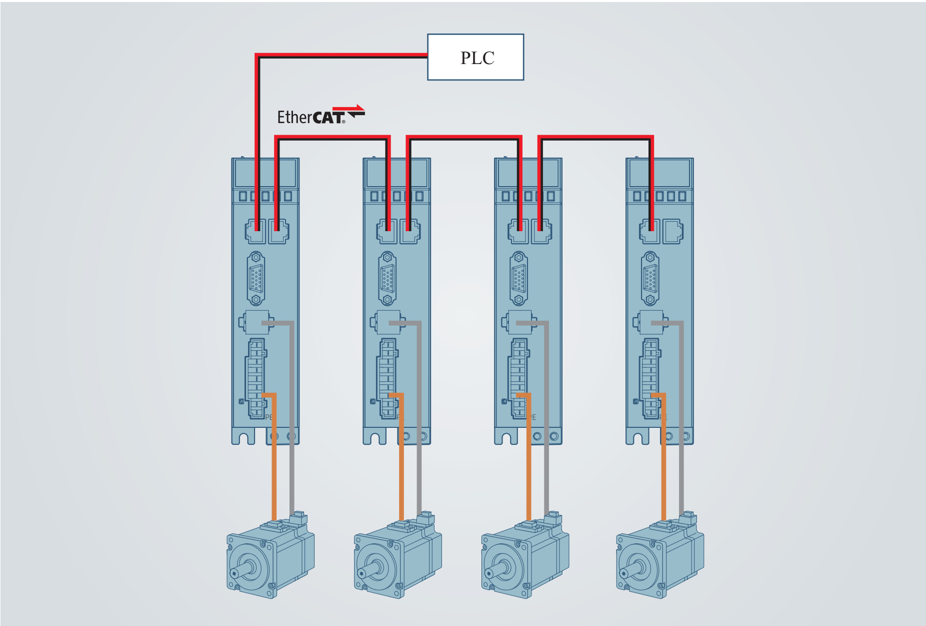


Figure 3-8 Communication networking topology

CAUTION

- To enhance the system's anti-interference capability, the EtherCAT communication cable must be an Ethernet Category 5 (100BASE-TX) network cable or high-strength shielded network cable of no more than 100 m.
- When multiple EtherCAT servo drives are installed, connect the network cables in the sequence of left-in and right-out.

EtherCAT communication supports multiple connection methods:

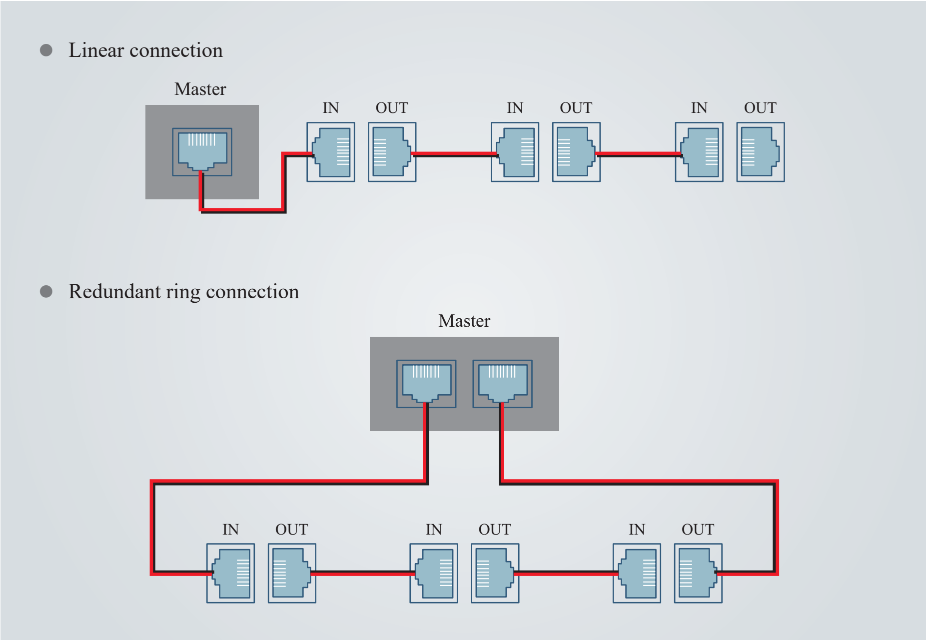


Figure 3-9 EtherCAT communication connection

CAUTION

- When a redundant ring network is used, the EtherCAT Enhanced Link Check function must be enabled, which will take effect upon next power-on of the servo drive.

3.9 Communication Terminal Connection (CN6)

You can connect the drive to the PC through the CN6 terminal by using a serial cable (two-part wiring: Type-c to serial, and serial to USB) or a USB cable.

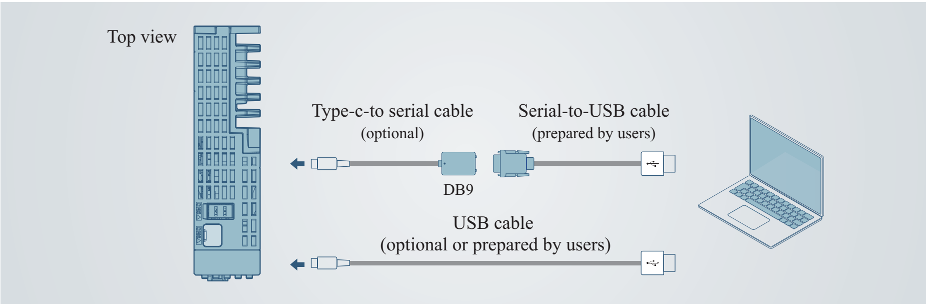
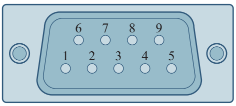


Figure 3-10 Communication terminal connection

DB9 Female Connector (Hole Type)	Pin No.	Signal	Description
	2	RXD	PC receive end
	3	TXD	PC transmit end
	5	GND	Ground
	Housing	PE	Shield

3.10 Braking Resistor Connection

CAUTION

- Do not connect the external braking resistor directly to positive and negative electrodes of the bus. Failure to comply may result in drive damage or even a fire.
- Do not select a resistor with resistance lower than the allowable minimum value. Failure to comply may result in an alarm or damage to the servo drive.
- Do not contact the external braking resistor during use. Failure to comply may result in burns caused by the hot braking resistor.

- Set parameters of the braking resistor properly before using the servo drive.
- Install the external braking resistor on incombustible objects (such as metal).

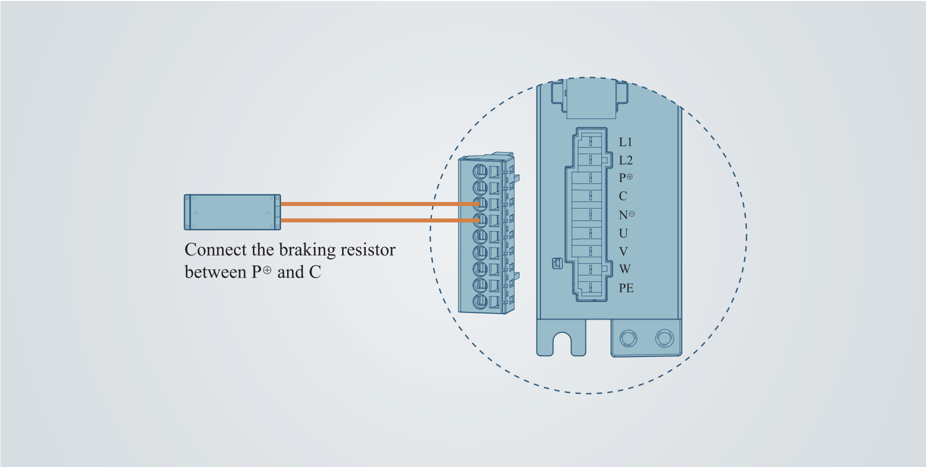


Figure 3-11 Connection of the external braking resistor

NOTICE

- The above connection example is for model SIZE A. Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor for other models.

Table 3-8 Specifications of the braking resistor

Drive Model		Built-in braking resistor		Minimum Allowable Resistance of External Resistor	Maximum Braking Energy Absorbed by Capacitor
		Resistance	Resistor Power		
SIZE A	JSS715N2T1R6	-	-	45 Ω	9.3 J
SIZE A	JSS715N2T2R8	-	-	45 Ω	26.29 J
SIZE B	JSS715N2T5R5	50 Ω	50 W	40 Ω	22.41 J
SIZE C	JSS715N2T7R6	25 Ω	80 W	20 Ω	26.70 J
SIZE C	JSS715N4T3R5	100 Ω	80 W	80 Ω	34.28 J
SIZE C	JSS715N4T5R4	100 Ω	80 W	60 Ω	34.28 J
SIZE D	JSS715N2T012	25 Ω	80 W	15 Ω	26.70 J
SIZE D	JSS715N4T8R4	50 Ω	80 W	45 Ω	50.41 J
SIZE D	JSS715N4T012	50 Ω	80 W	40 Ω	50.41 J

Drive Model		Built-in braking resistor		Minimum Allowable Resistance of External Resistor	Maximum Braking Energy Absorbed by Capacitor
		Resistance	Resistor Power		
SIZE E	JSS715N4T017	35 Ω	100 W	35 Ω	82.67 J
SIZE E	JSS715N4T021	35 Ω	100 W	25 Ω	100.82 J
SIZE E	JSS715N4T026	35 Ω	100 W	25 Ω	100.82 J

Chapter 4 Function Overview

4.1 Basic Functions of the Servo Drive

4.1.1 Function Overview

The servo system consists of three critical parts: the servo drive, servo motor, and encoder. The servo drive processes input signals and feedback signals to precisely control the position, speed, and torque of the servo motor.

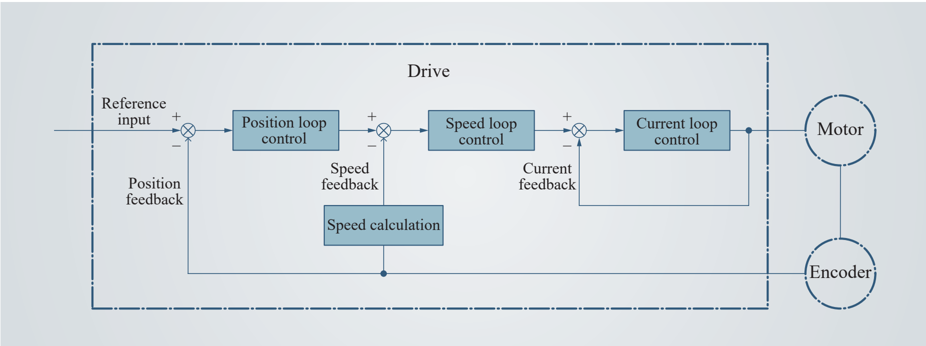


Figure 4-1 Structure of a servo system

Para. No.	Name	Description	Default
C00.00	Servo mode	0: Position mode 1: Speed mode 2: Torque mode 10: EtherCAT mode	10

4.1.2 Profile Position (PP) Mode

Position control is the most important and common control mode of the servo system. In PP mode, the drive can find the absolute position and relative position of the motor. You can set the target position, start speed, stop speed, acceleration rate, and deceleration rate on the host controller. When the PP mode is enabled, the object dictionary servo mode (6060h) must be set to 1.

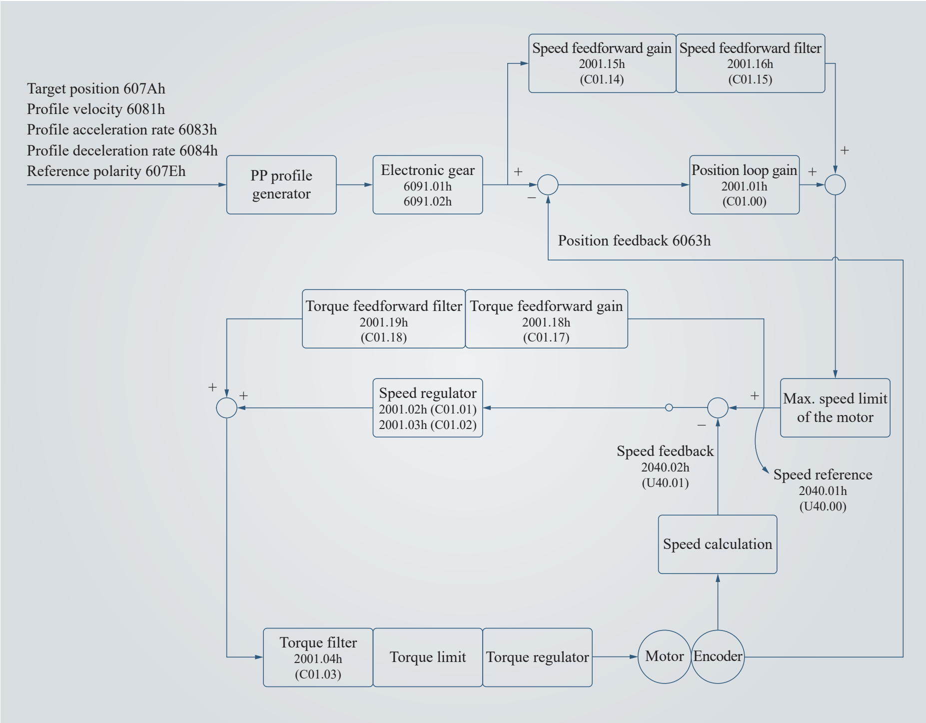


Figure 4-2 Control flow in PP mode

Basic configurations recommended in PP mode:

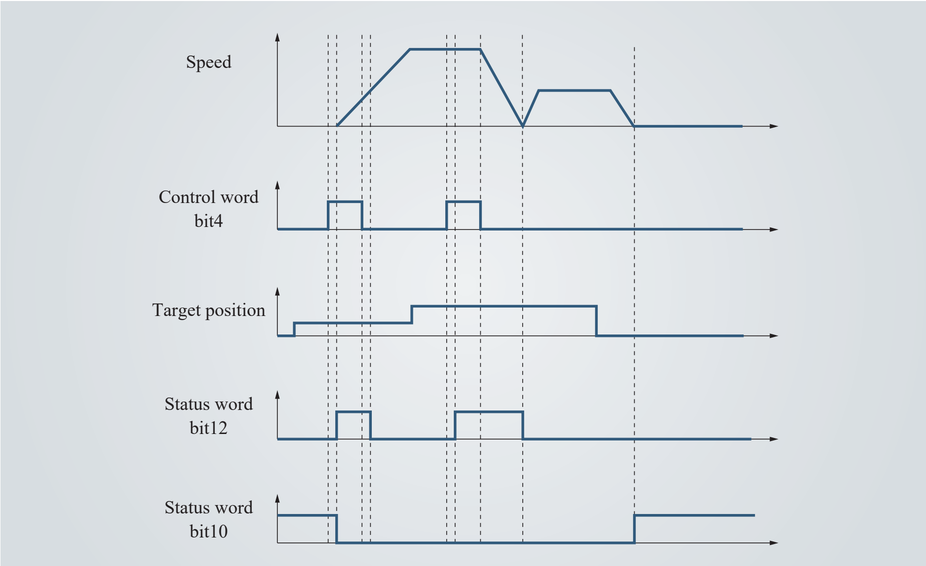
RPDO	TPDO	Remarks
6040h Control word	6041h Status word	Mandatory
607Ah Target Position	6064h Position actual value	Mandatory
6081h Profile velocity	-	Mandatory
6083h Profile acceleration	-	Optional
6084h Profile deceleration	-	Optional
6060h Modes of operation	6061h Modes of operation display	Optional

Control word settings in PP mode:

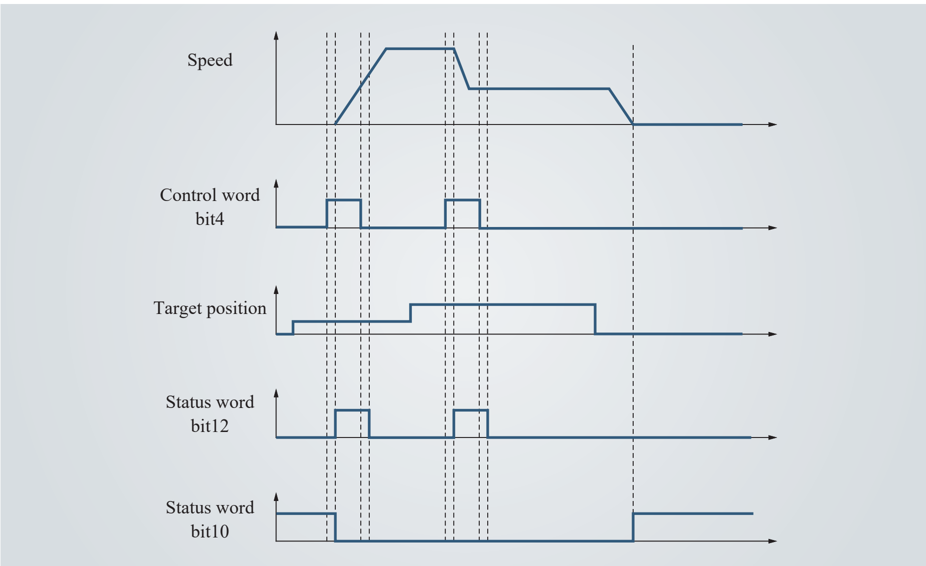
The following table lists the meanings of each bit in the control word (6040h) in PP mode.

Bit	Name	Description
0	Switch on	This bit must be set to 1 when the servo drive is enabled.
1	Enable voltage	This bit must be set to 1 when the servo drive is enabled.
2	Quick stop	This bit must be set to 1 when the servo drive is enabled. If this bit is set to 0, the servo drive stops quickly.
3	Operation enable	This bit must be set to 1 when the servo drive is enabled.
4	Position reference update	When this bit changes from 0 to 1, the next group of position reference parameters are loaded, including the target position or position increment, start speed, operating speed, acceleration rate, and deceleration rate.
5	Immediate update	0: Execute a new reference after the current position reference is executed. 1: Stop executing the current position reference and execute a new one.
6	Position reference type	0: Absolute position reference 1: Relative position reference
7	Fault reset	The system performs fault reset once when this bit changes from 0 to 1. If system needs fault reset for multiple times, this bit must change from 0 to 1 for multiple times. When this bit is set to 1, other control references are inactive.
8	Halt	0: Inactive 1: Active The system stops executing references when this bit is set to 1.

When bit 5 in the control word (6040h) is set to 0, the system waits for the current position reference to be executed before executing the new reference to update the position data in the motion, as shown in the following figure.



When bit 5 in the control word (6040h) is set to 1, the system stops executing the current position reference and immediately executes the new reference to update the position data in the motion, as shown in the following figure.



Status word definition in PP mode:

The following table lists the meanings of each bit in the status word (6041h) in PP mode.

Bit	Name	Description
0	Ready to switch on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
1	Switched on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
2	Operation enabled	0: Inactive 1: Active (indicating that the servo drive has been enabled)
3	Servo drive fault	0: No fault 1: Fault occurred
4	Voltage enabled	0: Inactive 1: Active (indicating that the servo drive can be enabled)
5	Quick stop	0: Active 1: Inactive
6	Switch on disabled	0: Inactive 1: Active (indicating that the servo drive cannot be enabled)
7	Alarm	0: No alarm 1: Alarm generated
9	Remote control	0: Inactive 1: Active (indicating that the control word has taken effect)
10	Position reach	Not supported. This bit remains 1 all the time.
11	Internal software position limit status	0: Software position limit not reached 1: Software position limit reached
12	Receiving status of new position reference	0: Position reference update allowed 1: Position reference update not allowed
13	Position deviation error	0: The position deviation value is within the preset range (6065h) 1: The position deviation value is beyond the preset range (6065h)
14	Manufacturer-specific	Not supported
15	Homing completion	0: Homing not completed 1: Homing completed

Parameters related to PP mode:

Dictionary objects related to PP mode:

Index	Sub-index	Name	Access	Data Type	Value Range	Default
6040h	00	Control word	RW	U16	0 to 65535	0
6041h	00	Status word	RO	U16	-	-
6060h	00	Operation mode	RW	I8	0 to 10	0
6061h	00	Mode display	RO	I8	-	-
6064h	00	Position feedback	RO	I32	-	-
6065h	00	Excessive position deviation threshold	RW	U32	0 to (2^{32}-1)	3145728
6066h	00	Following error time out	RW	U16	0 to 65535	0
6067h	00	Position reach threshold	RW	U32	0 to (2^{32}-1)	734
6068h	00	Position reach time window	RW	U16	0 to 65535	0
607Ah	00	Target position	RW	I32	-2^{31} to (2^{31}-1)	0
607Eh	00	Reference polarity	RW	U8	0 to 255	0
607Fh	00	Max. speed	RW	U32	0 to (2^{32}-1)	104857600
6081h	00	Profile operating speed	RW	U32	0 to (2^{32}-1)	1747627
6083h	00	Profile acceleration rate	RW	U32	0 to (2^{32}-1)	1747626667
6084h	00	Profile deceleration rate	RW	U32	0 to (2^{32}-1)	1747626667

PP mode example:

Start and operation processes in PP mode:

Address	Name	Value
6060h	Control mode	1
607Ah	Position reference	Set by the user
6081h	Set speed in PP mode	The rotation speed is 600 rpm for writing data of 1310720 bits at the default gear ratio of 1:1.

Address	Name	Value
6040h (control word)	Enable	Random number → 6 → 7 → 15
	Alarm clearance	Random number → 128 (rising edge active, if the alarm can be cleared)
	Set absolute position (not immediate update)	6→7→15→31
	Set absolute position (immediate update)	6→7→47→63
	Set relative position (not immediate update)	6→7→79→95
	Set relative position (immediate update)	6→7→111→127
6083h	Profile acceleration rate	Default: 13107200
6084h	Profile deceleration rate	Default: 1310720

4.1.3 Profile Velocity (PV) Mode

In PV mode, the host controller sends the target velocity, acceleration rate, and deceleration rate to the servo drive. The servo drive generates the speed reference profiles and executes speed control and torque control. When the PV mode is enabled, the object dictionary control mode (6060h) must be set to 3.

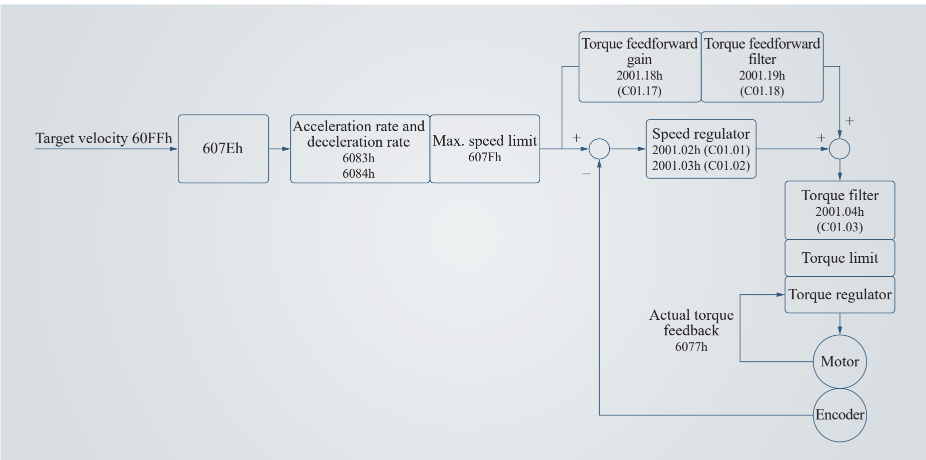


Figure 4-3 Control flow in PV mode

Basic configurations recommended in PV mode:

RPDO	TPDO	Remarks
6040h Control word	6041h Status word	Mandatory
60FFh Target Velocity	-	Mandatory
-	6064h Position actual value	Optional
-	606Ch Velocity actual value	Optional
6083h Profile acceleration	-	Optional
6084h Profile deceleration	-	Optional
6060h Modes of operation	6061h Modes of operation display	Optional

Control word settings in PV mode:

The following table lists the meanings of each bit in the control word (6040h) in PV mode.

Bit	Name	Description
0	Switch on	This bit must be set to 1 when the servo drive is enabled.
1	Enable voltage	This bit must be set to 1 when the servo drive is enabled.
2	Quick stop	This bit must be set to 1 when the servo drive is enabled. If this bit is set to 0, the servo drive stops quickly.
3	Operation enable	This bit must be set to 1 when the servo drive is enabled.
4 to 6	Reserved for PV mode	Not supported
7	Fault reset	The system performs fault reset once when this bit changes from 0 to 1. If system needs fault reset for multiple times, this bit must change from 0 to 1 for multiple times. When this bit is set to 1, other control references are inactive.
8	Halt	0: Inactive 1: Active (The system halts when this bit is set to 1 and executes references when this bit is set to 0.)
9	Reserved for PV mode	Not supported
10	Reserved for PV mode	Not supported

Status word definition in PV mode:

The following table lists the meanings of each bit in the status word (6041h) in PV mode.

Bit	Name	Description
0	Ready to switch on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
1	Switched on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
2	Operation enabled	0: Inactive 1: Active (indicating that the servo drive has been enabled)
3	Servo drive fault	0: No fault 1: Fault occurred
4	Voltage enabled	0: Inactive 1: Active (indicating that the servo drive can be enabled)
5	Quick stop	0: Active 1: Inactive
6	Switch on disabled	0: Inactive 1: Active (indicating that the servo drive cannot be enabled)
7	Alarm	0: No alarm 1: Alarm generated
9	Remote control	0: Inactive 1: Active (indicating that the control word has taken effect)
10	Speed reach	0: Speed not reached 1: Speed reached
11	Internal software position limit status	0: Software position limit not reached 1: Software position limit reached
12	Zero speed status	0: Speed not equal to 0 1: Speed equal to 0
13 to 15	Reserved for PV mode	Not supported

Parameters related to PV mode:

Dictionary objects related to PV mode:

Index	Sub-index	Name	Access	Data Type	Value Range	Default
6040h	00	Control word	RW	U16	0 to 65535	0
6041h	00	Status word	RO	U16	-	-
6060h	00	Operation mode	RW	I8	0 to 10	0
6061h	00	Mode display	RO	I8	-	-

Index	Sub-index	Name	Access	Data Type	Value Range	Default
606Ch	00	Actual speed	RO	I32	-	-
606Dh	00	Speed reach threshold	RW	U16	0 to 65535	10
606Eh	00	Speed reach time window	RW	U16	0 to 65535	0
606Fh	00	Zero speed threshold	RW	U16	0 to 65535	10
6070h	00	Zero speed time window	RW	U16	0 to 65535	0
607Eh	00	Reference polarity	RW	U8	0 to 255	0
607Fh	00	Max. speed	RW	U32	0 to (2^{32}-1)	104857600
6083h	00	Profile acceleration rate	RW	U32	0 to (2^{32}-1)	1747626667
6084h	00	Profile deceleration rate	RW	U32	0 to (2^{32}-1)	1747626667
60FFh	00	Target velocity	RW	I32	-2^{31} to (2^{31}-1)	0

PV mode example:

Start and operation processes in PV mode:

Address	Name	Value
6060h	Control mode	3
60FFh	Set speed in PV mode	The rotation speed is 600 rpm for writing data of 1310720 bits at the default gear ratio of 1:1.
6040h (control word)	Enable	Random number → 6 → 7 → 15
	Alarm clearance	Random number → 128 (rising edge active, if the alarm can be cleared)
	Motor moment	The motor rotates at the set speed reference after being enabled.
60830h	Profile acceleration rate	Default: 13107200
6084h	Profile deceleration rate	Default: 1310720

4.1.4 Profile Torque (PT) Mode

In PT mode, the host controller sends the target torque and torque reference change rate (torque slope) to the servo drive. The servo drive generates the torque reference profiles and executes torque control. When the PT mode is enabled, the object dictionary control mode (6060h) must be set to 4.

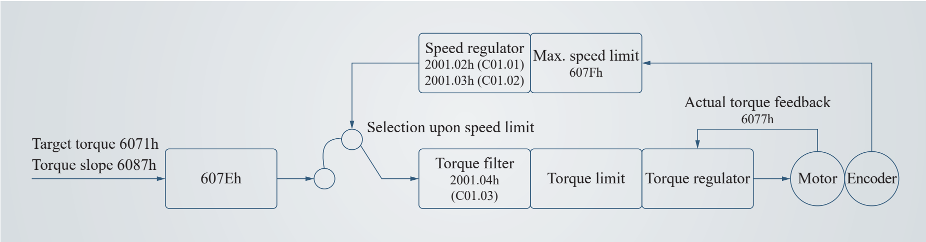


Figure 4-4 Control flow in PT mode

Basic configurations recommended in PT mode:

RPDO	TPDO	Remarks
6040h Control word	6041h Status word	Mandatory
6071h Target Torque	-	Mandatory
6087h Torque slope	-	Optional
-	6064h Position actual value	Optional
-	606Ch Velocity actual value	Optional
-	6077h Torque actualvalue	Optional
6060h Modes of operation	6061h Modes of operation display	Optional

Control word settings in PT mode:

The following table lists the meanings of each bit in the control word (6040h) in PT mode.

Bit	Name	Description
0	Switch on	This bit must be set to 1 when the servo drive is enabled.
1	Enable voltage	This bit must be set to 1 when the servo drive is enabled.
2	Quick stop	This bit must be set to 1 when the servo drive is enabled. If this bit is set to 0, the servo drive stops quickly.
3	Operation enable	This bit must be set to 1 when the servo drive is enabled.
4 to 6	Reserved for PT mode	Not supported
7	Fault reset	The system performs fault reset once when this bit changes from 0 to 1. If system needs fault reset for multiple times, this bit must change from 0 to 1 for multiple times. When this bit is set to 1, other control references are inactive.

Bit	Name	Description
8	Halt	0: Inactive 1: Active (The system halts when this bit is set to 1 and executes references when this bit is set to 0.)
9 to 10	Reserved for PT mode	Not supported
11 to 15	Manufacturer-specific	Not supported

Status word definition in PT mode:

The following table lists the meanings of each bit in the status word (6041h) in PT mode.

Bit	Name	Description
0	Ready to switch on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
1	Switched on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
2	Operation enabled	0: Inactive 1: Active (indicating that the servo drive has been enabled)
3	Servo drive fault	0: No fault 1: Fault occurred
4	Voltage enabled	0: Inactive 1: Active (indicating that the servo drive can be enabled)
5	Quick stop	0: Active 1: Inactive
6	Switch on disabled	0: Inactive 1: Active (indicating that the servo drive cannot be enabled)
7	Alarm	0: No alarm 1: Alarm generated
9	Remote control	0: Inactive 1: Active (indicating that the control word has taken effect)
10	Torque reached	0: Torque not reached 1: Torque reached
11	Internal software position limit status	0: Software position limit not reached 1: Software position limit reached

Parameters related to PT mode:

Dictionary objects related to PT mode:

Index	Sub-index	Name	Access	Data Type	Value Range	Default
6040h	00	Control word	RW	U16	0 to 65535	0
6041h	00	Status word	RO	U16	-	-
6060h	00	Operation mode	RW	I8	0 to 10	0
6061h	00	Mode display	RO	I8	-	-
6071h	00	Target torque	RW	I16	-4000 to 4000	0
6072h	00	Max. torque	RW	U16	0 to 4000	3000
6074h	00	Torque reference	RO	I16	-	-
6077h	00	Actual torque	RO	I16	-	-
6087h	00	Torque slope	RW	U32	0 to (2^{32}-1)	2^{32}-1
607Eh	00	Reference polarity	RW	U8	0 to 255	0
607Fh	00	Max. speed	RW	U32	0 to (2^{32}-1)	104857600
60E0h	00	Positive torque limit	RW	U16	0 to 4000	3000
60E1h	00	Negative torque limit	RW	U16	0 to 4000	3000
2003h	4a	Reference value for torque reach	RW	U16	0 to 4000	0
2003h	4b	Torque output value when DO signal for torque reach turned on	RW	U16	0 to 4000	20
2003h	4c	Torque output value when DO signal for torque reach turned off	RW	U16	0 to 4000	10

PT mode example:

Start and operation processes in PT mode:

Address	Name	Value
6060h	Control mode	4
6071h	PT reference	User-defined
6040h (control word)	Enable	Random number → 6 → 7 → 15
	Alarm clearance	Random number → 128 (rising edge active, if the alarm can be cleared)
	Motor moment	Reference after enabled
6087h	Torque slope	User-defined (acceleration/deceleration ramp in torque mode)

NOTICE

Torque limit:

- To protect mechanical devices, you can limit the torque references of the drive in each position, speed, and torque control mode by setting the maximum torque 6072h, positive torque limit 60E0h, and negative torque limit 60E1h. However, the torque cannot exceed the maximum torque allowed by the drive.

4.1.5 Homing Mode (HM)

The CiA402 protocol defines 33 homing modes according to the home switch (HSW) signal, limit switch signal, and encoder Z signal. When the mode is enabled, the object dictionary control mode (6060h) must be set to 6.

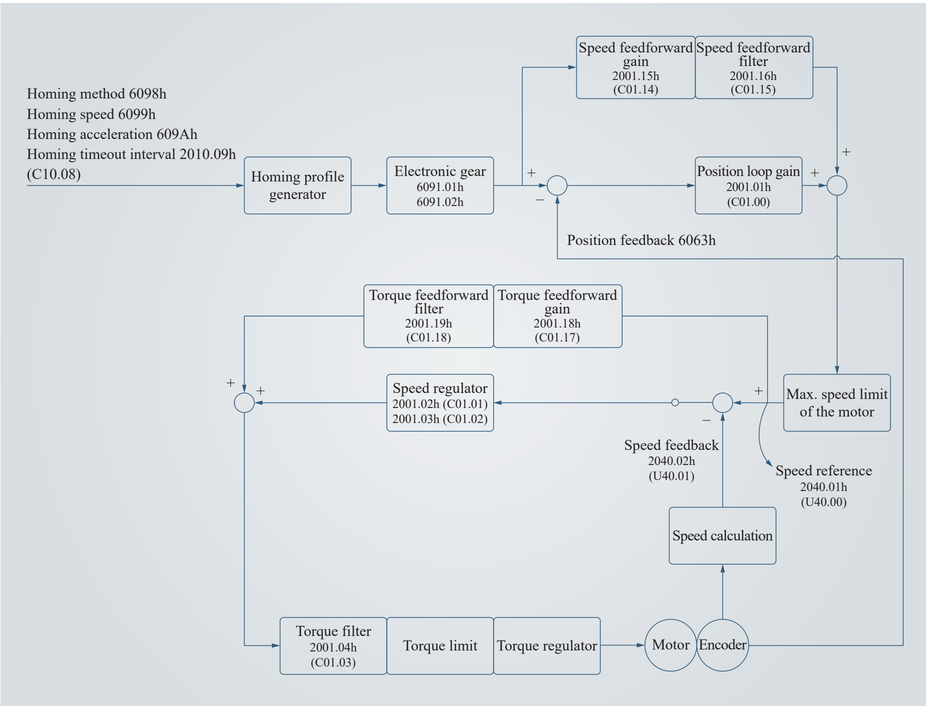


Figure 4-5 Control flow in homing mode

Basic configurations recommended in homing mode:

RPDO	TPDO	Remarks
6040h Control word	6041h Status word	Mandatory
6098h Homing method	-	Optional
6099.01h Speed during search for switch	-	Optional
6099.02h Speed during search for zero	-	Optional
609Ah Homing acceleration	-	Optional
-	6064h Position actual value	Optional
6060h Modes of operation	6061h Modes of operation display	Optional

Control word settings in homing mode:

The following table lists the meanings of each bit in the control word (6040h) in homing mode.

Bit	Name	Description
0	Switch on	This bit must be set to 1 when the servo drive is enabled.
1	Enable voltage	This bit must be set to 1 when the servo drive is enabled.
2	Quick stop	This bit must be set to 1 when the servo drive is enabled. If this bit is set to 0, the servo drive stops quickly.
3	Operation enable	This bit must be set to 1 when the servo drive is enabled.
4	Homing enable	0: Inactive 1: Active (indicating that the homing process is initiated and homing must be active throughout the homing process. If the value is switched to inactive, the homing process is stopped.)
5 to 6	Reserved for homing mode	Not supported
7	Fault reset	The system performs fault reset once when this bit changes from 0 to 1. If system needs fault reset for multiple times, this bit must change from 0 to 1 for multiple times. When this bit is set to 1, other control references are inactive.
8	Halt	0: Inactive 1: Active (indicating that the homing process is decelerated and stopped)
9	Reserved for homing mode	Not supported
10	Reserved for homing mode	Not supported
11 to 15	Manufacturer-specific	Not supported

Status word definition in homing mode:

The following table lists the meanings of each bit in the status word (6041h) in homing mode.

Bit	Name	Description
0	Ready to switch on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
1	Switched on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
2	Operation enabled	0: Inactive 1: Active (indicating that the servo drive has been enabled)
3	Servo drive fault	0: No fault 1: Fault occurred
4	Voltage enabled	0: Inactive 1: Active (indicating that the servo drive can be enabled)
5	Quick stop	0: Active 1: Inactive
6	Switch on disabled	0: Inactive 1: Active (indicating that the servo drive cannot be enabled)
7	Alarm	0: No alarm 1: Alarm generated
9	Remote control	0: Inactive 1: Active (indicating that the control word has taken effect)
10	Position reach	1: Home located or homing interrupted
11	Internal software position limit status	0: Software position limit not reached 1: Software position limit reached
12	Homing completion output	0: Homing not completed 1: Homing completed
13	Homing error	0: Homing error not occurred 1: Homing error occurred
14	Manufacturer-specific	Not supported
15	Homing completion	0: Homing not completed 1: Homing completed

Parameters related to homing mode:

Dictionary objects related to homing mode:

Index	Sub-index	Name	Access	Data Type	Value Range	Default
6040h	00	Control word	RW	U16	0 to 65535	0
6041h	00	Status word	RO	U16	-	-
6060h	00	Operation mode	RW	I8	0 to 10	0
6061h	00	Mode display	RO	I8	-	-
6064h	00	Position feedback	RO	I32	-	-
6065h	00	Excessive position deviation threshold	RW	U32	0 to $(2^{32}-1)$	3145728
6066h	00	Following error time out	RW	U16	0 to 65535(ms)	0
607Ch	00	Home offset	RW	I32	-2^{31} to $(2^{31}-1)$	0
607Fh	00	Max. speed	RW	U32	0 to $(2^{32}-1)$	104857600
6098h	00	Homing method	RW	I8	1 to 35	1
6099h	01	Speed during search for switch	RW	U32	0 to $(2^{32}-1)$	1747627
	02	Speed during search for zero	RW	U32	10 to $(2^{32}-1)$	174763
609Ah	00	Acceleration rate	RW	U32	0 to $(2^{32}-1)$	1747626667
60E6h	00	Homing position calculation method	RW	U8	0 to 1	0
60C5h	00	Max. profile acceleration rate	RW	U32	0 to $(2^{32}-1)$	$2^{31}-1$
2010h	09	Homing time limit	RW	U32	0 to $(2^{32}-1)$	60000

Homing mode example:

Start and operation processes in homing mode:

Address	Name	Value
6060h	Control mode	6
6098h	Homing mode	-2 to 35
6040h (control word)	Alarm clearance	Random number → 128 (rising edge active)
	Homing	6 → 7 → 15 → 31 (homing enabled when bit 4 reaches the rising edge)
6099-01h	Speed during search for switch in homing mode	Default: 13981013
6099-02h	Speed during search for zero in homing mode	Default: 1398101
609Ah	Homing acceleration rate	Default: 131072

Homing mode introduction:

Table 4-1 Mode overview table

Mode setting	Description
-2	The mode is used to search for the mechanical extreme position and Z pulse in the forward direction.
-1	The mode is used to search for the mechanical extreme position and Z pulse in the reverse direction.
0	-
1	The motor starts operation in the reverse direction, switches to low-speed operation when the negative limit (NL) status changes from OFF to ON during reverse operation, and then retreats to search for the nearest Z pulse position as the home.
2	The motor starts operation in the forward direction, switches to low-speed operation when the positive limit (PL) status changes from OFF to ON during forward operation, and then retreats to search for the nearest Z pulse position as the home.
3	The motor operates in the forward direction when HSW is inactive and reverse direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from ON to OFF during reverse operation, and then continues the reverse operation to search for the nearest Z pulse position as the home.
4	The motor operates in the forward direction when HSW is inactive and reverse direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from OFF to ON during forward operation, and then continues the forward operation to search for the nearest Z pulse position as the home.
5	The motor operates in the reverse direction when HSW is inactive and forward direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from ON to OFF during forward operation, and then continues the forward operation to search for the nearest Z pulse position as the home.
6	The motor operates in the reverse direction when HSW is inactive and forward direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from OFF to ON during reverse operation, and then continues the reverse operation to search for the nearest Z pulse position as the home.
7	The motor operates in the forward direction when HSW is inactive and reverse direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from ON to OFF during reverse operation, and then continues the reverse operation to search for the nearest Z pulse position as the home.

Mode setting	Description
8	The motor operates in the forward direction when HSW is inactive and reverse direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from OFF to ON during forward operation, and then continues the forward operation to search for the nearest Z pulse position as the home.
9	The motor operates in the forward direction no matter whether HSW is active or inactive. The motor switches to low-speed operation when the HSW status changes from OFF to ON during reverse operation, and then continues the reverse operation to search for the nearest Z pulse position as the home.
10	The motor operates in the forward direction no matter whether HSW is active or inactive. The motor switches to low-speed operation when the HSW status changes from ON to OFF during forward operation, and then continues the forward operation to search for the nearest Z pulse position as the home.
11	The motor operates in the reverse direction when HSW is inactive and forward direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from ON to OFF during forward operation, and then continues the forward operation to search for the nearest Z pulse position as the home.
12	The motor operates in the reverse direction when HSW is inactive and forward direction when HSW is active. The motor switches to low-speed operation when the HSW status changes from OFF to ON during reverse operation, and then continues the reverse operation to search for the nearest Z pulse position as the home.
13	The motor operates in the reverse direction no matter whether HSW is active or inactive. The motor switches to low-speed operation when the HSW status changes from OFF to ON during forward operation, and then continues the forward operation to search for the nearest Z pulse position as the home.
14	The motor operates in the reverse direction no matter whether HSW is active or inactive. The motor switches to low-speed operation when the HSW status changes from ON to OFF during reverse operation, and then continues the reverse operation to search for the nearest Z pulse position as the home.
15	Reserved
16	Reserved
17	Similar to mode 1. During reverse operation, the position where the NL status changes from OFF to ON is used as the home, without searching for the Z pulse.
18	Similar to mode 2. During forward operation, the position where the PL status changes from OFF to ON is used as the home, without searching for the Z pulse.
19	Similar to mode 3. During reverse operation, the position where the HSW status changes from ON to OFF is used as the home, without searching for the Z pulse.

Mode setting	Description
20	Similar to mode 4. During forward operation, the position where the HSW status changes from OFF to ON is used as the home, without searching for the Z pulse.
21	Similar to mode 5. During forward operation, the position where the HSW status changes from ON to OFF is used as the home, without searching for the Z pulse.
22	Similar to mode 6. During reverse operation, the position where the HSW status changes from OFF to ON is used as the home, without searching for the Z pulse.
23	Similar to mode 7. During reverse operation, the position where the HSW status changes from ON to OFF is used as the home, without searching for the Z pulse.
24	Similar to mode 8. During forward operation, the position where the HSW status changes from OFF to ON is used as the home, without searching for the Z pulse.
25	Similar to mode 9. During reverse operation, the position where the HSW status changes from OFF to ON is used as the home, without searching for the Z pulse.
26	Similar to mode 10. During forward operation, the position where the HSW status changes from ON to OFF is used as the home, without searching for the Z pulse.
27	Similar to mode 11. During forward operation, the position where the HSW status changes from ON to OFF is used as the home, without searching for the Z pulse.
28	Similar to mode 12. During reverse operation, the position where the HSW status changes from OFF to ON is used as the home, without searching for the Z pulse.
29	Similar to mode 13. During forward operation, the position where the HSW status changes from OFF to ON is used as the home, without searching for the Z pulse.
30	Similar to mode 14. During reverse operation, the position where the HSW status changes from ON to OFF is used as the home, without searching for the Z pulse.
31	Reserved
32	Reserved
33	The motor starts to operate in the reverse direction, and searches for the nearest Z pulse position as the home.
34	The motor starts to operate in the forward direction, and searches for the nearest Z pulse position as the home.
35	The current position is used as the home.

Home mode:

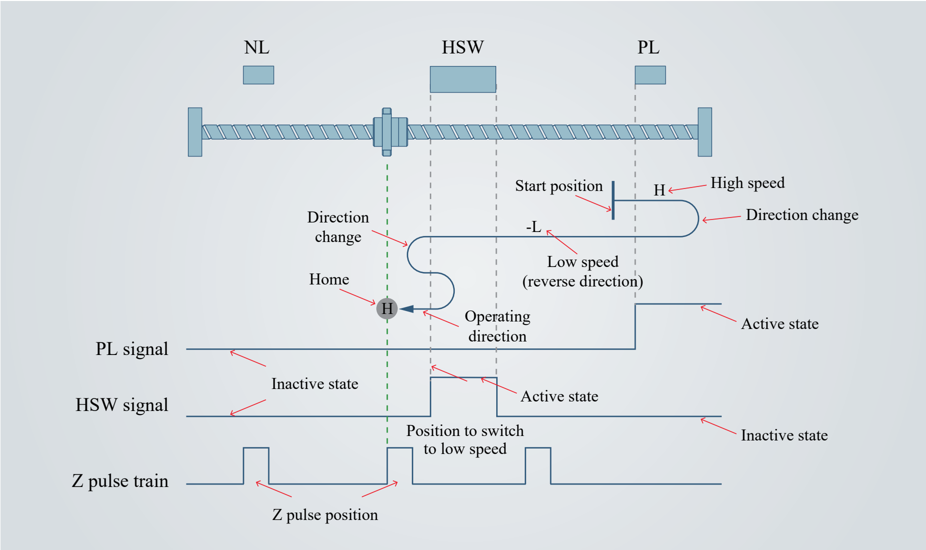


Figure 4-6 Definition of the home mode

Mode-2: The mode is used to search for the mechanical extreme position and Z pulse in the forward direction.

- The motor starts to operate in the forward direction at a high speed. After the motor runs into the mechanical extreme position, if the torque reaches the torque limit value, the speed is near zero, and the state is maintained for a certain period of time, the axis reaches the mechanical extreme position. The motor switches to operate in the reverse direction at a low speed, and searches for the nearest Z pulse position as the home.

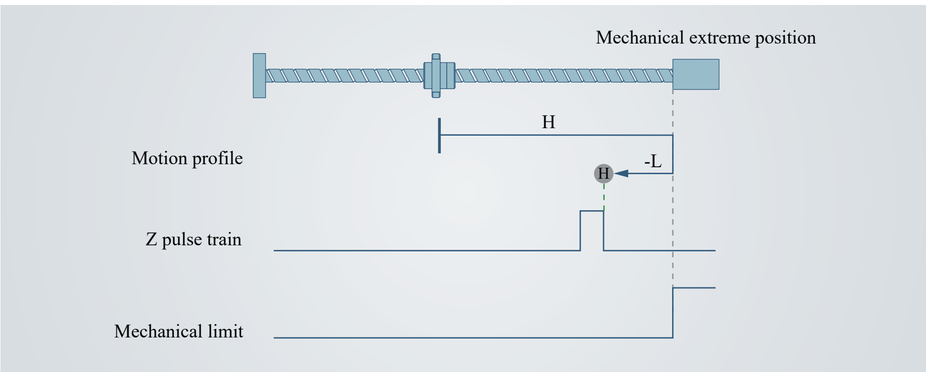


Figure 4-7 Home mode-2 profile and signal status

Mode-1: The mode is used to search for the mechanical extreme position and Z pulse in the reverse direction.

- The motor starts to operate in the reverse direction at a high speed. After the motor runs into the mechanical extreme position, if the torque reaches the torque limit value, the speed is near zero, and the state is maintained for a certain period of time, the axis reaches the mechanical extreme position. The motor switches to operate in the forward direction at a low speed, and searches for the nearest Z pulse position as the home.

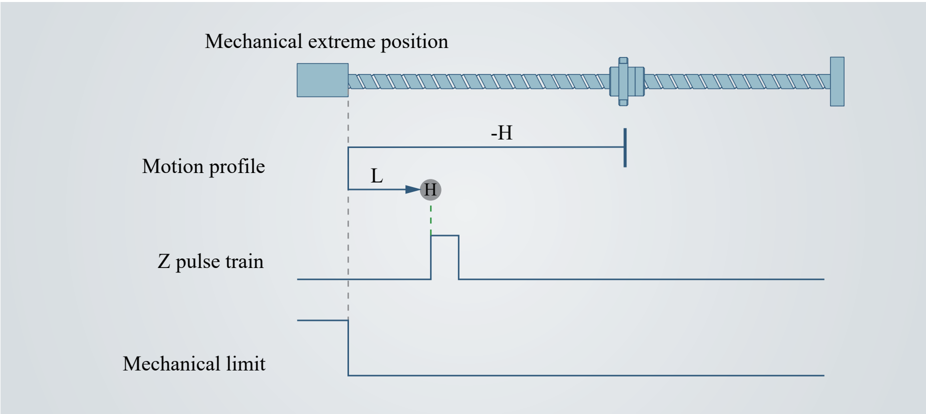


Figure 4-8 Home mode-1 profile and signal status

Mode 1: Search for the NL and Z pulse.

- If the NL is inactive upon startup, the motor operates in the reverse direction at a high speed. When the NL status changes from OFF to ON, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the NL status changes from ON to OFF during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the NL is active upon startup, the motor operates in the forward direction at a low speed. When the NL status changes from ON to OFF during forward operation, the motor continues the forward operation to search for the nearest Z pulse position as the home.

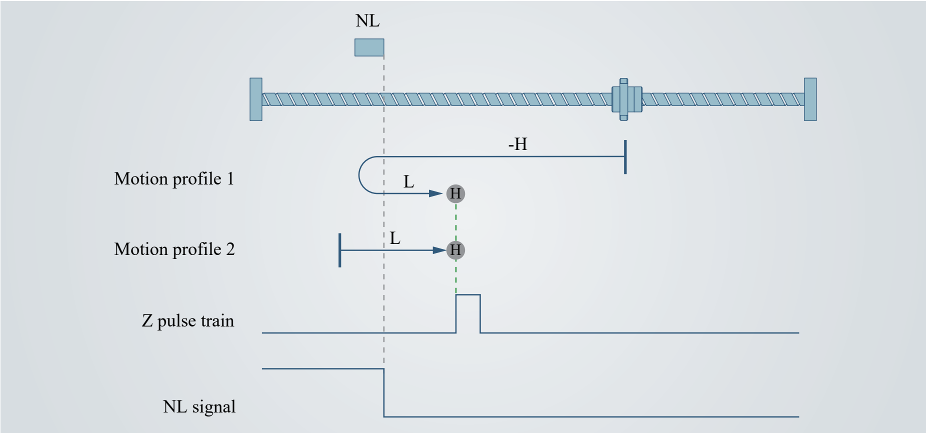


Figure 4-9 Home mode 1 profile and signal status

Mode 2: Search for the PL and Z pulse.

- If the PL is inactive upon startup, the motor operates in the forward direction at a high speed. When the PL status changes from OFF to ON, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the PL status changes from ON to OFF during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the PL is active upon startup, the motor operates in the reverse direction at a low speed. When the PL status changes from ON to OFF during reverse operation, the motor continues the reverse operation to search for the nearest Z pulse position as the home.

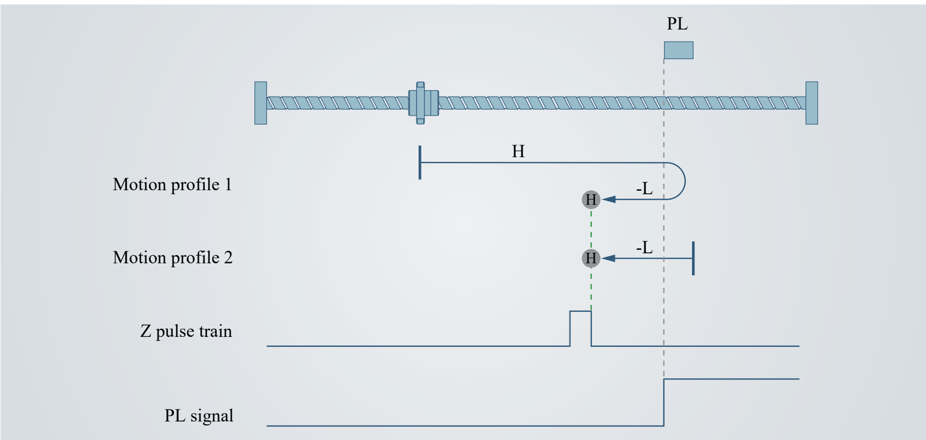


Figure 4-10 Home mode 2 profile and signal status

Mode 3: When the HSW status changes from ON to OFF during reverse operation, the motor searches for the position and Z pulse.

- If the HSW is inactive upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor searches for the nearest Z pulse position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

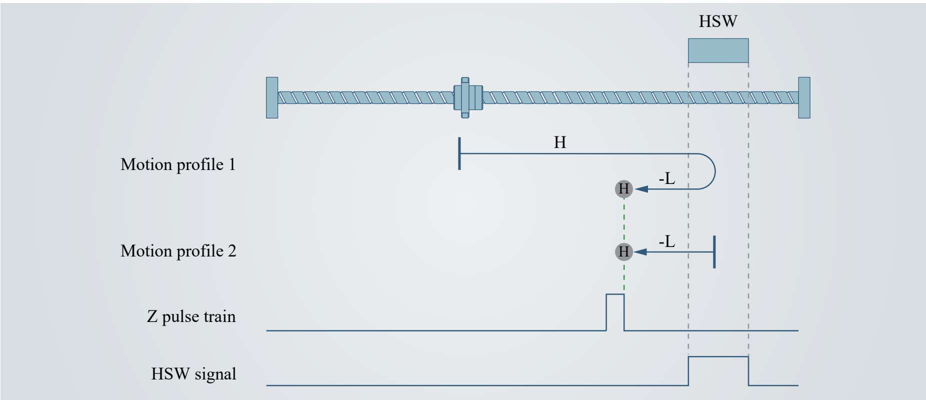


Figure 4-11　Home mode 3 profile and signal status

Mode 4: When the HSW status changes from OFF to ON during forward operation, the motor searches for the position and Z pulse.

- If the HSW is inactive upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

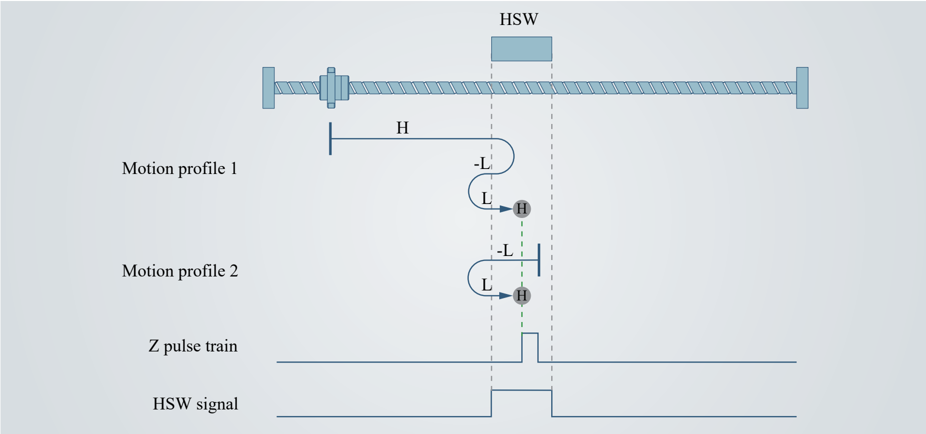


Figure 4-12 Home mode 4 profile and signal status

Mode 5: When the HSW status changes from ON to OFF during forward operation, the motor searches for the position and Z pulse.

- If the HSW is inactive upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor searches for the nearest Z pulse position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

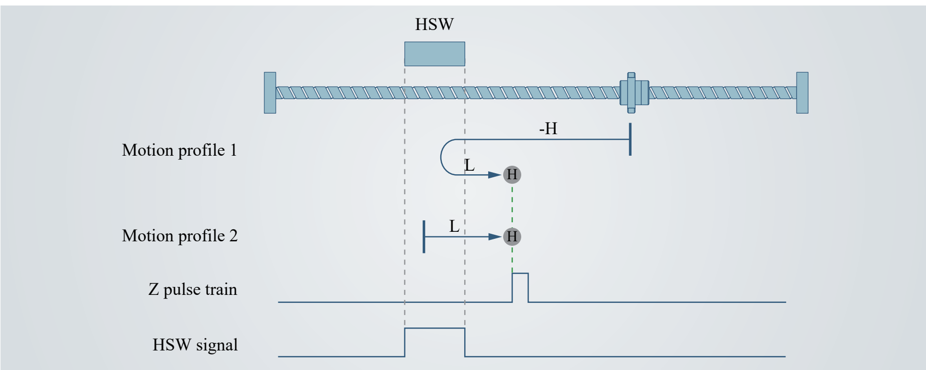


Figure 4-13 Home mode 5 profile and signal status

Mode 6: When the HSW status changes from OFF to ON during reverse operation, the motor searches for the position and Z pulse.

- If the HSW is inactive upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

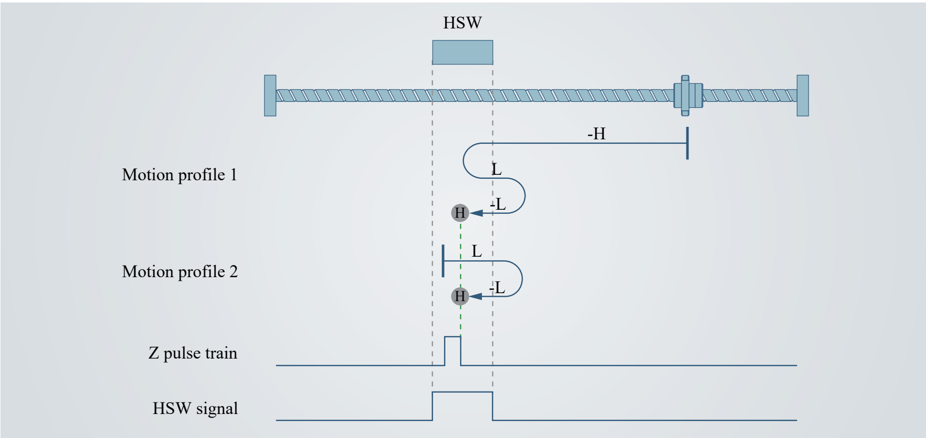


Figure 4-14 Home mode 6 profile and signal status

Mode 7: When the HSW status changes from ON to OFF during reverse operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.

- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor searches for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

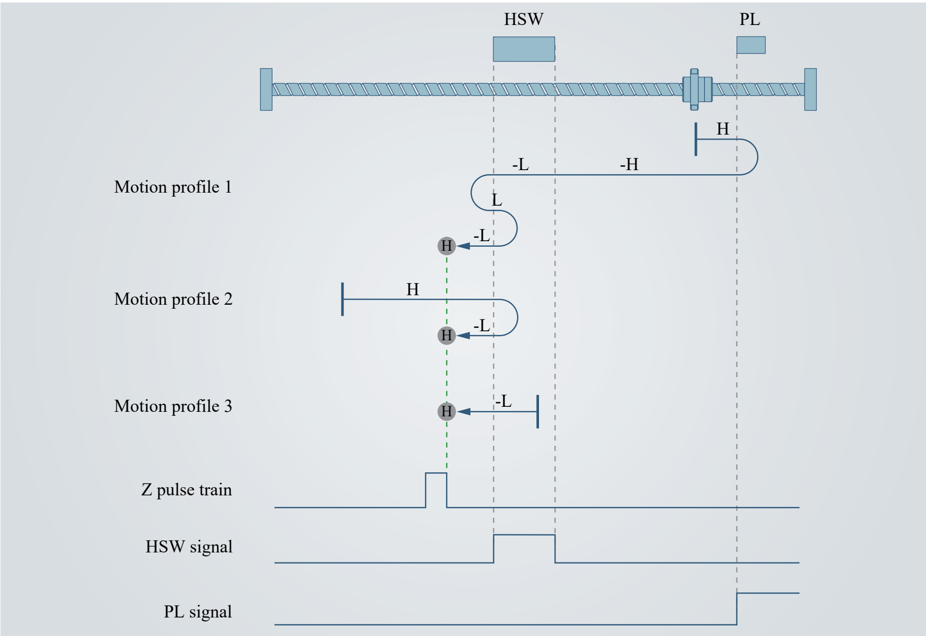


Figure 4-15 Home mode 7 profile and signal status

Mode 8: When the HSW status changes from OFF to ON during forward operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates, and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.

- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

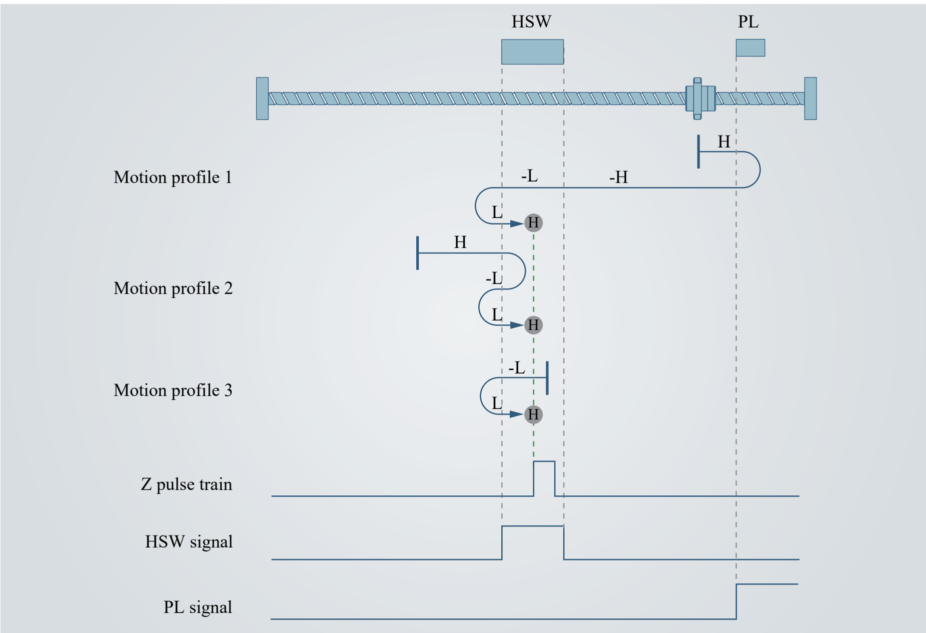


Figure 4-16 Home mode 8 profile and signal status

Mode 9: When the HSW status changes from OFF to ON during reverse operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates, and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

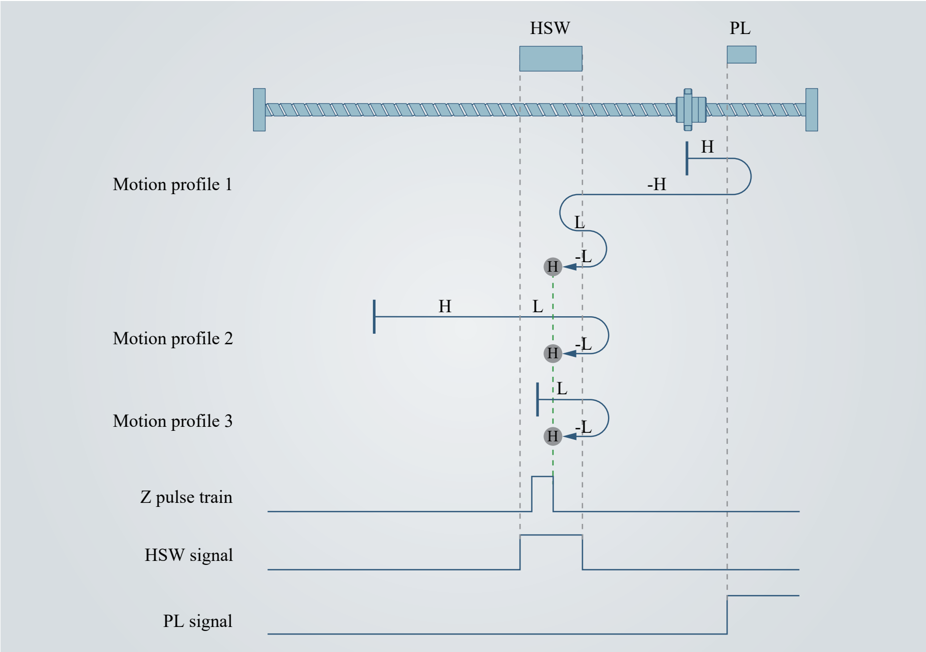


Figure 4-17 Home mode 9 profile and signal status

Mode 10: When the HSW status changes from ON to OFF during forward operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates, and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the

HSW status changes from ON to OFF during forward operation at a low speed, the motor searches for the nearest Z pulse position as the home.

- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

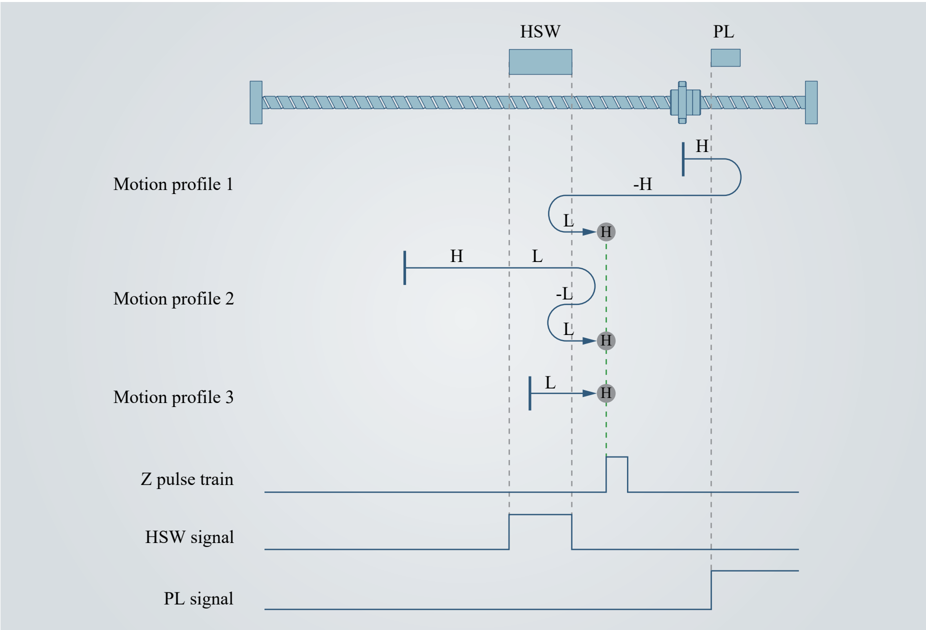


Figure 4-18   Home mode 10 profile and signal status

Mode 11: When the HSW status changes from ON to OFF during forward operation, the motor searches for the position and Z pulse and automatically turns to the forward direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range

is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.

- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor searches for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

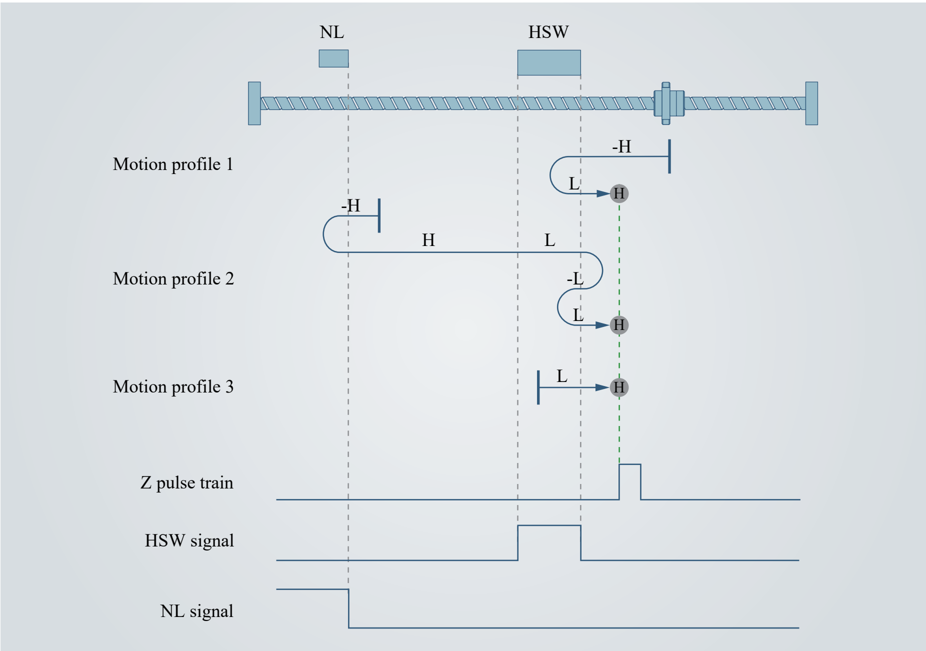


Figure 4-19   Home mode 11 profile and signal status

Mode 12: When the HSW status changes from OFF to ON during reverse operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.

- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates, and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

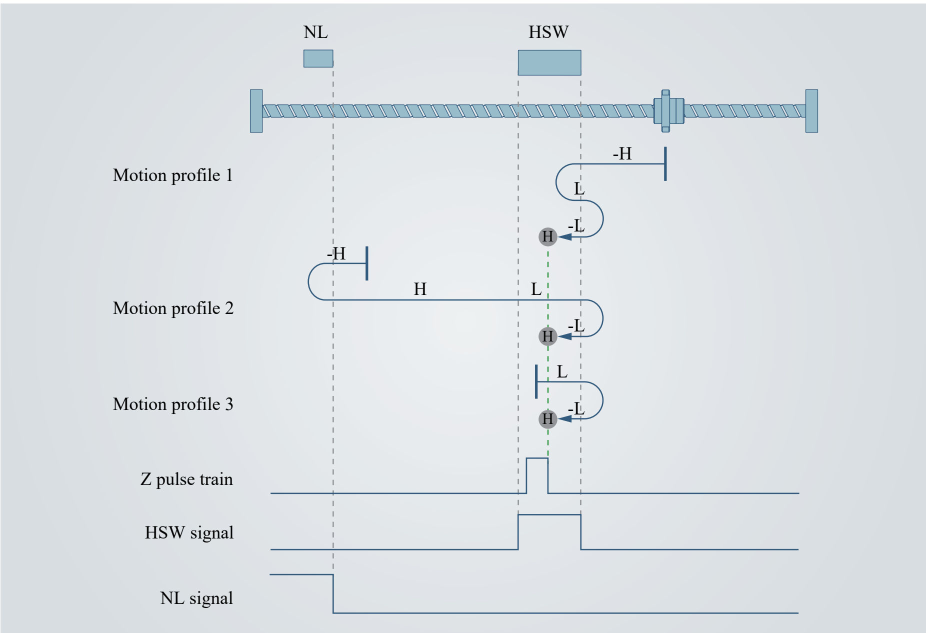


Figure 4-20 Home mode 12 profile and signal status

Mode 13: When the HSW status changes from OFF to ON during forward operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates, and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor continues the forward operation to search for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

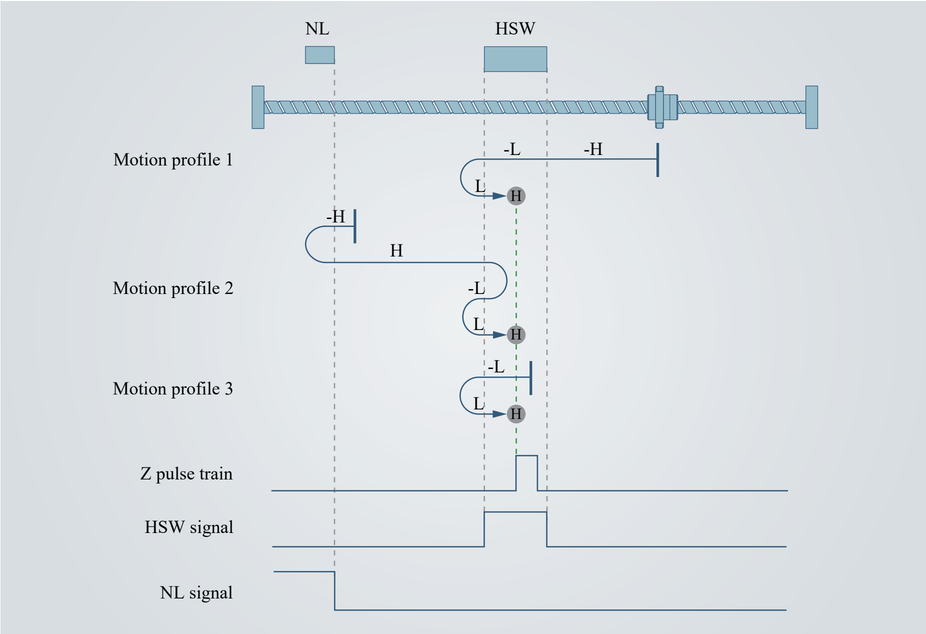


Figure 4-21 Home mode 13 profile and signal status

Mode 14: When the HSW status changes from ON to OFF during reverse operation, the motor searches for the position and Z pulse and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor continues the reverse operation to search for the nearest Z pulse position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor searches for the

nearest Z pulse position as the home.

- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

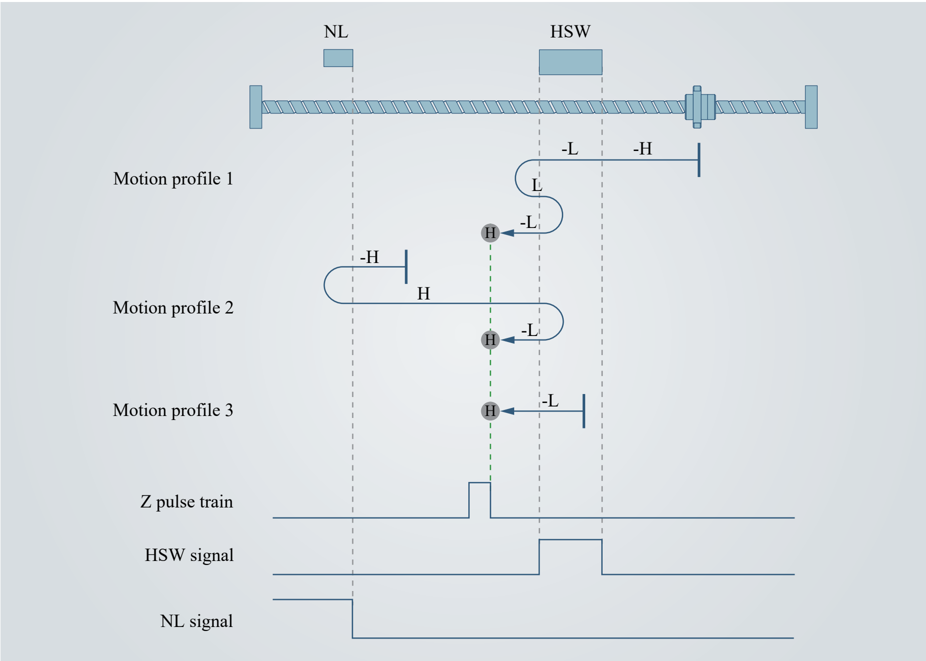


Figure 4-22 Home mode 14 profile and signal status

Mode 15 and mode 16: Reserved

Mode 17: Search for the NL.

- If the NL is inactive upon startup, the motor operates in the reverse direction at a high speed. When the NL status changes from OFF to ON, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the NL status changes from ON to OFF during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the NL is active upon startup, the motor operates in the forward direction at a low speed. When the NL status changes from ON to OFF during forward operation, the motor decelerates to stop and uses the stop position as the home.

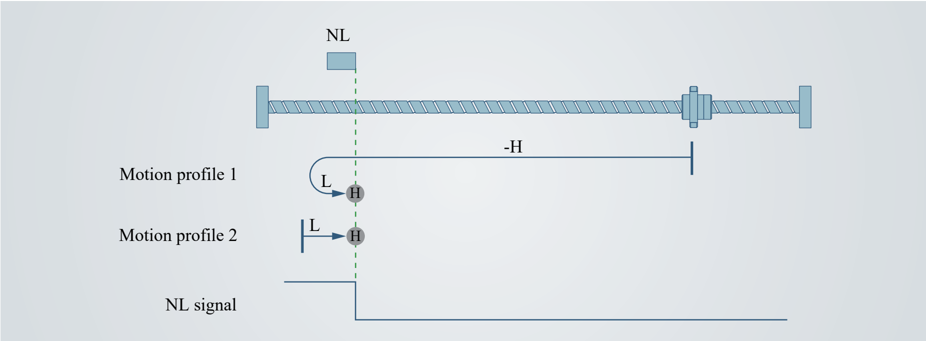


Figure 4-23 Home mode 17 profile and signal status

Mode 18: Search for the PL.

- If the PL is inactive upon startup, the motor operates in the forward direction at a high speed. When the PL status changes from OFF to ON, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the PL status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the PL is active upon startup, the motor operates in the reverse direction at a low speed. When the PL status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.

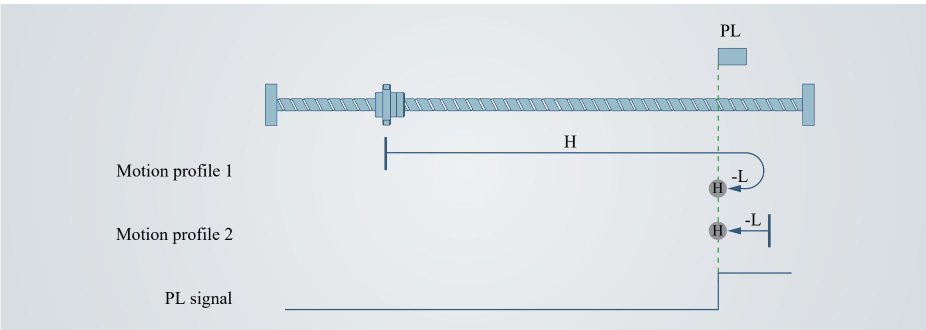


Figure 4-24 Home mode 18 profile and signal status

Mode 19: When the HSW status changes from ON to OFF during reverse operation, the motor searches for the position.

- If the HSW is inactive upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.

- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor uses the stop position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

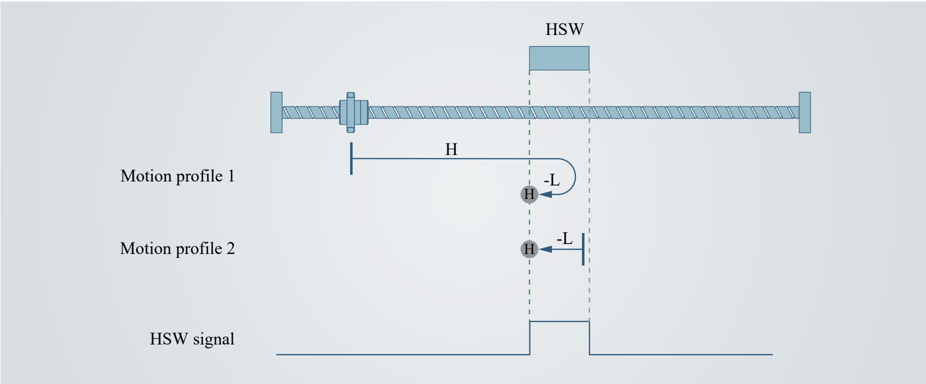


Figure 4-25 Home mode 19 profile and signal status

Mode 20: When the HSW status changes from OFF to ON during forward operation, the motor searches for the position.

- If the HSW is inactive upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

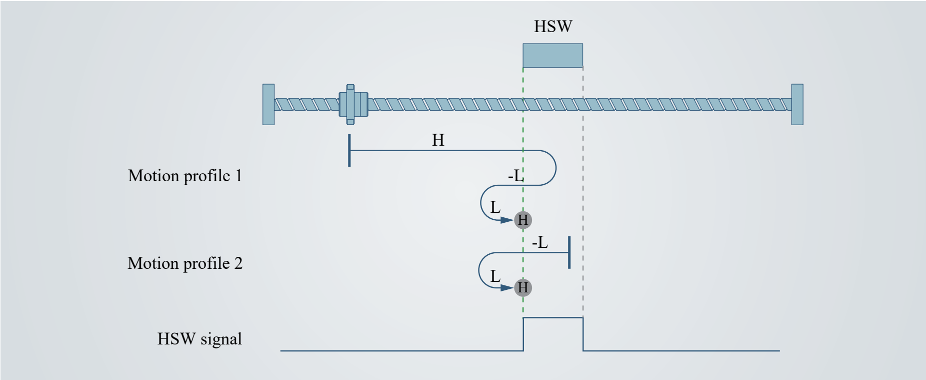


Figure 4-26   Home mode 20 profile and signal status

Mode 21: When the HSW status changes from ON to OFF during forward operation, the motor searches for the position.

- If the HSW is inactive upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor uses the stop position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

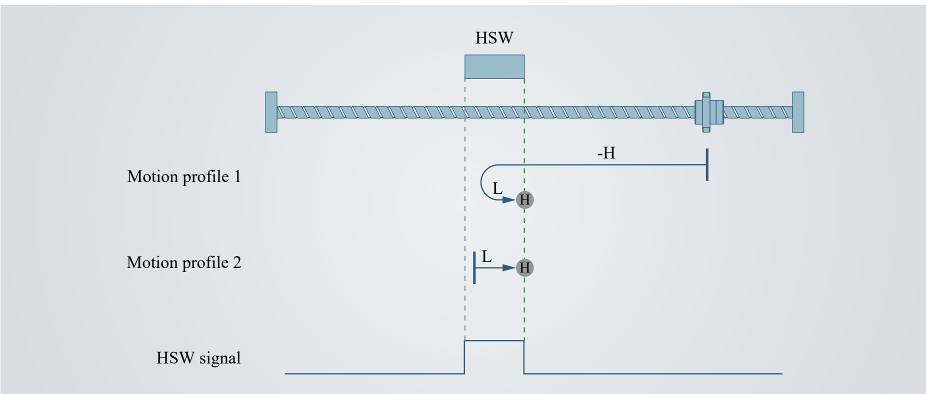


Figure 4-27   Home mode 21 profile and signal status

Mode 22: Search for the PL.

- If the HSW is inactive upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- In this mode, no matter whether the NL or PL is in ON state, the homing process is stopped and an alarm is reported.

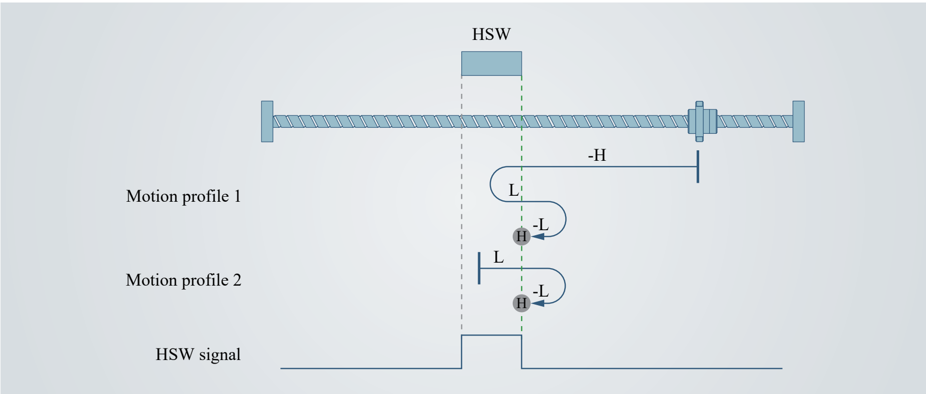


Figure 4-28   Home mode 22 profile and signal status

Mode 23: When the HSW status changes from ON to OFF during reverse operation, the motor searches for the position and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward

operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.

- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

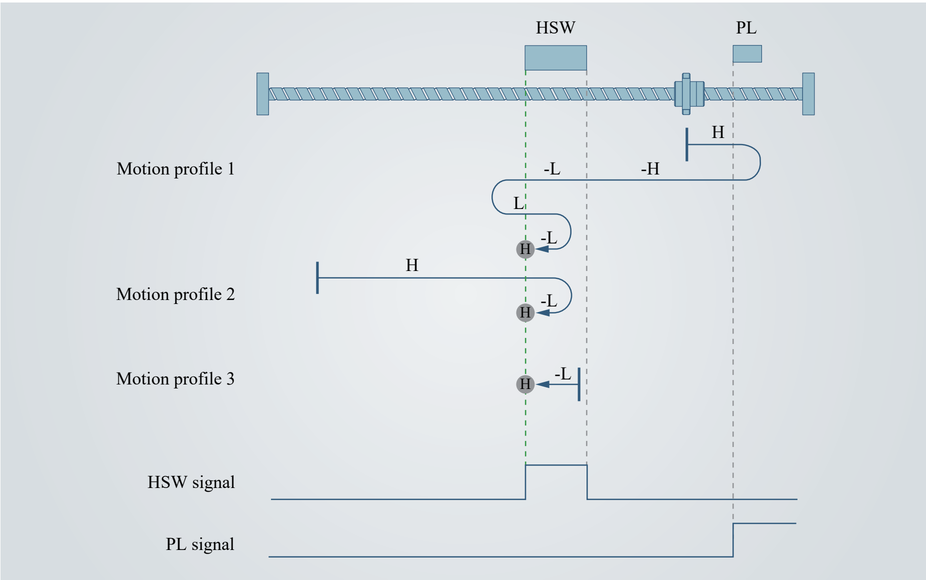


Figure 4-29 Home mode 23 profile and signal status

Mode 24: When the HSW status changes from OFF to ON during forward operation, the motor searches for the position and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates, and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward

operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.

- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

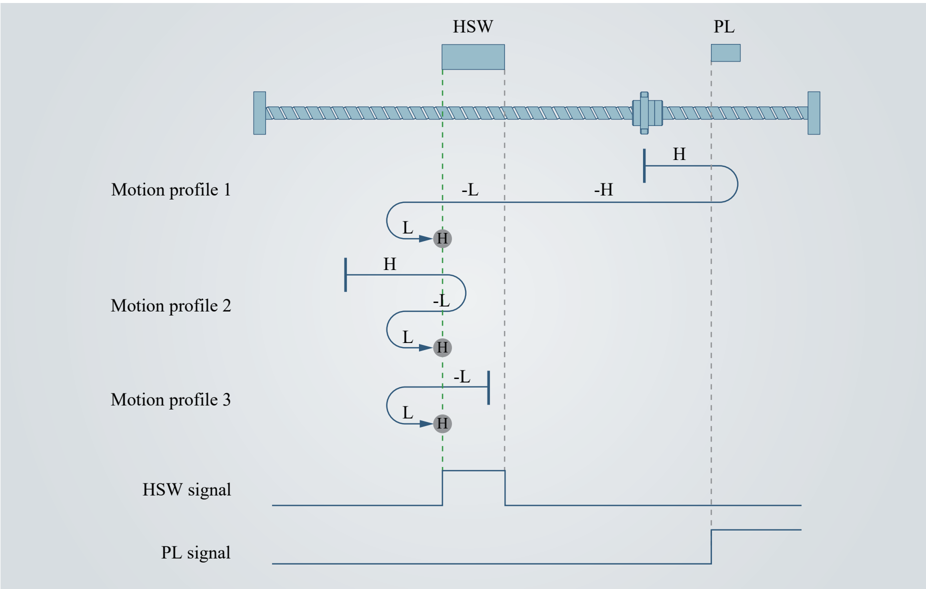


Figure 4-30 Home mode 24 profile and signal status

Mode 25: When the HSW status changes from OFF to ON during reverse operation, the motor searches for the position and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.

- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates, and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

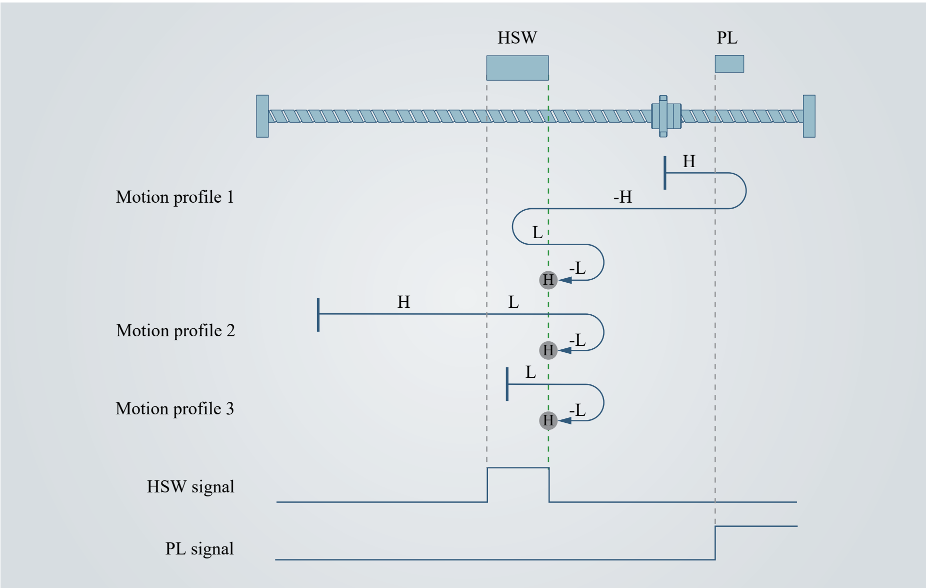


Figure 4-31 Home mode 25 profile and signal status

Mode 26: When the HSW status changes from ON to OFF during forward operation, the motor searches for the position and automatically turns to another direction upon the PL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the PL is in ON state, the motor decelerates to stop, and then operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.

- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

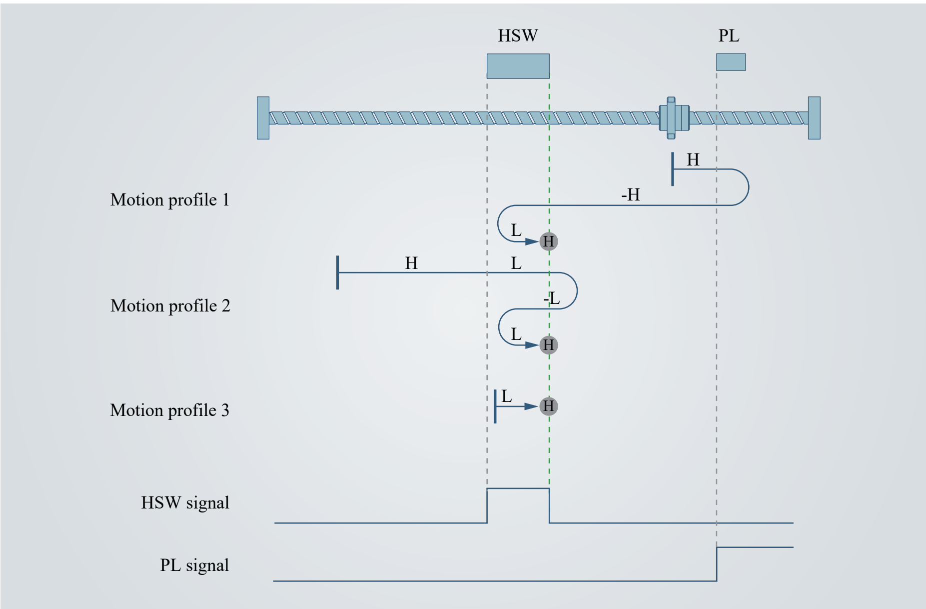


Figure 4-32 Home mode 26 profile and signal status

Mode 27: When the HSW status changes from ON to OFF during forward operation, the motor searches for the position and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

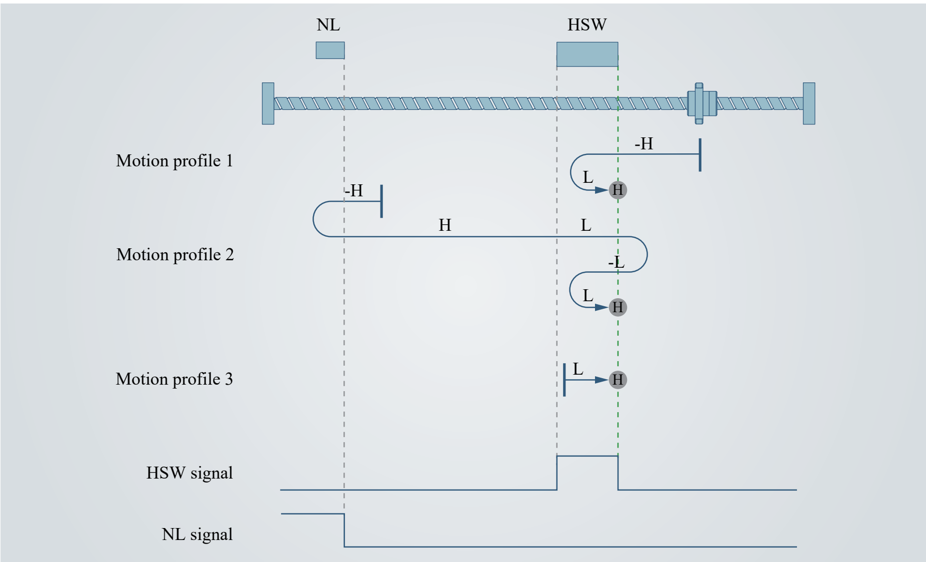


Figure 4-33 Home mode 27 profile and signal status

Mode 28: When the HSW status changes from OFF to ON during reverse operation, the motor searches for the position and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates, and continues to operate in the forward direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the forward direction at a low speed. When the HSW status changes from ON to OFF during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from OFF to ON during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

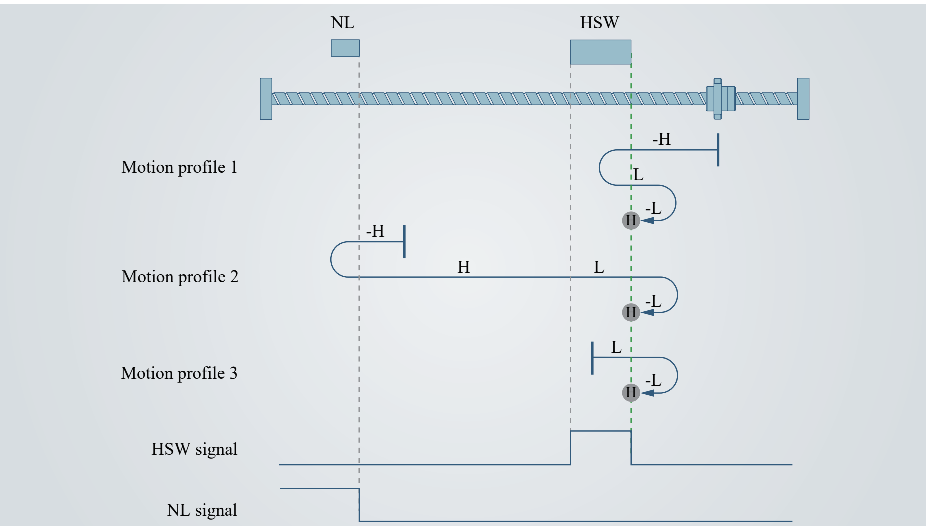


Figure 4-34 Home mode 28 profile and signal status

Mode 29: When the HSW status changes from OFF to ON during forward operation, the motor searches for the position and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates, and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, returns to the position where the HSW is inactive at a low speed, decelerates to stop again, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor decelerates to stop, and then switches to operate in the forward direction at a low speed. When the HSW status changes from OFF to ON during forward operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

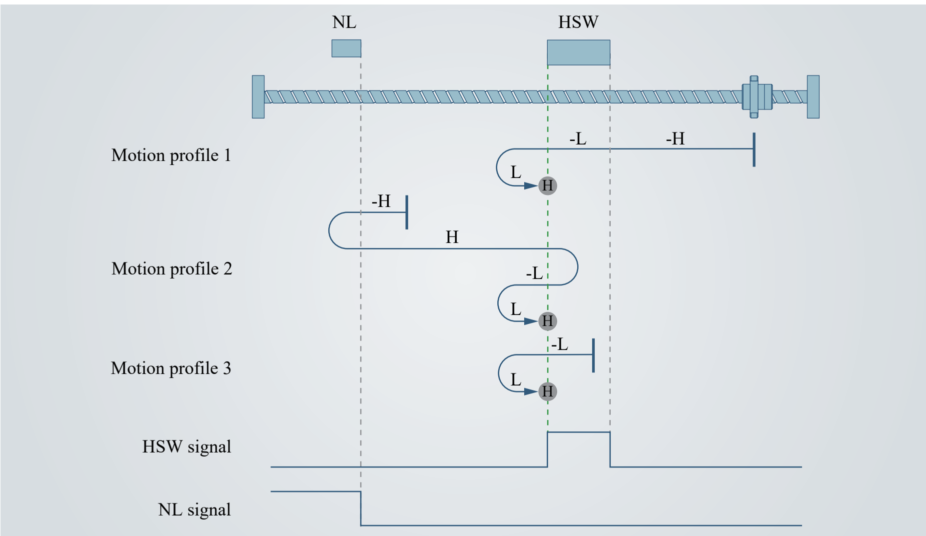


Figure 4-35 Home mode 29 profile and signal status

Mode 30: When the HSW status changes from ON to OFF during reverse operation, the motor searches for the position and automatically turns to another direction upon the NL.

- If the HSW is inactive and located in the forward direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the HSW status changes from OFF to ON during reverse operation, the motor decelerates and continues to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF, the motor decelerates to stop, returns to the position where the HSW is active at a low speed, decelerates to stop again (if the active HSW range is narrow, it may enter the inactive HSW position range on the other side), and switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is inactive and located in the reverse direction of the HSW upon startup, the motor operates in the reverse direction at a high speed. When the NL is in ON state, the motor decelerates to stop, and then operates in the forward direction at a high speed. When the HSW status changes from OFF to ON during forward operation, the motor decelerates to stop, and then switches to operate in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation at a low speed, the motor decelerates to stop and uses the stop position as the home.
- If the HSW is active upon startup, the motor operates in the reverse direction at a low speed. When the HSW status changes from ON to OFF during reverse operation, the motor uses the stop position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

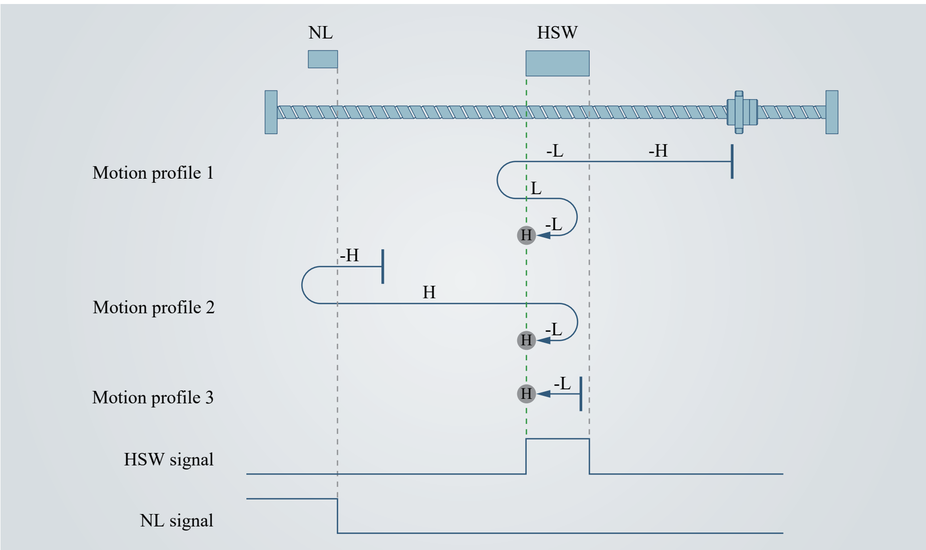


Figure 4-36 Home mode 30 profile and signal status

Mode 31 and mode 32: Reserved

Mode 33: The motor searches for the nearest Z pulse during reverse operation.

- The motor starts to operate in the reverse direction at a low speed, and searches for the nearest Z pulse position as the home. If the motor encounters the ON state of NL before the Z pulse during reverse operation, the motor decelerates to stop, and then operates in the forward direction to search for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the NL for the first time during reverse operation. When the motor encounters the ON state of the PL or encounters the ON state of the NL again, the homing process is stopped and an alarm is reported.

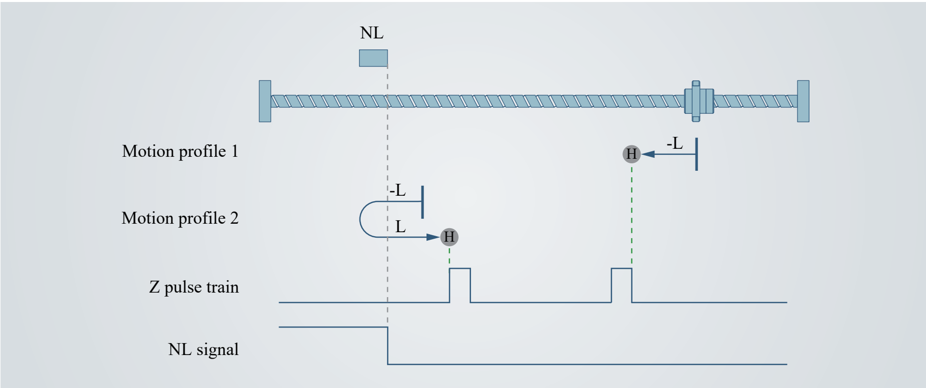


Figure 4-37 Home mode 33 profile and signal status

Mode 34: The motor searches for the nearest Z pulse during forward operation.

- The motor starts to operate in the forward direction at a low speed, and searches for the nearest Z pulse position as the home. If the motor encounters the ON state of PL before the Z pulse during forward operation, the motor decelerates to stop, and then operates in the reverse direction to search for the nearest Z pulse position as the home.
- In this mode, the motor automatically turns to another direction when it encounters the ON state of the PL for the first time during forward operation. When the motor encounters the ON state of the NL or encounters the ON state of the PL again, the homing process is stopped and an alarm is reported.

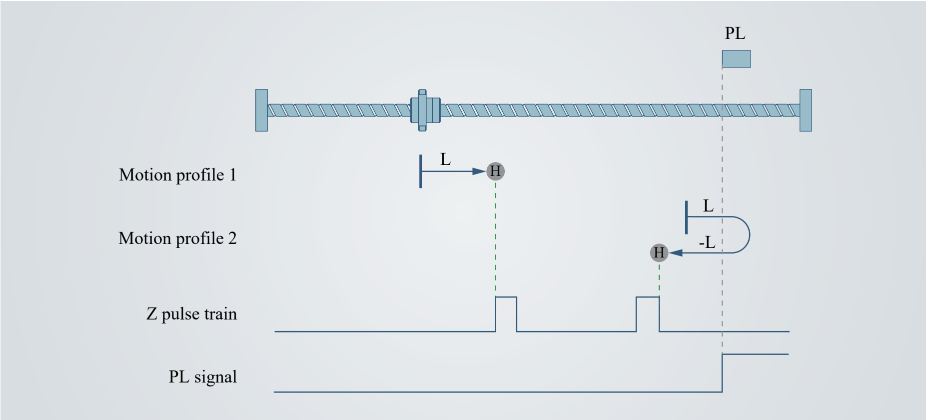


Figure 4-38 Home mode 34 profile and signal status

Mode 35: The current position is used as the home.

- Homing mode 35: The present position is taken as the mechanical home. After homing is triggered (control word 6040h: 0x0F → 0x1F):

  60E6 = 0 (absolute homing):

  6064 (position feedback) is set to 607C (home offset) after homing is done.

  60E6 = 1 (relative homing):

  6064 (position feedback) is the sum of the original value plus 607C (home offset) after homing is done.

4.1.6 Cyclic Synchronous Position (CSP) Mode

In CSP mode, the host controller generates the start speed, stop speed, acceleration rate, and deceleration rate for reaching the target position, and sends the absolute target position to the servo drive cyclically. The servo drive operates by following the target position. When the CSP mode is enabled, the object dictionary control mode (6060h) must be set to 8.

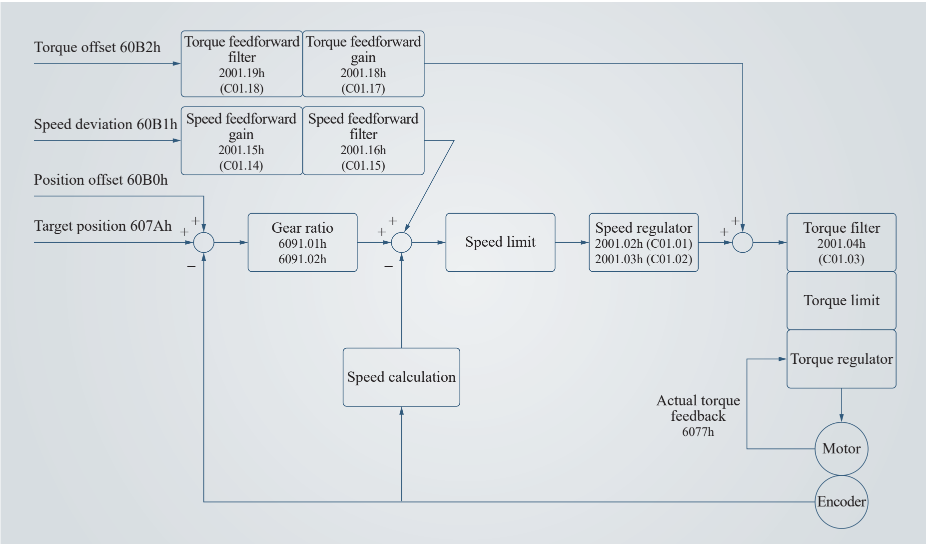


Figure 4-39 Control in CSP mode

Basic configurations recommended in CSP mode:

RPDO	TPDO	Remarks
6040h Control word	6041h Status word	Mandatory
607Ah Target position	6064h Position actual value	Mandatory
6060h Modes of operation	6061h Modes of operation display	Optional

Control word settings in CSP mode:

The following table lists the meanings of each bit in the control word (6040h) in CSP mode.

Bit	Name	Description
0	Switch on	This bit must be set to 1 when the servo drive is enabled.
1	Enable voltage	This bit must be set to 1 when the servo drive is enabled.

Bit	Name	Description
2	Quick stop	This bit must be set to 1 when the servo drive is enabled. If this bit is set to 0, the servo drive stops quickly.
3	Operation enable	This bit must be set to 1 when the servo drive is enabled.
4 to 6	Reserved for CSP mode	Not supported
7	Fault reset	The system performs fault reset once when this bit changes from 0 to 1. If system needs fault reset for multiple times, this bit must change from 0 to 1 for multiple times. When this bit is set to 1, other control references are inactive.
8 to 10	Reserved for CSP mode	Not supported
11 to 15	Manufacturer-specific	Not supported

Status word definition in CSP mode:

The following table lists the meanings of each bit in the status word (6041h) in CSP mode.

Bit	Name	Description
0	Ready to switch on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
1	Switched on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
2	Operation enabled	0: Inactive 1: Active (indicating that the servo drive has been enabled)
3	Servo drive fault	0: No fault 1: Fault occurred
4	Voltage enabled	0: Inactive 1: Active (indicating that the servo drive can be enabled)
5	Quick stop	0: Active 1: Inactive
6	Switch on disabled	0: Inactive 1: Active (indicating that the servo drive cannot be enabled)
7	Alarm	0: No alarm 1: Alarm generated
9	Remote control	0: Inactive 1: Active (indicating that the control word has taken effect)
10	Position reach	Not supported. This bit remains 1 all the time.

Bit	Name	Description
11	Internal software position limit status	0: Software position limit not reached 1: Software position limit reached
12	Target position following	This bit remains 1 all the time.
13	Followed position error alarm	0: No alarm generated 1: Alarm generated
14 to 15	Manufacturer-specific	Not supported

Parameters related to CSP mode:

Dictionary objects related to CSP mode:

Index	Sub-index	Name	Access	Data Type	Value Range	Default
6040h	00	Control word	RW	U16	0 to 65535	0
6041h	00	Status word	RO	U16	-	-
6060h	00	Operation mode	RW	I8	0 to 10	0
6061h	00	Mode display	RO	I8	-	-
6064h	00	Position feedback	RO	I32	-	-
6065h	00	Excessive position deviation threshold	RW	I32	0 to $(2^{32}-1)$	3145728
6066h	00	Following error time out	RW	U16	0 to 65535	0
606Ch	00	Actual speed	RO	I32	-	-
6077h	00	Actual torque	RO	I16	-	-
607Ah	00	Target position	RW	I32	-2^{31} to $(2^{31}-1)$	0
607Eh	00	Reference polarity	RW	U8	0 to 255	0
60B0h	00	Position offset	RW	I32	-2^{31} to $(2^{31}-1)$	0
60B1h	00	Speed deviation	RW	I32	-2^{31} to $(2^{31}-1)$	0
60B2h	00	Torque offset	RW	I16	-4000 to 4000	0
60F4h	00	Position deviation	RO	I32	-	-

CSP mode example:

Start and operation processes in CSP mode:

Address	Name	Value
6060h	Control mode	8
6040h (control word)	Enable	Random number → 6 → 7 → 15 or MC_Power
	Alarm clearance	Random number → 128 (rising edge active, if the alarm can be cleared)
	Axis fault reset	Host controller reference or PLC reference MC_Reset
607Ah	Position reference	Host controller reference (including the acceleration rate and deceleration rate)
	Analog speed control	Host controller reference, PLC reference MC_MoveVelocity
	Relative position reference	Host controller reference, PLC reference MC_MoveRelative
	Incremental position reference	Host controller reference, PLC reference MC_MoveAdditive
	Absolute position reference	Host controller reference, PLC reference MC_MoveAbsolute
	Axis deceleration to stop	Host controller reference, PLC reference MC_Stop
	Synchronization cycle time	Host controller reference (DC-SYn-chro)

4.1.7 Cyclic Synchronous Velocity (CSV) Mode

In CSV mode, the host controller generates the acceleration rate and deceleration rate for reaching the target torque, and sends the target torque to the servo drive cyclically. The servo drive operates by following the target torque. When the CSV mode is enabled, the object dictionary control mode (6060h) must be set to 9.

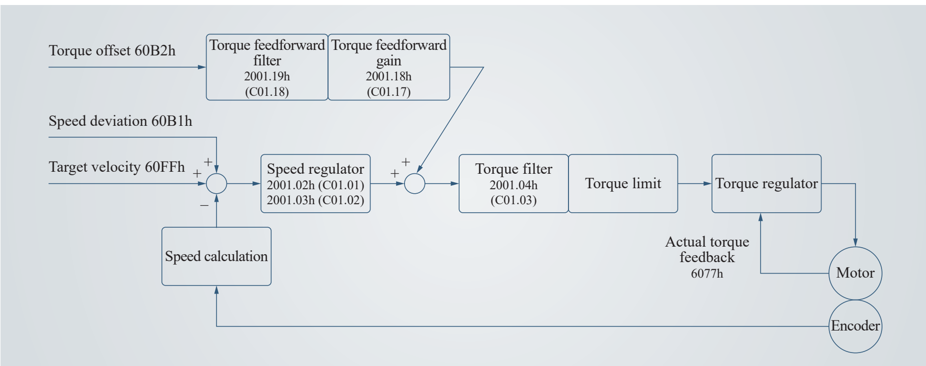


Figure 4-40 Control in CSV mode

Basic configurations recommended in CSV mode:

RPDO	TPDO	Remarks
6040h Control word	6041h Status word	Mandatory
60FFh Target Velocity	-	Mandatory
-	6064h Position actual value	Optional
-	606Ch Velocity actual value	Optional
6060h Modes of operation	6061h Modes of operation display	Optional

Control word settings in CSV mode:

The following table lists the meanings of each bit in the control word (6040h) in CSV mode.

Bit	Name	Description
0	Switch on	This bit must be set to 1 when the servo drive is enabled.
1	Enable voltage	This bit must be set to 1 when the servo drive is enabled.
2	Quick stop	This bit must be set to 1 when the servo drive is enabled. If this bit is set to 0, the servo drive stops quickly.
3	Operation enable	This bit must be set to 1 when the servo drive is enabled.
4 to 6	Reserved for CSV mode	Not supported
7	Fault reset	The system performs fault reset once when this bit changes from 0 to 1. If system needs fault reset for multiple times, this bit must change from 0 to 1 for multiple times. When this bit is set to 1, other control references are inactive.
8 to 10	Reserved for CSV mode	Not supported
11 to 15	Manufacturer-specific	Not supported

Status word definition in CSV mode:

The following table lists the meanings of each bit in the status word (6041h) in CSV mode.

Bit	Name	Description
0	Ready to switch on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
1	Switched on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
2	Operation enabled	0: Inactive 1: Active (indicating that the servo drive has been enabled)

Bit	Name	Description
3	Servo drive fault	0: No fault 1: Fault occurred
4	Voltage enabled	0: Inactive 1: Active (indicating that the servo drive can be enabled)
5	Quick stop	0: Active 1: Inactive
6	Switch on disabled	0: Inactive 1: Active (indicating that the servo drive cannot be enabled)
7	Alarm	0: No alarm 1: Alarm generated
9	Remote control	0: Inactive 1: Active (indicating that the control word has taken effect)
10	Reserved for CSV mode	Not supported
11	Internal software position limit status	0: Software position limit not reached 1: Software position limit reached
12	Target position following	This bit remains 1 all the time.
13	Reserved for CSV mode	Not supported
14 to 15	Manufacturer-specific	Not supported

Parameters related to CSV mode:

Dictionary objects related to CSV mode:

Index	Sub-index	Name	Access	Data Type	Value Range	Default
6040h	00	Control word	RW	U16	0 to 65535	0
6041h	00	Status word	RO	U16	-	-
6060h	00	Operation mode	RW	I8	0 to 10	0
6061h	00	Mode display	RO	I8	-	-
6064h	00	Position feedback	RO	I32	-	-
606Ch	00	Actual speed	RO	I32	-	-
6077h	00	Actual torque	RO	I16	-	0
607Eh	00	Reference polarity	RW	U8	0 to 255	0
60B1h	00	Speed deviation	RW	I32	-2^{31} to $(2^{31}-1)$	0

Index	Sub-index	Name	Access	Data Type	Value Range	Default
60B2h	00	Torque offset	RW	I16	-4000 to 4000	0
60FFh	00	Target velocity	RW	I32	-2^{31} to $(2^{31}-1)$	0

CSV mode example:

Start and operation processes in CSV mode:

Address	Name	Value
6060h	Control mode	9
6040h (control word)	Enable	Random number → 6 → 7 → 15 or MC_Power
	Alarm clearance	Random number → 128 (rising edge active, if the alarm can be cleared)
	Axis fault reset	Host controller reference or PLC reference MC_Reset
60FFh	Speed reference	Host controller reference, PLC reference MC_SyncMoveVelocity
	Axis deceleration to stop	Host controller reference, PLC reference MC_Stop
	Synchronization cycle time	Host controller reference (DC-SYn-chro)

4.1.8 Cyclic Synchronous Torque (CST) Mode

In CST mode, the host controller generates the torque slope change rate for reaching the target torque, and sends the target torque to the servo drive cyclically. The servo drive operates by following the target torque. When the CST mode is enabled, the object dictionary control mode (6060h) must be set to 10.

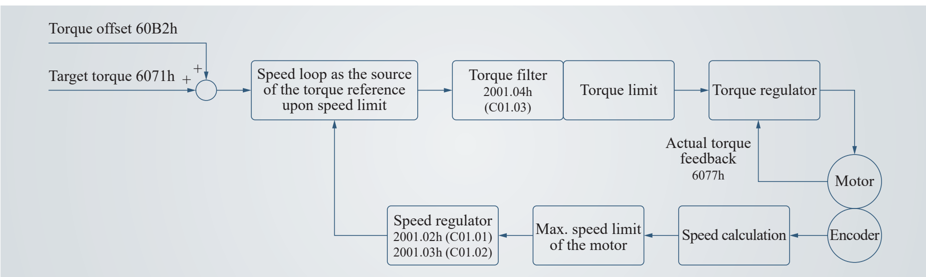


Figure 4-41 Control in CST mode

Basic configurations recommended in CST mode:

RPDO	TPDO	Remarks
6040h Control word	6041h Status word	Mandatory
6071h Target Torque	-	Mandatory
-	6064h Position actual value	Optional
-	606Ch Velocity actual value	Optional
-	6077h Torque actual value	Optional
6060h Modes of operation	6061h Modes of operation display	Optional

Control word settings in CST mode:

The following table lists the meanings of each bit in the control word (6040h) in CST mode.

Bit	Name	Description
0	Switch on	This bit must be set to 1 when the servo drive is enabled.
1	Enable voltage	This bit must be set to 1 when the servo drive is enabled.
2	Quick stop	This bit must be set to 1 when the servo drive is enabled. If this bit is set to 0, the servo drive stops quickly.
3	Operation enable	This bit must be set to 1 when the servo drive is enabled.
4 to 6	Reserved for CST mode	Not supported
7	Fault reset	The system performs fault reset once when this bit changes from 0 to 1. If system needs fault reset for multiple times, this bit must change from 0 to 1 for multiple times. When this bit is set to 1, other control references are inactive.
8 to 10	Reserved for CST mode	Not supported
11 to 15	Manufacturer-specific	Not supported

Status word definition in CST mode:

The following table lists the meanings of each bit in the status word (6041h) in CST mode.

Bit	Name	Description
0	Ready to switch on	0: Inactive 1: Active (indicating that the servo drive can be enabled)
1	Switched on	0: Inactive 1: Active (indicating that the servo drive can be enabled)

Bit	Name	Description
2	Operation enabled	0: Inactive 1: Active (indicating that the servo drive has been enabled)
3	Servo drive fault	0: No fault 1: Fault occurred
4	Voltage enabled	0: Inactive 1: Active (indicating that the servo drive can be enabled)
5	Quick stop	0: Active 1: Inactive
6	Switch on disabled	0: Inactive 1: Active (indicating that the servo drive cannot be enabled)
7	Alarm	0: No alarm 1: Alarm generated
9	Remote control	0: Inactive 1: Active (indicating that the control word has taken effect)
10	Target torque	This bit remains 1 all the time.
11	Internal software position limit status	0: Software position limit not reached 1: Software position limit reached
12	Target torque following	This bit remains 1 all the time.
13	Reserved for CST mode	Not supported
14 to 15	Manufacturer-specific	Not supported

Parameters related to CST mode:

Dictionary objects related to CST mode:

Index	Sub-index	Name	Access	Data Type	Value Range	Default
6040h	00	Control word	RW	U16	0 to 65535	0
6041h	00	Status word	RO	U16	-	-
6060h	00	Operation mode	RW	I8	0 to 10	0
6061h	00	Mode display	RO	I8	-	-
6071h	00	Target torque	RW	I16	-4000 to 4000	0
6072h	00	Max. torque	RW	U16	0 to 4000	3000
6074h	00	Torque reference	RO	I16	-	0

Index	Sub-index	Name	Access	Data Type	Value Range	Default
6077h	00	Actual torque	RO	I16	-	0
607Eh	00	Reference polarity	RW	U8	0 to 255	0
607Fh	00	Max. speed	RW	U32	0 to (2^{32}-1)	104857600
60B2h	00	Torque offset	RW	I16	-4000 to 4000	0
60E0h	00	Positive torque limit	RW	U16	0 to 4000	3000
60E1h	00	Negative torque limit	RW	U16	0 to 4000	3000

CST mode example:

Start and operation processes in CST mode:

Address	Name	Value
6060h	Control mode	10
6071h 607Fh	Torque/Speed reference	Torque reference/speed limit
6040h (control word)	Enable	Random number → 6 → 7 → 15 or MC_Power
	Alarm clearance	Random number → 128 (rising edge active, if the alarm can be cleared)
	Axis fault reset	Host controller reference or PLC reference MC_Reset
	Synchronization cycle time	Host controller reference (DC-SYn-chro)

4.1.9 Touch Probe Function

The touch probe function is used to latch the position. It can latch the position value (reference unit) when a DI signal or Z signal of the motor changes. The JSS715N series servo drive offers two touch probes to save position values corresponding to the rising edge and falling edge of each touch probe signal, which means a total of four position values can be latched simultaneously.

NOTICE

- No specific DI logic is required when a DI is used to trigger the touch probe signal.
- You can set the filter window for the touch probe signal in 2010.2Bh (C10.2A) when a DI is used to trigger the touch probe signal.
- The touch probe function can be set only for the DI4 and DI5 high speed DIs.

Related parameters:

Index	Sub-index	Name	Access	Data Type	Value Range	Default
2004h	0D	DI4 function	RW	U16	0 to 65535	30
2004h	11	DI5 function	RW	U16	0 to 65535	31
60B8h	0	Touch Probe Function	RW	U16	0 to 65535	0

Bit description for 60B8h:

Bit	Name	Description
0	Touch probe 1 function selection	0: Disabled 1: Enabled
1	Touch probe 1 trigger mode	0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger
2	Touch probe 1 trigger signal selection	0: DI signal 1: Z signal
3	Reserved	
4	Touch probe 1 positive edge	0: Switch off latching at positive edge 1: Enable latching at positive edge
5	Touch probe 1 negative edge	0: Switch off latching at negative edge 1: Enable latching at negative edge
6 to 7	Reserved	
8	Touch probe 2 function selection	0: Disabled 1: Enabled
9	Touch probe 2 trigger mode	0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger
10	Touch probe 2 trigger signal selection	0: DI signal 1: Z signal
11	Reserved	
12	Touch probe 2 positive edge	0: Switch off latching at positive edge 1: Enable latching at positive edge
13	Touch probe 2 negative edge	0: Switch off latching at negative edge 1: Enable latching at negative edge
14 to 15	Reserved	

Index	Sub-index	Name	Access	Data Type	Value Range	Default
60B9h	0	Touch probe status	RO	U16	-	0

Bit description for 60B9h:

Bit	Name	Description
0	Touch probe 1 function selection	0: Disabled 1: Enabled
1	Touch probe 1 positive edge value	0: No positive edge value latched 1: Positive edge value latched
2	Touch probe 1 negative edge value	0: No positive edge value latched 1: Positive edge value latched
3 to 7	Reserved	
8	Touch probe 2 function selection	0: Disabled 1: Enabled
9	Touch probe 2 positive edge value	0: No positive edge value latched 1: Positive edge value latched
10	Touch probe 2 negative edge value	0: No positive edge value latched 1: Positive edge value latched
11 to 15	Reserved	

Index	Sub-index	Name	Access	Data Type	Value Range	Default
60BAh	0	Touch probe 1 positive edge	RO	I32	-	0
60BBh	0	Touch probe 1 negative edge	RO	I32	-	0
60BCh	0	Touch probe 2 positive edge	RO	I32	-	0
60BDh	0	Touch probe 2 negative edge	RO	I32	-	0
60D5h	0	Touch probe 1 positive edge counter	RO	U16	-	0
60D6h	0	Touch probe 1 negative edge counter	RO	U16	-	0
60D7h	0	Touch probe 2 positive edge counter	RO	U16	-	0
60D8h	0	Touch probe 2 negative edge counter	RO	U16	-	0

4.1.10 Software Position Limit

Description:

In conventional drives, the position limit is defined by external sensor signals connected to the DI of the servo drive.

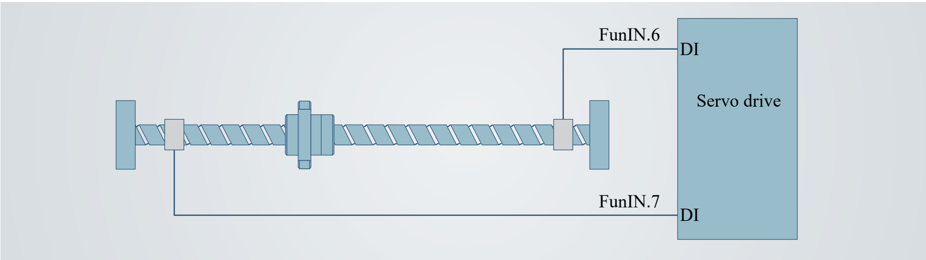


Figure 4-42 Installation of the limit switch

Table 4-2 Comparison between the hardware position limit and software position limit

Hardware Position Limit	Software Position Limit
Restricted to linear motion and single-turn rotational motion.	Applicable to both linear motion and rotational motion.
Requires an external mechanical limit switch.	Removes the need for hardware wiring, preventing malfunction due to poor cable contact.
Suffered from the risk of mechanical slip.	Prevents malfunction due to mechanical slip through internal position comparison.
Unable to sense or detect an overtravel fault after power-off.	

The software position limit works by comparing the limit value with the internal feedback value. If the latter exceeds the former, a warning will be reported and the servo drive stops. This function applies to both the absolute position mode and the incremental position mode. In incremental position mode, set 2006.08h (C06.07) to 2, which means the servo drive performs homing to find the mechanical home after power-on, and then enables the software position limit.

Related parameters:

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
2006.08h	C06.07	Mechanical limit position	0: Disabled 1: Enabled 2: Enabled after homing	0 to 2	0	-	U16	During operation	Immediately

Index	Name	Access	PDO Mapping	Data Type	Unit	Value Range	Default	Modification Mode	Effective Time
607D.01h	Min. software position limit	RW	RPDO	I32	Reference unit	-2^{31} to $(2^{31}-1)$	-2^{31}	During operation	Immediately
607D.02h	Max. software position limit	RW	RPDO	I32	Reference unit	-2^{31} to $(2^{31}-1)$	$2^{31}-1$	During operation	Immediately

⚠ CAUTION

- Ensure the value of 607D.01 is lower than or equal to 607D.02. If 607D.01 is set to a value higher than 607D.02, the servo drive prompts Er841 (software position limit setting error).
- In absolute rotation mode or single-turn mode, ensure that 607D.01 and 607D.02 are within the mechanical position limit. Otherwise, the servo drive reports Er841.
- Ensure that the value of 607C (home offset) is within the software position limit. Otherwise, the servo drive reports Er843 (home offset outside the software position limit).

Chapter 5 Absolute System

NOTICE

- The absolute encoder must carry a battery box.

5.1 Absolute System Setting

Overview

The absolute encoder, which carries a resolution of 131072 (2^{17}) PPR, detects the motor position within one revolution and counts the number of revolutions, with 16-bit multi-turn data saved.

The absolute encoder system works in the position control, speed control, and torque control modes. When the servo drive is powered off, the encoder battery serves as the power supply to enable the encoder to back up data. The servo drive therefore can calculate the absolute mechanical position through the encoder after power-on, removing the need for homing.

When JSS715N series servo drive matches the absolute encoder, set 2000.08h (C00.07) to (absolute system selection) based on actual conditions. Er208 (encoder battery fault) will be reported when the battery is connected for the first time. In this case, set 2031.11h (F31.10) to reset the encoder fault, and then perform homing.

NOTICE

- When the value of 2000.02h (C00.01) (rotation direction) or 2031.11h (F31.10) (absolute encoder reset selection), or the electronic gear ratio is changed, the mechanical position will change abruptly, requiring a homing operation.
- After homing is done, the deviation between the mechanical absolute position and that saved in the encoder will be calculated automatically and saved in the EEPROM of the servo drive.

Absolute system setting

Set 2000.08h (C00.07) to select the absolute position mode.

Related parameters:

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
08h	C00.07	Absolute mode	0: Incremental position mode 1: Absolute position linear mode 2: Absolute position linear infinite mode 3: Absolute position single-turn mode 4: Absolute position rotation mode 5: Absolute mechanical single-turn mode (operating direction selectable)	0 to 5	0	-	U16	At stop	Upon re-power-on

Encoder feedback data

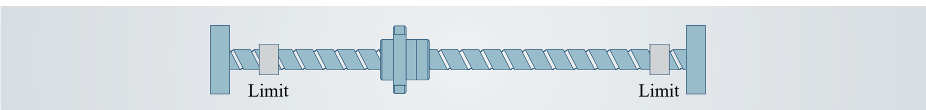
The feedback data of an absolute encoder includes the number of revolutions and the motor position within one revolution. In incremental position mode, the number of revolutions will not be counted.

Related parameters:

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
1Dh	U40.1C	Encoder single-turn data	-	-2^{31} to $(2^{31}-1)$	0	P	I32	-	Immediately
1Fh	U40.1E	Encoder multi-turn position data	-	0 to 65535	0	Rev	U16	-	Immediately
21h	U40.20	Encoder multi-turn data (low 32 bits)	-	-2^{31} to $(2^{31}-1)$	0	P	I32	-	Immediately
23h	U40.22	Encoder multi-turn data (high 32 bits)	-	-2^{31} to $(2^{31}-1)$	0	P	I32	-	Immediately

5.2 Absolute Position Linear Mode

This mode applies to scenarios where the axis travel range is fixed without multi-turn data overflow.



The value range of 2000.08h=1 (C00.07) (encoder multi-turn data) in absolute position linear infinite mode is 0 to 65535. If the number of forward or reverse revolutions is greater than 65535, ErA01 (encoder multi-turn counting overflow) will occur. In this case, set 2031.11h (F31.10) to 4 to reset the multi-turn data, and then perform homing again. In special occasions, you can set 2000.08h (C00.07) to 2 in absolute position linear infinite mode to prevent the encoder overflow alarm.

Related parameters:

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
17h	U40.16	Absolute position feedback (reference unit)	-	-2^{31} to $(2^{31}-1)$	0	Unit in application	I32	-	Immediately
25h	U40.24	Absolute position feedback (encoder unit) (low 32 bits)	-	-2^{31} to $(2^{31}-1)$	0	P	I32	-	Immediately
27h	U40.26	Absolute position feedback (encoder unit) (high 32 bits)	-	-2^{31} to $(2^{31}-1)$	0	P	I32	-	Immediately

Index	Sub-index	Name	Access	PDO Mapping	Data Type	Unit	Value Range	Default	Modification Mode	Effective Time
6063h	0	Position feedback	RO	TPDO	I32	Encoder unit	-	-	-	-
6064h	0	Position feedback	RO	TPDO	I32	Reference unit	-	-	-	-

5.3 Absolute Position Rotation Mode

This mode applies in cases where the load travel range is unlimited and the number of unidirectional revolutions is less than 32767, as shown in the following figure.

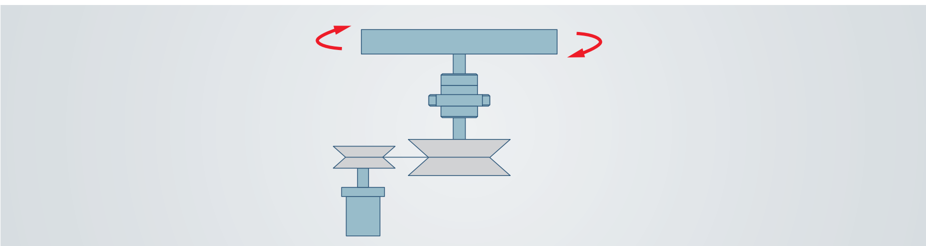
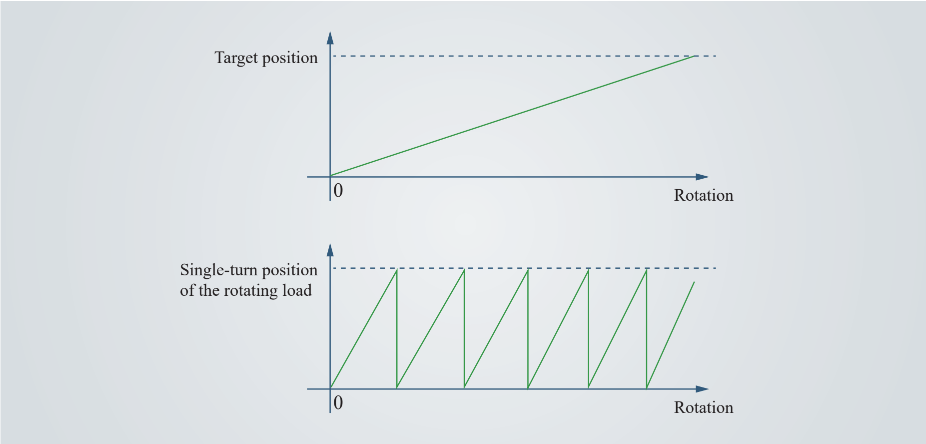
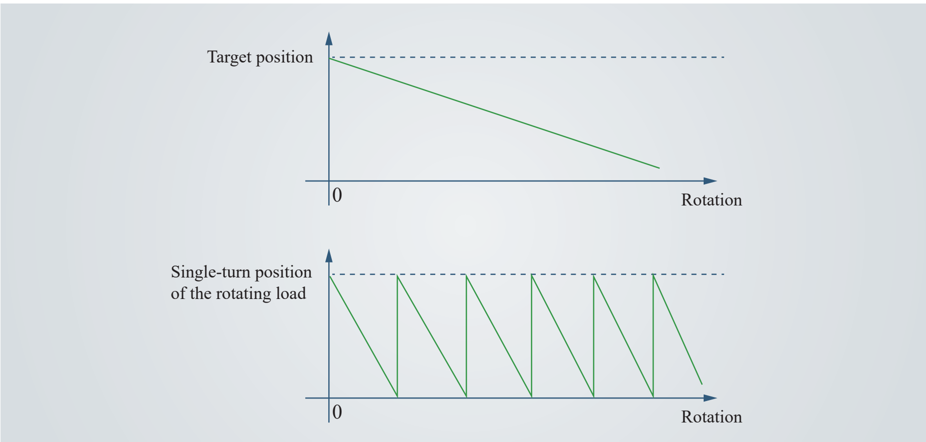


Figure 5-1 Rotating load

The single-turn position range of the rotating load is 0 to (R_M - 1) (R_M: Encoder pulses per load revolution). When the gear ratio is 1:1, the variation law of the target position and the single-turn position of the rotating load during forward operation is as follows.



The variation law of the target position and the single-turn position of the rotating load during reverse operation is as follows.



When the motor works in the absolute position rotation mode while the servo drive works in HM mode, the home offset range is 0 to (R_M - 1).

NOTICE

- The servo drive calculates the upper limit of the mechanical absolute position using 2010.1Bh (C10.1A) and 2010.1Dh (C10.1C) first. If 2010.1Bh (C10.1A) and 2010.1Dh (C10.1C) are both set to 0, the servo drive employs the electronic gear ratio 2010.19h (C10.18) and 2010.1Ah (C10.19) for calculation.

Related parameters:

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
19h	C10.18	Numerator of electronic gear ratio in rotation mode	-	1 to 65535	1	-	U16	At stop	Immediately
1Ah	C10.19	Denominator of electronic gear ratio in rotation mode	-	1 to 65535	1	-	U16	At stop	Immediately
1Bh	C10.1A	Upper limit of mechanical absolute position in rotation mode (low 32 bits)	-	0 to $(2^{32}-1)$	0	P	U32	At stop	Immediately
1Dh	C10.1C	Upper limit of mechanical absolute position in rotation mode (high 32 bits)	-	0 to $(2^{32}-1)$	0	P	U32	At stop	Immediately
29h	U40.28	Position feedback in rotation mode (reference unit) (low 32 bits)	-	-2^{31} to $(2^{31}-1)$	0	Unit in application	I32	-	Immediately
2Bh	U40.2A	Position feedback in rotation mode (encoder unit) (low 32 bits)	-	-2^{31} to $(2^{31}-1)$	0	P	I32	-	Immediately
2Dh	U40.2C	Position feedback in rotation mode (encoder unit) (high 32 bits)	-	-2^{31} to $(2^{31}-1)$	0	P	I32	-	Immediately

Index	Sub-index	Name	Access	PDO Mapping	Data Type	Unit	Value Range	Default	Modification Mode	Effective Time
6063h	0	Position feedback	RO	TPDO	I32	Encoder unit	-	-	-	-
6064h	0	Position feedback	RO	TPDO	I32	Reference unit	-	-	-	-

5.4 Absolute Position Single-turn Mode

In this mode, the absolute encoder needs no battery and does not record the number of motor revolutions. The input range for the target position of the EtherCAT host controller is -2^{31} to (2^{31} - 1), with no need for modulus operation on the encoder resolution. The initial position for feedback upon each power-on is the single-turn absolute position. For a 17-bit encoder, the value range of 6064 is 0 to (2^{17} - 1) for each power-on. If the value of C00.07 remains 3 (absolute position single-turn mode), after homing (homing mode of the servo drive, that is, 6060 = 6), the servo drive saves the absolute position of the encoder after homing and the value of 607C (home offset). Upon power-up again, the value of 6064 (current position feedback) will be calculated based on the coordinate system after the last homing operation, eliminating the need for re-homing.

If 60E6h (absolute position single-turn mode) is inactive, after successful homing, the value of 6064 (position feedback) is equal to that of 607C (home offset).

Related parameters:

Index	Sub-index	Name	Access	PDO Mapping	Data Type	Unit	Value Range	Default	Modification Mode	Effective Time
6063h	0	Position feedback	RO	TPDO	I32	Encoder unit	-	-	-	-
6064h	0	Position feedback	RO	TPDO	I32	Reference unit	-	-	-	-

5.5 Precautions for Use of the Absolute system Battery Box

Er208 (encoder battery fault) will be reported when the battery is connected for the first time. In this case, set 2031.11h (F31.10) to reset the encoder fault, power on again, and then perform the absolute position device operation.

When the battery voltage detected is lower than 3.0 V, ALF90 (encoder battery warning) will be reported. In this case, replace the battery based on the following steps:

① Power on the servo drive and make it stay in the non-operational state.
② Replace the battery.
③ After ALF90 (encoder battery warning) is automatically cleared, if no other warning/fault occurs, you can continue operating the servo drive.

If you replace the battery after power-off, Er208 (encoder battery fault) will be reported, with the multi-turn data changed abruptly. In this case, set 2031.11h (F31.10) to 4 to reset the fault, and then perform homing again.

Ensure the motor speed does not exceed 6000 RPM after the servo drive is powered off. This is to enable the encoder to save the position data accurately.

Keep the battery in environments within the required ambient temperature and ensure the battery is in reliable contact with sufficient power reserved. Failure to comply may result in encoder data loss.

NOTICE

- The absolute position saved by the encoder changes abruptly after multi-turn data reset. In this case, perform mechanical homing.

Related parameters:

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
11h	F31.10	Encoder data reset	-	0 to 31	0	-	U16	At stop	Immediately

Chapter 6 System Commissioning

6.1 Commissioning Tool

The JSS715N series servo drive can be commissioned by the operating panel which consists of an LED display area and five buttons.

6.1.1 Buttons

Button		Description
M	MODE	Press: ● Switch/return to menus of different levels Press and hold: ● Switch the group number quickly in level-2 menus
▲	UP	Press: ● Switch the state display quickly in level-1 menus ● Increase the value
▼	DOWN	Press: ● Switch the state display quickly in level-1 menus ● Decrease the value
◀◀	SHIFT	Press: ● Move the cursor to the left Press and hold: ● Enter the JOG mode quickly in level-1 menus ● Page up or down when the content is displayed on multiple pages
S	SET	Press: ● Switch to the lower-level menu ● Execute commands such as storing parameter setpoints

6.1.2 Display

When the servo drive is running, the servo drive status, parameters, faults, and monitored values are displayed in the LED display area.

Status display: Display current servo drive status, such as servo ready or servo running.

Parameter display: Display parameters and their setpoints.

Fault display: Display faults and alarms that occurred on the servo drive.

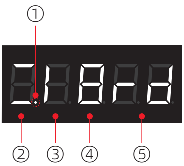
Monitored value display: Display values of running parameters of the servo drive.

NOTICE

- After power-on, "Init" is displayed in the LED display area and then the system enters the level-1 menu status display mode.
- In the status display mode, select the parameter to be monitored. When the motor rotates, the display area automatically switches to monitored value display. After the motor stops, the display area automatically returns to status display.
- In the parameter display mode, after you select the parameter to be monitored, the system switches to monitored value display.
- Once a fault occurs, the LED display area switches to fault display automatically, with all the LEDs blinking. Press S to stop the LEDs from blinking, and then press M to switch to parameter display.

Display menu

- **Level-1 menu**: Status display



① Display of the model with brake
② Status of the network port
③ Communication status
④ Running mode
⑤ Servo status

Press ▲ and ▼ to switch among different display modes.

Press M to enter a level-2 menu.

- **Level-2 menu**: Display the parameter group number in hexadecimal

Parameter group number

C: Function parameter
R: System parameter
F: Operation parameter
U: Monitoring parameter

Press and hold M to switch the group number.

Press S to enter a level-3 menu.

Press M to return to the level-1 menu.

- **Level-3 menu**: Offset within the parameter group in hexadecimal

Offset within the parameter group

Press **S** to enter a level-4 menu.

Press **M** to return to a level-2 menu.

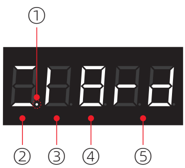
- **Level-4 menu**: Parameter setpoints in decimal

Press ▲ ▼ to increase or decrease the value.

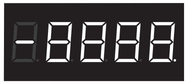
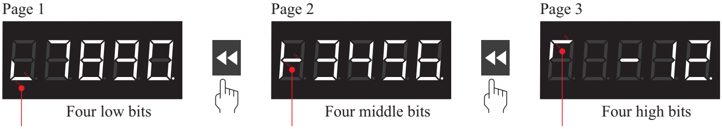
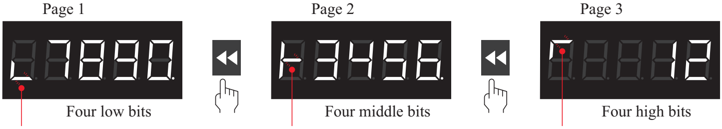
Press **S** to confirm the setting. Then, the system displays .

Press **M** to return to a level-3 menu.

Status display

LED Display	Meaning	Description
	① Display of the model with brake	On: Model with brake Off: Model without brake
	② Status of the network port	No display: No network port is connected. " ‾ " displayed: The OUT network port is connected. " _ " displayed: The IN network port is connected.
	③ Communication status	0: No meaning 1: Initializing 2: Pre-operation 4: Operating safely 8: Running
	④ Running mode	1: Profile position mode 3: Profile velocity mode 4: Profile torque mode 6: Homing mode 8: Cyclic synchronous position mode 9: Cyclic synchronous velocity mode A: Cyclic synchronous torque mode
	⑤ Servo status	nr: Servo not ready rd: Servo ready rn: Servo running 

Parameter display

Category	LED Display
Signed number with 4 digits and below: Display on one page (5 digits) When the rightmost "●" is turned on, the high bit "__" indicate a negative sign.	
Unsigned number with 5 digits and below: Display on one page (5 digits)	
Signed number with more than 4 digits: Such numbers are displayed from low to high bits in multiple pages (5 digits per page). For a negative value, when the rightmost "●" is turned on, the high bit "__" indicate a negative sign. Such numbers are displayed in the format of "number of current page + values on current page". To switch to the next page, press and hold for more than 2 seconds. 	
Unsigned number with more than 5 digits: Such numbers are displayed from low to high bits in multiple pages (5 digits per page). Such numbers are displayed in the format of "number of current page + values on current page". To switch to the next page, press and hold for more than 2 seconds. 	

Fault display

- The panel displays the current or history faults and alarm codes. For analysis and troubleshooting of faults and alarms, see the section "Troubleshooting".
- When a single fault or an alarm occurs, the panel displays the fault or alarm code. When multiple faults or alarms occur, the panel displays the fault code of the highest level.

6.2 Commissioning Process

Start

↓

Checklist before running

- Mechanical and wiring inspection and safety inspection

↓

Power on the servo drive

- Connect the power supply of the main circuit and control circuit

↓

Jogging

- Jog through the panel

↓

Set parameters

- Set common parameters
- Set relevant parameters in each control mode

↓

Servo running

- Run the servo drive at a low speed for the first time
- Set relevant parameters to achieve the required effect
- Commission the servo drive

↓

Stop the servo drive

- Turn off the S-ON signal
- Stop the servo drive upon a fault
- Stop the servo drive if the limit switch is reached
- Perform emergency stop

↓

Finish

6.3 Commissioning Procedure

CAUTION

- Confirm that the site is equipped with conditions suitable for the safe operation of the servo drive (no interference, no foreign objects, and no dangerous goods).
- Confirm that the power input terminals are connected correctly and firmly.
- Confirm that the wiring (U/V/W) between the servo drive and the motor is correct and firm.
- Confirm that the control signal cables of the servo drive are connected correctly. External signal cables for brake and overtravel protection are connected properly.
- Confirm that the servo motor and its axes are installed and mechanically connected reliably.
- Confirm that the servo drive and motor have been grounded reliably.

6.3.1 Power on the servo drive

NOTICE

- Single-phase input: The power terminals are L1 and L2.
- Three-phase input: The power terminals are R, S, and T for the main circuit or L1C and L2C for the control circuit.

After the input power supply is connected:

- The LED panel displays rd, which means that the servo drive is ready to run and is waiting for the S-ON signal from the host controller.
- If the LED panel keeps displaying nr or other faults, troubleshoot the problem according to the section "Troubleshooting".

6.3.2 Jogging

Use the jogging function for trial run of the servo motor and servo drive to check whether the servo motor rotates properly without abnormal vibration or noise generated during rotation.

During the jog, use F30.03 to set the acceleration/deceleration time constant for the velocity/position reference.

CAUTION

- To use the jogging function, deactivate the S-ON signal. Otherwise, this function cannot be used.

Procedure for setting the jogging function:

Start

↓ Power on the servo drive
Press and hold ◀◀ in the level-1 menu

Set the parameter F30-00 on the panel

↓ Press S to confirm the setting

Set the jog speed

↓ Press ▲ ▼ to increase or decrease the value

Confirm the motor speed

↓ Press S to confirm the setting

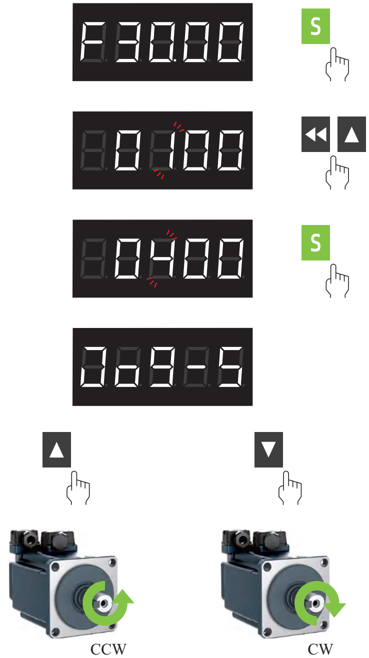
JOG-S is displayed

↓ Press ▲ ▼

Enable forward/reverse motor rotation

↓ Press M

Finish



NOTICE

- Press ▲ ▼ to increase or decrease the motor speed for the jog running. If the system exits jog running, the motor speed restores to the initial value.
- Press ▲ ▼ to make the servo motor rotate in the forward or reverse direction. After the button is released, the servo motor stops running immediately.

6.3.3 Set parameters

Select the rotation direction

Set C00.01 (2000.02h, rotation direction) to change the direction of motor rotation without modifying the input command polarity.

Set the brake

The brake is used to prevent the servo motor shaft from moving and lock the motor position when the servo drive is not running. This is to keep the mechanical load from moving due to gravity or external force.

NOTICE

- The built-in brake is a special non-energized mechanism designed for position-lock in the stop state. Do not use the built-in brake for any other purposes, such as braking.
- The brake coil has no polarity.
- Switch off the S-ON signal after the servo motor stops.
- When the motor with a built-in brake runs, the brake may generate a click sound, which does not affect its function.
- When brake coils are energized (the brake is released), flux leakage may occur on the shaft end. Pay special attention when using magnetic sensors near the motor.

For the servo motor with a brake, assign function 3 (brake output) to a DO terminal (DO3 by default) of the servo drive and set valid logic for the DO terminal.

The operating time sequences of the brake are different between normal state and fault state of the servo drive.

The brake time sequence in the normal state changes with the motor states: static and rotating.

- Static: The motor speed is lower than 30 rpm.
- Rotating: The motor speed is equal to or greater than 30 rpm.

Brake time sequence in the motor static state:

- If the servo enabling (S-ON) signal changes from ON to OFF, and the present motor speed is lower than 30 rpm, the servo drive acts according to the brake time sequence in the motor static state.

⚠ CAUTION

- After the brake (BK) output signal changes from OFF to ON, do not input a position/speed/torque reference within the time defined by C05.13. Otherwise, reference loss or running error may occur.

NOTICE

- When the motor is used to drive a vertical axis, the mechanical motion part may move slightly due to the gravity or external force. In the motor static state, if the S-ON signal becomes OFF, the brake (BK) output signal becomes OFF immediately. However, within the time defined by C05.10, the motor is still energized to prevent the mechanical motion part from moving due to the gravity or external force.

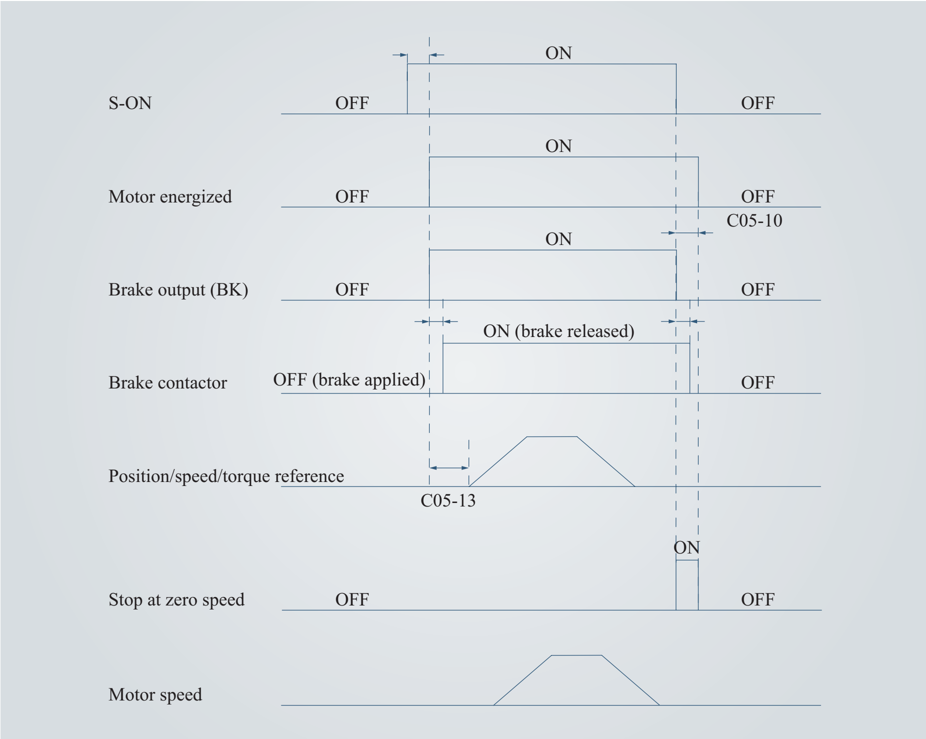


Figure 6-1 Brake time sequence in the motor static state

<u>Brake time sequence in the motor rotating state:</u>

- If the S-ON signal changes from ON to OFF, and the present motor speed is equal to or greater than 30 rpm, the servo drive acts according to the brake time sequence in the motor rotating state.

CAUTION

- If the S-ON signal changes from OFF to ON, do not input a position/speed/torque reference within the time defined by C05.13. Otherwise, reference loss or running error may occur.

NOTICE

- If the S-ON signal becomes OFF during motor rotating, the servo motor enters the "Stop according to ramp in 6085h" state, but the brake (BK) output signal becomes OFF only after one of the following conditions is met:
  - The motor has decelerated to the value defined by C05.11, but the time defined by C05.12 is not reached.
  - The time defined by C05.12 has been reached, but the motor speed is still higher than the value defined by C05.11.
- After the brake (BK) output signal changes from ON to OFF, the motor remains energized within the time defined in C05.10 to prevent the mechanical motion part from moving due to the gravity or external force.

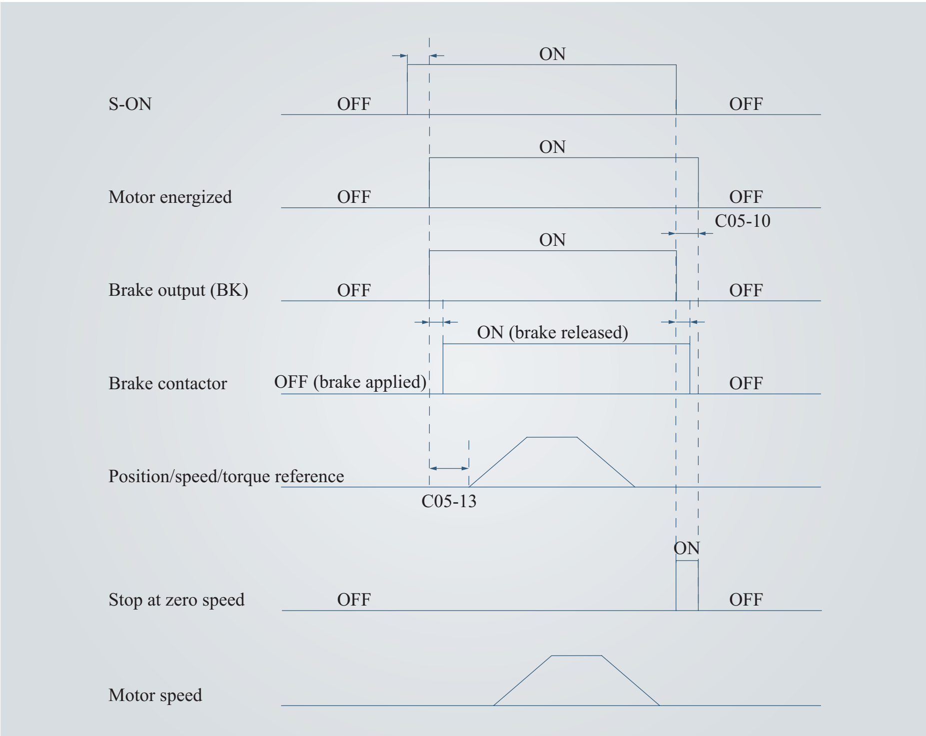


Figure 6-2 Brake time sequence in the motor rotating state

Set the brake

When the torque and speed directions of the motor are opposite, the energy is transferred from the motor to the drive, increasing the bus voltage. When the voltage is increased to the braking point, the energy can be consumed only by the braking resistor. In this case, the braking energy must be consumed according to the braking requirements. Otherwise, the servo drive may be damaged.

⚠ CAUTION

- Set the power (C00.11) and resistance (C00.12) for the external braking resistor properly. Otherwise, the braking function may be affected.
- When an external braking resistor is used, check whether its resistance is above the minimum allowable resistance.
- In a natural environment, the temperature of the resistor will rise above 120°C (under continuous braking) when the average power of the braking resistor is below its rated power. For safety consideration, use forced cooling to cool down the braking resistor or use a braking resistor with a thermal switch. Consult the manufacturer about load characteristics of the braking resistor.

Set the heat dissipation coefficient (C00.13) based on the heat dissipation condition of the external braking resistor.

6.3.4 Servo running

Switch on the S-ON signal. When the servo drive is ready to run, the LED panel displays .

If there is no command input at this moment, the servo motor does not rotate and stays locked.
After a command is input, the servo motor starts rotating.

NOTICE

Operation of the servo drive

- During initial operation, set a proper command to make the motor run at low speed and check whether the motor rotates properly.
- Check whether the motor rotates in the correct direction. If the direction of rotation is opposite to the expected direction, check the reference signal and reference direction signal.
- If the motor rotates in the correct direction, you can view the actual motor speed in U40.01 (2040.02h) and the average load factor in U40.07 (2040.08h) through the drive panel.
- After checking preceding conditions, adjust related parameters to make the motor operate as desired.
- Adjust the servo drive parameters according to the section "Gain Tuning".

6.3.5 Stop the servo drive

Five type of stop modes are available for the servo drive: coast to stop, stop at zero speed, ramp to stop, stop at emergency-stop torque, and dynamic braking (DB) stop, along with three kinds of stop status: de-energized, position lock, and DB. After brake output is enabled, the servo drive selects a stop mode.

Table 6-1 Comparison of the stop modes

Stop Mode	Description	Feature
Coast to stop	The servo motor is de-energized and coasts to 0 RPM. The deceleration time is affected by the mechanical inertia and mechanical friction.	This mode features smooth and slow deceleration with small mechanical shock.
Stop at zero speed	The servo motor decelerates to 0 RPM immediately and stops.	This mode features quick deceleration with obvious mechanical shock.
Ramp to stop	The motor decelerates to 0 RPM smoothly upon position/speed/torque reference input.	This mode features smooth and controllable deceleration with small mechanical shock.
Stop at emergency-stop torque	The servo drive outputs a reverse braking torque to stop the motor.	This mode features quick deceleration with obvious mechanical shock.
Dynamic braking	The servo motor is in the dynamic braking status.	This mode features quick deceleration with obvious mechanical shock.

Table 6-2 Comparison of the stop statuses

Stop Status	Description
De-energized	The motor is de-energized and the motor shaft can rotate freely after the motor stops rotating.
Position lock	The motor shaft is locked and cannot rotate freely after the motor stops rotating.
Dynamic braking	The motor is de-energized and the motor shaft cannot rotate freely after the motor stops rotating.

Table 6-3 Comparison of the stop modes

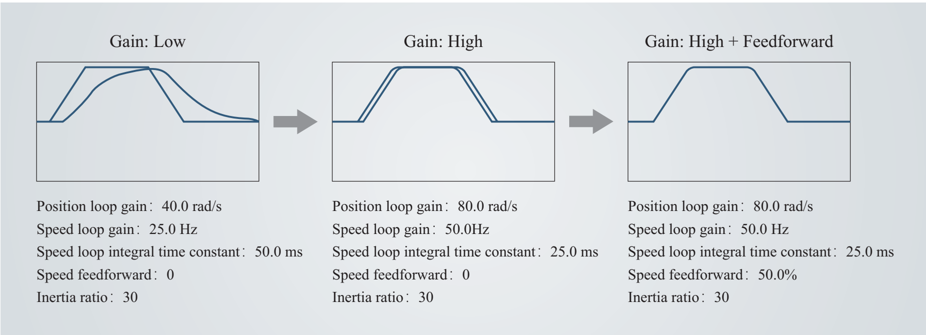
Stop Mode	Stop Mode (Model Without Brake)	Stop Mode (Model with Brake)	Description
Stop at S-ON OFF	605Ch	Ramp to quick stop as defined by 6085h, keeping dynamic braking status	Deactivate the S-ON signal through communication to make the servo drive stop according to the stop mode at S-ON OFF.

Stop Mode	Stop Mode (Model Without Brake)	Stop Mode (Model with Brake)	Description
Stop at fault	No.1 fault: C05.03	No. 1 fault: Dynamic braking stop, keeping dynamic braking status	The stop mode varies with the fault type. For fault classification, see sections related to faults.
	No.2 fault: 605Eh	Ramp to quick stop as defined by 6085h, keeping dynamic braking status	-
Stop at overtravel	C05.02	Ramp to quick stop as defined by 6085h, keeping position lock status	When a mechanical motion part moves beyond the range of safe movement, the limit switch outputs a level change to force the servo motor to stop.
Emergency stop	605Ah	605Ah < 4: Ramp to quick stop as defined by 6085h, keeping dynamic braking status	Use the DI function 4 for emergency stop (Note: The stop mode is specified by 605Ah. The final stop state is S-ON OFF.)
Quick stop	605Ah	605Ah < 4: Ramp to quick stop as defined by 6085h, keeping dynamic braking status	Quick stop applies when bit 2 (Quick stop) of the control word 6040h is set to 0 during operation of the servo drive.
Halt	605Dh		The halt function applies when bit 8 of the control word 6040h is set to 1 (Halt) during operation of the servo drive. The halt mode is defined by object dictionary 605Dh.

Chapter 7 Gain Tuning

7.1 Overview

The servo drive must drive the motor as quick and accurate as possible to follow the commands from the host controller or internal setting. A proper gain tuning is required to make the motor actions more closely follow the commands and to maximize the performance of the servo system.



CAUTION

- Before gain tuning, perform a trial run through jogging to ensure the motor operates properly.

7.2 Inertia Auto-tuning

The load inertia ratio is the ratio of the total moment of inertia of motor load to the moment of inertia of the motor. The load inertia ratio is a critical parameter of the servo system. A correct load inertia ratio facilitates commissioning.

You can set the C00.06 (load inertia ratio) manually based on the weight and composition of different mechanical parts, but the operation is very tedious. It is increasingly difficult to get the correct solution for the complex mechanical composition. However, it can also be automatically auto-tuned by F30.10 (inertia auto-tuning function) of the servo drive.

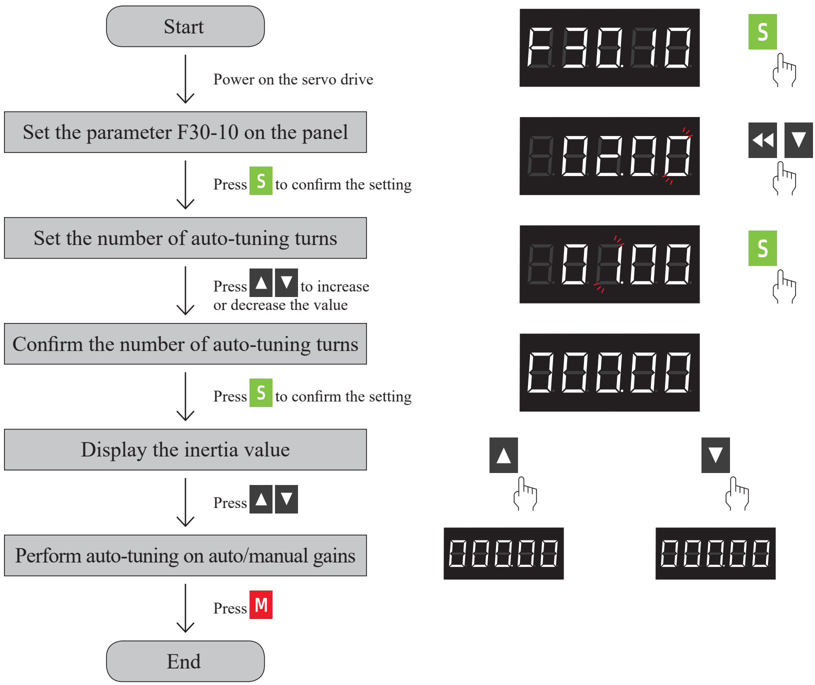
During auto-tuning, the drive will drive the servo motor to run in the forward or reverse direction multiple times, so as to obtain the load inertia ratio.

NOTICE

Inertia auto-tuning may fail in the following conditions:

- The load mechanical system is poor, with low stiffness and vibration during localization.
- The motor operation range is too small, less than 0.5 turns.
- The load torque changes dramatically.
- The motor acceleration rate is less than 3000 rpm/s.
- The actual maximum speed of the motor is less than 150 rpm.

Inertia auto-tuning process:



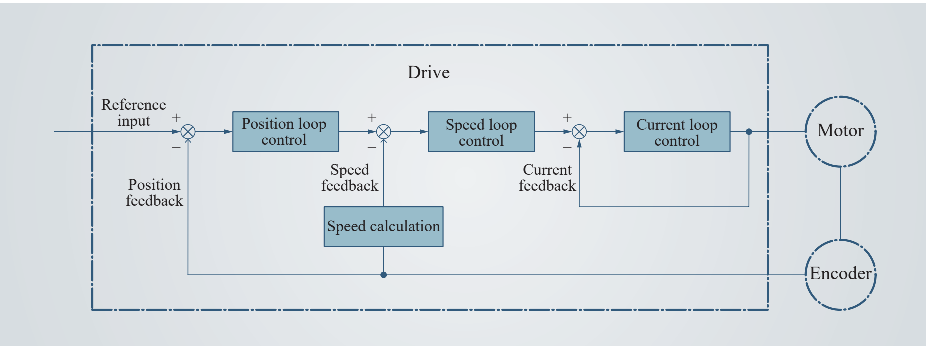
Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C00.06	Load inertia ratio	0 to 12000	100	%	-	During operation	Immediately

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C07.00	Offline inertia auto-tuning mode setting	0 to 785	769	-	Related modes during the auto-tuning are set.	At stop	Immediately
C07.01	Offline inertia auto-tuning speed reference	50 to 8000	500	rpm	The speed reference for auto-tuning is set.	At stop	Immediately
C07.02	Acceleration/ Deceleration time for offline inertia auto-tuning	0 to 65535	100	ms	The acceleration/ deceleration time for auto-tuning is set.	At stop	Immediately
C07.03	Offline inertia auto-tuning target torque	1 to 1500	150	0.1%	A larger target torque leads to shorter auto-tuning acceleration/ deceleration time.	At stop	Immediately
C07.04	Offline inertia auto-tuning revolutions	10 to 65535	200	0.01r	The number of auto-tuning revolutions should be within the mechanical motion range.	At stop	Immediately

7.3 Basic Gain Tuning

The servo system consists of three feedback loops, which are the position loop, speed loop, and current loop. The basic control diagram is shown in the following figure.



⚠ CAUTION

- The responsiveness of the inner loop must be higher than that of the outer loop. Otherwise, the responsiveness may be poor or vibrations may occur.

The default current loop gain of the servo drive ensures sufficient responsiveness, removing the need for further tuning. You only need to adjust the position loop gain, speed loop gain, and other auxiliary gains. Therefore, to ensure system stability during gain tuning in position control mode, the position loop gain must be increased together with the speed loop gain, and the responsiveness of the former must be lower than the latter.

The drive provides three types of gain auto-tuning modes:

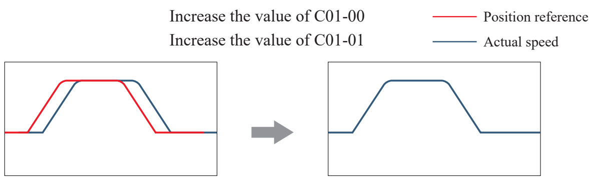
0: Manual tuning

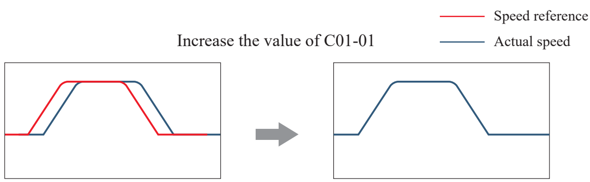
1: Standard tuning by stiffness level

2: Positioning mode

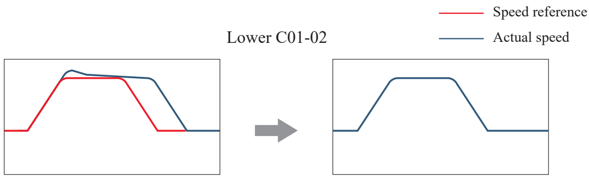
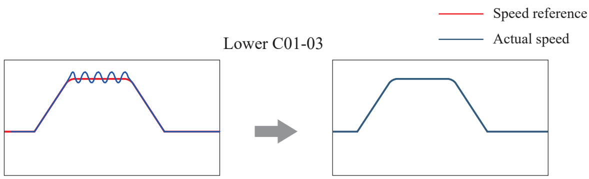
When the automatic gain tuning does not achieve the expected effect, you can manually fine-tune the gain. The effect can be optimized by more detailed tuning.

The following table lists the basic gain parameter tuning methods.

<table>
<tr><th>No.</th><th>Parameter</th><th>Name</th><th>Description</th></tr>
<tr><td>1</td><td>C01.00</td><td>Position loop gain</td><td>Function: Determines the responsiveness of the position loop of the servo unit. Increasing the position loop gain improves the responsiveness and shortens the positioning time. In general, the position loop gain cannot exceed the range of the certain vibration count of the mechanical system.


Tuning method: To ensure system stability, the gain frequency of the speed loop must be 3 to 5 times that of the position loop.</td></tr>
<tr><td>2</td><td>C01.01</td><td>Speed loop gain</td><td>Function: Determines the speed loop responsiveness. Too low responsiveness of the speed loop may be a delay factor of the outer position loop, so overshoot or a variable speed reference occurs. Therefore, within the non-vibration range of the mechanical system, increasing the setpoint stabilizes the speed and improves the responsiveness of the servo system.


Tuning method: In the vibration range without noise, increasing the parameter value will shorten the positioning time and lead to higher speed stability and following performance.</td></tr>
</table>

No.	Parameter	Name	Description
3	C01.02	Speed loop integral time constant	Function: To respond to even minor inputs, the speed loop contains an integral element. Since this integral element acts as a delay element for the servo system, when the time parameter is set too large, it will cause overshoot, or extend the positioning time, making the response worse.  Tuning method: Reducing the setpoint can enhance the integral effect and shorten the positioning time, but setting the value too low can easily cause mechanical vibration. If the value is set too high, the speed loop deviation will never return to zero.
4	C01.03	Torque reference filter cutoff frequency	Function: This parameter applies a low-pass filter to the torque reference, where the setpoint is the cutoff frequency of the low-pass filter. The smaller the setpoint, the better the filtering effect. Setting the value too low can cause excessive delay in the speed loop, thereby reducing the speed loop bandwidth. When mechanical vibrations occur, adjusting the following torque reference filter time parameters may potentially eliminate the vibrations.  Tuning method: Ensure that the cutoff frequency of the torque reference low-pass filter is more than four times the highest follow-up frequency of the speed loop.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C00.04	Auto-tuning mode	0 to 2	1	-	0: Manual mode 1: Standard mode 2: Positioning mode	During operation	Immediately

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C00.05	Stiffness level	1 to 31	12	-	Increasing the stiffness level improves the responsiveness, but a too high level can cause oscillation.	During operation	Immediately
C01.00	1st position loop gain	0 to 20000	400	0.1rad/s	Increasing the setpoint improves the responsiveness and shortens the positioning time.	During operation	Immediately
C01.01	1st speed loop gain	1 to 20000	250	0.1Hz	Increasing the setpoint improves the speed follow-up responsiveness of the servo system.	During operation	Immediately
C01.02	1st speed loop integral time parameter	1 to 51200	3184	0.01ms	Reducing the setpoint can enhance the integral effect and shorten the positioning time.	During operation	Immediately
C01.03	1st torque reference filter cutoff frequency	5 to 16000	200	Hz	Reducing the setpoint improves the filtering effect but increases the delay.	During operation	Immediately

7.4 Pseudo derivative feedback and feedforward control

In position and speed modes, the pseudo derivative feedback and feedforward control can be used for the speed loop. When C01.1B is 100%, the speed loop uses proportional-integral (PI) control; when C01.1B is 0%, the speed loop switches to pure integral-proportional (IP) control.

In PI control mode, the speed response is faster, but the overshoot increases. In IP control mode, the speed response decreases correspondingly, but the follow-up is better and the overshoot decreases.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C01.1B	PDFF control coefficient	0 to 1000	1000	0.1%	Decreasing the value can reduce the speed overshoot.	During operation	Immediately

7.5 Gain Switchover

In position and speed modes, gain switchover can improve the system responsiveness and reference follow-up and reduce the positioning time.

High gain parameters correspond to the second group of loop gains, while low gain parameters correspond to the first group of loop gains. When the switchover conditions are met, the loop gain will switch between the first and second groups of gains.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C01.38	Gain switchover mode	0 to 8	0	-	Set the gain switchover mode.	During operation	Immediately
C01.39	Gain switchover time	10 to 10000	50	0.1ms	Set the gain switchover time.	During operation	Immediately
C01.3A	Gain switchover threshold	0 to 65535	10	-	Set the gain switchover threshold.	During operation	Immediately
C01.3B	Gain switchover loop width	0 to 65535	10	-	Set the gain switchover loop width.	During operation	Immediately
C01.00	1st position loop gain	0 to 20000	400	0.1rad/s	Increasing the setpoint improves the responsiveness and shortens the positioning time.	During operation	Immediately
C01.01	1st speed loop gain	1 to 20000	250	0.1Hz	Increasing the setpoint improves the speed follow-up responsiveness of the servo system.	During operation	Immediately
C01.02	1st speed loop integral time parameter	1 to 51200	3184	0.01ms	Reducing the setpoint can enhance the integral effect and shorten the positioning time.	During operation	Immediately
C01.03	1st torque reference filter cutoff frequency	5 to 16000	200	Hz	Reducing the setpoint improves the filtering effect but increases the delay.	During operation	Immediately

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C01.08	2nd position loop gain	0 to 20000	560	0.1rad/s	Increasing the setpoint improves the responsiveness and shortens the positioning time.	During operation	Immediately
C01.09	2nd speed loop gain	1 to 20000	350	0.1Hz	Increasing the setpoint improves the speed follow-up responsiveness of the servo system.	During operation	Immediately
C01.0A	2nd speed loop integral time parameter	1 to 51200	2274	0.01ms	Reducing the setpoint can enhance the integral effect and shorten the positioning time.	During operation	Immediately
C01.0B	2nd torque reference filter cutoff frequency	5 to 16000	280	Hz	Reducing the setpoint improves the filtering effect but increases the delay.	During operation	Immediately

Mode description:

C01.38	Switchover Mode	Switchover Time	Switchover Threshold	Switchover Loop Width	Threshold and Loop Width Unit
0	Fixed to the 1st gain set	Inactive	Inactive	Inactive	-
1	DI switchover	Active	Active	Active	-
2	DI P-PI switchover	Active	Active	Active	-
3	Torque reference	Active	Active	Active	0.1%
4	Speed reference	Active	Active	Active	rpm
5	Speed feedback	Active	Active	Active	rpm
6	Speed reference change rate	Active	Active	Active	rpm/ms
7	Position deviation	Active	Active	Active	p
8	Position reference	Active	Active	Active	p

7.6 Speed Feedforward

Speed feedforward can be applied to position control mode to improve the speed reference responsiveness, shorten the positioning time, and reduce the position deviation at fixed speed.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C01.13	Speed feedforward source	0 to 5	0	-	0: No feedforward 1: Internal reference 2: Model tracking 5: Communication	At stop	Immediately
C01.14	Speed feedforward percentage	0 to 2000	0	0.1%	Increasing the speed feedforward improves the responsiveness.	During operation	Immediately
C01.15	Speed feedforward filter cutoff frequency	5 to 16000	318	Hz	Decreasing the cutoff frequency improves the feedforward smoothness but increases the response delay.	During operation	Immediately

7.7 Torque Feedforward

Torque feedforward can be applied only to the position and speed modes.

In position control mode, torque feedforward can improve torque reference responsiveness and reduce the speed deviation during operation at a constant speed. In speed control mode, torque feedforward can improve torque reference responsiveness and reduce the speed deviation during acceleration and deceleration.

A too high setpoint of torque feedforward may cause overshoot.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C01.16	Torque feedforward source	0 to 5	0	-	0: No feedforward 1: Internal reference 2: Model tracking 5: Communication	At stop	Immediately
C01.17	Torque feedforward percentage	0 to 2000	0	0.1%	Increasing the torque feedforward improves the responsiveness.	During operation	Immediately

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C01.18	Torque feedforward filter cutoff frequency	5 to 16000	318	Hz	Decreasing the cutoff frequency improves the feedforward smoothness but increases the response delay.	During operation	Immediately

7.8 Position Reference Filter

The position reference filter filters the position references (encoder unit) divided or multiplied by the electronic gear ratio to smoothen motor operation and reduce the shock on the machine.

The position reference filter includes the low-pass and overlapping average filters.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C01.20	Position reference overlapping average filter time constant A	0 to 1280	0	0.1ms	Increasing the setpoint improves the reference smoothness but increases the delay.	At stop	Immediately
C01.21	Position reference overlapping average filter time constant B	0 to 1280	0	0.1ms	Increasing the setpoint improves the reference smoothness but increases the delay.	At stop	Immediately
C01.22	Position reference low-pass filter time constant A	0 to 65535	0	0.1ms	Increasing the setpoint improves the reference smoothness but increases the delay.	At stop	Immediately
C01.23	Position reference low-pass filter time constant B	0 to 65535	0	0.1ms	Increasing the setpoint improves the reference smoothness but increases the delay.	At stop	Immediately

7.9 Model Tracking Control

Model tracking control can improve the responsiveness and shorten the positioning time.

This function is only available in the position control mode.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C02.00	Model tracking control	0 to 1	0	-	0: Disabled 1: Enabled	At stop	Immediately
C02.01	Model tracking control gain	10 to 20000	500	0.1rad/s	Increasing the setpoint improves the position tracking.	During operation	Immediately
C02.02	Model tracking inertia correction coefficient	10 to 8000	1000	0.1%	When the inertia ratio setpoint is not accurate, this value can be used for correction.	During operation	Immediately

7.10 Speed Feedback Filter

When the encoder bit number is low or the noise contribution is large, the speed feedback fluctuation or burr calculated by the drive is large. You can set the speed feedback low-pass filter or overlapping average filter to reduce the speed feedback fluctuation. However, a too high setpoint will increase the delay in the servo system, which could potentially cause system oscillation.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C01.10	Speed feedback filter	0 to 4	0	-	0: Internal setting 1: Low-pass filter 2: Overlapping average filter 3: Speed observer 4: No filter	At stop	Immediately
C01.11	Cutoff frequency of speed feedback low-pass filter	10 to 16000	8000	Hz	Set the cutoff frequency of the low-pass filter.	During operation	Immediately
C01.12	Speed feedback overlapping average filter time constant	0 to 6	0	-	0: No filter 1: Two times filter 2: Four times filter 3: Eight times filter 4: Sixteen times filter 5: Thirty-second times filter 6: Sixty-fourth times filter	During operation	Immediately

7.11 Speed Observer

The speed observer can filter high-frequency signals for speed feedback, reduce the impact of encoder position feedback noise on the servo system, and improves the stiffness level of the servo system to some extent.

To enable the speed observer function, set C01.10 to 3.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C01.10	Speed feedback filter	0 to 4	0	-	0: Internal setting 1: Low-pass filter 2: Overlapping average filter 3: Speed observer 4: No filter	At stop	Immediately
C02.30	Speed observer gain	0 to 40000	0	0.1Hz	Increasing the setpoint improves the observation speed responsiveness, but a too large value can cause oscillation.	During operation	Immediately
C02.31	Speed observer inertia correction	10 to 8000	1000	0.1%	When the inertia ratio setpoint is not accurate, this value can be used for correction.	During operation	Immediately
C02.32	Speed observer speed feedback cutoff frequency	0 to 16000	0	Hz	Set the cutoff frequency of the speed observer low-pass filter.	During operation	Immediately

7.12 Disturbance Observer

The disturbance observer effectively observes the external disturbance. Disturbances within the frequency range can be observed and suppressed with different cutoff frequencies and compensation values.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C02.60	Disturbance observer gain	0 to 40000	0	0.1Hz	Increasing the value improves the responsiveness to disturbances, but a too large value can cause vibration more easily.	During operation	Immediately
C02.61	Disturbance observer inertia correction coefficient	1 to 10000	1000	0.1%	When the inertia ratio setpoint is not accurate, this value can be used for correction.	During operation	Immediately
C02.62	Disturbance observer low-pass cutoff frequency	0 to 16000	0	Hz	Set the cutoff frequency of the speed observer low-pass filter.	During operation	Immediately
C02.63	Disturbance observer compensation torque percentage	0 to 2000	0	0.1%	Set the percentage for observation compensation.	During operation	Immediately

7.13 Friction Compensation

The friction compensation function is used to compensate for changes in viscous friction and variations in fixed loads.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C02.68	Friction compensation switch and relevant setting	0 to 0xFF	0	-	Bit 0: 0: Disabled 1: Enabled Bit 4: 0: Speed threshold from speed reference 1: Speed threshold from speed feedback	During operation	Immediately
C02.69	Friction compensation speed threshold	0 to 5000	20	0.1rpm	Set it to the coulomb friction compensation speed threshold.	During operation	Immediately

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C02.6A	Static friction compensation	0 to 2000	0	0.1%	Set it to the static friction compensation value.	During operation	Immediately
C02.6B	Forward friction compensation of coulomb friction	0 to 2000	0	0.1%	Set it to the friction force of compensation for the position reference in the forward direction.	During operation	Immediately
C02.6C	Reverse friction compensation of coulomb friction	-2000 to 0	0	0.1%	Set it to the friction force of compensation for the position reference in the reverse direction.	During operation	Immediately
C02.6D	Viscous friction torque for rated speed	0 to 2000	0	0.1%	Set it to the viscous friction torque for rated speed.	During operation	Immediately
C02.6E	Friction compensation filter time	0 to 65535	0	0.01ms	Determine the speed after overcoming resistance friction.	During operation	Immediately
C02.6F	Friction compensation threshold for zero speed	0 to 1000	10	0.1rpm	Set it to the friction compensation threshold for the zero speed.	During operation	Immediately

7.14 Vibration Suppression

The notch can suppress mechanical resonance by reducing the gain at a specific frequency. After the notch is correctly set, vibration can be effectively suppressed, and it may be possible to continue increasing the servo gain. The notch principle is shown in the figure below.

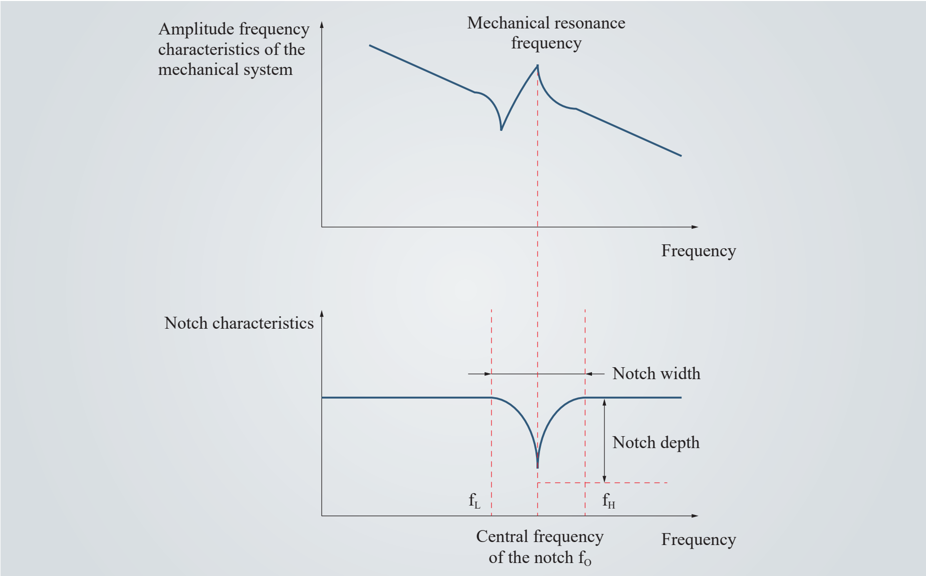


Figure 7-1 Notch suppression

The servo drive has a total of five notches, and each is defined by three parameters: notch frequency, width level, and depth level. The 1st and 2nd notches can be set manually or configured as adaptive notches (C01.30 = 1 or 2). In this case, the parameters are automatically set by the drive, while the other three notches can be set manually.

Steps to use adaptive notches:

① Set C01.30 (adaptive notch mode) to 1 or 2 based on the number of resonance points.

② When resonance occurs, set C01.30 to 1 to enable one adaptive notch. If resonance occurs again after gain tuning, set C01.30 to 2 to enable two adaptive notches. Parameters of the 1st and 2nd notches are updated automatically during servo operation.

③ If resonance is suppressed, the adaptive notch functions well. If resonance persists, use the backend tool to observe waveforms of related variables and use the other three notches to suppress resonance.

Related parameters:

Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C01.30	Adaptive notch mode	0 to 4	0	-	0: Disabled 1: 1st notch 2: 2nd notch 3: Notch parameter reset 4: Resonance frequency tested only	During operation	Immediately

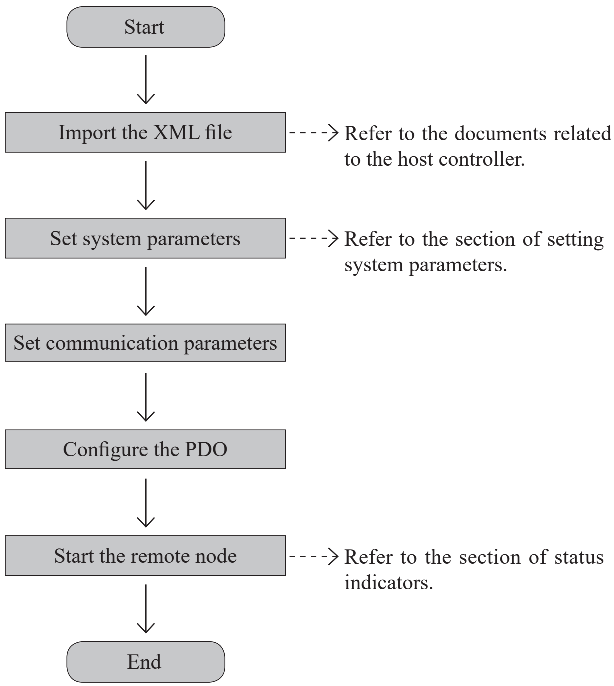
Parameter	Name	Value Range	Default	Unit	Options	Modification Mode	Effective Time
C01.31	Adaptive notch test times	0 to 65535	0	Times	-	During operation	Immediately
C01.40	Frequency of the 1st notch	10 to 8000	8000	Hz	Set it to the frequency of the 1st notch.	During operation	Immediately
C01.41	Width level of the 1st notch	0 to 4000	0	0.1%	Set it to the width level of the 1st notch.	During operation	Immediately
C01.42	Depth level of the 1st notch	10 to 1000	1000	0.1%	Set it to the depth level of the 1st notch.	During operation	Immediately
C01.43	Frequency of the 2nd notch	10 to 8000	8000	Hz	Set it to the frequency of the 2nd notch.	During operation	Immediately
C01.44	Width level of the 2nd notch	0 to 4000	0	0.1%	Set it to the width level of the 2nd notch.	During operation	Immediately
C01.45	Depth level of the 2nd notch	10 to 1000	1000	0.1%	Set it to the depth level of the 2nd notch.	During operation	Immediately
C01.46	Frequency of the 3rd notch	10 to 8000	8000	Hz	Set it to the frequency of the 3rd notch.	During operation	Immediately
C01.47	Width level of the 3rd notch	0 to 4000	0	0.1%	Set it to the width level of the 3rd notch.	During operation	Immediately
C01.48	Depth level of the 3rd notch	10 to 1000	1000	0.1%	Set it to the depth level of the 3rd notch.	During operation	Immediately
C01.49	Frequency of the 4th notch	10 to 8000	8000	Hz	Set it to the frequency of the 4th notch.	During operation	Immediately
C01.4A	Width level of the 4th notch	0 to 4000	0	0.1%	Set it to the width level of the 4th notch.	During operation	Immediately
C01.4B	Depth level of the 4th notch	10 to 1000	1000	0.1%	Set it to the depth level of the 4th notch.	During operation	Immediately
C01.4C	Frequency of the 5th notch	10 to 8000	8000	Hz	Set it to the frequency of the 5th notch.	During operation	Immediately
C01.4D	Width level of the 5th notch	0 to 4000	0	0.1%	Set it to the width level of the 5th notch.	During operation	Immediately
C01.4E	Depth level of the 5th notch	10 to 1000	1000	0.1%	Set it to the depth level of the 5th notch.	During operation	Immediately

Chapter 8 Communication Description

8.1 Overview

8.1.1 EtherCAT Overview

EtherCAT is an easy-to-use, industrial Ethernet technology featuring the high-performance, low cost, and flexible topology. It can be used for ultra-high-speed I/O networks at the industrial field level, and uses the standard Ethernet physical layer, with transmission media being twisted pair or optical fiber (100Base-TX or 100Base-FX).



The EtherCAT system consists of a master and several slaves. The master only requires a regular network card, while a slave requires a dedicated slave control chip, such as ET1100, ET1200, and FPGA.

EtherCAT provides an end-to-end connection over one network, with protocol processing reaching directly to the I/O layer:

- No need for any underlying sub-bus
- No gateway delay
- A single system covering all devices, including the I/O, sensor, activator, drive, and display
- Transmission rate: 2 x 100 Mbit/s (high speed Ethernet, full duplex mode)
- Synchronism: 300 nodes between two devices, cable of 120 m, and synchronization jitter less than 1 μs
- Update time:

  256 digital I/O: 11 μs

  1000 digital I/O distributed over 100 nodes: 30 μs = 0.03 ms

  200 analog I/O (16-bit): 50 μs, sampling rate of 20 kHz

  100 servo axes (each 8-byte IN+OUT): 100 μs = 0.1 ms

  12000 digital I/O: 350 μs

To support a wider variety of devices and application layers, EtherCAT provides the following application protocols:

- CANopen over EtherCAT (CoE) (CAN application protocol based on EtherCAT)
- SoE (Servo drive specification compliant with IEC 61800-7-204 standard)
- EoE (Ethernet implemented by EtherCAT)
- FoE (File reading implemented by EtherCAT)

Slave devices do not need to support all communication protocols. Instead, only the most suitable communication protocols need to be selected for their applications.

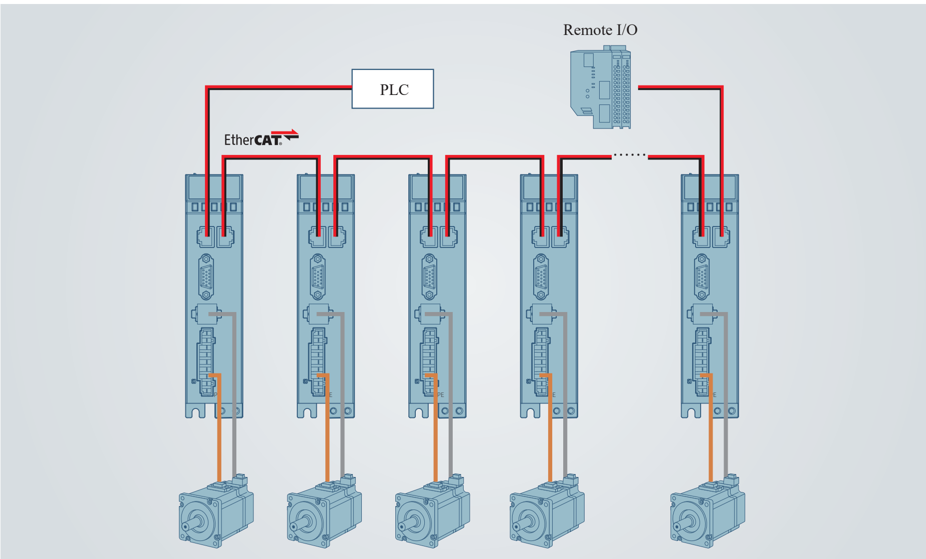


Figure 8-1 EtherCAT networking

NOTICE

- EtherCAT is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

8.1.2 EtherCAT communication technical specifications

Item		Specifications
Basic performance of EtherCAT slaves	Communication protocol	EtherCAT protocol
	Service supported	CoE (Process Data Object (PDO) and Service Data Object (SDO))
	Synchronization mode	Distributed clock (DC)
	Physical layer	100BASE-TX
	Baud Rate	100 Mbit/s (100Base-TX)
	Duplex mode	Full duplex
	Topology	Linear
	Transmission medium	Cat5 shielded cables or Cat6 and above cables with electrical performance specifications
	Transmission distance	Less than 100 m between two nodes (with proper environment and cables)
	Number of slaves	Up to 65535 supported by protocol, not exceeding 100 in actual use
	EtherCAT frame length	44 bytes to 1,498 bytes
	Process data	Up to 1486 bytes per Ethernet frame
	Synchronization jitter of two slaves	<1us
	Update time	About 30 μs for 1000 digital input/output About 100 μs for 100 servo axes Update time varying with the different interface types
	Communication bit error ratio	10^{-10} Ethernet standard
EtherCAT configuration units	Number of FMMU units	8
	Number of storage synchronization management units	8
	Process data RAM	8 KB
	DC	64 bits
	E2PROM capacity	32 kbit

8.1.3 EtherCAT communication specification

Item		Specifications
Communication protocol		IEC 61158 Type 12, IEC 61800-7 CiA 402 Drive Profile
Application Layer	SDO	SDO request and response
	PDO	Variable PDO mapping
	CiA402	PP mode
		PV mode
		PT mode
		HM mode
		CSP mode
		CSV mode
		CST mode
Physical layer	Transmission protocol	100BASE-TX (IEEE802.3)
	Max. distance	100M
	Interface	RJ45*2 (IN, OUT)

8.2 Communication Transmission Modes

8.2.1 EtherCAT Communication Structure

Various application layer protocols can be used in EtherCAT communication. The JSS-AS715N series servo drive adopts the IEC 61800-7 (CiA 402)-CANopen motion control sub-protocol.

The following figure shows the EtherCAT communication structure based on the CANopen application layer.

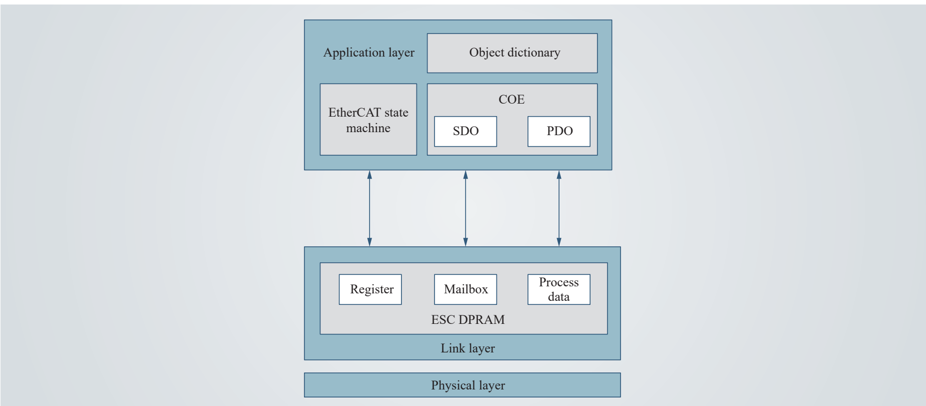


Figure 8-2 EtherCAT communication structure based on the CANopen application layer

As shown in the figure, the object dictionary of the application layer contains the following: Communication parameters, application data, and PDO mapping data PDOs contain real-time data during the operation of the servo drive, and are accessed for reading and writing periodically. SDO mailbox communication accesses and modifies some communication parameter objects and PDOs in a non-periodic manner.

8.2.2 Communication State Machine

CiA402 control introduction

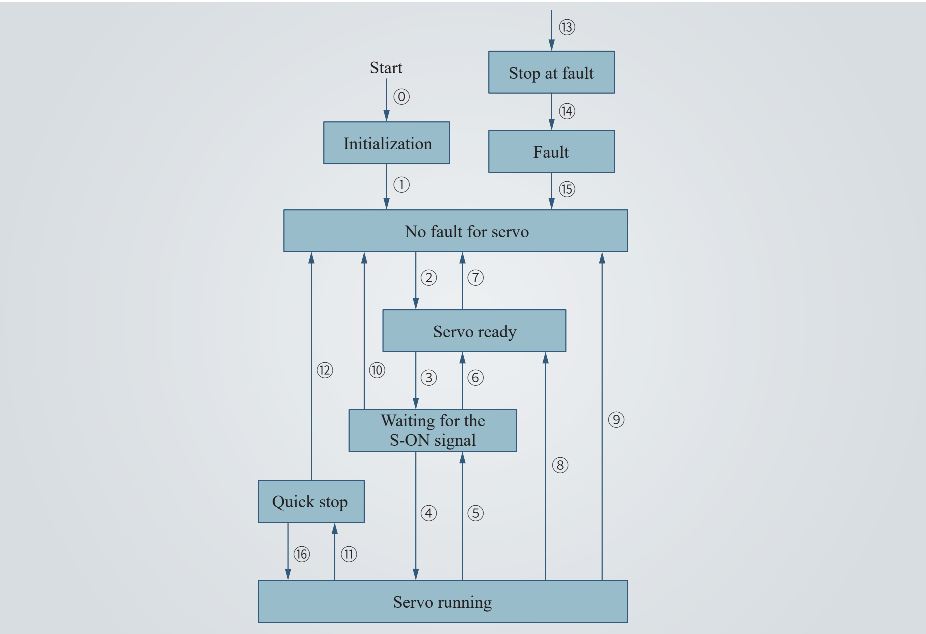


Figure 8-3 CiA402 state machine switchover

The JSS715N series servo drive should be operated according to the process specified by the standard CiA402 protocol, so that the servo drive can operate in the specified state. The following table lists each status.

State	Description
Initialization	● Initialization of the servo drive and internal self-inspection are done. ● Parameters of the servo drive cannot be set. Drive functions cannot be executed.
No fault for servo	● No fault exists in the servo drive or the fault has been cleared. ● Parameters of the servo drive can be set.

State	Description
Servo ready	● The servo drive is ready to run. ● Parameters of the servo drive can be set.
Waiting for the S-ON signal	● The servo drive is waiting for the S-ON signal. ● Parameters of the servo drive can be set.
Servo running	● The servo drive is running properly and a certain operation mode has been enabled. The motor is energized and starts rotating when the speed reference value inputted is not 0. ● Only parameters whose "Setting Condition" is "During running" can be set.
Quick stop	● Quick stop is activated and the servo drive is in the process of quick stop. ● Only parameters whose "Setting Condition" is "During running" can be set.
Stop at fault	● A fault occurs and the servo drive is in the process of stop. ● Only parameters whose "Setting Condition" is "During running" can be set.
Fault	● The stop process is done and all the drive functions are disabled. Parameters can be modified for the troubleshooting purpose.

EtherCAT status switchover

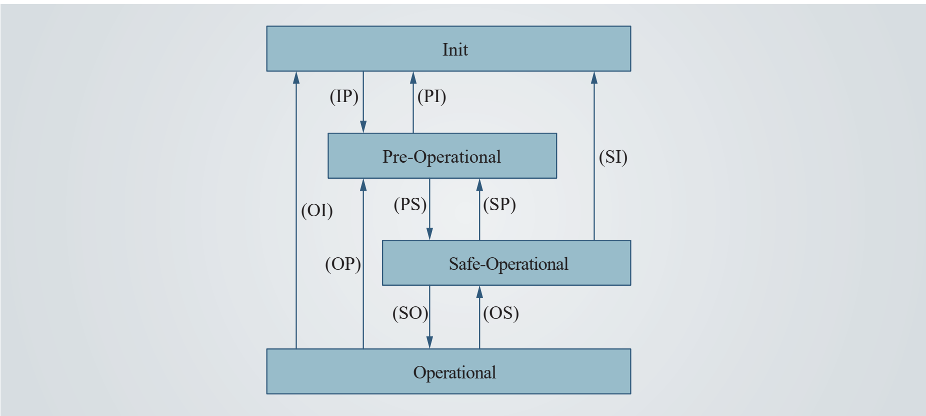


Figure 8-4 EtherCAT state machine

EtherCAT devices must support four statuses to coordinate the status relationship between the master and slave applications during initialization and operation.

- Init: Initialization, short as I
- Pre-Operational: Pre-operational, short as P
- Safe-Operational: Safe-operational, short as S
- Operational: Operational, short as O

When the initialized state is switched to the operational state, it must follow the sequence "Initialized → Pre-operational → Safe-operational → Operational", and running-through is not allowed. However, when the state is returned from the operational state, running-through is allowed.

The following table describes the status switchover and initialization process.

State	SDO	RPDO	TPDO	Description
Initialization (I)	No	No	No	● Communication is initialized. ● There is no communication at the application layer, and the master can only read data from and write data to the ESC register.
IP	No	No	No	● The master configures the slave addresses. ● The mailbox channel is configured. ● The DC is configured. ● The pre-operational state is requested.
Pre-operational (P)	Yes	No	No	● There is mailbox data communication (SDO) at the application layer.
PS	Yes	No	No	● The master uses SDOs to initialize process data mapping. ● The master configures the SM channel used for process data communication. ● The master configures FMMU. ● The safe-operational state is requested.
Safe-operational (S)	Yes	No	Yes	● Both SDOs and Transmission PDOs (TPDOs) are available. ● The DC mode is available.
SO	Yes	No	Yes	● The master sends valid output data. ● The operational state is requested.
Operational (O)	Yes	Yes	Yes	● It is in the normal operation state. ● All the input and output data is valid. ● Mailbox communication is available.

8.2.3 DC

The DC allows all EtherCAT devices to use the same system time, thereby controlling the synchronous execution of tasks on each device. Slave devices can generate sync signals based on the synchronized system time. The JSS715N series servo drive only supports the DC sync mode. The synchronization cycle is controlled by SYNC0. The period range varies with different motion modes.

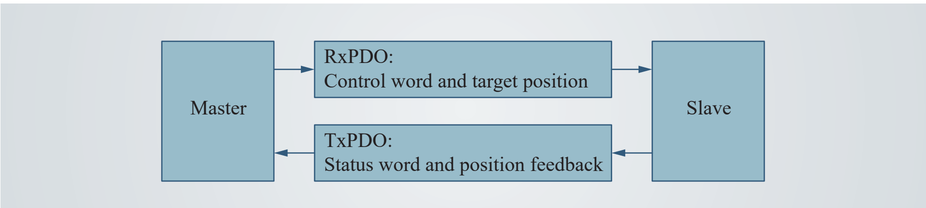
NOTICE

- The SYNC signal can be used for synchronization of all slaves and can achieve an error of less than 1 μs. Before the SYNC signal starts, the master needs to synchronize all slaves to the same clock. In the operational state, it also needs to continuously synchronize the slaves to the same clock to prevent the difference in the crystal oscillator from causing a clock offset. This is generally manifested as synchronizing the 0x910 register of the ESC.
- The SYNC starting time is the time of the ESC 0x990 register minus the 0x920 time. Enable the DC mode (0x981 = 0x03) before the 0x910 reaches the starting time. If the SYNC starting time setting is incorrect, the ESC 0x134 status register will report a fault code of 0x2D.

8.3 Communication Data Frame Structure

8.3.1 Process Data

EtherCAT real-time data is transmitted through PDOs. According to the data transmission direction, PDOs can be divided into Reception PDOs (RPDOs) and TPDOs. RPDOs send master data to slaves, and TPDOs feed back slave data to the master.



The JSS715N series servo drive supports user-defined PDO lists and PDO mapping objects.

PDO mapping

PDO mapping is used to establish the mappings between the object dictionary and PDOs. 1600h to 17FFh are RPDOs, and 1A00h to 1BFFh are TPDOs. The JSS715N series servo drive provides six RPDOs and five TPDOs, which are described in the following table.

RPDO (6)	1600h	Variable mapping
	1701h to 1705h	Fixed mapping
TPDO (5)	1A00h	Variable mapping
	1B01h to 0x1B04h	Fixed mapping

Fixed PDO mapping

The JSS715N series servo drive provides five fixed RPDOs and four fixed TPDOs. The following table lists some typical uses of RPDOs and TPDOs.

Available Servo Mode	PP CSP
1701h (Output)	Mapping object (four 12-byte objects)
	6040h (control word) 607Ah (target position) 60B8h (touch probe function) 60FEh sub-index 1 (forced physical DO)
1B01h (Input)	Mapping object (nine 28-byte objects)
	603Fh (fault code) 6041h (status word) 6064h (position actual value) 6077h (torque feedback) 60F4h (position deviation) 60B9h (touch probe status) 60BAh (touch probe 1 positive edge) 60BCh (touch probe 2 positive edge) 60FDh (DI status)

Available Servo Mode	PP PV PT CSP CSV CST
1702h (Output)	Mapping object (seven 19-byte objects)
	6040h (control word) 607Ah (target position) 60FFh (target velocity) 6071h (target torque) 6060h (mode selection) 60B8h (touch probe function) 607Fh (Max. speed)
1B02h (Input)	Mapping object (nine 25-byte objects)
	603Fh (fault code) 6041h (status word) 6064h (position actual value) 6077h (torque feedback) 6061h (mode display) 60B9h (touch probe status) 60BAh (touch probe 1 positive edge) 60BCh (touch probe 2 positive edge) 60FDh (DI status)

Available Servo Mode	PP PV CSP CSV
1703h (Output)	Mapping object (seven 17-byte objects)
	6040h (control word) 607Ah (target position) 60FFh (target velocity) 6060h (mode selection) 60B8h (touch probe function) 60E0h (positive torque limit) 60E1h (negative torque limit)
1B03h (Input)	Mapping object (ten 29-byte objects)
	603Fh (fault code) 6041h (status word) 6064h (position actual value) 6077h (torque feedback) 60F4h (position deviation) 6061h (mode display) 60B9h (touch probe status) 60BAh (touch probe 1 positive edge) 60BCh (touch probe 2 positive edge) 60FDh (DI status)

Available Servo Mode	PP PV PT CSP CSV CST
1704h (Output)	Mapping object (nine 23-byte objects)
	6040h (control word) 607Ah (target position) 60FFh (target velocity) 6071h (target torque) 6060h (mode selection) 60B8h (touch probe function) 607Fh (Max. speed) 60E0h (positive torque limit) 60E1h (negative torque limit)
1B02h (Input)	Mapping object (nine 25-byte objects)
	603Fh (fault code) 6041h (status word) 6064h (position actual value) 6077h (torque feedback) 6061h (mode display) 60B9h (touch probe status) 60BAh (touch probe 1 positive edge) 60BCh (touch probe 2 positive edge) 60FDh (DI status)

Available Servo Mode	PP PV CSP CSV
1705h (Output)	Mapping object (eight 19-byte objects)
	6040h (control word) 607Ah (target position) 60FFh (target velocity) 6060h (mode selection) 60B8h (touch probe function) 60E0h (positive torque limit) 60E1h (negative torque limit) 60B2h (torque offset)
1B04h (Input)	Mapping object (ten 29-byte objects)
	603Fh (fault code) 6041h (status word) 6064h (position actual value) 6077h (torque feedback) 6061h (mode display) 60F4h (position deviation) 60B9h (touch probe status) 60BAh (touch probe 1 positive edge) 60BCh (touch probe 2 positive edge) 606Ch (speed feedback)

Variable PDO mapping

The JSS715N series servo drive provides one variable RPDO and one variable TPDO.

Variable PDO	Index	Max. Number of Mappings	Max. Number of Bytes	Default Mapping Object
RPDO1	1600h	10	40	6040h (control word) 607Ah (target position) 60B8h (touch probe function)
TPDO1	1A00h	10	40	603Fh (fault code) 6041h (status word) 6064h (position actual value) 60BCh (touch probe 2 positive edge) 60B9h (touch probe status) 60BAh (touch probe 1 positive edge) 60FDh (DI status)

Sync manager PDO assignment setting

In EtherCAT periodic data communication, process data can contain multiple PDOs. the CoE protocol uses data objects 0x1C10 to 0x1C2F to define the PDO mapping object list of the corresponding sync manager (SM) channel. Multiple PDOs can be mapped in different sub-indexes. The JSS715N series servo drive supports one RPDO assignment and one TPDO assignment, which are listed in the following table.

Index	Sub-index	Item
0x1C12	01h	Choose one from 0x1600 and 0x1701 to 0x1705 as the actual RPDO used.
0x1C13	01h	Choose one from 0x1A00 and 0x1B01 to 0x1B04 as the actual TPDO used.

PDO configuration

PDO mapping parameters contain pointers to PDO-related process data that PDOs need to send or receive, including the index, sub-index, and mapping object length. Among them, sub-index 0 records the number N of specific objects mapped by the PDO. Each PDO data length can be up to 4 x N bytes and can map one or more objects at the same time. Sub-indexes 1 to N are the mapping content. The following table defines the mapping parameter content.

Bit	31	……	16	15	……	8	7	……	0
Meaning	Index			Sub-index			Object length		

The index and sub-index together determine the position of the object in the object dictionary, and the object length specifies the specific number of bits for the object, represented in hexadecimal.

Object length	Bits
08h	8 bits
10h	16 bits
20h	32 bits

For example, the mapping parameter for the 16-bit control word 6040h-00 is 60400010h.

The PDO configuration of the JSS715N series servo drive follows the process:

① Configure PDO mapping groups. Write 0 to the 00h sub-index of 1C12h (or 1C13h).

a. Clear the original mapping group: Writing "0" to the 00h sub-index of 1C12h (or 1C13h) can clear this PDO configuration group.

b. Write the PDO mapping group: Write the mapping configuration group based on the site requirements. Pre-write the values of 1600h and 1701h to 1705h in 1C12h, and pre-write the values of 1A00h and 1B01h to 1B04h in 1C13h. (Note: Only 1600h and 1A00h are configurable mapping groups. Others are fixed mapping configurations.)

c. Write the total number of the PDO mapping groups to sub-index 0 of the 1C12h (or 0x1C13h) object.

② Configure PDO mapping objects. Write 0 to the 00h sub-index of 1600h (or 1A00h).

a. Clear the original mapping object: Writing "0" to the 00h sub-index of 1600h (or 1A00h) can clear this PDO mapping configuration.

b. Write the PDO mapping content: According to the object parameter definition in the XML file, write the content to the mapping parameter sub-indexes 1 to 10 respectively. Only the objects that support mapping can be configured as the PDO mapping content.

c. Write the total number of PDO mapping objects, and write the number of mappings written in Step b to sub-index 0.

CAUTION

- The PDO configuration can be set only when the EtherCAT communication state machine is in pre-operational (2 displayed on the panel). Otherwise, an error will be reported.
- PDO configuration parameters cannot be stored in E2PROM. Be sure to reconfigure the mapping object after each power-on. Otherwise, the mapping object will be the default parameter of the servo drive.

The following operations will return an SDO fault code:

- Modifying PDO parameters in a non-pre-operational state.
- Pre-writing values other than 1600h and 1701h to 1705h in 1C12, or pre-writing values other than 1A00h and 1B01h to 1B04h in 1C13.

8.3.2 Mailbox Data

The EtherCAT mailbox data SDO is used to transmit non-periodic data, such as the configuration of communication parameters and servo drive operation parameters. CoE service types of EtherCAT include the following:

- Emergency event information
- SDO request
- SDO response
- Transmit PDO (TxPDO)
- Receive PDO (RxPDO)
- Remote request to send TxPDOs
- Remote request to send RxPDOs
- SDO information

The JSS715N series servo drive supports SDO requests and responses.

Chapter 9 DI/DO Function

Code	Name	Function Name	Description	Remarks
Input signal functions				
FunIN.1	S-ON	S-ON	Inactive: Servo motor disabled in local mode Active: Servo motor enabled in local mode	The S-ON function is only active in non-bus control mode. The logic of the corresponding terminal must be set to level valid.
FunIN.2	ALM-RST	Alarm reset signal	Active: Fault reset executed in local mode Inactive: Fault reset not executed in local mode	The ALM-RST function is only active in non-bus control mode. It is recommended to set the logic of the corresponding terminal to level valid.
FunIN.6	P-OT	PL switch	Active: Forward drive disabled Inactive: Forward drive enabled	When the mechanical movement is beyond the movable range, the overtravel prevention function will be activated. It is recommended to set the logic of the corresponding terminal to level valid.
FunIN.7	N-OT	Negative limit switch	Active: Reverse drive disabled Inactive: Reverse drive enabled	When the mechanical movement is beyond the movable range, the overtravel prevention function will be activated. It is recommended to set the logic of the corresponding terminal to level valid.
FunIN.5	HomeSwitch	Home switch	Inactive: Mechanical load beyond the home switch range Active: Mechanical load within the home switch range	The logic of the corresponding terminal must be set to level valid.
FunIN.4	Emergency Stop	Emergency stop	Active: Position locked after stop at zero speed Inactive: Current operating state unaffected	It is recommended to set the logic of the corresponding terminal to level valid.

Code	Name	Function Name	Description	Remarks
Input signal functions				
FunIN.30	TouchProbe1	Probe 1	Inactive: Touch probe not triggered Active: Touch probe triggerable	The touch probe logic is only related to the touch probe function (60B8h).
FunIN.31	TouchProbe2	Probe 2	Inactive: Touch probe not triggered Active: Touch probe triggerable	The touch probe logic is only related to the touch probe function (60B8h).

Code	Name	Function Name	Description	Remarks
Functions of output signals				
FunOUT.1	S-RDY	Servo ready	The servo drive is ready to receive the S-ON signal. Active: Servo ready Inactive: Servo not ready	-
FunOUT.2	TGON	Motor rotation signal	Inactive: Absolute value of filtered motor speed lower than the setpoint of C03.2D Active: Absolute value of filtered motor speed reaching the setpoint of C03.2D	-
FunOUT.3	BK	Brake output	Active: Brake signal outputted Inactive: Brake signal not outputted	-
FunOUT.5	WARN	Alarm	Active: Warning occurred on the servo drive Inactive: No warning occurred on the servo drive or the warning has been reset	-
FunOUT.4	ALM	Fault	Active: Fault occurred on the servo drive Inactive: No fault occurred on the servo drive or the fault has been reset	-

Chapter 10 Troubleshooting

10.1 Fault Alarms

10.1.1 Fault display and category

The servo drive provides various protection functions, and triggers an alarm when a protection functions acts. Then, the LED panel displays the fault and its alarm code.

Figure 10-1 Fault code display

NOTICE

- The servo drive can record the latest 10 faults/alarms and the servo drive status parameters upon occurrence of the faults/alarms. Repeated faults or alarms among the latest 5 logs are logged as one fault or alarm, and the servo drive status upon its occurrence is logged only once.
- When a single fault or an alarm occurs, the panel displays the fault or alarm code. When multiple faults or alarms occur, the panel displays the fault code of the highest level.
- After a fault or an alarm is reset, the servo drive still keeps the log of the fault or alarm. You can set F31.04 (Initialize fault record) to 1 to clear the fault and alarm records.

Alarm codes are divided into three categories (category 1 indicates the most severe level) based on the fault and alarm severity, which are specified by fault codes.

Fault Category	Fault Code	Resettable
Class 1	Er0x.x to Er3x.x	Non-resettable
	Er4x.x to Er7x.x	Resettable
Class 2	Er8x.x to ErCx.x	Resettable
Class 3	ALFxx	Resettable

NOTICE

- "Resettable" means that the panel stops displaying the fault/alarm when a "reset signal" is input.

10.1.2 Troubleshooting and reset

Checklist:

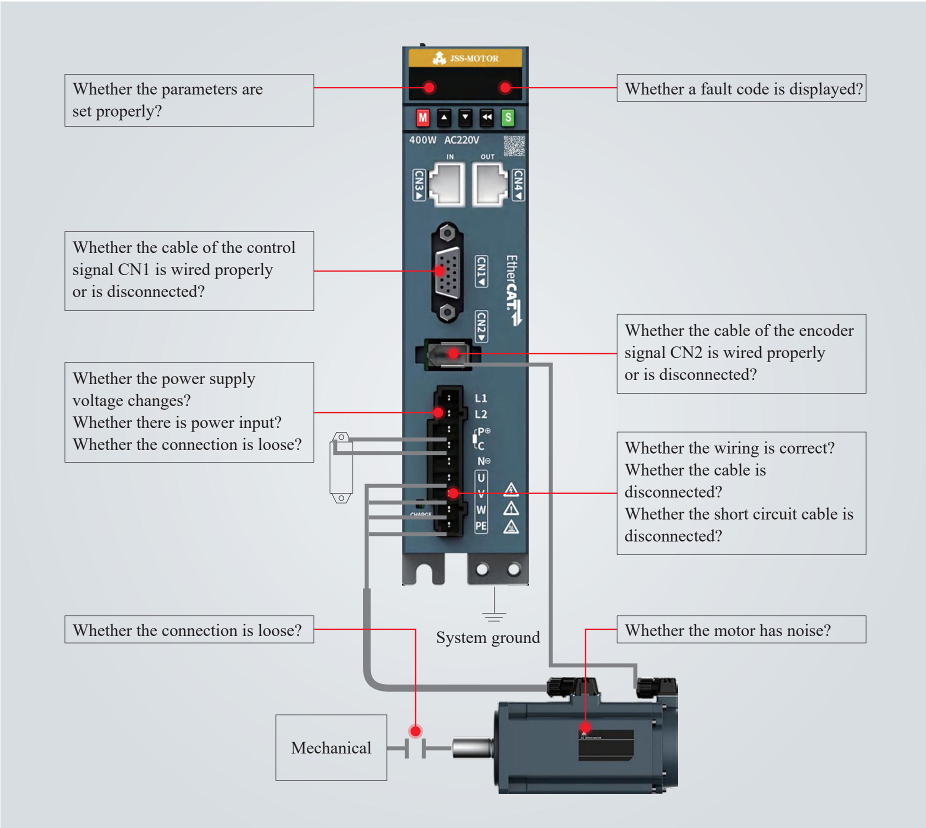


Figure 10-2 Troubleshooting checklist

Reset operation:

- Set F31.00 (Fault reset) to 1 to stop displaying the fault on the panel.
- To reset resettable faults, switch off the S-ON signal first and then send the fault reset signal (set F31.00 to 1).
- To reset resettable alarms, eliminate the alarm source and then the servo drive automatically resets the alarms.

CAUTION

- Some faults/alarms can only be reset after the causes are rectified through setting modifications. However, a reset operation does not activate modifications.
- If the modification can be effective only after power-on, power on the device again.
- If the modification can be effective only after stop, turn off the S-ON signal. The servo drive can operate properly only after modifications are activated.

10.1.3 List of faults and alarms

Table 10-1 List of factory fault codes

Fault Group	Fault Code	Fault Name	Fault Code (203F)	Bus Fault Code (603F)	Resettable
Class 1	Er01.0	Mismatch of software versions	0x010	0x6100	Non-resettable
	Er01.1	Mismatch of motor parameters	0x011	0x7122	Non-resettable
	Er02.0	Product matching fault. No specified drive	0x020	0x6100	Non-resettable
	Er02.1	Product matching fault. No specified motor	0x021	0x6100	Non-resettable
	Er02.2	Product matching fault. No specified encoder	0x022	0x6100	Non-resettable
	Er03.0	System parameter error	0x030	0x6320	Non-resettable
	Er03.1	Parameter out-of-range	0x031	0x6320	Non-resettable
	Er03.2	Parameter writing error	0x032	0x6320	Non-resettable
	Er03.3	Parameter reading error	0x033	0x6320	Non-resettable
	Er05.0	Current loop timeout	0x050	0x7500	Non-resettable
	Er05.1	Speed loop timeout	0x051	0x7500	Non-resettable
	Er05.2	Position loop timeout	0x052	0x7500	Non-resettable
	Er05.3	Serial port data check failure	0x053	0x7500	Non-resettable
	Er06.0	Protection from out of control	0x060	0x8400	Non-resettable
	Er10.0	P-hardware overcurrent	0x100	0x2312	Non-resettable
	Er10.1	N-hardware overcurrent	0x101	0x2312	Non-resettable

Fault Group	Fault Code	Fault Name	Fault Code (203F)	Bus Fault Code (603F)	Resettable
Class 1	Er10.2	U phase software overcurrent	0x102	0x2312	Non-resettable
	Er10.3	V phase software overcurrent	0x103	0x2312	Non-resettable
	Er10.4	Output short circuited to ground	0x104	0x2330	Non-resettable
	Er10.5	Current sampling failure	0x105	0x6100	Non-resettable
	Er10.6	Incorrect current parameter setting	0x106	0x6320	Non-resettable
	Er10.7	UV current correction failure	0x107	0x6100	Non-resettable
	Er10.8	Excessive current zero drift	0x108	0x6100	Non-resettable
	Er10.9	Current exception during enabling	0x109	0x2312	Non-resettable
	Er11.0	Excessive motor speed upon servo drive power-on	0x110	0xFF00	Non-resettable
	Er11.1	Drive over-temperature	0x111	0x2312	Non-resettable
	Er20.1	Encoder internal fault	0x201	0x7305	Non-resettable
	Er20.2	Encoder reading/writing error	0x202	0x7305	Non-resettable
	Er20.3	Encoder data frame loss	0x203	0x7305	Non-resettable
	Er20.4	Excessive encoder incremental position	0x204	0x7305	Non-resettable
	Er20.5	Abnormal encoder data	0x205	0x7305	Non-resettable
	Er20.6	Mismatch of encoder type	0x206	0x7305	Non-resettable
	Er20.7	Encoder model not supported	0x207	0x7305	Non-resettable
	Er20.8	Encoder battery failure	0x208	0x7305	Non-resettable
	Er20.9	Encoder multi-turn error	0x209	0x7305	Non-resettable
	Er21.0	Mismatch between encoder pulses per revolution and drive pulses per revolution	0x210	0x7305	Non-resettable
	Er31.0	More than ten PDO mapping objects	0x310	0x8220	Non-resettable
	Er32.0	EtherCAT peripheral error	0x320	0x6100	Non-resettable
	Er32.1	ESI check error in FLASH	0x321	0x7600	Non-resettable
	Er32.2	Failure to read data from EEPROM through bus	0x322	0x7600	Non-resettable

Fault Group	Fault Code	Fault Name	Fault Code (203F)	Bus Fault Code (603F)	Resettable
Class 1	Er32.3	Failure of update to EEPROM through bus	0x323	0x7600	Non-resettable
	Er32.4	Correctness of checksum in ESC configuration area	0x324	0x7600	Non-resettable
	Er32.5	EtherCAT failed to obtain valid XML information	0x325	0x7600	Non-resettable
	Er40.0	Drive overload	0x400	0x3230	Resettable
	Er41.0	Motor overload	0x410	0x3230	Resettable
	Er41.1	Motor over-temperature due to locked-rotor	0x411	0x7121	Resettable
	Er41.2	Motor over-temperature	0x412	0x4210	Resettable
	Er42.1	Discharge tube temperature too high	0x421	0x4210	Resettable
	Er42.2	Heatsink temperature too high	0x422	0x4210	Resettable
	Er43.0	Overvoltage	0x430	0x3210	Resettable
	Er43.1	Undervoltage	0x431	0x3220	Resettable
	Er45.0	S-ON enabling failure	0x450	0xFF00	Resettable
	Er46.0	Motor overspeed	0x460	0x8400	Resettable
	Er47.0	Excessive position deviation	0x470	0x8611	Resettable
	Er47.1	Position deviation overflow	0x471	0x8611	Resettable
	Er50.1	D/Q current overflow	0x501	0x6100	Resettable
	Er51.0	Offline inertia auto-tuning failure	0x510	0x6310	Resettable
	Er51.1	Offline inertia parameter error	0x511	0x6310	Resettable
	Er52.0	Angle auto-tuning failure	0x520	0x7122	Resettable
	Er53.0	Motor parameter auto-tuning timeout	0x530	0x7122	Resettable
	Er53.1	Resistance parameter auto-tuning failure	0x531	0x7122	Resettable

Fault Group	Fault Code	Fault Name	Fault Code (203F)	Bus Fault Code (603F)	Resettable
Class 1	Er53.2	Inductance parameter auto-tuning failure	0x532	0x7122	Resettable
	Er53.3	Back EMF parameter auto-tuning failure	0x533	0x7122	Resettable
	Er54.0	Current loop auto-tuning failure	0x540	0x7122	Resettable
	Er55.0	Excessive vibration	0x550	0x7122	Resettable
	Er74.0	EtherCAT synchronization cycle setting error	0x740	0x6320	Resettable
	Er74.1	No sync signal	0x741	0x8700	Resettable
	Er74.2	Chip synchronization process uncompleted in OP	0x742	0x8700	Resettable
Class 2	Er80.0	Control power undervoltage	0x800	0x3120	Resettable
	Er81.0	Input phase loss 1	0x810	0x3130	Resettable
	Er81.1	Input phase loss 2	0x811	0x3130	Resettable
	Er81.2	Output phase loss (reserved)	0x812	-	Resettable
	Er82.0	DI function allocation fault	0x820	0x6320	Resettable
	Er82.1	DO function allocation fault	0x821	0x6320	Resettable
	Er84.0	Electronic gear ratio setting error	0x840	0x6320	Resettable
	Er84.1	Software limit setting error	0x841	0x6320	Resettable
	Er84.2	Encoder resolution setting error	0x842	0x7122	Resettable
	Er84.3	Home position setting error	0x843	0xFF00	Resettable
	Er87.1	One-time excessive position reference increment (One-time increment of the target position is over 5 times of the maximum speed)	0x871	0xFF00	Resettable
	Er87.2	Continuous excessive position reference increment (Increment of the target position exceeds the maximum speed for 3 consecutive times)	0x872	0xFF00	Resettable
	Er87.3	Overflow of 32-bit sign bit of the target position during limiting	0x873	0xFF00	Resettable

Fault Group	Fault Code	Fault Name	Fault Code (203F)	Bus Fault Code (603F)	Resettable
Class 2	Er87.4	Target position exceeding maximum value of mechanical single-turn position in rotating mode	0x874	0xFF00	Resettable
	ErA0.1	Multi-turn overflow fault	0xA01	0x7305	Resettable
	ErC1.0	Excessive EtherCAT synchronization period error	0xC10	0x8700	Resettable
	ErC1.1	Synchronization loss	0xC11	0x8700	Resettable
	ErC1.2	Network status switchover error	0xC12	0x8700	Resettable
	ErC1.4	Network cable connection unreliable	0xC14	0x8700	Resettable
	ErC1.5	Data frame loss protection error	0xC15	0x8700	Resettable
	ErC1.6	Data frame forwarding error	0xC16	0x8700	Resettable
	ErC1.7	Data update timeout	0xC17	0x8700	Resettable
	ErC1.8	Watchdog expired	0xC18	0x8700	Resettable
	ErC2.0	SYNC signal loss	0xC20	0x8700	Resettable

Table 10-2 List of factory alarm codes

Fault Group	Alarm Code	Alarm Name	Alarm Code (203F)	Bus Fault Code (603F)	Resettable
Class 3	ALF0.0	Emergency stop alarm	0x0F00	0x0F00	Resettable
	ALF1.0	Re-power-on required for parameter settings to take effect	0xF10	0x6320	Resettable
	ALF1.1	Frequent parameter storage alarm	0xF11	0x5530	Resettable
	ALF1.2	Torque reached parameter error	0xF12	0x6320	Resettable
	ALF1.3	Too frequent writing of EEPROM by host controller SDO	0xF13	0x7600	Resettable
	ALF2.0	Forward overtravel alarm	0xF20	0x5443	Resettable
	ALF2.1	Reverse overtravel alarm	0xF21	0x5444	Resettable
	ALF4.0	Homing timeout	0xF40	0x6320	Resettable
	ALF4.1	Homing DI conflict	0xF41	0x6320	Resettable

Fault Group	Alarm Code	Alarm Name	Alarm Code (203F)	Bus Fault Code (603F)	Resettable
Class 3	ALF4.2	Homing mode conflict	0xF42	0x6320	Resettable
	ALF5.0	Braking resistor overload	0xF50	0x3210	Resettable
	ALF5.1	Too small resistance of external regenerative resistor	0xF51	0x6320	Resettable
	ALF6.1	Output phase loss	0xF61	0x3230	Resettable
	ALF8.0	Vibration occurred during auto-tuning	0xF80	0x7122	Resettable
	ALF9.0	Encoder battery voltage low	0xF90	0x7305	Resettable
	ALFA.0	Drive high temperature warning	0xFA0	0x7305	Resettable
	xxnr	Servo not ready	0xFFFF	-	Resettable

Table 10-3 List of bus fault codes

Bus Fault SN	Bus Fault Code	Bus Fault Name
0	0x0000	No fault
1	0x2312	Continuous current fault
2	0x2330	Short circuit to ground
3	0x3120	Control power overvoltage
4	0x3130	Phase loss
5	0x3210	Main circuit overvoltage
6	0x3220	Main circuit undervoltage
7	0x3230	Overload
8	0x4210	Over-temperature
9	0x5443	Forward overtravel
10	0x5444	Reverse overtravel
11	0x5530	Storage fault
12	0x6320	Parameter error
13	0x7121	Motor locked-rotor
14	0x7122	Motor mismatch
15	0x7305	Encoder error

Bus Fault SN	Bus Fault Code	Bus Fault Name
16	0x7500	Communication fault
17	0x7600	Data storage
18	0x8400	Speed control
19	0x8611	Following fault
20	0x8220	Length error
21	0x8700	Synchronization controller
22	0x8900	Process data monitoring
23	0x0FFF	Factory fault

10.2 Solutions

Table 10-4 List of causes and solutions for faults and alarms

Code	Name	Cause	Solution
Er01.0	Mismatch of software versions	● The MCU and FPGA versions are incorrect.	● Check whether the software versions are consistent. ● Contact technical support personnel or update the FPGA or MCU software.
Er01.1	Mismatch of motor parameters	● Incorrect motor parameters	● Replace with a servo drive or motor of the matching power. ● Contact our company for technical support.
Er02.0	Product matching fault. No specified drive	● The set servo drive model is incorrect.	● Check whether the model of the U42.10 servo drive is correct. If not, contact technical support and correct the model.
Er02.1	Product matching fault. No specified motor	● The set motor model is incorrect.	● Read the motor model U42.11 and contact technical support.
Er03.0	System parameter error	● The software is updated.	● Check whether the software is updated. ● Reset the servo drive model and the motor model, and restore default settings (set F31.02 to 1).
		● The control power voltage drops instantaneously. ● Instantaneous power failure occurs during parameter storage.	● Check whether the voltage drops during control power cutoff or instantaneous power failure occurs. ● Restore default settings (set F31.02 to 1) and write the parameters again.

Code	Name	Cause	Solution
		● The times of parameter writing within a certain period of time exceeds the limit.	● Check whether parameter update is performed frequently from the host controller. ● Change the way of parameter writing and write the parameters again.
		● The servo drive is faulty.	● If the fault persists after several times of power-on and parameter initialization, replace the servo drive.
Er03.1	Parameter out-of-range	● The number of software parameters changes after upgrade. An address error occurs during reading and writing the change.	● Check whether the parameter access address is out of range. You can view the group number and offset of the error code in U41-06 and U41-07. ● Restore factory settings.
Er03.2	Parameter writing error	● Parameter writing is frequent. ● The control power is unreliable. ● The servo drive is faulty.	● Check whether the communication program contains a command that frequently modifies and writes parameters. ● Check the wiring of the control power and ensure that the control power voltage is within the limit. ● If the fault still persists after several times of power-on, replace the servo drive.
Er03.3	Parameter reading error	● Parameter reading is frequent. ● The servo drive is faulty.	● Check whether the communication program contains a command that frequently reads parameters. ● Modify a parameter, power on the servo drive again, and check whether the modification is saved. ● If the modification is not saved and the fault still persists after several times of power-on replace the servo drive.
Er05.0	Current loop timeout	● The interval for MCU torque interruption scheduling is abnormal.	● If the fault persists after several times of power-on, replace the servo drive.
Er05.1	Speed loop timeout	● The interval for MCU speed scheduling is abnormal.	● If the fault persists after several times of power-on, replace the servo drive.
Er05.2	Position loop timeout	● The interval for MCU position interruption scheduling is abnormal.	● If the fault persists after several times of power-on, replace the servo drive.

Code	Name	Cause	Solution
Er06.0	Runaway protection	● The control circuit is abnormal due to incorrect wiring, resulting in motor runaway and stall.	● Check whether the servo drive power cables are connected to UVW terminals of the motor and servo drive in the correct sequence on both sides. ● Connect the U, V, and W phases according to the correct sequence.
		● The interference signal causes an error in the initial phase detection of the motor rotor upon power-on.	● The U, V, and W phase sequence is correct, but Er06.0 occurs when the servo drive is enabled. Power on the device again.
		● The encoder model is set incorrectly.	● Check the motor model and encoder type. ● Use the matching products.
		● The encoder cable is connected incorrectly, aging, or corroded, or the encoder connector is loose.	● Check whether the encoder cable is aging, corroded, or loosened. ● Re-solder, tighten, or replace the encoder cable.
		● The gravity load is too large when the motor controls a vertical axis.	● Check whether the load of the vertical axis is too large. Reduce the load of the vertical axis, increase the rigidity, or shield this fault without affecting safety and use.
		● The servo vibration is too large due to improper parameters setting.	● Set the parameters properly to avoid large servo vibration.
		● The motor is dragged by an external force in the reverse direction.	● If the motor runs properly and is actually dragged by an external force, consider to shield the protection from out of control (set C06.20 to 0 with caution).
Er10.0	P-hardware overcurrent	● The gain is set improperly and the motor oscillates.	● Adjust the gain after determining the cause.
		● The encoder cable is connected incorrectly, aging, or corroded, or the encoder connector is loose.	● Re-solder, tighten, or replace the encoder cable.
		● Braking resistor overcurrent	● Select a discharge resistor of proper resistance and model and route it again.
		● The servo drive is faulty.	● Replace the servo drive.

Code	Name	Cause	Solution
Er10.1	N-hardware overcurrent	● The gain is set improperly and the motor oscillates.	● Adjust the gain after determining the cause.
		● The encoder cable is connected incorrectly, aging, or corroded, or the encoder connector is loose.	● Re-solder, tighten, or replace the encoder cable.
		● Braking resistor overcurrent	● Select a braking resistor of proper resistance and model and route it again.
		● The motor U/V/W cables are short circuited.	● Connect motor cables correctly or replace the motor with unbalanced resistance.
		● The servo drive is faulty.	● Replace the servo drive.
Er10.2	U phase software overcurrent	● The motor cables are in poor contact.	● Tighten the cables that are loosened or disconnected.
		● The motor cables are grounded.	● Replace the motor in the case of poor insulation.
		● The motor U/V/W cables are short circuited.	● Unplug the motor cables and check whether short-circuit occurs among U, V, and W phases and whether burrs exist on the cable connections. Unplug the motor cables and measure whether the resistance among U, V, and W phases of the motor cable is balanced.
		● The motor is damaged.	● Connect motor cables correctly or replace the motor with unbalanced resistance.
Er10.3	V phase software overcurrent	● The motor cables are in poor contact.	● Tighten the cables that are loosened or disconnected.
		● The motor cables are grounded.	● Replace the motor in the case of poor insulation.
		● The motor U/V/W cables are short circuited.	● Unplug the motor cables and check whether short-circuit occurs among U, V, and W phases and whether burrs exist on the cable connections. Unplug the motor cables and measure whether the resistance among U, V, and W phases of the motor cable is balanced.
		● The motor is damaged.	● Connect motor cables correctly or replace the motor with unbalanced resistance.

Code	Name	Cause	Solution
Er10.4	Output short circuited to ground	● The servo drive power cables (U/V/W) are short-circuited to ground.	● Re-connect or replace the power cables of the servo drive.
		● The motor is short-circuited to ground.	● Replace the motor.
		● The servo drive is faulty.	● Replace the servo drive.
Er10.5	Current sampling failure	● Current sampling of phase U or V is abnormal.	● Check for interference sources on the site. ● Check the grounding of the servo drive and motor and whether anti-interference measures such as shielding are properly applied. ● Add magnetic rings to the power cable and encoder cable of the motor.
		● The internal current sampling chip is damaged.	● Replace the servo drive.
Er10.6	Incorrect current parameter setting	● Incorrect setting of current sampling parameters	● If the fault persists upon next power-on, replace the servo drive.
Er10.7	UV current correction failure	● The current correction detection accuracy error is greater than 5%.	● If the fault persists upon next power-on, replace the servo drive.
Er10.8	Excessive current zero drift	● The current zero drift detected upon power on is greater than the threshold.	● If the fault persists upon next power-on, replace the servo drive.
Er10.9	The sampled current during enabling is too large	● The sampled current during enabling is too large.	● If the fault persists after several times of drive enabling, replace the servo drive.
Er11.0	Excessive motor speed upon servo drive power-on	● The motor is rotating when the servo drive is powered on.	● Keep the motor stationary when the servo drive is powered on.
Er11.1	Drive over-temperature	● Drive over-temperature	● Check whether the fan is abnormal or whether the ambient temperature is too high. ● Improve the installation conditions of the servo unit to reduce the ambient temperature. ● If the fault persists upon next power-on, replace the servo drive.
Er20.1	Encoder internal fault	● The encoder has an internal fault.	● Replace the motor.

Code	Name	Cause	Solution
Er20.2	Encoder reading/writing error	● Encoder data exchange exception upon power-on.	● Use a new encoder cable. If the fault no longer occurs after cable replacement, the original encoder cable is damaged. If the fault persists after the encoder cable is replaced, the encoder may be faulty. In this case, replace the servo motor. ● Add magnetic rings to the power cable and encoder cable of the motor.
Er20.3	Encoder data frame loss	● The encoder cable is abnormal.	● Replace the encoder cable.
		● Intensive interference to the encoder	● Add magnetic rings to the power cable and encoder cable of the motor. ● If the fault persists after the servo drive is powered off and on several times, the encoder is faulty. In this case, replace the servo motor.
Er20.4	Excessive encoder incremental position	● Abnormal single-turn position of the encoder	● Route the motor cables and encoder cables through different routes if they are bundled together. ● If the fault persists after the servo drive is powered off and on several times, the encoder is faulty. In this case, replace the servo motor.
Er20.5	Abnormal encoder data	● Internal parameters of the encoder are abnormal.	● Route the motor cables and encoder cables through different routes if they are bundled together. ● If the fault persists after the servo drive is powered off and on several times, the encoder is faulty. In this case, replace the servo motor.
Er20.6	Mismatch of encoder type	● Motor model mismatch	● Use the motor that matches the drive.
Er20.7	Encoder model not supported	● Encoder model not supported	● Use the motor that matches the drive.
Er20.8	Encoder battery failure	● The encoder battery voltage is too low.	● Replace with a new battery of matching voltage.
		● The battery is replaced or no battery is connected during power-off. ● C00.07 is set to the absolute value for the first time.	● Set F31-10 to 4 to reset the encoder, and power on the machine again.

Code	Name	Cause	Solution
Er20.9	Encoder multi-turn error	● An encoder multi-turn counting error occurs.	● Set F31.10 to 4 to reset the encoder, and power on the machine again. ● If the fault persists after multiple times of power-on, replace the motor.
Er21.0	Mismatch between encoder pulses per revolution and drive pulses per revolution	● Mismatch between encoder pulses per revolution and drive pulses per revolution	● Distribute parameters again for the encoder.
Er31.0	More than ten PDO mapping objects	● The number of mapping objects in TPDO or RPDO exceeds 10.	● Modify the number of PDO mapping objects to a value smaller than or equal to 10.
Er32.0	EtherCAT peripheral error	● EEPROM or IIC bus error.	● Replace the servo drive.
Er32.1	ESI check error in FLASH	● The XML configuration file is not programmed.	● Check whether the XML version in U42.0B is normal. Program the XML file.
Er32.2	Failure to read data from EEPROM through bus	● Reading EtherCAT data from EEPROM fails.	● If the fault persists after the servo drive is powered off and on several times, replace the servo drive.
Er32.3	Failure of update to EEPROM through bus	● The bus fails to update EtherCAT data to EEPROM.	● If the fault persists after the servo drive is powered off and on several times, replace the servo drive.
Er32.4	Correctness of checksum in ESC configuration area	● An error occurs during XML load check.	● If the fault persists after the servo drive is powered off and on several times, replace the servo drive.
Er32.5	EtherCAT failed to obtain valid XML information	● Failed to load the XML file during EtherCAT communication.	● Check whether the XML version in U42.0B is normal. Program the XML file. Contact the technical support personnel.
Er40.0	Drive overload	● The servo drive overloads.	● Check whether the load rate (U40.07) and current feedback during drive running are too large. If large load is required by the operating conditions, use a servo drive of a higher power.
Er41.0	Motor overload	● The motor and encoder cables are connected improperly or in poor contact.	● Connect the cables according to the correct wiring diagram. ● When customized cables are used, prepare and connect the cables according to the wiring instructions.
		● The load is too large. The motor keeps outputting effective torque higher than the rated torque for a long time.	● Check whether the average load factor of the servo drive is greater than 100.0% for a long time.

Code	Name	Cause	Solution
		● Acceleration/deceleration is too frequent or the load inertia is too large.	● Use a large-capacity servo drive and a matching motor, or reduce the load and increase the acceleration/deceleration time. ● Check the mechanical inertia ratio or perform inertia auto-tuning, and view the value. Check the single running cycle when the servo motor runs cyclically. Increase the acceleration/deceleration time during single-cycle running.
		● The gain is improper or the rigidity is too high.	● Check whether the motor vibrates and generates abnormal noise during running. ● Adjust the gain again.
		● The servo drive or motor model is set incorrectly.	● View the servo drive nameplate, set the servo drive and motor models correctly, and use a matching servo motor.
		● Motor locked-rotor occurs due to mechanical factors, resulting in overload during running.	● Eliminate mechanical factors.
		● The servo drive is faulty.	● If the fault persists after the servo drive is powered off and on again, replace the servo drive.
Er41.1	Motor over-temperature due to locked-rotor	● Power output (UVW) phase loss, disconnection, or incorrect phase sequence occurs on the servo drive.	● Perform motor trial run without load and check cable connections with a multimeter. Check whether the cable phase sequence is correct. ● Connect cables again according to the correct wiring diagram or replace the cables.
		● Motor parameters are set incorrectly.	● Read parameters in group R20 and check whether the number of pole pairs is correct. ● Auto-tune the motor angle multiple times and check whether the obtained values are consistent. ● Correct motor parameters.
		● The communication command is interfered.	● Check whether commands from the host controller jitters and eliminate EtherCAT communication interference.
		● Motor locked-rotor occurs due to mechanical factors.	● Check for mechanical factors such as locking, occasional jamming, or eccentricity. ● If the fault persists after the servo drive is powered off and on several times, contact our company for technical support.

Code	Name	Cause	Solution
Er41.2	Motor over-temperature	● The PTC temperature sensor of the motor detects motor over-temperature.	● Check for the PTC motor and check whether the PTC cable is connected to the servo drive. ● If the servo drive or motor does not support PTC, disable the PTC function (C06-16=0).
Er42.2	Heatsink temperature too high	● The ambient temperature is too high.	● Improve the cooling conditions of the servo drive to reduce the ambient temperature.
		● The servo drive is powered off and on for several times to reset the overload fault.	● Change the fault reset method. After overload occurs, wait for 30s before reset. Increase the capacity of the servo drive and motor, increase the acceleration/deceleration time, and reduce the load.
		● The fan is damaged.	● Check whether the fan works when the motor runs. Replace the servo drive.
		● The installation direction or clearance of the servo drive is improper.	● Install the servo drive according to the installation requirements.
		● The servo drive is faulty.	● If the fault persists even though the servo drive is restarted 5 minutes after power-off, replace the servo drive.
Er43.0	Overvoltage	● The main circuit input voltage is too high.	● Replace or adjust the power supply according to the specifications.
		● The power supply is unstable or affected by lightning.	● Monitor whether the power supply of the servo drive is stable, affected by lightning or satisfies the specifications. ● Connect an SPD and then switch on the power supplies of the control circuit and the main circuit. If the fault persists, replace the servo drive.
		● The braking resistor fails.	● Check the wiring of the braking resistor. Measure the resistance of the external braking resistor between P⊕ and C. If the resistance is ∞, the internal cables of the braking resistor are broken. In this case, replace the resistor. ● Set the power and resistance of the external braking resistor according to the specifications of the external braking resistor in use.

Code	Name	Cause	Solution
		● The resistance of the external braking resistor is too large, and energy absorption during braking is insufficient.	● Measure the resistance of the external braking resistor between P⊕ and C and compare the measured value with the recommended value. Connect a new external braking resistor of recommended resistance. ● Set the power and resistance of the external braking resistor according to the specifications of the external braking resistor in use.
		● The motor is in abrupt acceleration/deceleration status. The maximum braking energy exceeds the energy absorption value.	● Confirm the acceleration/deceleration time during running and measure whether the DC bus voltage exceeds the fault threshold during deceleration.
		● The bus voltage sampling value deviates greatly from the actual measured value.	● Ensure the input voltage of the main circuit is within the specified range, and then increase the acceleration/deceleration time within the allowable range. ● Contact our company for technical support.
		● The servo drive is faulty.	● If the fault persists after the main circuit is powered off and on several times. ● Replace the servo drive.
Er43.1	Undervoltage	● The power supply of the main circuit is unstable or power failure occurs. ● Instantaneous power failure occurs.	● Measure whether the input voltages at the main circuit cables and servo drive comply with the specifications. Increase the power capacity.
		● The power voltage drops during operation.	● Monitor the power input voltage of the servo drive and check whether the main circuit power supply is applied to other devices, resulting in insufficient power capacity and voltage drop. Increase the power capacity.
		● Phase loss: A single-phase power supply is used for a three-phase servo drive.	● Check whether the main circuit wiring is correct and secure. ● Replace the cables and connect the main circuit cables properly.
		● The servo drive is faulty.	● If the fault persists after the main circuit is powered off and on several times, replace the servo drive.
Er45.0	S-ON enabling failure	● The multiple S-ON enabling methods conflict.	● Do not turn on the S-ON signal simultaneously for multiple control modes (such as servo background and host controller).

Code	Name	Cause	Solution
Er46.0	Motor overspeed	● The motor cable U, V, and W phase sequence is incorrect.	● Check whether the servo drive power cables are connected to UVW terminals of the motor and servo drive in the correct sequence on both sides. Connect the U, V, and W phases according to the correct sequence.
		● The overspeed threshold is set incorrectly.	● Check whether the overspeed threshold is smaller than the actual maximum motor speed. Reset the overspeed threshold according to the mechanical requirements. When C06.03 is set to 0, the overspeed threshold is the maximum speed of the motor.
		● The input reference exceeds the overspeed threshold.	● Check whether the motor speed corresponding to the input reference exceeds the overspeed threshold. Set the speed limit to a value smaller than the overspeed threshold.
		● The motor speed overshoots.	● Check whether the speed feedback exceeds the overspeed threshold through the commissioning platform. Adjust the gain or mechanical operating conditions.
		● The servo drive is faulty.	● If the fault persists after the servo drive is powered off and on, replace the servo drive.
Er47.0	Excessive position deviation	● Power output (UVW) phase loss or incorrect phase sequence occurs on the servo drive.	● Perform motor trial run without load and check cable connections. ● Connect cables again according to the correct wiring diagram or replace the cables.
		● The servo drive UVW output cable or the encoder cable breaks.	● Check and connect the cables again. Check whether the servo motor power cables (UVW) are in the same phase sequence as the servo drive cables. ● Replace all the cables with new cables if necessary and ensure all the cables are connected securely.
		● Motor locked-rotor occurs due to mechanical factors.	● Eliminate mechanical factors.
		● The servo drive gain is low.	● Adjust the gain manually or perform gain auto-tuning.
		● The position reference increment is too large.	● Increase the acceleration/deceleration ramp. Decrease the gear ratio according to the actual conditions.

Code	Name	Cause	Solution
		● The fault value is too small in relative to the operating conditions.	● Check whether the position deviation fault value is set to a too small value. Increase the position deviation alarm threshold (6065h).
		● The servo drive or motor is faulty.	● Monitor the operating waveform through the oscilloscope function in the drive commissioning platform: position reference, position feedback, speed reference, and torque reference. If the position reference is not 0, but the position feedback is always 0, replace the servo drive or motor.
Er47.1	Position deviation overflow	● Power output (UVW) phase loss or incorrect phase sequence occurs on the servo drive.	● Perform motor trial run without load and check cable connections. ● Connect cables again according to the correct wiring diagram or replace the cables.
		● The servo drive UVW output cable or the encoder cable breaks.	● Check and connect the cables again. Check whether the servo motor power cables (UVW) are in the same phase sequence as the servo drive cables. ● Replace all the cables with new cables if necessary and ensure all the cables are connected securely.
		● Motor locked-rotor occurs due to mechanical factors.	● Eliminate mechanical factors.
		● The servo drive gain is low.	● Adjust the gain manually or perform gain auto-tuning.
		● The position reference increment is too large.	● Adjust the position reference. Decrease the gear ratio according to the actual conditions.
		● The fault value is too small in relative to the operating conditions.	● Check whether the position deviation fault value is set to a too small value. Increase the setpoint.
		● The servo drive or motor is faulty.	● Monitor the operating waveform through the oscilloscope function in the drive commissioning platform: position reference, position feedback, speed reference, and torque reference. If the position reference is not 0, but the position feedback is always 0, replace the servo drive or motor.
Er50.1	D/Q current overflow	● A current sampling error occurs.	● If the fault persists after several times of power-on, replace the servo drive.

Code	Name	Cause	Solution
Er51.0	Offline inertia auto-tuning failure	● Continuous vibration occurs during auto-tuning. The auto-tuning result fluctuates greatly. ● The mechanical connection of the load is loose due to offset of the machinery. ● An alarm is reported during the auto-tuning process, leading to operation interruption. ● Vibration of the load with large inertia cannot be suppressed. The acceleration/deceleration time must be increased to ensure that the motor current is not saturated.	● Enable the vibration suppression function to eliminate vibration if vibration cannot be automatically suppressed. ● Troubleshoot and remove the alarm. After that, perform auto-tuning again. ● Increase the maximum running speed, decrease the acceleration/deceleration time, and shorten the travel of the screw machinery.
Er51.1	Offline inertia parameter error	● The torque during auto-tuning is too large.	● Decrease the auto-tuning speed (C07.01) and auto-tuning target torque (C07.03), and increase the number of auto-tuning turns (C07.04).
Er52.0	Angle auto-tuning failure	● Angle auto-tuning failure	● Set the motor parameters correctly. ● Perform motor wiring again.
Er53.0	Motor parameter auto-tuning timeout	● Motor parameter auto-tuning timeout	● Contact our company for technical support.
Er53.1	Resistance parameter auto-tuning failure	● Resistance parameter auto-tuning failure	● Contact our company for technical support.
Er53.2	Inductance parameter auto-tuning failure	● Inductance parameter auto-tuning failure	● Contact our company for technical support.
Er53.3	Back EMF parameter auto-tuning failure	● Back EMF parameter auto-tuning failure	● Contact our company for technical support.
Er54.0	Current loop auto-tuning failure	● Current loop auto-tuning failure	● Contact our company for technical support.
Er55.0	Excessive vibration	● The vibration is excessive.	● Reset the gain parameters.
Er74.0	EtherCAT synchronization cycle setting error	● After the system switches over to the operation mode, the synchronization cycle is not an integral multiple of 250 μs.	● Change the synchronization cycle of the host controller.

Code	Name	Cause	Solution
Er74.1	No sync signal	● The communication synchronization clock is configured incorrectly for the master.	● Correct the master communication configuration.
Er74.2	Chip synchronization process uncompleted in OP	● Synchronization interrupt is not detected in several position loop periods of the servo drive.	● If the fault persists after re-power-on, contact us.
Er80.0	Control power undervoltage	● The control power supply is unstable or power failure occurs.	● Check whether the voltage drops during control power cutoff or instantaneous power failure occurs. Power on the device again. If the fault is caused by abnormal power failure, ensure stable power supply. Check whether the input voltage of the control power cables satisfies the specifications. Increase the power capacity.
		● The control power cables are in poor contact.	● Check whether control power cables are connected and whether voltage of control power cables on the servo drive side satisfies the specifications. Connect the cables again or replace the cables.
Er81.0	Input phase loss 1	● Input phase loss	● Check whether the input three-phase AC power supply is normal. If the power supply is normal, replace the drive.
Er81.1	Input phase loss 2	● Input phase loss	● Check whether the input three-phase AC power supply is normal. If the power supply is normal, replace the drive.
Er81.2	Output phase loss (reserved)	● Output UVW disconnection	● Replace the motor cable.
Er82.0	DI function allocation fault	● One function is allocated to multiple DI terminals.	● Allocate different function numbers to parameters allocated with the same non-zero function number, and turn on the control power supply to make the settings take effect. Or, disable the S-ON signal and then send a reset signal to make the settings take effect.
		● The function number set for the DI terminal exceeds the maximum value.	● Check whether the MCU program is updated. Restore default settings (F31.02=1) and power on the system again.
Er82.1	DO function allocation fault	● The function number set for the DO terminal exceeds the maximum value.	● Set the correct DO function number. Restore default settings (F31.02=1) and power on the system again.

Code	Name	Cause	Solution
Er84.0	Electronic gear ratio setting error	● The electronic gear ratio exceeds the limit.	● Set the electronic gear ratio correctly (0.001, 4000 x Encoder resolution/10000).
Er84.1	Software limit setting error	● The software limit lower limit is greater than or equal to the upper limit.	● Reset the value to make the minimum software absolute position limit is smaller than the maximum one.
Er84.2	Encoder resolution setting error	● The encoder resolution is abnormal.	● Restore default settings (C31.02=1) and power on the system again.
Er84.3	Home position setting error	● The home offset is beyond the software limits.	● When the encoder works in the incremental, absolute linear, or single-turn absolute value mode, set the home offset to be within the software limits.
		● The home offset is beyond the limits in rotating mode.	● When the encoder works in the rotating mode, set the home offset to a value between the upper and lower limits of the mechanical single-turn.
Er87.1	One-time excessive position reference increment (one-time increment of the target position is over 5 times of the maximum speed)	● The target position increment is too large. One-time increment of the target position is over 5 times of the maximum speed.	● Check the change of two adjacent target positions through the drive commissioning platform. ● Check whether the maximum speed of the motor meets application requirements. If yes, decrease the target position reference increment to lower the planned reference speed. If no, replace the motor. ● Before switching the mode or enabling the S-ON signal, align the target position with the current position feedback. ● Check the encoder resolution and electronic gear ratio set for the host controller. Check whether the encoder resolution matches the actual motor encoder resolution. ● If data received from the slave is incorrect due to communication time sequence error of the host controller, check the communication sequence of the host controller.

Code	Name	Cause	Solution
Er87.2	Continuous excessive position reference increment (increment of the target position exceeds the maximum speed for 3 consecutive times)	● The target position increment is too large. Increment of the target position exceeds the maximum speed for 3 consecutive times.	● Check the change of two adjacent target positions through the drive commissioning platform. ● Check whether the maximum speed of the motor meets application requirements. If yes, decrease the target position reference increment to lower the planned reference speed. If no, replace the motor. ● Before switching the mode or enabling the S-ON signal, align the target position with the current position feedback. ● If data received from the slave is incorrect due to communication time sequence error of the host controller, check the communication sequence of the host controller.
Er87.3	Overflow of 32-bit sign bit of the target position during limiting	● 32-bit sign bit of the target position overflows during limiting.	● The target position reference at the limit is too large.
Er87.4	Target position exceeding maximum value of mechanical single-turn position in rotating mode	● The target position exceeds the single-turn position upper/lower limit in absolute value rotation mode or single-turn rotation mode.	● Set the target position to a value between the single-turn upper and lower limits.
ErA0.1	Multi-turn overflow fault	● The number of turns of the absolute encoder in the forward direction or reverse direction exceeds 32767 or 32768, respectively.	● Set F31-10 to 4 to reset the fault and multi-turn data, and power on the machine again. Perform homing again when necessary.
ErC1.0	Excessive EtherCAT synchronization period error	● The synchronization period error of the controller is too large.	● Increase the value of the manufacturer parameter C13.06. If the fault persists, replace the drive.
ErC1.1	Synchronization loss	● The communication synchronization clock is configured incorrectly for the master.	● Perform the test on another master. Correct the master communication configuration.
		● The IN and OUT ports for EtherCAT communication are connected inversely.	● Connect the IN and OUT ports in the correct sequence.

Code	Name	Cause	Solution
		● The controller chip of the slave is damaged.	● If the fault persists after the master is replaced, use an oscilloscope to measure the synchronization signal generated by the slave controller chip. If there is no signal, the slave controller chip is damaged. Return to factory for repair or replace the controller chip of the slave.
		● The MCU pin is damaged.	● Use an oscilloscope to measure the synchronization signal generated by the slave controller chip. If there is signal, the MCU chip pin is damaged. Return to factory for repair or replace the MCU chip.
ErC1.2	Network status switchover error	● Master malfunction or manual malfunction occurs.	● Check the network status switchover program of the host controller. ● Use a shielded twisted-pair communication cable. ● Ground the servo drive according to the standard. ● Check the network connection status according to the LED.
ErC1.4	Network cable connection unreliable	● The physical connection of the data link is unstable, or the process data is lost due to network cable connection and removal.	● Check whether the network cable connection of the drive is reliable and firm, and whether there is severe vibration on site.
ErC1.5	Data frame loss protection error	● Data loss occurs due to EMC interference, poor network cable quality, or poor connection.	● Ensure reliable grounding and correct EMC. ● Check whether the network cable is the one specified by JSS-MOTOR. ● Check whether the network cable connection is reliable.
ErC1.6	Data frame forwarding error	● An upper station has detected and marked that the data frame has been damaged. When the data frame is forwarded to the current slave, an alarm is reported.	● Ensure reliable grounding and correct EMC. ● Check whether the network cable is the one specified by JSS-MOTOR. ● Check whether the network cable connection is reliable.
ErC1.7	Data update timeout	● The data frame has been lost or discarded at an upper station or the master performance is poor.	● Check whether the load of the master CPU is excessive. Change the sync signal offset value.
ErC1.8	Watchdog expired	● The master configuration is incorrect.	● Modify the watchdog configuration of the host controller.

Code	Name	Cause	Solution
ErC2.0	SYNC signal loss	● The physical connection of the data link is unstable, or the process data is lost due to network cable connection and removal.	● Replace the network cable with a more reliable one. If the fault persists, contact technical support.
ALF0.0	Emergency stop alarm	● Check whether the logic of the DI allocated with function 4 (Emergency stop) is valid.	● Check the operation mode and clear DI emergency stop valid signal when safety is guaranteed.
ALF1.0	Re-power-on required for parameter settings to take effect	● Modifications of some servo drive parameters take effect only after the servo drive is powered on again. After these parameters are modified, the servo drive reminds users to restart it.	● Power on the device again.
ALF1.2	Torque reached parameter error	● In torque control mode, the DO setting for torque reach is invalid.	● Set the torque output when torque reached DO signal turned on to be greater than torque output when torque reached DO signal turned off. Set C03.4A to be greater than C03.4B.
ALF1.3	Too frequent writing of EEPROM by host controller SDO	● A large number of parameters are modified and saved frequently.	● Do not frequently write parameters into cloud platform EEPROM on the host controller.
ALF2.0	Forward overtravel alarm	● The positive limit (PL) DI is active.	● Run the motor in the reverse direction to the restricted range.
		● The drive position feedback is at the forward software position limit.	● Run the motor in the reverse direction to the re-stricted range or increase the positive software position limit.
		● The home offset setting exceeds the software position limit.	● Set the home offset within the software position limit range.
ALF2.1	Reverse overtravel alarm	● The negative limit (NL) DI is active.	● Run the motor in the forward direction to the restricted range.
		● The drive position feedback is at the reverse software position limit.	● Run the motor in the forward direction to the restricted range or decrease the positive software position limit.
		● The home offset setting exceeds the software position limit.	● Set the home offset within the software position limit range.

Code	Name	Cause	Solution
ALF4.0	Homing timeout	● The homing time exceeds the setpoint.	● Appropriately adjust the homing speed and homing time, and ensure that the external home signal connection is reliable (if used).
ALF4.1	Homing DI conflict	● During homing, both the forward and reverse limits are valid or both the home signal and limit signal are valid.	● Check whether the home signal and limit signal are correct.
ALF4.2	Homing mode conflict	● The homing mode is set incorrectly.	● Check whether the homing mode set in object dictionary 6098h on the host controller is correct.
ALF5.0	Braking resistor overload	● The cable connected to the external braking resistor is in poor contact, disconnected, or broken.	● Connect the external braking resistor between P⊕ and C with a new cable. ● Replace the external braking resistor with a new one. Ensure that the resistance measured is the same as the nominal value, and then connect the resistor between P⊕ and C.
		● The resistance of the external braking resistor used is too large.	● Select a resistor with a proper resistance according to the specification requirements.
		● The resistance setpoint is greater than the resistance of the external braking resistor used.	● Set the value according to the resistance of the external bleeder resistor in use.
		● The input voltage of the main circuit is beyond the specification.	● Replace or adjust the power supply according to the specifications.
		● The load moment of inertia ratio is too large.	● Select an external braking resistor with large capacity and set its resistance to the actual one.
		● The motor speed is too high and the deceleration process is not completed within the set deceleration time. The motor is in continuous deceleration state during cyclic running.	● Select a servo drive with a large capacity.
		● The capacity of the servo drive or the braking resistor is insufficient.	● Reduce the load if allowed. ● Increase the acceleration/deceleration time if allowed. ● Increase the motor running cycle if allowed.

Code	Name	Cause	Solution
ALF5.1	External braking resistance too small	● The resistance of the external braking resistor is smaller than permissible minimum resistance by the servo drive.	● Replace with an external braking resistor matching the servo drive, with the resistance greater than the minimum value, and set C00.10 to the resistance value.
ALF6.1	Output phase loss	● The output current is abnormal.	● Check whether the power cable is broken. If so, replace the cable.
ALF8.0	Vibration occurred during auto-tuning	● Continuous vibration occurs during auto-tuning. ● The mechanical connection of the load is loose due to offset of the machinery.	● Check the mechanical installation clearance and connection reliability.
		● Vibration of the load with large inertia cannot be suppressed. The acceleration/deceleration time must be increased to ensure that the mo-tor current is not saturated.	● Appropriately adjust the inertia auto-tuning parameters (C07.00, C07.01, C07.03, and C07.04), reduce the values of the auto-tuning speed (C07.01) and auto-tuning target torque (C07.03), and increase the number of auto-tuning turns (C07.04).
ALF9.0	Encoder battery voltage low	● The encoder battery voltage is too low.	● Replace the encoder battery.
ALFA.0	Drive high temperature warning	● Drive high temperature warning	● Check whether the fan is abnormal or whether the ambient temperature is too high. ● Improve the installation conditions of the servo unit to reduce the ambient temperature.
xxnr	Servo not ready	● The voltage of the control power is too low.	● Check the U40.35 parameter for the control bus voltage, and ensure that the power supply is normal.
		● The main circuit voltage is too low.	● Check the U40.36 parameter for the primary bus voltage, and ensure that the power supply is normal.
		● The input AC signal is abnormal.	● Check the input AC power supply and the three-phase AC main power supply, and ensure that the power supply is normal.
		● The encoder battery voltage is too low.	● Measure the voltage of the encoder battery. If the voltage is less than 2.9 V, replace the battery.

Chapter 11 Parameter List

11.1 Parameter Group Description

Parameter access address: index+subindex, both in hexadecimal format

The CiA402 protocol has the following constraints on the address of system parameters.

Index	Description
0001h—0FFFh	Data type description
1000h—1FFFh	CoE communication object
2000h—5FFFh	Manufacturer specific object
6000h—9FFFh	Sub-protocol object
A000h—FFFFh	Reserved

11.2 Parameter List

11.2.1 Common Parameters in Group 2000h

Parameters (2000h/C00)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C00.00	Control mode	10: EtherCAT	0-10	10	-	U16	At stop	Immediately
02h	C00.01	Motor rotating direction	0: CCW 1: CW	0-1	0	-	U16	At stop	Upon re-power-on
05h	C00.04	Auto-tuning mode	0: Manual mode 1: Standard mode 2: Positioning mode	0-2	1	-	U16	During operation	Immediately
06h	C00.05	Stiffness level	-	1-31	12	-	U16	During operation	Immediately
07h	C00.06	Load inertia ratio	-	0-12000	100	%	U16	During operation	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
08h	C00.07	Absolute mode	0: Incremental position mode 1: Absolute position linear mode 2: Absolute position linear infinite mode 3: Absolute position single-turn mode 4: Absolute position rotation mode 5: Absolute mechanical single-turn mode (operating direction selectable)	0-5	0	-	U16	At stop	Upon re-power-on
11h	C00.10	Bleeder resistor selection	0: Internal bleeder resistor 1: External bleeder resistor 2: No bleeder resistor 3: Capacitor bleeder resistor	0-3	0	-	U16	At stop	Immedi-ately
12h	C00.11	Bleeder resistor power	-	1-65535	50	W	U16	At stop	Immedi-ately
13h	C00.12	Bleeder resistor resistance	-	1-65535	50	Ω	U16	At stop	Immedi-ately
14h	C00.13	Bleeder resistor heat dissipation coeffi-cient	-	1-100	30	-	U16	During operation	Immedi-ately
15h	C00.14	Brake enable switch	-	0-1	0	-	U16	At stop	Immedi-ately
17h	C00.16	Panel display	0: Default display 1: Speed display 2: Torque display 3: Voltage display 4: Load rate display	0-4	0	-	U16	During operation	Immedi-ately
32h	C00.31	Super user	-	0-65535	0	-	U16	During operation	Immedi-ately

NOTICE

- For details about parameters above, refer to section 11.3.1 "Group C00".

Basic Gain Parameters (2001h/C01)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C01.00	1st position loop gain	-	0-20000	400	0.1rad/s	U16	During operation	Immediately
02h	C01.01	1st speed loop gain	-	1-20000	250	0.1Hz	U16	During operation	Immediately
03h	C01.02	1st speed loop integral time parameter	-	1-51200	3184	0.01ms	U16	During operation	Immediately
04h	C01.03	1st torque reference filter cutoff frequency	-	5-16000	200	Hz	U16	During operation	Immediately
09h	C01.08	2nd position loop gain	-	0-20000	560	0.1rad/s	U16	During operation	Immediately
0Ah	C01.09	2nd speed loop gain	-	1-20000	350	0.1Hz	U16	During operation	Immediately
0Bh	C01.0A	2nd speed loop integral time parameter	-	1-51200	2274	0.01ms	U16	During operation	Immediately
0Ch	C01.0B	2nd torque reference filter cutoff frequency	-	5-16000	280	Hz	U16	During operation	Immediately
11h	C01.10	Speed feedback filter	0: Internal setting 1: Low-pass filter 2: Overlapping average filter 3: Speed observer 4: No filter	0-4	0	-	U16	At stop	Immediately
12h	C01.11	Cutoff frequency of speed feedback low-pass filter	-	10-16000	8000	Hz	U16	During operation	Immediately
13h	C01.12	Speed feedback overlapping average filter time constant	0: No filter 1: 2 times filter 2: 4 times filter 3: 8 times filter 4: 16 times filter 5: 32 times filter 6: 64 times filter	0-6	0	-	U16	During operation	Immediately
14h	C01.13	Speed feedforward source	0: No feedforward 1: Internal reference 2: Model tracking 5: Communication	0-5	0	-	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
15h	C01.14	Speed feedforward percentage	-	0-2000	0	0.1%	U16	During operation	Immediately
16h	C01.15	Speed feedforward filter cutoff frequency	-	5-16000	318	Hz	U16	During operation	Immediately
17h	C01.16	Torque feedforward source	0: No feedforward 1: Internal reference 2: Model tracking 5: Communication	0-5	0	-	U16	During operation	Immediately
18h	C01.17	Torque feedforward percentage	-	0-2000	0	0.1%	U16	During operation	Immediately
19h	C01.18	Torque feedforward filter cutoff frequency	-	5-16000	318	Hz	U16	During operation	Immediately
1Ch	C01.1B	PDFF control coefficient	-	0-1000	1000	0.1%	U16	During operation	Immediately
1Dh	C01.1C	Damping factor control coefficient	-	0-1000	0	0.1%	U16	During operation	Immediately
21h	C01.20	Position reference overlapping average filter time constant A	-	0-1280	0	0.1ms	U16	At stop	Immediately
22h	C01.21	Position reference overlapping average filter time constant B	-	0-1280	0	0.1ms	U16	At stop	Immediately
23h	C01.22	Position reference low-pass filter time constant A	-	0-65535	0	0.1ms	U16	At stop	Immediately
24h	C01.23	Position reference low-pass filter time constant B	-	0-65535	0	0.1ms	U16	At stop	Immediately
25h	C01.24	1st notch filter frequency of position reference	-	0-2000	0	0.1Hz	U16	At stop	Immediately
26h	C01.25	1st notch filter width of position reference	-	0-1000	0	0.1%	U16	At stop	Immediately
27h	C01.26	1st notch filter depth of position reference	-	10-1000	1000	0.1%	U16	At stop	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
28h	C01.27	2nd notch filter frequency of position reference	-	0-2000	0	0.1Hz	U16	At stop	Immediately
29h	C01.28	2nd notch filter width of position reference	-	0-1000	0	0.1%	U16	At stop	Immediately
2Ah	C01.29	2nd notch filter depth of position reference	-	10-1000	1000	0.1%	U16	At stop	Immediately
2Bh	C01.2A	Position reference pre-charge filter time constant	-	0-1280	0	0.1ms	U16	At stop	Immediately
31h	C01.30	Adaptive notch mode	0: Disabled 1: 1st notch 2: 2nd notch 3: Notch parameter reset 4: Resonance frequency tested only	0-4	0	-	U16	During operation	Immediately
32h	C01.31	Adaptive notch test times	-	0-65535	0	Times	U16	At stop	Immediately
39h	C01.38	Gain switchover mode	0: Fixed to the 1st gain set 1: DI switchover 2: DI P-PI switchover 3: Torque reference 4: Speed reference 5: Speed feedback 6: Speed reference change rate 7: Position deviation 8: Position reference	0-8	0	-	U16	At stop	Immediately
3Ah	C01.39	Gain switchover time	-	10-10000	50	0.1ms	U16	During operation	Immediately
3Bh	C01.3A	Gain switchover threshold	-	0-65535	10	-	U16	During operation	Immediately
3Ch	C01.3B	Gain switchover loop width	-	0-65535	10	-	U16	During operation	Immediately
41h	C01.40	Frequency of the 1st notch	-	10-8000	8000	Hz	U16	During operation	Immediately
42h	C01.41	Width level of the 1st notch	-	0-4000	0	0.1%	U16	During operation	Immediately
43h	C01.42	Depth level of the 1st notch	-	10-1000	1000	0.1%	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
44h	C01.43	Frequency of the 2nd notch	-	10-8000	8000	Hz	U16	During operation	Immediately
45h	C01.44	Width level of the 2nd notch	-	0-4000	0	0.1%	U16	During operation	Immediately
46h	C01.45	Depth level of the 2nd notch	-	10-1000	1000	0.1%	U16	During operation	Immediately
47h	C01.46	Frequency of the 3rd notch	-	10-8000	8000	Hz	U16	During operation	Immediately
48h	C01.47	Width level of the 3rd notch	-	0-4000	0	0.1%	U16	During operation	Immediately
49h	C01.48	Depth level of the 3rd notch	-	10-1000	1000	0.1%	U16	During operation	Immediately
4Ah	C01.49	Frequency of the 4th notch	-	10-8000	8000	Hz	U16	During operation	Immediately
4Bh	C01.4A	Width level of the 4th notch	-	0-4000	0	0.1%	U16	During operation	Immediately
4Ch	C01.4B	Depth level of the 4th notch	-	10-1000	1000	0.1%	U16	During operation	Immediately
4Dh	C01.4C	Frequency of the 5th notch	-	10-8000	8000	Hz	U16	During operation	Immediately
4Eh	C01.4D	Width level of the 5th notch	-	0-4000	0	0.1%	U16	During operation	Immediately
4Fh	C01.4E	Depth level of the 5th notch	-	10-1000	1000	0.1%	U16	During operation	Immediately

NOTICE

- For details about parameters above, refer to section 11.3.2 "Group C01".

Advanced Gain Parameters (2002h/C02)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C02.00	Model tracking control	0: Disabled 1: Single mass model tracking	0-1	0	-	U16	At stop	Immediately
02h	C02.01	Model tracking control gain	-	10-20000	500	0.1rad/s	U16	During operation	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
03h	C02.02	Model tracking inertia correction coefficient	-	10-8000	1000	0.1%	U16	During operation	Immedi-ately
31h	C02.30	Speed observer gain	-	0-40000	0	0.1Hz	U16	During operation	Immedi-ately
32h	C02.31	Speed observer inertia correction	-	10-8000	1000	0.1%	U16	During operation	Immedi-ately
33h	C02.32	Speed observer speed feedback cutoff frequency	-	0-16000	0	Hz	U16	During operation	Immedi-ately
39h	C02.38	Frequency for vibration suppression 1	-	10-20000	1000	0.1Hz	U16	During operation	Immedi-ately
3Ah	C02.39	Inertia correction for vibration suppression 1	-	10-8000	1000	0.1%	U16	During operation	Immedi-ately
3Bh	C02.3A	Low-pass filter correction for vibration suppression 1	-	-9999-9999	0	0.1Hz	I16	During operation	Immedi-ately
3Ch	C02.3B	Correction of high-pass filter 1 for vibration sup-pression 1	-	-9999-9999	0	0.1Hz	I16	During operation	Immedi-ately
3Dh	C02.3C	Frequency of high-pass filter 2 for vibration sup-pression 1	-	10-50000	20000	0.1Hz	U16	During operation	Immedi-ately
3Eh	C02.3D	Ratio of compensation 1 for vibration suppression 1	-	0-20000	0	0.1%	U16	During operation	Immedi-ately
3Fh	C02.3E	Ratio of compensation 2 for vibration suppression 1	-	0-20000	0	0.1%	U16	During operation	Immedi-ately
41h	C02.40	Frequency for vibration suppression 2	-	10-20000	1000	0.1Hz	U16	During operation	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
42h	C02.41	Inertia correction for vibration suppression 2	-	10-8000	1000	0.1%	U16	During operation	Immediately
43h	C02.42	Low-pass filter correction for vibration suppression 2	-	-9999-9999	0	0.1Hz	I16	During operation	Immediately
44h	C02.43	Correction of high-pass filter 1 for vibration suppression 2	-	-9999-9999	0	0.1Hz	I16	During operation	Immediately
45h	C02.44	Frequency of high-pass filter 2 for vibration suppression 2	-	10-50000	20000	0.1Hz	U16	During operation	Immediately
46h	C02.45	Ratio of compensation 1 for vibration suppression 2	-	0-20000	0	0.1%	U16	During operation	Immediately
47h	C02.46	Ratio of compensation 2 for vibration suppression 2	-	0-20000	0	0.1%	U16	During operation	Immediately
49h	C02.48	Frequency for vibration suppression 3	-	10-20000	1000	0.1Hz	U16	During operation	Immediately
4Ah	C02.49	Inertia correction for vibration suppression 3	-	10-8000	1000	0.1%	U16	During operation	Immediately
4Bh	C02.4A	Low-pass filter correction for vibration suppression 3	-	-9999-9999	0	0.1Hz	I16	During operation	Immediately
4Ch	C02.4B	Correction of high-pass filter 1 for vibration suppression 3	-	-9999-9999	0	0.1Hz	I16	During operation	Immediately
4Dh	C02.4C	Frequency of high-pass filter 2 for vibration suppression 3	-	10-50000	20000	0.1Hz	U16	During operation	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
4Eh	C02.4D	Ratio of compensation 1 for vibration suppression 3	-	0-20000	0	0.1%	U16	During operation	Immedi-ately
4Fh	C02.4E	Ratio of compensation 2 for vibration suppression 3	-	0-20000	0	0.1%	U16	During operation	Immedi-ately
61h	C02.60	Disturbance observer gain	-	0-40000	0	0.1Hz	U16	During operation	Immedi-ately
62h	C02.61	Disturbance observer inertia correction coefficient	-	1-10000	1000	0.1%	U16	During operation	Immedi-ately
63h	C02.62	Disturbance observer low-pass cutoff frequency	-	0-16000	0	Hz	U16	During operation	Immedi-ately
64h	C02.63	Disturbance observer compensation torque per-centage	-	0-2000	0	0.1%	U16	During operation	Immedi-ately
69h	C02.68	Friction compensation switch and relevant setting	-	0-255	0	-	U16	During operation	Immedi-ately
6Ah	C02.69	Friction compensation speed threshold	-	0-5000	20	0.1rpm	U16	During operation	Immedi-ately
6Bh	C02.6A	Static friction compensation	-	0-2000	0	0.1%	U16	During operation	Immedi-ately
6Ch	C02.6B	Forward friction compensation of coulomb friction	-	0-2000	0	0.1%	U16	During operation	Immedi-ately
6Dh	C02.6C	Reverse friction compensation of coulomb friction	-	-2000-0	0	0.1%	I16	During operation	Immedi-ately
6Eh	C02.6D	Viscous friction torque for rated speed	-	0-2000	0	0.1%	U16	During operation	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
6Fh	C02.6E	Friction compensation filter time	-	0-65535	0	0.01ms	U16	During operation	Immediately
70h	C02.6F	Friction compensation threshold for zero speed	-	0-1000	10	0.1rpm	U16	During operation	Immediately

Instruction Parameters (2003h/C03)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
22h	C03.21	Speed reference	-	-8000-8000	100	rpm	I16	During operation	Immediately
23h	C03.22	Acceleration rate	-	0-3600000	10	ms	U32	During operation	Immediately
25h	C03.24	Deceleration rate	-	0-3600000	10	ms	U32	During operation	Immediately
28h	C03.27	Internal positive speed limit	-	0-8000	6000	rpm	U16	During operation	Immediately
29h	C03.28	Internal negative speed limit	-	0-8000	6000	rpm	U16	During operation	Immediately
2Ch	C03.2B	Speed reach threshold	-	0-8000	1000	rpm	U16	During operation	Immediately
2Dh	C03.2C	Speed synchronization threshold	-	0-1000	10	rpm	U16	During operation	Immediately
2Eh	C03.2D	Speed rotation threshold	-	0-1000	20	rpm	U16	During operation	Immediately
2Fh	C03.2E	Zero speed output threshold	-	0-1000	10	rpm	U16	During operation	Immediately
42h	C03.41	Torque reference	-	-4000-4000	0	0.1%	I16	During operation	Immediately
44h	C03.43	Internal positive torque limit	-	0-4000	3000	0.1%	U16	During operation	Immediately
45h	C03.44	Internal negative torque limit	-	0-4000	3000	0.1%	U16	During operation	Immediately
48h	C03.47	Positive speed limit in torque mode	-	0-8000	3000	rpm	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
49h	C03.48	Negative speed limit in torque mode	-	0-8000	3000	rpm	U16	During operation	Immediately
4Ah	C03.49	Reference value for torque reach	-	0-4000	0	0.1%	U16	During operation	Immediately
4Bh	C03.4A	Valid value for torque reached	-	0-4000	200	0.1%	U16	During operation	Immediately
4Ch	C03.4B	Invalid value for torque reached	-	0-4000	100	0.1%	U16	During operation	Immediately

NOTICE

- For details about parameters above, refer to section 11.3.3 "Group C03".

I/O Parameters (2004h/C04)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C04.00	DI1 function selection	0: No definition 1: S-ON 2: Fault reset 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 30: Probe 1 31: Probe 2	0-32	6	-	U16	At stop	Immediately
02h	C04.01	DI1 logic selection	0: Active low 1: Active high	0-1	0	-	U16	During operation	Immediately
03h	C04.02	DI1 filter time	-	0-65535	150	0.01ms	U16	During operation	Immediately
05h	C04.04	DI2 function selection	0: No definition 1: S-ON 2: Fault reset 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 30: Probe 1 31: Probe 2	0-32	7	-	U16	At stop	Immediately
06h	C04.05	DI2 logic selection	0: Active low 1: Active high	0-1	0	-	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
07h	C04.06	DI2 filter time	-	0-65535	150	0.01ms	U16	During operation	Immediately
09h	C04.08	DI3 function selection	0: No definition 1: S-ON 2: Fault reset 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 30: Probe 1 31: Probe 2	0-32	5	-	U16	At stop	Immediately
0Ah	C04.09	DI3 logic selection	0: Active low 1: Active high	0-1	0	-	U16	During operation	Immediately
0Bh	C04.0A	DI3 filter time	-	0-65535	150	0.01ms	U16	During operation	Immediately
0Dh	C04.0C	DI4 function selection	0: No definition 1: S-ON 2: Fault reset 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 30: Probe 1 31: Probe 2	0-32	31	-	U16	At stop	Immediately
0Eh	C04.0D	DI4 logic selection	0: Active low 1: Active high	0-1	0	-	U16	During operation	Immediately
0Fh	C04.0E	DI4 filter time	-	0-65535	150	0.01ms	U16	During operation	Immediately
11h	C04.10	DI5 function selection	0: No definition 1: S-ON 2: Fault reset 4: Emergency stop 5: Home switch 6: Forward overtravel 7: Reverse overtravel 30: Probe 1 31: Probe 2	0-32	30	-	U16	At stop	Immediately
12h	C04.11	DI5 logic selection	0: Active low 1: Active high	0-1	0	-	U16	During operation	Immediately
13h	C04.12	DI5 filter time	-	0-65535	150	0.01ms	U16	During operation	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
31h	C04.30	DO1 function selection	0: No definition 1: Servo ready 2: Motor rotation 9: Brake output 10: Alarm 11: Fault 32: EDM safety state	0-20	1	-	U16	At stop	Immediately
32h	C04.31	DO1 logic selection	0: Active low 1: Active high	0-1	0	-	U16	During operation	Immediately
33h	C04.32	DO2 function selection	0: No definition 1: Servo ready 2: Motor rotation 9: Brake output 10: Alarm 11: Fault 32: EDM safety state	0-20	4	-	U16	At stop	Immediately
34h	C04.33	DO2 logic selection	0: Active low 1: Active high	0-1	0	-	U16	During operation	Immediately
35h	C04.34	DO3 function selection	0: No definition 1: Servo ready 2: Motor rotation 9: Brake output 10: Alarm 11: Fault 32: EDM safety state	0-20	3	-	U16	At stop	Immediately
36h	C04.35	DO3 logic selection	0: Active low 1: Active high	0-1	0	-	U16	During operation	Immediately

Stop Mode (2005h/C05)

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
03h	C05.02	Stop mode at overtravel	0: Coast to stop, keeping de-energized status 1: Stop at zero speed, keeping position lock status 2: Stop at zero speed, keeping de-energized status 3: Ramp to stop as defined by 6085h, keeping de-energized status 4: Ramp to stop as defined by 6085h, keeping position lock status 5: Dynamic braking stop, keeping de-energized status 6: Dynamic braking stop, keeping dynamic braking status 7: Not responding to overtravel	0-7	1	-	U16	At stop	Immedi-ately
04h	C05.03	Stop mode at No. 1 fault	0: Coast to stop, keeping de-energized status 1: Dynamic braking stop, keeping de-energized status 2: Dynamic braking stop, keeping dynamic braking status	0-2	2	-	U16	At stop	Immedi-ately
0Dh	C05.0C	Limit for stop at emergency-stop torque	-	0-3000	1000	0.1%	U16	During operation	Immedi-ately
0Eh	C05.0D	Maximum downtime	-	0-65535	10000	ms	U16	At stop	Immedi-ately
11h	C05.10	Delay from brake close to motor de-energized	-	0-65535	100	ms	U16	During operation	Immedi-ately
12h	C05.11	Speed threshold at brake closing	-	10-3000	30	rpm	U16	During operation	Immedi-ately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
13h	C05.12	Maximum waiting time with S-ON off at brake closing	-	0-65535	100	ms	U16	During operation	Immediately
14h	C05.13	Delay from brake on to command received	-	0-65535	100	ms	U16	At stop	Immediately
15h	C05.14	Energizing delay of DB relay	-	0-65535	20	ms	U16	At stop	Immediately

NOTICE

- For details about parameters above, refer to section 11.3.4 "Group C05".

Protection Parameters (2006h/C06)

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
04h	C06.03	Threshold of excessive speed	-	0-9000	0	rpm	U16	During operation	Immediately
05h	C06.04	Input phase loss detection	0: Enabled 1: Disabled	0-1	0	-	U16	At stop	Immediately
06h	C06.05	Retentive at power failure	0: Non-retentive 1: Retentive	0-1	0	-	U16	At stop	Immediately
08h	C06.07	Mechanical limit position	0: Inactive 1: Enabled 2: Enabled after homing	0-2	0	-	U16	During operation	Immediately
09h	C06.08	Mechanical PL	-	-2^{31}-(2^{31}-1)	2^{31}-1	Unit in application	I32	During operation	Immediately
0Bh	C06.0A	Mechanical NL	-	-2^{31}-(2^{31}-1)	-2^{31}	Unit in application	I32	During operation	Immediately
11h	C06.10	Drive overload protection threshold	-	0-3500	1150	0.1%	U16	At stop	Immediately
12h	C06.11	Motor overload protection threshold	-	0-3500	1150	0.1%	U16	At stop	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
13h	C06.12	Motor locked-rotor detection	0: Inactive 1: Enabled	0-1	1	-	U16	At stop	Immedi-ately
14h	C06.13	Motor locked-rotor detection time	-	0-3000	200	ms	U16	At stop	Immedi-ately
15h	C06.14	Motor locked-rotor detection speed	-	0-1000	10	rpm	U16	During operation	Immedi-ately
16h	C06.15	Output phase loss detection	0: Inactive 1: Enabled	0-1	0	-	U16	At stop	Immedi-ately
1Dh	C06.1C	Encoder communication fault tolerance threshold	-	0-88	3	-	U16	At stop	Immedi-ately
21h	C06.20	Protection from out of control	0: Inactive 1: Enabled	0-1	1	-	U16	At stop	Immedi-ately

NOTICE

- For details about parameters above, refer to section 11.3.5 "Group C06".

Auto-tuning Parameters (2007h/C07)

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
01h	C07.00	Offline inertia auto-tuning mode setting	-	0-785	769	-	U16	At stop	Immedi-ately
02h	C07.01	Offline inertia auto-tuning speed reference	-	50-1000	500	rpm	U16	At stop	Immedi-ately
03h	C07.02	Acceleration/ Deceleration time for offline inertia auto-tuning	-	0-65535	100	ms	U16	At stop	Immedi-ately
04h	C07.03	Offline inertia auto-tuning target torque	-	1-1500	150	0.1%	U16	At stop	Immedi-ately
05h	C07.04	Offline inertia auto-tuning revolutions	-	10-65535	200	0.01r	U16	At stop	Immedi-ately

Communication Parameters (200Ah/C0A)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
09h	C0A.08	Commissioning software communication station ID	-	1-255	1	-	U16	At stop	Immediately
0Ah	C0A.09	Commissioning software communication baud rate	0: 1200bps 1: 2400bps 2: 4800bps 3: 9600bps 4: 19200bps 5: 38400bps 6: 57600bps 7: 115200bps	0-7	7	-	U16	At stop	Upon re-power-on
0Bh	C0A.0A	Commissioning software communication format	0: No parity, 1 stop bit 1: Odd parity, 1 stop bit 2: Even parity, 1 stop bit 3: No parity, 2 stop bits 4: Odd parity, 2 stop bits 5: Even parity, 2 stop bits	0-5	0	-	U16	At stop	Upon re-power-on
0Ch	C0A.0B	Commissioning software communication response time	-	1-1000	1	ms	U16	At stop	Immediately
0Dh	C0A.0C	Commissioning software communication timeout	-	0-65535	0	-	U16	Read only	Immediately
0Eh	C0A.0D	Commissioning software communication storage	0: No storage 1: Storage	0-1	1	-	U16	At stop	Immediately
0Fh	C0A.0E	Commissioning software data format	0: Low 16 bits before high 16 bits 1: High 16 bits before low 16 bits	0-1	0	-	U16	At stop	Immediately

NOTICE

- For details about parameters above, refer to section 11.3.6 "Group C0A".

Homing Touch Probe Parameters (2010h/C10)

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
01h	C10.00	Homing enable	0: Inactive 1: Written through communication 2: DI trigger 3: Current position as home	0-3	0	-	U16	During operation	Immedi-ately
09h	C10.08	Homing timeout interval	-	0-(2^{32}-1)	60000	ms	U32	During operation	Immedi-ately
11h	C10.10	Multi-turn absolute position offset (low 32 bits)	-	-2^{31}-(2^{31}-1)	0	P	I32	At stop	Upon re-power-on
13h	C10.12	Multi-turn absolute position offset (high 32 bits)	-	-2^{31}-(2^{31}-1)	0	P	I32	At stop	Upon re-power-on
15h	C10.14	Multi-turn revolutions data offset	-	0-65535	0	Rev	U16	Read only	Immedi-ately
16h	C10.15	Multi-turn overflow flag	-	0-1	0	-	U16	Read only	Immedi-ately
17h	C10.16	Reference running mode in rotation mode	0: Nearest 1: Always in forward direction 2: Always in reverse direction 3: Always in current direction 4: Not specified	0-4	0	-	U16	At stop	Immedi-ately
19h	C10.18	Numerator of electronic gear ratio in rotation mode	-	1-65535	1	-	U16	At stop	Immedi-ately
1Ah	C10.19	Denominator of electronic gear ratio in rotation mode	-	1-65535	1	-	U16	At stop	Immedi-ately
1Bh	C10.1A	Upper limit of mechanical absolute position in ro-tation mode (low 32 bits)	-	0-(2^{32}-1)	0	P	U32	At stop	Immedi-ately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
1Dh	C10.1C	Upper limit of mechanical absolute position in ro-tation mode (high 32 bits)	-	0-(2^{32}-1)	0	P	U32	At stop	Immediately
1Fh	C10.1E	Single-turn homing absolute value offset	-	-2^{31}-(2^{31}-1)	0	Unit in application	I32	At stop	Upon re-power-on
31h	C10.30	Torque limit of homing upon hit-and-stop	-	0-3000	1000	0.1%	U16	During operation	Immediately
32h	C10.31	Speed for homing upon hit-and-stop	-	0-1000	10	rpm	U16	During operation	Immediately
33h	C10.32	Number of times for homing upon hit-and-stop	-	0-65535	30	-	U16	During operation	Immediately

EtherCAT Parameters (2013h/C13)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	C13.00	EtherCAT slave name	-	0-65535	0	-	U16	Read only	Immediately
02h	C13.01	EtherCAT slave alias	-	0-65535	0	-	U16	During operation	Immediately
03h	C13.02	EtherCAT sync loss threshold	-	1-20	8	-	U16	During operation	Immediately
04h	C13.03	EtherCAT synchronization detection mode	-	0-65535	0	-	U16	At stop	Immediately
05h	C13.04	EtherCAT sync loss count	-	0-65535	0	-	U16	Read only	Immediately
06h	C13.05	EtherCAT synchronization mode setting	-	0-2	1	-	U16	During operation	Immediately
07h	C13.06	EtherCAT synchronization error threshold	-	0-6000	3000	ns	U16	At stop	Immediately
08h	C13.07	Occurrence count of excessive position ref-erence increment in sync position mode	-	1-30	5	-	U16	During operation	Immediately
09h	C13.08	EtherCAT enhanced link selection	0: Inactive 1: Enabled	0-1	0	-	U16	During operation	Upon re-power-on

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
0Ah	C13.09	Maximum errors and invalid frames of EtherCAT port 0 per unit time	-	0-65535	0	-	U16	Read only	Immediately
0Bh	C13.0A	Maximum errors and invalid frames of EtherCAT port 1 per unit time	-	0-65535	0	-	U16	Read only	Immediately
0Ch	C13.0B	Max. transfer error of EtherCAT port per unit time	-	0-65535	0	-	U16	Read only	Immediately
0Dh	C13.0C	Max. EtherCAT data frame processing unit error per unit time	-	0-65535	0	-	U16	Read only	Immediately
0Eh	C13.0D	Max. link loss value of EtherCAT port per unit time	-	0-65535	0	-	U16	Read only	Immediately
0Fh	C13.0E	EtherCAT state machine status and port connection status	-	0-65535	0	-	U16	Read only	Immediately
10h	C13.0F	EtherCAT AL status code	-	0-65535	0	-	U16	Read only	Immediately
11h	C13.10	EtherCAT parameter storage	0: No storage 1: Storage	0-1	1	-	U16	During operation	Immediately
12h	C13.11	EtherCAT IRQ loss threshold	-	0-10	5	-	U16	During operation	Immediately
13h	C13.12	EtherCAT IRQ loss count	-	0-65535	0	-	U16	Read only	Immediately
1Ah	C13.19	Use of the loop network	-	0-1	0	-	U16	At stop	Immediately

NOTICE

- For details about parameters above, refer to section 11.3.7 "Group C13".

Motor Parameters (2020h/R20)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	R20.00	Motor model	-	0-65535	20000	-	U16	At stop	Upon re-power-on
23h	R20.22	Encoder type	-	0-65535	0	-	U16	Read only	Upon re-power-on

Drive Parameters (2021h/R21)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	R21.00	Drive model	-	0-65535	3	-	U16	At stop	Upon re-power-on
02h	R21.01	Internal drive model	-	0-65535	3	-	U16	Read only	Immediately
0Dh	R21.0C	Drive voltage class	-	0-2	0	-	U16	Read only	Immediately
0Eh	R21.0D	Rated drive power	-	$1\text{-}(2^{32}\text{-}1)$	40	0.01kW	U32	Read only	Immediately
10h	R21.0F	Rated output current of drive	-	$1\text{-}(2^{32}\text{-}1)$	280	0.01A	U32	Read only	Immediately
12h	R21.11	Maximum output current of drive	-	$1\text{-}(2^{32}\text{-}1)$	980	0.01A	U32	Read only	Immediately
14h	R21.13	Internal bleeder resistor power	-	1-65535	40	W	U16	Read only	Immediately
15h	R21.14	Internal bleeder resistor resistance	-	1-65535	50	Ω	U16	Read only	Immediately

NOTICE

- For details about parameters above, refer to section 11.3.8 "Group R21".

Motor Gain Parameters (2022h/R22)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	R22.00	Current loop mode	0: Standard mode 1: Performance mode	0-1	0	-	U16	At stop	Upon re-power-on
02h	R22.01	Current loop response level	-	0-4000	0	0.1%	U16	At stop	Upon re-power-on

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
21h	R22.20	MTPA field-weakening switch	-	0-65535	256	-	U16	At stop	Immediately
22h	R22.21	Field-weakening depth	-	500-2000	1000	0.1%	U16	At stop	Immediately
23h	R22.22	Field-weakening proportional gain	-	10-1000	100	Hz	U16	At stop	Immediately
24h	R22.23	Field-weakening integral gain	-	0-8000	100	0.1%	U16	At stop	Immediately
25h	R22.24	Cutoff frequency of d axis current low-pass filter	-	0-16000	0	Hz	U16	At stop	Immediately
26h	R22.25	Field-weakening d axis current limit	-	0-3000	1500	0.1%	U16	At stop	Immediately
31h	R22.30	Dead zone compensation	-	0-2000	1000	0.1%	U16	At stop	Immediately

Parameters of Control in Progress (2030h/F30)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	F30.00	JOG enabling in velocity mode	-	0~8000	0	-	U16	During operation	Immediately
02h	F30.01	JOG enabling in position mode	-	0~8000	0	-	U16	During operation	Immediately
03h	F30.02	JOG velocity reference	-	0~8000	100	rpm	U16	During operation	Immediately
04h	F30.03	JOG acceleration/ deceleration time	-	0~3600000	100	ms	U32	During operation	Immediately
06h	F30.05	JOG distance in position mode	-	-2^{31}-(2^{31}-1)	20000	Unit in application	I32	During operation	Immediately
11h	F30.10	Inertia auto-tuning selection	0: Disabled 1: Enabled	0-65535	0	-	U16	During operation	Immediately
12h	F30.11	Initial angle auto-tuning selection	0: Disabled 1: Enabled	0-1	0	-	U16	During operation	Immediately

NOTICE

- For details about parameters above, refer to section 11.3.9 "Group F30".

Parameters of Control in Progress (2031h/F31)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	F31.00	Fault reset	0: Inactive 1: Reset	0-1	0	-	U16	At stop	Immediately
02h	F31.01	Software reset	0: Inactive 1: Reset	0-1	0	-	U16	At stop	Immediately
03h	F31.02	Parameter initialization	0: Inactive 1: Restore default settings of parameters 2: Restore default settings of the object dictionary	0-2	0	-	U16	At stop	Immediately
04h	F31.03	Drive motor parameter reset	0: Inactive 1: Factory reset drive parameters 2: Factory reset motor parameters	0-2	0	-	U16	At stop	Immediately
05h	F31.04	Fault record initialization	0: Inactive 1: Fault record clearing	0-1	0	-	U16	At stop	Immediately
11h	F31.10	Encoder data reset	0: Inactive 1: Read encoder 2: Write encoder 3: Reset encoder fault 4: Reset encoder fault and multi-turn data 16: Operation failed	0-31	0	-	U16	At stop	Immediately

NOTICE

- For details about parameters above, refer to section 11.3.10 "Group F31".

Running Monitoring Parameters (2040h/U40)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	U40.00	Speed reference	-	-9000-9000	0	rpm	I16	Read only	Immediately
02h	U40.01	Speed feedback	-	-9000-9000	0	rpm	I16	Read only	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
03h	U40.02	Torque reference	-	-4000-4000	0	0.1%	I16	Read only	Immediately
04h	U40.03	Torque feedback	-	-4000-4000	0	0.1%	I16	Read only	Immediately
05h	U40.04	DI status	-	0-65535	0	-	U16	Read only	Immediately
06h	U40.05	DO status	-	0-65535	0	-	U16	Read only	Immediately
07h	U40.06	Bus voltage	-	0-9000	0	0.1V	U16	Read only	Immediately
08h	U40.07	Average load ratio	-	0-4000	0	0.1%	U16	Read only	Immediately
09h	U40.08	Electrical angle	-	0-36000	0	0.01°	U16	Read only	Immediately
0Ah	U40.09	Mechanical angle	-	0-36000	0	0.01°	U16	Read only	Immediately
0Dh	U40.0C	RMS value of phase current	-	-9000-9000	0	0.1A	I16	Read only	Immediately
11h	U40.10	Position deviation counter	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately
15h	U40.14	Absolute position reference	-	-2^{31}-$(2^{31}-1)$	0	Unit in application	I32	Read only	Immediately
17h	U40.16	Absolute position feedback (reference unit)	-	-2^{31}-$(2^{31}-1)$	0	Unit in application	I32	Read only	Immediately
19h	U40.18	Absolute position feedback (encoder unit)	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately
1Bh	U40.1A	Absolute position feedback (encoder unit)	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately
1Dh	U40.1C	Encoder single-turn data	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately
1Fh	U40.1E	Encoder multi-turn position data	-	0-65535	0	Rev	U16	Read only	Immediately
20h	U40.1F	Encoder initial angle	-	0-36000	0	0.01°	U16	Read only	Immediately
21h	U40.20	Encoder multi-turn data (low 32 bits)	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately
23h	U40.22	Encoder multi-turn data (high 32 bits)	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
25h	U40.24	Absolute position feedback (encoder unit) (low 32 bits)	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately
27h	U40.26	Absolute position feedback (encoder unit) (high 32 bits)	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately
29h	U40.28	Position feedback in rotation mode (reference unit) (low 32 bits)	-	-2^{31}-$(2^{31}-1)$	0	Unit in application	I32	Read only	Immediately
2Bh	U40.2A	Position feedback in rotation mode (encoder unit) (low 32 bits)	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately
2Dh	U40.2C	Position feedback in rotation mode (encoder unit) (high 32 bits)	-	-2^{31}-$(2^{31}-1)$	0	P	I32	Read only	Immediately
31h	U40.30	Heatsink temperature	-	-9000-9000	0	0.1°C	I16	Read only	Immediately
35h	U40.34	Offline inertia auto-tuning value	-	0-12000	0	%	U16	Read only	Immediately
37h	U40.36	Instantaneous value in phase U current	-	-2^{31}-$(2^{31}-1)$	0	0.001A	I32	Read only	Immediately
39h	U40.38	Instantaneous value in phase V current	-	-2^{31}-$(2^{31}-1)$	0	0.001A	I32	Read only	Immediately
3Bh	U40.3A	Synchronization cycle measured value	-	0-$(2^{31}-1)$	0	10ns	U32	Read only	Immediately
3Dh	U40.3C	SYNC and IRQ phase value	-	-2^{31}-$(2^{31}-1)$	0	10ns	I32	Read only	Immediately
3Fh	U40.3E	Drive accumulated heat	-	0-2000	0	0.1%	U16	Read only	Immediately
40h	U40.3F	Motor accumulated heat	-	0-2000	0	0.1%	U16	Read only	Immediately

NOTICE

- For details about parameters above, refer to section 11.3.11 "Group U40".

Status Monitoring Parameters (2041h/U41)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	U41.00	MCU system status	-	0-65535	0	-	U16	Read only	Immediately
02h	U41.01	MCU fault state	-	0-65535	0	-	U16	Read only	Immediately
05h	U41.04	Encoder system status	-	0-65535	0	-	U16	Read only	Immediately
06h	U41.05	Encoder fault state	-	0-65535	0	-	U16	Read only	Immediately
07h	U41.06	Group number of abnormal parameter	-	0-255	0	-	U16	Read only	Immediately
08h	U41.07	Offset of the abnormal parameter within the parameter group	-	0-255	0	-	U16	Read only	Immediately
0Bh	U41.0A	Servo Status	-	0-3	0	-	U16	Read only	Immediately
0Ch	U41.0B	Servo running mode	-	0-9	0	-	U16	Read only	Immediately
0Dh	U41.0C	Servo running time	-	0-(2^{32}-1)	0	0.1s	U32	Read only	Immediately

Version Parameters (2042h/U42)

Index	Parameter	Name	Options	Value Range	Default	Unit	Data Type	Modification Mode	Effective Time
01h	U42.00	ARM version	-	0-65535	0	0.01	U16	Read only	Immediately
03h	U42.02	Encoder version	-	0-65535	0	0.01	U16	Read only	Immediately
04h	U42.03	ARM-based machine	-	0-65535	0	0.01	U16	Read only	Immediately
06h	U42.05	Internal software version	-	0-65535	0	0.01	U16	Read only	Immediately
0Bh	U42.0A	EtherCAT CoE version	-	0-65535	0	0.01	U16	Read only	Immediately
0Ch	U42.0B	EtherCAT XML version	-	0-65535	0	0.01	U16	Read only	Immediately
11h	U42.10	Drive model	-	0-65535	0	-	U16	Read only	Immediately
12h	U42.11	Motor model	-	0-65535	0	-	U16	Read only	Immediately
13h	U42.12	Encoder model	-	0-65535	0	-	U16	Read only	Immediately
14h	U42.13	Power supply unit model identification	-	0-65535	0	-	U16	Read only	Immediately

Index	Param-eter	Name	Options	Value Range	Default	Unit	Data Type	Modifica-tion Mode	Effective Time
15h	U42.14	Inverter model identification 1	-	0-65535	0	-	U16	Read only	Immediately
16h	U42.15	Inverter model identification 2	-	0-65535	0	-	U16	Read only	Immediately
17h	U42.16	Servo version	-	0-65535	0	-	U16	Read only	Immediately

11.2.2 Common Parameters in Group 6000h

Parameter group 6000h contains supported sub-protocol DSP 402 related objects.

Index	Sub-index	Name	Access the Platform	PDO Mapping	Data Type	Unit	Value Range	Default	Modifica-tion Mode	Effective Time
603Fh	0	Error code	RO	TPDO	U16	-	-	-	-	-
6040h	0	Control word	RW	RPDO	U16	-	0-65535	0	During operation	Immedi-ately
6041h	0	Status word	RO	TPDO	U16	-	-	-	-	-
605Ah	0	Quick stop option code	RW	NO	I16	-	0-7	2	During operation	Upon re-power-on
605Ch	0	Stop mode upon servo-off	RW	NO	I16	-	-4-1	0	During operation	Upon re-power-on
605Dh	0	Halt option code	RW	NO	I16	-	1-3	1	During operation	Upon re-power-on
605Eh	0	Stop mode at No. 2 fault	RW	NO	I16	-	5-3	2	During operation	Upon re-power-on
6060h	0	Servo mode	RW	RPDO	I8	-	0-10	0	During operation	Immedi-ately
6061h	0	Modes of operation display	RO	TPDO	I8	-	-	-	-	-
6062h	0	Position reference	RO	TPDO	I32	Reference unit	-	-	-	-
6063h	0	Position feedback	RO	TPDO	I32	Encoder unit	-	-	-	-
6064h	0	Position feedback	RO	TPDO	I32	Reference unit	-	-	-	-
6065h	0	Following error window	RW	RPDO	U32	Reference unit	0-(2^{32}-1)	0	During operation	Immedi-ately
6066h	0	Following error time out	RW	RPDO	U16	ms	0-65535	0	During operation	Immedi-ately
6067h	0	Position reach threshold	RW	RPDO	U32	Reference unit	0-(2^{32}-1)	734	During operation	Immedi-ately

Index	Sub-index	Name	Access the Platform	PDO Mapping	Data Type	Unit	Value Range	Default	Modification Mode	Effective Time
6068h	0	Position window time	RW	RPDO	U16	ms	0-65535	0	During operation	Immediately
606Ch	0	Actual speed	RO	TPDO	I32	Reference unit/s	-	-	-	-
606Dh	0	Speed reach threshold	RW	RPDO	U16	rpm	0-65535	10	During operation	Immediately
606Eh	0	Velocity window time	RW	RPDO	U16	ms	0-65535	0	During operation	Immediately
606Fh	0	Velocity threshold	RW	RPDO	U16	rpm	0-65535	10	During operation	Immediately
6070h	0	Velocity threshold time	RW	RPDO	U16	ms	0-65535	0	During operation	Immediately
6071h	0	Target torque	RW	RPDO	I16	0.1%	4000-4000	0	During operation	Immediately
6072h	0	Max. torque	RW	RPDO	U16	0.1%	0-4000	3500	During operation	Immediately
6074h	0	Torque reference	RO	TPDO	I16	0.1%	-	0	-	-
6077h	0	Actual torque	RO	TPDO	I16	0.1%	-	0	-	-
607Ah	0	Target position	RW	RPDO	I32	Reference unit	-2^{31}-(2^{31}-1)	0	During operation	Immediately
607Ch	0	Home offset	RW	RPDO	I32	Reference unit	-2^{31}-(2^{31}-1)	0	During operation	Immediately
607D	Software absolute position limit									
	0	Highest sub-index supported	RO	NO	U8	-	-	0x02	-	-
	1	Minimum software position limit	RW	RPDO	I32	Reference unit	-2^{31}-(2^{31}-1)	-2^{31}	During operation	Immediately
	2	Maximum software position limit	RW	RPDO	I32	Reference unit	-2^{31}-(2^{31}-1)	2^{31}-1	During operation	Immediately
607Eh	0	Reference polarity	RW	RPDO	U8	-	0-255	0	During operation	Immediately
607Fh	0	Maximum speed	RW	RPDO	U32	Reference unit/s	0-(2^{32}-1)	104857600	During operation	Immediately
6081h	0	Profile operating speed	RW	RPDO	U32	User velocity	0-(2^{32}-1)	1747627	During operation	Immediately
6083h	0	Profile acceleration rate	RW	RPDO	U32	Reference unit/s^2	0-(2^{32}-1)	174762666	During operation	Immediately

Index	Sub-index	Name	Access the Platform	PDO Mapping	Data Type	Unit	Value Range	Default	Modifica-tion Mode	Effective Time
6084h	0	Profile deceleration rate	RW	RPDO	U32	Reference unit/s^2	0-(2^{32}-1)	174762666	During operation	Immedi-ately
6085h	0	Quick stop deceleration	RW	RPDO	U32	Reference unit/s^2	0-(2^{32}-1)	2^{31}-1	During operation	Immedi-ately
6086h	0	Motion profile type	RW	RPDO	I16	-	32767-32767	0	During operation	Immedi-ately
6087h	0	Torque slope	RW	RPDO	U32	0.1%/s	0-(2^{32}-1)	2^{32}-1	During operation	Immedi-ately
6091h	Gear ratio									
	0	Highest sub-index supported	RO	NO	U8	U8	-	0x02	-	-
	1	Motor revolutions	RW	RPDO	U32	-	0-(2^{32}-1)	1	During operation	Immedi-ately
	2	Shaft revolutions	RW	RPDO	U32	-	1-(2^{32}-1)	1	During operation	Immedi-ately
6098h	0	Homing method	RW	RPDO	I8	-	2-35	1	During operation	Immedi-ately
6099h	Homing speed									
	0	Highest sub-index supported	RO	NO	U8	-	-	2	-	-
	1	Speed during search for switch	RW	RPDO	U32	Reference unit/s	0-(2^{32}-1)	1747627	During operation	Immedi-ately
	2	Speed during search for zero	RW	RPDO	U32	Reference unit/s	10-(2^{32}-1)	174763	During operation	Immedi-ately
609Ah	0	Homing acceleration	RW	RPDO	U32	Reference unit/s^2	0-(2^{32}-1)	1747626667	During operation	Immedi-ately
60B0h	0	Position offset	RW	RPDO	I32	Reference unit	-2^{31}-(2^{31}-1)	0	During operation	Immedi-ately
60B1h	0	Speed deviation	RW	RPDO	I32	Reference unit/s	-2^{31}-(2^{31}-1)	0	During operation	Immedi-ately
60B2h	0	Torque offset	RW	RPDO	I16	0.10%	4000-4000	0	During operation	Immedi-ately
60B8h	0	Touch probe function	RW	RPDO	U16	-	0-65535	0	During operation	Immedi-ately
60B9h	0	Touch probe status	RW	TPDO	U16	-	-	0	-	-
60BAh	0	Touch probe 1 positive edge	RW	TPDO	I32	Reference unit	-	0	-	-

Index	Sub-index	Name	Access the Platform	PDO Mapping	Data Type	Unit	Value Range	Default	Modifica-tion Mode	Effective Time
60BBh	0	Touch probe 1 negative edge	RW	TPDO	I32	Reference unit	-	0	-	-
60BCh	0	Touch probe 2 positive edge	RW	TPDO	I32	Reference unit	-	0	-	-
60BDh	0	Touch probe 2 negative edge	RW	TPDO	I32	Reference unit	-	0	-	-
60C5h	0	Max. acceleration	RW	RPDO	U32	User acceleration unit	$0\text{-}2^{32}\text{-}1$	$2^{31}\text{-}1$	During operation	Immedi-ately
60C6h	0	Max. deceleration	RW	RPDO	U32	User acceleration unit	$0\text{-}2^{32}\text{-}1$	$2^{31}\text{-}1$	During operation	Immedi-ately
60D5h	0	Touch probe 1 positive edge counter	RO	TPDO	U16	-	-	0	-	-
60D6h	0	Touch probe 1 negative edge counter	RO	TPDO	U16	-	-	0	-	-
60D7h	0	Touch probe 2 positive edge counter	RO	TPDO	U16	-	-	0	-	-
60D8h	0	Touch probe 2 negative edge counter	RO	TPDO	U16	-	-	0	-	-
60E0h	0	Positive torque limit	RW	RPDO	U16	0.1%	0-4000	3500	During operation	Immedi-ately
60E1h	0	Negative torque limit	RW	RPDO	U16	0.1%	0-4000	3500	During operation	Immedi-ately
60E3h	Supported homing method									
	0	Highest sub-index supported	RO	NO	U8	-	-	22	-	-
	1	1st supported homing method	RO	NO	I16	-	-	1	-	-
	2	2nd supported homing method	RO	NO	I16	-	-	2	-	-
	3	3rd supported homing method	RO	NO	I16	-	-	3	-	-
	4	4th supported homing method	RO	NO	I16	-	-	4	-	-
	5	5th supported homing method	RO	NO	I16	-	-	5	-	-
	6	6th supported homing method	RO	NO	I16	-	-	6	-	-

Index	Sub-index	Name	Access the Platform	PDO Mapping	Data Type	Unit	Value Range	Default	Modifica-tion Mode	Effective Time
	7	7th supported homing method	RO	NO	I16	-	-	7	-	-
	8	8th supported homing method	RO	NO	I16	-	-	8	-	-
	9	9th supported homing method	RO	NO	I16	-	-	9	-	-
	A	10th supported homing method	RO	NO	I16	-	-	10	-	-
	B	11th supported homing method	RO	NO	I16	-	-	11	-	-
	C	12th supported homing method	RO	NO	I16	-	-	12	-	-
	D	13th supported homing method	RO	NO	I16	-	-	13	-	-
	E	14th supported homing method	RO	NO	I16	-	-	14	-	-
	F	15th supported homing method	RO	NO	I16	-	-	17	-	-
	10	16th supported homing method	RO	NO	I16	-	-	18	-	-
	11	17th supported homing method	RO	NO	I16	-	-	19	-	-
	12	18th supported homing method	RO	NO	I16	-	-	20	-	-
	13	19th supported homing method	RO	NO	I16	-	-	21	-	-
	14	20th supported homing method	RO	NO	I16	-	-	22	-	-
	15	21th supported homing method	RO	NO	I16	-	-	23	-	-
	16	22th supported homing method	RO	NO	I16	-	-	24	-	-
	17	23th supported homing method	RO	NO	I16	-	-	25	-	-
	18	24th supported homing method	RO	NO	I16	-	-	26	-	-
	19	25th supported homing method	RO	NO	I16	-	-	27	-	-

Index	Sub-index	Name	Access the Platform	PDO Mapping	Data Type	Unit	Value Range	Default	Modification Mode	Effective Time
	1A	26th supported homing method	RO	NO	I16	-	-	28	-	-
	1B	27th supported homing method	RO	NO	I16	-	-	29	-	-
	1C	28th supported homing method	RO	NO	I16	-	-	30	-	-
	1D	29th supported homing method	RO	NO	I16	-	-	33	-	-
	1E	30th supported homing method	RO	NO	I16	-	-	34	-	-
	1F	31th supported homing method	RO	NO	I16	-	-	35	-	-
60E6h	0	Encoder increments for the additional position	RW	NO	U16	-	0-1	0	During operation	Immediately
60F4h	0	Position deviation	RO	TPDO	I32	Reference unit	-	-	-	-
60FCh	0	Position reference	RO	TPDO	I32	Encoder unit	-	-	-	-
60FDh	0	DI status	RO	TPDO	U32	-	-	-	-	-
60FFh	0	Target velocity	RW	RPDO	I32	Reference unit/s	$(-2^{31}-1)$-$(2^{31}-1)$	0	During operation	Immediately
6502h	0	Supported drive modes	RO	NO	U32	-	-	941	-	-

NOTICE

- For details about parameters above, refer to section 11.3.12 "Group 6000".

11.3 Description of Parameters

11.3.1 Group C00

C00.05: Stiffness level

- Defines the stiffness level of the servo system. The higher the stiffness level, the stronger the gains and the quicker the response will be. But an excessively high stiffness level will cause vibration. The setpoint 0 indicates the lowest stiffness and 41 indicates the highest stiffness.

C00.06: Load inertia ratio

- Defines the mechanical load inertia ratio relative to the motor moment of inertia.
- When C00.06 is set to 0, it indicates the motor carries no load; if it is set to 1.00, it indicates the mechanical load inertia is the same as the motor moment of inertia.
- When the value of C00.06 is equal to the actual inertia ratio, the value of speed loop gain can represent the maximum follow-up frequency of actual speed loop.

11.3.2 Group C01

C01.00: 1st position loop gain

- Defines the proportional gain of the position loop.
- This parameter determines the responsiveness of the position loop. A high setpoint shortens the positioning time. Note that an excessively high setpoint may cause vibration.
- The 1st gain set includes C01.00, C01.01, C01.02, and C01.03.

C01.01: 1st speed loop gain

- Defines the speed loop proportional gain.
- This parameter determines the responsiveness of the speed loop. The higher the setpoint, the faster the speed loop response is. Note that an excessively high setpoint may cause vibration.
- In the position control mode, the position loop gain must be increased together with the speed loop gain.

C01.02: 1st speed loop integral time

- Defines the speed loop integral time constant.
- The lower the setpoint, the better the integral action, and the quicker will the deviation value be close to 0.
- There is no integral action when C01.02 is set to 512.00 ms

C01.08: 2nd position loop gain

- Defines the 2nd gain of the position loop.
- The 2nd gain set includes C01.08, C01.09, C01.0A, and C01.0B.
- For details about gain switchover, see section 7.5 "Gain Switchover".

C01.0B: 2nd torque reference filter cutoff frequency

- Defines the torque reference filter time constant.
- Low-pass filtering of torque references helps to smoothen torque references and reduce vibration.
- Pay attention to the responsiveness during setting as an excessively high setpoint lowers down the responsiveness.

NOTICE

- The servo drive offers two low-pass filters for torque references. By default, the 1st filter is used.
- Gain switchover can be used in the position or speed control mode. Once certain conditions are satisfied, the servo drive can switch to filter 2.

C01.11: Cutoff frequency of speed feedback low-pass filter

- Defines the cutoff frequency for first-order low-pass filtering on the speed feedback.
- The lower the setpoint, the weaker the speed feedback fluctuation, and the longer the feedback delay will be.
- Setting this parameter to 8000 Hz negates the filtering effect.

C01.12: Speed feedback overlapping average filter time constant

- Defines the moving average filtering times for speed feedback.
- The higher the setpoint, the weaker the speed feedback fluctuation, but the longer the feedback delay will be.
- When C01.12 is set to a value higher than 0, C01.11 (Cutoff frequency of speed feedback low-pass filter) is invalid.

C01.13: Speed feedforward source

- Defines the source of the speed loop feedforward signal.
- In the position control mode, the speed feedforward control can improve the position reference responsiveness.

Setpoint	Speed Feedforward Source	Remarks
0	No feedforward	-
1	Internal reference	The speed corresponding to the position reference (encoder unit) is defined as the speed feedforward source.
2	Model tracking	Model tracking control can improve the responsiveness and shorten the positioning time. It is only available in the position control mode. It must be used with C02.00. When C02.00 is set to 1, the speed feedforward is sourced from the speed feedforward output of model tracking.
5	Communication	In CSP, 60B1h is used as the source of the external speed feedforward signal. Bit 6 of 607Eh can specify the polarity of the speed feedforward signal (60B1h).

C01.14: Speed feedforward percentage

- In the position control mode, speed feedforward is the value of C01.14 multiplied by the speed feedforward signal, which is part of the speed reference. Increasing the setpoint improves the responsiveness to position references and reduces the position deviation during operation at a constant speed.

- Set C01.15 to a fixed value first, and then gradually increase the value of C01.14 from 0 to a certain setpoint at which speed feedforward achieves the desired effect.
- Adjust C01.15 and C01.14 repeatedly until a balanced setting is achieved.
- For the speed feedforward function and speed feedforward signal selection, see C01.13 (Speed feedforward source selection).

C01.15: Speed feedforward filter cutoff frequency

- Defines the speed feedforward smoothing filter time.

C01.16: Torque feedforward source

- Defines whether to enable the internal torque feedforward function in a non-torque control mode.
- The torque feedforward function can improve the torque reference responsiveness and reduce the position deviation during operation at constant acceleration/deceleration rate.

Setpoint	Torque Feedforward Source	Remarks
0	No feedforward	-
1	Internal reference	The torque feedforward signal source is the speed reference. In the position control mode, the speed reference is output from the position controller. In the speed control mode, the speed reference is output from the user speed reference.
2	Model tracking	It must be used with C02.00. When C02.00 is set to 1, the torque feedforward is sourced from the torque feedforward output of model tracking.
5	Communication	In CSP, 60B1h is used as the source of the external torque feedforward signal. Bit 6 of 607Eh can specify the polarity of the torque feedforward signal (60B1h).

- Torque feedforward parameters include C01.17 (Torque feedforward percentage) and C01.18 (Torque feedforward cutoff frequency).
- In a non-torque control mode, the control block diagram of torque feedforward is as follows:

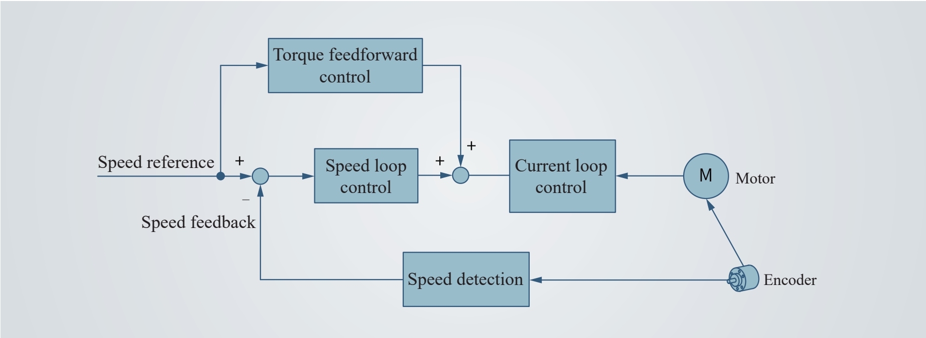


Figure 11-1 Torque feedforward control

C01.17: Torque feedforward percentage

- In control modes other than torque control, torque feedforward is the product of torque feedforward signal multiplied by C01.17 and is part of the torque reference. Increasing the setpoint improves the responsiveness to variable speed references and position references and reduces the position deviation during operation at a constant speed.

C01.18: Torque feedforward filter cutoff frequency

- Defines the filter time constant of torque feedforward.

C01.1B: PDFF control coefficient

- Defines the control method of the speed loop.
- When the setpoint is 100.0, PI control (default control mode of the speed loop) is applied to the speed loop, which features fast dynamic response.
- When the setpoint is 0.0, speed loop integral action is enhanced, which filters out low-frequency interference but also slows down the dynamic response.
- C01.1B can be used to keep a good responsiveness of the speed loop, with the anti-interference capacity in low-frequency bands improved and the speed feedback overshoot not increased.

C01.30: Adaptive notch mode

Setpoint:

0: Adaptive notch not updated

1: One adaptive notch activated (3rd notch)

2: Two adaptive notches activated (3rd and 4th notches)

3: Adaptive notch cleared, values of the 3rd and 4th notches restored to default settings

4: Resonance point tested only, displayed in C01.31, C01.32, and C01.33

Description:

- Defines the operation mode of the adaptive notch.

C01.38: Gain switchover mode

Setpoint	Gain Switchover Condition	Remarks
0	Fixed to the 1st gain set	The 1st gain set applies.
1	DI switchover	Gains are switched through bit 26 of 60FE. Bit 26 signal inactive: 1st gain set Bit 26 signal active: 2nd gain set If the bit 26 signal cannot be allocated to a DI terminal, the 1st gain set applies.
2	DI P-PI switchover	Gains are switched through bit 26 of 60FE. Bit 26 signal inactive: 1st gain set Bit 26 signal active: 2nd gain set (The 2nd speed loop integral (C01.0A) is forced to be 512 ms.) If the bit 26 signal cannot be allocated to a DI terminal, the 1st gain set applies.
3	Torque reference	When the absolute value of the torque reference exceeds (threshold + loop width, %) in the last 1st gain set, the drive switches to the 2nd gain set. When the absolute value of the torque reference is less than (threshold – loop width, %) and this status lasts within the delay (C01.39) in the last 2nd gain set, the drive returns to the 1st gain set.
4	Speed reference	When the absolute value of the speed reference exceeds (threshold + loop width, rpm) in the last 1st gain set, the drive switches to the 2nd gain set. When the absolute value of the speed reference is less than (threshold – loop width, rpm) and this status lasts within the delay (C01.39) in the last 2nd gain set, the drive returns to the 1st gain set.
5	Speed feedback	It is valid only in the position control mode. When the absolute value of the actual speed exceeds (threshold + loop width, rpm) in the last 1st gain set, the drive switches to the 2nd gain set. When the absolute value of the actual speed is less than (threshold – loop width, rpm) and this status lasts within the delay (C01.39) in the last 2nd gain set, the drive returns to the 1st gain set. The 1st gain set applies when the drive is not in the position control mode.
6	Speed reference change rate	It is valid only in non-speed control modes. When the absolute value of the change rate in the speed reference exceeds (threshold + loop width, 10 rpm/s) in the last 1st gain set, the drive switches to the 2nd gain set. When the absolute value of the change rate in the speed reference is less than (threshold – loop width, 10 rpm/s) and this status lasts within the delay (C01.39) in the last 2nd gain set, the drive returns to the 1st gain set. The 1st gain set applies in the speed control mode.

Setpoint	Gain Switchover Condition	Remarks
7	Position deviation	When the absolute value of the position deviation exceeds (threshold + loop width, encoder unit) in the last 1st gain set, the drive switches to the 2nd gain set. When the absolute value of the position deviation is less than (threshold + loop width, encoder unit) and this status lasts within the delay (C01.39) in the last 2nd gain set, the drive returns to the 1st gain set. The 1st gain set applies when the drive is not in the position control mode.
8	Position reference	It is valid only in the position control mode. When the position reference is not 0 in the last 1st gain set, the drive switches to the 2nd gain set. When the position reference is 0 and this status lasts within the delay (C01.39) in the last 2nd gain set, the drive returns to the 1st gain set. The 1st gain set applies when the drive is not in the position control mode.

C01.39: Gain switchover time

Defines the duration when the drive switches from the 2nd gain set to the 1st gain set.

C01.3A: Gain switchover threshold

- Defines the gain switchover threshold.
- Gain switchover is affected by both the threshold and the loop width, as defined by C01.38. The unit of gain switchover threshold varies with the switchover condition.
- Set C01.3A to a value greater than or equal to C01.3B. If C01.3A is set to a value less than C01.3B, the servo drive sets C01.3A to the same value as C01.3B.

C01.3B: Gain switchover loop width

- Defines the gain switchover loop width.
- Gain switchover is affected by both the threshold and the loop width. The unit of gain switchover threshold varies with the switchover condition.
- Set C01.3A to a value greater than or equal to C01.3B. If C01.3A is set to a value less than C01.3B, the servo drive sets C01.3A to the same value as C01.3B.

C01.40: Frequency of the 1st notch

- Defines the center frequency of the notch, which is the mechanical resonance frequency.
- In the torque control mode, setting the notch frequency to 8000 Hz deactivates the notch function.

C01.41: Width level of the 1st notch

- Defines the width level of the notch. Use the default value in general cases.
- Width level is the ratio of the notch width to the notch center frequency.

C01.42: Depth level of the 1st notch

- Defines the depth level of the notch.
- The depth level of the notch is the ratio between the input to the output at the notch center frequency.
- The higher the setpoint, the lower the notch depth and the weaker the mechanical resonance suppression will be. Note that an excessively high setpoint may cause system instability.
- For the use of notch, see 7.14 "Vibration Suppression".

C01.45: Depth level of the 2nd notch

- Description of the 2nd notch parameters is the same as that of the 1st notch parameters.

NOTICE

- The 1st and 2nd notches can be set manually or configured as adaptive notches (C01.30 = 1 or 2). In this case, the parameters are automatically set by the drive, while the other three notches can be set manually.

11.3.3 Group C03

C03.21: Speed reference

- It is the speed reference in the local speed mode, which is invalid in EtherCAT mode.

C03.22: Acceleration rate

- It is the acceleration ramp time of the speed reference in the local speed mode, which is invalid in EtherCAT mode.

C03.24: Deceleration rate

- It is the deceleration ramp time of the speed reference in the local speed mode, which is invalid in EtherCAT mode.

C03.27: Internal positive speed limit

- It is the PL of the speed reference in the local speed mode, which is invalid in EtherCAT mode.

C03.28: Internal negative speed limit

- It is the NL of the speed reference in the local speed mode, which is invalid in EtherCAT mode.

C03.43: Internal positive torque limit

- It is valid only in the local torque mode. For torque limit in EtherCAT mode, use 60E0h/60E1h/6072h. Use the torque limit with caution as an excessively low limit value may lead to insufficient motor torque output.
- If the setpoint exceeds the maximum torque of the servo motor and servo drive, the actual torque is limited to the maximum torque of the servo motor and servo drive.

C03.44: Internal negative torque limit

- It is valid only in the local torque mode. For torque limit in EtherCAT mode, use 60E0h/60E1h/6072h.

Use the torque limit with caution as an excessively low limit value may lead to insufficient motor torque output.

- If the setpoint exceeds the maximum torque of the servo motor and servo drive, the actual torque is limited to the maximum torque of the servo motor and servo drive.

C03.47: Positive speed limit in torque mode

- It is valid only in the local torque mode. Use 607F for the speed limit in the EtherCAT, CST, and PT modes.

C03.48: Negative speed limit in torque mode

- It is valid only in the local torque mode. Use 607F for the speed limit in the EtherCAT, CST, and PT modes.

C03.4B: Invalid value for torque reached

- The torque reached function is used to judge whether the actual torque reference reaches the range of the valid value for torque reached. If yes, the servo drive outputs the corresponding flag (bit 10 of the status word) to the host controller.

  A: Actual torque reference (U40.02)

  B: Base value for torque reach (C03.49)

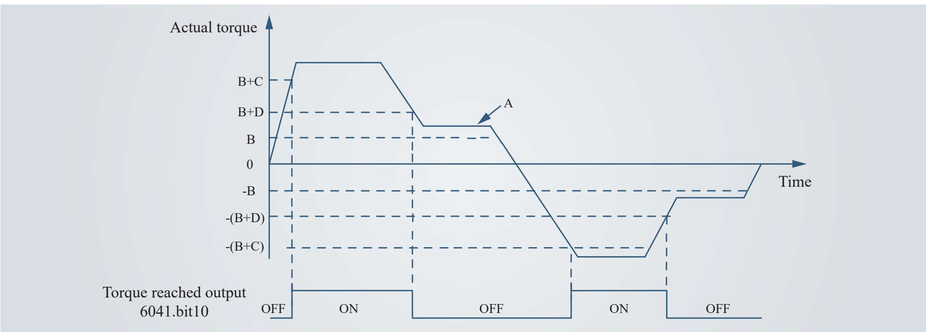
  C: Valid value for torque reach (C03.4A)

  D: Invalid value for torque reach (C03.4B)

  C and D are offsets on the basis of B.

  The torque reach signal is activated only when the actual torque reference meets the condition: $|A| \geq B + C$. Otherwise, the torque reach signal remains inactive.

  The torque reach signal is deactivated only when the actual torque reference meets the condition: $|A| < B + D$.



11.3.4 Group C05

C05.0D: Maximum downtime

- Defines the maximum time taken by the motor in decelerating from 6000 RPM to 0 RPM when the stop mode is set to "Ramp to stop as defined by 6084h/609Ah (HM)" or "Ramp to stop as defined by 6085h".

11.3.5 Group C06

C06.04: Input phase loss detection

Servo drives support three-phase 380 V power supplies. When voltage fluctuation or phase loss occurs on the power supply, power input phase loss protection will be triggered by the servo drive based on the setting of C06.04.

- C06.04 = 0: The servo drive reports Er81.0 (Phase loss fault) when the servo drive is set to 3 kW.
- C06.04 = 1: The servo drive does not report Er81.0 (Phase loss fault) when the servo drive is set to 3 kW, with deration of 80%.

C06.11: Motor overload protection threshold

- Determines the motor overload duration before Er41.0 (Motor overload) is reported.
- You can change the setpoint to advance or delay the time when overload protection is triggered based on the motor temperature. The setpoint 50% indicates the time is cut by half; 150% indicates the time is prolonged by 50%.
- Set this parameter based on the actual temperature of the motor.

C06.20: Protection from out of control

- Sets whether to enable the runaway protection function.

11.3.6 Group C0A

C0A.09: Commissioning software communication baud rate

- Defines the communication rate between the servo drive and the host controller.
- The baud rate set in the servo drive must be the same as that in the host controller. Otherwise, communication will fail.

C0A.0A: Commissioning software communication format

- Defines the data check mode between the servo drive and the host controller during communication.
- The data format of the servo drive and the host controller must be the same; otherwise, the communication fails.

11.3.7 Group C13

C13.00: EtherCAT slave name

- Indicates the station number assigned to the slave by the master during EtherCAT communication.

C13.01: EtherCAT slave alias

- Indicates the station number assigned to the slave EtherCAT communication since the master cannot automatically assign station numbers.
- C13.01 = 0: The master assigns the station numbers by default. C13.01 ≠ 0: The set station number applies by default, with the one assigned by master deactivated.

C13.05: EtherCAT synchronization mode setting

- Defines the synchronization work mode:

Setpoint	Function	Remarks
0	Manufacturer Function	Manufacturer Function
1	Sync 1	Applies to the scenarios where the synchronization performance indicator of the host controller jitters for 1 us.
2	Sync 2	Applies to the scenarios where the synchronization performance indicator of the host controller jitters for more than 1 us.

- In the work mode, the synchronization cycle must be an integer multiple of 125 μs. Otherwise, the serve drive will report Er74.0 (EtherCAT synchronization cycle setting is incorrect.)

C13.06: EtherCAT synchronization error threshold

- Defines the permissible jitter range of synchronization signals when the servo drive works in synchronization mode 1 (C13.05 = 1).

C13.08: EtherCAT enhanced link selection

- When a redundant loop network is used, the EtherCAT Enhanced Link Check function must be enabled (C13.08 = 1), which will take effect upon next power-on of the servo drive.
- When a loop network is used, both C13.08 and C13.19 need to be set to 1.

11.3.8 Group R21

R21.00: Drive model

Setpoint:

2: 2T1R6
3: 2T2R8
5: 2T5R5
6: 2T7R6
7: 2T012
10001: 4T3R5
10002: 4T5R4
10003: 4T8R4
10004: 4T012
10005: 4T017
10006: 4T021
10007: 4T026

Description:

- Sets the SN of the servo drive. The following table lists the servo drive SNs.

Setpoint	Servo Drive SN	Remarks
2	2T1R6	The rated drive power is 0.2 kW. The main circuit inputs single-phase 220 V.
3	2T2R8	The rated drive power is 0.4 kW. The main circuit inputs single-phase 220 V.
5	2T5R5	The rated drive power is 0.75 kW. The main circuit inputs single-phase 220 V.

Setpoint	Servo Drive SN	Remarks
6	2T7R6	The rated drive power is 1.0 kW. The main circuit inputs single-phase or three-phase 220 V. (The main circuit of the servo drive supports single-phase 220 V power supplies without derating.)
7	2T012	The rated drive power is 1.5 kW. The main circuit inputs single-phase or three-phase 220 V. (The main circuit of the servo drive supports single-phase 220 V power supplies without derating.)
10001	4T3R5	The rated drive power is 0.85 kW. The main circuit inputs three-phase 380 V.
10002	4T5R4	The rated drive power is 1.5 kW. The main circuit inputs three-phase 380 V.
10003	4T8R4	The rated drive power is 2.0 kW. The main circuit inputs three-phase 380 V.
10004	4T012	The rated drive power is 3.0 kW. The main circuit inputs three-phase 380 V.
10005	4T017	The rated drive power is 5.0 kW. The main circuit inputs three-phase 380 V.
10006	4T021	The rated drive power is 6.0 kW. The main circuit inputs three-phase 380 V.
10007	4T026	The rated drive power is 7.5 kW. The main circuit inputs three-phase 380 V.

If the voltage input to the main circuit of the servo drive does not comply with the preceding specifications, a fault or damage occurs.

11.3.9 Group F30

F30.03 JOG acceleration/deceleration time

- Acceleration/Deceleration time setpoint for jog in velocity mode, which can be enabled through parameter F30.00 on the panel or through the software

F30.10: Inertia auto-tuning selection

- Used to enable offline inertia auto-tuning through the keypad.
- In the parameter display mode, switch to F30.10 and press the SET key to enable offline inertia auto-tuning. For details about offline inertia auto-tuning, see section 7.2 "Inertia Auto-tuning".

11.3.10 Group F31

F31.00: Fault reset

- Defines whether to enable fault reset.

Setpoint	Function	Remarks
0	No operation	-

Setpoint	Function	Remarks
1	Enable	When a No.1 or No.2 resettable fault occurs, you can enable the fault reset function in the non-operational state after rectifying the fault cause and stopping the keypad from displaying the fault. When a No.3 warning occurs, you can enable the fault reset function directly.

- For fault classification, see section 10.1.3 "List of faults and alarms".
- The fault reset function, once enabled, stops the keypad from displaying the fault only. It does not activate modifications made on parameters.
- This function is not applicable to non-resettable faults. Use this function with caution in cases where the fault causes are not rectified.

F31.01 Software reset

- Defines whether to enable fault reset.

Setpoint	Function	Remarks
0	No operation	-
1	Enable	Programs in the drive are reset automatically (similar to the program reset upon power-on) after the software reset function is enabled, without the need for a power cycle.

- Software reset conditions: The servo drive is disabled, and there is no non-resettable fault such as No.1 fault.

F31.10: Encoder data reset

- The absolute position saved by the encoder changes abruptly after multi-turn data reset. In this case, perform mechanical homing.

11.3.11 Group U40

U40.00: Speed reference

- Indicates the present speed reference (accurate to 1 RPM) of the drive in the position and speed control modes.

U40.01: Speed feedback

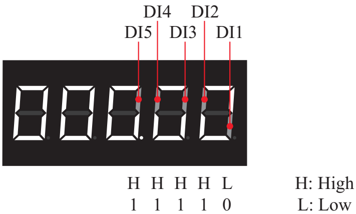
- Indicates the actual motor speed after round-off, which is accurate to 1 rpm.
- This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

U40.02: Actual torque reference

- Indicates the present torque reference (accurate to 0.1%). The value 100.0% corresponds to the rated torque of the motor.

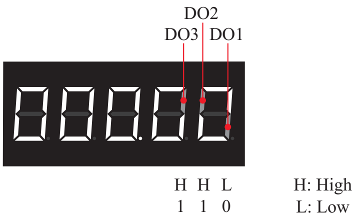
U40.04: DI status

- Indicates the level status of five DIs without filtering.
- Upper LED segments ON: high level (indicated by "1")
  Lower LED segments ON: low level (indicated by "0") In cases where DI1 is low level and DI2 to DI5 are high level, the corresponding binary value is 11110, and the value of U40.04 read in the software tool is 30.
- The keypad displays as follows:



U40.05: DO state

- Indicates the level status of three DOs without filtering.
- Upper LED segments ON: high level (indicated by "1")
  Lower LED segments ON: low level (indicated by "0") In cases where DO1 is low level and DO2 to DO3 are high level, the corresponding binary value is 110, and the value of U40.05 read in the software tool is 6.
- The keypad displays as follows:



U40.06: Bus voltage

- Indicates the DC bus voltage of the main circuit input voltage after rectification, which is accurate to 0.1 V.

U40.07: Average load ratio

- Indicates the percentage of the average load torque to the rated torque of the motor, which is accurate to 0.1%. The value 100.0% corresponds to the rated torque of the motor.

U40.08: Electrical angle

- Indicates the present electrical angle of the motor, which is accurate to 0.1°.
- The electrical angle variation range is ±360.0° when the motor rotates.
- If the motor has four pairs of poles, each revolution generates four rounds of angle changes from 0° to 359.9°.
- Similarly, if the motor has five pairs of poles, each revolution generates five rounds of angle changes from 0° to 359.9°.

U40.09: Mechanical angle

- Indicates present mechanical angle (encoder unit) of the motor. The value 0 indicates that the mechanical angle is 0°.

U40.0C: RMS value of phase current

- Indicates the RMS value of the phase current of the servo motor, which is accurate to 0.1 A.

U40.10: Position deviation counter

- Counts the position pulses fed back by the encoder in any control mode.
- This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

U40.30: Heatsink temperature

- Indicates the temperature of the module inside the servo drive, which can be used as a reference for estimating the actual temperature of the servo drive.

11.3.12 Group 6000

603Fh: Fault code

- When a fault described in the DSP402 profile occurs on the drive, 603Fh is as described in DSP402.
- When a fault specified by the user occurs on the servo drive, 603Fh is 0xFF00. The value of 603Fh is in hexadecimal.
- In addition, the object dictionary 203Fh displays auxiliary bytes of fault code in hexadecimal.
- 203Fh is a UInt32 value, in which the high 16 bits indicate the internal fault code of the manufacturer, and the low 16 bits indicate the external fault code of the manufacturer.

605Ah: Quick stop option code

0: Coast to stop, keeping de-energized status
1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized status
2: Ramp to stop as defined by 6085h, keeping de-energized status
3: Stop at emergency stop torque, keeping de-energized status
5: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock status
6: Ramp to stop as defined by 6085h, keeping position lock status
7: Stop at emergency stop torque, keeping position lock status

605Ch: Stop mode at S-ON OFF

–4: Ramp to stop as defined by 6085h, keeping dynamic braking status
–3: Stop at zero speed, keeping dynamic braking status
–2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking status
–1: Dynamic braking stop, keeping dynamic braking status
0: Coast to stop, keeping de-energized status
1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized status

605Dh: Stop option code

1: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock status

2: Ramp to stop as defined by 6085h, keeping position lock status

3: Stop at emergency stop torque, keeping position lock status

605Eh: Stop mode at No. 2 fault

-5: Stop at zero speed, keeping dynamic braking status

–4: Stop at emergency stop torque, keeping dynamic braking status

-3: Ramp to stop as defined by 6085h, keeping dynamic braking status

–2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking status

–1: Dynamic braking stop, keeping dynamic braking status

0: Coast to stop, keeping de-energized status

1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized status

2: Ramp to stop as defined by 6085h, keeping de-energized status

3: Stop at emergency stop torque, keeping de-energized status

4: Dynamic braking stop, keeping de-energized status

6060h: Modes of operation

Setpoint:

1: Profile position (PP) mode

3: Profile velocity (PV) mode

4: Profile torque (PT) mode

6: Homing mode (HM)

8: Cyclic synchronous position (CSP) mode

9: Cyclic synchronous velocity (CSV) mode

10: Cyclic synchronous torque (CST) mode

Others: N/A

Description:

- If an unsupported operation mode is selected through an SDO, an SDO error will be returned.
- If an unsupported operation mode is selected through a PDO, the change of the operation mode will be invalid.

6061h: Modes of operation display

1: PP mode

3: PV mode

4: PT mode

6: HM

8: CSP mode

9: CSV mode

10: CST mode

6064h: Position actual value

- Position actual value in user-defined unit (6064h) x Gear ratio (6091h) = Position actual value in encoder unit (6063h)

6065h: Following error window

- When the difference value between position reference (6062h) and position actual value (6064h) keeps exceeding ±6065h after the time defined by 6066h elapses, Er47.0 (Position deviation too large) occurs.

6066h: Following error time out

- Defines the time lapse to trigger excessive position deviation, used with 6065h.

6067h: Max. profile velocity

- Defines the threshold for position reach.
- If the difference between the position reference value (6062h) and the position actual value (6064h) is within ±6067h and the time reaches 6068h, the position is reached. In this case, bit 10 of 6041h is set to 1 in PP mode.
- This flag bit is meaningful only when the S-ON signal is active in PP mode.

6068h: Position window time

- Defines the window time for position reach, which must be used together with 6067h.

606Dh: Velocity window

- Defines the threshold for speed reach.
- If the difference value between the target speed (60FFh) and the actual speed (606Ch) is within ±606Dh and the time reaches 606Eh, the speed is reached and bit 10 of the status word 6041h is set to 1 in the PV mode.
- This flag bit is meaningful only when the S-ON signal is active in PV mode.

606Fh: Velocity threshold

- Defines the threshold for determining whether the user velocity is 0.
- When the velocity actual value (606Ch) is within ±606Fh and the time reaches the value set by 6070h, the user velocity is 0. When either condition is not met, the user velocity is not 0.
- This flag bit is valid only in PV mode.
- It is not related to the S-ON state.

6070h: Velocity threshold time

- Defines the time window for determining whether the user velocity is 0, which must be used together with 606Fh.

6071h: Target torque

- Defines the target torque of the servo drive in PT mode.
- The value 1000 corresponds to the rated torque of the motor.

6072h: Max. torque

- Defines the maximum torque reference limit.

- The value 1000 corresponds to the rated torque of the motor.

6074h: Torque reference value

- Defines the target torque value.
- The value 1000 corresponds to the rated torque of the motor.

6077h: Torque actual value

- Indicates the internal torque feedback of the servo drive.
- The value 1000 corresponds to the rated torque of the motor.

607Ah: Target position

- Defines the target position of the servo drive in PP mode.
- When bit 6 of 6040h is set to 0, 607Ah indicates the absolute target position of current segment. After positioning of the current segment is done, the value of 6064h will be the same as the value of 607Ah.
- When bit 6 of 6040h is set to 1, 607Ah indicates the target incremental displacement of the current segment. After positioning of current segment is done, the incremental displacement will be the same as the value of 607Ah.

607Ch: Home offset

- Defines the physical location of mechanical zero that deviates from the home of the motor in position control modes (profile position mode, interpolation mode, and homing mode).
- The home offset in active under the following conditions: The device is powered on, the homing operation is complete, and bit 15 of 6041h is set to 1.
- After homing is done, the position actual value (6064h) will be the same as the value of 607Ch.
- If 607Ch is set to a value outside 607Dh (Software position limit), Er84.3 (Home setting error) will occur.

607D.01h: Minimum software position limit

- Defines the minimum software position limit relative to the mechanical zero.
- Minimum software position limit = (607D.01h)
- The software position limit is used to judge the absolute position. When homing is not performed, the internal software position limit is inactivated.

607D.02h: Maximum software position limit

- Defines the maximum software position limit relative to the mechanical zero.
- Maximum software position limit = (607D.02h)

607Eh: Polarity

- Defines the polarity of position or speed references.
- When bit 7 is 1, it indicates the position reference is multiplied by "–1" and the motor direction is reversed in the standard position mode or interpolation mode.
- When bit 6 is 1, it indicates the speed reference (60FFh) is multiplied by "–1" and the motor direction is reversed in the speed mode.

- When bit 5 is 1, it indicates the torque reference (6071h) is multiplied by "–1" and the motor direction is reversed in the torque mode.
- Other bits are meaningless.

607Fh: Max. profile velocity

- Defines the maximum operating speed in user-defined unit.

6081h: Profile velocity

- Defines the constant operating speed of the target position in PP mode
- The setpoint takes effect after the slave receives the displacement reference.

6083h: Profile acceleration

- Defines the acceleration rate in the acceleration stage of the displacement reference in PP mode.
- The following formula applies if a motor equipped with 17-bit encoder needs to run at 400 RPM (6081h: 400 x 131072/60) with acceleration rate being 400 RPM/s (6083h: 400 x 131072/60) and deceleration rate being 200 RPM/s (6084h: 200 x 131072/60) under a gear ratio of 1:1:

  Acceleration time tup = Δ6081h/Δ6083h = 1 (s).

  Deceleration time tdown = Δ6081h/Δ6084h=2 (s).
- The setpoint 0 will be forcibly changed to 1.

6084h: Profile deceleration

- Defines the deceleration rate in the deceleration stage of the displacement reference in PP mode.
- The following formula applies if a motor equipped with 17-bit encoder needs to run at 400 RPM (6081h: 400 x 131072/60) with acceleration rate being 400 RPM/s (6083h: 400 x 131072/60) and deceleration rate being 200 RPM/s (6084h: 200 x 131072/60) under a gear ratio of 1:1:

  Acceleration time tup = Δ6081h/Δ6083h = 1 (s).

  Deceleration time tdown = Δ6081h/Δ6084h=2 (s).
- The setpoint 0 will be forcibly changed to 1.

6085h: Quick stop deceleration

- Defines the deceleration rate when the quick stop command (6040h set to 0x0002) is active and 605Ah (Quick stop option code) is set to 2 or 5.
- The setpoint 0 will be forcibly changed to 1.

6087h: Torque slope

- Defines the acceleration rate (torque reference increment per second) of the torque reference in PT mode.
- In PT mode, if 605Ah is set to 1, 2, 5, or 6, or 605Dh is set to 1 or 2, the servo drive decelerates to stop as defined by 6087h.
- If the setpoint exceeds the torque reference limit, the limit value will be used.
- The setpoint 0 will be forcibly changed to 1.

6091.01h: Torque slope

- Defines the numerator of the gear ratio.
- The gear ratio is used to establish the proportional relationship between the load shaft displacement designated by the user and the motor shaft displacement.
- The relationship between motor position feedback (encoder unit) and load shaft position feedback (reference unit) is as follows.

  Motor position feedback = Load shaft position feedback x Gear ratio

  The relationship between the motor speed (rpm) and the load shaft speed (reference unit/s) is as follows.

  Motor speed (rpm) = Load shaft speed x 6091h x 60/Encoder resolutions
- The relationship between the motor acceleration (rpm/ms) and the load shaft acceleration (reference unit/s^2) is as follows.

  Motor acceleration (rpm/ms) = Load shaft acceleration x 6091h x 1000/Encoder resolutions/60

6091.02h: Shaft revolutions

- Defines the denominator of the gear ratio.

6098h: Homing method

- For details, see Table 4-1 "Mode lists".

6099.01h: Speed during search for switch

- Defines the speed during search for the deceleration point signal. A large setpoint helps prevent homing timeout.

6099.02h: Speed during search for zero

- Defines the speed in searching for the home signal. Setting this speed to a low value prevents overshoot during stop at high speed, avoiding excessive deviation between the stop position and the set mechanical home.

609Ah: Homing acceleration

- Defines the acceleration rate in homing mode.

60B8h: Touch Probe Function

Bit	Name	Description
0	Touch probe 1 function selection 0: Disabled 1: Enabled	bit0 to bit5: Probe 1 related settings When DI is used as the probe trigger signal, the DI source cannot be changed after the probe is enabled. For an absolute encoder, the Z signal refers to the zero point of motor single-turn position feedback.
1	Touch probe 1 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger	
2	Touch probe 1 trigger signal selection 0: DI signal 1: Z signal	
3	Reserved	
4	Touch probe 1 positive edge 0: Switch off latching at positive edge 1: Enable latching at positive edge	
5	Touch probe 1 negative edge 0: Switch off latching at negative edge 1: Enable latching at negative edge	
6 to 7	Reserved	
8	Touch probe 2 function selection 0: Disabled 1: Enabled	bit8 to bit13: Probe 2 related settings
9	Touch probe 2 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger	
10	Touch probe 2 trigger signal selection 0: DI signal 1: Z signal	
11	Reserved	
12	Touch probe 2 positive edge 0: Switch off latching at positive edge 1: Enable latching at positive edge	bit8 to bit13: Probe 2 related settings
13	Touch probe 2 negative edge 0: Switch off latching at negative edge 1: Enable latching at negative edge	
14 to 15	Reserved	

60BAh: Touch probe 1 positive edge

- Indicates the position feedback value (reference unit) latched at positive edge of touch probe 1 signal.

60BBh: Touch probe 1 negative edge

- Indicates the position feedback value (reference unit) latched at negative edge of touch probe 1 signal.

60BCh: Touch probe 2 positive edge

- Indicates the position feedback value (reference unit) latched at positive edge of touch probe 2 signal.

60BDh: Touch probe 2 negative edge

- Indicates the position feedback value (reference unit) latched at negative edge of touch probe 2 signal.

60C5h: Max. acceleration

- Defines the maximum permissible deceleration in PP mode, PV mode, and homing mode.
- The setpoint 0 will be forcibly changed to 1.

60C6h: Max. deceleration

- Defines the maximum permissible deceleration in PP mode, PV mode, and homing mode.
- The setpoint 0 will be forcibly changed to 1.

60D5h: Touch probe 1 positive edge counter

- The counting value is added by "1" each time this object is triggered.

60D6h: Touch probe 1 negative edge counter

- The counting value is added by "1" each time this object is triggered.

60D7h: Touch probe 2 positive edge counter

- The counting value is added by "2" each time this object is triggered.

60D8h: Touch probe 2 negative edge counter

- The counting value is added by "2" each time this object is triggered.

60E0h: Positive torque limit

- Defines the maximum torque limit of the servo drive in the forward direction.

60E1h: Negative torque limit

- Defines the maximum torque limit of the servo drive in the reverse direction.

60E3.01h: 1st supported homing method

- Bit 0 to bit 7: The low 8 bits indicate the supported homing method. Set 6098h to the corresponding value.
- Bit 8: Relative position homing
  0: Not supported
  1: Supported
- Bit 9: Absolute position homing
  0: Not supported
  1: Supported
- Bit 10 to bit 15: N/A

60E6h: Actual position calculation method

- Defines the method for calculating the mechanical position after homing is completed. After homing is triggered, changes in 60E6h will be blocked.

60F4h: Position deviation

- This object indicates the position deviation (in reference unit).

60FCh: Position reference value

- Indicates the position reference (encoder unit).
- If no warning is detected when the S-ON signal is active, the relationship between the position reference in reference unit and that in encoder unit is as follows:

  60FCh (in encoder unit) = 6062h (in reference unit) x 6091h

60FDh: DI status

- Indicates current DI logic of the drive. 0: Inactive; 1: Active

Bit	Description
0	Reverse overtravel active
1	Forward overtravel active
2	Home signal active
3 to 15	N/A
16	DI1 input active
17	DI2 input active
18	DI3 input active
19	DI4 input active
20	DI5 input active
21 to 26	NA

60FFh: Target velocity

- Defines the target velocity in CSV and PV mode.

6502h: Supported drive modes

- Defines the target velocity in CSV and PV mode.

Chapter 12 Application Example

12.1 JSS715N and KEYENCE KV8000 Confguration

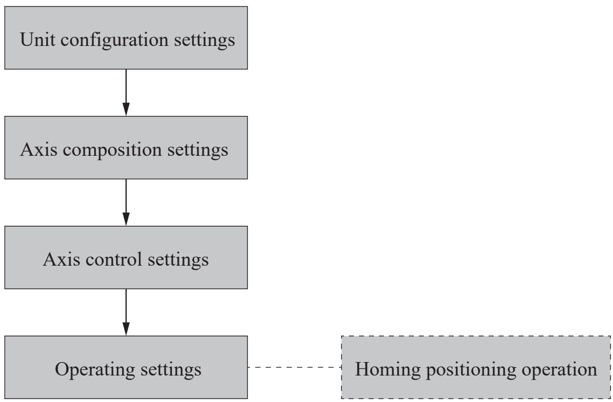
12.1.1 Servo Drive Configuration

Servo drive version:

It is recommended to use the device description file "JSS715N_sAxis_V0.10" and above to test the JSS715N series servo drive.

12.1.2 KEYENCE KV8000 Software Tool Configuration

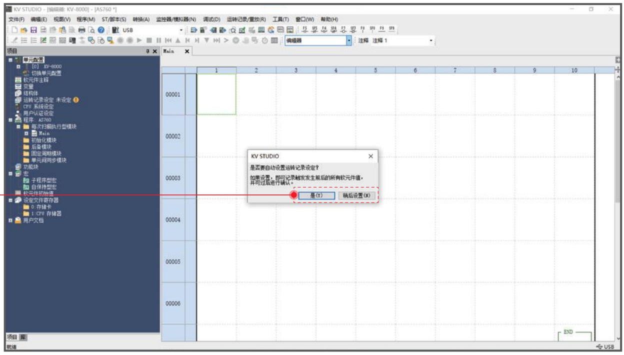
The KEYENCE software tool is "KV STUDIO 11.63" and above. Lower versions may not support the extension of the KEYENCE EtherCAT module "KV XH16EC".



Unit configuration settings

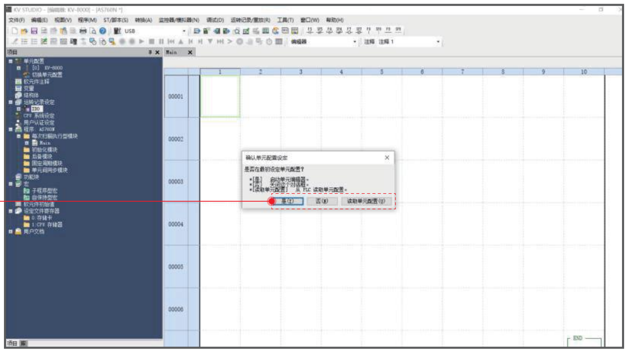
Create a project. After confirmation, the [Operation record settings] dialog box will automatically pop up.

Select as required.
[Yes]
[Set it later]



Then the [Unit configuration settings] dialog box will automatically pop up.

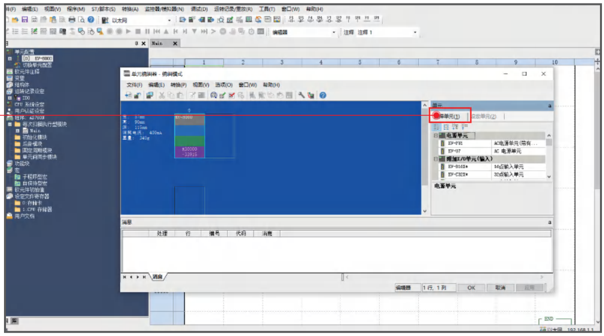
Select as required.
[Yes]
[No]
[Read unit configuration]



If the PLC physical unit is correctly connected and has established a communication connection with the software tool, click [Read unit configuration]. The software tool will automatically obtain the unit configuration based on the physical connection.

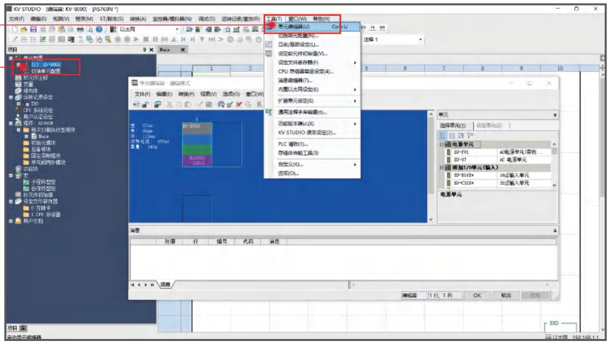
If you click [Yes], the unit editor dialog box will automatically pop up, and you can drag or double-click the required units for configuration.

Select a unit for configuration.



If you click [No], you can choose [Tools] > [Unit Editor] or directly double-click [[0] KV8000] in the [Unit configuration] directory in the [Project] working space.

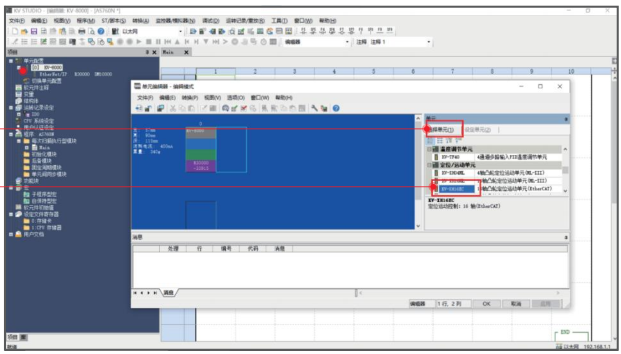
Click [Unit Editor] or [[0] KV8000].



In the [Unit Editor] dialog box, click [Select Unit (1)] and select [KV-XH16EC] in [Position/Motion Unit] below.

Click [Select Unit (1)].

Select [KV-XH16EC].

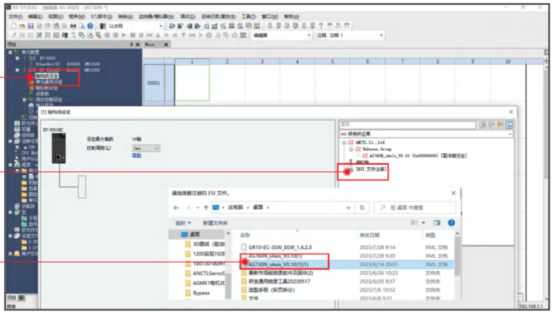


Axis Composition Settings

① Click [Axis Composition Settings].

② Double-click [ESI File Registration].

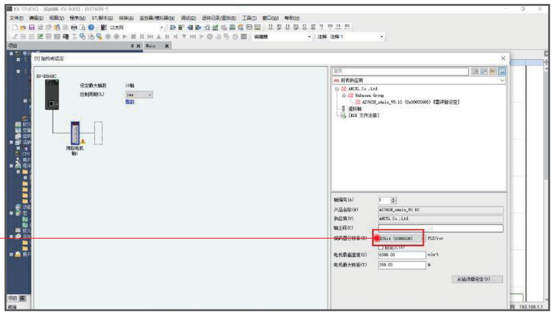
③ Locate and import the device description file (.XML).



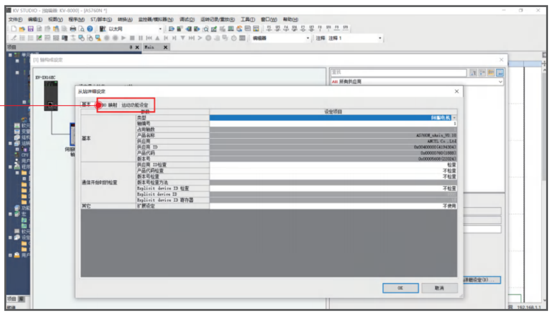
After the device description file is successfully imported, you can add axes. At the same time, in the axis composition settings, you can also set the control period. The minimum period is 250 μs, and the default period is 1 ms.

Double-click or drag the required axis to add it. Select the corresponding axis, and set key information of the axis, such as [Encoder Resolution], [Motor Max. Speed], and [Motor Max. Torque]. (The resolution is defaulted to 20 bits. Change it to the actual resolution of the motor.)

Set [Encoder Resolution].



You can add information such as the PDO and motion function settings in slave detail settings.

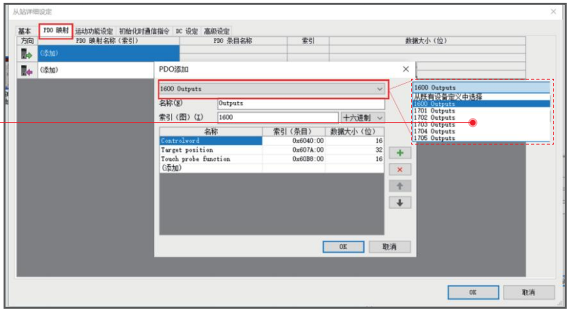


To make extended settings, set [Extended Settings] in the Others column to [Use].

Select [Use].

For motion function settings, double-click or select the required PDO configuration from the drop-down box.

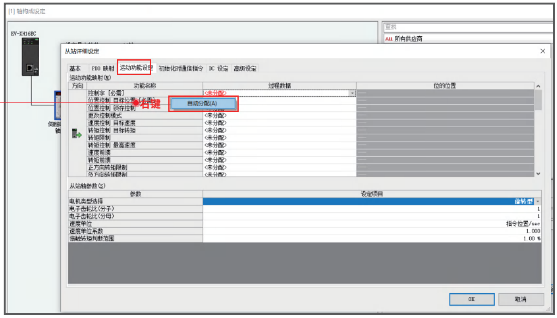
Select the required PDO configuration.



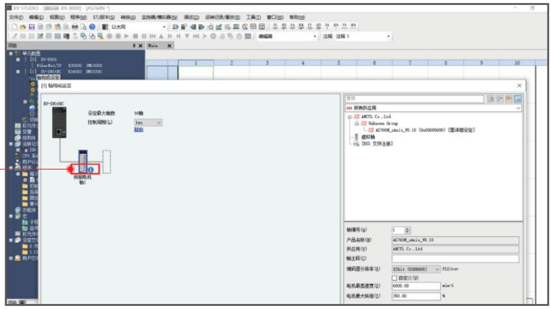
During manual matching, ensure that no content in the PDO mapping is missing. Otherwise, a pop-up window will prompt for missing content when you click [OK]. In general, [Initial communication command], [DC setting], [Advanced setting] maintain their default values. After setting, click [OK].

You can also [Right click] the function, choose [Automatic Assignment], and click [Yes] for automatic assignment. The matched content automatically matches the above PDO content one by one.

Click [Automatic Assignment].

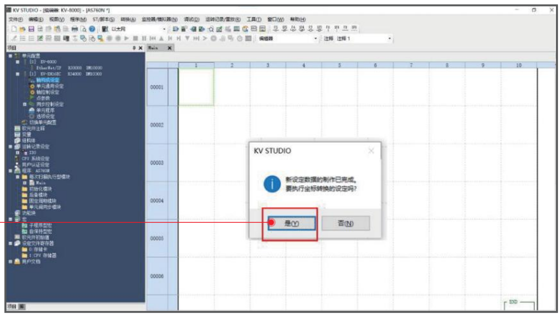


After [Slave Axis Detail Settings] is completed, the yellow exclamation mark disappears.



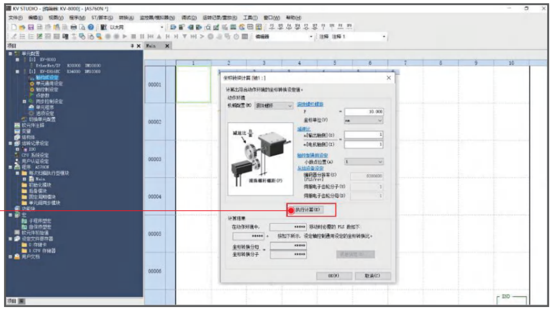
After adding the axis as needed, confirm it. The following dialog box will pop up, asking whether to set the coordinate conversion (that is, the electronic gear ratio).

Select whether to set the coordinate conversion.



- If you click [Yes], the coordinate conversion dialog box pops up. Set the mechanical parameters and coordinate units based on the actual situation, and then click [Execute Calculation]. The software automatically calculates the denominator and numerator values for the coordinate conversion, and automatically writes the parameters into [Axis Control Settings].

Click [Execute Calculation].



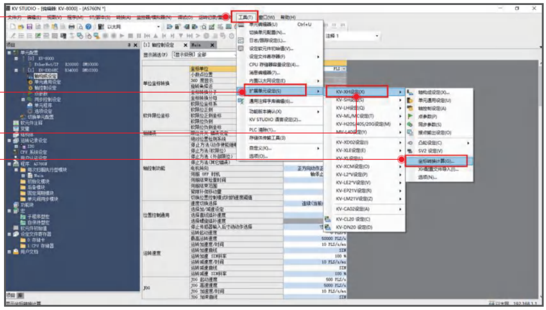
- If you click [No], choose [Tools] > [Extension Unit Settings] > [KV-XH Settings] > [Coordinate Conversion Calculation].

① Click [Tools].

② Choose [Extension Unit Settings].

③ Choose [KV-XH Settings].

④ Choose [Coordinate Conversion Calculation].



Axis Control Settings

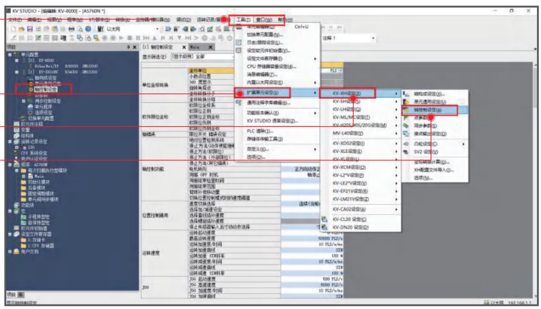
You can access axis control settings from the unit configuration project tree on the left, choose [Tools] > [Extension Unit Settings] > [KV XH Settings] > [Axis Control Settings], or choose [Project] > [Axis Control Settings].

① Click [Tools].

② Choose [Extension Unit Settings].

③ Choose [KV-XH Settings].

④ Choose [Coordinate Conversion Calculation].



Axis control settings include [Unit Coordinate Conversion], [Software Limit Coordinate], [Axis Error], [Axis

Control Function], [General Position Control], [Operating Speed], [JOG], [Homing], [Absolute Position Tracking Control], and [Synchronous Tracking Control].

Operating Settings

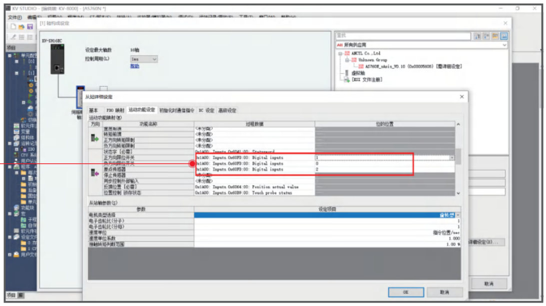
Homing

Before homing, it is necessary to associate the corresponding relationships of various bit positions of 60FD, such as [Positive Direction Limit Switch], [Negative Direction Limit Switch], and [Origin Sensor], in [Motion Function Settings] in [Axis Composition Settings]. Our company specifies the information for each bit of 60FD as follows:

Bit 0, bit 1, and bit 2 respectively indicate the NL, PL, HSW, and bit 16 to bit 20 correspond to DI1 to DI5 respectively.

After automatic assignment is selected in motion function settings, the PL and NL switches and origin sensor still need to be manually matched with the corresponding bit positions of 60FD. The corresponding relationship shown in the figure below can be used for assignment. Bit 16 to bit 20 can also be assigned to the PL and NL switches and origin sensor. However, in this case, the corresponding DI function needs to be configured to the corresponding PL and NL switches and origin sensor on the servo drive side (with the drive side configured by default).

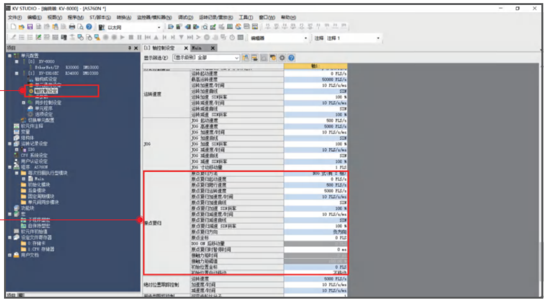
Relationship for assignment



The constraint parameters for homing are set in [Axis Control Settings] - [Homing]. The parameters include [Homing Method], [Homing Startup Speed], [Homing Creep Speed], and [Homing Direction]. The major homing methods are as follows. For specific trajectories, refer to the KEYENCE user manual named *Position/Motion Control Unit KV XH16EC User Manual*.

Click [Axis Control Settings].

Set parameters in [Homing].



Default	Value Range	Description
DOG type (with phase Z)	DOG type (with phase Z)	After the DOG signal is input, the servo drive starts to decelerate and performs homing with the phase Z signal.
	DOG type (without phase Z)	After the DOG signal is input, the servo drive starts to decelerate and performs homing at the falling edge of the DOG signal.
	DOG type inching (with phase Z)	After the DOG signal is input, the servo drive moves according to the movement distance after DOG is turned on, and then pauses. Then, the servo drive moves to the homing direction by position-based speed control, and performs homing with the phase Z signal.
	DOG type inching (without phase Z)	After the DOG signal is input, the servo drive moves according to the movement distance after DOG is turned on, and then performs homing.
	DOG type (contact)	After the DOG signal is input, the servo drive performs homing when the ON time of the torque limit signal is longer than the pressing torque time.
	Origin sensor and phase Z	After the origin sensor is ON, the servo drive performs homing at the initial position of phase Z.
	Origin sensor rising edge	The servo drive performs homing at the rising edge of the origin sensor.
	Homing in progress (without phase Z)	The servo drive uses the intermediate point of the range where the origin sensor is ON as the home. Different from setting of the origin sensor rising edge, even if the light receiving performance of the origin sensor ages, the homing completion position is unlikely to change over time.

Default	Value Range	Description
	Limit switch rising edge	The servo drive uses the negative limit switch (in the direction where the current coordinate decreases) as the origin sensor to perform homing.
	Immediate homing with phase Z	The servo drive performs homing by using the phase Z signal.
	Data setting type	The servo drive sets the current coordinate as the home coordinate.

The JSS715N series servo drive supports the following homing methods.

No.	Homing Mode	JSS715N
1	DOG type (with phase Z)	OK
2	DOG type (without phase Z)	OK
3	DOG type inching (with phase Z)	NO
4	DOG type inching (without phase Z)	NO
5	DOG type (contact)	OK
6	Origin sensor and phase Z	OK
7	Origin sensor rising edge	OK
8	Origin sensor intermediate point	NO
9	Limit switch rising edge	Homing is supported but the reference coordinate after homing is not 0.
10	Immediate homing with phase Z	OK

Positioning Operation

Before the positioning operation, the correct unit coordinate conversion needs to be set. The default unit coordinate conversion is "PLS". In this unit, the coordinate conversion numerator and denominator cannot be changed. If the servo drive needs to select N revolutions, the number of commands that the host controller needs to send is "N x encoder feedback pulses per revolution". After coordinate conversion calculation, the unit coordinate conversion parameter automatically matches the coordinate conversion result.

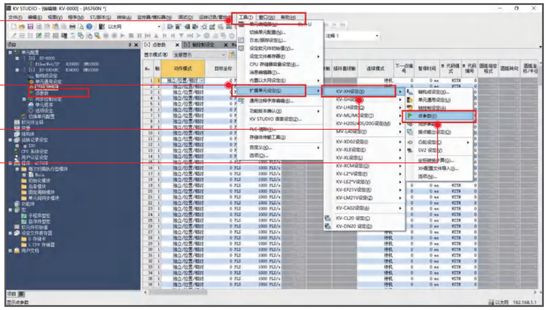
Choose [Tools] > [Extension Unit Settings] > [KV XH Settings] > [Point Parameters] to set the servo drive trajectory.

① Click [Tools].

② Choose [Extension Unit Settings].

③ Choose [KV-XH Settings].

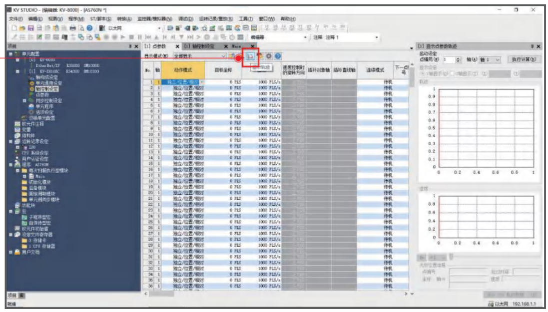
④ Choose [Point Parameters].



Set the target coordinates and speed for each positioning segment based on the site requirements. After the setting is completed, the servo drive can call the corresponding [Point Number] to run using the program.

You can preview the point parameter trajectory using the following shortcut.

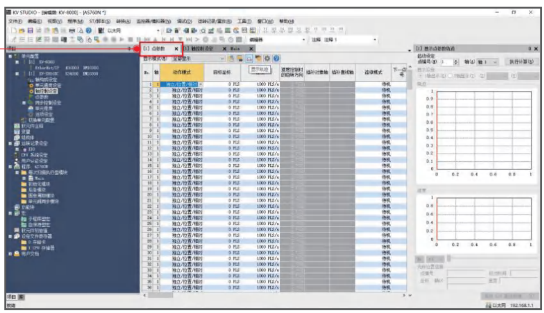
Click the icon to preview the point parameter trajectory.



The ladder diagram can be compiled using conventional methods. At the same time, KEYENCE provides a method of quickly compiling common functions.

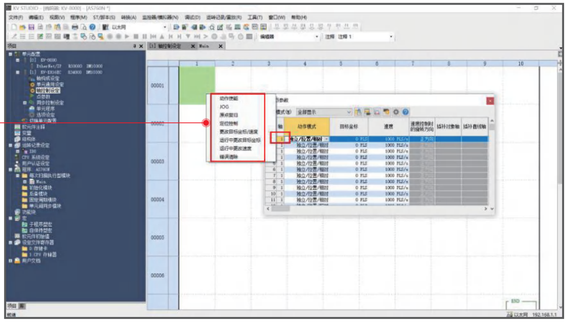
① Drag the [Point Parameters] window down and zoom out the window to the appropriate position.

Click [Point Parameters] and drag it down.



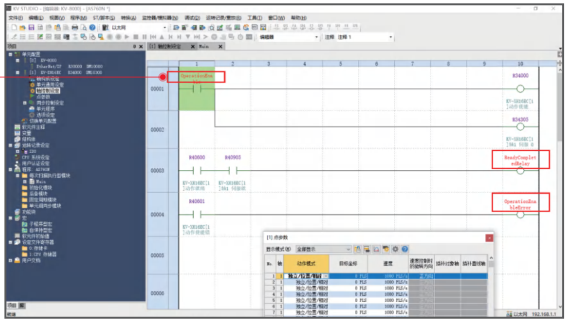
② Move the mouse over the point parameter, such as "No.1 Axis 1". The mouse icon changes from an arrow to a hand shape. Right-click and drag it to the program editing interface. The following shortcuts pop up.

Select a shortcut.



③ Select the required function. For example, click [Action Enable] to automatically generate a DEMO program. Specify the red part as the required relay, so that the function compilation is completed.

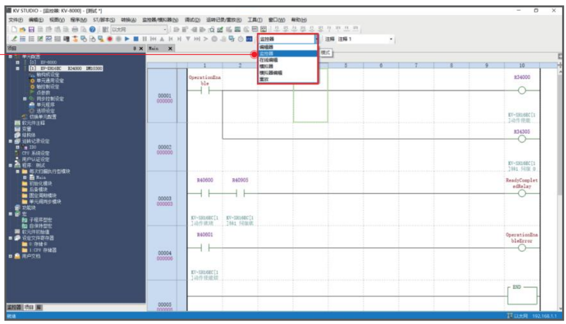
Specify it as the required relay.



④ Start the unit monitor.

The unit monitor provides the function of monitoring the operating status or internal data of KV XH16EC.

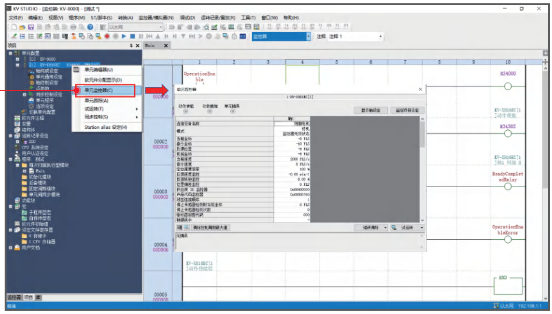
Select [Monitor].



The methods of starting the [Unit Monitor] are as follows:

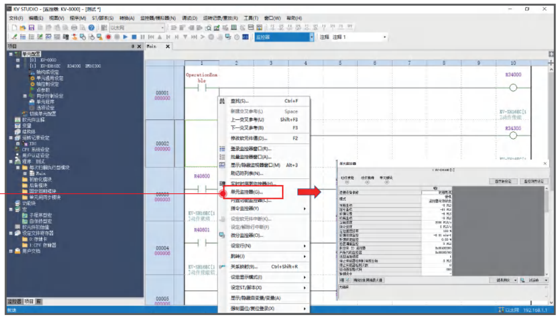
- Select the target unit to monitor in the work area unit composition, right-click it, and choose [Unit Monitor].

Choose [Unit Monitor].



- Right-click in the blank space of the [Main] program and choose [Unit Monitor] from the pop-up menu.

Choose [Unit Monitor].

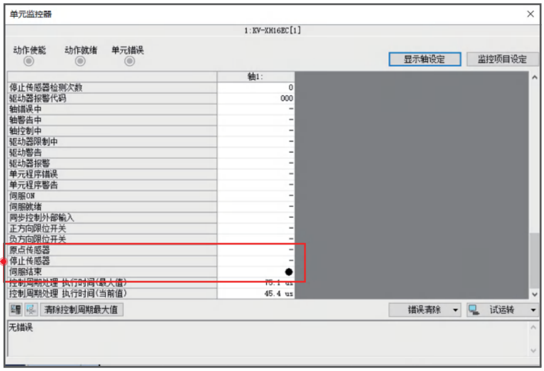


The unit monitor can display the operating status of each axis. To change the monitored items of the operating status, click [Monitor Item Settings] in the upper right corner.

Click [Monitor Item Settings].

To check whether the I/O signals are normal, such as the signals of the PL and NL switches and home switch, start the [Unit Monitor] and find the corresponding monitoring position. If the corresponding signal is received, a black dot appears.

After the signal is received, a black dot appears.



Information about the unit, such as the error state, can also be displayed in the [Unit Monitor]. In addition, you can click [Error Clear] in the lower right corner to clear the axis error of the corresponding axis.

12.1.3 Trial Run

You can confirm the action by using the trial run function, without programming the ladder diagram program.

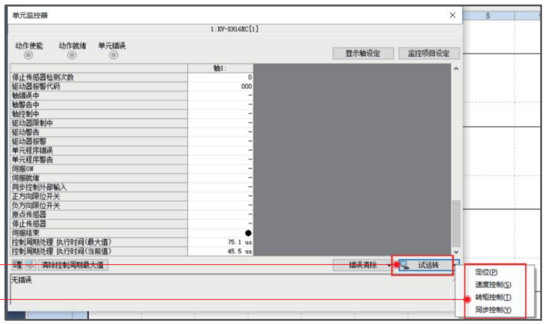
① Click [Trial Run] in the lower right corner of the [Unit Monitor].

② Select the control mode.

③ Select the axis for the trial run.

① Click [Trial Run].

② Select the control mode and axis.



NOTICE

- A warning will occur when you attempt to perform a trial run in [Speed Control Mode] or [Torque Control Mode]. When performing a trial run, set the control mode to [Position Control Mode].

Choose [Trial Run] > [Position Control] as an example.

Action Enable, S-ON

Regardless of the status of the ladder diagram program, [Commissioning] can enable the action and switch on the S-ON signal. Upon successful completion, the [Action Ready] and [Servo Ready] indicators turn green. To ensure safety, set the CPU unit to the PROG mode and stop the ladder diagram program before performing the operation.

If the Servo Ready indicator does not turn green, confirm the following points:

- Whether an axis error occurs.
- Whether a servo drive alarm is reported.
- Whether the main circuit power supply of the servo drive is connected.
- Whether the Ethernet cable is connected.

Axis Error/Axis Error Clear

When an axis error occurs, check the error content and clear the error. After eliminating the cause of the error, click [Clear Error].

JOG

Click [Positive Direction] and [Negative Direction], so that the servo drive jogs in the positive direction and negative direction respectively. In case of [Axis Control General Setting] > [JOG High Speed], the servo drive runs at a speed multiplied by a certain ratio. The ratio can be set in increments of 1% between 10% and 100%.

Inch

Click [+ Direction] or [- Direction], so that the servo drive inches in the positive direction and negative direction respectively. Choose [Axis Control General Setting] > [Inching Startup Speed]. The servo drive runs according to the movement distance set in [Axis Control General Setting] > [Inching Distance].

Homing

After you click [Homing], the servo drive performs homing.

Teaching

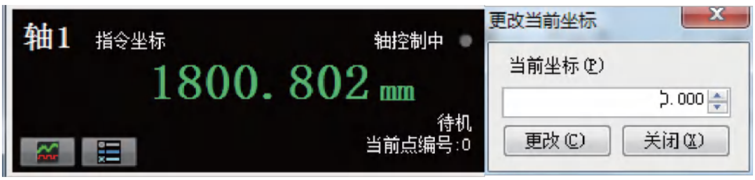
After you click [Load], the current instruction coordinate value is stored in the buffer memory of the target coordinate of the specified point number. The teaching function can be performed only in online editing mode. The value of teaching is reflected in both the buffer memory and the point parameters.

Trial Run

Specify the point number. After you click [Start], the servo drive can perform point positioning. After you click [Stop], the servo drive stops. In the case of [1-point running], the servo drive performs point positioning of the specified one point. In the case of [continuous running], the servo drive can perform point positioning of up to 10 continuous points. After [Loop] is checked and point positioning of the bottom line is completed, the servo drive returns to point positioning of the first line for repeated execution. The standby time to switch to the next point can be set in the range of 0.1s to 20.0s.

Change Current Coordinate

After you click the instruction coordinate, the [Change Current Coordinate] dialog box pops up. Enter the target coordinate to change, click [Change] to change the current coordinates of the axis in trial run, and close the [Change Current Coordinate] dialog box. After you click [Close], the current coordinate does not change. Close the [Change Current Coordinate] dialog box.



12.2 JSS715N and Beckhof PLC Confguration

TwinCAT3 installation

Project creation

Network card drive installation

Device searching

Servo parameter setting

PDO configuration

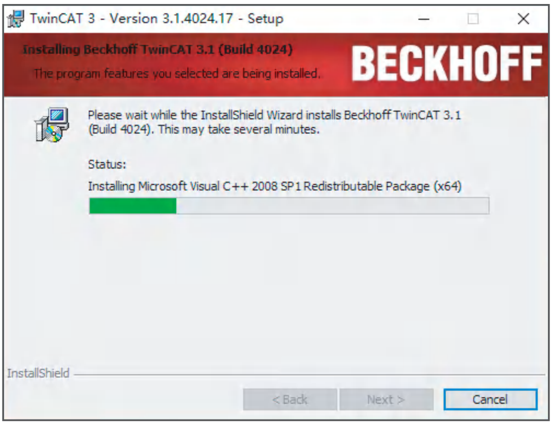
Running information configuration

Configuration activation

Servo running controlling

12.2.1 TwinCAT3 installation

Install the host controller software (TwinCAT3) of Beckhoff PLC.



Operating system and hardware requirements:

Operating system	Windows 7 (with the Service Pack 1 patch) Windows 10 Professional/Enterprise editions (only supporting TwinCAT 3.1.4020 and above)
Network card	Ethernet card of Intel 100 Mbit/s and above (Other network cards may not support TwinCAT3 or have poor stability.)

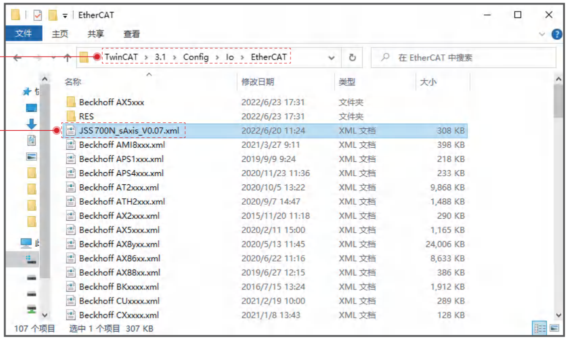
⚠ CAUTION

- Windows 10 Home/Education editions are not recommended, as the system may crash when switching to the run mode.

Add the device description file (JSS715N_sAxis_V0.07.xml) to the EtherCAT device directory of TwinCAT3 (for example, C:\TwinCAT\3.1\Config\Io\EtherCAT).

Confirm the path.

Add the device description file of the XML format.



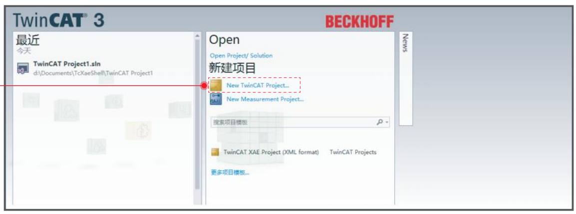
NOTICE

- The device description file is maintained and updated irregularly. If you need the latest version, contact us.

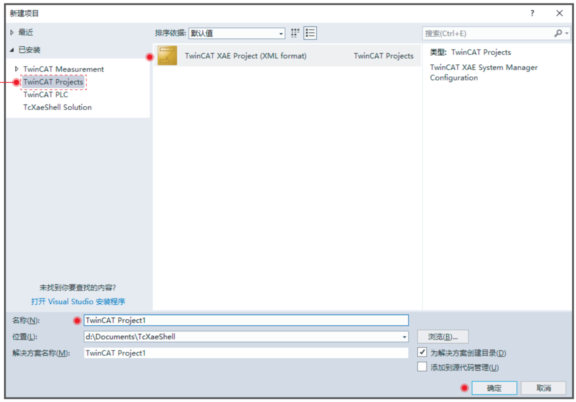
12.2.2 Project creation

Run the TwinCAT3 program and create the TwinCAT3 project.

Create New TwinCAT Projects.



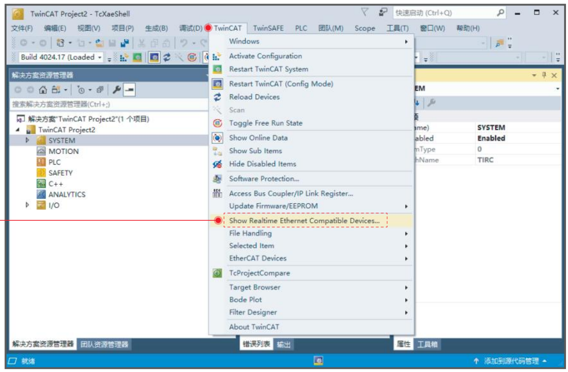
Click [TwinCAT Projects].
Enter the project name and click OK.



12.2.3 Network card drive installation

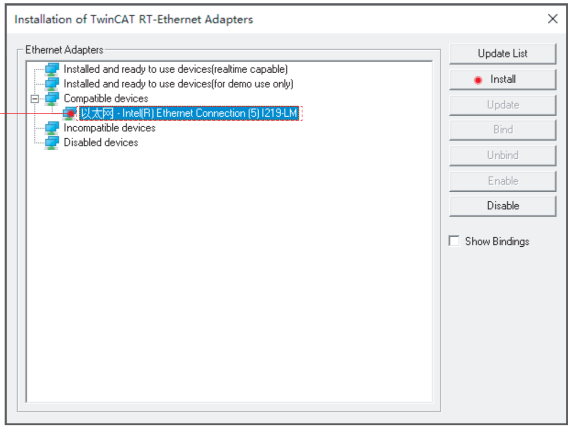
After creating a project, click the [TwinCAT] drop-down menu and select [Show RealTime Ethernet Compatible Devices].

Click [Show RealTime Ethernet Compatible Devices].



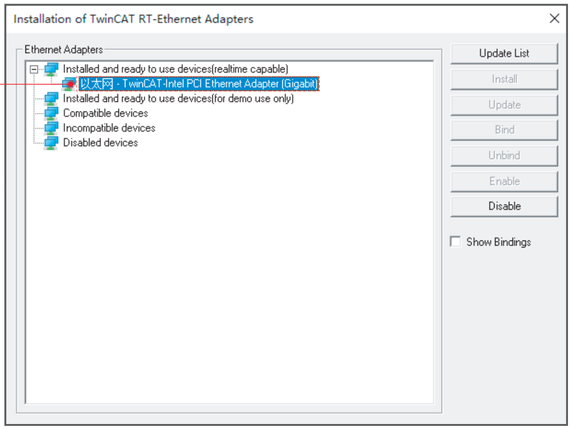
Select a local network card and click [Install].

Select a local network card and click [Install].



The installation is completed, as shown in the figure below.

The TwinCAT network card drive is installed.

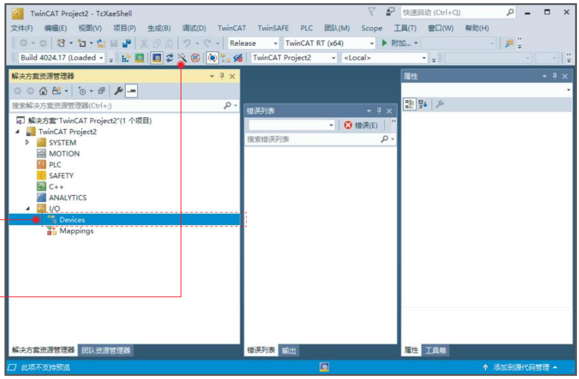


12.2.4 Device searching

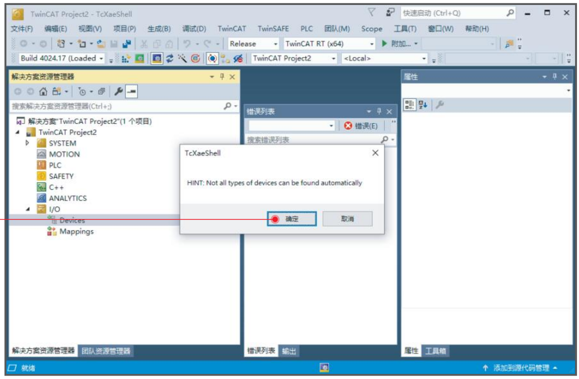
After creating a new project, start to search for devices.

① Click Devices.

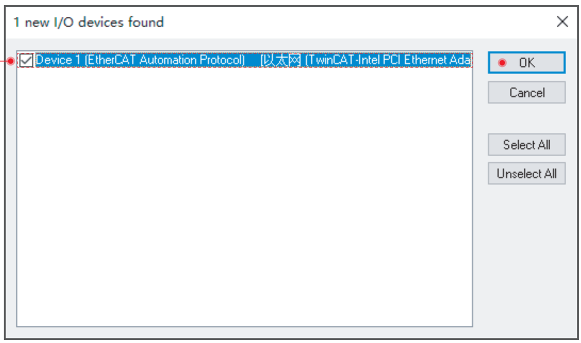
② Click on the [Magic Wand] tool to search for devices.



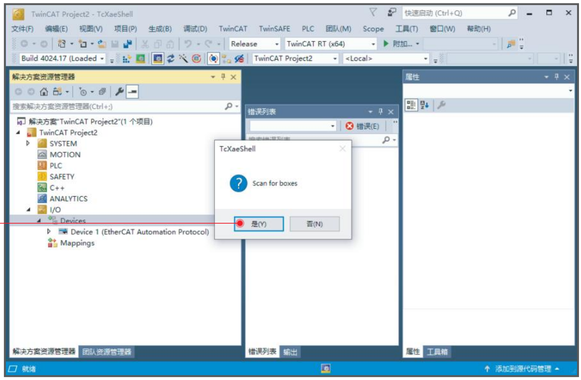
③ Click [OK].



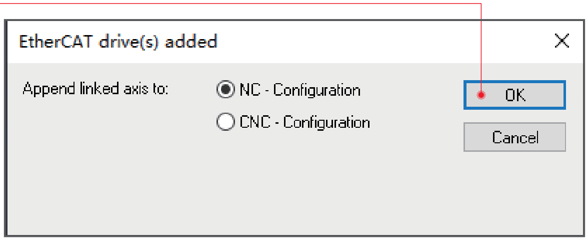
④ Check the installed drive and click [OK].



⑤ Click [Yes].



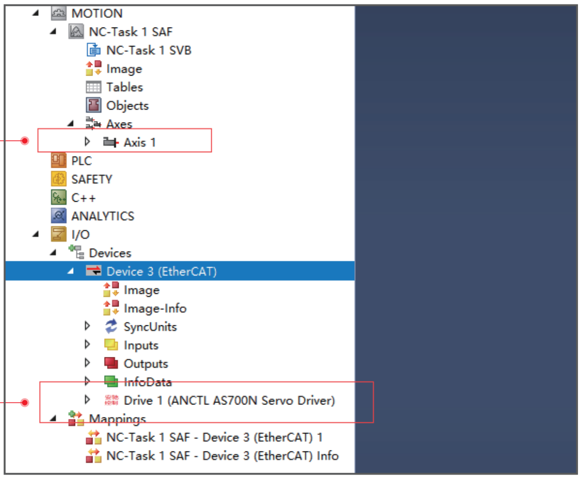
⑥ Click [OK].



Searching for devices is successful, as shown in the figure below.

Adding an axis after searching for devices is successful.

The JSS730N slave is found.

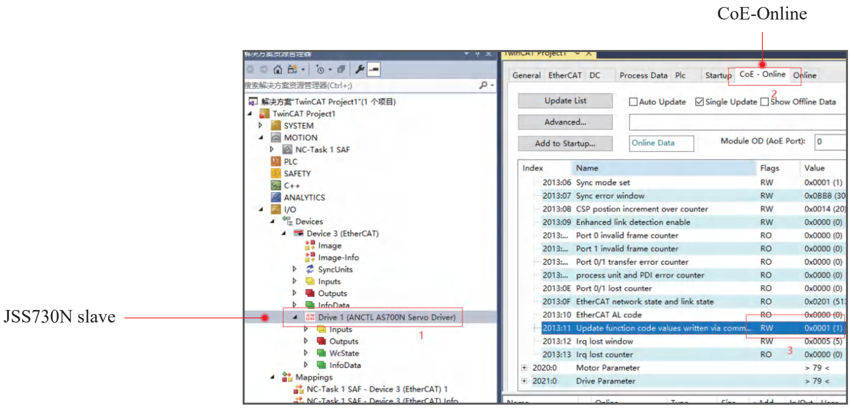


12.2.5 Servo parameter setting

Users can view and configure servo parameters on the [CoE-Online] interface as needed.

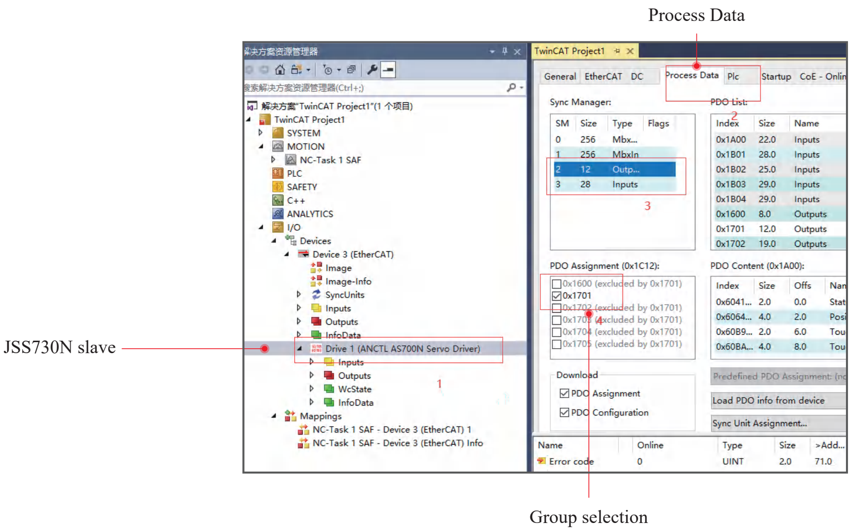
NOTICE

- When 2013:11h equals 1, the written SDO data is retentive at power failure.



12.2.6 PDO configuration

PDO defaults to groups 0x1701 and 0x1B01. Users can reserve or choose to use other groups as needed.



NOTICE

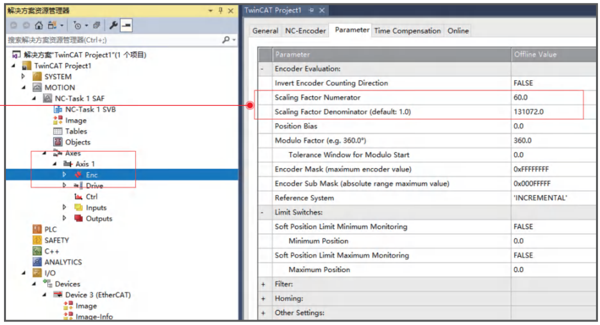
- Groups 0x1600 and 0x1A00 are freely configurable, supporting the addition and subtraction of objects, and other groups have fixed configuration.
- When using ECAT's PLC, if you choose a PDO group with a torque limit value (such as group 1703) and then choose a group without torque limit (such as group 1600) before powering off the servo drive, once the torque limit is defaulted to 0, the motor will be powerless. In this case, the servo drive can continue to run if you re-power it or restore the PDO parameters.

12.2.7 Running information configuration

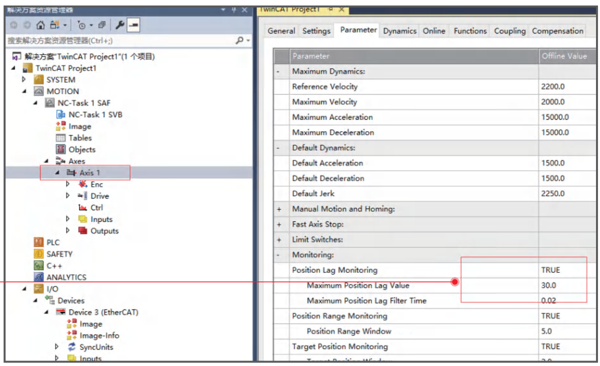
Set the gear ratio and following deviation on TwinCAT according to the encoder adapted by the servo drive.

- For a 17-bit encoder, the gear ratio is 131072: 60, and the deviation is set to 30.

Set the gear ratio.

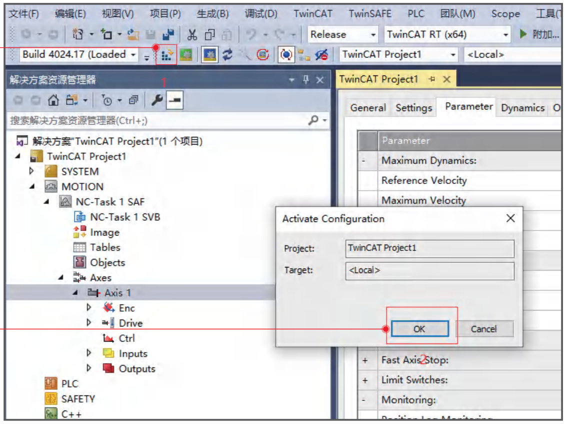


Set the following deviation.

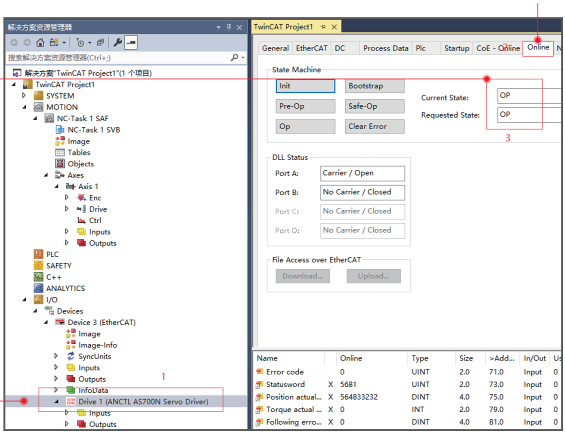


12.2.8 Configuration activation

Click [Activate Configuration], and click [OK] in the pop-up dialog box.



After confirmation, switch to the [Online] interface and observe whether the device enters the OP state.



NOTICE

- After the device enters the OP state, [88rd] is displayed on the keypad of the servo drive, indicating that the servo network is working normally.

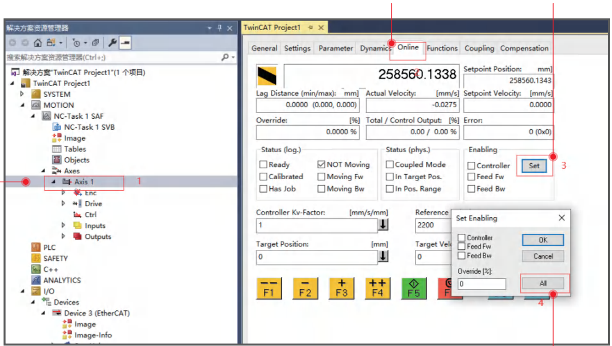
12.2.9 Servo running controlling

Enable the servo drive:

② Switch to the Online interface.

③ Click [Set].

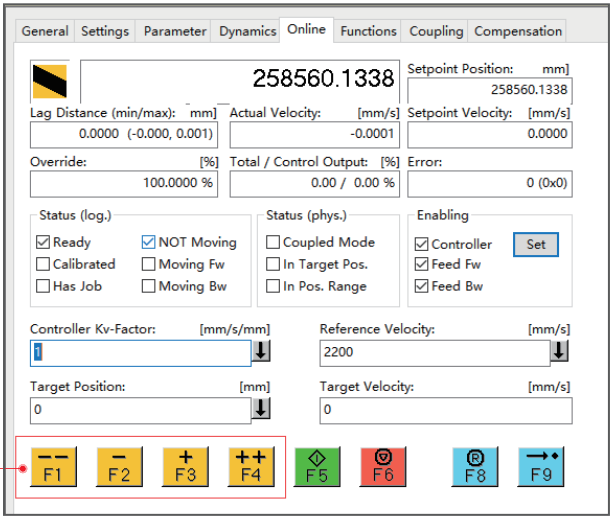
① Click to switch to axis settings.



④ Click [All] in the pop-up dialog box.

Click [F1], [F2], [F3], and [F4] for servo jogging.

Jogging



12.3 JSS715N and Omron NX1P2 Confguration

Sysmac Studio installation

Network connection

Servo setting

Project creation

Communication configuration

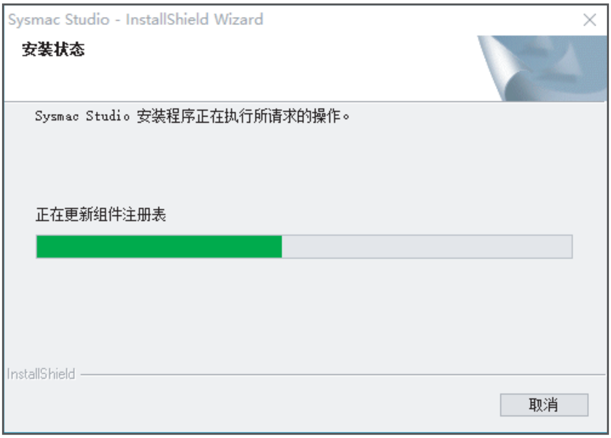
Device scanning

Parameter setting

Servo running controlling

12.3.1 Sysmac Studio installation

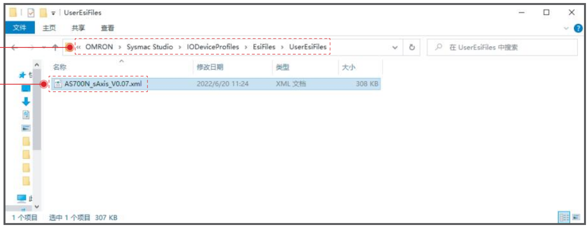
Install Omron Sysmac Studio of V1.45 or above.



Add the device description file (JSS715N_sAxis_V0.07.xml) to the Sysmac Studio directory (for example, C:\Program Files (x86)\OMRON\Sysmac Studio\IODeviceProfiles\EsiFiles\UserEsiFiles).

Confirm the path.

Add the device description file of the XML format.



NOTICE

- When placing the XML file in this path for the first time, restart Sysmac Studio.
- The device description file is maintained and updated irregularly. If you need the latest version, contact us.

12.3.2 Network connection

JSS715N and Omron NX1P2 can be connected by USB (two segments of wiring: Type-c to serial port, serial port to USB) or a network (Ethernet port).

USB direct connection:

Select [USB Direct Connection].

Click [Connect].

Ethernet direct connection:

Set the IP address of the computer to the same segment as the PLC.

12.3.3 Servo setting

Confirm the servo software version.

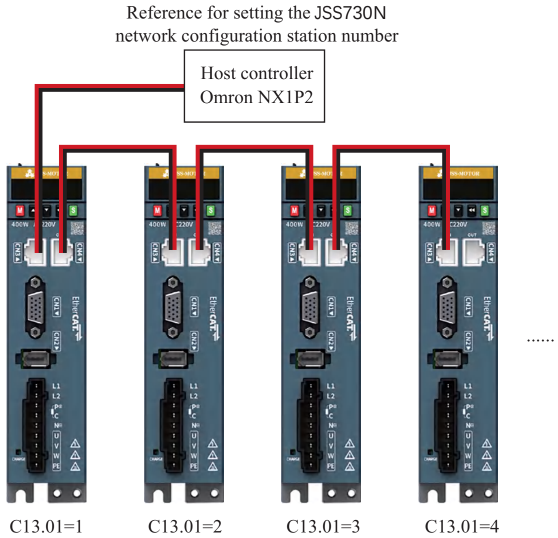
Recommended test version: The MCU version of JSS715N single board software is "U42.00=201.5" or above.

Set servo related parameters.

Parameter	Name	Value Range	Default	Modifica-tion Mode	Effective Time	Setpoint
C13.01	EtherCAT slave alias	0-65535	0	At stop	Immediately	Value other than 0

NOTICE

- When using Omron controller, it is necessary to set the EtherCAT communication station number by using C13.01. It is recommended to set the number according to the actual physical connection order for easy management and configuration.
- After setting C13.01, power on again.

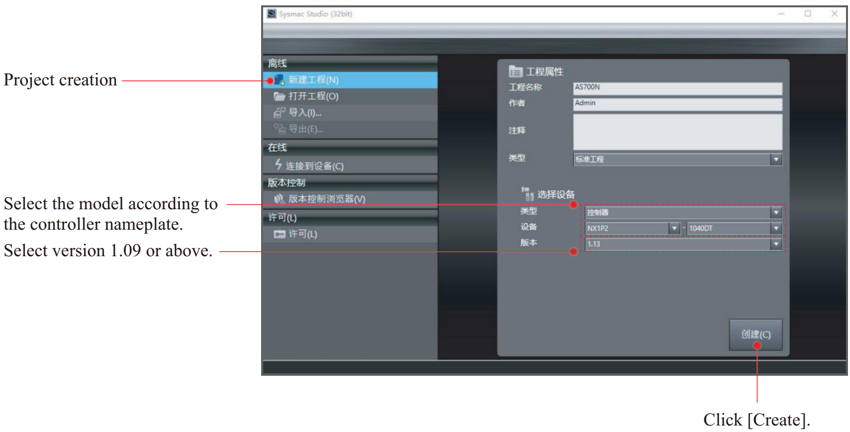


12.3.4 Project creation

NOTICE

- A single servo drive is used as an example.
- NX1P2-1140DT only supports version 1.13.

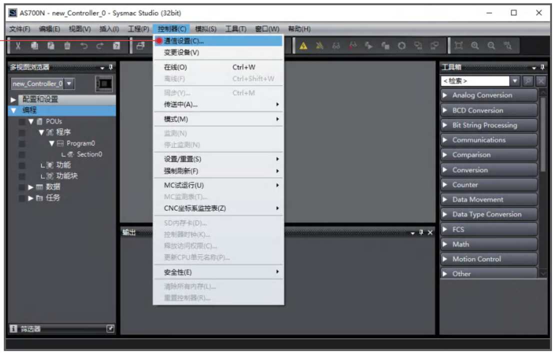
Start Sysmac Studio and create a project.



12.3.5 Communication configuration

After entering the main screen, choose [Controller] > [Communication Configuration] and set the way of connection between the computer and the controller.

Click [Communication Configuration].



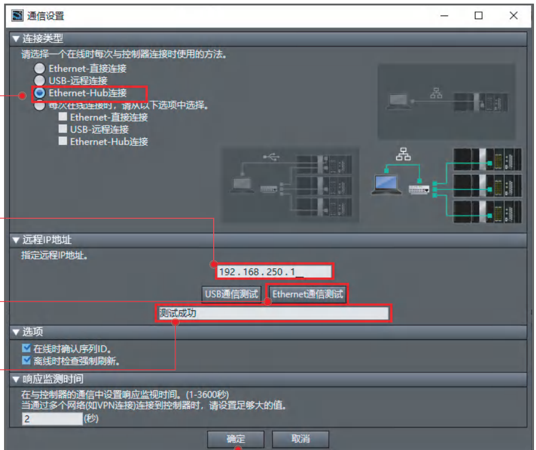
- Select [USB-Remote Connection]: Directly perform the "USB Communication Test". If the test is successful, proceed to the next step.
- Select [Ethernet-Hub Connection]: Set the IP address to the controller IP address (192.168.250.1), and then perform the "Ethernet Communication Test". If the test is successful, proceed to the next step.

① Select [Ethernet-Hub Connection].

② Set IP address (same as the controller IP address).

③ Click [Ethernet Communication Test].

Test result display.



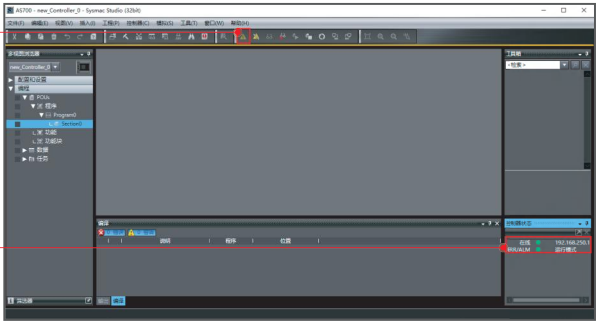
If the test is successful, click [OK].

12.3.6 Device scanning

Switch the controller to the [Online] running mode.

① Click the [Online] icon.

② Observe the controller status.



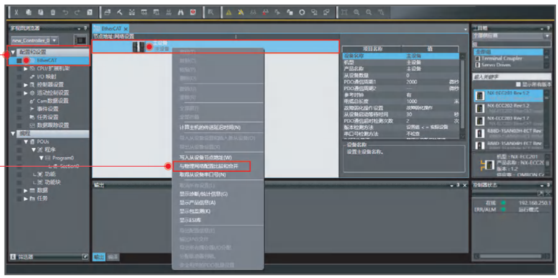
New controller prompt pop-up window.

③ Click [Yes].

Device scanning:

④ Choose [Configuration and Setup] , [EtherCAT], right-click the [Master Device]

⑤ Choose [Compare and Merge with Actual Network Configuration].



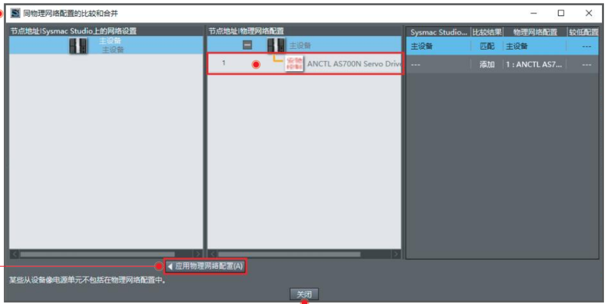
NOTICE

- The controller automatically scans all slaves in the network. A fault will be reported if any station number is 0.

Slave adding:

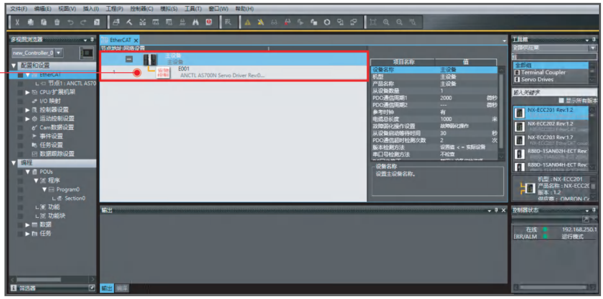
Pop-up window upon scanning completion.

⑥ Click [Apply Physical Network Configuration].



After the slave is added, click [Close].

The added slave is displayed on the home page.



12.3.7 Parameter setting

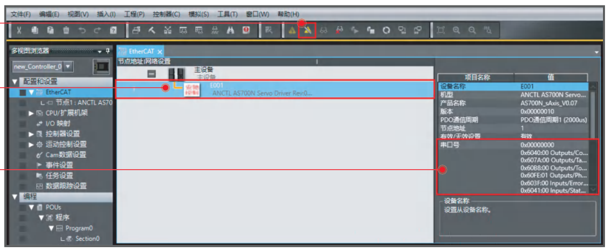
Switch the controller to the offline mode, and set the PDO mapping, axis parameters, and DC.

PDO mapping settings:

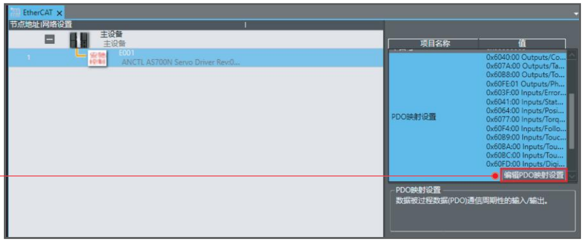
① Click the [Offline] icon.

② Click the slave device.

③ Click the PDO list.

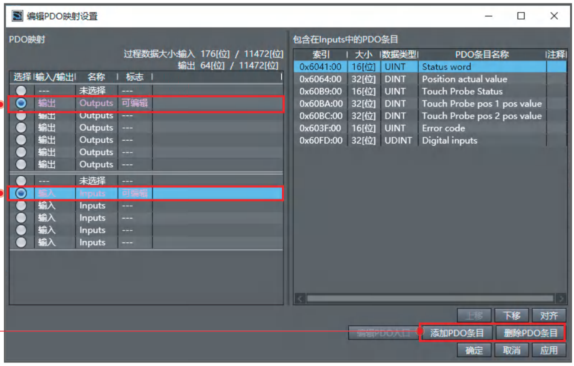


④ Click [Edit PDO Mapping].

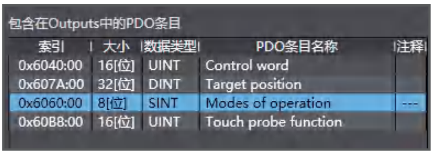


⑤ Select the editable RPDO and TPDO provided by AS730N.

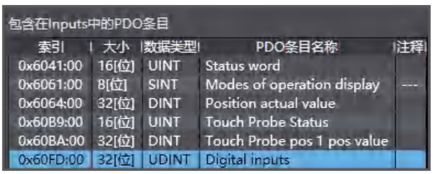
⑥ Click [Add PDO Entry] and [Delete PDO Entry] to change PDO mapping objects.



Common basic mapping parameters


包含在Outputs中的PDO条目

索引	大小	数据类型	PDO条目名称	注释
0x6040:00	16[位]	UINT	Control word	
0x607A:00	32[位]	DINT	Target position	
0x6060:00	8[位]	SINT	Modes of operation	---
0x60B8:00	16[位]	UINT	Touch probe function	


包含在Inputs中的PDO条目

索引	大小	数据类型	PDO条目名称	注释
0x6041:00	16[位]	UINT	Status word	
0x6061:00	8[位]	SINT	Modes of operation display	---
0x6064:00	32[位]	DINT	Position actual value	
0x60B9:00	16[位]	UINT	Touch Probe Status	
0x60BA:00	32[位]	DINT	Touch Probe pos 1 pos value	
0x60FD:00	32[位]	UDINT	Digital inputs	

NOTICE

- When using ECAT's PLC, if you choose a PDO group with a torque limit value (such as group 1703) and then choose a group without torque limit (such as group 1600) before powering off the servo drive, once the torque limit is defaulted to 0, the motor will be powerless. In this case, the servo drive can continue to run if you re-power it or restore the PDO parameters.

Axis parameter configuration:

Add a motion control axis.

① Click [Motion Control Axis Setup].

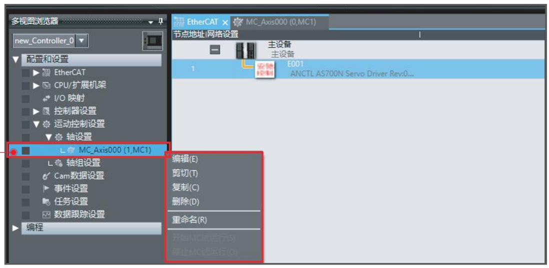
② Right-click [Axis Setup] and choose [Add] > [Motion Control Axis].

Axis setup:

NOTICE

- Right-click the axis name to change it, such as renaming (Chinese is also acceptable). If the name is "Rewinding Axis", then using the axis variable "Rewinding Axis" in the NX program represents controlling this JSS715N servo axis.

Right-click the axis name to rename it.



Double-click the axis name, and configure the JSS715N device of the corresponding station on the basic settings page.

Axis assignment

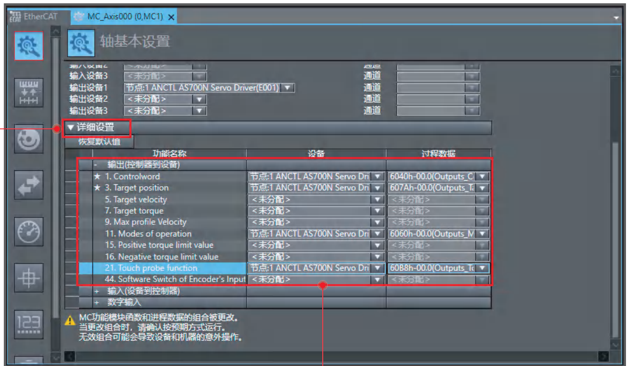
Axis number: Number of the servo Ethernet communication station, value of C13.01

Axis usage: Axis in use

Axis type: Servo axis

Output device 1: Select this servo.

Detail Setup

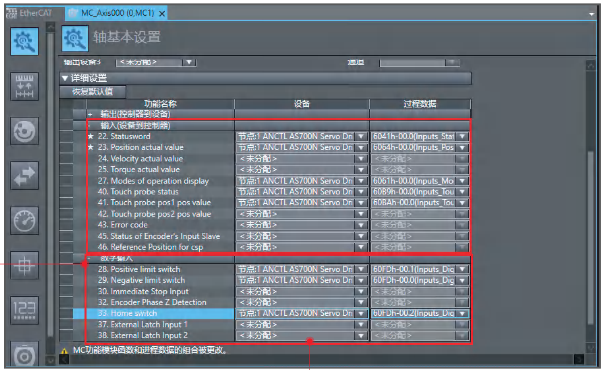


Based on the selected PDO mapping object, assign output parameters (controller to device) and input parameters (device to controller).

⚠ CAUTION

- The object name, node number, index number must be correctly selected.
- Mapping objects selected in each step must be correctly assigned. Otherwise, an error will occur.

Bit mapping



60FD must be mapped by bit to be consistent with that of Omron, as shown in the figure.

NOTICE

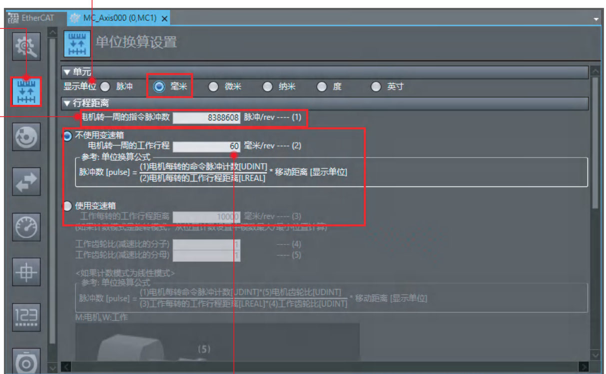
- Bits 0 to 2 of JSS715N respectively indicate the NL, PL, and home. Bits 16 to 20 indicate the statuses of DI1 to DI5.

Unit conversion settings:

Set [Display Unit] according to the actual running unit of the load.

Click the [Unit Conversion Setting] icon.

Set it according to motor resolutions.



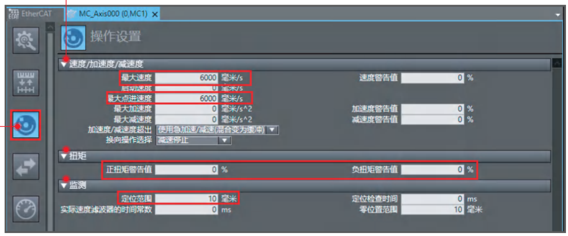
Set 60 mm per revolution.

(During commissioning, 1 mm/s equals to the motor speed of 1 RPM.)

Operation setting:

Set parameters as needed.

Click the [Operation Setting] icon.



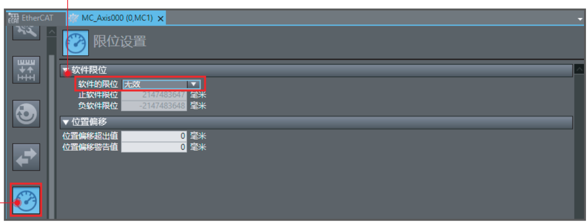
NOTICE

- Set the maximum speed of the load as needed (if the equivalent motor speed exceeds 6000 RPM, the host controller software will prompt the incorrect parameter settings in red boxes).
- Acceleration/Deceleration of 0 means that the running curve is planned with the maximum acceleration/deceleration (if the customer has no special requirements, it does not need to be set).
- Torque: A warning value of 0 means no warning (if the customer has no special requirements, it does not need to be set).
- Monitoring: The positioning range and zero position range must be set according to the actual motor and mechanical conditions. If the values are too small, positioning or homing will never be completed.

Limit setting:

Software limit setting

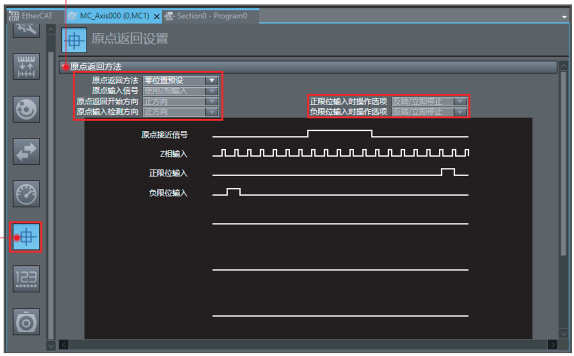
Click the [Limit Setting] icon.



NOTICE

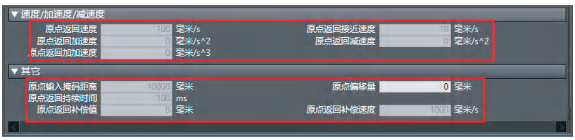
- If the software position limit function is used, after the host controller is used for homing, the function takes effect.

Homing setting:



- If the home switch or limit switch is not configured, select "Zero Position Preset".
- To use other methods for the servo to match the host controller function, refer to the following table for settings.

NX Software Description	Servo Function	Terminal Configuration
Home proximity signal	Home switch (FunIN.5)	DI3
Phase Z signal input	Phase Z signal of the motor encoder	NA
PL input	P-OT (FunIN.6)	DI1
NL input	N-OT (FunIN.7)	DI2



NOTICE

- Select a homing method for the host controller according to the actual mechanical conditions, and set the homing speed, acceleration rate, and home offset. If you select "Zero Position Preset", the parameters can be ignored.

Homing Overview

Function block: MC_Home and MC_HomeWithParameter

- MC_Home parameters are set in the figure above.
- MC_HomeWithParameter parameters are set in the function block.

MC_Home and MC_HomeWithParameter homing functions are the same, including 10 kinds of homing modes.

MC_Home	MC_HomeWithParameter
Approaching reverse running/home proximity input OFF Approaching reverse running/home proximity ON Home proximity input OFF Home proximity input ON Limit input OFF Approaching reverse running/home input mask distance Only limit input Approaching reverse running/holding time No home proximity input/holding home input Zero position preset	Specify the home reset action to be rewritten: 0: Nearby avoidance or near home input OFF 1: Nearby avoidance or near home input ON 4: Near home input OFF 5: Near home input ON 8: Limit input OFF 9: Nearby avoidance or home input shield distance 11: Only limit input 12: Nearby avoidance or contact time 13: No near home input, or contact home input 14: Home preset

- Home proximity input OFF: The servo drive starts to search for the home signal when encountering the falling edge of the home proximity switch.
- Home proximity input ON: The servo drive starts to search for the home signal when encountering the rising edge of the home proximity switch.
- Nearby avoidance/Approaching reverse running: When homing starts, the home proximity signal is ON, and the servo drive runs in the reverse direction after encountering the falling edge of the home proximity signal.
- Home input mask/shield distance: After the host controller receives the home signal (such as the edge change of the home proximity signal), it shields the home signal within a set distance, and then receives the home signal after the distance.
- Holding time/contact time: After the host controller receives the home signal (such as the edge change of the home proximity signal), it shields the home signal within the set time, and then receives the home signal after the time.
- Zero position preset/home preset: That is, the current position is regarded as the home, the motor does not work, and the host controller writes the home offset into the position reference/position feedback in the host controller.

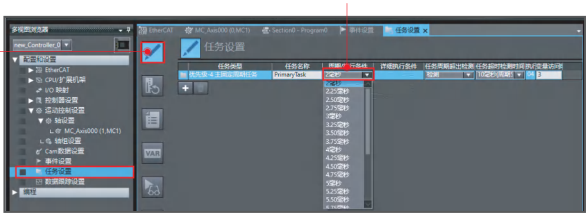
DC setting:

The default clock is 2 ms. The steps to change the default setting are as follows:

- In offline state, change the synchronization clock (period of the main fixed-cycle task) in [Task Setting].
- After changing, power on again, and switch to the online state for the change to take effect.

Changing the synchronization clock

Click the [Limit Setting] icon.



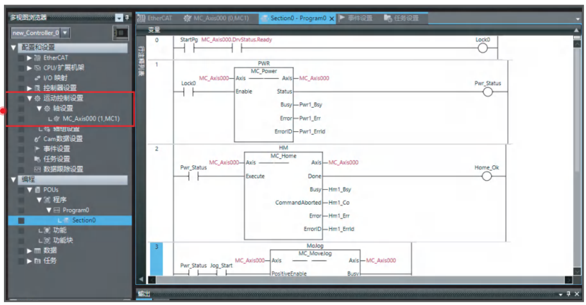
12.3.8 Servo running controlling

① After configuration, you can control the servo running by using the PLC program.

NOTICE

- When using the "MC_POWER" module, it is recommended to add the servo status bit "MC_Axis000.DrvStatus.Ready" of this axis for judgment (where MC_Axis000 is the axis name). This prevents the final enabling failure due to PLC program running before communication configuration is completed.

Add the axis servo status bit.



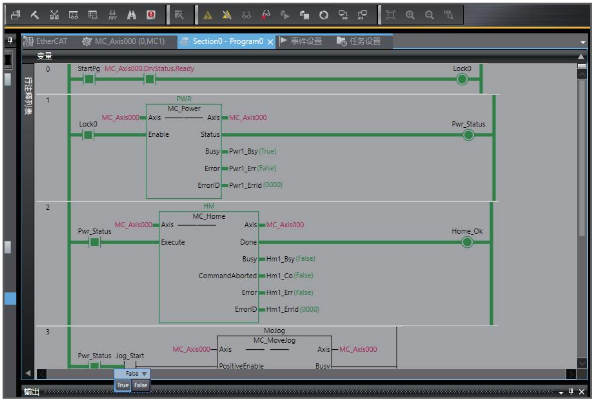
② After the configuration and programming are complete, click the compile controller , switch the controller back to the online state, and click to download the program to the controller.

NOTICE

- If the program has changed, click  to use the synchronization function to compare the current program and the program in the controller, and then decide whether to download to the controller, or click  to download from the controller. Making no change is also allowed.

The program after running is shown in the figure.

Servo running controlled by the program.



Chapter 13 Motor and Options

13.1 Model

JSSMK1 - H 2T 04 30B S 1 6 - **

Standard mark	**: Reserved, customized
Shaft specifications	1: Hollow shaft, straight keyway 2: Straight shaft, unkeyed and unthreaded 6: Straight shaft, keyed and threaded
Encoder type	1: 17-bit single-turn absolute encoder 2: 17-bit multi-turn absolute encoder
Brake and oil sealing	N: No brake and oil sealing S: No brake, with oil sealing C: With brake. no oil sealing E: With brake and oil sealing
Rated speed	05B: 500 rpm 10B: 1000 rpm 30B: 3000 rpm B: $\times 10^2$ C: $\times 10^3$
Power class	A3: 30 W A5: 50 W 01: 100 W 02: 200 W ... 75: 7.5 kW
Voltage class	2T: 220 V 4T: 380 V
Product series	JSSMK1 series

13.2 Nameplate

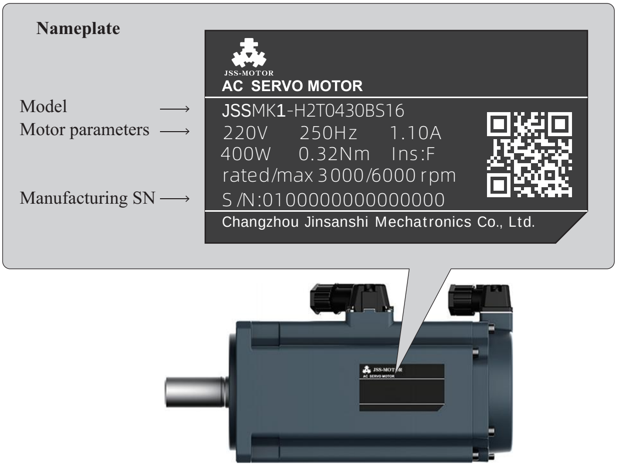


Figure 13-1 *Nameplate of the JSSMK1servo motor*

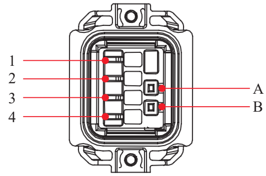
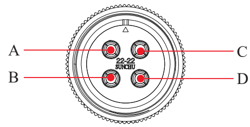
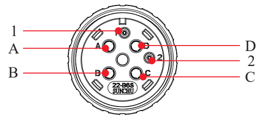
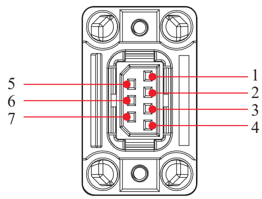
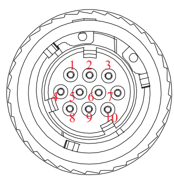
13.3 Components

Figure 13-2 *Components of the JSSMK1servo motor*

13.4 Terminal Definition

NOTICE

- The figure is for reference only. For details about the motor correspondence and size information, refer to the supporting relationships and drawings. Pay attention to the mirror relationship between the motor side and the cable side.

<table>
<tr><th>Cable Type</th><th>Terminal Layout (Cable Side)</th><th>Pin No.</th><th>Usage</th></tr>
<tr><td rowspan="16">Power input connector
</td><td rowspan="6"></td><td>1</td><td>Phase V</td></tr>
<tr><td>2</td><td>Phase U</td></tr>
<tr><td>3</td><td>Phase W</td></tr>
<tr><td>4</td><td>Grounding cable</td></tr>
<tr><td>A</td><td>Brake (polarity insensi-tive)</td></tr>
<tr><td>B</td><td>Brake (polarity insensi-tive)</td></tr>
<tr><td rowspan="4"></td><td>A</td><td>Phase U</td></tr>
<tr><td>B</td><td>Phase V</td></tr>
<tr><td>C</td><td>Phase W</td></tr>
<tr><td>D</td><td>Grounding cable</td></tr>
<tr><td rowspan="6"></td><td>A</td><td>Phase U</td></tr>
<tr><td>B</td><td>Phase V</td></tr>
<tr><td>C</td><td>Phase W</td></tr>
<tr><td>D</td><td>Grounding cable</td></tr>
<tr><td>1</td><td>Brake (polarity insensi-tive)</td></tr>
<tr><td>2</td><td>Brake (polarity insensi-tive)</td></tr>
<tr><td rowspan="14">Encoder connector
</td><td rowspan="7"></td><td>1</td><td>DATA+</td></tr>
<tr><td>2</td><td>DATA-</td></tr>
<tr><td>3</td><td>BAT+</td></tr>
<tr><td>4</td><td>BAT-</td></tr>
<tr><td>5</td><td>+5V</td></tr>
<tr><td>6</td><td>0V</td></tr>
<tr><td>7</td><td>Enclosure</td></tr>
<tr><td rowspan="7"></td><td>1</td><td>DATA+</td></tr>
<tr><td>2</td><td>DATA-</td></tr>
<tr><td>4</td><td>+5V</td></tr>
<tr><td>5</td><td>BAT-</td></tr>
<tr><td>6</td><td>BAT+</td></tr>
<tr><td>9</td><td>0V</td></tr>
<tr><td>10</td><td>Enclosure</td></tr>
</table>

13.5 General Specifications

13.5.1 Mechanical Characteristics

<table>
<tr><th colspan="2">Item</th><th>Description</th></tr>
<tr><td colspan="2">Duty</td><td>S1 (Continuous)</td></tr>
<tr><td colspan="2">Vibration class[1]</td><td>V15</td></tr>
<tr><td colspan="2">Insulation resistance</td><td>500 V DC, above 10 MΩ</td></tr>
<tr><td colspan="2">Excitation mode</td><td>Permanent magnetic</td></tr>
<tr><td colspan="2">Mounting mode</td><td>Flange</td></tr>
<tr><td colspan="2">Thermal class</td><td>Level F</td></tr>
<tr><td colspan="2">Insulation voltage</td><td>1500 V AC, 1 minute (220 V level)
1800 V AC, 1 minute (380 V level)</td></tr>
<tr><td colspan="2">IP rating of the enclosure</td><td>IP67 with an oil seal (oil seal installed on the axis side)</td></tr>
<tr><td colspan="2">Forward direction of rotation</td><td>The servo drive rotates counterclockwise (CCW) as observed from the axis side under the forward rotation command.</td></tr>
<tr><td rowspan="4">Ambient conditions</td><td>Ambient temperature</td><td>(Non-freezing) (Derate based on the derating curve for temperatures above 40°C.)</td></tr>
<tr><td>Ambient humidity</td><td>20% to 80% (Non-condensing)</td></tr>
<tr><td>Installation site</td><td>● Free from corrosive or explosive gases
● Well ventilated with minimum amount of dust, waste, and moisture
● Convenient for inspection and cleaning
● Derating required only for altitudes above 1000 m
● Away from sources that may generate strong magnetic field
● Away from heating sources such as a heating stove
● Use a motor with oil seal in places with grinding fluid, oil mist, iron powders or cuttings.</td></tr>
<tr><td>Storage environment</td><td>Observe the following requirements for storage of a de-energized motor:
● Storage temperature: (Non-freezing)
● Storage humidity: (Non-condensing)</td></tr>
<tr><td rowspan="2">Shock resistance[2]</td><td>Shock acceleration rate at flange</td><td>490 m/s²</td></tr>
<tr><td>Number of shocks</td><td>2</td></tr>
<tr><td>Vibration resistance[3]</td><td>Vibration acceleration rate at flange</td><td>49 m/s²</td></tr>
</table>

CAUTION

- [1] The vibration class V15 indicates that the vibration amplitude is less than 15 μm when a servo motor rotates at its rated speed.
- [2] The value in the table indicates the resistance against shock in the vertical direction with the servo motor shaft mounted horizontally.
- [3] The value in the table indicates the resistance against vibration in the vertical, left-right, and forward-backward directions with the servo motor shaft mounted horizontally.
- The strength of the vibration that the servo motor can withstand depends on the application. Check the vibration acceleration rate applied to the servo motor through the actual product.

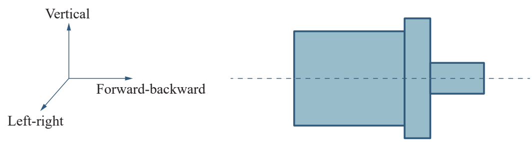


Figure 13-3 Directions of short and vibration applied to the servo motor

13.5.2 Overload Characteristics

The motor is compliant with NEC and CEC requirements and equipped with protective functions against overload and over-temperature.

To protect different load motors, set the motor overload protection gain based on the overload capacity of the motor. Use the default gain in general conditions. However, when one of the following conditions occurs, change the gain based on actual motor temperature:

- The motor operates in environments with high temperature.
- The motor is in cyclic motion featuring a short motion cycle and frequent acceleration/deceleration.

See the following inverse time lag curve for motor overload protection.

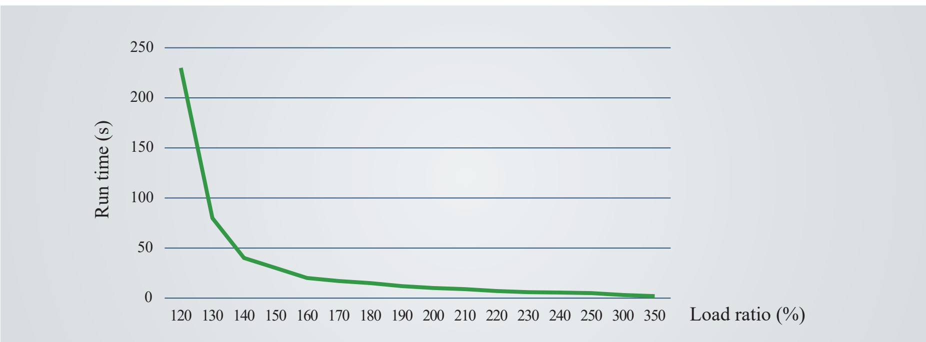


Figure 13-4 Motor overload protection curve

13.5.3 Load moment of inertia

The load moment of inertia represents the inertia of the load. Larger load moment of inertia means slower response, which may result in unstable motion. The allowable load moment of inertia of the motor is subject to a limit. The limit varies with the driving conditions of the servo motor.

An overvoltage warning may occur during deceleration if the load moment of inertia exceeds the allowable value. The servo drive with a built-in braking resistor may generate an overload warning. In case of such warnings, take one of the following measures:

- Reduce the torque limit value.
- Reduce the deceleration rate.
- Reduce the maximum speed.
- Install an external braking resistor if the warning cannot be cleared using the above measures.

NOTICE

- Servo motors with the capacity below 400 W do not have built-in braking resistors.
- When a built-in braking resistor is used, some energy generated under certain regenerative driving conditions still exceeds the allowable capacity loss (W) of the built-in braking resistor. In this case, an external braking resistor is required.

The following figure shows the relationship between the ratio of allowable load moment of inertia and the speed when a servo is used without a built-in regenerative resistor or an external braking resistor. (The following figure shows the reference values upon deceleration at 200 VAC input and torques greater than the rated torque.)

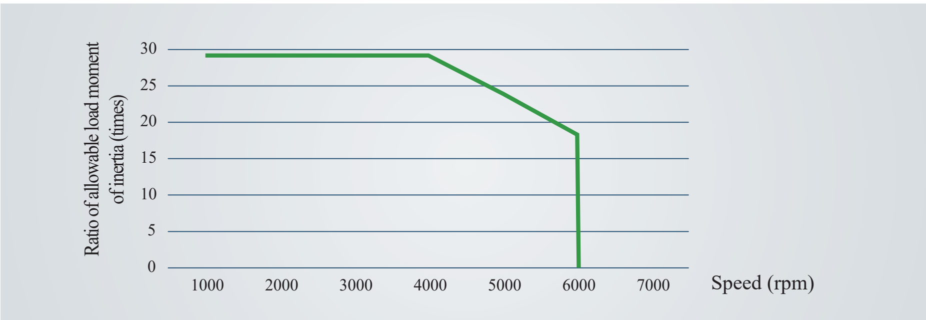


Figure 13-5 Ratio of allowable load moment of inertia for the speed

When the servo unit is used by load whose moment of inertia exceeds the allowable value, an overvoltage alarm may be triggered.

13.6 Selection Precautions

- Motors with oil seals must be derated by 10% during use.
- Do not share the power supply of the brake with other electrical devices. Failure to comply may result in malfunction of the brake due to voltage or current drop caused by other devices.
- Use cables with a cross-sectional area above 0.5 mm^2.
- All parameters and torque-speed characteristic values are subject to the conditions that the motor works with a servo drive and the armature coil temperature is 20°C.
- The torque for fastening the terminal screws must be 0.19 N·m to 0.21 N·m. Excessive torque may damage the screws.
- Radial and axial loads of the motor

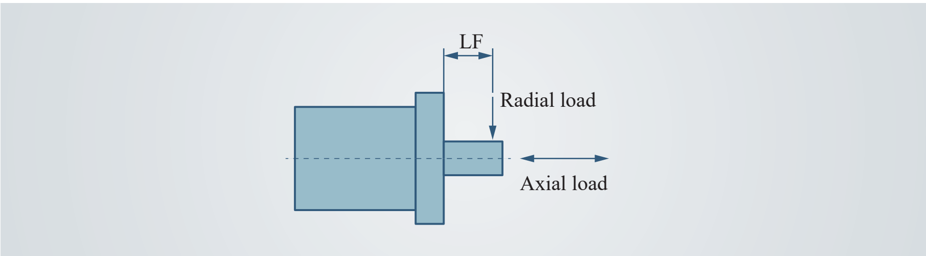


Figure 13-6 Radial and axial loads of the motor

13.7 Technical Specifications

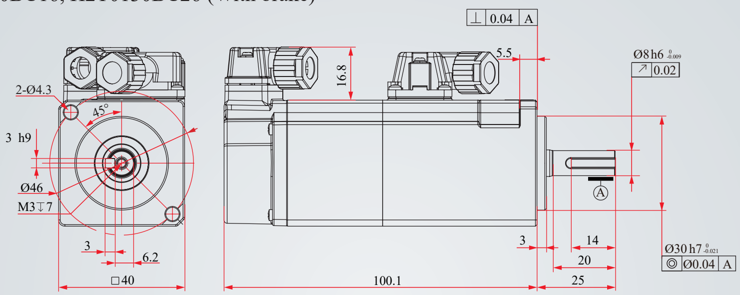
13.7.1 Model of 3000 rpm

100 W (40 frame)

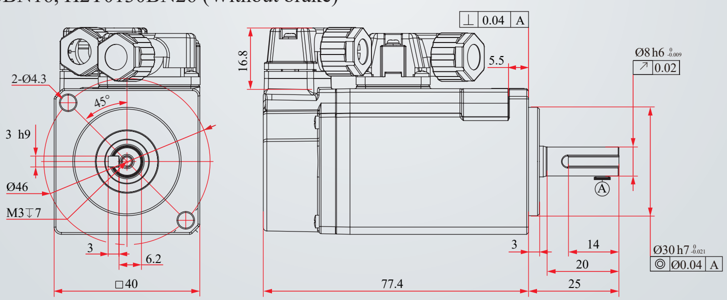
Item (JSSMK1-XXXXXXXXXXX	H2T0130BC16, H2T0130BC26 (With brake)	H2T0130BN16, H2T0130BN26 (Without brake)
Rated power (W)	100	
Rated current (A)	1.1	
Maximum current (A)	3.9	
Rated torque (N·m)	0.32	
Maximum torque (N·m)	1.12	
Rotor inertia (10^{-4}·kg·m²)	0.033	0.03
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

H2T0130BC16, H2T0130BC26 (With brake)



H2T0130BN16, H2T0130BN26 (Without brake)

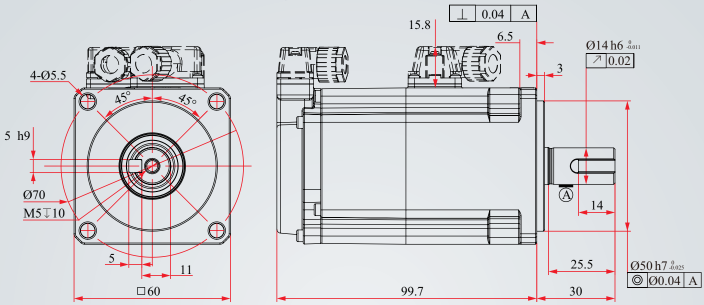


200 W (60 frame)

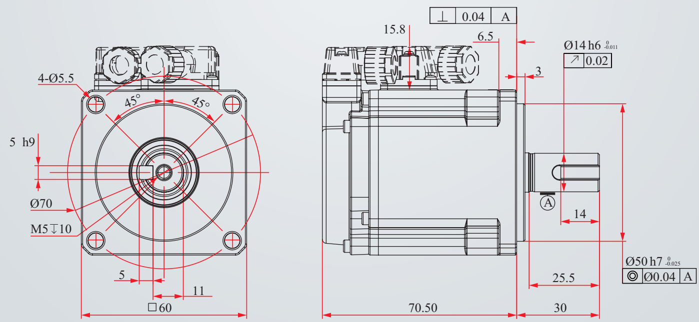
Item (JSSMK1-XXXXXXXXXX)	H2T0230BE16, H2T0230BE26 (With brake)	H2T0230BS16, H2T0230BS26 (Without brake)
Rated power (W)	200	
Rated current (A)	1.29	
Maximum current (A)	4.41	
Rated torque (N·m)	0.64	
Maximum torque (N·m)	2.23	
Rotor inertia (10^{-4}·kg·m²)	0.35	0.34
Overload multiplier	3.5	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

H2T0230BE16, H2T0230BE26 (With brake)



H2T0230BS16, H2T0230BS26 (Without brake)

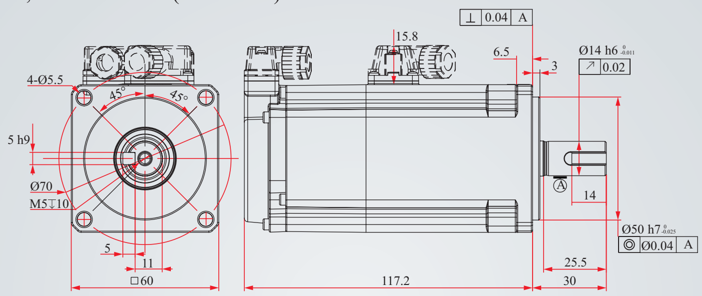


400 W (60 frame)

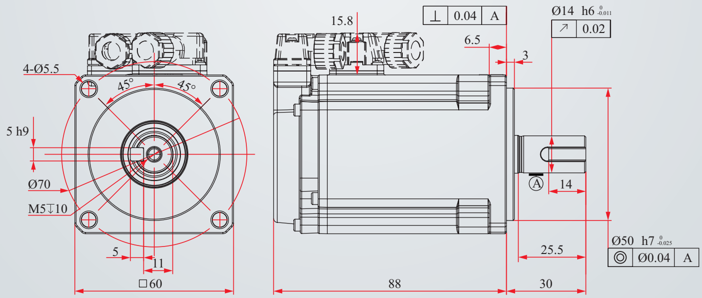
Item (JSSMK1-XXXXXXXXXX)	H2T0430BE16, H2T0430BE26 (With brake)	H2T0430BS16, H2T0430BS26 (Without brake)
Rated power (W)	400	
Rated current (A)	2.51	
Maximum current (A)	8.78	
Rated torque (N·m)	1.27	
Maximum torque (N·m)	4.45	
Rotor inertia (10^{-4}·kg·m²)	0.60	0.59
Overload multiplier	3.5	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

H2T0430BE16, H2T0430BE26 (With brake)



H2T0430BS16, H2T0430BS26 (Without brake)

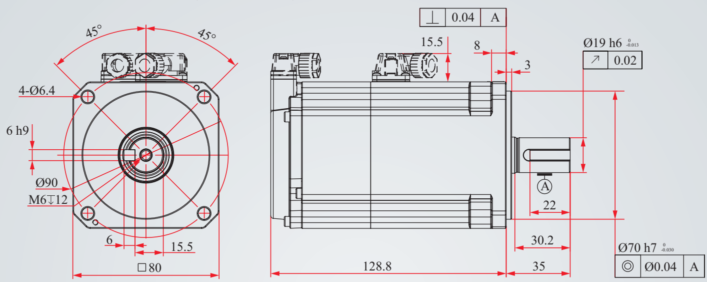


750 W (80 frame)

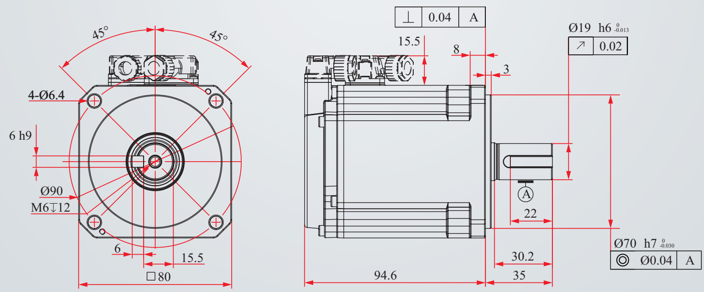
Item (JSSMK1-XXXXXXXXXX)	H2T0830BE16, H2T0830BE26 (With brake)	H2T0830BS16, H2T0830BS26 (Without brake)
Rated power (W)	750	
Rated current (A)	4.60	
Maximum current (A)	16.30	
Rated torque (N·m)	2.39	
Maximum torque (N·m)	8.36	
Rotor inertia (10^{-4}·kg·m²)	1.77	1.72
Overload multiplier	3.5	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

H2T0830BE16, H2T0830BE26 (With brake)



H2T0830BS16, H2T0830BS26 (Without brake)

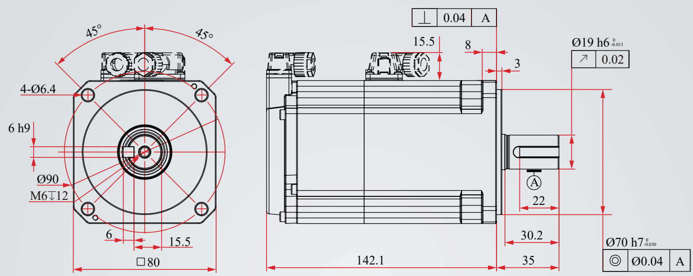


1 kW (80 frame)

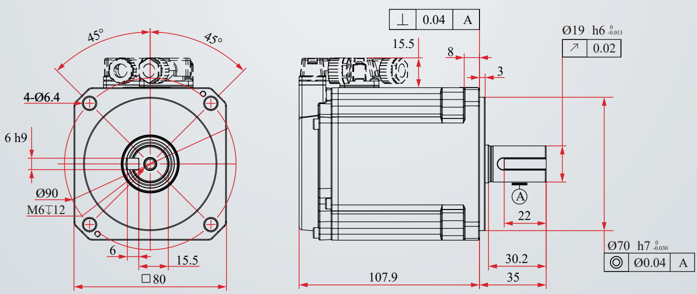
Item (JSSMK1-XXXXXXXXXX)	H2T1030BE16-80, H2T1030BE26-80 (With brake)	H2T1030BS16-80, H2T1030BS26-80 (Without brake)
Rated power (W)	1000	
Rated current (A)	6.3	
Maximum current (A)	20.9	
Rated torque (N·m)	3.18	
Maximum torque (N·m)	11.13	
Rotor inertia (10^{-4}·kg·m²)	2.28	2.23
Overload multiplier	3.5	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

H2T1030BE16-80, H2T1030BE26-80 (With brake)



H2T1030BS16-80, H2T1030BS26-80 (Without brake)

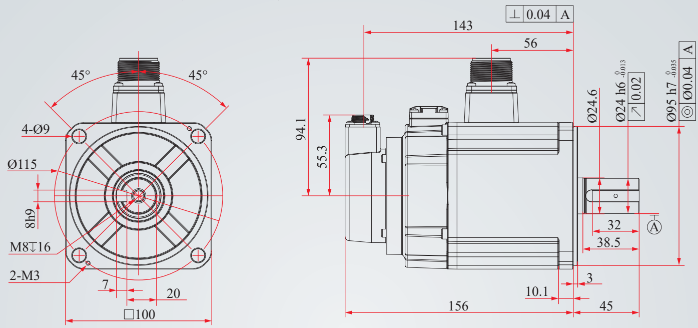


1 kW (100 frame, 220 V)

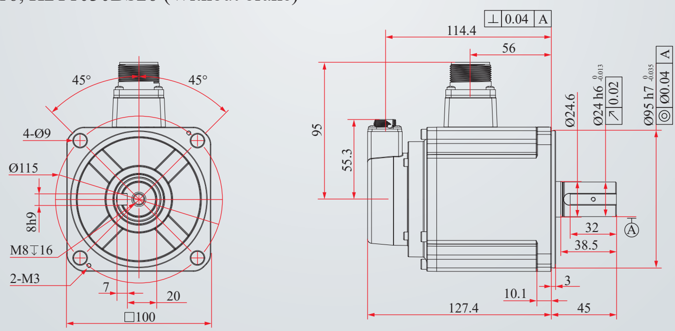
Item (JSSMK1-XXXXXXXXXX)	H2T1030BE16, H2T1030BE26 (With brake)	H2T1030BS16, H2T1030BS26 (Without brake)
Rated power (W)	1000	
Rated current (A)	6.23	
Maximum current (A)	18.69	
Rated torque (N·m)	3.18	
Maximum torque (N·m)	9.54	
Rotor inertia (10^{-4}·kg·m²)	1.76	1.7
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

H2T1030BE16, H2T1030BE26 (With brake)



H2T1030BS16, H2T1030BS26 (Without brake)

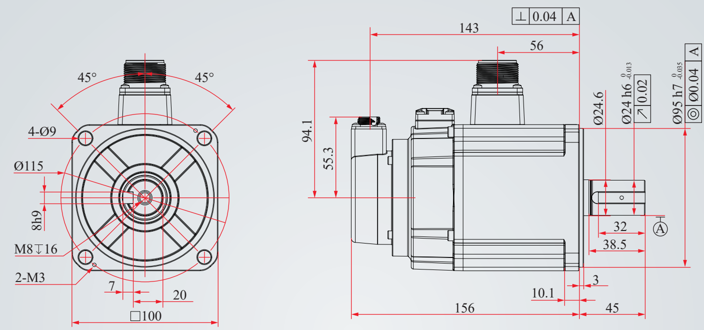


1 kW (100 frame, 380 V)

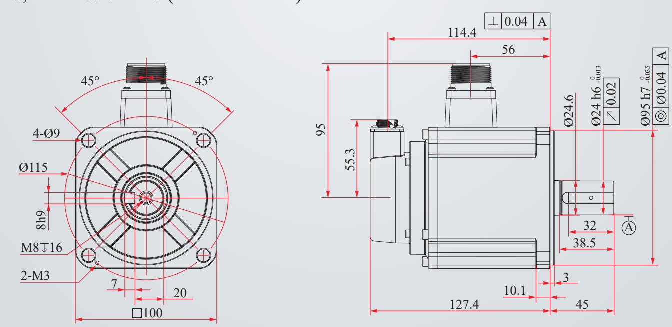
Item (JSSMK1-XXXXXXXXXX)	H4T1030BE16, H4T1030BE26 (With brake)	H4T1030BS16, H4T1030BS26 (Without brake)
Rated power (W)	1000	
Rated current (A)	3.61	
Maximum current (A)	10.83	
Rated torque (N·m)	3.18	
Maximum torque (N·m)	9.54	
Rotor inertia (10^{-4}·kg·m²)	1.76	1.7
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Rated voltage (V)	380	

Product Dimensions (unit: mm)

H4T1030BE16, H4T1030BE26 (With brake)



H4T1030BS16, H4T1030BS26 (Without brake)

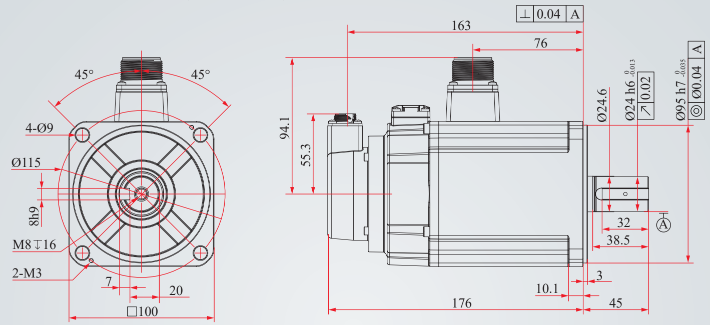


1.5 kW (100 frame, 220 V)

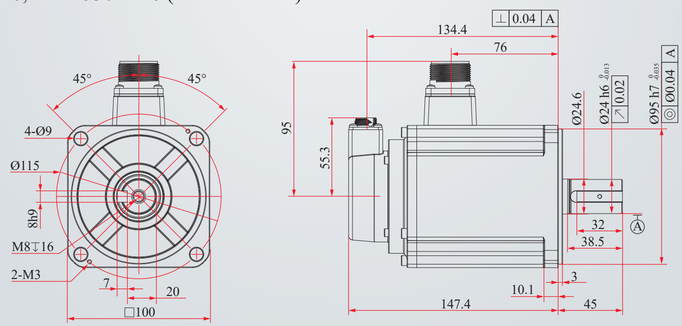
Item (JSSMK1-XXXXXXXXXX)	H2T1530BE16, H2T1530BE26 (With brake)	H2T1530BS16, H2T1530BS26 (Without brake)
Rated power (W)	1500	
Rated current (A)	8.55	
Maximum current (A)	15.65	
Rated torque (N·m)	4.9	
Maximum torque (N·m)	14.7	
Rotor inertia (10^{-4}·kg·m²)	2.58	2.51
Rated speed (rpm)	3000	
Maximum speed (rpm)	5000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

H2T1530BE16, H2T1530BE26 (With brake)



H2T1530BS16, H2T1530BS26 (Without brake)

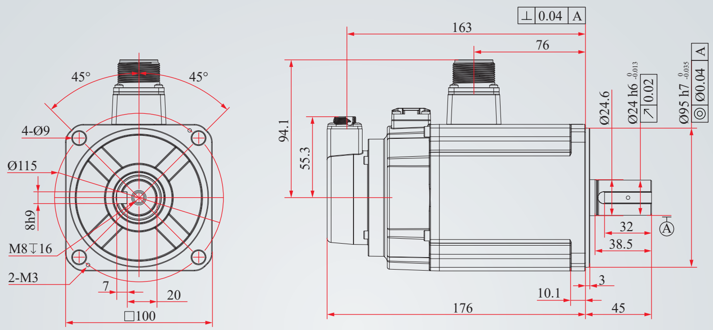


1.5 kW (100 frame, 380 V)

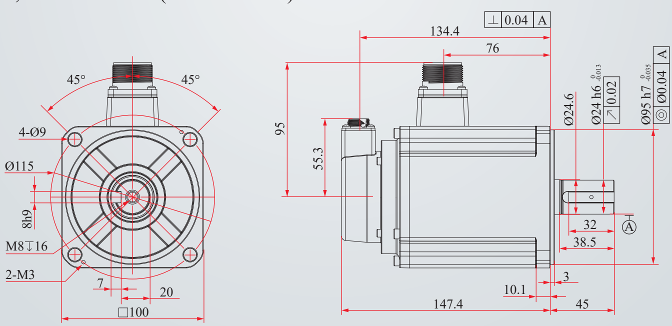
Item (JSSMK1-XXXXXXXXXX)	H4T1530BE16, H4T1530BE26 (With brake)	H4T1530BS16, H4T1530BS26 (Without brake)
Rated power (W)	1500	
Rated current (A)	4.95	
Maximum current (A)	14.85	
Rated torque (N·m)	4.9	
Maximum torque (N·m)	14.7	
Rotor inertia (10^{-4}·kg·m²)	2.58	2.51
Rated speed (rpm)	3000	
Maximum speed (rpm)	5000	
Rated voltage (V)	380	

Product Dimensions (unit: mm)

H4T1530BE16, H4T1530BE26 (With brake)



H4T1530BS16, H4T1530BS26 (Without brake)

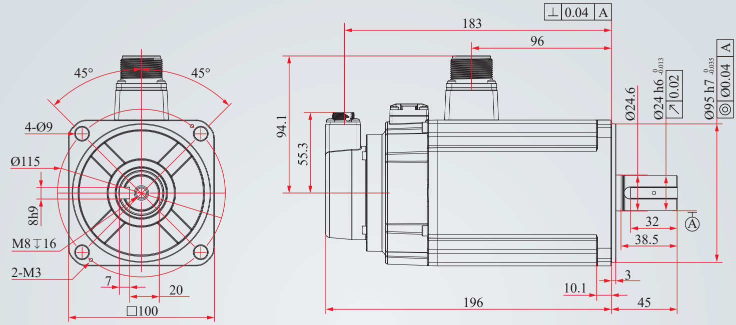


2 kW (100 frame)

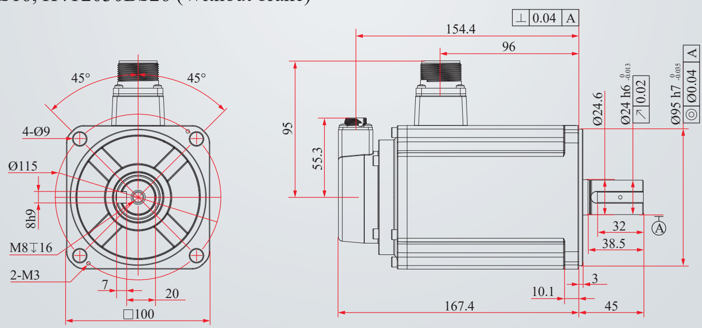
Item (JSSMK1-XXXXXXXXXX)	H4T2030BE16, H4T2030BE26 (With brake)	H4T2030BS16, H4T2030BS26 (Without brake)
Rated power (W)	2000	
Rated current (A)	6.38	
Maximum current (A)	19.14	
Rated torque (N·m)	6.37	
Maximum torque (N·m)	19.1	
Rotor inertia (10^{-4}·kg·m²)	3.39	3.33
Rated speed (rpm)	3000	
Maximum speed (rpm)	5000	
Rated voltage (V)	380	

Product Dimensions (unit: mm)

H4T2030BE16, H4T2030BE26 (With brake)



H4T2030BS16, H4T2030BS26 (Without brake)

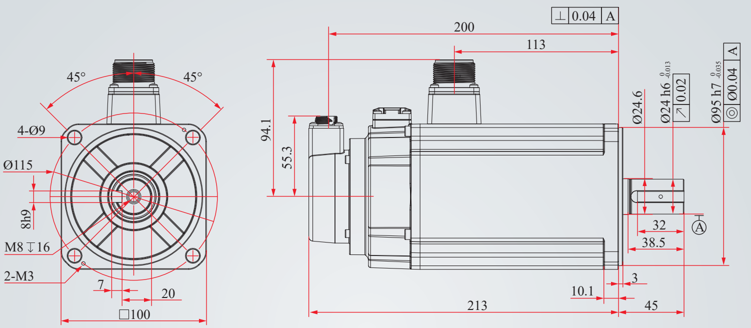


2.5 kW (100 frame)

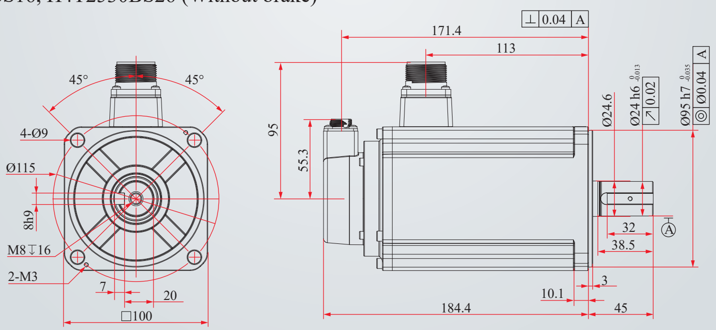
Item (JSSMK1-XXXXXXXXXX)	H4T2530BE16, H4T2530BE26 (With brake)	H4T2530BS16, H4T2530BS26 (Without brake)
Rated power (W)	2500	
Rated current (A)	8.01	
Maximum current (A)	24.03	
Rated torque (N·m)	7.96	
Maximum torque (N·m)	23.9	
Rotor inertia (10^{-4}·kg·m²)	4.03	3.97
Rated speed (rpm)	3000	
Maximum speed (rpm)	5000	
Rated voltage (V)	380	

Product Dimensions (unit: mm)

H4T2530BE16, H4T2530BE26 (With brake)



H4T2530BS16, H4T2530BS26 (Without brake)



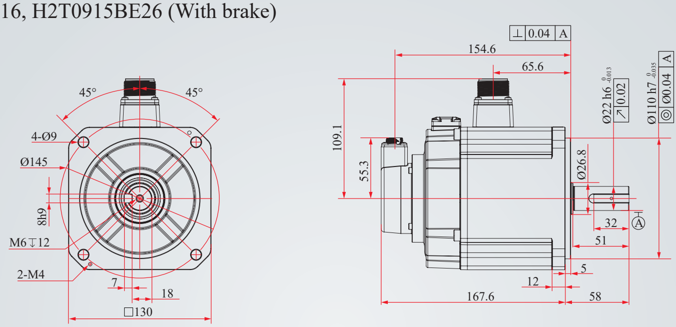
13.7.2 Model of 1500 rpm

850 W (130 frame, 220 V)

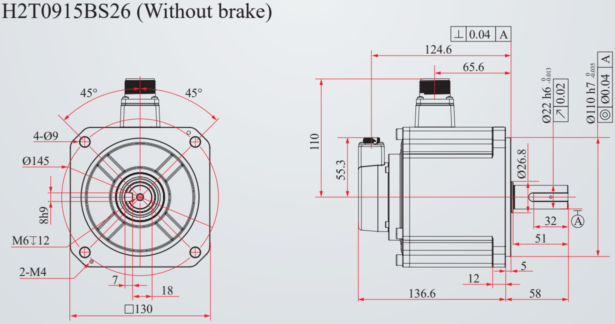
Item (JSSMK1-XXXXXXXXXX)	H2T0915BE16, H2T0915BE26 (With brake)	H2T0915BS16, H2T0915BS26 (Without brake)
Rated power (W)	850	
Rated current (A)	5.72	
Maximum current (A)	13.89	
Rated torque (N·m)	5.39	
Maximum torque (N·m)	13.5	
Rotor inertia (10^{-4}·kg·m²)	14.56	13.62
Rated speed (rpm)	1500	
Maximum speed (rpm)	3000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

H2T0915BE16, H2T0915BE26 (With brake)



H2T0915BS16, H2T0915BS26 (Without brake)

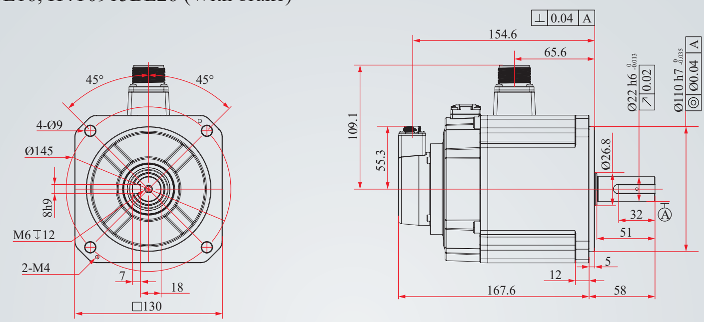


850 W (130 frame, 380 V)

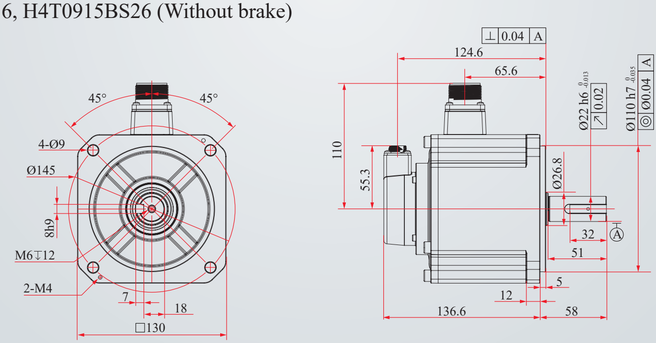
Item (JSSMK1-XXXXXXXXXX)	H4T0915BE16, H4T0915BE26 (With brake)	H4T0915BS16, H4T0915BS26 (Without brake)
Rated power (W)	850	
Rated current (A)	3.16	
Maximum current (A)	7.99	
Rated torque (N·m)	5.39	
Maximum torque (N·m)	13.5	
Rotor inertia (10^{-4}·kg·m²)	14.56	13.62
Rated speed (rpm)	1500	
Maximum speed (rpm)	3000	
Rated voltage (V)	380	

Product Dimensions (unit: mm)

H4T0915BE16, H4T0915BE26 (With brake)



H4T0915BS16, H4T0915BS26 (Without brake)

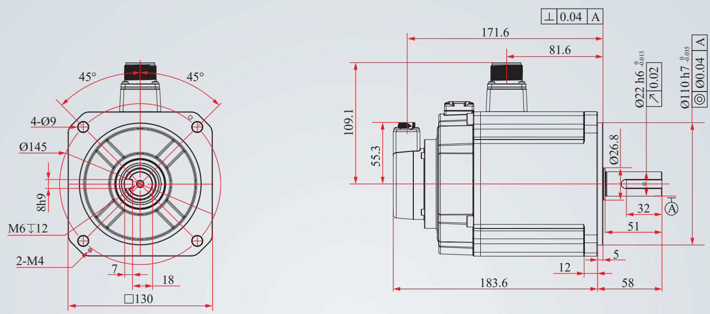


1.3 kW (130 frame, 220 V)

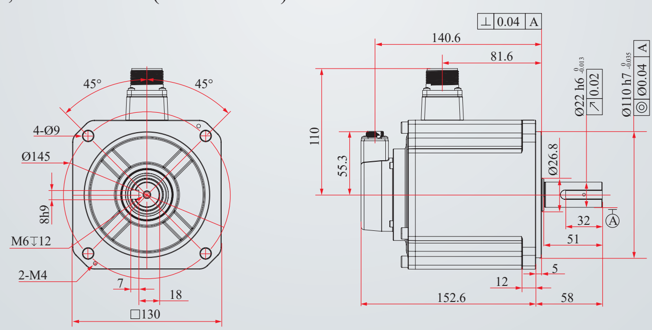
Item (JSSMK1-XXXXXXXXXX)	H2T1315BE16, H2T1315BE26 (With brake)	H2T1315BS16, H2T1315BS26 (Without brake)
Rated power (W)	1300	
Rated current (A)	8.61	
Maximum current (A)	21.1	
Rated torque (N·m)	8.34	
Maximum torque (N·m)	20.85	
Rotor inertia (10^{-4}·kg·m²)	20.54	19.6
Rated speed (rpm)	1500	
Maximum speed (rpm)	3000	
Rated voltage (V)	220	

Product Dimensions (unit: mm)

H2T1315BE16, H2T1315BE26 (With brake)



H2T1315BS16, H2T1315BS26 (Without brake)

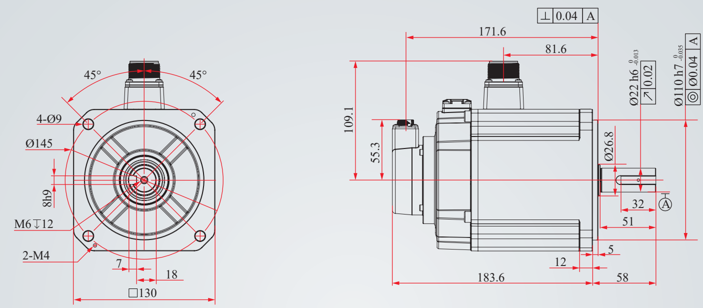


1.3 kW (130 frame, 380 V)

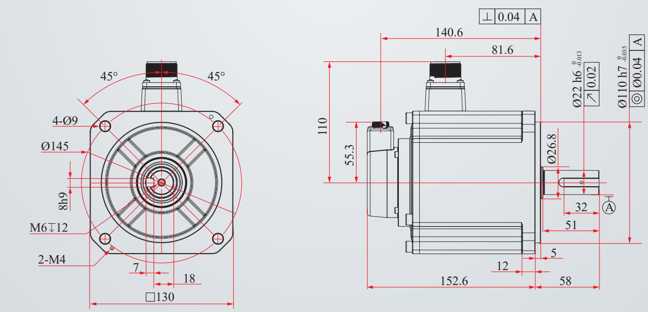
Item (JSSMK1-XXXXXXXXXXX)	H4T1315BE16, H4T1315BE26 (With brake)	H4T1315BS16, H4T1315BS26 (Without brake)
Rated power (W)	1300	
Rated current (A)	4.97	
Maximum current (A)	12.05	
Rated torque (N·m)	8.34	
Maximum torque (N·m)	20.85	
Rotor inertia (10^{-4}·kg·m²)	20.54	19.6
Rated speed (rpm)	1500	
Maximum speed (rpm)	3000	
Rated voltage (V)	380	

Product Dimensions (unit: mm)

H4T1315BE16, H4T1315BE26 (With brake)



H4T1315BS16, H4T1315BS26 (Without brake)

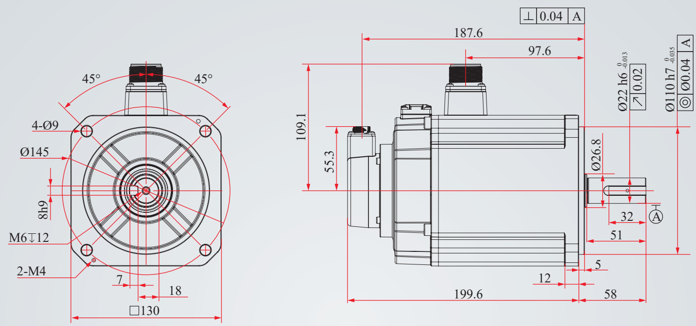


1.8 kW (130 frame)

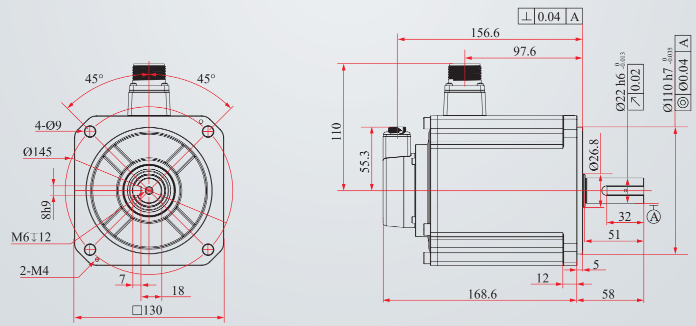
Item (JSSMK1-XXXXXXXXXX)	H4T1815BE16, H4T1815BE26 (With brake)	H4T1815BS16, H4T1815BS26 (Without brake)
Rated power (W)	1800	
Rated current (A)	7.03	
Maximum current (A)	17.01	
Rated torque (N·m)	11.5	
Maximum torque (N·m)	28.75	
Rotor inertia (10^{-4}·kg·m²)	25.72	24.78
Rated speed (rpm)	1500	
Maximum speed (rpm)	3000	
Rated voltage (V)	380	

Product Dimensions (unit: mm)

H4T1815BE16, H4T1815BE26 (With brake)



H4T1815BS16, H4T1815BS26 (Without brake)

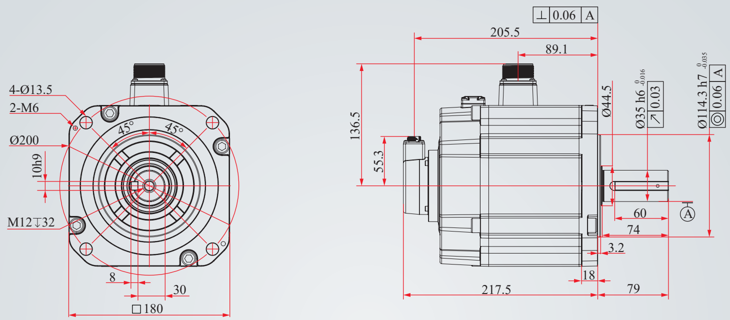


2.9 kW (180 frame)

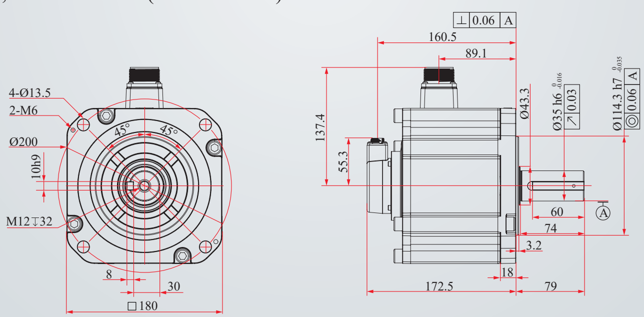
Item (JSSMK1-XXXXXXXXXX)	H4T2915BE16, H4T2915BE26 (With brake)	H4T2915BS16, H4T2915BS26 (Without brake)
Rated power (W)	2900	
Rated current (A)	10.26	
Maximum current (A)	25.81	
Rated torque (N·m)	18.5	
Maximum torque (N·m)	46.5	
Rotor inertia (10^{-4}·kg·m²)	46.19	43.04
Rated speed (rpm)	1500	
Maximum speed (rpm)	3000	
Rated voltage (V)	380	

Product Dimensions (unit: mm)

H4T2915BE16, H4T2915BE26 (With brake)



H4T2915BS16, H4T2915BS26 (Without brake)

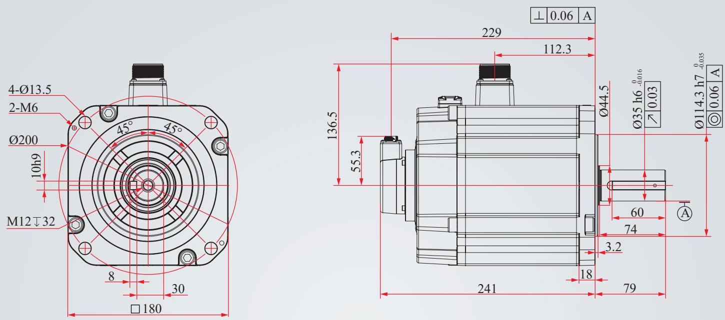


4.4 kW (180 frame)

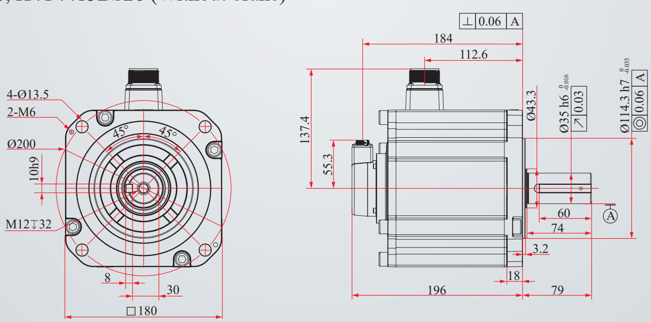
Item (JSSMK1-XXXXXXXXXX)	**H4T4415BE16, H4T4415BE26 (With brake)**	**H4T4415BS16, H4T4415BS26 (Without brake)**
Rated power (W)	4400	
Rated current (A)	15.6	
Maximum current (A)	37.8	
Rated torque (N·m)	28.4	
Maximum torque (N·m)	71.1	
Rotor inertia (10^{-4}·kg·m²)	72.97	67.22
Rated speed (rpm)	1500	
Maximum speed (rpm)	3000	
Rated voltage (V)	380	

Product Dimensions (unit: mm)

H4T4415BE16, H4T4415BE26 (With brake)



H4T4415BS16, H4T4415BS26 (Without brake)

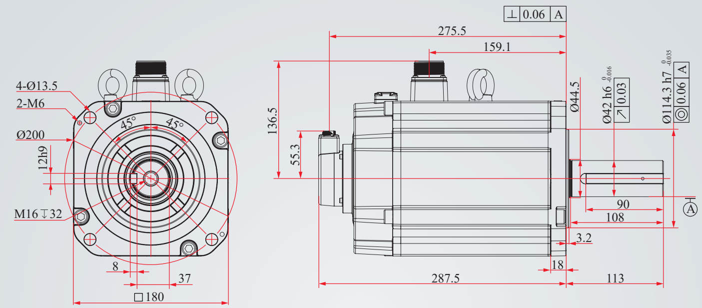


5.5 kW (180 frame)

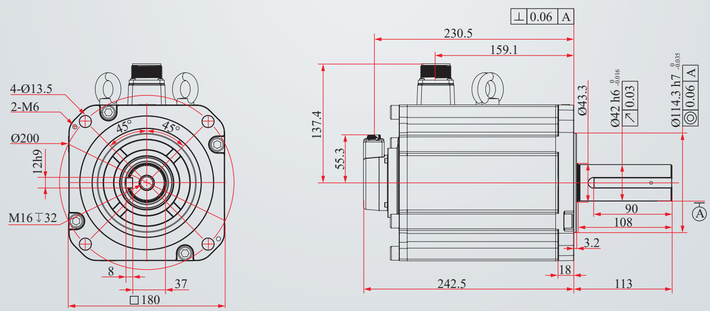
Item (JSSMK1-XXXXXXXXXX)	H4T5515BE16, H4T5515BE26 (With brake)	H4T5515BS16, H4T5515BS26 (Without brake)
Rated power (W)	5500	
Rated current (A)	19.77	
Maximum current (A)	49.43	
Rated torque (N·m)	35	
Maximum torque (N·m)	87.6	
Rotor inertia (10^{-4}·kg·m²)	111.58	110.53
Rated speed (rpm)	1500	
Maximum speed (rpm)	3000	
Rated voltage (V)	380	

Product Dimensions (unit: mm)

H4T5515BE16, H4T5515BE26 (With brake)



H4T5515BS16, H4T5515BS26 (Without brake)

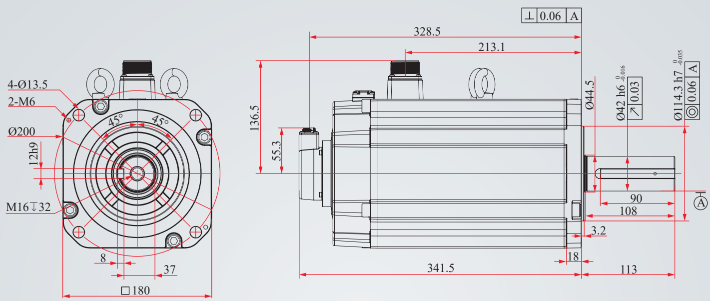


7.5 kW (180 frame)

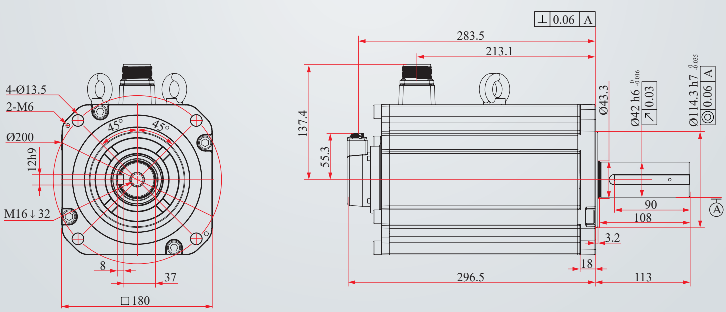
Item (JSSMK1-XXXXXXXXXX)	H4T7515BE16, H4T7515BE26 (With brake)	H4T7515BS16, H4T7515BS26 (Without brake)
Rated power (W)	7500	
Rated current (A)	26.55	
Maximum current (A)	66.38	
Rated torque (N·m)	48	
Maximum torque (N·m)	119	
Rotor inertia (10^{-4}·kg·m²)	161.51	160.45
Rated speed (rpm)	1500	
Maximum speed (rpm)	3000	
Rated voltage (V)	380	

Product Dimensions (unit: mm)

H4T7515BE16, H4T7515BE26 (With brake)



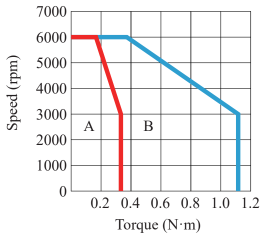
H4T7515BS16, H4T7515BS26 (Without brake)



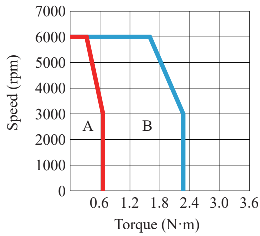
13.8 Motor torque-speed characteristics

Model of 3000 rpm

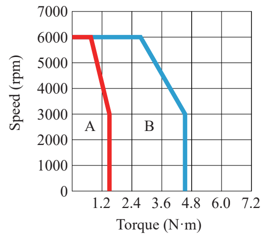
JSSMK1-H2T0130B***



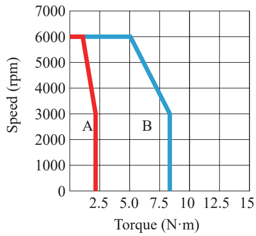
JSSMK1-H2T0230B***



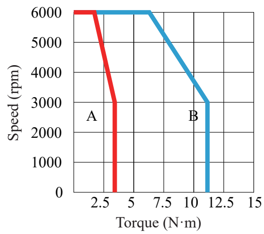
JSSMK1-H2T0430B***



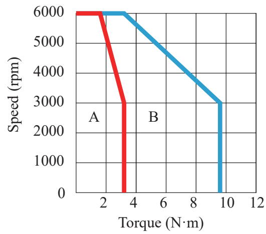
JSSMK1-H2T0830B***



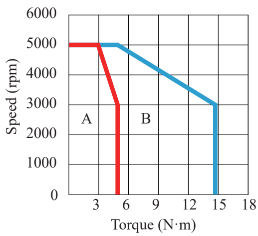
JSSMK1-H2T1030B***-80



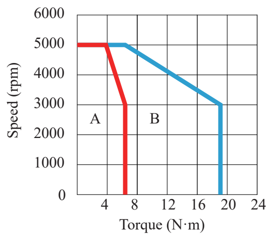
JSSMK1-H*T1030B***



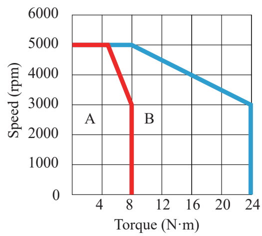
JSSMK1-H*T1530B***



JSSMK1-H4T2030B***

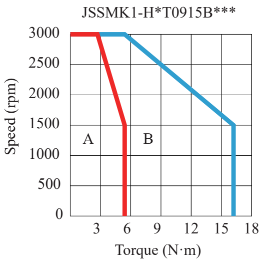


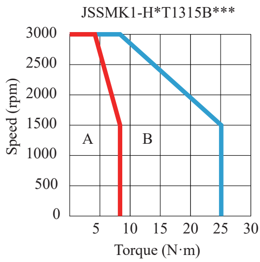
JSSMK1-H4T2530B***

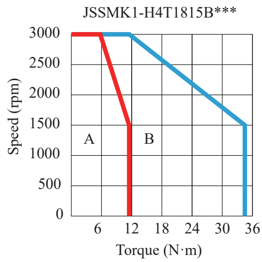


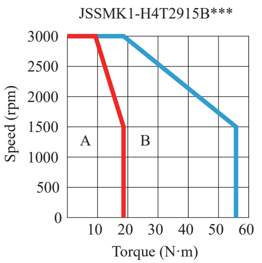
A Continuous work area
B Short-time work area

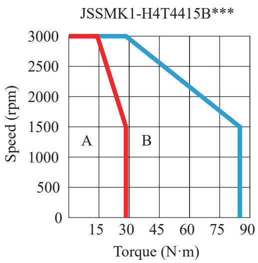
Model of 1500 rpm

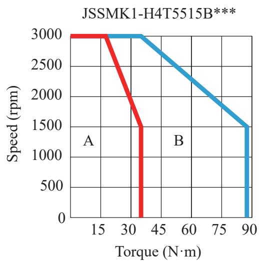


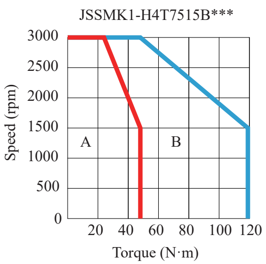


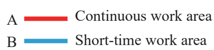












13.9 Supporting relationship between the drive and motor

220 V

<table>
<tr><th></th><th colspan="2">SIZE A</th><th>SIZE B</th></tr>
<tr><td rowspan="2">Drive model
JSS715N-</td><td colspan="3">Single-phase 220V</td></tr>
<tr><td>2T1R6</td><td>2T2R8</td><td>2T5R5</td></tr>
<tr><td rowspan="4">Motor model
JSSMK1-</td><td>100W</td><td>400W</td><td>750W</td></tr>
<tr><td>H2T0130BN16
H2T0130BN26
H2T0130BC16
H2T0130BC26</td><td rowspan="3">H2T0430BS16
H2T0430BS26
H2T0430BE16
H2T0430BE26</td><td rowspan="3">H2T0830BS16
H2T0830BS26
H2T0830BE16
H2T0830BE26</td></tr>
<tr><td>200W</td></tr>
<tr><td>H2T0230BS16
H2T0230BS26
H2T0230BE16
H2T0230BE26</td></tr>
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<table>
<tr><th></th><th colspan="2">SIZE C</th><th>SIZE D</th></tr>
<tr><td rowspan="2">Drive model
JSS715N-</td><td colspan="3">Single-phase/three-phase 220V</td></tr>
<tr><td colspan="2">2T7R6</td><td>2T012</td></tr>
<tr><td rowspan="4">Motor model
JSSMK1-</td><td colspan="2">850W</td><td>1.3kW</td></tr>
<tr><td colspan="2">H2T0915BE16
H2T0915BE26
H2T0915BS16
H2T0915BS26</td><td>H2T1315BE16
H2T1315BE26
H2T1315BS16
H2T1315BS26</td></tr>
<tr><td colspan="2">1kW</td><td>1.5kW</td></tr>
<tr><td>H2T1030BE16-80
H2T1030BE26-80
H2T1030BS16-80
H2T1030BS26-80</td><td>H2T1030BE16
H2T1030BE26
H2T1030BS16
H2T1030BS26</td><td>H2T1530BE16
H2T1530BE26
H2T1530BS16
H2T1530BS26</td></tr>
</table>

380 V

<table>
<tr><td></td><td colspan="2">SIZE C</td><td colspan="2">SIZE D</td></tr>
<tr><td rowspan="2">Drive model
JSS715N-</td><td colspan="4">Three-phase 380V</td></tr>
<tr><td>4T3R5</td><td>4T5R4</td><td>4T8R4</td><td>4T012</td></tr>
<tr><td rowspan="6">Motor model
JSSMK1-</td><td>850W</td><td>1kW</td><td>1.8kW</td><td>2.9kW</td></tr>
<tr><td rowspan="5">H4T0915BE16
H4T0915BE26
H4T0915BS16
H4T0915BS26</td><td>H4T1030BE16
H4T1030BE26
H4T1030BS16
H4T1030BS26</td><td>H4T1815BE16
H4T1815BE26
H4T1815BS16
H4T1815BS26</td><td rowspan="5">H4T2915BE16
H4T2915BE26
H4T2915BS16
H4T2915BS26</td></tr>
<tr><td>1.3kW</td><td>2kW</td></tr>
<tr><td>H4T1315BE16
H4T1315BE26
H4T1315BS16
H4T1315BS26</td><td>H4T2030BE16
H4T2030BE26
H4T2030BS16
H4T2030BS26</td></tr>
<tr><td>1.5kW</td><td>2.5kW</td></tr>
<tr><td>H4T1530BE16
H4T1530BE26
H4T1530BS16
H4T1530BS26</td><td>H4T2530BE16
H4T2530BE26
H4T2530BS16
H4T2530BS26</td></tr>
</table>

<table>
<tr><td></td><td colspan="3">SIZE E</td></tr>
<tr><td rowspan="2">Drive model
JSS715N-</td><td colspan="3">Three-phase 380V</td></tr>
<tr><td>4T017</td><td>4T021</td><td>4T026</td></tr>
<tr><td rowspan="2">Motor model
JSSMK1-</td><td>4.4kW</td><td>5.5kW</td><td>7.5kW</td></tr>
<tr><td>H4T4415BE16
H4T4415BE26
H4T4415BS16
H4T4415BS26</td><td>H4T5515BE16
H4T5515BE26
H4T5515BS16
H4T5515BS26</td><td>H4T7515BE16
H4T7515BE26
H4T7515BS16
H4T7515BS26</td></tr>
</table>

13.10 Supporting relationship between the motor and cable

Model of 3000 rpm

Motor frame number	Motor Power	Motor Model JSSMK1-	17-bit Absolute Encoder		Brake	Oil Sealing	Shaft Diameter	Matching Accessories of Motor	
			Single-turn	Multi-turn				Power cable model	Encoder cable model
40	100W (220V)	H2T0130BN16	●				Ø8	⑦	⑬
		H2T0130BN26		●				⑦	⑮
		H2T0130BC16	●		●			①	⑬
		H2T0130BC26		●	●			①	⑮
60	200W (220V)	H2T0230BS16	●			●	Ø14	⑦	⑬
		H2T0230BS26		●		●		⑦	⑮
		H2T0230BE16	●		●	●		①	⑬
		H2T0230BE26		●	●	●		①	⑮
	400W (220V)	H2T0430BS16	●			●		⑦	⑬
		H2T0430BS26		●		●		⑦	⑮
		H2T0430BE16	●		●	●		①	⑬
		H2T0430BE26		●	●	●		①	⑮
80	750W (220V)	H2T0830BS16	●			●	Ø19	⑦	⑬
		H2T0830BS26		●		●		⑦	⑮
		H2T0830BE16	●		●	●		①	⑬
		H2T0830BE26		●	●	●		①	⑮

Motor frame number	Motor Power	Motor Model JSSMK1-	17-bit Absolute Encoder		Brake	Oil Sealing	Shaft Diameter	Matching Accessories of Motor	
			Single-turn	Multi-turn				Power cable model	Encoder cable model
80	1kW (220V)	H2T1030BS16-80	●			●	Ø19	⑦	⑬
		H2T1030BS26-80		●		●		⑦	⑮
		H2T1030BE16-80	●		●	●		①	⑬
		H2T1030BE26-80		●	●	●		①	⑮
100	1kW (220V)	H2T1030BS16	●			●	Ø24	⑧	⑭
		H2T1030BS26		●		●		⑧	⑯
		H2T1030BE16	●		●	●		②	⑭
		H2T1030BE26		●	●	●		②	⑯
	1kW (380V)	H4T1030BS16	●			●		⑧	⑭
		H4T1030BS26		●		●		⑧	⑯
		H4T1030BE16	●		●	●		②	⑭
		H4T1030BE26		●	●	●		②	⑯
	1.5kW (220V)	H2T1530BS16	●			●		⑧	⑭
		H2T1530BS26		●		●		⑧	⑯
		H2T1530BE16	●		●	●		②	⑭
		H2T1530BE26		●	●	●		②	⑯

Motor frame number	Motor Power	Motor Model JSSMK1-	17-bit Absolute Encoder		Brake	Oil Sealing	Shaft Diameter	Matching Accessories of Motor	
			Single-turn	Multi-turn				Power cable model	Encoder cable model
100	1.5kW (380V)	H4T1530BS16	●			●	Ø24	⑧	⑭
		H4T1530BS26		●		●		⑧	⑯
		H4T1530BE16	●		●	●		②	⑭
		H4T1530BE26		●	●	●		②	⑯
	2kW (380V)	H4T2030BS16	●			●		⑧	⑭
		H4T2030BS26		●		●		⑧	⑯
		H4T2030BE16	●		●	●		②	⑭
		H4T2030BE26		●	●	●		②	⑯
	2.5kW (380V)	H4T2530BS16	●			●		⑧	⑭
		H4T2530BS26		●		●		⑧	⑯
		H4T2530BE16	●		●	●		②	⑭
		H4T2530BE26		●	●	●		②	⑯

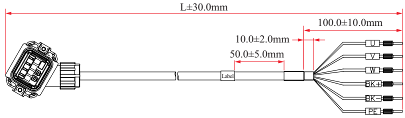
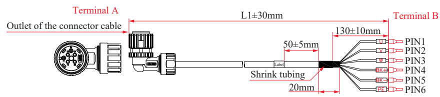
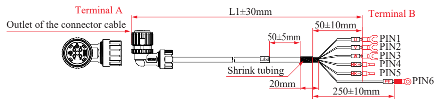
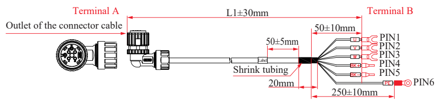
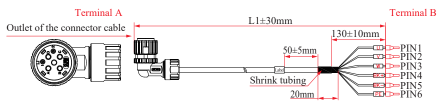
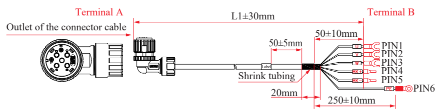
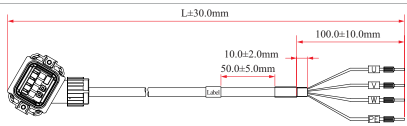
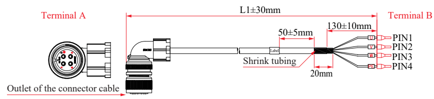
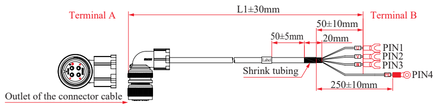
Model of 1500 rpm

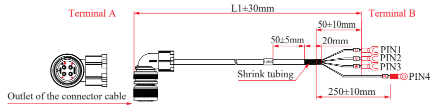
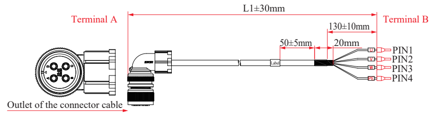
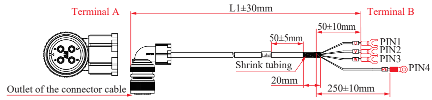
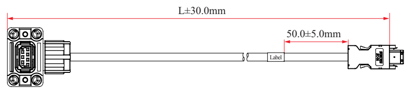
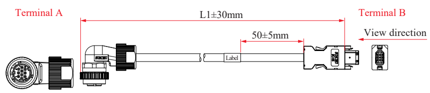
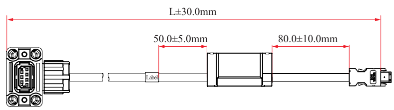
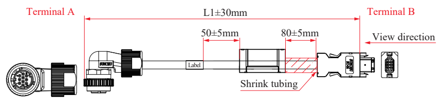
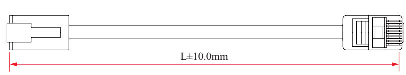
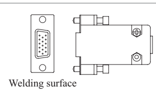
Motor frame number	Motor Power	Motor Model JSSMK1-	23-bit Absolute Encoder		Brake	Oil Sealing	Shaft Diameter	Matching Accessories of Motor	
			Single-turn	Multi-turn				Power cable model	Encoder cable model
130	850W (220V)	H2T0915BS16	●			●	Ø22	⑧	⑭
		H2T0915BS26		●		●		⑧	⑯
		H2T0915BE16	●		●	●		②	⑭
		H2T0915BE26		●	●	●		②	⑯
130	850W (380V)	H4T0915BS16	●			●	Ø22	⑧	⑭
		H4T0915BS26		●		●		⑧	⑯
		H4T0915BE16	●		●	●		②	⑭
		H4T0915BE26		●	●	●		②	⑯
	1.3kW (220V)	H2T1315BS16	●			●		⑧	⑭
		H2T1315BS26		●		●		⑧	⑯
		H2T1315BE16	●		●	●		②	⑭
		H2T1315BE26		●	●	●		②	⑯
	1.3kW (380V)	H4T1315BS16	●			●		⑧	⑭
		H4T1315BS26		●		●		⑧	⑯
		H4T1315BE16	●		●	●		②	⑭
		H4T1315BE26		●	●	●		②	⑯

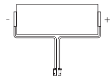
Motor frame number	Motor Power	Motor Model JSSMK1-	23-bit Absolute Encoder		Brake	Oil Sealing	Shaft Diameter	Matching Accessories of Motor	
			Single-turn	Multi-turn				Power cable model	Encoder cable model
130	1.8kW (380V)	H4T1815BS16	●			●	Ø22	⑧	⑭
		H4T1815BS26		●		●		⑧	⑯
		H4T1815BE16	●		●	●		②	⑭
		H4T1815BE26		●	●	●		②	⑯
180	2.9kW (380V)	H4T2915BS16	●			●	Ø35	⑪	⑭
		H4T2915BS26		●		●		⑪	⑯
		H4T2915BE16	●		●	●		⑤	⑭
		H4T2915BE26		●	●	●		⑤	⑯
	4.4kW (380V)	H4T4415BS16	●			●		⑫	⑭
		H4T4415BS26		●		●		⑫	⑯
		H4T4415BE16	●		●	●		⑥	⑭
		H4T4415BE26		●	●	●		⑥	⑯
	5.5kW (380V)	H4T5515BS16	●			●	Ø42	⑫	⑭
		H4T5515BS26		●		●		⑫	⑯
		H4T5515BE16	●		●	●		⑥	⑭
		H4T5515BE26		●	●	●		⑥	⑯

Motor frame number	Motor Power	Motor Model JSSMK1-	23-bit Absolute Encoder		Brake	Oil Sealing	Shaft Diameter	Matching Accessories of Motor	
			Single-turn	Multi-turn				Power cable model	Encoder cable model
180	7.5kW (380V)	H4T7515BS16	●			●	Ø42	⑫	⑭
		H4T7515BS26		●		●		⑫	⑯
		H4T7515BE16	●		●	●		⑥	⑭
		H4T7515BE26		●	●	●		⑥	⑯

13.11 Cable Information

Cable Name	Cable Model	Cable Length	Cable Appearance	No.
Power cable with brake	JSS7-C-PWB075-3.0	3.0 m		①
	JSS7-C-PWB075-5.0	5.0 m		
	JSS7-C-PWB075-10.0	10.0 m		
	JSS7-C-PWB062-3.0	3.0 m		②
	JSS7-C-PWB062-5.0	5.0 m		
	JSS7-C-PWB062-10.0	10.0 m		
	JSS7-C-PWB152-3.0	3.0 m		③
	JSS7-C-PWB152-5.0	5.0 m		
	JSS7-C-PWB152-10.0	10.0 m		
	JSS7-C-PWB142-3.0	3.0 m		④
	JSS7-C-PWB142-5.0	5.0 m		
	JSS7-C-PWB142-10.0	10.0 m		
	JSS7-C-PWB053-3.0	3.0 m		⑤
	JSS7-C-PWB053-5.0	5.0 m		
	JSS7-C-PWB053-10.0	10.0 m		
	JSS7-C-PWB143-3.0	3.0 m		⑥
	JSS7-C-PWB143-5.0	5.0 m		
	JSS7-C-PWB143-10.0	10.0 m		
Power cable without brake	JSS7-C-PWR075-3.0	3.0 m		⑦
	JSS7-C-PWR075-5.0	5.0 m		
	JSS7-C-PWR075-10.0	10.0 m		
	JSS7-C-PWR062-3.0	3.0 m		⑧
	JSS7-C-PWR062-5.0	5.0 m		
	JSS7-C-PWR062-10.0	10.0 m		
	JSS7-C-PWR152-3.0	3.0 m		⑨
	JSS7-C-PWR152-5.0	5.0 m		
	JSS7-C-PWR152-10.0	10.0 m		

Cable Name	Cable Model	Cable Length	Cable Appearance	No.
Power cable without brake	JSS7-C-PWR142-3.0	3.0 m		⑩
	JSS7-C-PWR142-5.0	5.0 m		
	JSS7-C-PWR142-10.0	10.0 m		
	JSS7-C-PWR053-3.0	3.0 m		⑪
	JSS7-C-PWR053-5.0	5.0 m		
	JSS7-C-PWR053-10.0	10.0 m		
	JSS7-C-PWR143-3.0	3.0 m		⑫
	JSS7-C-PWR143-5.0	5.0 m		
	JSS7-C-PWR143-10.0	10.0 m		
Single-turn encoder cable	JSS7-C-ENC075-3.0	3.0 m		⑬
	JSS7-C-ENC075-5.0	5.0 m		
	JSS7-C-ENC075-10.0	10.0 m		
	JSS7-C-ENC072-3.0	3.0 m		⑭
	JSS7-C-ENC072-5.0	5.0 m		
	JSS7-C-ENC072-10.0	10.0 m		
Multiple-turn encoder cable	JSS7-C-ENC075-BAT-3.0	3.0 m		⑮
	JSS7-C-ENC075-BAT-5.0	5.0 m		
	JSS7-C-ENC075-BAT-10.0	10.0 m		
	JSS7-C-ENC072-BAT-3.0	3.0 m		⑯
	JSS7-C-ENC072-BAT-5.0	5.0 m		
	JSS7-C-ENC072-BAT-10.0	10.0 m		
Servo drive 100-gigabit communication network cable	JSS7-C-NET-0.3	0.3 m		-
	JSS7-C-NET-3	3.0 m		
Type-c-to-serial commissioning cable	JSS7-C-DBG	-		-
DB15 terminal accessories	JSS7-DB15	-		-

Cable Name	Cable Model	Cable Length	Cable Appearance	No.
Battery accessories	JSS7-BAT	-		-

NOTICE

- For cables related to frames of model 100 and above models, contact the manufacturer.

Chapter 14 Peripheries

14.1 List of Peripheries

Component Name	Installation Location	Applicable Model	Description
Fuse and circuit breaker	Input side of the drive	All	To comply with EN 61800-5-1 and UL 61800-5-1 standards, install a fuse/circuit breaker on the input side of the servo drive to prevent accidents caused by short circuit in the internal circuit.
AC input reactor	Input side of the drive	All	Eliminate harmonics and improves the power factor on the input side.
EMC filter	Input side of the drive	All	Reduce the conducted and radiated interference that escapes from the servo drive to the outside.
Magnetic ring	Output side of the drive	All	Reduce interference to the outside and the bearing current.
	Signal cable	All	Improve the anti-interference performance of signals.

14.2 Fuse

To prevent accidents caused by short circuit, install a fuse on the input side of the drive.

Drive Model		Rated Input Current	Recommended Fuse		
			Manufacturer	Rated Current	Model
Single-phase 220 V					
SIZE A	JSS715N2T1R6	2.3 A	Bussmann	15 A	FWP-15B
SIZE A	JSS715N2T2R8	4 A	Bussmann	20 A	FWP-20B
SIZE B	JSS715N2T5R5	7.9 A	Bussmann	35 A	FWP-35C
SIZE C	JSS715N2T7R6	9.6 A	Bussmann	40 A	FWP-40C
SIZE D	JSS715N2T012	12.8 A	Bussmann	40 A	FWP-40C
Three-phase 220 V					
SIZE C	JSS715N2T7R6	5.1 A	Bussmann	50 A	FWP-50C

Drive Model		Rated Input Current	Recommended Fuse		
			Manufacturer	Rated Current	Model
SIZE D	JSS715N2T012	8 A	Bussmann	50 A	FWP-50C
Three-phase 380 V					
SIZE C	JSS715N4T3R5	2.4 A	Bussmann	15 A	FWP-15B
SIZE C	JSS715N4T5R4	3.6 A	Bussmann	20 A	FWP-20B
SIZE D	JSS715N4T8R4	5.6 A	Bussmann	20 A	FWP-20B
SIZE D	JSS715N4T012	8 A	Bussmann	50 A	FWP-50C
SIZE E	JSS715N4T017	12 A	Bussmann	50 A	FWP-50C
SIZE E	JSS715N4T021	16 A	Bussmann	70 A	FWP-70C
SIZE E	JSS715N4T026	21 A	Bussmann	125 A	FWP-125C

14.3 Electromagnetic Contactor

Drive Model		Rated Input Current	Recommended Contactor		
			Manufacturer	Rated Current	Model
Single-phase 220 V					
SIZE A	JSS715N2T1R6	2.3 A	Schneider	9 A	LC1 D09
SIZE A	JSS715N2T2R8	4 A	Schneider	9 A	LC1 D09
SIZE B	JSS715N2T5R5	7.9 A	Schneider	9 A	LC1 D09
SIZE C	JSS715N2T7R6	9.6 A	Schneider	12 A	LC1 D12
SIZE D	JSS715N2T012	12.8 A	Schneider	18 A	LC1 D18
Three-phase 220 V					
SIZE C	JSS715N2T7R6	5.1 A	Schneider	9 A	LC1 D09
SIZE D	JSS715N2T012	8 A	Schneider	9 A	LC1 D09
Three-phase 380 V					
SIZE C	JSS715N4T3R5	2.4 A	Schneider	9 A	LC1 D09
SIZE C	JSS715N4T5R4	3.6 A	Schneider	9 A	LC1 D09
SIZE D	JSS715N4T8R4	5.6 A	Schneider	9 A	LC1 D09
SIZE D	JSS715N4T012	8 A	Schneider	9 A	LC1 D09

Drive Model		Rated Input Current	Recommended Contactor		
			Manufacturer	Rated Current	Model
SIZE E	JSS715N4T017	12 A	Schneider	12 A	LC1 D12
SIZE E	JSS715N4T021	16 A	Schneider	18 A	LC1 D18
SIZE E	JSS715N4T026	21 A	Schneider	25 A	LC1 D25

14.4 Circuit Breaker

Drive Model		Rated Input Current	Recommended Contactor		
			Manufacturer	Rated Current	Model
Single-phase 220 V					
SIZE A	JSS715N2T1R6	2.3 A	Schneider	4 A	OSMC32N2C4
SIZE A	JSS715N2T2R8	4 A	Schneider	6 A	OSMC32N2C6
SIZE B	JSS715N2T5R5	7.9 A	Schneider	16 A	OSMC32N2C16
SIZE C	JSS715N2T7R6	9.6 A	Schneider	16 A	OSMC32N2C16
SIZE D	JSS715N2T012	12.8 A	Schneider	20 A	OSMC32N2C20
Three-phase 220 V					
SIZE C	JSS715N2T7R6	5.1 A	Schneider	10 A	OSMC32N2C10
SIZE D	JSS715N2T012	8 A	Schneider	16 A	OSMC32N2C16
Three-phase 380 V					
SIZE C	JSS715N4T3R5	2.4 A	Schneider	4 A	OSMC32N2C4
SIZE C	JSS715N4T5R4	3.6 A	Schneider	6 A	OSMC32N2C6
SIZE D	JSS715N4T8R4	5.6 A	Schneider	10 A	OSMC32N2C10
SIZE D	JSS715N4T012	8 A	Schneider	16 A	OSMC32N2C16
SIZE E	JSS715N4T017	12 A	Schneider	20 A	OSMC32N2C20
SIZE E	JSS715N4T021	16 A	Schneider	25 A	OSMC32N2C25
SIZE E	JSS715N4T026	21 A	Schneider	32 A	OSMC32N2C32

14.5 Absolute Encoder Battery

Select an appropriate battery according to the following table.

Battery Spec.	Item and Unit	Ratings			Requirements
		Min.	Typical	Max.	
Output Specifications: 3.6V 2500mAh	External battery volt-age (V)	3.2	3.6	5	In standby state[1]
	Circuit fault voltage (V)	-	2.6	-	In standby state
	Battery alarm voltage (V)	2.85	3	3.15	-
	Current consumed by the circuit (μA)	-	2	-	In normal operation[2]
		-	10	-	In standby state, shaft at a standstill
		-	80	-	In standby state, shaft rotating
	Ambient temperature during battery opera-tion (ºC)	0	-	40	Same as the motor
	Battery storage tem-perature (ºC)	-20	-	60	

NOTICE

- The preceding data is measured at an ambient temperature of 20ºC.
- [1] The "standby state" means that the encoder performs multi-turn counting by using the power from an external battery when the servo drive power supply is off. In this case, data transmission stops.
- [2] The "normal operation" means that the absolute encoder supports single-turn or multi-turn data counting and transceiving. Power on the servo drive after connecting the absolute encoder properly. The encoder starts data transmission after a short delay of about 5s after power-on. The motor speed must be lower than or equal to 10 rpm during transition from the standby state to the normal operation state (upon power-on). Otherwise, E740 (Encoder fault) may be reported. In this case, power off and power on the servo drive again.
- Theoretically, a battery can be used for two years, but different working conditions and environments can lead to significant differences.

Chapter 15 Maintenance

15.1 Daily Maintenance

Standard operating conditions:

- 30°C (annual average ambient temperature)
- Average load rate < 80%
- Daily operation time < 20 hours

Due to the influence of ambient temperature, humidity, dust, and vibration, the internal components of the device may age and be damaged, causing faults or reducing the service life of the device. Therefore, to ensure the normal function of the device and prevent damage, refer to the following items for daily inspection and cleaning.

Check

- The ambient temperature and humidity are normal. There is no dust or unwanted objects in the servo drive.
- There is no abnormal vibration or noise for the device.
- The voltage of the power supply is normal.
- There is no strange smell.
- There are no fibers adhered to the air inlet.
- There is no intrusion of unwanted objects on the load end.

Cleaning

- Clear the dust, especially metallic dust, on the drive surface to prevent the dust from entering the drive.
- Keep the drive in a well ventilated environment.
- Keep the front end of the servo drive and the connectors clean.

⚠ CAUTION

- Disconnect the power supply before cleaning. Use a blower gun or dry cloth to clean the equipment.
- Do not use gasoline, diluent, alcohol, acidic and alkaline detergents, to prevent discoloration or damage to the enclosure.

15.2 Periodic Maintenance

The electrical and electronic parts inside the servo drive may be mechanically worn out and degraded. Perform periodic maintenance according to the following table.

Contact us or the agent before replacement to double check whether the part needs to be replaced.

Object	Type	Standard Replacement Interval
Drive	Bus filter capacitor	About 5 years
	Cooling fan	2 to 3 years (10,000 h to 30,000 h)
	Aluminum electrolytic capacitor of the circuit board	About 5 years
	Pre-charge relay	100,000 operations (depending on the operating conditions)
	Pre-charge resistor	20,000 operations (depending on the operating conditions)
Motor	Bearing	3 to 5 years (20,000 h to 30,000 h)
	Oil Seal	5000 hours
	Encoder	3 to 5 years (20,000 h to 30,000 h)
	Absolute encoder battery	Depends on the operating conditions. See the operation instructions for the encoder battery for details.

15.3 Part Replacement

15.3.1 Plain Key Replacement

CAUTION

- Observe the uninstallation requirements described in this chapter. Failure to comply may result in equipment fault or damage.
- Disassembly by force is strictly prohibited to prevent injury to hands from bumps and knocks.

Currently, the plain keys for JSSMK1 standard motors with 60/80/130 frames have been unified to B-type plain keys, and come with key extraction holes. The specifications for the key extraction screws are as listed in the following table.

Motor Mode	Flat Key Size	Screw Specifications (Hexagon Screw Recommended)
40 frame	A-type plain key - A3 x 3 x 14	Without key extraction holes
60 frame	B-type plain key - B5 x 5 x 16.5	M3x10 and above
80 frame	B-type plain key - B6 x 6 x 25	M3x15 and above
100 frame	C-type plain key - C8 x 7 x 35	M3x20 and above
130 frame	B-type plain key - B8 x 7 x 35	M3x20 and above
180 frame	C-type plain key - C10 x 8 x 64	M3x20 and above

Tools: Internal hexagonal wrench

Disassembly procedure:

① Prepare key extraction screws (hexagon bolts as recommended) of the corresponding specifications according to the motor models.

② Use an Allen key to turn the screws clockwise until the A-A end of the plain key completely disengages from the keyway. This will allow you to remove the plain key.

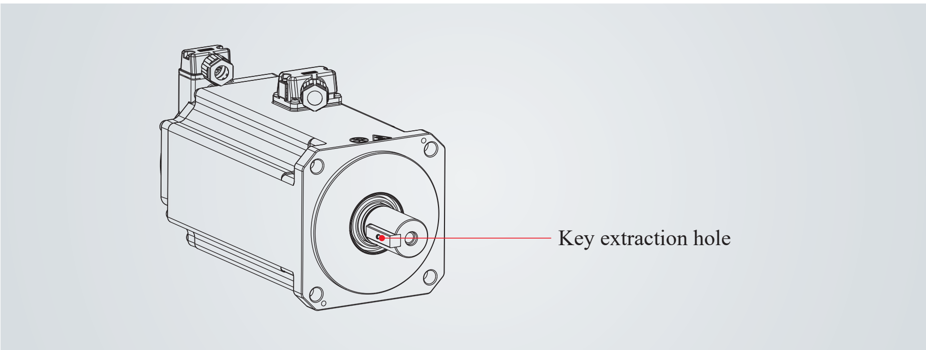


Figure 15-1 Plain key disassembly

15.3.2 Oil Seal Replacement

Tools: Needle-nose pliers, non-slip gloves, and cotton cloth

Disassembly procedure:

① Put a cotton cloth at support point B to protect the end bracket against scratch during disassembly.

② Fix the motor and prop the oil seal outer lip at point A with one end of the needle-nose pliers.

③ Pry out the oil seal slowly at point B.

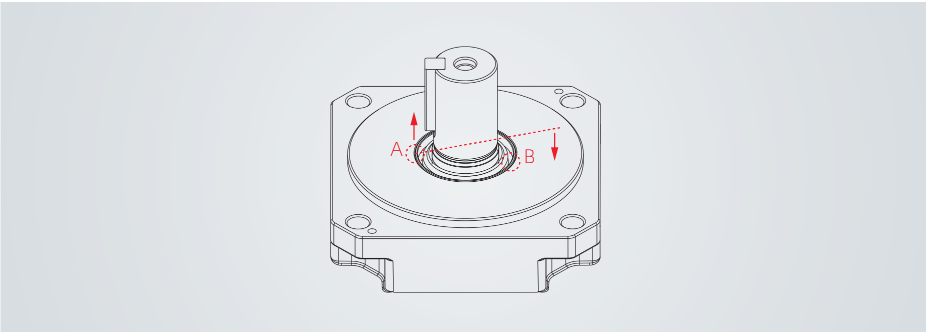


Figure 15-2 Oil seal disassembly

Chapter 16 Troubleshooting for Common EMC Issues

16.1 RCD Malfunction

If a residual current device (RCD) is needed, select the RCD according to the following requirements:

- Use a B-type RCD because the drive may generate DC leakage current in the protective conductor.
- For each drive, use an RCD whose tripping current is not lower than 100 mA to prevent RCD malfunction due to high-frequency leakage current generated by the drive.
- When multiple drives are connected in parallel and share one RCD, select an RCD whose tripping current is not lower than 300 mA.
- Use Chint or Schneider RCDs (recommended).

When an RCD malfunctions, perform troubleshooting according to the following table.

<table>
<tr><th>Fault</th><th>Possible Cause</th><th>Solution</th></tr>
<tr><td rowspan="4">Tripping upon power-on</td><td>The anti-interference performance of the RCD is poor.</td><td rowspan="4">● Use an RCD from a recommended brand.
● Use an RCD with a high tripping current.
● Move the unbalanced load to the front end of the earth leakage circuit breaker.</td></tr>
<tr><td>The rated tripping current of the RCD is too low.</td></tr>
<tr><td>An unbalanced load is connected to the rear end of the RCD.</td></tr>
<tr><td>The ground capacitance at the front end of the drive is high.</td></tr>
<tr><td rowspan="4">Tripping during operation</td><td>The anti-interference performance of the RCD is poor.</td><td rowspan="4">● Use an RCD from a recommended brand.
● Use an RCD with a high tripping current.
● Install a simple filter on the input side of the drive, and wind the LN/RST cable on a magnetic ring near the RCD.
● Reduce the carrier frequency without compromising the performance.
● Use a shorter motor cable.</td></tr>
<tr><td>The rated tripping current of the RCD is too low.</td></tr>
<tr><td>An unbalanced load is connected to the rear end of the RCD.</td></tr>
<tr><td>The ground distributed capacitance of the motor cable and the motor is too high.</td></tr>
</table>

16.2 Harmonic Suppression

To suppress the harmonic current of the servo drive and improve the power factor, install an AC input reactor on the input side of the servo drive to meet standard requirements.

The following figure shows the reactor mounting mode.

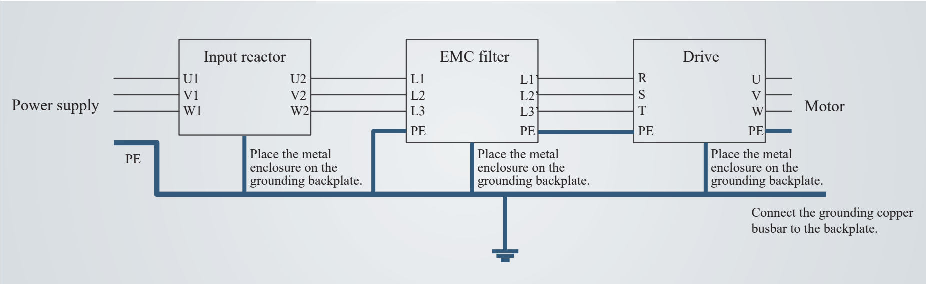


Figure 16-1 Reactor mounting mode

16.3 Control Circuit Interference

16.3.1 Common I/O Signal Interference

The drive generates very strong interference during operation. In the case of improper routing or grounding, the drive may interfere with or be interfered with by other devices. In such a case, take the following measures.

- Use shielded cables as the I/O signal cables and connect the shield to the PE terminal.
- Reliably connect the PE terminal of the motor to the PE terminal of the servo drive, and connect the PE terminal of the servo drive to the PE terminal of the grid.
- Add an equipotential bonding grounding wire between the host controller and the drive.
- Add a magnetic ring for the U/V/W output cable of the drive. Wind the cable on the ring for two to four turns.
- Increase the filter capacitance at low-speed DI terminals. A maximum of 0.1 μF capacitance is recommended.
- Increase the filter capacitance between AI and GND terminals. A maximum of 0.22 μF capacitance is recommended.
- Add a magnetic buckle or magnetic ring for the signal cable. Wind the signal cable on the buckle or ring for one or two turns.
- Use shielded cables as power cables and ground the shield securely.

16.3.2 EtherCAT Communication Interference

In such a case, take the following measures.

- Check that the communication network cables meet the specification requirements for Cat5e shielded cables.
- Check that the communication port is secure and in good contact.
- Separate communication cables from power cables by a distance of at least 30 cm.
- Add equipotential grounding cables between nodes in the case of multi-node communication.
- Check that any cable between two nodes is within 100 m in length.
- Add a magnetic buckle at each end of the communication cable. Wind the communication cable on the buckle for one or two turns.
- Add a magnetic ring for the U/V/W output cable of the drive. Wind the cable on the ring for two to four turns.
- Use shielded cables as power cables and ground the shield securely.

Chapter 17 Certification and Standard

17.1 CE Certification

Directives	Standards
EMC Directive 2014/30/EU	EN 61800-3
Low Voltage Directive 2014/35/EU	EN 61800-5-1
	EN 60034
RoHS Directive 2011/65/EU	EN 50581

17.2 UL/cUL Certification

Certification	Standards
UL/cUL certification	UL61800-5-1 C22.2 No.274-17
	UL 1004-6 CSA C22.2 No. 100-14

Notes

Revision History

Date	Changed Version	Change Description
July 2024	A00	First release

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